

**AN EVALUATION OF THE PERFORMANCE OF GIS AS A DECISION
SUPPORT TOOL IN LAND USE MANAGEMENT**

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To the Naude family for everything they have done for me.

To my mother and sister, for their understanding, love, patience and help through everything.

To Erin, who has always been honest, helpful, and supportive through all the tricky bits and for always having an unfailing belief in me.

To my Dad, for making this possible

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List of Acronyms

DFA- Development Facilitation Act

DSS- Decision Support System

DST- Decision Support Tool

GIS- Geographic Information Systems

IDP- Integrated Development Plan

LUF- Land Use Framework

LUMS- Land Use Management Systems

MSA- Municipal Systems Act

SDF- Spatial Development Framework

TPO- Town Planning Ordinance

Abstract

This research aims at evaluating the level at which GIS is currently performing as a Decision Support Tool in Land Use Management Systems in KwaZulu Natal. Research was conducted amongst all of the district municipalities (in survey format, with a seventy percent response rate), as well as amongst representatives of three local municipalities, and representatives of the only Metropolitan municipality (all in the form of in-depth interviews). The results of the research were certainly revealing, and at points, significantly concerning.

This research illustrates that despite the fact that the municipal LUMS should be in place, in most instances, the local municipalities have not completed their LUMS, and many districts have not finalised their specific components of the LUMS (namely the Land Use Framework, or LUF). Reasons for the difficulties experienced in developing the municipal LUMS were mainly capacity related, although there were a few additional impediments worth noting. Due to this, it was difficult to successfully evaluate the role that GIS is playing in LUMS as a Decision Support Tool.

Despite this difficulty, it was still possible to evaluate the current use of GIS in the development of LUMS, as well as its perceived use in the future. Furthermore, the general perceptions regarding GIS as a Decision Support Tool were open for examination, along with how it will be used as such in LUMS. This research confirms that GIS has been used to some extent in the development of the municipal LUMS, and that it will be used extensively in the future, particularly in Decision Support.

This research concludes by offering various solutions or recommendations to the problems being experienced by the municipalities. These solutions originate both from points mentioned in the literature review, as well as from the responses to the questionnaires and interviews; and could assist in resolving the noteworthy problems revealed during the research.

Chapter One- Introduction

Geographic Information Systems is a tool that has become increasingly popular in many fields, including planning. It plays an important role in many spheres of planning, ranging from basic spatial representation of features, to advanced analysis and data manipulation. GIS is used to aid in zoning, land use inventories, site suitability assessments, comprehensive planning and socio- demographic analysis (Nedovic- Budic 2000).

GIS can also be used as a decision support tool, due to the fact that it can store, and manipulate large amounts of data. Thus, GIS can be used to aid planners and decision makers to make suitable choices regarding development.

Land Use Management in the South African context is a fairly recent idea. It is related heavily to zoning, although it is more modern in approach, and more flexible in application. Furthermore, Land Use Management Systems (or LUMS) have more categories than a traditional zoning system (which uses “commercial”, “residential” and “industrial” as the main zone types, each having related sub-categories), thus allowing for a wider variety of land uses to be recognised in the Land Use scheme. This leads to LUMS generally being more flexible and adaptable than traditional planning practices.

This research aims to understand the relationship between Land Use Management Systems and GIS. It thus aims to examine how GIS is used in Land Use Management, with a special emphasis being placed on how GIS is used to help the authority/ decision maker in the planning process in LUMS. Through the use of case studies, this research aims to highlight the key issues relating to GIS and its use as a decision support tool in LUMS. This will be done by examining its current use in LUMS, any restrictions on its use in LUMS, as well as where its use as a decision support tool in LUMS can be improved. Finally, this research aims to look at possible future uses for GIS in Land Use Management.

1.1. Research Problem

GIS is a tool that is growing in popularity in numerous fields. Although GIS is becoming almost ubiquitous in nature as it is being used by so many people in numerous fields, the extent to which it really adds value as a tool that can be used for more than simply mapping, is less known. GIS is theoretically, a tool that is not necessarily confined to basic spatial representation due to the fact that it can be used as a means of analysis, as well as a decision support tool in many fields, and is thus perfectly suited to Land Use Management.

GIS is used heavily in LUMS, especially in the basic representation of spatial features. Unfortunately however, there has been little research that provides information on how well GIS performs as a decision support tool in Land Use Management Systems, or indeed the value, if any, that it adds to LUMS, beyond being a basic mapping tool.

Therefore, the purpose of this research therefore is to determine how successfully GIS can be used as a decision support tool in Land Use Management, as well as the limitations to the use of this tool.

1.2. Aims and Objectives

The aim of this study is to investigate how GIS performs as a decision making tool in Land Use Management Systems. This is important as it will help one to understand not only how GIS is used, but where its use can be improved.

There are numerous objectives relating to this research that should be achieved with the end result, and will be discussed below.

The first objective is to evaluate how GIS is being used in Land Use Management Systems. This is the crux of the research. The key problem is that at present, there is an

uncertainty as to how well GIS is used in LUMS. Thus, the first objective of the research has to be an examination of how well it is used in Land Use Management.

The second objective of the research is to determine whether or not GIS adds value to LUMS. This is linked to the first objective, although, it is more focused on determining if there is actually a need or scope for GIS as a decision support tool in LUMS.

The third objective of the research is to examine the extent to which GIS is used as a decision support tool in LUMS. This is important, because, in order to understand whether or not GIS adds value in LUMS as a decision support tool, or indeed, just to evaluate its performance, it will be important to understand the extent to which GIS is used as a support tool (if at all).

1.3. Research Question

The key research question that needs to be answered relates to how well GIS performs as a decision support tool in Land Use Management Systems.

The research conducted should always bear in mind the key research question, as the research should provide an answer to this question by determining how well GIS is used as a decision support tool in LUMS.

The following questions are the key subsidiary questions that link into the main research question, and thus help to provide an answer to the research problem. Whilst each question is separate, one must realise that they are intrinsically linked, being questions that all need to be answered if the research is to successfully examine how well GIS performs as a decision support tool in LUMS.

- How can GIS be used as a decision support tool?
- In what facets of Land Use Management Systems can GIS be used as a decision support tool?

- What are the limitations for GIS being used as a support tool?
- How is GIS being used at present in LUMS?
- Where can the use of GIS be improved to make Land Use Management Systems more efficient?

1.4. Hypothesis

GIS, whilst a valuable tool, is not being used to its full potential as a decision support tool in Land Use Management Systems. Its primary use as present is for mapping, which could be due to a lack of capacity or skills.

From the topic, it is evident that a number of aspects need to be addressed. Firstly, a review on GIS in general, with reference to its uses in planning is necessary. Secondly, a look at how GIS can be used as a decision support tool, with special reference to planning. Finally, an examination of Land Use Management in the South African context is required, with a look at how GIS is used in Land Use Management, as well as how it can be used as a decision making tool.

1.5. Definition of Key Concepts

The following are the key concepts that need to be examined and fully understood before the research can commence. It is important to understand each term (through the literature review) so that when conducting research, the researcher will have a thorough theoretical knowledge of the question and the direction of the research.

- What is GIS?

GIS is a broad term to describe any system which is used to display, manipulate and analyse spatially orientated information.

- What is LUMS?

LUMS is a recent planning approach which forms a part of a municipality's Integrated Development Plan (IDP), and thus is a system which is supposed to be implemented in every local municipality. LUMS are systems which enable a municipality to manage land, and consist of a variety of elements including: Spatial Development Frameworks (SDF's), systems for the evaluation of land, environmental issues and bylaws. It is important to bear in mind that LUMS is not the same as schemes, as whilst schemes are documents containing a map (or series of maps), and the relevant written regulations, Land Use Management is more of a system for managing land as a whole. Thus, whilst LUMS does indeed contain schemes (especially in with regards to the SDF component of LUMS), it also has other facets such as a means to evaluate land, which ensure a holistic approach to managing land management.

- What does the term "decision support tool" mean?

A Decision Support Tool or DST is any system (usually computer based), which helps a person to make a decision. It is important to note that a DST can not make a decision, but rather, it makes it easier for a person to make a decision.

1.6.1. Methodology

For the research, it was necessary for a hybrid approach to be taken, with both qualitative and quantitative research being used. This was because the topic lends itself towards a qualitative approach (due to the required interviews), and a quantitative approach (due to questionnaires being used).

Much of the research was, as mentioned, qualitative. This was due to the fact that most of the information gathered in the research came from various in-depth interviews with individuals from the relevant case studies. This will be discussed in greater detail further

on. Unfortunately, due to time constraints, not all of the local municipalities could be interviewed, and it was thus necessary to send questionnaires to all of the district municipalities so that a picture for the whole of KwaZulu Natal was created.

However, the research was also quantitative, due to the fact that the research conducted involved questionnaires being sent to the relevant individuals in all of KwaZulu Natal's district municipalities. It was necessary to send questionnaires to all of the districts, because, although the district municipalities are not directly responsible for LUMS, they do play an enabling role. Furthermore, by also researching the districts, it was felt that a clearer picture on the topic would be gained, as the districts would also provide information on their local municipalities, thus creating an image for the whole municipality.

1.6.2. Research Design

A 'Case study' approach was undertaken, with uMhlathuze, Ndwedwe, Msunduzi and eThekweni being the case study municipalities that were examined in detail. These case studies were selected due to the fact that they cover a broad spectrum of capacity with regards to applying GIS as a decision support tool in Land Use Management.

uMhlathuze, with Richards Bay at its main centre can be considered quite highly capacitated. It is also quite urbanised, and contains peri-urban landscapes. Msunduzi, with Pietermaritzburg as its main centre is also well capacitated, and has a fairly mixed land use (having urban areas, such as Pietermaritzburg, and some fairly rural areas). Ndwedwe is a rural municipality, containing no major town as its centre. It was felt that this municipality would be fairly representative of most of the more rural municipalities in the province. eThekweni was the final municipality interviewed, and is very highly capacitated, being the only metropolitan municipality in KwaZulu Natal. Furthermore, these municipalities vary in typology- eThekweni is a Metro municipality, while uMhlathuze, Msunduzi and Ndwedwe are local municipalities. By using a broad range of municipality types, a thorough understanding of how GIS is applied as a decision support

tool was found. This is due to the fact that if the research was to focus solely on a highly capacitated municipality, without focussing on any other level of capacity, the results would be skewed and not truly representative of the situation.

The district municipalities in KwaZulu Natal were also examined, but on a broader scale. It was important to examine the role that the district municipalities are currently playing with regards to Land Use Management. Although the district municipalities are not required to create a LUMS, they should create a Land Use Framework (LUF), which the local municipalities can use to help ensure that their LUMS falls within the broader vision of the district. As such, it was important to examine the role that the districts are playing in the facilitation of the development of the local municipalities LUMS.

1.6.3. Sampling

Respondents were selected through purposive sampling. The reason for using purposive sampling was that the topic lends itself towards having the input of highly skilled individuals. As such, the relevant individuals from the municipalities were identified and interviewed. These individuals came from both the private, and public sector. A consultant who has been involved in the development of many of the LUMS in the province (including some of the case studies) was also interviewed. Thus, respondents were not only selected from within the selected municipalities, but from other sectors as well.

Purposive sampling was also used for the questionnaires. The individuals in the district municipalities involved in LUMS were identified, and asked to fill in a short questionnaire regarding the LUMS for their district.

The groups targeted in the research were the municipal departments responsible for the LUMS development and implementation. The other 'target group' was the consultant involved in the development of the LUMS for many of KwaZulu Natal's municipalities.

1.6.4. Research Tools

When conducting the research, two instruments were used, namely, in- depth interviews and questionnaires. The following is a brief description of how these tools were used.

In- depth interviews were conducted with the key informants, who were the individuals that were involved in Land Use Management. Informants came from both the relevant municipalities, and the consultant who was involved in the development of the LUMS for numerous municipalities.

In addition to in-depth interviews, a survey was done of all of the district municipalities in the province. The rationale for doing this is that it aided in determining the capacity for using GIS and LUMS throughout the province, and provided a general picture of all of the local municipalities. Questionnaires were sent to the ten district municipalities of KwaZulu Natal, with follow-up calls conducted where necessary. As mentioned, the purpose of this was to create a broader sense of how GIS is used in LUMS throughout the province.

1.6.5. Data analysis

The majority of the data analysis came from the information gleaned in the interviews. As such, a thematic analysis was required for this part of the research

A quantitative analysis was used for the questionnaires completed by the district municipalities. By using this approach, along with a thematic analysis, it was possible to determine the role that the districts are currently playing with regards to facilitating the development of the local district LUMS.

List of Acronyms

DFA- Development Facilitation Act

DSS- Decision Support System

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This research illustrates that despite the fact that the municipal LUMS should be in place, in most instances, the local municipalities have not completed their LUMS, and many districts have not finalised their specific components of the LUMS (namely the Land Use Framework, or LUF). Reasons for the difficulties experienced in developing the municipal LUMS were mainly capacity related, although there were a few additional impediments worth noting. Due to this, it was difficult to successfully evaluate the role that GIS is playing in LUMS as a Decision Support Tool.

Despite this difficulty, it was still possible to evaluate the current use of GIS in the development of LUMS, as well as its perceived use in the future. Furthermore, the general perceptions regarding GIS as a Decision Support Tool were open for examination, along with how it will be used as such in LUMS. This research confirms that GIS has been used to some extent in the development of the municipal LUMS, and that it will be used extensively in the future, particularly in Decision Support.

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This research aims to understand the relationship between Land Use Management Systems and GIS. It thus aims to examine how GIS is used in Land Use Management, with a special emphasis being placed on how GIS is used to help the authority/ decision maker in the planning process in LUMS. Through the use of case studies, this research aims to highlight the key issues relating to GIS and its use as a decision support tool in LUMS. This will be done by examining its current use in LUMS, any restrictions on its use in LUMS, as well as where its use as a decision support tool in LUMS can be improved. Finally, this research aims to look at possible future uses for GIS in Land Use Management.

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GIS is used heavily in LUMS, especially in the basic representation of spatial features. Unfortunately however, there has been little research that provides information on how well GIS performs as a decision support tool in Land Use Management Systems, or indeed the value, if any, that it adds to LUMS, beyond being a basic mapping tool.

Therefore, the purpose of this research therefore is to determine how successfully GIS can be used as a decision support tool in Land Use Management, as well as the limitations to the use of this tool.

1.2. Aims and Objectives

The aim of this study is to investigate how GIS performs as a decision making tool in Land Use Management Systems. This is important as it will help one to understand not only how GIS is used, but where its use can be improved.

There are numerous objectives relating to this research that should be achieved with the end result, and will be discussed below.

The first objective is to evaluate how GIS is being used in Land Use Management Systems. This is the crux of the research. The key problem is that at present, there is an

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- How can GIS be used as a decision support tool?
- In what facets of Land Use Management Systems can GIS be used as a decision support tool?

- What are the limitations for GIS being used as a support tool?
- How is GIS being used at present in LUMS?
- Where can the use of GIS be improved to make Land Use Management Systems more efficient?

1.4. Hypothesis

GIS, whilst a valuable tool, is not being used to its full potential as a decision support tool in Land Use Management Systems. Its primary use as present is for mapping, which could be due to a lack of capacity or skills.

From the topic, it is evident that a number of aspects need to be addressed. Firstly, a review on GIS in general, with reference to its uses in planning is necessary. Secondly, a look at how GIS can be used as a decision support tool, with special reference to planning. Finally, an examination of Land Use Management in the South African context is required, with a look at how GIS is used in Land Use Management, as well as how it can be used as a decision making tool.

1.5. Definition of Key Concepts

The following are the key concepts that need to be examined and fully understood before the research can commence. It is important to understand each term (through the literature review) so that when conducting research, the researcher will have a thorough theoretical knowledge of the question and the direction of the research.

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A Decision Support Tool or DST is any system (usually computer based), which helps a person to make a decision. It is important to note that a DST can not make a decision, but rather, it makes it easier for a person to make a decision.

1.6.1. Methodology

For the research, it was necessary for a hybrid approach to be taken, with both qualitative and quantitative research being used. This was because the topic lends itself towards a qualitative approach (due to the required interviews), and a quantitative approach (due to questionnaires being used).

Much of the research was, as mentioned, qualitative. This was due to the fact that most of the information gathered in the research came from various in-depth interviews with individuals from the relevant case studies. This will be discussed in greater detail further

on. Unfortunately, due to time constraints, not all of the local municipalities could be interviewed, and it was thus necessary to send questionnaires to all of the district municipalities so that a picture for the whole of KwaZulu Natal was created.

However, the research was also quantitative, due to the fact that the research conducted involved questionnaires being sent to the relevant individuals in all of KwaZulu Natal's district municipalities. It was necessary to send questionnaires to all of the districts, because, although the district municipalities are not directly responsible for LUMS, they do play an enabling role. Furthermore, by also researching the districts, it was felt that a clearer picture on the topic would be gained, as the districts would also provide information on their local municipalities, thus creating an image for the whole municipality.

1.6.2. Research Design

A 'Case study' approach was undertaken, with uMhlathuze, Ndwedwe, Msunduzi and eThekweni being the case study municipalities that were examined in detail. These case studies were selected due to the fact that they cover a broad spectrum of capacity with regards to applying GIS as a decision support tool in Land Use Management.

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tool was found. This is due to the fact that if the research was to focus solely on a highly capacitated municipality, without focussing on any other level of capacity, the results would be skewed and not truly representative of the situation.

The district municipalities in KwaZulu Natal were also examined, but on a broader scale. It was important to examine the role that the district municipalities are currently playing with regards to Land Use Management. Although the district municipalities are not required to create a LUMS, they should create a Land Use Framework (LUF), which the local municipalities can use to help ensure that their LUMS falls within the broader vision of the district. As such, it was important to examine the role that the districts are playing in the facilitation of the development of the local municipalities LUMS.

1.6.3. Sampling

Respondents were selected through purposive sampling. The reason for using purposive sampling was that the topic lends itself towards having the input of highly skilled individuals. As such, the relevant individuals from the municipalities were identified and interviewed. These individuals came from both the private, and public sector. A consultant who has been involved in the development of many of the LUMS in the province (including some of the case studies) was also interviewed. Thus, respondents were not only selected from within the selected municipalities, but from other sectors as well.

Purposive sampling was also used for the questionnaires. The individuals in the district municipalities involved in LUMS were identified, and asked to fill in a short questionnaire regarding the LUMS for their district.

The groups targeted in the research were the municipal departments responsible for the LUMS development and implementation. The other 'target group' was the consultant involved in the development of the LUMS for many of KwaZulu Natal's municipalities.

1.6.4. Research Tools

When conducting the research, two instruments were used, namely, in- depth interviews and questionnaires. The following is a brief description of how these tools were used.

In- depth interviews were conducted with the key informants, who were the individuals that were involved in Land Use Management. Informants came from both the relevant municipalities, and the consultant who was involved in the development of the LUMS for numerous municipalities.

In addition to in-depth interviews, a survey was done of all of the district municipalities in the province. The rationale for doing this is that it aided in determining the capacity for using GIS and LUMS throughout the province, and provided a general picture of all of the local municipalities. Questionnaires were sent to the ten district municipalities of KwaZulu Natal, with follow-up calls conducted where necessary. As mentioned, the purpose of this was to create a broader sense of how GIS is used in LUMS throughout the province.

1.6.5. Data analysis

The majority of the data analysis came from the information gleaned in the interviews. As such, a thematic analysis was required for this part of the research

A quantitative analysis was used for the questionnaires completed by the district municipalities. By using this approach, along with a thematic analysis, it was possible to determine the role that the districts are currently playing with regards to facilitating the development of the local district LUMS.

1.7. Limitations to the research

First and foremost, this research was seriously limited with regards to time. This factor was important, as it limited the amount of time that could be dedicated to fieldwork (i.e. conducting the in-depth interviews and questionnaires). This limitation resulted in the research not covering all municipalities and thus, it is not able to provide a completely representative evaluation of GIS's use as a decision support tool in all of the municipalities. This was an important constraint, as it meant that whilst the research provided some clear answers to the research problem, the results could not be applicable to all municipalities in KwaZulu Natal or South Africa.

Secondly, the research does not provide concrete answers to all the problems facing GIS in LUMS. This again is due to the fact that there were limitations in both time and scope, which thus meant that the research can only provide some guidance to those municipalities involved. However, some possible solutions mentioned from the interviews and questionnaires were analysed and discussed.

Thirdly, the research can not imply that because "x" happens in uMhlatuze, it must happen in Ndwedwe. Throughout the research, it was important to bear in mind that these municipalities have entirely different capacities, limitations, support and funding. Thus, one should realise that because the municipalities are so unique, with varying limitations, one can not, and should not, generalise on what should and should not be done, especially since the research conducted is exploratory in nature, and thus does not offer strict guidelines or levels to be followed.

Finally, whilst the research provides an evaluation of GIS's performance as a decision support tool in LUMS, as well as stating some recommendations for the improvement of the use of GIS therein, the recommendations are simply recommendations, and thus not binding nor final. The research does not and indeed, can not provide definite "musts" for the municipalities involved, especially considering that the municipalities have such varying capacities. Basic recommendations were made which can apply to the

municipalities, however, detailed recommendations that can be applied across the board to all municipalities were difficult to make, due to the fact that the research will focus on only four municipalities with specific factors prevalent in each.

1.8. Chapter Outline

The following is a brief outline of the different chapters in this research.

Chapter One- Introduction

Chapter Two- Literature Review

This chapter discusses the relevant theoretical concepts that need to be understood for the research.

Chapter Three- Presentation of Findings- Survey

This chapter presents the various findings from the survey of the district municipalities.

Chapter Four- Presentation of Findings- Interviews

This chapter presents the various findings from the interviews conducted with the representatives from the Case Studies, as well as the interview with the private consultant.

Chapter Five- Analysis and Synthesis of the Findings

The chapter discusses the major themes that arose from the research, and creates the necessary linkages. This chapter also offers possible solutions to any problems that became evident in the research, and then concludes by summarising the research.

Chapter Six- Conclusion

This chapter summarises the research, and presents any concluding comments.

Chapter 2- Literature Review

From the topic of this research, one can see that GIS, along with its literature, is key to the research process. As such, the literature review focuses primarily on GIS and its use in planning, notably Land Use Management. A number of bodies of literature have been consulted, due to the multi-faceted nature of GIS, as well as its use in planning and Land Use Management. The first body concerns GIS: what it is, its basic uses and its limitations. The second looks at the role or potential role of GIS in planning. Literature on GIS as a 'decision support tool' was also necessary, as this provides some key insights into how GIS can be used for this purpose, as well as some of the limitations thereof. Another important body explores Land Use Management, allowing a broader understanding of the concepts involved. Literature on the use of GIS in LUMS is crucial, providing the framework within which the research can take place. Finally relevant literature that critiques GIS was incorporated into the research, in order to create a balanced perspective on the tool.

2.1. Geographic Information Systems

The use of GIS as a tool has increased dramatically in many fields, including planning. GIS, as a "spatial data handling tool", emerged in the 1960's but only really became an important force with the advancement of computer technology that occurred in the late 1980's and early 1990's (Cassettari 1993: 2). It is thus a tool of the so-called "Information Age", forming an important role in the world's environmental (both natural and built) information structure (Davis 2001). In order to really go forward, it is of utmost importance to understand the true definition of GIS. Davis (2001: 13) describes GIS as "A computer-based technology and methodology for collecting, managing, analyzing, modelling and presenting geographic data for a wide range of functions". This definition demonstrates the wide range of uses offered by this tool, ranging from the basic data collection and management, to the more advanced data analysis and modelling. Simply put, GIS is a "computerized mapping system capable of holding and manipulating spatially referenced data" (Carver, Evans, Kingston and Turton 2001: 908). Thus, in

essence, one can say that GIS is basically a tool that can spatially represent numerous fields (either separately or at the same time), offering data analysis, which is then interpreted and used by the operator.

GIS offers a vast array of functions ranging from mere spatial representation (mapping) to decision support (Campbell 1996). Planning, being a spatially orientated discipline, can, and does, make use of many of these functions. According to Laurini (2001: 29), GIS has four main “functionalities”, which are: a subsystem for “geographical data acquisition”, spatial analysis, cartographic representation and data management. All of these have a bearing on planning and Land Use Management, and will be discussed later. An important point to note about GIS is that the geographical database that requires frequent updating (Laurini 2001). This has a major bearing on Land Use Management, as will be demonstrated later.

GIS is not necessarily restricted to the realms of administration, as its importance, for example, as a public participation tool or an on-line tool is starting to be realized. Carver et al (2001) illustrate how GIS is being used in an increasingly public orientated manner, with numerous online GIS systems. For example, many South African municipalities have an on-line GIS system available to the public, such as www.durban.gov.za. These systems are merely examples of how GIS has grown from a tool used mainly by professionals and administrators to one that can be easily accessed by the general public. Although there are constraints and limitations to GIS as an on-line or a public participation tool (or a combination of both), this study helps to demonstrate the increasing use, and usability thereof.

An important component of GIS is compiling the necessary data into a database. This data can come from various sources, many of which can be diverse, thus resulting in difficult integration (Davis 2001). This can be a problem in planning, because most GIS users need data from numerous sources (Van Buskirk, Ryffel and Clare 2003). Although GIS data is, by its very nature “disaggregated”, it is usually compiled of shared data and it is also data that will be given to others (if necessary), and so the database managers

should try their best to make the data as easily adaptable to other systems or users as possible (Van Buskirk et al. 2003: 35). It is thus important for all organisations using GIS to make sure that the data built and stored is adaptable, and can thus be shared (Van Buskirk et al 2003)

The use of GIS by any organisation can have important implications, which are sometimes not considered as thoroughly as they should be. GIS, whilst offering an array of functions has some limitations. GIS systems are costly, and require skilled people to successfully utilise them (Innes and Simpson 1993). As such, institutions often neglect to take into account the requirements of the tool when purchasing such a system. Furthermore, due to its ability, GIS can change operational procedures within an organisation, making these shorter or simpler (Innes and Simpson 1993). As such, it is important for the organisation to understand both the capabilities of a GIS, and what it will be used for in the organisation, before the system is purchased, in order for it to be used to its full potential, and also to prevent any wastage in money or resources.

2.2. Geographic Information Systems in Planning

GIS, as previously mentioned, is an important tool in planning. It is most commonly used for zoning, land use inventories, site suitability assessments, comprehensive planning and socio- demographic analysis, the former two being heavily linked to Land Use Management (Nedovic- Budic 2000). Nedovic- Budic (2000) goes further to say that GIS should be used to advance the following goals in planning: to create quality environments that are environmentally and socially sustainable, to aid in the effective spatial organization of urban activities, to create efficient communication between various “urban functions”, and to “democratize the planning and policy making process” (Nedovic- Budic 2000: 81). Furthermore, she argues that GIS can be used to aid in the revitalization of deteriorated areas and solve the housing problems. These goals of GIS in planning are useful in Land use Management as will be seen in the discussion regarding LUMS. However, according to Nedovic-Budic (2000), GIS is, for numerous reasons, being under-utilized in planning, which is a key aspect of this topic.

Finally, Nedovic- Budic (2000) argues that whilst there has been a considerable growth in the use of GIS in planning, there are still limitations to the applicability of the tool. Firstly, GIS is primarily a scientific tool that does not offer very much with regards to understanding planning and social phenomena. However, this is more to do with the application of GIS rather than its actual capabilities. A second problem arises in that GIS has a generic quality, which is problematic in planning due to each situation being different and requiring specific needs that the GIS may not necessarily be able to address. Another problem is that GIS does not easily diffuse to the user communities (Nedovic-Budic 2000). At present, it tends to be used by a small percentage, thus leading to the argument that GIS can be used in a technocratic way.

Numerous agencies (both public and private) are spending large sums of money on GIS due to its wide range of features. It is a tool that can help planners perform their tasks, as GIS can in fact display such a vast range of “spatially referenced information” (Innes and Simpson 1993: 232). However, as previously mentioned, Innes and Simpson (1993) highlight the fact that technology is socially constructed and used by administrators (as well as planners). Thus, whilst GIS is indeed an important tool in planning, planners themselves are in fact more important, as they have to operate the system. In fact, according to Innes and Simpson (1993), the biggest problem when using GIS in planning, is the planners themselves. It is argued that planners have a limited understanding of GIS and its applications as well as unrealistic expectations of its capabilities. Finally, according to Innes and Simpson (1993), GIS as a tool in planning needs to be re-evaluated, so that planners can make full use of its capabilities. Most planners simply regard GIS as a cartographic tool, and whilst this is important, it is by no means its only aspect. GIS should be understood and applied as a tool that empowers planners, aiding them in all aspects of their profession, including decision support.

2.3. Geographic Information Systems as a decision support tool

Decision making in planning is a complex process due to one important matter- people are different, and thus offer different solutions or approaches to the solutions. Decision

making is usually controlled by four major factors: regulations, changing circumstances, the individuals experience and knowledge about desired outcomes (Cassettari 1993). A number of computer tools exist (including GIS), which can support in the decision making process. However, even these programmes can not make the final decisions- when it comes down to it, the most important factor in the decision making process is the human component (Cassettari 1993). In the end, it is the administrator who must make the final decision based on whatever factors exist or information available (which can be provided by the computer).

Decision Support Systems (DSS) are computer based information systems that support individuals “engaged in the decision making process” (Cassettari 1993). Cassettari (1993) further goes on to point out the key aspects of a decision support system, these being that they aid the decision maker to help define (limit) the problem, and offer solutions to this problem. A user- friendly interface is also required in order to combine data successfully. Furthermore, DSS’s need to be adaptable, and more importantly, interactive (which means that the decision maker should be able to get involved in the process, and not just allow the computer to do the work). Older GIS packages were not that effective as a tool for decision support, in that they only really offered a cartographic display. They had limitations and were thus difficult to use for other purposes (Cassettari 1993). However, as will be demonstrated, this is no longer necessarily the case.

Laurini (2001: 10) describes DSS’s as “computer systems able to assist the decision makers by analyzing issues and proposing solutions”. This further adds to the argument that the administrators are the vital constituents of the decision making process- the computer merely clarifies and analyses. Laurini (2001:10) goes further to say that decision support systems have a number of key requirements, which are summarized as follows:

- Adequate for all types of real life problems
- Varying managerial levels
- Sequential or interdependent decisions
- Aid in all phases of the decision making process

- Must be able to adapt able
- The system must be user friendly
- The system should be capable of accessing all types of data
- Accuracy and quality should always be important

From the above, one can see that decision support systems have a number of essential components. However, again it must be emphasized that the most important of these is not the system, but rather the administrator.

Budic (1994) conducted a study on the effectiveness of GIS in local planning in an attempt to determine the level at which it is being used in planning. This study examined possible improvements for data handling and management, as well how suitably GIS can be used as a decision support tool. After conducting her research, Budic determined that although GIS can be effective in its role as a decision support tool, it is still not being used to its full potential (although, it is important to bear in mind that this research was conducted in 1994). However, the basic findings of the study are highly relevant and indicate that due to the rich and varied database that GIS is able to use and manipulate, the decision making process can be enhanced. One of the major reasons for the effectiveness of GIS is that the visual component of the instrument adds “credibility”, because it enables planners to “represent planning related information” (Budic 1994: 257). This is important, as graphics are an important communication tool, and it is this communication that assists in the decision making process. Thus, the essential benefits that GIS has to offer as a planning support tool are: it conveys the relevant information, in the necessary manner required by the user (usually as a map, but also as a graphic), and it enables the planner/ decision maker to make an informed decision. One must bear in mind that if GIS is to be a credible support tool, it is necessary for it to be equipped in order to correctly analyze and synthesize the data, and thus enable the operator to make an informed decision (Budic 1994).

Campbell (1996) adds an important point regarding GIS’s use as a decision support tool. She argues that planners “make and create their own worlds, regardless of the

technology” (1996: 105). Simply put: although technology is an important aspect, it is not the vital component of planning- this is the planner. GIS, like any technology is shaped to suit the needs of the planner. As such, it is up to the planner to determine what is right and wrong, GIS can only aid in the decision (Campbell 1996). This is an important point to bear in mind regarding this topic: GIS is only as effective as the decision maker allows it to be.

Matthews, Sibbald and Craw (1999) suggest four key elements regarding how GIS can be used as a part of decision support system. Firstly, the GIS should enable the decision maker to select maps that can be manipulated to suit their needs. Secondly, the user should be able to have access to any form of “spatially distributed data”, including models if necessary. Furthermore, it should be possible to display information or models that can be represented either as a time series, or as animations. Finally, and most importantly, the GIS must offer the decision maker a means for comparative analysis as well as enabling them the view of alternative scenarios. This means that if GIS is to be used as a decision support tool, it should be user-friendly, easy to manipulate, represent relevant data, and finally, enable additional sites/ scenarios to be evaluated at the same time as the main site/ scenario. These factors are important as they will enable the decision maker to draw a complete conclusion.

2.4. Critique of GIS

GIS as a tool has its criticisms, some being trivial, whilst others significant. An understanding of these criticisms is important in order to help balance the perceptions of GIS, and thus to allow the researcher the opportunity to grasp the various limitations thereof.

The first major critique of GIS that will be discussed regards the argument that GIS is a tool created and moulded by man, and can thus be manipulated to illustrate what is important to the user. GIS can be said to be “socially constructed” (Schuurman 2000:571), meaning that it is created by man, and represents the social demands or trends

of the time. It can be argued that it is pre-disposed to suit man. This is detrimental, as if it specifically suits a manipulated purpose, incorrect information can be shown in the GIS as being correct, which can lead to inaccurate decisions based on misrepresentation.

Another major critique of GIS is that it is a “positivist tool” (Schuurman 2000: 572). GIS is a scientific tool, often in a positivist manner. However, with this come the problems related to positivism, such as the inability to take into account people’s history, desires and needs. As such, it can be argued that when GIS is too heavily relied upon, it can eliminate the ‘human’. Therefore, if GIS is over used in decision making, then it can be deficient, as it does not take into account human emotions and histories. Whilst GIS is a successful tool for straightforward geographical issues (such as determining the decline of a rainforest over a number of years), when it comes to using it in problem solving with a distinct human facet, the manner in which it is used must be altered. This brings in the element of the user (Schuurman 2000). At all times, GIS should be operated by a suitably trained professional, even more so for human related problems. The professional needs to bear in mind that when it comes to problems with a social twist, one must ensure that the GIS is not merely used as a positivist tool, but rather one that aids the decision. The GIS should not be the primary decision maker. This is also a consideration when it comes to LUMS, as from the previously mentioned description, it is evident that it deals with social issues as well as those of simple land use. As such, when using GIS as a decision support tool in LUMS, the social sphere must be noted, and the GIS should not be solely relied upon as a positivist tool.

GIS as a spatial tool always generalises land into pixels on a screen. Thus, there are issues of scale and resolution as GIS always summarises data into a presentable form (Mark 2000). Therefore, if one is not aware of the summarised nature of the data, it is possible to make an incorrect decision due to it being based on summarised, inaccurate data. A problem related to this “fusion of data” (Mark 2000: 48) is that when one links it with other fused data, it is difficult to make sure that no spatial data is lost in the process. Once again, inaccurate decisions are possible, due to incorrect or inadequate data.

Another criticism of GIS, is that of cost versus benefit. Whilst this is not a critique of the actual value of GIS, this idea simply points out an important truth: GIS is an expensive tool and should only be used when the cost is outweighed by the benefits that the system returns (Gillespie 2000). According to Gillespie (2000: 7), “accurate data on benefits generated by GIS technology are rare”. Thus, in many circumstances it is not known what the actual value is that GIS brings into an organisation, when compared to the cost of not only the system, but obtaining the required data as well. As previously discussed GIS also requires constant updating, and this in itself can be expensive and time consuming. However, Gillespie (2000) also points out that whilst GIS can be very expensive, especially at the outlay, once setup, the cost of performing operations are negligible (if the data is present) in comparison to performing the same operation without the system.

Linked to the issue of cost versus benefit, is the fact that using GIS at an adequate level requires considerable and expensive training (Mark 2000). GIS as a tool can be used by most people for simple viewing of maps. However, as an analytical tool, sufficient training is required to enable the user to understand the nuances of the system. As mentioned, training can be costly, and again the benefits must be weighed. If simply conducting basic procedures or tasks on the GIS, it is sufficient to use individuals with a baseline knowledge of the system. However, if advanced analysis is required, then it is necessary to either employ someone with sufficient training, or train existing staff in the use of GIS.

2.5. Land Use Management

Zoning has been a dominant force in planning since the early part of the twentieth century, the original intent being to protect properties from land devaluation by preventing “incompatible” land uses existing near to, or adjacent to, the owners (Fischel 2002). After 1910, there was a rapid rise in the use of zoning as a tool for regulation and control, thereby giving a city’s administrators management of the value, and future uses of the land. According to Feiock (2002), land use planning and zoning aims to ensure a higher quality of life. However, as the years have progressed, flaws have begun to

emerge, such as the resultant fragmentation, rigidity regarding change and a bias towards homeowners (Fischel 2002).

According to McDonald and McMillen (2002), there were three crucial reasons for zoning. Firstly, it was an attempt to promote “the general welfare by separating land uses in order to mitigate negative external effects” (McDonald and McMillan 2002: 342). Secondly, zoning was used, through the regulations, to “influence the size of the local tax base” in order for the government to obtain a substantial profit. The third reason (linked to that just mentioned) is that zoning was used in an “exclusionary manner”, to prohibit selected demographic groups (McDonald and McMillan 2002: 342). Clearly, in post-apartheid South Africa, this is a critical issue, and a core reason why zoning, as it was known, was done away with is being replaced by Land Use Management Systems. One must realise that zoning is made up not only of a map illustrating land use, it is also linked with regulations that govern the complete set of features of a site.

Zoning, as discussed, was basically a form of government intervention that attempted to protect the “natural environment and to avoid uncontrolled development” (White and Allmendinger 2002: 953) Thus, its original purpose was to regulate the markets, as well as to protect property prices by preventing incompatible developments occurring in close proximity to one another. Whilst there were variations in zoning application in America and England (America’s focus on the market and England’s on planning), its main implications remain the same- zoning can negatively affect the market by being too restrictive on new developments (White and Allmendinger 2002).

A further criticism of zoning and traditional land use regulations is that, by protecting the homeowner, they artificially inflate the cost of housing, thereby excluding “lower-income households from suburban communities” (Ihlanfeldt 2003: 261). This is a common criticism of zoning, as it allows a stronger advantage of security for suburban areas thereby inflating the value of these properties and in turn, preventing the lower income citizens access to suburban locations. This is commonly referred to as “the exclusionary nature” of zoning (Ihlanfeldt 2003: 261).

With the arrival of democracy, in South Africa in 1994, the legislation of the country had to be altered. Furthermore, change was required in the method that planners approached the preparation of schemes (zoning), and their uses (The Planning Initiative Team 2004: 1). This has led a change from a traditional zoning approach to a Land Use Management System being adopted by the country.

A key reason for the implementation of Land Use Management Systems in South Africa is to address the “injustices from apartheid” (Williamson 2001: 297). The country’s difficult and disjointed past has resulted in a fragmented landscape. As such, land administrations are important in that they play a vital role in reshaping the country. The reason for this is that they are responsible for the “social, legal, economic and technical framework” of the population at large (Williamson 2001: 297). Thus, LUMS should provide the correct information for the land administrators and decision makers, to aid them in the process of determining what land uses are adequate in the new South Africa.

The aim of LUMS in South Africa is to provide each local municipality with a “commonly applicable land use management system that can be used throughout the province” (Forse, Doesebs and Botes 2002: 1). This means that LUMS extends beyond traditional town planning schemes, and covers entire municipalities in response to the “new municipal demarcation” (Forse et al 2002: 1). It is important to bear in mind that LUMS enables a development control to be implemented which covers all areas of a municipality (both rural and urban), with differing levels of complexity in relation to the location (Forse et al 2002). Furthermore, LUMS provides a set of boundaries in a development which gives “property owners, developers, and the authorities a clear point of reference” and thus equips them with appropriate land management methods (Forse et al 2002: 1).

In terms of the Municipal Systems Act, Act no 32 of 2000, every municipality in South Africa has to prepare an Integrated Development Plan (IDP) (The Planning Initiative Team 2004). This must include a Spatial Development Framework (SDF), which in turn has to include guidelines for a Land Use Management System (LUMS), which must be

created by every local municipality (The Planning Initiative Team 2004). LUMS are basically systems that help enable a municipality to manage land. LUMS have a number of key elements, which include: a Spatial Development Framework, a valuation and rating system, a system for monitoring property ownership, a system for monitoring infrastructure and services, a system for incorporating building and health bylaws, a means for incorporating environmental issues and requirements, and finally, a means for including transportation requirements (The Planning Initiative Team 2004). Although zoning is not the only aspect of LUMS, it is involved to a large extent.

As mentioned, the development of LUMS by each local municipality is required by law. However, district municipalities should also play a role in the development of LUMS. Although the districts are not required to directly play a role in the development of LUMS, they should play a facilitatory role between the local councils (The Planning Initiative Team 2004). Thus, the district municipalities should try to ensure that the local municipalities LUMS are aligned and co-ordinated in order to ensure the best possible planning (The Planning Initiative Team 2004). According to The Planning Initiative Team (2004), the district municipalities can play a facilitatory role by: aiding in the preparation of schemes, assisting in decisions that cross local boundaries, and by continually training their local municipalities.

LUMS, especially schemes can be seen from the above to be an important tool in the management of development. The objectives of the schemes in LUMS can be briefly summarized as having the following purposes: (The Planning Initiative Team 2004)

- The designation of advantageous land uses, with regulations
- Promoting certain land uses
- Protecting land value and amenity
- Resolving conflicts between different land uses
- Balancing the desires of public interest as well as the individual
- Co-ordinating use of land
- Promoting the economy

- Protecting natural resources as well as unique features and cultural resources
- General management of land
- A means of enforcing regulations

From the above list, it is evident that whilst LUMS is indeed very similar to zoning, it is also different in the respect that it is less rigid, whilst also evaluating a wider spectrum. Furthermore, from the above, it is evident that LUMS does not cover building regulations per se, but rather focuses on controlling the land use of the site.

Following an understanding regarding the purpose of LUMS in South Africa, it is important to know what constitutes a LUMS. A LUMS refers to all the “actions required by a municipality to manage land” (The Planning Initiative Team 2004: 2). This means that it has a number of essential elements, not simply schemes. These are as follows (The Planning Initiative Team 2004):

Firstly, a Spatial Development Framework, with its various spatial plans and schemes, needs to be in place (The Planning Initiative Team 2004). Simply put, a scheme is a statutory mechanism used to guide development. It usually consists of a map (or series of maps), with attached written documentation or regulations. Secondly, the LUMS requires an adequate system that can aid in the valuating and rating of land and development (The Planning Initiative Team 2004). Infrastructure and service provision are imperative factors as well (The Planning Initiative Team 2004). Further key elements in the system are building bylaws for the area, as well as any health bylaws (The Planning Initiative Team 2004). Finally, the LUMS must take into account any environmental issues and transportation requirements (The Planning Initiative Team 2004).

One method of analyzing a Land Use Management Systems is by comparing it to the Transaction Cost Theory, which is a conceptual model in economics that defines how institutions adapt for the perfect financial market (Alexander 2001). Although this theory originally focused on economic exchanges, it now covers almost all regions of the public

and private sectors, including land use changes. A key quote regarding the Transaction Cost Theory in planning, argues that the goal of all planning control systems are:

“To provide information that will reduce uncertainties of the processes involved in production and transformation of the built environment, to ensure that the information provided is authoritative or reliable; and to maximise the contribution of the proposed system of planning and development control to net transaction cost reduction”
(Alexander 2001: 767)

This quote indicates that all planning systems (including LUMS) aim to negate any uncertainties relating to development by using the best available information, in order to achieve the most successful outcomes possible.

In planning terms, when a development occurs, a site is transformed, following a number of stages (Alexander 2001). The first of these stages is “site maturation” which involves the public sector planning or making decisions regarding the site, determining factors such as its value. This is followed by the “project conception” stage, in which the developer and his role is determined. (Alexander 2001: 764). The third stage is the “land acquisition”, in which the site is acquired and plans are drawn up. (Alexander 2001: 764). Following this is the “financing stage”, where the capital required for the development of the site is secured. (Alexander 2001: 764). During the “land preparation and development” stage, (Alexander 2001: 764), the plot is prepared for development, infrastructure begins, and the final plans are drawn up. The sixth phase deals with “land disposition”, in which the development, or parts thereof, is then sold to various clients as a formal transaction (either through a sale or lease of the land). After this, construction occurs, with all the buildings being erected. Finally, the “property transfer stage” takes place, when the developers hand over the land (or its subdivisions) to the new proprietors (Alexander 2001: 764).

The most important stages in the above process that relate to planning and Land Use Management are “site maturation” and “project conception”. Despite these phases being

so marked, one must bear in mind, that planning does in fact fit uniformly into all of the categories. The reason for the attention paid to the above two mentioned, is that in these stages, the essential planning decisions are determined (relating to whether or not the site should be developed / redeveloped and the extent thereof) (Alexander 2001). Furthermore, it is in these two phases that the decision maker needs to assess the relevant information relating to the development, and just as importantly, the site (by looking at the statutory land use plans for the area). It is in these stages that forward thinking land use planning must occur, with special importance being placed on the strategic and statutory plans for the area (Alexander 2001). The reason for this importance is that once permission has been granted, and the development goes up, it will be too late for any amendments. Thus, a fair and competent decision is important to ensure that the project is suitable for the site, and that the development falls within the overall strategy for the area. (Alexander 2001). The Transaction Cost Theory can be applied to South Africa as it covers both Brownfield and Greenfield development, and ensures effective costing and thus a successful outcome.

According to Forse et al (2002), LUMS will take time before being implemented in South Africa, due to numerous setbacks or restrictions that need to be first overcome. These problems range from implementation issues such as capacity, to difficulties in community participation in the development and implementation of the LUMS, to the actual role that local governments can play in the process (it is important to note that at the date of publication; tribal, local and district municipalities did not have the decision making power) (Forse et al 2002). Thus, as LUMS is still in its infancy, issues remain in relation to its implementation in South Africa. This point must be kept in mind whilst conducting the research as it implies that the use of LUMS will be varied across the municipalities.

Finally, in viewing LUMS, it is important to understand the relationship between institutional decision making and LUMS. The institutions involved in decision making must always bear in mind that sustainability must always be prominent (The Planning Initiative Team 2004). Furthermore, LUMS must always try to protect the natural resources, and people of an area (The Planning Initiative Team 2004). Land Use

Management must also ensure harmony, integration and participation amongst people. As such, it is up to the institutions involved in decision making to ensure that these principles are adhered to. Thus, if an application may be approved in terms of its land use, the decision maker must ensure that the proposed development does not infringe on any of the above mentioned points.

2.6. The use of GIS in LUMS

Because LUMS is inherently cartographically orientated, and is also traditionally linked to cadastre (zoning is reflected on the schemes), GIS is a tool that can be very important in the process. From the previous literature, it is clear that GIS has a vital role in planning, and its use in land use management will be briefly discussed below.

As previously mentioned, GIS can easily represent and manipulate, not only spatial information, but other forms of data as well (such as census information). LUMS contain schemes (maps that reflect zoning), which signifies that GIS can be used to create the schemes. However, that which can not be represented on the LUMS must not be neglected (such as health, education and service delivery). Furthermore, that which is not necessarily represented on the scheme can in fact still be used by the GIS in the LUMS. This is due to the fact that GIS does not necessarily only have to create the schemes, it can reflect and manipulate other data, such as demographics, health etc, which can be useful in the LUMS. It can be argued that people are becoming aware that GIS is moving beyond simply representing what exists, and can thus be used in planning for the future. This is represented in the following quote:

“Land managers and their advisors are looking increasingly beyond the use of GIS for inventory purposes, and to add value to their investment in GIS, by using it as the basis for a land use planning tool” (Matthews, Sibbald and Craw 1999: 11)

From the above quote, it is possible to draw an important conclusion: Land use planners are starting to realise that GIS can do more than just represent spatial data, and thus aid

them in planning for the future. It enables them the power to manipulate data, resulting in a planning process that is thorough and accurate.

A key element of all land administration systems, including LUMS, is the cadastral component (which again makes GIS prevalent in LUMS, as it is first and foremost a cadastrally linked system) (Williamson 2001). Land administration can be defined as “the processes of determining, recording and disseminating information about the tenure, value and use of land when implementing land management policies”. (Williamson 2001: 298). Its two fundamental elements are a core cadastre system, and the relevant information relating to land parcels (Williamson 2001). GIS is one means to do this as although it can be implemented to simply represent cadastre, it is also capable of illustrating all the various aspects of the relevant land parcels when required. Unfortunately, most information is either outdated or simply inadequate (Williamson 2001). This is a salient point: how can a decision maker establish full and competent deductions based on old, incorrect data? These land administration systems should include information relating to who is responsible for the land, what policies should relate to the land, land tenure principles, the administration of the land, all cadastre, and all infrastructure, as well as any technical principles that may relate to the land (Williamson 2001). Due to the layering ability of GIS, as well as its data storage and manipulation characteristics, it can be used as a land administration system.

According to Mitchell and Bennett (2003), the most important part of any Land Use Management System is its information, which must be credible and as up-to-date as possible. This will help to ensure that the correct land use is applied to each area, as incorrect information can lead to degradation of the land, erosion and a decrease in property value (Mitchell and Bennett 2003). Thus, if the GIS information is accurate, it should play a role in LUMS. This will allow for efficient decisions that are best suited to the land.

An important part of the decision making process is that the planners have access to all the relevant data at their fingertips in order to make decisions relating to Land Use

Management (Geneletti 2004). Unfortunately, often the applicable information is not provided, or it is difficult to use or apply (Geneletti 2004). Due to the nature of GIS, this problem should not occur- GIS should enable the decision maker to view all the necessary data on the relevant plot of land (e.g. soil type, biodiversity, current land use, slope etc.) at the click of a mouse, and make the correct decision based on the information provided by the software. It is important to bear in mind that decision making is complex, and the planner needs to use his or her own knowledge to determine the final outcome, whilst not being completely reliant on the GIS (Geneletti 2004).

In order for GIS to be successfully used in LUMS, sufficient data is required from various relevant sources (which is problematic as many are not open to sharing their information) (The Planning Initiative Team 2004). This is also elevated by the fact that many councils do not readily share their data. However, with the Spatial Data Infrastructure Act of 2004, some of these issues should be resolved. This act aims to provide the policy to facilitate the “capturing, management, maintenance, integration, distribution and use of spatial information”, as well as it facilitating the spread of data to the necessary recipients. (The Planning Initiative Team 2004).

Garba and Al- Mubaiyedh (1999) add to the literature of poor data management and reliability, by saying that many urban problems can be linked to poor land management. One of the reasons for this issue is that it is an absolute requirement that the administrators have accurate and up to date data regarding the land, and this is often not the case ‘on-the-ground’. This is required so that the planning and decision making are effective and easily carried through. Furthermore, by having sufficient data, evaluation of the development or of building programs will also be successful (Garba and Al- Mubaiyedh 1999). They further go on to say that poor land use management can lead to “rising land prices, increase in slum and squatter settlement population and areas, and the inability to control physical growth and development” (Garba and Al- Mubaiyedh 1999: 269). Thus, conversely, good land use management should lead to stable and reflective land prices as well as a means to control development in order to protect our natural resources.

According to Joerin and Musy (2000), laws and procedures on land use management should only set the general framework for the operation, and should allow for specific adaptations to be made depending on the specific location and circumstances. As such, they argue that LUMS need to be adaptable, due to the ever changing conditions. They further go on to say that when GIS is used in land use management as a decision support tool, it needs to meet several objectives. Firstly, the GIS needs to show an accurate and precise description of the project is proposed, and any notable impacts or aspects thereof. It should also be able to compare alternatives, and thus enable the right decisions. Finally, the GIS should include all relevant parties in the process, meaning that it needs to be user friendly and graspable (Joerin and Musy 2000). The key element of GIS in land use management is that it needs to be able to take into account various criteria, which Joerin and Musy (2000:68) term “multi-criteria analysis”. They also argue that it should incorporate subjective parameters (such as views). Thus, the GIS must allow for the administrator to have some say in the way that it operates. It would also require some form of weighting system to aid in the decision process. Finally, the GIS, as mentioned, needs to determine alternatives or solutions in the case of any problems or disputes (Joerin and Musy 2000: 68).

The element of “alternatives” is a key part of the GIS. In land use planning, a typical approach to evaluating a project would be to simply analyse the size of the site. The GIS should enable the planner to look further and examine all factors of the area, as well as all similar sites in order to determine where the development would best be suited (Joerin and Musy 2000). The study of effective land use is imperative. Methods of determining other suitable sites, according to Joerin and Musy (2000: 73) involve using numerous criteria, namely: “impacts, air quality, noise, accessibility, climate, landslide, technical networks (water, electricity, etc) and view”. These criteria can be used in. For example, for a factory proposal, the land use management officer and use GIS, and by filling in the important values, is able to make a well rounded decision that involves all the criteria, at the click of a button. This is a very, quick, effective and theoretically unbiased approach to determining land use suitability. Furthermore, the land use management officer would

also be able to compare what the GIS indicates in relation to the LUMS for the area, which will aid in informing his decision.

As mentioned, LUMS is not as rigid as traditional zoning, and thus by considering alternatives, the administrator can determine the viability of the development, even if it does not quite fit into the original LUMS. Therefore, multi-criteria analysis should form a key part of GIS for it to be truly effective and beneficial in land use management. This is due to the fact that there are almost always numerous factors which need to be taken into account when conducting a decision making process, and GIS has the technical capacity to do this.

2.7. Conclusion

It is possible to draw some conclusions from the above bodies of literature. Firstly, that GIS has numerous uses (of which a few are relevant to this topic, most notably its basic cartographic use, its use regarding data storage and manipulation, and most importantly, its use as a decision making tool), and also some limitations, which have to be borne in mind with regards to this study. The uses and limitations of GIS gleaned from the literature will definitely inform the research, as one has to bear in mind the boundaries of the tool in order to fully understand its potential performance in LUMS. By fully understanding LUMS (both in practice and legislation), it will be possible to recognise exactly where and how GIS fits in with the system, as well as how its usage can be improved (or indeed, if it is being over used).

From the literature, one can see that because GIS is cartographically orientated, and offers enormous analytical potential, the system offers significant opportunities with regards to its use in LUMS. However, when conducting the research, one will have to bear in mind the limitations (which include institutional and financial constraints), which will have an impact on the study.

The literature also provides some interesting critiques of GIS (such as that of it being a positivist tool), which one must bear in mind whilst conducting the research. It is one thing to value GIS, and another to see it as a perfect tool. It does have flaws, even if these are due to the incorrect application of the tool.

From the literature, the argument of the research is that GIS is not being used to its full potential by planners/ administrators of LUMS. This ill usage of the tool has varying factors, many of which can be linked to the fact that whilst the technical capacity of GIS is enormous, in many instances, the institutional capacity of the municipalities is in fact very weak.

In order for GIS to be used effectively by municipalities in the administration of Land Use Management Systems, individuals must realise that they are responsible for the data, and must thus maintain the highest standards. Secondly, straightforward data exchange is crucial, and any duplication of data should be negated. Therefore, data should be readily available for other public bodies, and even the private sector. The third point that one must bear in mind is that the Municipal Systems Act, no. 32 of 2000, implies that transparency is of the utmost importance (The Planning Initiative Team 2004). As such, the development of LUMS, should be a transparent process, in which, the public should have a role.

In conclusion, one can see how and why GIS is a very powerful tool, which can offer a multitude of solutions to a wide variety of problems. GIS can be used for a wide variety of applications, including Land Use Management, and although the tool has its limitations, it can still offer a lot to the planner. One can also see that whilst LUMS may be new, and may have some internal flaws, it has great potential to be a very powerful and effective method of planning, especially when combined with GIS. Finally, one must realise that although there is often a tendency to focus on GIS as a technical entity or positivist tool, this should not be the case. GIS, when used wisely, and with full knowledge of ones role in its use, can be a tool that is not only technical, but rather one which can take into account the human aspect of planning.

Chapter Three- Research findings: Questionnaires

The first stage of the research involved conducting a study of the district municipalities in KwaZulu Natal. All ten districts in the province received a questionnaire, via email or fax, to which the selected individuals responded, and follow up calls were conducted where necessary. The following is a presentation of the results. A total of seven replies were received, which was deemed sufficient as it was the majority of the municipalities. Respondents that represented the municipalities included individuals from various spheres of government, from GIS technicians to town planners and LUMS managers, thus providing a wide range of perspectives. The three municipalities that did not reply did so due to work pressure, which in itself is an important point to bear in mind. The following is an overall analysis of the various themes that emerged from the questionnaires.

It is important to note that it was important to focus on the district municipalities of Kwa Zulu Natal for various reasons. Firstly, these play a role in facilitating the development of the local municipality LUMS. This means that the district municipalities are not responsible for the development of LUMS, but rather, through the creation of a district Land Use Framework (which is optional and not required), should aid in the development of their local municipality's LUMS. Secondly, by researching the district municipalities, one can gain an idea of the state of LUMS in the local municipalities that fall within the district.

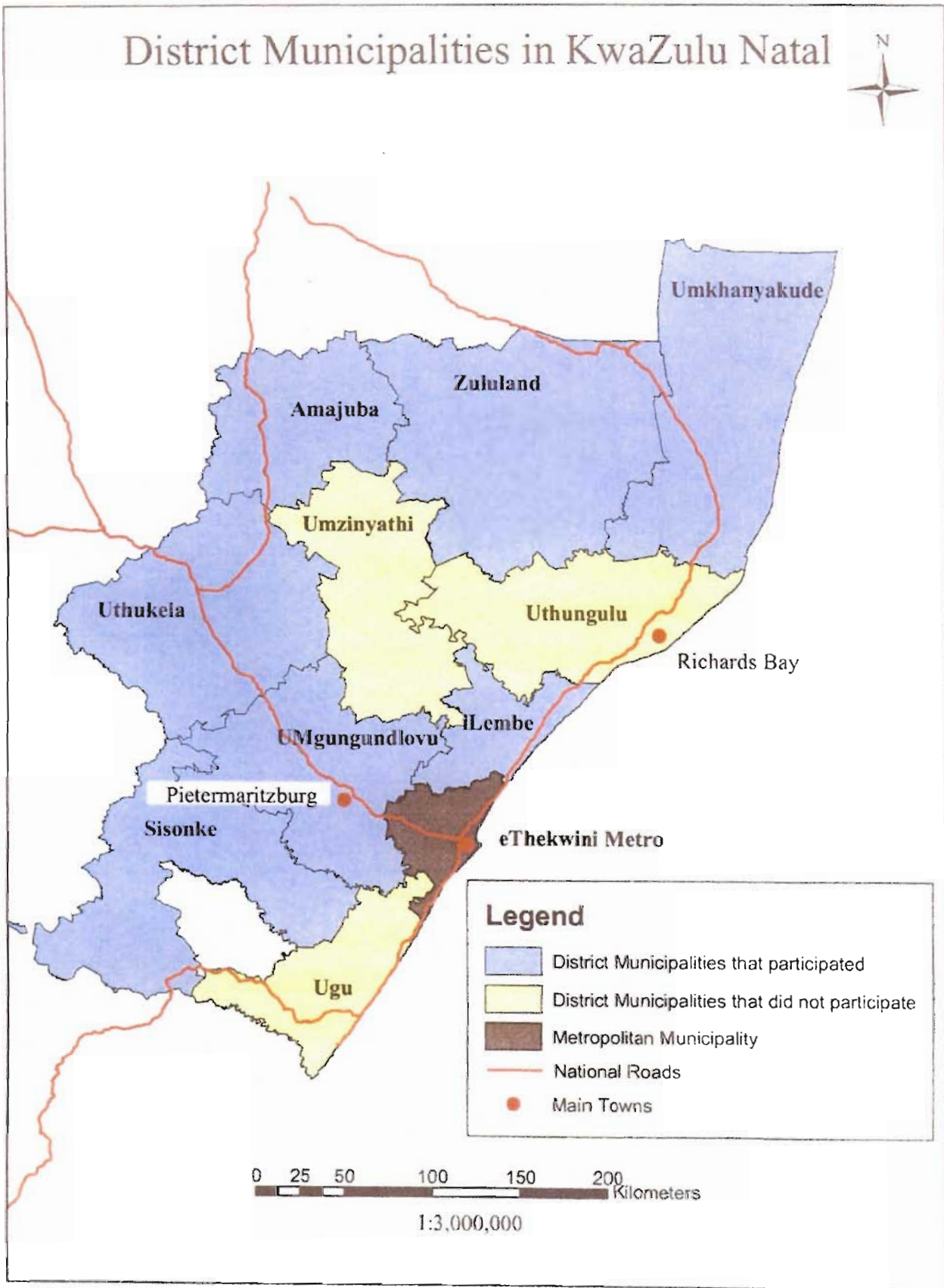
Table 3.1. Municipalities in KwaZulu Natal

Districts	Local Municipalities	Districts	Local Municipalities
Amajuba Participated	Danhauser	Umzinyathi Did not participate	Endumeni
	Newcastle		Msinga
	Utrecht		Nquthu
			Umvoti
Sisonke Participated	Ingwe	Zululand Participated	Abaqulusi
	Matatiele		eDumbe
	KwaSani		Uphongolo
	Ixopo		Ulundi

	Greater Kokstad		Nongoma
Umkhanyakude Participated	Jozini	Ilembe Participated	KwaDukuza
	Umhlabuyalingana		Maphumulo
	Big Five False Bay		Ndwedwe
	Myubatuba		eDondakusuka
	Hlabisa		
Uthungulu Did not participate	Mbonambi	Umgungundlovu Participated	Mooi Mpofana
	Ntambanana		Richmond
	uMhlathuze		uMgeni
	Umlalazi		Mkhamabthini
	Knandla		Impendle
	Mthojaneni		Msunduzi
			uMshwathi
Ugu Did not participate	Ezongoleni	Uthukela Participated	Imbabazane
	Umzumbe		Indaka
	Vulamehlo		Okhahlamba
	Umdoni		Umtshezi
	Hibiscus Coast		Emnambithi
	Umuziwabantu		

The above table shows all of the district and local municipalities in KwaZulu Natal, and also shows which district municipalities responded to the questionnaires. One must bear in mind that LUMS is implemented by the local municipalities, and in general, the district municipalities only play a facilitatory role. In other words, the districts aid the local municipalities in creating their LUMS, by providing the relevant information or data. However, it was necessary to send the districts the questionnaires in order for the researcher to gain an understanding of how advanced the local municipalities are in relation to LUMS. Furthermore, this research will also be able to give one an overall understanding of the state of LUMS in KwaZulu Natal. Figure One (next page) shows the location of the district municipalities.

The questionnaire sent to the district municipalities was fairly short in length, consisting of nine questions, many of which had sub-sections. It can be found in Annexure A. The various themes that the questions represented can be grouped as follows- The Use of GIS by the municipalities, Perceptions of GIS in LUMS, Perspectives on the Performance of GIS in LUMS and its limitations and Capacity issues and the type of GIS users wanted. Each of these themes will be discussed below.



3.1. The Use of GIS by the Municipalities

The first theme to be discussed is the manner in which GIS is being implemented by the municipalities (if at all), as well as the reasons for the tool not being used. This theme can be broken down into a number of broad sections, as will be discussed further. Before one can evaluate how GIS is being used by municipalities, one has to first gain knowledge of the number of districts using the tool. The questionnaires revealed that all of the district municipalities own a GIS. However, it was also important to deduce the specific purpose of the system.

Table 3.2. Use of GIS by the District Municipalities

Use of GIS by the Municipalities						
Municipalities	Data Management	Decision Making	Map Production	Analytical Work	All Planning	Modelling
Ilembe	✓	✓	✓			
uThukela			✓	✓		
Umgungundlovu		✓	✓			
Amajuba	✓	✓	✓			
Sisonke	✓		✓			
Zululand	✓		✓		✓	✓
Umkhanyakude	✓	✓	✓	✓		

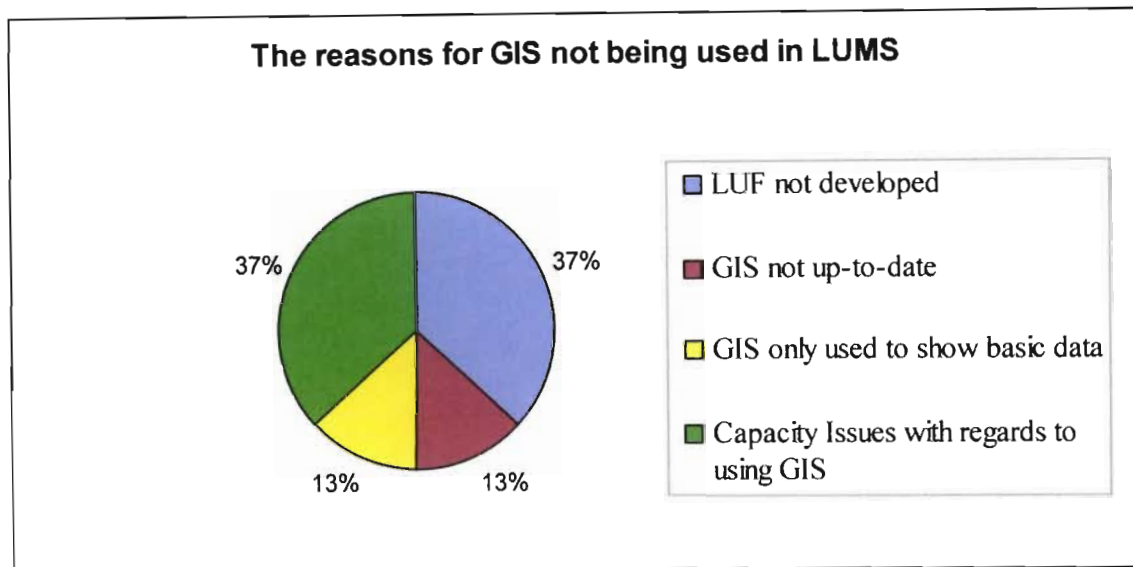
The above table shows what GIS is currently being used for by the municipalities. The general points mentioned include using GIS for basic data management and manipulation, using GIS as a decision support tool for the relevant fields (including LUMS), using GIS to produce basic maps and using GIS for analytical work that is geographically orientated. Other themes mentioned include using GIS for general planning, as well as the modeling of future scenarios. Finally, the last theme mentioned includes the use of GIS as a tool to query things of a geographic nature.

Table 3.2 shows that GIS is being used for many different purposes, with some purposes being more common than others. The first point to note is that the municipalities use GIS mainly for general map production. Other fundamental areas are basic data management, decision making and analytical work. This illustrates that whilst GIS is being used to some extent, its function is not uniform across the municipalities. It also shows that certain features of GIS are not being incorporated to their full potential. For example, GIS is only used by a minority for modeling and general planning. This is an important point to bear in mind. The questionnaires further indicate that GIS is not being employed for all planning purposes. This relates to whether or not GIS is being used in LUMS, which itself is a planning method. The above table shows that GIS is being applied at a fairly basic level, with little or no use of its more advanced applications.

The questionnaires also indicated that most local municipalities use GIS in their LUMS. However, only 57% of the district municipalities use GIS in their part of LUMS (even though they all have a GIS), with 43% not using it. This means that either 43% of the districts have not played a role in the development of LUMS (through the creation of a LUF), or they have not used GIS to create the LUF. As illustrated by the questionnaires, all the district municipalities implementing GIS were more than satisfied with it. One municipality was assured enough to rate their GIS as the best in the country, due to the fact that the data they use is highly accurate, used regularly, and used by the most up-to-date system available. It is thus clear that all the municipalities using GIS recognize the value of the system and its potential.

Whilst it is positive to see that more than half of the municipalities are using GIS in their LUMS, it is also important to understand the reasons for it not being implemented. The following graph outlines this issue.

Figure Two



The above figure is crucial in understanding why GIS is not being used by the district municipalities. The two major issues that have arisen from this section involve the fact that those municipalities not using GIS either do not own a sufficiently developed system (and thus can not incorporate it in the facilitation of the development of the local LUMS), and/or have capacity issues. The questionnaires show that the reason for LUF's not being developed by all the municipalities is capacity constraints. In other words, these municipalities have not yet developed a LUF due to inadequate or insufficient professionals and finances. This relates to the capacity issues involved with GIS, and thus results in it not being used by the districts. Such capacity issues are important to bear in mind due to their affect on the local municipalities (which will be discussed further in a later chapter). Another point mentioned regarding why GIS is not being used for the LUF's is that the GIS in some municipalities is quite outdated, thus rendering it ineffective for LUF's. Finally, some municipalities only use GIS to show basic data, and thus do not use it for their LUF's. There are thus a variety of reasons for certain district municipalities not using GIS in their LUF's.

The final aspect regarding the use of GIS in LUMS involves understanding how GIS is applied from a local municipality perspective. In order to do this, it is imperative to assess whether or not the local districts use GIS. By doing so, a number of trends can be noted.

From the research conducted, it is evident that the majority of local municipalities in fact use GIS in their LUMS. The results from the questionnaires indicate that 71% of the local municipalities use GIS for their LUMS, with 29% not using GIS. This is an interesting result, as by comparing the 71% using GIS in LUMS with the 57% of district municipalities using GIS for their LUF's, a serious discrepancy is apparent. This is interesting as it leads to some district municipalities not using GIS in their part of LUMS, whilst the locals apply it for theirs. The reason for this is pointed out in one of the responses, where the individual mentions that whilst the local municipalities have their LUMS, the district's Land Use Framework has not yet been fully developed, thus not enabling GIS to be used for this purpose. This may be problematic due to the fact that if the local municipalities have their LUMS in place without the district being in the same position with regards to the development of the LUF, a misalignment between the local LUMS and districts LUF can occur. It must also be clear that whilst GIS may be used by the local municipalities, the capacity constraints in these cases must be comprehended. This will be reiterated in a later section. Finally, an important point to bear in mind is that although GIS is not being used in all the district or local municipalities, all of these areas municipalities envisage obtaining GIS at a later stage. Once sufficient funding and personnel are acquired in the near future, GIS will be a more evident feature.

3.2. Perceptions of GIS in LUMS

The second theme that will be discussed examines the manner in which the respondents feel that GIS should be incorporated in Land Use Management by the local municipalities. Whilst this theme focuses on the specific purpose of GIS in LUMS, it also examines how GIS should be used as a decision support tool.

GIS as a tool in LUMS is used by most of the local municipalities. However, its actual use needs to be clear before one can truly evaluate or critique it. The following graph depicts how the local municipalities who use GIS in LUMS view its performance.

The questionnaires showed conclusively that all of the respondents felt positively about using GIS in LUMS, with 75% of the respondents stating that GIS is highly useful, and the remaining 25% saying that it was fairly useful. This response shows clear proof of how those who use the tool eminently respect it, as well as its applications. Following on from this, it is possible to assess the respondents opinions regarding GIS as a decision support tool. All answered that GIS can be used for this purpose, and it was interesting to note that even those municipalities without the system agreed.

The questionnaires highlighted numerous points in relation to how GIS can be used as a decision support tool in LUMS. The points raised include: using GIS for spatial analysis and using GIS to create LUMS

The most common response was that GIS can be used to highlight important sectors of growth and decline, as well as perform spatial analyses. For example, GIS can be used to monitor land use, environmental change as well as social change (such as the spread of HIV AIDS). Therefore, GIS can be used to aid in decisions relating to the above mentioned sectors along with others. These sectors can all be highlighted for current decision requirements, and can also be modeled on the GIS to predict future trends or scenarios. This allows for successful planning for the future. This use can be expanded to include all forms of spatial analysis required for decision making in LUMS. Using a GIS, one can overlay maps, assess contours, create buffers around important features (such as water and roads), and base decisions on data analysis. It was however mentioned that again, capacity issues are preventing the use of GIS for this purpose. A lack of suitable staff and funding has made it difficult to use GIS in LUMS for more than simple map production.

The second point raised regarding the use of GIS in LUMS, is that the system can be employed when creating the LUMS. GIS, being a spatial tool, can create most types of maps, whilst LUMS is a system that requires maps. Therefore, LUMS can be reliant on GIS. Through this, the appropriate land use for each site can be determined. This point can be noted in some of the responses, and despite it not being as prevalent as GIS as decision support tool with regards to its analytical capabilities, it is still important. Although this point was not mentioned as much as the first one, it was still mentioned by a significant number of the respondents.

The second facet relating to the general use of GIS in LUMS examines the way in which GIS can be improved. Numerous points regarding this issue were mentioned, as will be discussed below.

The first point brought up in the questionnaires emphasizes that in order for GIS to be an effective tool, it needs to be constantly updated. However, as mentioned in one of the responses, this tends to be costly and time consuming, and thus, an advanced municipality would be necessary to handle this problem correctly. In order to reflect the constant evolution of an areas landscape, it is imperative for the GIS of a region to be current. This relates to the second issue discussed: the problem of accuracy.

As mentioned in the literature review, GIS is only useful if the information provided is accurate. This exact detail was mentioned by a respondent, who commented: "Garbage in, garbage out". This implies that if the information placed in the system is poor, that which is displayed and analyzed will be inadequate.

A further response regarding improving the use of GIS in LUMS is that many of the local (and district) municipalities lack capacity. Due to the issue of funding, municipalities either do not own GIS, or lack sufficiently trained staff to operate the system, thus making it all but useless. Furthermore, as stated by a respondent, even in the case of a municipality owning a GIS, along with sufficient operators, the system is still not being used to its full potential. This is due to the fact that many individuals (such as planners)

are not yet completely accepting of advanced technology. Furthermore, not all departments have access to a GIS, and are thus being forced to operate independently. As LUMS is often an inter-departmental system, this is an issue that needs to be addressed in the future.

Therefore, it is clear that the use of a complete GIS is dependent on professional users and good funding. These limitations severely affect certain municipalities, and thus the LUMS for those regions as well

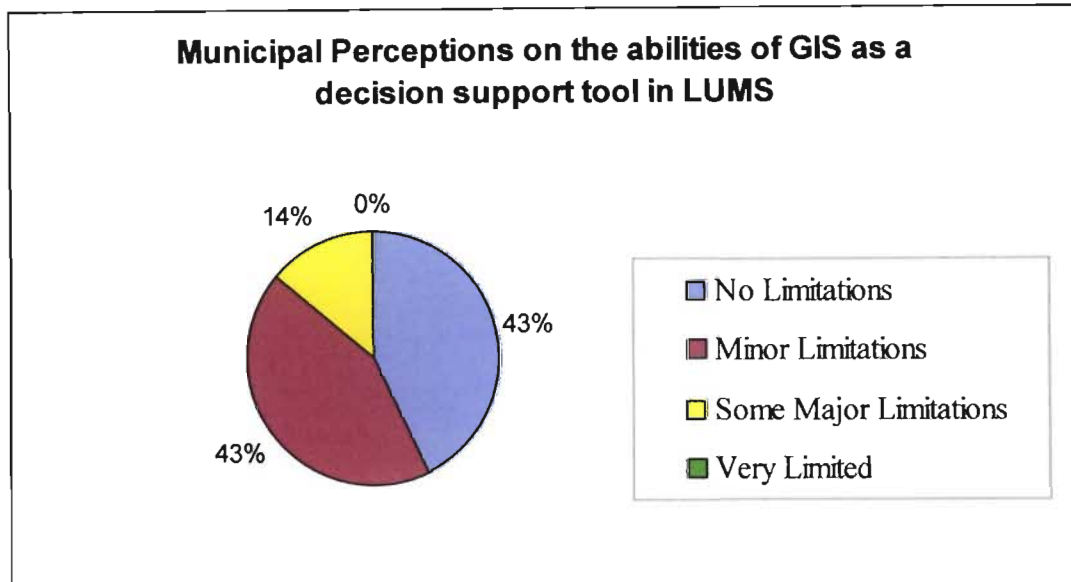
A final point to be mentioned is that some respondents felt that an assessment of the limitations of GIS can only be successfully carried out in the future, once GIS is more firmly entrenched. GIS is still considered as a 'new' tool, and whilst limitations have been noted, further issues are sure to surface. Furthermore, it is impossible for a municipality to evaluate the limitations of using GIS in LUMS until they have had a system operating for an adequate period of time. Unfortunately, as LUMS and GIS are relatively new, many of these systems have not been in place long enough for all of the problems to emerge.

It is important to note that the responses reflect not only how it is being used and can be improved at present (by those municipalities with GIS), but also how it will be incorporated in the future (by those municipalities that do not yet have access to the system).

3.3. Perspectives on the Performance of GIS in LUMS and its Limitations

A further theme for discussion derived from the questionnaires regards evaluating the performance of GIS in LUMS as well as its limitations as a decision support tool. This theme forms a major aspect of the entire research, as based on the topic. This section will be further expanded on when discussing the interviews with the local municipalities.

Figure Three.



It is evident from the above figure that the majority of the respondents felt that the limitations to using GIS as a decision support tool were either minor or non-existent. Some limitations were mentioned and will be discussed further. However, in general, it is clear that most of the respondents view GIS as a beneficial decision support tool, with very few limitations.

The first limitation relating to the use of GIS as a decision support tool in LUMS is that again, it is imperative for the GIS data to be up-to-date and accurate. A decision can not be based on dated and imprecise data. Despite this point being previously discussed, it is necessary to reiterate it, as poor data can severely limit the capabilities of GIS as a decision support tool.

Another limitation, as previously mentioned is that GIS is costly, which restricts its usage. Furthermore, the decision maker must be adequately qualified in GIS and LUMS to ensure constructive results, and as discussed, this is also expensive. Once again, funding severely limits the ability of GIS as a decision support tool.

A notable drawback to using GIS as a decision support tool is that it merely aids the decision maker. The system itself can not be solely relied upon. For example, if incorrect or outdated data plays a more weighted role in planning than the professional, problems will arise for which the individual will have to take responsibility. Without the human in the picture, there runs the risk of GIS being solely implemented as a positivist tool; and as mentioned in the literature, this can be severely problematic. A point brought up in a response to the questionnaire, is that GIS should be used to help substantiate ones decisions, and not make them.

A respondent successfully summarized the problems of GIS: "GIS is such an intelligent piece of equipment that it does not have many limitations that can not be circumvented". This quote states that GIS, whilst limited to a degree as a decision support tool, is able to be adapted or moulded resulting in problems either being negated completely, or at least not influential.

3.4. Capacity issues and the type of GIS users wanted

There are two major points that were brought up in the responses relating to the capacity issues faced by the municipalities. The first of these issues is that of cost, and will be discussed below.

GIS is an expensive tool, as mentioned in many of the responses. Due to this, many municipalities have not purchased the system. Furthermore, as previously discussed, funding has limited qualified personnel being employed. This leads to the second point of capacity.

The research showed that the majority of the municipalities feel poorly capacitated, with 57% of the respondents saying that they felt poorly capacitated. It must be noted that most of these are the institutions that do not have a GIS in place due to a lack of funding or resources. This is because it is obviously the poorer municipalities who do not have the money to have sufficient staff or a GIS system to aid in the development of the local

district LUMS. A point to note from the questionnaires is that all but one of the municipalities have only one staff member operating the GIS, with the one exception employing only two professionals. This in itself is an important capacity issue, as mentioned, as in the instance of the person being absent, there is no back up.

An interesting additional issue that arose in a few of the responses regarding capacity is that some of the district municipalities have bought computers along with GIS software for their local municipalities, thus enabling the local municipalities to develop a LUMS. Thus, even though these municipalities may have some capacity issues (such as finding suitable staff), many at least have a suitable setup, which will enable them to have GIS for use in their LUMS in the future.

A noteworthy issue mentioned is, what the respondent termed “a high staff turn over”. It was further pointed out that only incompetent or poorly skilled individuals are willing to be employed by the rural municipalities. Once GIS work experience has been gained and abilities improved, they then move off to the larger centres, leaving the institutions with no progression in the GIS sector. This results in recurring costs for advertising, hiring and training of new staff. This, according to the respondent, is a major problem that has recently emerged. Another point mentioned is that highly skilled people are more attracted to the larger incomes offered by- the developed centres.

Another remarkable comment made by one of the respondents is that there is a problem of incompetence in the municipalities. Many of the more rural municipalities are forced to hire incompetent people, as all the highly skilled and competent people would rather go to the larger municipalities. As such, these municipalities are almost forced to hire people who are not capable of doing the job. These people, according to the respondent often cause more harm than good.

When asked what type of people they would like to have operating the GIS, all of the respondents said that they would prefer highly skilled professionals rather than those with a general knowledge (and who can work in spheres other than GIS). There are numerous

reasons for this. Firstly, they seek individuals with a detailed comprehension of the system in order to obtain the full benefits of the system. It was mentioned that the municipalities have sufficient staff for the general sectors, but are in desperate need for GIS specialists.

Another statement is that due to the small budget of most, one highly qualified person would be preferred rather than employing a few, less trained staff.

A key point mentioned by one of the respondents is that a qualified professional would have the ability to develop procedures and tasks. In other words, this person would be able to expand upon and fully understand the necessary processes, for example, evaluating development applications. Thus, the GIS operator would be competent in creating the correct model to use for a development application, as well as implementing it thoroughly and promptly.

3.5. Conclusions from the questionnaires

There are numerous conclusions that can be drawn from the responses to the questionnaires. Firstly, the research has illustrated that whilst the majority of the district municipalities have their LUMS in place, there are still those that function without. This raises the issue of capacity, and highlights the problems that some of the rural municipalities are encountering. As such, one must realize that it is difficult to accurately compare one municipality with another with regards to individual issues, as the capacities differ. However, when viewing the broader picture, it is evident that there are aspects in many of the municipalities that allow for a degree of analysis, as proven above.

Secondly, the use of GIS across the KwaZulu Natal is uneven, with some municipalities having a GIS in place and relying heavily upon it, whilst others simply can not afford to operate a system. Its varied use does not only run across the district, but also the local municipalities, with some branches within a district using GIS for LUMS, whilst others are without GIS completely. Although no sense of the local municipal use of GIS was

obtained from the questionnaires, this issue will be dealt with in detail in the following chapter. As noted from the questionnaires, some of the local municipalities used GIS for their LUMS, whereas their relevant districts did not even have a LUF in place. This issue of capacity provides some interesting insights into the problems faced by the various regions.

The research also provides a clear idea of how GIS can be used as a decision support tool in Land Use Management by the local municipalities. According to the study, GIS offers a vast array of functions and applications that can enhance the implementation of LUMS.

It is also apparent that whilst most of the respondents spoke very highly of GIS, they remain aware of the limitations both to its general use, as well as its role as a decision support tool in LUMS. However, what must be borne in mind, is that despite these limitations, GIS still provides a vast array of applications that can be argued, to outweigh the constraints. It should also be realized that most of the problems or limitations can be overcome or circumvented effortlessly due to the advanced functionality of GIS.

It is also important to understand that the district municipalities do try to play a facilitatory role. Many of the district municipalities have supplied their local branches computers equipped with GIS systems in an attempt to aid the implementation of their LUMS and GIS. This is a key point, as one must note that the districts are supposed to play a facilitatory role in LUMS and, despite capacity issues are attempting to do so.

One must bear in mind a number of points regarding this element of the research. Firstly, because of the small response group, a single answer would obtain a heavier weighting and may be less reflective than if the study group were larger. Unfortunately, this was not possible due to there only being ten district municipalities in KwaZulu Natal, and thus a seventy percent response is considered as adequately reflective of this figure.

A further point to bear in mind is that the respondents may have unintentionally overlooked specific points that could have altered the results, or provided a broader range

of answers (it was noted that for some of the questions, each person only mentioned one or two points, whereas overall, a number of points were raised). These questions were not illustrated in the form of a graph or chart, but were rather discussed thematically.

Finally, as mentioned, numerous questions attained various depths of responses. For example, some respondents only stated one or two points whereas others may have gone into more detail. As such, the data analysis would not always have been consistent- there would never be the same amount of answers per question throughout the questionnaires. Yet again, this is one of the reasons for the thematic analysis playing a vital role in this part of the research.

Chapter Four- Findings: Case Studies

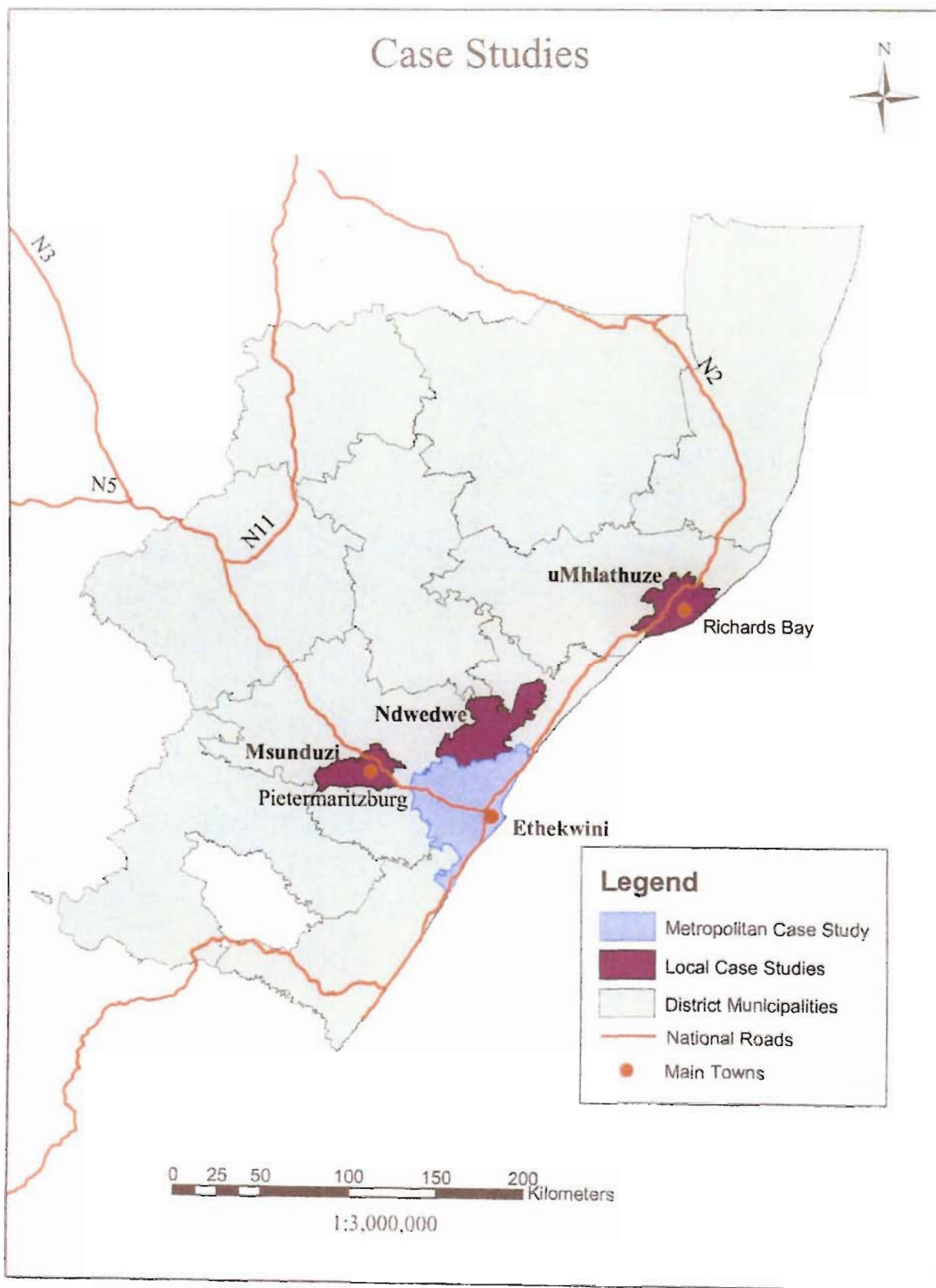
The previous chapter demonstrated a variety of issues that relate to Land Use Management, both with regards to its application at a district and local level. The following involves analysing the interviews that were conducted among the local municipalities, metro municipality, and the interview with the consultant. This chapter will look at three general themes, which include: an analysis of the current state of LUMS, an examination of GIS and its use in LUMS, and finally, based on the interviews, this chapter will highlight the various issues that are having a negative impact on LUMS.

The interviews conducted amongst the subjects from the case studies, and with the private consultant were semi-structured. The case studies, as mentioned include, uMhlathuze, Ndwedwe, Msunduzi and eThekweni Metropolitan Municipality (see Figure Two). There were a set of questions which were felt to be pertinent, and thus, there were some questions that were repeated at all of the interviews (See Appendix B). However, due to the individual circumstances of each of the municipalities, it was important to at times, break away from the set questions. This was also a common occurrence, because, often new questions arose as the respondent answered the set questions.

4.1. The state of Land Use Management

The following analysis will discuss perceptions of LUMS, other issues faced and LUMS current state. This is a pertinent part of the research, as it helps one to understand the general use and state of LUMS, from a local municipality level.

Figure Four:



4.1.1. Perceptions of Land Use Management and other direct problems

It is apparent from the interviews that there is a general feeling of uncertainty amongst the municipalities with regards to exactly what Land Use Management is. All of the subjects felt that the concept of LUMS is challenging, in that most were not sure of exactly what the components of LUMS should be. Furthermore, the respondents all had different ideas regarding what the focus of LUMS should be. For example, the respondent from one municipality felt that LUMS should place a special emphasis on the environmental concerns in the area, whereas the planner from another felt that there should be a special emphasis on it being used to aid in the calculation of rates. However, the general consensus amongst the respondents is that they all know that LUMS must contain a variety of layers and attached policies which all inter-relate to create the Land Use Management System. Everyone interviewed is fairly certain that LUMS should be holistic, in that it covers everything from the environment to land use regulations and also that it should help in terms of aiding in the assessment of rates. The issue however, is that these people are not certain about what all the layers are, or how to go about creating all the elements of the LUMS.

Most of the subjects felt fairly confident on what a scheme is, and were fairly sure what the scheme part of LUMS should contain (although, there were some uncertainties). However, schemes are not only part of LUMS, with other systems also playing a part. The interviewees from the municipalities were, for the most part, unsure how to incorporate the other systems which play a role in LUMS. It is this issue of confusion, which has played a role in inhibiting the development of LUMS amongst the municipalities interviewed.

During an interview with the consultant, it became evident as to why there is such confusion around LUMS and how to implement it. It was pointed out that firstly, whilst the Town Planning Ordinance (TPO) has in fact been around for a long time, LUMS is a relatively new concept, and as such, has taken a while to get off the ground. This problem is further compounded, because, the Town Planning Ordinance, Development Facilitation

Act (DFA) and KwaZulu Land Affairs Act, are also all in place and all play a role in development control. As such, there is currently a complicated situation regarding development control, as there is simply too much legislation. This is a problem as it means that if one intends to develop a site, one can go through a variety of means to allow this to happen. The consultant and one of the respondents mentioned the array of legislation as a problem as it confuses LUMS and perceptions of it.

Another cause identified by the consultant is that the LUMS “education process” was incredibly short. The process of presenting the concept of LUMS to the municipalities involved a few brief presentations and workshops. These workshops were typically a day long, and were conducted at a time when the consultants were themselves still working out the finer details of LUMS. As LUMS is such a new and different approach to planning, the subject felt that these short presentations were insufficient in trying to get the concept across to the people involved in the workshops. The consultant further pointed out that LUMS as a concept is completely different to, for example, the Town Planning Ordinance. When people used to learn about the Town Planning Ordinance, they would go through a mentoring process, which lasted a long time, and as such, people left the process with a clear understanding of the Ordinance. However, these same people, were only given a day to learn a totally new approach to planning. As such, the consultant felt that the time allocated to them for teaching the municipalities about LUMS was inadequate, especially considering that the consultants had not yet finalised the concept. It is important to bear in mind that LUMS as an approach, is different to previous planning approaches in that LUMS is far more strategic. As such, it requires a different mindset than the one used for the ‘Ordinance’. As such, one can not simply go to a day long course on LUMS and know all about it, when one has been working with the Ordinance for a number of decades- the paradigm shift is simply too large.

A final issue regarding the perceptions of LUMS is that, as with everything new, there is some resistance to it. The interview with the private consultant highlighted the fact that many people had been working with the Town Planning Ordinance for more than a decade. As such, these people felt that there was nothing wrong with the Ordinance, and

did not really understand why a new system of planning was needed. As such, these people were felt to have closed their minds off to LUMS.

4.1.2. Other issues in LUMS

Other than the issues of legislation and perceptions inhibiting LUMS, an issue mentioned by two municipalities, and discussed also by the consultant, is that of authority. The first issue discussed with regards to authority involves the problems associated with incorporating the traditional councils. In some of the rural areas, the traditional councils do not like to be interfered with when it comes to land use, as they feel that land use control or regulation is their prerogative. As such, they are not open to having the municipality tell them how to monitor or assess land use. For years, the traditional councils have had the sole say in approving or refusing land use. Therefore, according to one subject, and the consultant, these authorities are not often open to using a system such as LUMS, which they feel usurps their power. Although there has been some improvement with regards to this issue, both of these respondents felt that this is still a major problem.

The final issue facing LUMS is the issue of legislation. This interesting point was brought up by the same respondent as the one who mentioned the issue of the traditional councils. This subject pointed out that there is no specific legislation that gives the municipalities “teeth”. As such, this respondent felt that if a development occurred that was not approved of by the municipality, there is not much that the municipality can do about it. However, the consultant mentioned there is a means to circumvent this. If a district municipality goes through the correct means of developing a Land Use Framework, in their Integrated Development Plan, which has legal status in terms of the Municipal Systems Act, then the developer can not develop a site which goes contrary to the LUMS for the local municipality. Another option is to have authority delegated to them by the Premier’s office. The DFA makes provision for the responsible minister to delegate authority to the local municipality, thus giving the municipality the power of the

minister. As such, the municipality would be able to block a development because; they would have the power of the minister.

4.1.3. The Current State of LUMS

This section highlights the current state of LUMS amongst the municipalities interviewed. In order to evaluate LUMS, it is important to analyse the level of implementation of LUMS amongst the local municipalities.

4.1.3.1. uMhlathuze

As of the date of the interview, LUMS has, according to the respondent “been put on the back burner”. Although there are elements of a LUMS in place, and some of these elements are being referred to (namely the environmental aspect), in general, LUMS is not being used. The reason for LUMS not being fully in place is that there has been a significant difficulty in trying to amalgamate the Town Planning Schemes of Richards Bay and Empangeni. These schemes were completely different, with different zones and uses, and it is because of these differences that it has been difficult to create a LUMS that covers the whole municipality. Another issue identified in the interview is that there has been a problem with the data on the schemes. The respondent, and the consultant interviewed mentioned that there are numerous instances where the planning schemes do not reflect what really exists in reality. As such, the de jure does not reflect the de facto. This has been an inhibiting factor in the development of the LUMS for uMhlathuze, as it has taken a long time, and has been a very costly exercise. As such, the LUMS for Richards Bay is still only in its first draft, which, according to the interviewee contained a significant number of errors. In fact, according to the respondent, it is believed that the LUMS will only be able to be implemented in the next two years.

4.1.3.2. Msunduzi

Again, the LUMS for this municipality is not fully in place. This municipality is instead still focusing on the Town Planning Ordinance until such a time that the LUMS is adequate and fully legislated. Elements of the LUMS for this municipality are in place, however, the subject was uncertain as to how aligned these elements were. The SDF for the municipality is in place, and this is related to LUMS. In fact, the SDF is about to be reviewed. The reasons for the LUMS not being fully in place is that there have been problems relating to the understanding of LUMS, as well as the difficulty of involving the traditional councils in the process of developing the LUMS (this issue has already been discussed in general in section 4.1.2).

4.1.3.3. Ndwedwe

Ndwedwe does not have an implemented LUMS. Rather, Ndwedwe, being a small municipality is focussing on the implementation of a Pilot Study. According to the respondent, and the consultant interviewed, it was felt to be unrealistic to develop a full LUMS for the whole municipality, because the infrastructure and economy is too small to really require one for the whole municipality. Instead, it was decided to develop a pilot scheme in the more developed parts of the municipality. This scheme consists of a Land Use Framework, which has been used to guide development in the areas with the most pressure. The purpose of the pilot study has also been to aid in assessing any problems or barriers to implementing a LUMS, so that, when the time comes for a full LUMS, the planners would have a clearer idea of what to expect. The use of pilot studies instead of a full LUMS has not been restricted to Ndwedwe. According to the consultant interviewed, this has been a common approach amongst the more rural and poorer municipalities in KwaZulu Natal, such as Vulamehlo.

4.1.3.4. eThekwini

Two people were involved in the interview process for this municipality, namely, a GIS operator, and the LUMS officer for the municipality.

eThekwini municipality is the only metropolitan municipality in KwaZulu Natal, and is much larger, and wealthier than any other municipality in the province. The interviews showed that this municipality, like the others, does not have a LUMS in place. The respondents from this municipality stated that the municipality was not certain as to what their LUMS should or shouldn't contain. The municipality felt clear about the LUMS containing a map and document, but were not clear on what these should contain or display. Furthermore, this municipality feels unclear on the urban design involved in LUMS. eThekwini wants to focus on its urban design in the run-up to the 2010 Soccer World Cup, and is not sure of the relationship between urban design and LUMS. There are also issues such as capacity problems which are delaying the LUMS, but this will be discussed at a later stage.

From the above, it is possible to evaluate the current level of Land Use Management in KwaZulu Natal. One can see that LUMS, for the municipalities interviewed, is still in its infancy, with the problems and drawbacks that are often associated with what is "new". All of the municipalities interviewed were not using a full LUMS (and were instead using elements of it), and this in itself is a sign of its infancy. This point is interesting, as it seems to contradict the survey, which indicated that most local municipalities have a LUMS in place. This will be discussed further at a later stage. The level of implementation of LUMS will obviously affect how GIS is used in LUMS. The following is an analysis of how GIS has been used in the LUMS for the municipalities so far, and also shows how they envisage using GIS in LUMS, with an emphasis on how it will be used as a decision support tool.

4.2. GIS and its use in Land Use Management

This section forms a pertinent part of the research, and can be divided into the following subheadings: Perceptions of GIS, the use of GIS in general, the use of GIS in LUMS, and also the issues regarding using GIS in LUMS. The last two of these will emphasise the Decision Support function of GIS.

4.2.1. Perceptions of GIS

GIS, as seen in the literature review, and in the analysis of the questionnaires, is viewed as a powerful tool by most people and offers a wide range of applications to the planner. This general perception was carried through in the interviews, with all respondents speaking favourably of the tool. GIS is seen, by all the municipalities as a tool that can aid in their planning, and decision making. Every respondent said, in one way or another, that they were very optimistic about the uses of GIS, and felt that its potential is only starting to be felt.

4.2.2. The Use of GIS by the municipalities

GIS is used at different levels across the municipalities. Simply put, GIS is not used at the same level throughout the municipalities. What follows is a break down of how GIS is used by each of the study areas.

4.2.2.1. uMhlathuze

The respondent interviewed at Richards Bay is heavily involved in the GIS department of the municipality, and thus offered some interesting points regarding the use of GIS and its potential.

This local authority has got a very detailed level of information stored in their GIS. However, according to the respondent, the GIS for the municipality is in a “very

staggered” state. A major problem facing this municipality is that, each department has its own “portion or piece” of GIS, and so the information that the departments have has not been collated into one single system. This is problematic, as, according to the subject, often one department does not know what another one offers in terms of data. Furthermore, some departments who don’t use GIS very much, but could benefit from its use. The example given by the respondent is that the Parks Department does not use GIS to monitor which sections of the open spaces and parks have been updated and by whom. The respondent felt that if the department used GIS to do this, the department would be more efficient.

The respondent mentioned that uMhlathuze has one of the better GIS systems in KwaZulu Natal, with fairly up to date information. However, the respondent felt that GIS was not being used to its potential because of the issues mentioned above. Other issues relating to the use of GIS in LUMS will be discussed further in this chapter.

4.2.2.2. Msunduzi

The interviewee from this municipality is a planner involved in the Development Application Department of Msunduzi, and so offered information on the GIS from a planner’s perspective.

According to the respondent, Msunduzi has a “huge amount of information” stored on the GIS. The entire municipality’s cadastre has been stored onto the GIS, and the correctness of this information is of a very high level. Each department in this municipality is responsible for its information, much like uMhlathuze. The respondent gave the example of the roads department creating and maintaining the roads information, and the “people responsible for water and drainage” would put information in. Thus, each department is responsible for its own information. Unfortunately, whilst there is a good GIS system in place, not everyone is aware of what is in the system, and do not access the system very much. As such, the use of GIS has been left to the select few, and also the GIS department, who are responsible for updating and collating the information from the

various departments. Again the issue of uncertainty regarding access to GIS information, as mentioned in the section discussing uMhlathuze, has arisen in this municipality, and according to the respondent, this is a major problem.

4.2.2.3. Ndwedwe

The respondent from this municipality is the only planner in the municipality and is directly involved in the LUMS for the municipality. This municipality presented a very interesting situation, in that the municipality has a fairly advanced GIS, with all the necessary data, but does not use the system at all.

Ndwedwe is a rural municipality, and, according to the respondent, people are not “that keen to work” in the municipality. This is due to the fact that the municipality is seen to be far from any major city. As such, the municipality is finding it very difficult to hire someone to use the GIS. This issue will be discussed in detail further in this chapter.

According to the respondent, the GIS in the municipality is fairly advanced, and all the necessary information has been obtained from the district offices (Ilembe District Municipality). It is envisaged that once someone has been hired to manage the GIS, it will be used in the LUMS, and other activities. The respondent, although GIS is not being used there at present, is very excited about the possibilities that the tool offers, and envisages that it will be used by the end of 2006.

4.2.2.4.eThekwini

eThekwini is, as already mentioned, the only Metro municipality in KwaZulu Natal, and so, is the most highly capacitated of all the municipalities. The respondents felt that this municipality had the best GIS system in the province, and admitted that the municipality was very reliant on the system. Each department has its own GIS, which it is responsible for. Furthermore, the information is updated on a weekly basis, and is shared with all of the departments using GIS. The subjects revealed that each department can view all the

data from other departments; however, each department can only edit the information it is responsible for. An interesting point mentioned by the GIS specialist from this municipality, is that one only realises how important GIS is, when the system crashes, and everything comes to a stand still.

The GIS in eThekweni is used for a variety of activities ranging from basic displaying information, to analysing development applications and decision support. In fact, the GIS operator said that “GIS runs parallel to everything, it supports everything. Everything that you see will be GIS based”. As such, GIS is used by the municipality for all spheres of planning.

4.2.3. The use of GIS in LUMS

Although the LUMS for all of the municipalities have not been fully developed yet, it is still necessary to understand how GIS has been used so far in the LUMS process, as well as how it will be used once the LUMS for the municipalities are running. The consensus among the respondents has been that GIS will be used extensively in LUMS, both in the development of the LUMS, and in decision making once it is in force.

4.2.3.1 uMhlathuze

GIS has been used by this municipality to help develop the first draft of the LUMS. It has been used to create all the necessary maps for the LUMS, ranging from basic zoning, to the relevant environmental layers. As such, GIS has already played a key role in the LUMS so far. Once the LUMS for uMhlathuze is in place, it is envisaged that GIS will play a major role in the LUMS on a number of levels. Firstly, according to the subject, GIS will be used to constantly maintain and update land use information. This is important, as it will enable the planner/ application officer to easily see what land use exists on a site. This is directly related to the next point mentioned by the subject, which is the aspect of decision support. By using the relevant information stored on the LUMS, it will be easy for the assessor to make a decision on a land use, or development

application. An example mentioned by the subject is that on numerous occasions, developments have been delayed because protestors/ environmental groups want to protect a “rare species”, which they say exists on the site. The subject believes that the GIS will enable the assessor to quickly evaluate the environmental aspects of a site, and thus, a decision can be made almost instantaneously. Thus, it is felt that GIS will be an important part of the decision making process in LUMS, considering the speed in which it can analyse data. It will thus give the decision maker all the necessary information in a presentable manner, which will enable the assessor to make the correct decision. However, the respondent mentioned that the GIS can not make the decision- this is still the responsibility of the operator.

4.2.3.2. Msunduzi

The respondent from this municipality believes that once the LUMS for Msunduzi is in place, GIS will play an important role. Again, for this municipality, GIS has been, and will continue to be used to create the LUMS for the area. However, the main means in which GIS will be used, according to the subject, is that it will be used to swiftly evaluate development applications, by enabling the operator to evaluate the ownership, plot sizes, land use etc. and combining these to make a suitable decision. GIS, according to the subject, is being used by each of the departments to evaluate an application, and comment on it. As such, GIS is used for almost all aspect of current land use administration, and will continue to be used in a similar manner when LUMS becomes implemented. However, according to the respondent, there are some instances where GIS is not, and will not be used in the evaluation of development applications. The respondent described the “in principle situation”, where regardless of what is on the GIS, a proposal can be dealt with in principle. Some land use changes, which are small, and considered to be insignificant in terms of land use control (the example mentioned was where a person wanted to put a tuck-shop on a residential site.), are felt by the respondent to not really require the use of GIS, as sometimes, the principle or policy regarding changing certain land uses is not reflected in GIS. As such, the subject felt that whilst GIS will be used

extensively in LUMS, especially as a decision support tool, it will still be the prerogative of the operator to make the decision on a land use.

4.2.3.3 Ndwedwe

GIS has been used by this municipality (through private consultants), to help develop the Pilot Study that has been implemented for the area. Although this municipality is currently not using GIS at all, it is envisaged by the respondent, that the system will form an integral part of the decision making process. Furthermore, the respondent mentioned that GIS will be used to finish the LUMS for the entire area.

The subject felt that the system would offer a great advantage to LUMS, as it will speed up the decision making process. However, the respondent also raised an important issue, being, that the efficacy of GIS as a decision support tool is based on the user of the system. If the person using the system is poor at GIS, then the decision making process will not be enhanced. However, if the operator is knowledgeable of the capabilities and procedures involved in using GIS as a decision support tool, then, the respondent feels that the process will be greatly enhanced.

4.2.3.4 eThekweni

GIS, as mentioned is currently used in all aspect of decision making in this municipality. It has been used to create the LUMS maps, and according to the subjects, will play an important role in LUMS. GIS will be used to constantly monitor changes in land use. GIS will, according to the LUMS officer, form an integral part of creating the final LUMS for the municipality. It will also play an important role as a decision support tool, and as discussed previously, it will make the whole process much quicker. GIS will also be used to help in the calculation of taxes. This subject felt that GIS will offer so much to the LUMS, that it would be very difficult to create the LUMS without GIS. The subject felt that GIS would enable swift decisions because of its ability to show “every bit of information” on a site (“from lot size, to the number of bedrooms”) at once.

From the above, it is possible to understand how GIS will be used in LUMS, and how and why it will play an important role as a decision support tool. The following describes some of the issues relating to using GIS as a decision support tool.

4.3. The issues in using GIS in LUMS

The following, unlike the above, is not a break down of the problems experienced by each municipality, but rather, this section will focus on the broader themes mentioned by all the respondents (including the consultant interviewed). This section will also not look at the capacity issues involved, which will be discussed in the next section.

4.3.1. Problems with data and accuracy.

The first problem to be discussed is the issue of data accuracy, and in fact data completeness. A number of the municipalities mentioned that whilst they have excellent GIS systems, with a wide range of data, some of the data is inaccurate. The uMhlathuze respondent mentioned that there are examples where a land use that changed more than a year ago has not been captured onto the GIS. Another important problem, mentioned by the eThekweni respondent, is that although the land use for the entire municipality has been captured, some of it has not been updated for up to seven years, and because land use is dynamic and changes constantly, this is a major problem. Finally, some of the municipalities pointed out that whilst they have the information for most of the area, there are still some pockets of land that have not been captured. The lack of data, and lack of accurate data needs to be addressed before GIS can be used fully as a decision support tool. Thus, some of the municipalities feel that whilst their data is occasionally updated, it needs to be updated more regularly and at a more accurate level.

Two respondents also mentioned that it is important to regularly update information in case the system crashes. One mentioned that if the municipality did not update the information regularly and it crashed, then they would reach a stage where they would not be sure what land use exists on a site. Furthermore, they felt that it would be best to have

the information in hard copy as well, as an added backup in case the system crashes for an extended period of time.

4.3.2. Issues as a decision support tool.

GIS, as a decision support tool, is felt by the respondents to be very useful. However, there are some issues that have been noted by the respondents that need to be borne in mind when considering using GIS as a decision support tool, both in general, and in Land Use Management.

Most of the respondents felt that GIS is only as useful as a decision support tool as the person operating the system. The respondents felt that GIS can not make the decision, as it is up to the operator to make the final decision. It is of the utmost importance that the information be accurate so that the decision maker can make a fair and accurate decision. Furthermore, it is important for the decision maker to be competent in the functions of GIS, as well as the operational procedures for decision making. If the decision maker does not know the correct procedure for using GIS to make a decision, then the result is that the GIS output will be incorrect. The respondents thus felt that GIS can only be used aid in the decision making process- they can not make the final decision.

4.3.3. Other issues

Two other issues brought up in the interviews are the issues of cost, and regular training. A full GIS system is very expensive to purchase, and as the system requires frequent updating (both in terms of the information, and the software), the cost does not just end at the purchase- it continues as long as the programme is used. As such, the cost of GIS can be a very important negative, as it means that municipalities on a tight budget can only put GIS on a few computers, thus excluding a number of people from the system. This is felt to be a major problem in using GIS.

GIS, as previously discussed, is constantly evolving. Programmes and procedures are updated and altered at regular intervals, which means that in order for the system to be as effective as possible, it is important to have operators who are knowledgeable of the most up to date systems. As such, municipalities often have to send their operators to training courses, especially when a new system is purchased. These courses can be very expensive, and only add to the issue of cost.

4.4. Capacity issues facing the municipalities

As mentioned in the previous section, there are numerous issues relating to the use of GIS by the municipality, ranging from its cost, to its capacity. The following section identifies the capacity issues that are facing the various municipalities. For most of the municipalities, capacity issues directly related to LUMS have not been analysed, as the LUMS for all are not in place, and the reasons for this have already been discussed.

4.4.1. uMhlathuze

uMhlathuze, being one of the major centres of KwaZulu Natal, is financially stable, with sufficient funds to allow for adequate numbers of staff to be involved in using the GIS, and working with the LUMS. The main problem mentioned by the subject is that some people are more open to using GIS than others. In fact, the respondent stated that “people are scared of computers”. This is, according to the subject, a major issue facing the area, as it means that the use of GIS is limited to those who are open to using it. This is directly related to the fact that the respondent felt that the GIS software that uMhlathuze is using, is not very user friendly and is “too technical”. This is a contributing factor to the apprehension that people have of using GIS.

Another important problem noted regarding the use of GIS is that, as mentioned, not all departments use GIS, even though a basic form of it is available through uMhlathuze’s intranet. This capacity issue should be improved in time, as the GIS system for the municipality will be upgraded in the future.

4.4.2. Msunduzi

Msunduzi Local Municipality is, in general terms, far wealthier than some of the municipalities in KwaZulu Natal. However, the respondent felt that most of the GIS is controlled by the GIS unit of the municipality. As such, they are seen as the “custodians of that information”, which the subject felt was fine to an extent, but was slightly problematic in that the people who are really responsible for the individual datasets (such as roads, water etc.) are outside of the GIS department. Thus, the problem is that each department has to be sure that its information is correct because the information is then stored in the GIS department, to be shared with other departments if the others so wish. Whilst this is not directly a capacity issue, one can see how it relates, as it means that sufficient staff are required to constantly update the system.

The above point is directly related to the important capacity issue of human resources. The respondent felt that whilst Msunduzi was relatively “wealthy”, the GIS department (and many others), is heavily under-capacitated. The subject felt that many of the staff in the GIS do not stay very long, or move into the management of the municipality. Furthermore, these people are not swiftly replaced, and when they are, it takes a while to train the new staff. As such, this is an important capacity issue, as it means that for much of the time, the department either has too few people, or staff still being trained. This problem causes the whole GIS department to slow down, which is problematic for such an important department.

The final issue mentioned by the subject is that of training. The respondent felt that whilst there are, in general, sufficient people in the planning department, and other major departments, many of these people are poorly trained. As such, the work they do often takes longer than it should, thus causing delays. This poor training needs to be addressed if LUMS is to be successfully adapted and enforced.

4.4.3. Ndwedwe

Ndwedwe is a rural municipality, and by the respondents own admission, is fairly poor, when compared to other, larger centres. Ndwedwe was considered to be a very useful area to study, because it is so similar to many municipalities in KwaZulu Natal.

The major issue in Ndwedwe is the fact that the municipality does not have a qualified person to run the GIS, and as such, the system is not being used at all. This is directly related to the fact that there is no real centre, with no qualified GIS personnel living in the vicinity. The subject mentioned that a major problem facing all the municipalities is that most people do not want to work at a rural municipality. This issue will be discussed further in the general discussion of the capacity issues, as it is an issue that has appeared both in the questionnaires and in the interview with the private consultant.

Thus, whilst Ndwedwe has the GIS, and the funding to hire someone to operate the system, people simply do not want to travel all the way to work there, when they could work in a larger centre, with a much shorter travel time.

4.4.4. eThekweni

This municipality has, according to the GIS operator “various GIS departments”, with each major department (such as engineering, planning etc) having access to its own GIS. This information is then shared with all the departments through an intranet. The data in the system is updated weekly, and although this is time consuming, the respondent felt that it did not cause a capacity issue. The only real issue facing the municipality is that people need to be sufficiently trained (which the subject feel they are), and need to training at regular intervals (as the software or procedures are updated). This can be time consuming, and problematic, because, if someone goes for training, and the system only gets installed at the municipality’s offices a month later, then that person would have “forgotten it already”. Thus, in terms of the GIS, the subject felt that there are only minor capacity issues facing the municipality.

In terms of the LUMS, and its development, there are some serious capacity issues. There is a small team working with the LUMS officer. However, most of this team is comprised of people from various departments, and so these people do not have much time to work on the LUMS. Therefore, for most of the time, there is only one person working on the LUMS for the whole municipality. This is, according to the subject, a huge problem, as the subject feels that it is almost impossible for a LUMS to be developed by just one person- “there is too much to do”.

Thus, whilst eThekweni may not have any major capacity issues in terms of its GIS, the reason for its LUMS having stalled is that there are significant capacity issues.

4.5. General issues raised in the interviews

The following discusses other capacity issues raised in the interviews with the municipalities, and the private consultant. Although the above issues can probably apply to many municipalities, the following are considered by the respondents to be the main issues facing municipalities in general.

4.5.1. High staff turnover

Many of the respondents mentioned that for numerous municipalities in KwaZulu Natal, a high staff turnover is experienced. Simply put, the subjects mentioned that the staff in the municipalities often work at a municipality for a couple of months, gain experience, and then move off to higher paying jobs. This issue was also raised in some of the questionnaires, and so can be seen to be quite a serious problem.

There are various reasons that were mentioned relating to the high staff turnover, the most important of which is salary. Thus, staff tend to gain experience and training, to improve their earning potential, and then move to higher paying municipalities, or into the private sector. According to the private consultant, this problem is rooted in the competition for scarce resources. Highly qualified and skilled people are seen as scarce

resources, and so can often pick the best (highest paying) place to work. As such, there is some competition between the municipalities for these people. This problem has gotten so bad, that according to the private consultant, that some levels of government had created a rule whereby one can not easily move between the provincial government and the district and local levels. Thus, one can not simply “job- hop”- one has to stay at ones job for a specific time.

A second, directly related reason for the high staff turnover in some of the smaller, more rural municipalities is that highly trained people do not want to travel far to work, when they can find a job closer to home. As such, the rural municipalities, who are far from any major centre, are seen to be undesirable places to work, when compared to the larger centres. Therefore, these municipalities tend to have less skilled people work for them, as the higher skilled people are able to work in the “more desirable” centres.

4.5.2. Aligning the local and district.

An issue mentioned by the consultant, and by one of the subjects, is the issue of the repository for GIS data being stored at a district level. It is seen to be a problem that the GIS data for a local municipality is stored at the district offices. This is because, any changes made to a scheme have to be made in the local database, and district database, so that the information is aligned. It is, according to the consultant, an “onerous process” to archive the data and its changes.

4.5.3. Legislation and enforcement.

Although this issue has already been discussed, it was brought up on numerous occasions, and so will be briefly discussed here, as it is a form of a capacity issue. Currently, because of the various legislation (which is often conflicting), such as the KwaZulu Land Affairs Act, and the Town Planning Ordinance, it is difficult to enforce LUMS. Whilst one may have a scheme for an area, there is currently no specific way to

enforce it statutorily. Although there are means to enforce it (such as those mentioned previously), there is no specific legislation, to, as one subject put it, give LUMS “teeth”.

4.6. Conclusion

From the above analysis, it is possible to draw numerous conclusions, which will be expanded on in the following chapter. However, one will note that there are many problems currently facing the development and implementation of LUMS. Furthermore, there are also some problems with using GIS in LUMS, which need to be adapted before GIS can be used completely successfully as a decision support tool in LUMS. As one of the respondents mentioned; “It will be interesting to see how GIS will really be used in LUMS in ten years”.

Chapter Five: Analysis and Recommendations

The preceding two chapters present and discuss the results from the research conducted. This section aims to consolidate the two previous chapters in order to create a holistic representation of the use of GIS in LUMS, as well as its application as a decision support tool. Finally, this chapter will highlight some of the possible solutions to the problems facing LUMS and GIS, drawing from comments from both the case studies, along with the responses in the questionnaires.

5.1. The state of LUMS and related issues

The first point to be discussed regarding the state of LUMS is that in fact, the use, and level of LUMS across KwaZulu Natal is extremely varied. All of the case studies have a Land Use Management System to some extent, however, each is very different, and at different stages of implementation, and none is finished. What one must note is that none of the case studies is using a complete LUMS, with one using a pilot study, and the rest either still finalising their LUMS, or simply not using the LUMS that has been developed. As LUMS is not really being used by any of the case studies, one can probably assume that this scenario is fairly symptomatic of the rest of the province.

The problem of implementation is also apparent in the district municipalities, many of which do not have the required Land Use Framework in place. In turn, this creates a hindrance to the development of LUMS by the local municipalities. The causes of the problems facing implementation will be discussed at a later stage.

An important theme brought up, both in the interviews and the survey, is that there is some concern regarding exactly what LUMS is. There seems to be some confusion regarding LUMS, and its different constituents. However, the interview with the consultant, mentioned that this confusion has important roots which explain the problem. Firstly, there was little time given by the government for the introduction and training of the local and district municipalities about LUMS. Secondly, many of the municipal staff

working in planning were accustomed to the Town Planning Ordinance which resulted in LUMS seeming difficult and time consuming. It is, according to the consultant interviewed, because of these factors that there is confusion over Land Use Management.

An interesting point noted from the survey conducted amongst the district municipalities is that whilst approximately 57% of the district municipalities use GIS in what is required from them in terms of LUMS, 71% of the local municipalities use GIS in their LUMS. As mentioned this can be problematic. If the district and local municipalities are at different stages in the use of GIS in LUF's/ LUMS, it can result in a misalignment between the two. The reason for this discrepancy, according to one of the respondents is that the district municipalities have not yet finished their LUF's (due to capacity issues), whereas the local municipalities have finished their LUMS.

What is fascinating to note is that according to the survey conducted amongst the district municipalities, 71% of the local municipalities are using GIS in their LUMS. However out of interviews conducted, none of the local municipalities are actually using GIS for LUMS. There are a number of possible reasons for this discrepancy, the most notable of which is that the LUMS for these municipalities are not yet finalised. This issue can be looked at from a few perspectives. The first reason for this inconsistency can be that possibly, there is little communication between the district and local municipalities, and thus the district municipalities do not really know the exact state of the LUMS in their districts. The second reason could be that, the respondents to the survey meant that parts of the LUMS were developed (which, from the case studies, can be seen to be true). If this is what was meant, then this is a possible reason for the discrepancy, due to the fact that all of those municipalities interviewed had some elements of LUMS in place. However, none of the respondents actually mentioned this, as all those who said that GIS was being used in LUMS implied that the LUMS had been prepared. The final possible reason for this inconsistency could be that the sample was not reflective of the actual situation. Whilst this is a possibility, the probability for this reason is not very high, due to the fact a wide municipal type was covered (ranging from rural to fairly developed to Metro), and none of these had a finished LUMS. Furthermore, if indeed 71% of the local

municipalities were using GIS for LUMS, then one would think that at least one of the subjects would use GIS, or even have a LUMS fully in place.

The issue of working with the traditional councils, and getting them to accept LUMS, is also a point that was brought up on numerous occasions, and needs to be examined. The traditional councils, especially in KwaZulu Natal plays a powerful role in 'planning', and thus, in many municipalities, the success of LUMS rests on getting the traditional leaders to accept the system. Unfortunately, the traditional councils are not all accepting of LUMS, as, according to one respondent, they feel that it takes away from their power.

The final major point to be discussed with regards to the basic issues facing LUMS is the issue of legislation. As mentioned previously, there is almost a maze of legislation currently in place relating to development control. Furthermore, the legislation relating to LUMS does not have an effective means of enforcement. Both of these issues have had a negative impact on LUMS, as some respondents felt that in many instances, LUMS is not enforceable.

5.2. Current Application of GIS in LUMS

GIS, whilst having great potential as a tool that could aid in LUMS, is currently not being used for LUMS at a local level (or indeed a district level with regards to the development of the required Land Use Frameworks). This is due to the fact that the LUMS in all of the municipalities studied are either not yet finished, or are simply not being applied. As such, this makes it impossible to utilize GIS in their LUMS. However, GIS is used, in some way or other, in most facets of municipal planning (bar Ndwedwe, which has GIS, but no operator). Furthermore, GIS is being used by many of the municipalities in the development of the municipal LUMS, the most notable example of which is the eThekweni Metropolitan Municipality.

Although GIS is not being used as a support tool in LUMS at present, the vast majority of the municipalities interviewed, as well as those district municipalities believe that GIS

has the potential to become an integral part of their LUMS. All of these municipalities foresee GIS being used to aid in decision making in LUMS, once their LUMS are in operation.

From the research, one can conclude that, for what GIS is used in most planning fields, such: as application evaluations, basic mapping and decision support (all of which also indicate its use in LUMS, once the LUMS are in place), it is used effectively. Whilst the municipalities may not have a LUMS in place, those municipalities using GIS are confident in its ability as a tool. However, there are issues, such as capacity constraints and costs, which are preventing GIS from being used to its full potential. It is these issues, as well as a few others (such as confusion over the development of LUMS), which are also delaying the development and implementation of LUMS in most of the case studies. These limitations need to be fully addressed before GIS can be successfully used as a decision support tool in LUMS.

5.3. Current issues facing GIS in LUMS

There are a variety of issues facing the use of GIS in LUMS. The following aims to highlight these issues with reference to its applicability as a decision support tool.

5.3.1. The Cost of GIS

The first issue to be discussed deals with the financial aspect of using GIS. A number of respondents, at both the district and local level, mentioned that GIS is a very expensive tool to buy and operate. It is not a tool that requires only an initial payment- it requires frequent updating of both the software, and the information used by the system. The updating and maintenance of the system is very time consuming, and thus costly, and is an important issue that preventing the use of GIS amongst the local municipalities, especially the rural ones like Ndwedwe. Related to this is the fact that because GIS is such an intricate tool, individuals with specialist knowledge are required to operate it so

that its full potential is reached. In turn These skills require a sufficient salary in order to secure them with the government. This issue will be discussed.

5.3.2. Capacity Constraints

The second and primary issue facing the use of GIS as a decision support tool is the capacity constraints facing many municipalities. This issue has numerous aspects, ranging from the lack of staff, to the lack of qualified or suitable staff. Firstly, many of the district and local municipalities believed that there is insufficient staff in planning in general, and more specifically, with regards to LUMS. They all stated that the municipalities should hire more people to help in all aspects of municipal function, including LUMS. However, as mentioned, the hiring of people with specialised GIS knowledge is costly, and thus, difficult to bring about. This lack of staff is a major reason for the LUMS in the municipalities not yet being fully developed, and thus a reason why GIS is not being used as a decision support tool in LUMS.

Another point relating to the capacity issues facing the municipalities is that a number of respondents mentioned that the current staff in the municipality, and in planning, inadequately trained, and are thus incompetent. Such people can thus hinder the process of developing a LUMS, and this is a possible reason for the stalling of LUMS. Furthermore, because GIS is such an advanced tool, it is important for the municipalities to hire sufficiently trained staff, and according to some respondents, this is a problem. One only needs to look at Ndwedwe to fully comprehend the problem. This municipality has a GIS, and all the required data, but can not find a suitably trained person willing to work at that location (possibly because Ndwedwe is largely rural).

The final general issue regarding capacity in the municipalities is what one respondent termed “job hopping”. A few of the respondents and interviewees admitted that many people work at the municipalities to get experience and knowledge, only to move on to higher paying jobs. This is problematic for a number of reasons. Firstly, time and effort have to be put into training these people in the first place, which is costly. Secondly,

when these people leave, new individuals have to be trained once again, which again takes time and money. Finally, one respondent mentioned that the process of re-hiring is long and tedious, which results in staff shortages for extended periods of time. Due to the fact that people move to other jobs after six or so months, it means that the departments are often short staffed until a suitable candidate can be hired. This is applicable to GIS because, the system is expensive enough as it is, and the training and re-training of staff simply adds to the cost. Thus, the training of new staff every couple of months simply adds to the cost of GIS, and puts a damper on the whole system, especially due to the fact that it takes time to train people adequately in municipal GIS procedures.

From the above, one can see that there are numerous issues facing the municipalities in general, especially capacity issues. It is these capacity issues that make it difficult for GIS to be used as a decision support tool in LUMS, they are not only preventing the LUMS for the municipalities from being developed, but are also making it harder to have suitable people operating the GIS, thus severely limiting the tools applicability as a decision support tool. If GIS is to be used as a decision support tool, it needs to be operated by someone who has an intricate knowledge of the system. However, the above points show that finding, and keeping such people is difficult, thus making it almost impossible for GIS to be currently used as a decision support tool in LUMS.

One can thus conclude from all of the above that there are a number of issues facing GIS and its use in LUMS. Issues such as legislation, capacity, the development of LUMS, and the cost of GIS have all meant that it is difficult to evaluate the current performance of GIS as a decision support tool in LUMS. However, what is clear from the research is that all of the respondents are very optimistic regarding the applicability of GIS to planning in general, and specifically, with regards to its use in LUMS. Furthermore, the research also shows that in those parts of LUMS that have been developed, and where GIS has been used, its use has been very successful.

5.4. Recommendations

There are a number of possible means to improve the use of GIS in LUMS, some of which have arisen from the research, others from the literature review. The following is a brief description of the different means in which the use of GIS in LUMS can be improved.

5.4.1. Capacity

The biggest problem facing the use of GIS in LUMS is that of capacity, both at a local and district level. Even though the district municipalities are not required to play a large role in the development of the local LUMS, they still face capacity problems. These issues impact on their ability to help in the facilitation of the development of LUMS.

GIS as a tool has huge potential, however, this potential is not being reached due to the capacity issues previously discussed. There are a variety of means to improving this situation. Firstly, if the municipalities were to improve the job packages, thus making the work more appealing, then the problem of finding and keeping staff would not be so prevalent. By offering competitive salaries, more individuals would apply to the municipalities, thus enabling the municipalities to select the best suited for the job. Furthermore, by having competitive packages, the cycle of “job hopping” would be broken, as employees would be more compelled to stay at their municipalities. This would thus save time and effort, as it would prevent continual training and retraining of staff.

Another possible solution to the problem of staff shortages could be to make the hiring process less stringent and shorter. As mentioned previously, the hiring process is long and intricate, which results in municipal departments being ill-capacitated for long periods of time. If the municipalities were to make this process more streamlined, then in the case of someone leaving, there would be less of an impact on the department as that person would be swiftly replaced.

5.4.2. Completing LUMS

As mentioned, the LUMS in all of the municipalities interviewed have not yet been finalised. According to one respondent, the municipalities need to dedicate more human resources to the development of LUMS, instead of focusing on other municipal functions. LUMS is an important tool that helps municipal planning to function, and according to some of the respondents, not enough time, people, or funding has been dedicated to the development of LUMS. By dedicating more to the development of LUMS, the process would be sped up, thus improving the situation.

According to some of the interviewees, including the consultant, insufficient time has been given to training regarding LUMS. Thus, another possible means to facilitate the development of LUMS is to offer further training courses to the people involved. This would help clarify the concept, as well as crystallise what is required in a LUMS, thus making it easier to develop.

5.4.3. The Traditional Councils

As mentioned, the role of the traditional council in some parts of KwaZulu Natal makes the implementation of LUMS complicated. Although it is difficult to name solutions to this problem (as each situation is unique), it is important to involve the traditional councils as much as possible. Thus, constant meetings between the planners and traditional councils are required so that in the long run, the traditional leaders will be 'fully on board' with regards to LUMS.

5.4.4. Legislation

Currently, the legislation regarding Land Use Management is very complicated, with numerous pieces of legislation playing a role in development control. A possible solution to this problem is to create a single piece of legislation, which will simplify the process, and hopefully make LUMS more enforceable. According to the respondent, legislation is

in the process of being developed along these exact lines, and will probably be labelled the “Planning and Development Act”. This piece of legislation will cover LUMS, and may help fix some of the problems mentioned. Furthermore, it is hoped that this legislation will help to ensure that the district LUF and local LUMS are correctly aligned.

5.4.5. Improving GIS and its use in LUMS

Whilst it is difficult to critique a specialist system like GIS, some points can be raised which could improve its use. Regular training courses are currently being run amongst most of the municipalities in an attempt to keep the GIS operators as up to date as possible. However, some respondents mentioned that although these people are very well trained in GIS, it might be more beneficial to also train all employees involved in planning regarding the basics of GIS. Many respondents felt that GIS is a tool that is controlled by a few, with the majority of people not using the system. This is either due to a fear of the unknown or inadequate skills. Thus, many respondents felt that all staff in planning disciplines should have some knowledge of GIS, so that they can at least understand the benefits of the system, and thus be more open to it.

A possible solution to the shortage of qualified GIS personnel is that possibly, it should be a compulsory requirement that all planning students attend some courses in GIS at university. This will ensure that all new planners entering municipal positions have some understanding of GIS and its applications to planning and LUMS.

As previously mentioned, the biggest factor holding GIS back in LUMS is that most municipal LUMS have not yet been finalised. Thus, once the LUMS have been finalised (a process which can in itself use GIS to help create the document), it is important for competent people to operate the system. This is probably the most important recommendation of all, because once GIS is used in LUMS, its success will lie solely in the people operating and using the system.

Due to the fact that the municipal LUMS do not yet appear to be completed, it would probably be very interesting to conduct a similar study, at possibly a larger scale, in five or ten years time. By then, LUMS should be fully in place, and operational, and thus a full evaluation would be possible.

From the above, one can see that there are a number of means in which the use of GIS in LUMS can be improved. These means range from improving the salaries of the people involved in developing the LUMS, as well as the GIS operators, to training people in LUMS and GIS, to ensuring that competent people operate the GIS.

Finally, the recommendations from this chapter are simply general recommendations, meaning that one can not apply every recommendation to every municipality, simply because each municipality has different circumstances. However, there are some general recommendations, such as those relating to improving salaries, and legislation, which one could probably apply to all of the municipalities. Furthermore, these recommendations show that although there are some issues facing LUMS and the use of GIS therein, these problems are not insurmountable, and indeed, with a bit of time and thought, the situation can be greatly improved.

Chapter 6- Conclusion

6.1. Response to Research Question and Hypothesis

The research conducted proves that it is almost impossible to evaluate the current performance of GIS as a decision support tool in LUMS, because for most of the local municipalities, LUMS is not in place. However, for those elements that are in place, and in which GIS has been used, it is clear that GIS is an invaluable tool. It should also be noted that in the future, the use of GIS in LUMS as a decision support tool will be significant, as long as qualified individuals operate the system.

The hypothesis for this research was that GIS is not being used to its full potential as a decision support tool in LUMS. The research proves this hypothesis correct. The lack of capacity and unfinished LUMS has resulted in GIS not being used to its full potential. However, the research has also found that most people think very highly of the tool, and believe that its use will increase with time, especially once LUMS is in place.

6.2. General Conclusions

This research has illustrated much regarding the use of GIS as a decision support tool in LUMS. The first, and most important point, is that GIS is currently not being used as a decision support tool in LUMS, simply because the LUMS for the municipalities interviewed have not yet been finalised. However, it must be understood that despite the LUMS not being finalised, GIS is being used as a decision support tool in other aspects of planning, such as 'Development Control'.

Furthermore, the research revealed that there are a number of problems facing the implementation of GIS as a decision support tool in LUMS. These issues range from capacity problems, to the cost of GIS. However, the recommendations show that these issues are not insurmountable, and can in fact be dealt with quite easily, given sufficient time and funding.

Finally, the research has also proven that most people involved with GIS are optimistic about the tool. The individuals all believed that GIS is a tool with almost limitless functions and applications. In fact, most of the subjects involved in the research felt that GIS is only as limited as the person operating the system.

6.3. Limitations of the Research

The first limitation in this dissertation is the issue of scale and time. Unfortunately, due to the short timeframe involved in the dissertation 'process', the scale of the project is limited. Further time for the research would have enabled the researcher to evaluate more case studies. As previously mentioned, of the four case studies examined, none had a LUMS in place. Therefore, a broader variety of case studies would have increased the chances of contact with a municipality with a LUMS in place.

The second problem noted is the fact that whilst the researcher examined the use of GIS by the municipalities to the best of his ability, the fact that none of the municipalities had a LUMS in place inhibited the research. This is problematic as the research was intended to place an emphasis on LUMS. It thus might have been useful to either have more case studies, or to send a survey to all of the local municipalities, both of which would be difficult due to the time constraints involved.

In hindsight, a further 'weakness' of the dissertation is the timing of it. Seeing as LUMS is still rather new, and new legislation is currently being developed, it would possibly have been more useful to conduct this research at a later stage. Unfortunately, for obvious reasons, this is impossible, as it was felt by some respondents that it will take a few years before LUMS is implemented, which thus means that this weakness is unavoidable. However, it may be interesting to conduct similar research in five or ten years in order to compare the situations of 2006 and 2011 or 2016.

The final limitation of the research process was that only seven out of ten municipalities participated in the project, which could possibly have led to a weighting in answers, and

may not be completely representative. It might have been useful to include other provinces in the research, as this would have provided a larger sample size, thus making the research more representative.

6.4. Summary

In conclusion, one can argue that whilst this research does not really cover an evaluation of the use of GIS as a decision support tool in LUMS (simply because none of the municipalities interviewed actually had a LUMS in place), it does highlight the issues facing LUMS in general, as well as those facing GIS. Furthermore, the research also shows how the use of GIS in LUMS can be improved. Finally, the research demonstrates that everyone who comes into contact with the tool believes strongly in its use, and all feel that it has great potential as a decision support tool for LUMS, and in fact as a tool for most aspects of planning.

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Appendix A- Survey

Questionnaire examining the use of GIS in Land Use Management

Section A

Name	
District Council Name	
Department	
Designation	
What part of LUMS are you involved in	
Contact details	Phone: Fax: E-mail:
Date Questionnaire filled in	

Section B

Question One

In what capacity are you involved in LUMS ?

--

Question Two

Does your District Council office have a GIS? If yes, what is the GIS used for?

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Question Three

Is GIS currently used for any aspects of Land Use Management by your municipality? If yes, how would you rate it? If not, please explain why.

Question Four

Is your GIS used by Local Councils for LUMS? If yes, what is the capacity of the local council? If not, will they use GIS in the future?

Question Five

Do you think GIS could be used as a decision support tool in LUMS? How?

Question Six

Are there any ways in which the use of GIS in LUMS can be improved to make LUMS more effective? How?

--

Question Seven

How would you rate the limitations of GIS as a decision support tool?

Very Limited	Slightly Limited	Average	No Limitations

Please explain your answer

--

Question Eight

How many people are employed in the GIS department of your organisation? Do you feel that this is sufficient?

--

Question Nine

Do you think that the GIS should be operated by a highly trained person or someone with a generalist knowledge?

Yes (highly trained)	No (generalist)

Please explain your answer

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Appendix B- Interview Schedule

Interview Schedule: Case Studies

The following are questions which should be covered during the in depth interviews with the key informants.

❖ **Is your LUMS completed? If yes (or almost completed), then the following questions apply.**

- How would you rate the current use of GIS in your Land Use Management as a tool to aid you in decision making?
- How would you rate the skills of the people involved in LUMS?
- How do you think GIS should be used as a support tool in LUMS, or simply as a cartographic tool?
- How is GIS being used in LUMS?
- How many applications would you say are evaluated each month using GIS to aid in your decision making? How many aren't?
- Are there any ways in which the use of GIS in LUMS can be improved to make LUMS more effective?
- How would you rate the limitations of GIS as a decision support tool?

If the LUMS is not completed, then the following questions apply.

- Why is your LUMS not completed yet?

- What are the capacity issues that your municipality is currently facing?
- How comprehensive is your GIS?
- How is GIS being used to help develop your LUMS?
- How do you see GIS being used in your LUMS?
- Will GIS be used as a decision support tool in your LUMS? How?
- What are the capacity issues that you see affecting the use of GIS in LUMS?
- What are your thoughts on the effectiveness of GIS as a tool? How can it be improved?

Interview Schedule: Private consultant

- What are your thoughts on LUMS in general? Will it be effective?
- Why do you think that so many municipalities have not finished their LUMS? Examples?
- What are the general capacity issues facing municipalities?
- What are the problems with the legislation with regards to LUMS?
- What are your thoughts on the use of GIS in LUMS? Is it suitable?
- How should GIS be used as a decision support tool?
- How can the use of GIS by the municipalities be improved?
- The traditional council seems to be a problem in some municipalities- can you expand on this?