Geographical Information Systems (GIS) as a tool to provide information to disadvantaged communities

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Submitted in fulfillment of the requirements for the degree
Master of Arts

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October 2000

Summary: Geographical Information Systems (GIS) as a tool to provide information to disadvantaged communities.

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This research reports on geographical information systems (GIS) and how the technology can be used to provide spatial information to disadvantaged communities with limited access to information regarding their community itself. It investigates whether illiterate and innumerate people can use the technology, as well as whether an information counselor needs to be present to facilitate the process of information supply. Emphasis is placed upon the use of a GIS to meet an information need, rather then the use thereof to interpret data. In order to test the use of GIS in this context a *Community GIS* was established in the disadvantaged community of Atteridgeville, Saulsville and the informal settlements located outside Pretoria. The project was initiated to determine if a GIS can be used as a way to supply information to communities, and whether a *Community GIS* holds any positive value for such communities The *Community GIS* is not a full-blown GIS, but a system based thereupon, running with a interface called ViewMap. The *Community GIS* is made available to the community at a Community Information Resource Centre within the area, and contains information about the businesses, services and residential aspects of the community. Through this it was possible to test the potential of a GIS as a tool to supply information, as well as the limitations of such communities that reduced the success of such a system.

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Chapter 1: Introduction

1.1 Introduction

This research reports on how geographical information systems (GIS) can be used to provide spatial information to communities with limited access to information regarding their communities and what business and services are available within the community. It investigates whether illiterate and innumerate people can use the technology, or whether an information counsellor needs to be present to enable the people to use such technology. The revolution in information technology has presented developing countries with enormous promises and challenges; on the other hand there is the question as to the ability of communities to make the appropriate investment (human and other) that will allow them to benefit from the revolution. It should, however, be remembered that technology facilitates access to these resources, and could in turn enable communities and economies to accelerate development through access to better information. Information technology is transforming the way people do things (Hanna, 1994: xi). Information technology covers all activities and technologies that involve the handling of information by electronic means: that is, information acquisition, storage, retrieval, processing, transmission and control, it dramatically increases the amount and timeliness of information available, and the productivity of processes to organise, process, communicate, store and retrieve information (Hanna, 1994:1). Computing and communications technologies have dramatically increased the information intensity of processes, occupations, and institutions, as well as that of products and economies. But only if information technology is diffused more broadly and a critical mass of domestic users is developed will the promised benefits be realised (Hanna, 1994:xi).

In South Africa developing communities are the most disadvantaged in terms of the application of information resources and the access to these resources. Better information resources and modes of delivery, which provide accurate, relevant and useful information is desperately required. The availability of technologically based information is a very important requirement for access to information at this point in time, and future technological developments will undoubtedly give even more prominence to such information. However, many people do not have the aptitude, inclination or means to utilise high-technological equipment.

According to a Memorandum by the Human Sciences Research Council (HSRC) and Community Information Resource Centre (CIRC) to the Gumbi Task Force for the Freedom of Information (Conradie et al, 1994:25), information should be made available on the following three levels:

- The supplier level (especially government and para-statal institutions).
- The intermediate level (the mass media, non-governmental organisations, community-based organisations, and computer-based networks), and ways may have to be found to ensure that these intermediaries will know which information is available and how it can be obtained.
- The end-user level (mainly individuals from the poor / less privileged / illiterate or disenfranchised segments of the South African population, who should clearly be among the eventual beneficiaries).

These levels represent the basic entry or exit points for information. However, it should be understood that the linkages between these levels are also of critical importance.

1.2 Background

This research project explores the potential of a geographical information system (GIS) to better equip developing communities with information resources that can accelerate development. In communities where literacy and numeracy are in question, access to the software, hardware and human

resources around which these technologies are built are severely limited. The project was focussed on the identification of the potential a GIS has to offer to empower one such community in search for development. The key to the empowerment of disadvantaged communities is unfettered access to relevant information, coupled with the development of skills and capacity that would equip these communities to utilise such information for community building purposes.

The information resources currently used by the communities of Atteridgeville, Saulsville, Phomolong, Concern and Jeffsville are largely newspapers, magazines and radio. There is however limited opportunities to get information about and concerned with the community itself. There is a lack of information within the community. Through the supply of relevant information, related to and in connection with the community as well as residents of the community, the *Community GIS* might prove to be a solution to the information shortage, with the *Community GIS* being a GIS focussed on addressing the needs of all community residents. In order to operate the *Community GIS*, the appropriate delivery mechanism was considered. Some questions that needed to be answered were whether an end-user system could be a more appropriate way to supply this information or whether an information counsellor acting as an interface is of more value to the community. Each system has its own advantages and disadvantages and to a large extent the answer may depend to on the capabilities of the community.

When looking at the level of education within the community, it is noticeable that the community has a majority of illiterate residents. The illiteracy level within the community might play a major role in the use of the *Community GIS*, as well as dictating whether it will be an end-user system or a system mainly used by the information counsellors in order to achieve their goal of information supply. The visual impact of the GIS can help bridge the gaps created by illiteracy, making information through GIS more accessible to the illiterate people within such a community. Maps are amongst the most

important visual output products of GIS, but do illiterate people have the ability to read maps? GIS, as a visual-based information system may be the answer to the lack of accessible information to the residents of disadvantaged communities. Visual presentation of information in GIS may enable the information to be accessed by residents in the community that are illiterate. The question that arises was whether community information presented in GIS format would facilitate information supply to the literate as well as illiterate residents within the community. Visualisation is about exploring the communication power of visual interpretation (Cassettari, 1993: 534).

1.3 Problem Statement

South Africa with its large number of disadvantaged communities, which are poor and have a large number of illiterate and innumerate people can use visualisation as a method to supply information may solve some of the problems experienced within such communities.

Possible problem areas that can be identified are:

- Technological illiteracy and technophobia.
- Inability to read.
- Spatial illiteracy (inability to read maps).
- Innumeracy (inability to count).

This project seeked to identify the potential that technology such as geographical information systems have to offer to empower communities like Atteridgeville, Saulsville and the informal settlements. In doing so the following questions were answered:

1. Can technology enhance the understanding that illiterate and innumerate people have of their own community? Can this type of technology reduce the need for literacy in information supply?

2. Are barriers built around technophobia of such a nature that GIS has little or no potential in such communities?
3. Under which conditions (if any) can GIS reach beyond the realms of the technology elite?
4. Can users help themselves, or is there a need for the presence of information counsellors with knowledge of the system?

With the community being poor and disadvantaged it is understandable that the exposure to technology is limited due to the lack of opportunity in this regard. Technological illiteracy was taken into account when looking at the abilities of the system. Since the community is disadvantaged and exposure to computers is limited, the use of technology to supply information may influence the usability of GIS quite severely. This may happen due to fear being experienced by users when confronted with a "new" technology. Illiteracy and innumeracy, and the ability of the users to understand and use GIS must be taken into account, as these are important factors effecting the supply of information.

Illiteracy is probably the most easily addressed via visual presentation, colour or graphics. By studying the way that the system is used and what type of person uses the system, this project may show that using GIS as a way to supply information has limited value to the resident without the presence of an information counsellor. This may be due to the fear of technology being greater that the need for information from the *Community GIS.* The users experiencing this fear may then revert back to the traditional way of getting information regarding the community (word of mouth, radio, newspapers).

The questions regarding the potential of GIS, as discussed previously may be answered by implementing a GIS system called the *Community GIS*. This GIS will be tailored (as far as possible) to meet the communities' information needs and re-engineered to be as accessible as possible. The impact of the facility on the community will be assessed via community information

counsellors tasked with providing information to the community. An interface to a GIS will be used to enhance and simplify the means by which people communicate and interact with the system.

1.4 Aim of the project

The aim of the project is to establish to what extent GIS technology can be used to provide information to disadvantaged communities like Atteridgeville, Saulsville and the informal settlements (Phomolong, Concern and Jeffsville). This study examines the relevance of available information to the community once collected. In order to assess the application during the project a GIS that anticipates the needs of the community was developed. This was based partly on the needs identified in the survey by the HSRC and partly on the queries received by the information centre. The information was then spatially referenced and evaluated. An interface was created was a difficult task, since the interface had to be adapted to the needs and abilities of the individual user and situation.

Atteridgeville could be considered a disadvantaged community, located within the Greater Pretoria area. The informal settlements consist of three informal areas that can be considered disadvantaged areas within an already disadvantaged community. The informal settlements are characterised by the informal housing, lack of in-house water, and electricity supply via the card system (payment for electricity in advance). The aim was to place the *Community GIS* in close proximity to the disadvantaged communities in Atteridgeville. The *Community GIS* therefore acted as an access mechanism at community level. It delivered information through the assistance of a geographical information system and information counsellors, which made information accessible to as wide an audience or user community as possible. During this project emphasis was placed upon the use of a GIS to meet an information need, rather than the use of GIS as tool to interpret data.

The supply of data through the *Community GIS* may help to improve the overall quality of life within the community.

1.5 Goals and objectives

With the *Community GIS* the geographical information system was primarily used to provide the community with basic information, leading to the fulfilment of basic needs. Through this more emphasis was placed on the provision of information at a more localised level than is generally the case when using GIS. The study was concerned with the development of a GIS for grassroots initiatives, of which participation by the community is a primary objective. The development process involved feedback, linked to the dissemination of information, map construction and discussion.

This *Community GIS* was used to try and:

- Facilitate access to spatially referenced information at a local level.
- Create an extensive up-to-date database by gathering information on all community-based organisations and businesses, ranging from schools, clinics, churches, etc.
- Provide access to relevant, interpreted information to all residents at a community level.
- Provide a user-friendly system to get information to the end-user (either directly by the end-user himself, or via information counsellors).
- Examine the ability of GIS to provide community-based information at grassroots level.

The objectives of this study were to establish a participatory GIS in which the community can integrate local knowledge about their community, with community access to the knowledge by the use of advanced technology for the distribution of information. The *Community GIS* attempted to develop methods through which the community could use GIS to get more information about their community. In the long-term, it was envisaged that the *Community*

GIS would consist of information collected, accessed and managed by the community members. The key to this GIS was the ability to disseminate a wider range of information to a wider sector of the community. The *Community GIS* had at its core a relational database of relevant information consolidated from various sources, and a suite of software that presents the information in a format that can easily be interpreted by the user.

1.6 Existing research

In spite of the apparent pervasiveness of geo-spatial information needs, there is a lack of published research regarding GIS as a tool to supply information. Geographic information is about the earth at scales ranging from room size to the whole planet (Gluck, Damley, and Lahmon, 1996:408). This type of information is among our most common information needs such as way finding involving geo-spatial information. The focus of GIS seems to be on the analysis that can be done with data to help with decision-making, with very little on the supply of spatial information to residents of disadvantaged communities.

Literature on projects relevant to South Africa is limited. South Africa, for several reasons has lagged behind the rest of the world, especially in the socio-economic arena and in spatial analyses. However, since the re-acceptance of South Africa into the world arena, the use of GIS has increased rapidly and the future use and application of GIS is poised to grow quickly in the coming years (Hall et al, 1998:10). Recently GIS in South Africa has been used in applications regarding policing in South Africa, with a case study in Paarl (Lochner and Zietsman, 1998:60), as well as during the 1996 government elections.

Research on GIS is largely focused on aspects of the cultural and natural environment. This, together with the commercial applications of GIS has been documented. GIS has commercial applications because it can be used

to address many significant global, national and local social and scientific problems (Maquire, 1991:14). GIS applications to date have been confined to users with adequate training and research skills or for technical applications like engineering and land use management. Taking into consideration the potential advantages that the visual aspect of GIS can hold for the community, it might prove to be the tool needed to make information available to the illiterate people within developing communities. Although GIS used by individuals as citizens within the public setting is growing, the current literature describes GIS use mostly within organisational contexts (Medyckyi-Scott & Hearnshaw, 1993:38).

1.7 Project focus area

Activities during the project dealt with a relatively small geographical area. Through concentrating on a smaller area as it's more likely to:

- Involve identifiable decision-makers who had direct control over resource management.
- Produce demonstrable and measurable impacts.
- Be easily replicated in other communities.
- Yield results in a relatively short time period.

Way finding is a basic human need. Knowing how to navigate through a neighbourhood and how to find the best route from home to the nearest schools are a few varieties on the basic theme. The information needs of communities like Atteridgeville are primarily being addressed by newspapers, radio and television, but to a large extent this information is not enough. These information resources are not entirely fulfilling the information needs experienced within the community, especially since these sources are not only focussed on the community itself.

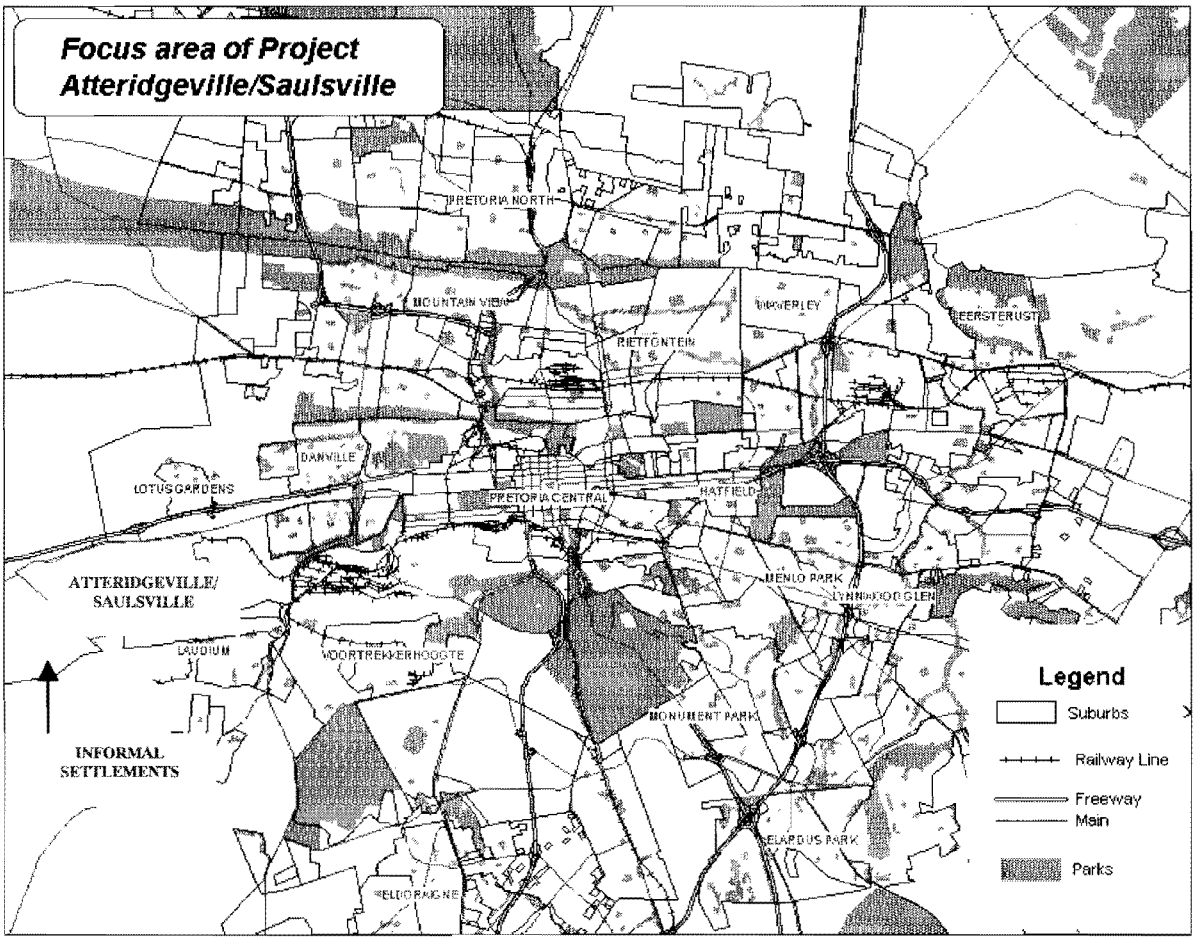

Fig 1.1 Location of project area relative to the rest of Pretoria.

For this project a decision was made to focus on Atteridgeville, Saulsville and the informal settlements (Phomolong, Jeffsville and Concern), physically situated 11 km west of the Central Business District of Pretoria. A physical boundary is created to the South of the community by the Kwaggasrand and Skurweberg mountain range. Khalafong Hospital, SANTA and property owned by the South African Police Services - Dog Training Depot borders the town on the east. Church street extension, as well as the proposed K26 route forms the boundary to the north, while the Gauteng (PWV) route forms the Western boundary. The area covered in this project is Atteridgeville, Saulsville and three nearby located informal settlements.

1.8 Methodology

During this project a *Community GIS* was established, reflecting the information needed by the community. This information system was made available to the community to test the impact or potential of such a system to disadvantaged communities like Atteridgeville, Saulsville and the informal settlements. For the successful implementation of this project a clear understanding of the potential users and their needs were required. An information needs survey has been done in 1994 by the HSRC for the communities of Atteridgeville and Saulsville. The results of the needs survey, as well as the knowledge of the information counsellors was used as a source of information regarding what the user categories would look like, what the current work practices is within the community are, as well as what the users abilities may be. It was not deemed necessary to initiate another survey, since such a survey of Atteridgeville and Saulsville has already been completed.

In view that the *Community GIS* was being created as a tool for information supply, it was necessary to focus on the location thereof. Potential sites were evaluated to make sure that the information source is available to the majority of the potential users. In order to ensure that the *Community GIS* can be used by the larger segment of the community; a system interface was designed to make the GIS more user-friendly. It was however possible that innumeracy, illiteracy and the fear of new technologies may have proved that the system is only usable through the presence of an information counsellor.

During the project all possible information about the businesses, services, and education facilities etc. was be gathered for both the formal areas, as well as the informal areas. All data needed to be capturing, cleaning and setting-up into a database. After the implementation of the *Community GIS* the system was evaluated according to interviews, observation and questionnaires.

During the project many of the resources that was used was already been in place, such as information counsellors and the information resource centre. The Information Resource Centre project was done jointly by the HSRC and CIRC. This resulted in a Needs survey being conducted in 1994, and the subsequent establishment of a Community Information Resource Centre. The *Community GIS* project is a separate study which I was started while I was still employed by the HSRC, which resulted in the opportunity to use the ViewMap software developed for HSRC projects while incorporating the interface specifications as needed for this project. The project uses many of the resources and knowledge gathered during the Community Information Resource Centre project, since there is an inevitable overlap, in the need for space, resources and the Community Information Needs Survey.

1.9 GIS implementation

Over the last couple of years some generalised models for the design and implementation of GIS capabilities have emerged. Most of the models are similar to those used in development project planning (World Bank, 1995:5). The same processes are followed in establishing the *Community GIS* and can be divided into five broad stages, as shown in Fig 1.2.

The five stages consist of the following:

- Identification and conceptualisation.
- Planning and design.
- Procurement and development.
- Installation.
- Review and audit (World Bank, 1995:5).

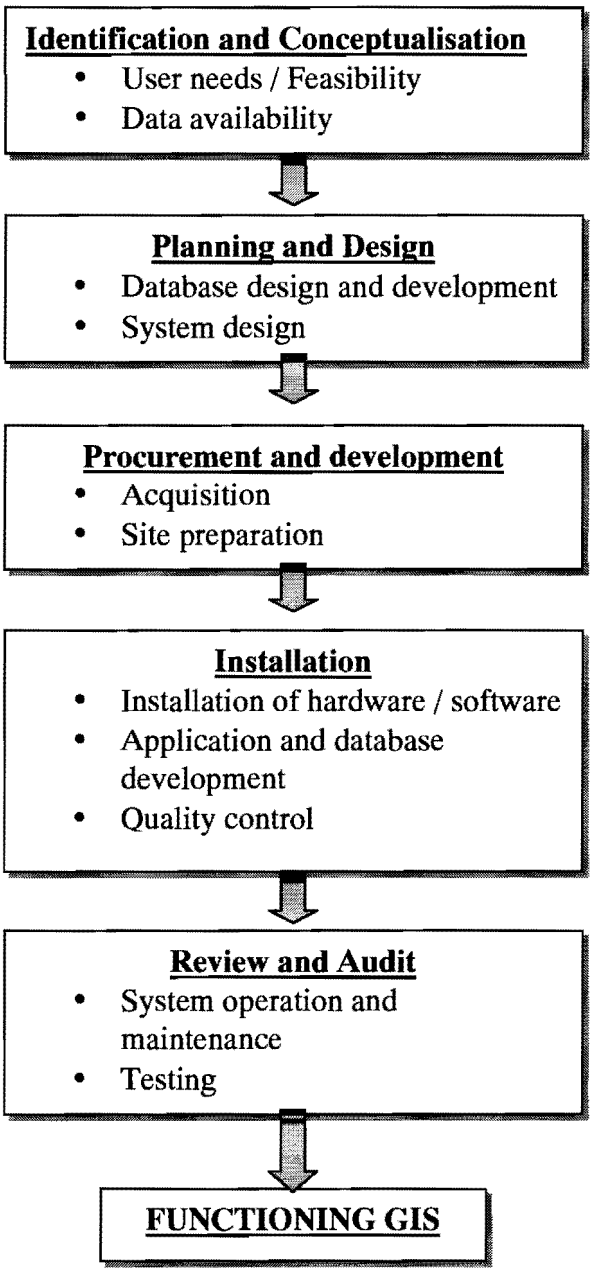

Fig 1.2 Steps in GIS implementation (The World Bank, 1995:5).

1.9.1 Identification and conceptualisation

According to the World Bank (1995:1) there are various issues that should be considered during the implementation of a GIS project. These can be targeted by:

- Assessment of user needs.
- Type of information culture in community.
- Volume of data needed.

a) Assessment of user needs:

An early assessment of the needs of potential users can help ensure the development of an efficient operation. The number and type of users influence the way data is collected and how the information system is designed and managed. A system should be built on existing capabilities as much as possible. The specific problems and issues to be addressed during the problem must be noted.

b) Degree and type of information culture:

The current work practice regarding the gathering of information was determined through interviews with the information counsellors. This as well as observing the residents within the community indicated what the preferred ways of information gathering in the community is. An understanding of the information-gathering phenomenon within the community was necessary to determine the ideal location of the *Community GIS* since limitations created by choosing the incorrect location can be limited.

c) Volume of data needed:

Finally, determining the amount of data available, as well as which data is needed, will be a crucial step in the early stages of building the *Community GIS*.

1.9.2 Planning and design

According to the World Bank (1995:4) this stage of the planning process consists of three separate, but interconnected parts:

- The implementation plan.
- System design.
- Database design and development.

a) Implementation plan:

This process identified the roles, responsibilities and relationships of all the

individuals actively involved in the project.

a) System design:
The system design includes the specification of the system configuration, defining the hardware and software capabilities. The compatibility between the hardware and software and existing databases and the proposed new technology needs to be closely examined.

b) Database design and development:
This process will accompany the overall system design. The design will contain descriptions of content, specifications and sources of data to be incorporated into the database. The comparability and compatibility of different data sources must be evaluated.

1.9.3 Procurement and development

The stage of building the GIS involved the acquisition of the system and database; physical site and infrastructure needed for proper operation of hardware and software procedures. The procurement and development stage can be divided into:

- Acquisition.
- Site preparation.

a) Acquisition will be based on the system and database design. In some cases a previously tested commercial system is better than building a system from scratch.

b) Site preparation includes providing space for the computer facilities, stable and sufficient electricity supply, security, accessibility etc.

1.9.4 Installation and operation

This phase starts with the actual installation of the GIS, including the testing thereof. A major step in this phase is the development of the database.

Information may be gathered from maps, plans, tables and reports. Quality controls must be in place to ensure a sufficient degree of data reliability, precision and accuracy.

1.9.5 Review and Audit

This final phase includes the review and audit of the system, through the evaluation and testing thereof. This testing can be done through questionnaires, interviews and observation to determine the successes and failures of a system like the *Community GIS.*

1.10 Chapters to be incorporated

- Chapter 2 is a brief overview history and background of GIS. It focussed on what a GIS is, what it can do, and why GIS is being considered as a possible solution to the problem faced in disadvantaged communities.

- Chapter 3 focuses on the community that is used in the study, with information as to the location of the study, information needs, as well as the demographics thereof. This chapter gives an indication of what the information needs within the community like Atteridgeville ans Saulsville is, as well as how the needs were determined.

- Chapter 4 gives an indication of how the *Community GIS* database is designed, how the data was gathered, what type of information was collected and captured, and how this information was structured into a database.

- Chapter 5 illustrates the steps that were followed to create the GIS system, software and interface that were developed in order to meet the information needs of the residents through the use of GIS. Primarily

attention is given to what it looks like, the capabilities, how the system was built, as well as screen prints of the functions available to the users.

- Chapter 6 focusses on the testing of the software, how testing took place, and gives an indication as to what was found during the observations and questionnaires that were filled out by the information counsellors. Possibilities for changes within the software will be highlighted as well as areas that did not perform as expected.

- Chapter 7 is a summary of findings and recommendations.

- Glossary gives descriptions and definitions of terms.

1.11 Summary

A common thread running through successful nations, organisations, communities and individuals are their access to and utilisation of information. Within most societies a transformation occurs when the society becomes more reliant on information as well as the efficiency of allocation of these information sources. An understanding of the spatial distribution and characteristics of human activity has an increasingly important role to play in many questions relating to the management of the physical environment (Martin and Bracken, 1993:46). With the project focussing on the supply of information to a disadvantaged community, it was important to look at information systems, as it is necessary to understand the relationship between traditional information systems and geographical information systems. It is therefore necessary to investigate what it is that sets GIS apart from other information systems. A *Community GIS* might prove to be part of the solution to the shortage of locally pertinent information. By supplying information in a visually accessible way and through putting the power of GIS into the hands that need it most, a *Community GIS* may contribute

significantly to development in communities like Atteridgeville, Saulsville and the Informal Settlements.

The *Community GIS* has the potential to serve the communities' interest, develop public information applications and solve the needs of businesses and individuals within the community. It has the possibility of filling or bridging the information gap experienced in communities like Atteridgeville and Saulsville. By granting the community the latest information about services, businesses etc. within the area, the technology could help members to understand their local environment better in terms of individual, business and development needs. In doing so these communities could gain more of the characteristics typical of successful social organisations. The *Community GIS* will therefore try to act primarily as an access mechanism at a community level, and will deliver information to as wide an audience or community as possible. In order for this to be possible, it is critical to understand the potential and advantages of GIS. The next chapter will give an introduction to geographical information systems, indicating the potential uses of GIS. Chapter 2 will give a better understanding as to where GIS fits into the broader spectrum of information systems.

Chapter 2: Introduction to GIS

2.1 Introduction

Communication and information represent some of the fundamental needs of both the individual as well as for society (research, education, labour, health, food etc.). Access to information is a decisive factor in the present competitive framework. It represents the opportunity for growth (Bisogno & Paci, 1994:13). The information revolution is real and likely to accelerate. The focus within the study is GIS and the utilisation thereof within a disadvantaged community. It is, however, crucial to understand GIS - where it came from, what the traditional uses are and where it fits in within the broader spectrum of information technology. Good information resources deliver relevant and useful information on time and provide the user with valuable opportunities to respond to situations. The value of information depends on many things, including the timeliness, the context in which it is applied and the cost of collection, storage, manipulation and presentation of the information. Information is now a valuable asset that can be bought or sold at a high price (Maquire, 1991:10). We are positioned in a time of exciting developments with the ability to obtain data about the physical and cultural worlds, and to use data to do research or to solve practical problems (Laurini & Thompson, 1992: 3). Information systems provide an integrated environment for data collection, reporting and analysis and "attempt to get the right kind of information to the right people at the right time with a minimum of effort and cost" (Powers, Brown and Arnold (eds.) 1974:12).

Geographic information systems have been recognised as a unique tool for the integration, analysis and display of spatial information, a capacity that no other single technology is able to do. A good definition of GIS can be found in "A Glossary of GIS terminology" (Padmanabhan, Leipnik & Yoon, 1992:1).

GIS is "a computer system designed to allow users to collect, manage, and analyse large volumes of spatially referenced and associated attribute data.

2.2 Information systems

The role of an information system is to offer the user enhanced decision-making capabilities by providing access to information (through the use of a computer) and putting the information in usable format. Conventional information systems provide information to a variety of users. Such information systems, however, do not provide any spatial reference with regards to the data they contain, and can thus not be used in any application in which physical location plays an important role. A new breed of information technology systems caters for both spatial and attribute data in an integrated whole (Riley, 1991:40). Conventional management information systems provide information to a variety of users. Such information systems are presently not of concern, as they do not provide for any spatial reference with regard to the data they contain, and these systems can thus not be used for applications in which physical location plays an important role. The newer breed of information technology systems caters for both spatial and attribute data in an integrated whole (Riley, 1991:40).

Information systems have a number of important general attributes. The information in the system must be organised in such a way that it will have utility when retrieved; access to information in the system must be managed and carefully regulated; there must be continued support and maintenance of the information and technology within the system over time; and users need to be encouraged and educated (Maguire, 1991:10). An information system is an organised combination of people, hardware, software, communication networks and data resources that collects and disseminates information (O'Brien, 1997:6).

By looking at the following taxonomy of information systems, it clearly indicates as to where GIS fits in:

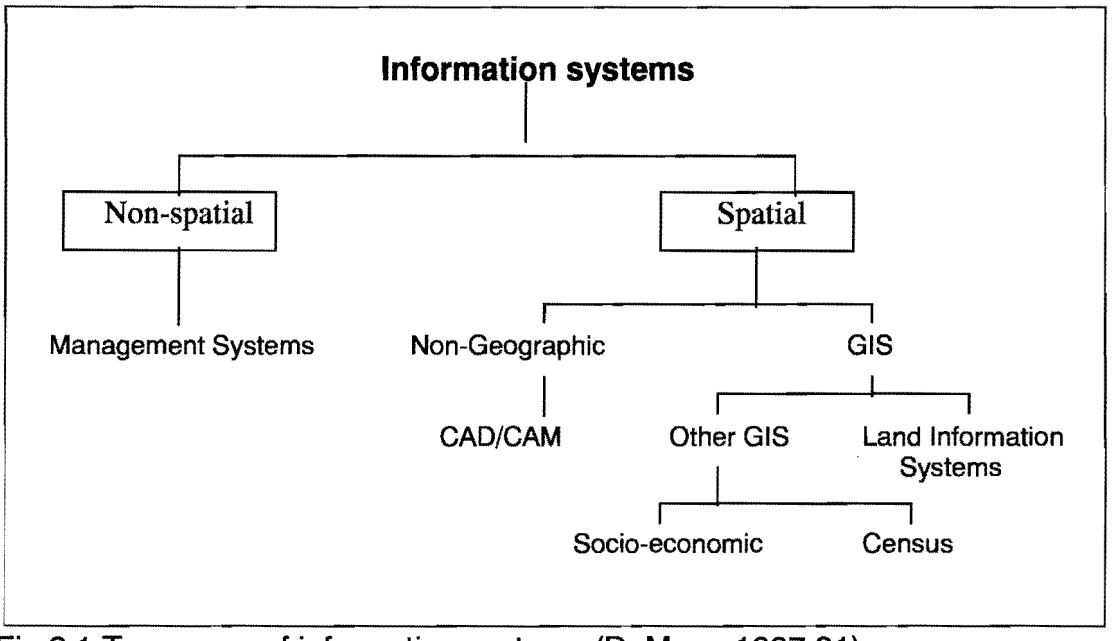

Fig 2.1 Taxonomy of information systems (DeMers, 1997:31).

This taxonomy in Fig 2.1 clearly shows the separation between spatial and non-spatial information systems. Two general classes of information systems are identified: Systems with a spatial component, as well as non-spatial systems. Spatial information systems can be sub-divided into geographical information systems and Non-geographic information systems. Non-geographic information systems have strong links to locations on the earth, but don't handle topology very well. Topology can be defined as the spatial relationships between map features (Chou, 1997:56). The geographical information system handles topological relationships very well. The geographical information system can be divided into land information systems (LIS) and Non-land information systems (other GIS) (DeMers, 1997:31). Although this division is somewhat artificial it is important because it separates GIS technology into those focussing primary on the land itself, where the GIS is used for the purposes of land planning etc, as well as decision-making in regard to the environment, and those more focussed on

information where the GIS is used with other data like the census information for planning purposes.

2.3 Geographical information systems

Rather than being completely new GIS has evolved by linking a number of technologies into a whole that is greater than the sum of its parts. geographical information systems have emerged as a very powerful technology because it integrates data and methods that support traditional forms of geographical analysis. With GIS it is possible to map, model, query and analyse large quantities of data all held together within a single database (Foote and Lynche, 1999:3). Geographical information systems are probably some of the most up-to-date and flexible information presentation systems available. They provide powerful tools to view data stored in a database, by visual browsing of files and records, as well as a means to convey information graphically (Green, Rix & Cadoux-Hudson, 1994: 20).

GIS processes allow the user to perform complex spatial analysis that is difficult with any of the original software that gave rise to Geographical information systems. Two basic kinds of information systems where initially developed, i.e. database management systems (DBMS) and systems designed for computer aided design and drafting (CAD). DBMSs are designed to manage non-spatial attributes of entities using various database structures such as network, hierarchical and relational. These systems specialise in the storage and management of all types of data including geographic data. DBMSs are optimised to store and retrieve data and many GISs rely on them for this purpose. They do not have the analytic and visualisation tools common to GIS. CAD systems on the other hand aim at handling spatial data as graphic entities organised into layers, but support only limited analytical capabilities. CAD systems can handle maps but typically have limited utility for managing and analysing large geographic databases (ESRI, 1998:2). Geographical information systems emerged from

a combination of all above mentioned systems, as can be seen in Fig 2.2 and shows a somewhat different approach by using a more complex data model. Both Spatial and Non-spatial data are handled in a similar way by separating these into cartographic and database management elements. A Geographical information system focuses on the spatial relationships between these entities within the database management systems; as such a GIS is more than the sum of a CAD and a DBMS combined (Zietsman, 1991:6).

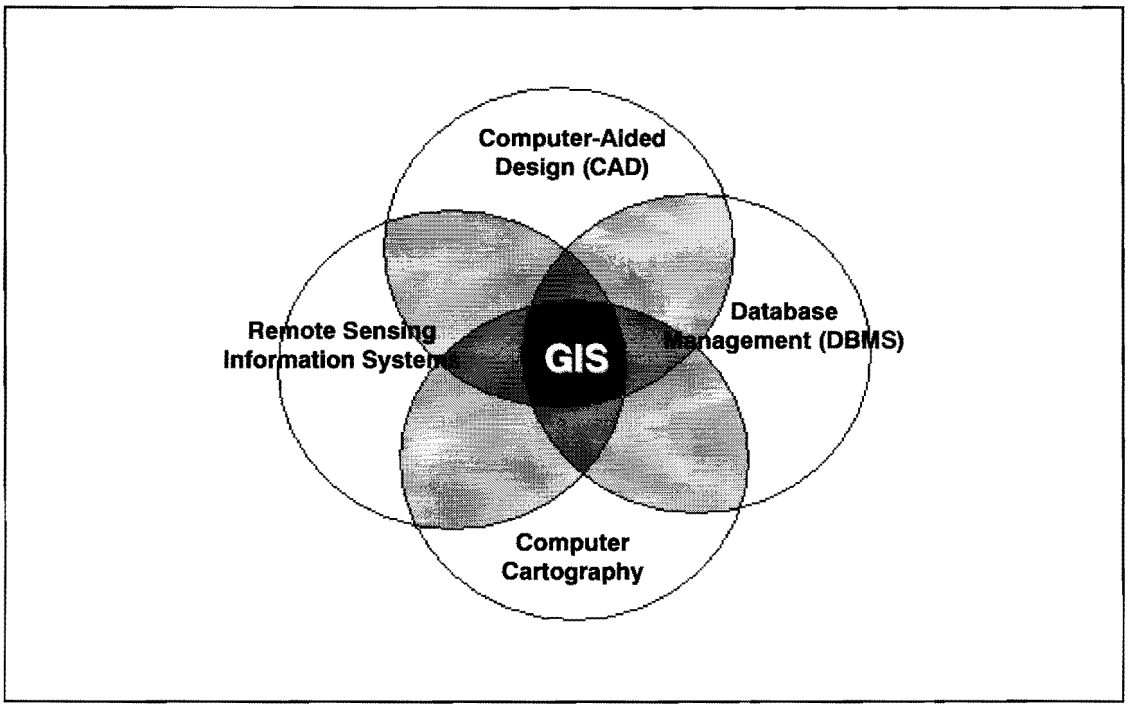

Fig 2.2 The relationship between GIS, computer-aided design, computer cartography, database management and remote sensing information systems (Maguire, 1991:13).

The first example of a workable GIS was the Canada GIS (CGIS), which was developed during the 1960's as a resource management tool. The incentive for this development was the need to manage large quantities of spatial (map-based) data. Since those early years the development of powerful computers, cheaper storage media, GIS software and sophisticated spatial analysis algorithms have facilitated the proliferation of GIS throughout the world (Hall, et. al, 1998:10).

There are several competing definitions of GIS, but essentially it is a combination of computerised cartography, database management and spatial analytical tools. These components facilitate the following three functions: the representation of the object world as proportionate symbols on a scale-transformed geography; the accumulation of relevant information about these objects on a spatial database; and the elaboration of a set of procedures for the accumulation, manipulation and representation of this information (Goss, 1994: 136). As can be seen from studying the definitions used to describe geographical information systems (see Glossary) it is clear that GIS systems are hardware and software systems that provide for the creation, management, analysis and display of spatial information. One of the reasons it can be difficult to decide on a single definition for GIS, is that various types of geographical information systems can be found, each created with a different application, and different decision-making in mind.

In essence, GIS entails the use of computers to create and depict digital representations of the earth's surface. Such depictions are models, simplifications, of reality, and what is quite fascinating about the recent (1990s) development of GIS is the greatly enhanced richness and detail of such models and the wide range of data sources that are used to assemble them (Longley, 1998:53).

According to Bogaerts and Kraak (1989:278) a Geographical information system consist of six main modules:

- Data capture.
- Data output.
- Storage.
- Manipulation.
- Management.
- User.

As can be seen from Fig 2.3 the first three modules function to support the manipulation module, being the core of the system. The manipulation module contains the spatial data analysis capabilities and the software for the organisation of data flow between each of the modules. The two larger boxes around the modules indicate the importance of the environment within which GIS has to function, and of the spatial data, which may be textual or graphic (Bogaerts & Kraak, 1989:278). Current applications of GIS are geared largely towards improving technical functions of GIS as a tool for data processing, storage and integration as well as the presentation of spatial data.

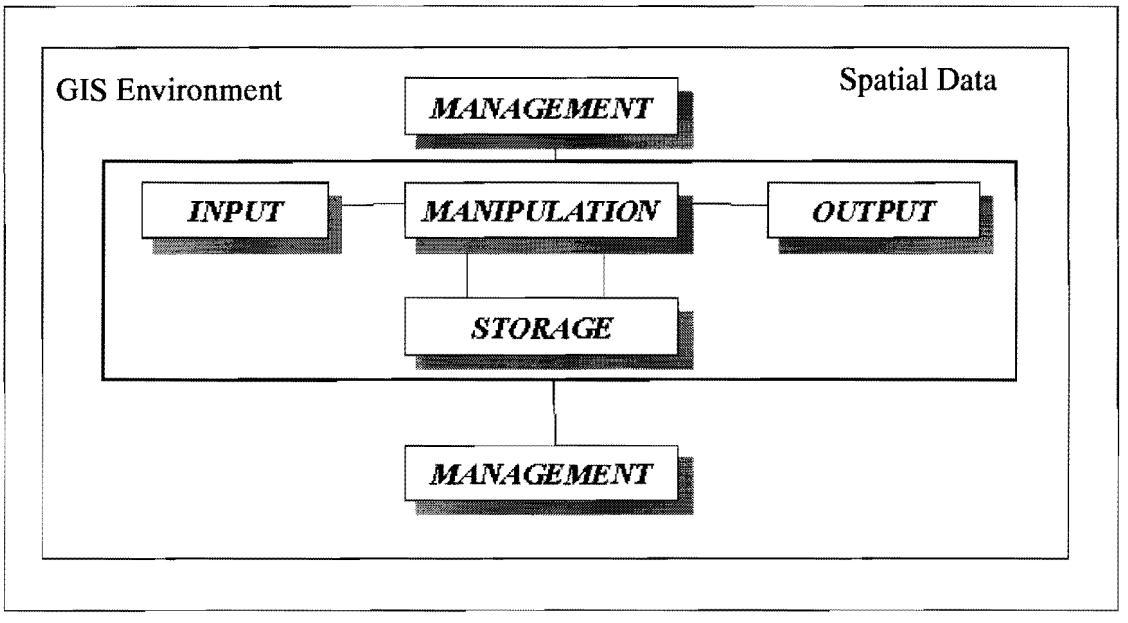

Fig 2.3 General layout of GIS (Bogaerts & Kraak, 1989:278).

2.4 GIS in Southern Africa

The use of GIS in Southern Africa has spread faster in some countries than in others. This is a reflection of the different constraints existing in the different countries. The introduction of this technology in the Southern Africa region has mostly been top-down with the first initiative in most cases, if not all, being taken by donor agencies. If the region is to realise the full potential of

GIS it has to use the technology to solve relevant problems relating to its sustainable socio-economic development. Some of these problems experienced are better solved at the national level while others are solved better at a micro level. Therefore, it is appropriate to use a mixture of top-down and bottom-up approaches in the adoption of the technology (Bujakiewics and Mulolwa, 1994:30).

In South Africa Geographical information systems are developed at a national level, mainly for management of water resources, geological information and soil data by their relevant organisations. At a regional, local authority and company level there are many GIS systems being used. Examples for development of rural areas are the development and improvement of water and sanitation, the capture and storage of census information and management of health and school related data (Bujakiewics and Mulolwa, 1994:36).

A number of issues can be raised as to whether the concepts and practices of grassroots community developments and participation, sustainability, and local empowerment actually represent an alternative to development. GIS can also be linked to issues of equality in terms of access to data, information, and knowledge. This is especially pertinent in South Africa, where there is a profound apartheid legacy in information generation and dissemination. In the context of "traditional" developmentalism, GIS can be interpreted as representing a continuation and reinforcement of this structural distortion of knowledge. In the mode of top-down data creation, GIS empowers the powerful and disenfranchise the weak and the not so powerful via selective participation of groups and individuals (Harris, et al. 1995:203).

2.5 Major advantages of GIS

There are a number of advantages to implementing a particular application on a Geographical information system. Some advantages of GIS are less

tangible and are therefore frequently left out of cost-benefit analysis but they are none the less important and in the long term may prove to be more important (Geodata institute, 1998:6).

According to the Geodata Institute (1998:6) the benefits to using a GIS are:

- GIS has the major advantage of replacing paper maps and documents which have traditionally been duplicated throughout an organisation and which require frequent updating and replacing. GIS based maps can quickly be updated, edited, printed or duplicated whereas traditional maps can take days of careful manual labour to achieve the same.

- GIS provides the technology to perform tasks not previously possible because they were too time consuming or not physically practical before automation.

- GIS provides all the advantages of controlled information management such as sharing the data between multiple users, reducing data duplication and increasing security, accuracy, integrity and validity of data. Shared access to a central database is much more efficient than providing numerous copies of the same data. It is then that inconsistencies in the data arise and errors can develop.

- GIS provides the potential to create new information from existing data, through selection and combination analysis techniques.

- GIS tends to be based around the realisation that information is a valuable resource to be utilised to its full potential. GIS provides very effective data management, retrieval and analysis tools, but perhaps the greatest strength of GIS is the capability to visualise spatial features and relationships.

According to Hall, et. al. in South Africa's magnifying glass (1998:10) the major advantages of GIS are that:

- Information is presented in a visual and usable format, which makes it more accessible and promotes the sharing of information.
- It provides a logical and convenient way of combining and storing spatial and non-spatial information.
- Accurate and current information can be made available in the form of maps and tables for decision-making.
- The integration of information can be effectively done and will in the long term assist in the productive use of information.

The advantages listed above highlight the fact that geographical information systems have several important capabilities that can make the use of a GIS very advantageous. The ability of GIS to handle both spatial and non-spatial data is an advantage since the system can be used to address spatial problems, and therefore contribute to the understanding of the relationship between people and their environment. Geographical information systems have the ability to present data in a more visually exciting way, and add to the value of this information because findings can be presented in a map format. GIS therefore provides a framework from which existing data can be repackaged and distributed.

2.6 Visualisation

The word visualisation has acquired different interpretations. In the Oxford Illustrated Dictionary (1975) visualisation is defined as "make mental vision of image of (something not present or visible) make visible to the imagination". Another definition found in the Shorter Oxford English Dictionary (1990) indicated visualisation to mean the following, "the action, fact or power of visualising; a picture formed by visualising". The definition of visualise is " to form a mental vision, image or picture". The term is also used to refer to the

process of the making a visible image of something otherwise invisible. Visualisation is essential for visual data exploration, interpretation and communication. There is a need for the modelling of geographic information at different levels.

Visualisation is the presentation of data in a graphic form. Whereas tables and lists of numbers are usually difficult to understand, visualisation is used as a convenient and effective way to communicate information (Davis, 1996:13). Furthermore, maps are used as a visual means of communication. The display, presentation and interaction with the spatial information are central to any user of GIS. With the computer we have a huge number of display methods available for data, well beyond the limitations of a static map. Those methods are only beginning to be realised and exploited by the GIS community (Fisher (ed.) 1995).

Fig 2.4 shows that visualisation is primarily concerned with the relationships between technology and the aspects of cognition and communication that enable it to be used in a problem-solving context. Visualisation has to address the issues related to the human use of geographic information and the strategies for improving the human/computer interface.

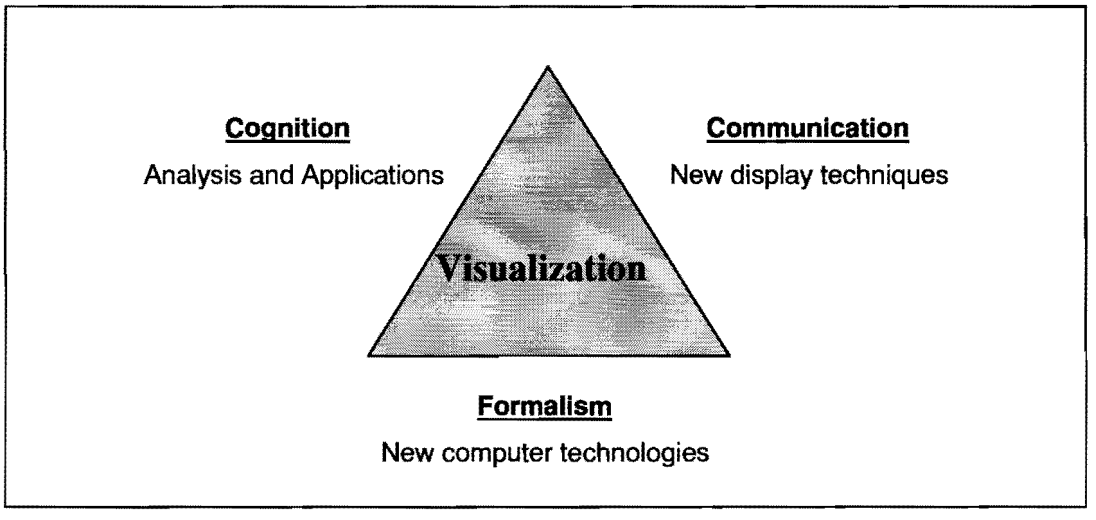

Fig 2.4 The components of visualisation (Cassettari, 1995: 534).

Visualisation in GIS involves consideration of the data presentation in many forms. In the information era the need to understand and improve visual communication is increasing. At the same time the need to convert increasing volumes of data into usable information has never been greater (Fraser-Taylor, 1994:20). It is this visualisation of data in a map format that is used to see if information can be made available in communities where the residents are illiterate and if this visualisation of maps can be used to display the answers to information needs. The maps and related cartographical products are ideal media for the presentation and communication of information in a variety of subject areas (Fraser-Taylor, 1994:20).

2.7 Components of a GIS

GIS is one of the many information technologies that has transformed the way in which information is provided to society. In this context geographical information systems have served an important role as an integrating technology. The great appeal of GIS stems from its ability to integrate large quantities of information, the ability to separate information into layers, and combine it with other layers of information. This is then also the reason why GIS has the potential to be used in such a variety of applications. The power of GIS is often said to lie in the ability to act as an integration tool, bringing together people, places and the environment. The ability of technology-based information to sucure access to relevant information is a very important requirement and future developments will undoubtedly give prominence to such information.

As shown in Fig 2.5 spatial data is modelled in layers, all defined by the same object, space and coordinate system. Regardless of the way in which the data is structured all geographical information systems separate different data types into different layers. Whereas other technologies might be used to analyse aerial photographs and satellite images, to create statistical models,

or to draft maps, these capabilities are all offered together within a comprehensive GIS.

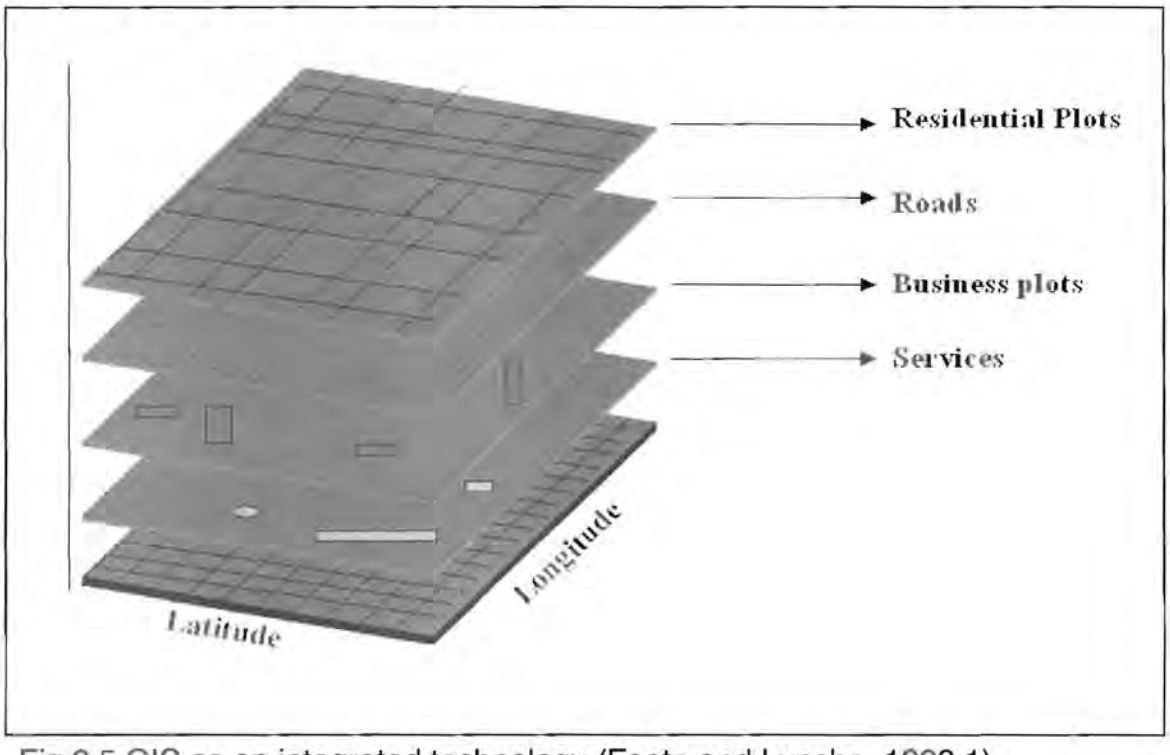

Fig 2.5 GIS as an integrated technology (Foote and Lynche, 1998:1).

GIS consists of components or attribute processing entities that function in an interrelated manner. These components form a functioning whole and are characterised by inputs, flows, processes and outputs. A working GIS integrates five key components: hardware, software, data, people, and methods.

Previously in this Chapter it was mentioned that a geographical information system consists of six main modules. These modules represent the general layout and functionality of a GIS. There is however five components that are critical to the successful implementation of a GIS. These components are:

- Software.
- Hardware.

- Data.
- People.
- Methods.

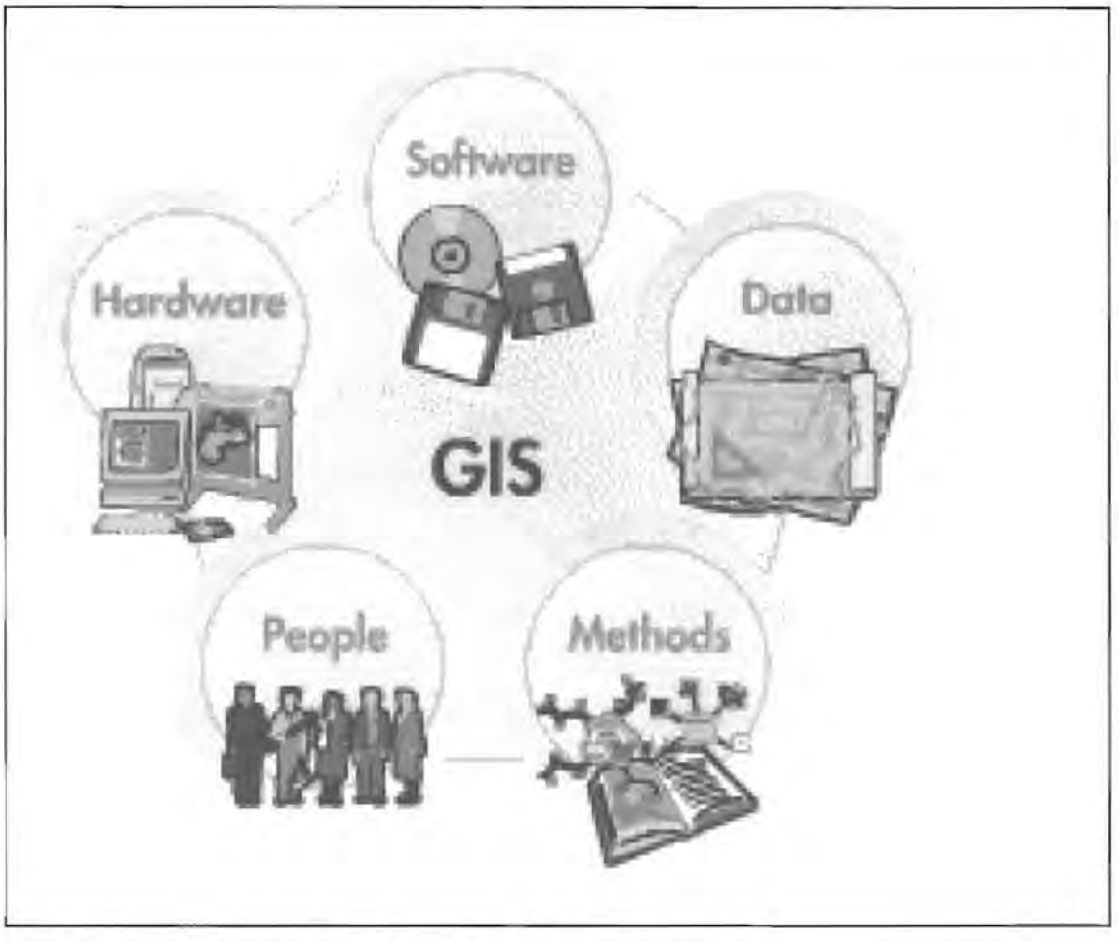

Fig 2.6 Components of a GIS (ESRI, 1998:1).

2.7.1 Data

A detailed database design is a critical component of any GIS system. Building the database is typically the most expensive, time-consuming, and problematic part of implementing a geographical information system. Data generation and preparation usually consist of up to 70% of GIS implementation cost. Easy access to existing databases, or developing new data is the heart of any information system (The World Bank, 1995:2). Possibly the most important of GIS is the data. GIS will integrate spatial data with other data resources (ESRI, 1998:1).

Data plays a primary role in setting up a geographical information system. Without data a GIS is practically useless, as is a GIS with unreliable or inappropriate data. Geographical data differs in many respects from other data types. The large volume of data is one major characteristic associated with a GIS, with the unavailability of data the major hindrance. Geographical information systems need both graphic and text data in order to function, but in developing countries the limited availability of data could limit the use of a GIS. Any GIS can only be as reliable and relevant as the information entered into it. The accuracy, source, ownership, copyright, security and formats of data are important issues to consider. GIS technology allows the integration of data from a variety of sources, scales and formats for visualisation and analysis purposes, however the output from any GIS can only be as relevant as the data that was entered into it. Care is needed during data acquisition and input in order to maintain accurate and reliable data sets.

Geographical entities (lines, points and polygons) as illustrated in Fig 2.7 are uniquely located in space. The geographical data are bound by a particular coordinate system to obtain a definition of location. Each of these entities can thus be defined in terms of its spatial location and its descriptive or non-descriptive attributes (Liebenberg, 1994:12).

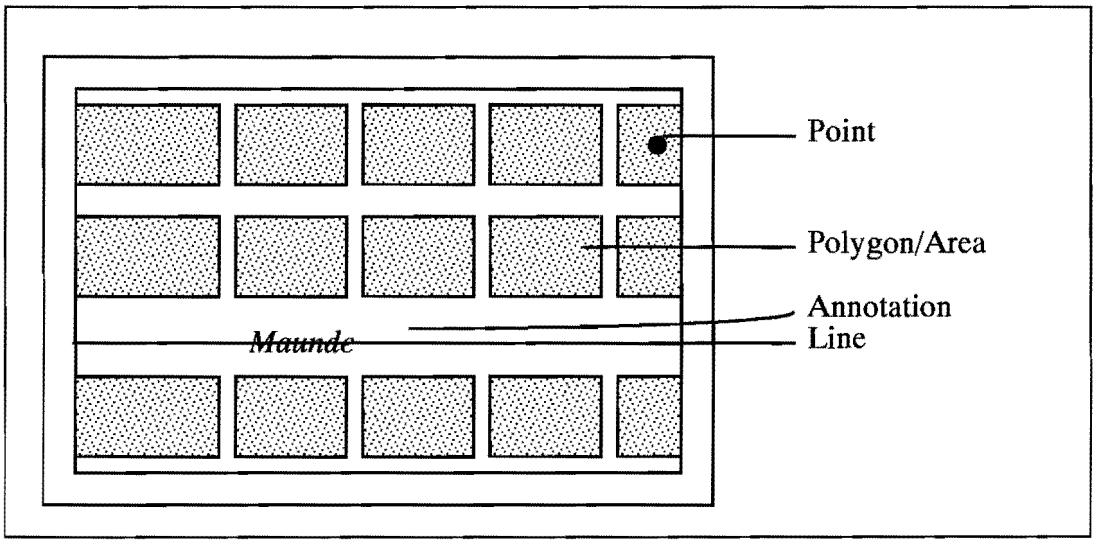

Fig 2.7 Geographic example as used in the *Community GIS*.

In general three basic notations are used for presenting the spatial location of geographic phenomena, namely points, polygons and lines.

- Points: Point data refers to a single location in two-or three-dimensional space and which has only one reference coordinate.
- Lines: Line data describes the linear features within a GIS. These entities such as roads can be represented as isolated entities or as multiple entities such as river systems.
- Polygons: This type of entity can be defined as a continuous closed boundary.

Data within a GIS is usually varied and complex. It may include digital descriptions of map features, logical geographic relations among features, and non-graphic data that describe characteristics of features and phenomena that occur at specific geographical locations. Ongoing maintenance of the database is essential to the success of any application of a GIS. As requirements change the GIS must also change and evolve over time.

2.7.2 Hardware and software

GIS systems are available already packaged, or can be custom designed, with varying degrees of sophistication and capabilities and with a wide range of hardware and software options. At the one end of the spectrum there are a number of systems that rely on microcomputers running small and inexpensive programs. At the other end are mainframes supporting large and expensive packages of programs associated with massive databases, typically maintained for programmatic purposes (The World Bank, 1995:3). The equipment required by a GIS consists of devices for data input, data storage, and data processing and display. The types of machines, number of terminals, network requirements, digitising and printing needs to be considered for successful implementation of a GIS. Final choices will depend on the budget available, the number and location of potential end users and the type of GIS to be installed.

The required operating system, database, GIS package or other supporting software also need to be decided upon. There is no "best" GIS software; the most appropriate choice depends on the individual organisation, number of users, type of applications involved and the budget at its disposal. GIS implementation can range from a PC based system for individual use, to departmental workstations and up to corporate systems based on a mainframe, which serves an entire organisation. There is also a choice of a toolbox or menu-driven system. Increasingly, however, commercial GIS will offer a basic menu-driven system but with the option of using a command or macro language to create tailored functions, interfaces or full applications (Geodata Institute, 1998).

GIS software provides the functions and tools needed to store, analyse and display geographic information. Key software components are:

- Tools for the input and manipulation of geographic information.
- A database management system (DBMS).
- Tools that support geographic query, analysis, and visualization.
- A graphic user interface (GUI) for easy access to tools (ESRI, 1998:2).

2.7.3 People

Perhaps the most underrated step in GIS development and implementation is that of human resource development. Well-trained and organised staff is the key element of success in any GIS application (The World Bank, 1995:2). People are required for the operation of all information systems. These people resources include end users and information system specialists. The end users are people who use an information system or the information it produces. The information system specialists are people who develop and operate the information systems (O'Brien, 1997:23).

GIS technology is of limited value without people who manage the system

and develop plans for applying it to real-world problems. Another important theme is related to the differential access to GIS data, technology and expertise. The establishment of a GIS database and the acquisition of hardware, software and trained personnel is an expensive process. This cost usually limits the technology to those communities and organisations that can afford it, and make it an inaccessible tool to those communities that could make use of it in a simple but important way.

2.8 Why use GIS in this project?

GIS may prove a valuable source of information to the community. The *Community GIS* is focussed on the community and an effort is made to enhance the community's capacity to use GIS as an information tool, through which basic information can be accessed, in a visual way. Through this visual part it may be that illiteracy problems experienced in disadvantaged communities in South Africa can be overcome. GIS is not only about maps, but it is the mapping capabilities of a GIS that is going to be exploited to its fullest during the project. More focus is placed on the mapping capabilities since it may prove an ideal solution to make information accessible to illiterate and innumerate communities, information otherwise out of their reach.

The disadvantaged communities in South Africa are not homogeneous entities. In order to incorporate a *Community GIS* successfully, participation will have to be broad-based, inclusive, gender sensitive, and biased toward the interest of marginalised people. GIS has the potential to serve disadvantaged communities' interests, develop information applications from the technology to benefit local people, businesses and individuals. GIS might prove to be the solution to the lack of community information in disadvantaged communities, because it reduces the importance of literacy through the visual representation of information. The information technology today lends itself to giving communities direct and regular access to all data about resources within the local area. GIS provides the opportunity for all to

become knowledgeable about what is "out there".

2.9 Summary

Considering the disappointing success of GIS in lesser developed countries in Africa during the 1980's it has been argued that many, if not the most GIS applications were driven by the desire to demonstrate the technology rather than an interest in solving problems in data collection, analysis or the supply of information (Hutchingson, & Toledano, 1993:13). In South Africa, as in other developing countries the success of GIS can be gauged by their actual use in the decision-making process. The development process depends to a large extent on the good supply of relevant and accurate geographic data. Geographical information systems technology can assist in applying this data to facilitate the development effort.

GIS is usually a computer-based system, which provides facilities for data capture, storage, manipulation, analysis and presentation. The emphasis is on preserving and utilising the inherent characteristics of spatial data. Spatial data comprises of both a physical location in space, and a set of characteristics about a specific location. During this study emphasis will be placed upon the use of GIS to meet a need, rather than the use of GIS to interpret data. All spatial information will be processed to facilitate some aspect of human decision-making. Thus the methods available for decision-making are an essential part of the geographical information process. GIS technology integrates common database operations such as query and statistical analysis with the unique visualisation and geographic analysis offered by maps. These abilities distinguish GIS from other information systems.

Within this study, GIS is used purely as a tool, through which information can be displayed. To focus the study on the community and to ensure that the

communities' needs are met, it is critical to understand the community as well as the communities' needs.

Chapter 3: Community Profile

3.1 Introduction

Since the project explores the potential of a *Community GIS* to better equip developing communities with information resources that will accelerate development, it is necessary to get a firm understanding of the community. In order to do this the needs of the users of the GIS must to be understood. Developing communities in South Africa are experiencing a vast shortage in the way information is distributed within the community, with most of the information sources available not supplying information aimed at the local community level. Good information resources deliver relevant and useful information providing the user with valuable advantages as to be able to respond to a situation so as to benefit from the event.

The *Community GIS* project started in 1995 with discussions being held with the Information counsellors active within the Community Information Resource Centre, as well as with the Atteridgeville/Saulsville Residents Organisation (ASRO). During these discussions a basic idea of the needs of the community was established, which corresponded with the results of the Needs Assessment done by CIRC and the HSRC in 1994. An accurate insight into the functioning of the community is necessary in order to be able to focus the study on the community's needs in order to increase the possible success of the study. During the discussions the aim of the project was discussed with the information counsellors to ascertain whether they thought that the *Community GIS* could be of value to the community as well as to make sure that the information counsellors were willing to help during the project. The information counsellors were already involved in the dissemination of information to the community, although information supply was mainly verbal or in a paper-based format. The information counsellors

gave a favourable response to the implementation of the *Community GIS* into the Community information Centre. With the limited exposure to information systems, especially GIS the favourable response may have been influence by a number of factors:

- Interested in establishing the *Community GIS* due to an interest in the possibilities GIS has to offer for the dissemination of information.
- Interested because the Information Centre has a need for computers, and this project may be seen as a way of obtaining a computer.

By granting the community information about services, businesses etc. within the area the technology can help members of the community to understand their local environment better in terms of individual, business and development needs. The *Community GIS* will therefore try to act primarily as a mechanism at a community level, and will deliver information to as wide an audience as possible. For the project to prove successful it is necessary to have a firm understanding of the community, its profile and information needs. As indicated in Fig 1.2 (Chapter 1) the assessment of the users needs is one of the first steps during the implementation of a GIS.

3.2 GIS implementation steps

During the implementation of the *Community GIS*, it was necessary to obtain a better understanding of the community, their needs and limitations. Figures 1.2 (Chapter 1) indicate three steps to the identification and conceptualisation stages of a GIS project. The three steps are:

- Assessment of users needs.
- Type of information culture.
- Volume of data needed.

3.2.1 Assessment of user needs

In order to identify the information that would be appropriate to be put into the system, it was necessary to have a clear understanding of the information and development needs within the community. The information needs study by the HSRC was initiated to establish the development and information needs of the community, and to develop a detailed community profile or directory for the establishment of a Community Resource Center within the community of Atteridgeville and Saulsville. The results of this survey were used as a basis to identify what information would be appropriate during the study. The abilities of the users needed to be identified in order to get a clear understanding of the requirements of the system. This was done in order to ensure that the system was developed to be of use to a large quantity of residents, irrespective of them being literate, illiterate or whatever their education level.

3.2.2 Type of information culture

By documenting the current information gathering work practices within the community, it is possible to anticipate problems the community may have when faced with an additional source for community information. This also creates the opportunity to find ways to change the current ethos of information gathering within the community, and to understand their attitude to gathering information. In developing communities it is necessary to get the community involved through contributing to the project. Due to the communities' limited exposure to computers and a more limited understanding of GIS it was necessary to make use of the knowledge and expertise of the community information counsellors and well as members of the Atteridgeville/Saulsville Community Residents Organisation (ASRO). The people active in the Community Information Resource Centres were informed of the project and their reactions noted. A positive and enthusiastic reaction was forthcoming as well as an indication of a commitment towards the project at hand.

3.3.3 Volume of data needed

The Community of Atteridgeville, Saulsville and the informal settlements are small, and that makes it possible to easily capture data when needed.

3.3 Community information Project

An organisational survey was conducted in Atteridgeville and Saulsville as part of a Community Information Survey, which was the first part of a Community Information Resource Centre Project. The survey was conducted in the period starting July 1994 through to September 1994. The aim of the project was to create an extensive up-to-date community profile directory database, which was created by gathering all information on Community Based Organisations, Businesses, etc. ranging from spaza shops and shebeens to churches and schools. Questionnaires were used to identify the organisations active within the areas and to identify their specific information needs as well as problems currently experienced by these organisations. The Community Information Resource project concentrated on organisations functioning within or delivering services to Atteridgeville, Saulsville and the informal settlements (Phomolong, Jeffsville and Concern). External organisations (both NGO's and sponsors/donors) in Atteridgeville were contacted after they had been identified during the survey (Oxley, 1995a:2).

3.4 Community Profile

The community profile of Atteridgeville/Saulsville is based on the 1991 Census information as was released by Central Statistical Services (now known as Statistics SA).

Total population 1991	Male population	Female population
92 007	49 462	42 545

Fig 3.1 Population demographics for the formal areas of Atteridgeville and Saulsville (Census 1991, Statistics SA).

The figures reflected in Fig 3.1 indicate the population breakdown, children included, based on the 1991 Census information. This information does, however, not include the informal settlements of Phomolong, Jeffsville and Concern, due to these settlements not being included in the 1991 census count. The informal areas are, however, growing fast and it is therefore difficult to estimate the population accurately.

In a report by the HSRC on the development needs in the Pretoria region (Saayman, 1994:16) population figures for the informal areas were derived for 1992 from secondary sources (mainly local authorities). This report indicated that figures might have been inflated by the source. The reported number of informal dwellings varied considerably, possibly because of the numbers of informal backyard structures and occupied garages making it more difficult to estimate (Saayman, 1994:16). The estimates are further complicated by land invasions of free-settlement areas and the high mobility of the informally housed population. According to this Development Needs Study the population is estimated at 101 000 residents.

Historically the population growth in the Atteridgeville/Saulsville community from 1985 was close to 3,2%. The natural population growth being 2,4% which means that close to 0.8% of the growth can be attributed to migration into the area as well as urbanisation (DEMACON, 1992:4).

3.4.1 Housing

The information in Fig 3.2 shows that in the formal area of Atteridgeville and Saulsville the majority of residents live in houses with hostels accounting for the second largest residential type. Unfortunately the 1991 Census does not

take the informal settlements of Phomolong, Jeffsville and Concern into account. These areas were not counted during the 1991 census and no precise figures could be found that give a good indication of the type of dwelling found within the informal areas. At this stage the 1996 census data has not been made available at such a micro level, as would be needed during this study. From visiting the area it became clear that the majority of residents in the informal settlements lived in shacks, indicating the poverty situation within the area, which could have an impact on the payment for services.

Number of residents per dwelling type	
House	72 188
Town House /Cluster house	1 706
Traditional Dwelling for blacks	559
Shack	3 062
Hostel	11 502
Other	2 976

Fig 3.2 Housing by dwelling type (Census 1991: Statistics SA).

In order to accommodate the largest sector within the community the location of the *Community GIS* must be of such a nature that it is as close as possible to the residents that need it most. Identifying the poorest areas within the township may help with the final decision as to where the *Community GIS* should be situated.

3.5 Information needs assessment

3.5.1 Organisational information needs assessment

During the Community Information Resource Centre (CIRC) Project a total of 471 organisations participated in the survey in Atteridgeville and Saulsville, which resulted in a community profile database being created. The

organisational survey was conducted as the first phase of the CIRC project. The survey was conducted starting July 1994 through to September 1994 (Oxley, 1995a:1).

Summary of information needs according to the CIRC Project (Oxley, 1995a:17):

- Most organisations felt that an information centre would have great advantages for the community of Atteridgeville as a whole. The advantage most mentioned during the interviews was that the information would be closer to the residents of the community and that the community would not have to spend travelling money to access information.
- Organisations indicated that they would prefer to get information in the vernacular because it would promote better understanding as well as to assist people in the community who are illiterate.
  The following remarks were made:
  - The information would be better and quicker understood.
  - It will be easier for people who do not understand English.
  - Communication would be more effective.
- Most organisations indicated that they would like to participate in a technology-training programme regarding personnel as well as business skills.
- Wide ranges of reasons were given in terms of what the information will be used for. The main reasons centred around "improvement" in general.

Smaller businesses that were interviewed indicated that a Community Information Resource centre would be an advantage to the community because (Oxley, 1995a:21):

- Information will be easily accessible. Access to information will be wider.
- Help with community development.
- "Information is power".
- Awareness will be created as to what is happening within the community.

- The knowledge of the community, about the community will be broadened.
- People in the community would know where to go for entertainment.
- Such a centre will be able to give businesses advice.
- Knowledge (local and international) will be broadened and improved.

This needs assessment and the information needs identified by the organisations active within the community will be used in establishing a *Community GIS*. Within Atteridgeville and Saulsville most information relates to the formal areas within the community, and does not take the informal settlements into consideration. The needs of the community are important to try and develop a GIS that is primarily aimed at answering the basic information needs of the community. Since many of the users or potential users in the study area are not informed about GIS, and are to a large extent computer illiterate, it is therefore not logical to put out an inquiry as to what the needs of the community will be on a GIS. This factor, as well as the fact that a similar study has been done in 1994 by the HSRC, contributed to the decision to use the information needs as was established during the Community Information Resource project. These information needs study with the information counsellors were considered a good source of information as to what the specific needs in the community are.

3.5.1.1 Types of information needed by organisations involved with infrastructure

- Legal information.
- Funding/sponsorship.
- Community related information.
- Education.
- Health information.
- Network information (on other organisations within Atteridgeville and Saulsville).
- Training (computer, capacity building, general).

- Development information.
- Employment information etc. (Oxley, 1995a:19).

3.5.1.2 Types of information needed by small businesses

- Business information – general.
- Funding/sponsorship.
- Community related information.
- Marketing.
- Legal information.
- Network information.
- Business expansion information.
- Financial information etc. (Oxley, 1995a:23).

3.5.1.3 Types of information needed by sports organisations

- Funding/sponsorship.
- Network information (on other organisations in Atteridgeville).
- Sports related information.
- Sports development etc. (Oxley, 1995a:29).

3.5.1.4 Types of information needed by churches and church organisations

- Funding/ sponsorship.
- Social information.
- Academic information.
- Business information.
- Community related information (Oxley, 1995a:29).

3.5.1.5 Types of information needed by education and training organisations

- Business related information.
- Funding/sponsorship.

- Arts and culture.
- Community related information.
- Development information etc. (Oxley, 1995a:32).

3.5.1.6 Types of information needed by contractors

- Building information.
- Building materials.
- Community related information etc. (Oxley, 1995a:40).

From the survey regarding the information needs of organisations within the community, most organisations expressed a need towards:

- Community related information.
- Business information.
- Funding/sponsorship.
- Training.
- Network information (on other organisations in Atteridgeville).

3.5.2 Individual needs assessment

Community Information Resource Centre (CIRC), Human Sciences Research Council (HSRC) and the Atteridgeville/Saulsville Residents Organisation (ASRO), came together to establish what information needs existed in the area in 1994. A representative sample of 500 people was drawn for the Atteridgeville/Saulsville and Informal Settlements areas that concentrated on subject areas like:

- Types of information needed.
- The various formats information should be supplied in.
- Sources of information currently used.
- Problem experienced with obtaining the information.

It is necessary to ensure that information gets filtered down to the grassroots level in acceptable formats.

A total of 500 individual questionnaires were completed. The age distribution for the survey completed ranged from 10 - 65+ years. To prove a proper all inclusive information provision service it is necessary to include all age groups in the survey (Oxley, 1995b:4). Due to the visual way in which the information is displayed the *Community GIS* could help residents that have a lower level of education through the supplying information in such a way that reduces the need for literacy to understand it, since it can be supplied in a map format. The *Community GIS* could also help with the supply of information in communities, which are characterised by the presence of different languages, since the system would allow users to indicate the language of choice of receiving information.

3.5.2.1 Education

From Fig 3.3 it is obvious that a large number of the older generation received less formal education than the younger generation. In the age group 65 years and older, 81% of the respondents had a Std. 6 and lower education and 44% no education at all. In the younger generation (aged 20-39 years), a large number of the respondents attained a Std. 9 or Std. 10 level of education. The age education ratio is extremely important for effective information provision to the people. This is especially important in terms of the format in which the information will be provided. The education profile of respondents established during the needs survey is as follows (Oxley, 1995b:15):

Age	None	Grd 1/2 Std 1	Std 2-5	Std 6	Std 7-8	Std 9-10	Degree or Higher	Total
0-4	99.4%	0.6%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0
5-9	22.0%	66.0%	11.0%	1.0%	0.0%	0.0%	0.0%	100.0
10-14	0.3%	13.0%	67.7%	12.0%	7.0%	0.0%	0.0%	100.0
15-19	3.0%	2.0%	11.0%	17.0%	40.0%	27.0%	0.0%	100.0
20-24	1.0%	0.0%	7.0%	5.0%	19.5%	56.5%	11.0%	100.0
25-29	2.0%	0.1%	7.0%	7.0%	21.0%	51.9%	11.0%	100.0
30-39	2.0%	0.6%	16.4%	10.0%	31.0%	33.0%	7.0%	100.0
40-49	5.0%	1.0%	23.0%	30.0%	20.0%	16.0%	5.0%	100.0
50-64	19.5%	2.0%	26.5%	28.0%	12.0%	9.0%	3.0%	100.0
65+	44.0%	3.0%	14.0%	20.0%	9.0%	8.0%	2.0%	100.0

Fig 3.3 Education profiles of respondents (Oxley, 1995b:15).

3.5.2.2 Employment status

According to the CIRC survey (Oxley, 1995b:25) a large number (43.2%) of the respondents are employed, while nearly as large a number (30%) are currently unemployed and looking for work. Three categories where identified:

- Employed (43.2%).
- Unemployed, looking for work (30.1%).
- Unemployed, not looking for work (26.7%) - includes students, housewives and retired people.

The three employment status categories resulted into different information needs. Respondents involved in the informal sector indicated needs regarding business loans, training etc. while respondents involved in the formal sector need information that support their jobs. The majority (70.9%) of the employed respondents are working full time while 8.7% of those respondents are working in the informal sector. Different sectors of employment will require different information needs. A large number of respondents were working in

the area of Atteridgeville and Saulsville (23%), while the majority (67%) are working within the Pretoria Region (Oxley, 1995b:25).

3.5.2.3 Language

The predominant home language of respondents as can be seen in Fig 3.4, in Atteridgeville and Saulsville and the Informal Settlements is North Sotho (46.4%), followed by Tswana (13.4%). The following diagram represents the home languages of the respondents (Oxley, 1995b:27).

Language	Percentage
Afrikaans	0.70%
English	0.00%
Ndebele	6.20%
North Sotho	46.40%
South Sotho	4.50%
Swazi	2.00%
Tsonga/Shangaan	9.80%
Tswana	13.40%
Venda	3.90%
Xhosa	2.40%
Zulu	10.70%

Fig 3.4 Home languages of respondents (Oxley, 1995:27).

The respondents indicated that the home language isn't always the language of preference when it comes to information supply. Respondents indicated that they would prefer to receive information in the following languages, as stipulated in Fig 3.5.

Language	Percentage
Afrikaans	1.00%
English	66.30%
Ndebele	1.20%
North Sotho	16.60%
South Sotho	1.80%
Swazi	0.40%
Tsonga/Shangaan	2.70%
Tswana	4.40%
Venda	0.80%
Xhosa	0.60%
Zulu	4.20%

Fig 3.5 Preferred languages for obtained information (Oxley, 1995b:28).

Although no respondents indicated that they had English as a home language (Fig 3.4), 66.3% indicated that English is the preferred language for receiving information (Fig 6.5). It is therefore interesting to note that although North Sotho is by far the largest in terms of home language, only 16.6% of the respondents want their information in North Sotho.

Although respondents indicated that English is the preferred language, provision still has to be made to provide information in the vernacular (Oxley, 1995b:29). Since it is clear that all 11 official languages can be found in the area it would be better if an interface could be used which gave the residents the ability to use the system in their own language. From the number of people per home language as was established during the 1991 census, as well as information needs assessment 1994 it is possible to decide what languages should be incorporated into the *Community GIS* software.

3.5.2.4 Information resources used

According to the Atteridgeville Individual Report by Community Information Resource Centre (Oxley, 1995b:44) the information resources used within the

community are:

a) Newspapers: Daily newspapers that are most regularly read are the Sowetan (41.9%), followed by the City Press (22.2%), Citizen, Pretoria News and the Star also being read. Weekly newspapers most read are the Sunday Times (21.7%), followed by the Sunday Nation (2.2%) and the Weekly Mail/Guardian (2.0%), with other newspapers making up the difference.

b) Magazines: Primarily five magazines are being read namely Drum, True Love, Cosmopolitan, Bona and Pace. It was however found that respondents do not buy magazines on a regular basis and very few of them use the library to read them.

c) Television: A majority (94.3%) of the respondents watch television, with news being the program that is watched the most, followed by entertainment, actuality programs, educational and documentaries.

d) Radio: Less of the respondents indicated that they listened to the radio than those who indicated that they watched television. The top radio stations are Radio Tswana, Radio Metro, Radio Sotho, Radio Bop and then Radio 702.

e) Libraries: The majority of people do not make use of libraries. Most people have a very negative feeling towards the library and some people do not even know of the existence of libraries. It is clear that there is a culture of non-library usage in Atteridgeville and surrounding areas. Respondents making use of libraries use reference works, general books, magazines and newspapers as a source of information.

e) Public meetings, conferences and workshops: The majority of residents use public meetings, conferences and workshops organised as a source of information. The people indicated that they use civic organisations as a main source of information, followed by parent-school organisations and service

organisations. This also gives an indication that the civic is well supported in Atteridgeville, Saulsville and the informal settlements. The Civic organisations proved to be the most popular, closely followed by political organisations.

3.5.2.5 Most important purposes for needing information

Most important purpose for needing information:

- School/study purpose.
- Small business.
- Employment opportunities.
- Community information.
- Cultural activities.
- Health situations (Oxley, 1995b:52).

Within the community of Atteridgeville and Saulsville and the informal settlements there are three primary ways in which residents can obtain information. Only one of these sources can be identified as a way of getting information about the community itself.

- Formal services such as libraries that have traditionally only supplied information to the literate residents within a community. This information service in Atteridegville is inadequately equipped to answer the information needs of the illiterate residents of the community. During the 1994 CIRC study it was indicated that the majority of the people do not make use of libraries. Some people indicated negative feelings towards the libraries, and some indicated that they didn't even know of the existence of a library within their community.

- The second source of information is television, radio and newspapers. Information obtained from these sources is normally not at a community level, and contains information about areas and events outside the community. Radio and newspapers can be considered a very difficult way of obtaining specific information, as it will not address residents' specific

information needs at a specific point in time. Radio's, television and newspapers are, however, a very accessible information source since residents only need to buy the newspaper or turn on the radio in order to gather information.

- The third information source found within the area can be called the informal communications network. This seems to be the primary as well as the cheapest way of gathering information within the community, by the community. Information is obtained by asking other residents within the community as to where certain businesses and services can be found. This can be considered a fairly unreliable way of gaining information, as the recipient can't be sure that the truth is being relayed to him or her. The informal communications networks that exist in every community have the possibility to be a good source of information. Information obtained through informal communication may however be inaccurate, with the receiver of the information not always being able to identify the accuracy thereof. It is a non-threatening way of obtaining information, as well as being available to anybody willing to ask a question. To a large extent, this is the way information about the community is being gathered.

3.6 Summary

The community profile indicates that Atteridgeville, Saulsville and the informal settlements area with a wide variety of different needs and people. Although most residents speak North Sotho, the survey indicated that most people would like information in the English language. This does not mean that there is no need for information in the vernacular. It is therefore necessary to remember that information needs to be supplied to the users, in the language they prefer, giving them a choice if possible.

From the survey it is clear that the information needs of organisations and businesses differ slightly from the individuals within the community.

Individuals indicated that information is needed regarding small businesses, employment, community information, cultural activities, health etc. Organisations indicated similar needs with slight variations like a need for training related information, funding and sponsorship information as well as information regarding other organisations that could be used for networking. Respondents indicated that the current information sources used are newspapers, magazines, television and radio. These information sources can, however, not really be considered local in content, with the only resource used specifically focussed on the community being public meetings, conferences and workshops.

The following chapter focuses on the other stages of the implementation model. Aspects that will be handled are data availability, the second aspect found in the Identification and conceptualisation phase. It will also cover the acquisition of data, as well as site preparation that can be found in the third stage of the model. The second stage of the GIS implementation model will only be handled in part, covering the database design and development. System design will be handled in a separate chapter.

Chapter 4: Procedures in establishing the Community GIS

4.1 Introduction

The GIS implementation model (Chapter 1, Fig 1.2) indicates that there are five broad stages to implementing a GIS. This model was used, and the focus of this chapter is on the first three stages of the model. A part of the first stage has been covered in Chapter 3. The part of the model that has been covered in the previous chapter indicates that during the preparation of the GIS it is necessary to first establish the needs of the community in order to determine additional ways of supplying information to the community. Looking at the information resources available compared to the information needs of the community can help determine the way of supplying information. This way it is possible to establish which information needs cannot be answered within the community, what information resources are currently being used and how the community goes about answering the information questions.

This chapter will cover aspects that influence the ease with which the GIS can be implemented and established. Attention will be focused on the availability of data as well as how spatial as well as attribute data was acquired.

4.2 Location of the Community GIS

Within the community there are two sites where the *Community GIS* can be located. The location and placement of the *Community GIS* will influence the success and the use thereof, it should be accessible to the largest segment of the community. Within the community the most secure area is probably not the most accessible to the least literate residents of the community. Two possible locations were identified:

1. Atteridgeville Technical College (ATC): Although this could be considered a very secure site, it is located to the east of Atteridgeville and thus far from the informal settlements. The area bordering the College is of a higher income, and with a higher level of educated people. If placed here the GIS will end up answering information request from students, and not from the rest of the community.

2. Molambo Hall: This site is situated close to the Black Rock sports terrain and is in the western site of Atteridgeville, closely located to the informal settlements, hostels and accessible to almost the entire Saulsville. Although this site is less secure, it is by far more accessible to the larger and more appropriate sector of the community. With the Community Resource Centre already located at Molambo Hall, it was decided that it is a good place to put the *Community GIS* in order to make use of the existing infrastructure and to acquire the help of the information counsellors present at the centre. The location of Molambo Hall can be seen in Fig 4.1. Other factors that identified Molamo Hall as the ideal location for the *Community GIS*:

   - Due to the Community Information Resource Centre located a Molambo Hall, the location is free, making the provision of a low cost service possible.
   - The *Community GIS* will be located in close proximity to food handouts, church gatherings, etc. making it part of the community as well as accessible to the community.
   - With the *Community GIS* being computer driven, the need for uninterrupted power supply is important. This is available at Molambo Hall while it cannot be guaranteed in the informal settlements.

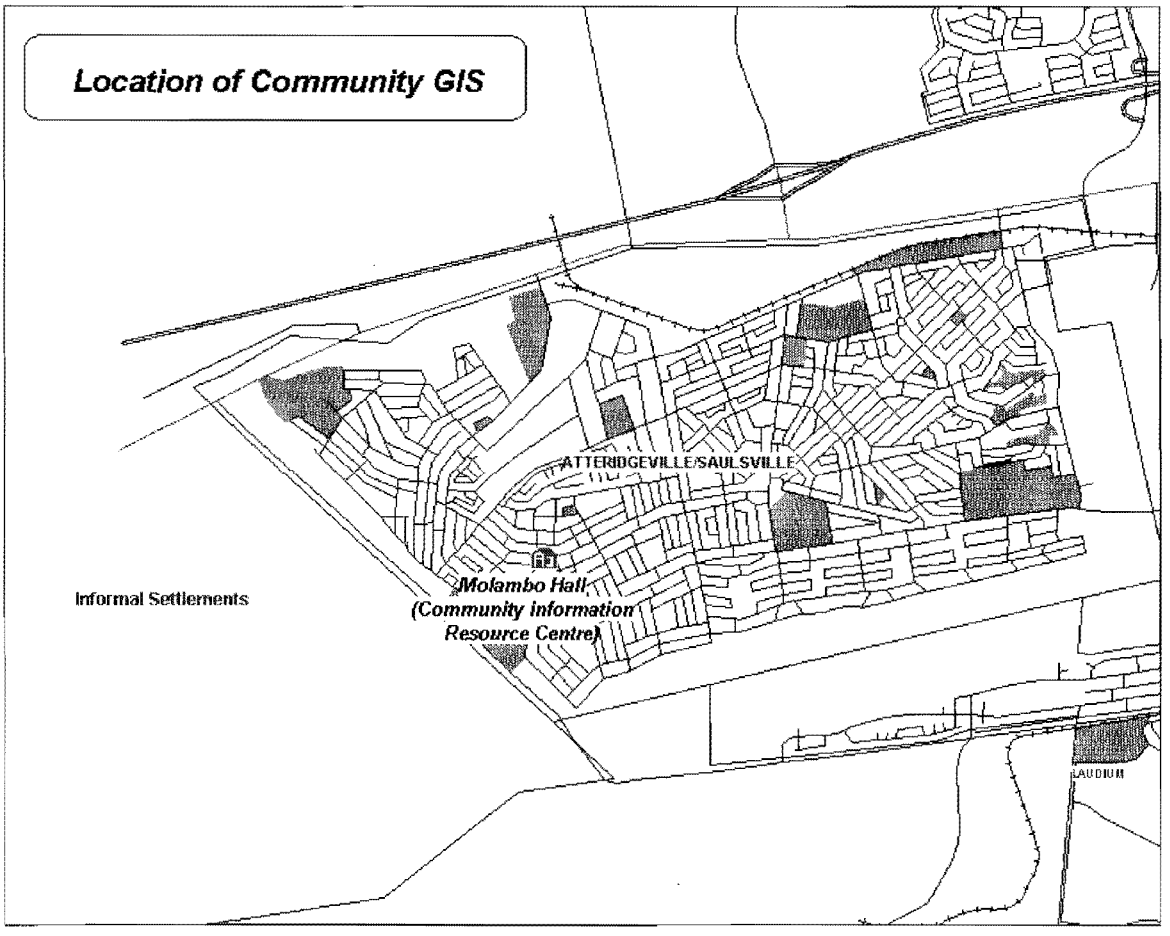

Fig 4.1 Location of the *Community GIS.*

4.3 Data availability

Determining the *data availability* and data needed is a crucial step in the early stages of building the GIS system (World Bank, 1995:4). In South Africa information in a GIS format is still limited, especially where informal areas are concerned. Due to the disadvantaged nature of the areas being covered in *Community GIS*, the data needed for the project was not readily available in the format as required. This was expected for the informal settlements due to the unstructured way that they have been established and grown. Since only a small amount of data is needed, due the relatively small area being covered in the project, simple manual techniques could be used in cases where data could not be sourced from elsewhere.

4.4 Data acquisition

During the process of acquiring the data it was necessary to handle the formal areas separate from the informal areas. This was done due to the information for the formal areas being more readily available. Acquiring the spatial information was handled differently from the attribute data.

4.4.1 Data acquisition: Spatial

4.4.1.1 Formal Areas: Atteridgeville and Saulsville

Cadastral data for Atteridgeville and Saulsville were sourced from Munitoria (Municipality of Pretoria), already in a GIS format. Munitoria was using the GIS data for planning purposes. Different software packages being used created the need to import the information from a REGIS format REGIS (software used by Munitoria) to the format used by Atlas GIS (software used during the project). This spatial data were for the formal areas and did not cover the informal areas.

Due to the nature of GIS, and the purpose thereof, the information from Munitoria contained only stand numbers as attribute information. During this project there were, however, a need for both the stand numbers and the street addresses. Munitoria could at that stage in time, not provide the street addresses in a digital format, and it was therefore necessary to obtain maps from Munitoria, that contained this type of information. Since the project covered only a relatively small area, a decision was made that the street addresses could be entered manually into the system. The process involved the selection of a particular stand, getting the corresponding stand on the map, and adding it to the database.

4.4.1.2 Informal Areas: Phomolong, Jeffsville and Concern

Obtaining GIS data for the informal areas posed a bigger problem. The information was obtained from an engineering firm called Nienaber and Van

der Walt, in a Computer Aided Design (CAD) format as illusrtated in Fig 4.2. The engineering firm obtained the data through aerial photographs taken in 1995, and were used for an electrification plan for the informal areas. Although the data covered the informal areas as was needed, it contained no attribute information. The data was not spatially referenced, meaning that when the data is imported into the GIS no coordinate information exists. Coordinates (longitude and latitude) are used to identify where areas are on earth; without such coordinates it is impossible to place the informal settlements within their correct space on earth. Due to no other information on the areas being available, it was necessary to obtain the needed coordinate information elsewhere.

A decision was made to obtain the coordinate information through the use of a Global Positioning System (GPS). It was necessary to obtain from Nienaber and Van der Walt a layout plan of the informal settlements (Drawing no: 95/04/E11) A scanned image of this drawing can be seen in Fig 4.3. This plan corresponded with the spatial information obtained. This layout plan and spatial information contained the following information:

- High mast lights.
- Transformer pylons and numbers.
- Transformer area boundaries.
- Conductors.
- Roads etc.

On the layout plan a unique number identifies all the transformer towers. This presented the opportunity to use the towers as a reference point, from where GPS coordinates can be taken and transferred onto the map. In total eight towers spread across all three informal settlements were selected, from where the GPS coordinates were taken.

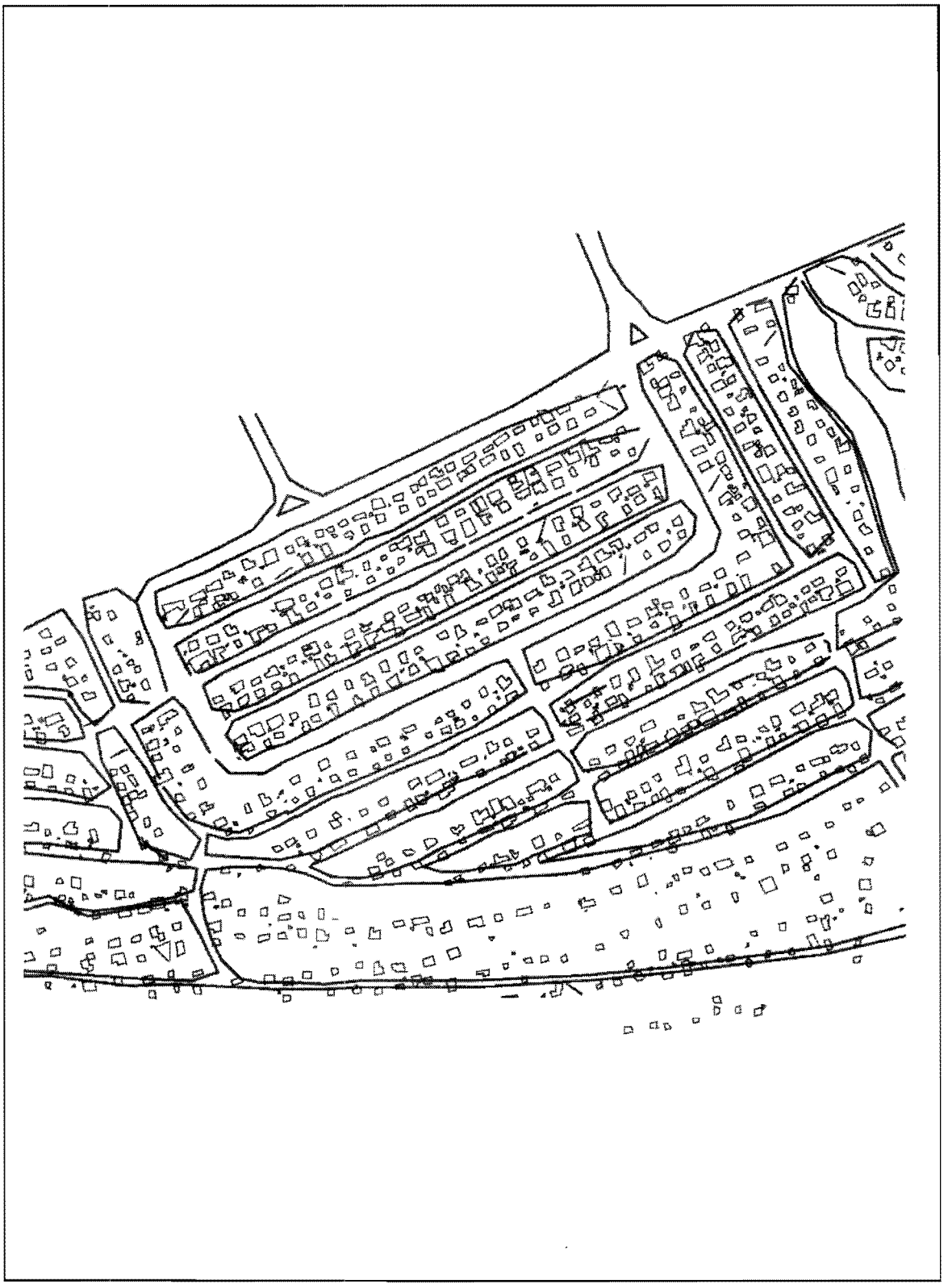

Fig 4.2 Example of CAD information obtained from Nienaber and Van der Walt.

The selected towers were visited and the coordinates for every tower determined. Once all the points (tower) coordinates were captured, they were used to place the CAD information into the correct geographical context. These reference points could then be used to spatially orientate the data into its correct space on earth.

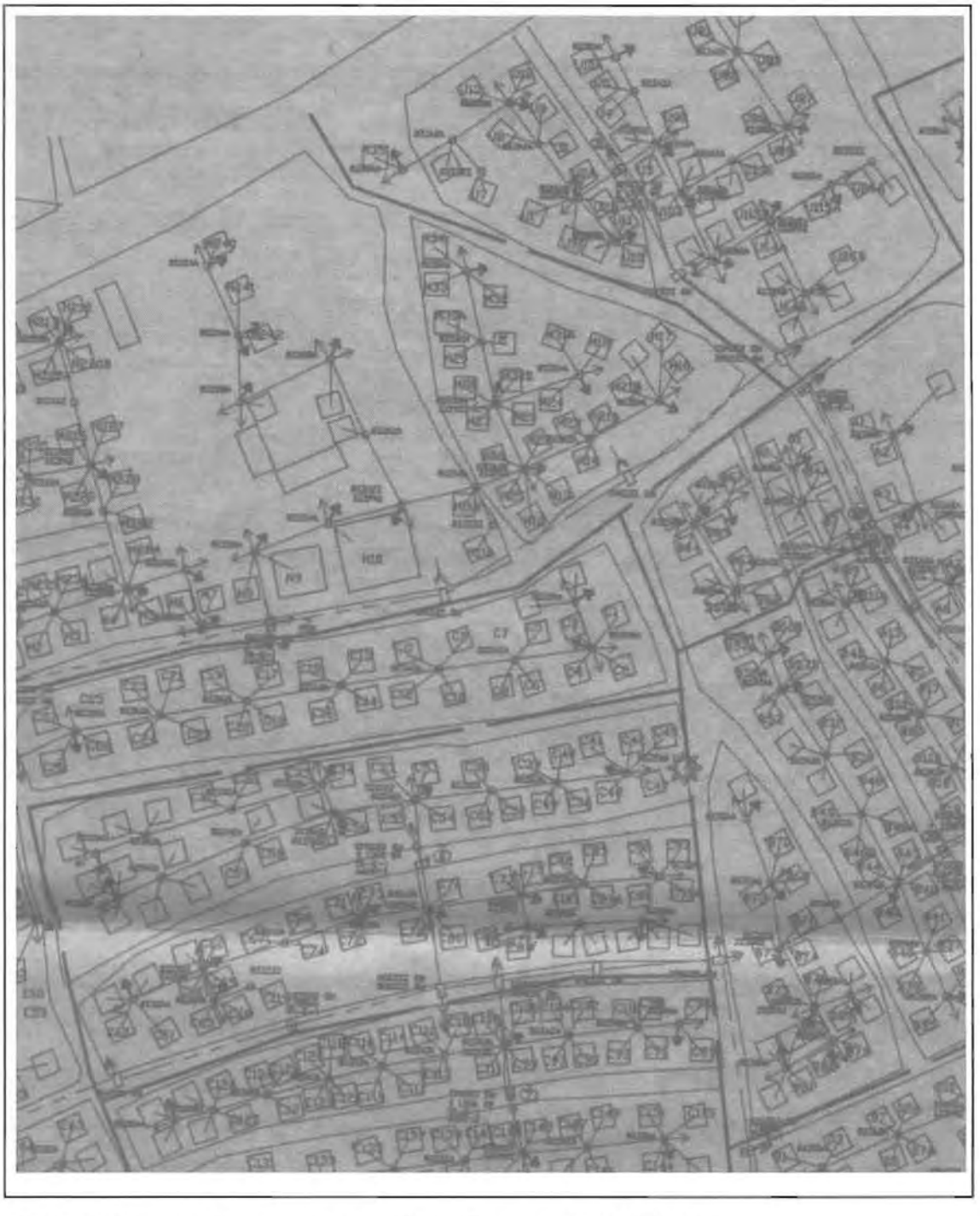

Fig 4.3 Scanned image of plan (Drawing no: 95/04/E11).

Due to GPS systems not being 100% accurate, a decision was made to make sure that the selected towers should be spread across all three of the informal settlement areas. This way distortions due to the inherit inaccuracies of the GPS, could be kept to the minimum. Since the *Community GIS* were going to be used for the purposes of information supply, and not for planning, it was decided that a small margin of error due to distortions are acceptable. This decision was made in view of the financial constraints, and the fact that the GIS will be used for social purposes that does not require the accuracy levels associated with that for engineering and planning applications.

4.4.2 Data acquisition: Database

To make sure that all services, businesses etc. are included in the database, a decision was made to conduct a site survey for both the formal and the informal areas.

4.4.2.1 Formal Settlements

The information counsellors from the Community Information Resource Centre were used during the site survey. During this phase of the study an extensive and up-to-date community profile database was created based on all the organisations, businesses and services found within the formal area, ranging from spaza shops, schools, churches, etc. The site survey required the information counsellors to locate all business addresses. In order to reduce the possibility of error due to addresses not being displayed, it was necessary to print maps of the areas. These maps contained the street name and number, as seen in Fig 4.4. The information counsellors were required to walk through the entire area represented on the map, indicating all information about businesses, organisations, and services such as business name, street address, telephone number, owner name etc. Although the information counsellors explained to the owners what the information is needed for, they were still unwilling to give information like telephone numbers, owners name, etc. This may be attributed to a lack of understanding and a fear of the unknown.

Once the entire area was completed, the maps and all other information that was gathered were returned. The next task was to enter all the gathered information into a database linked to the relevant stand. Once all the information was entered into the database, maps were once again supplied to the information counsellors.

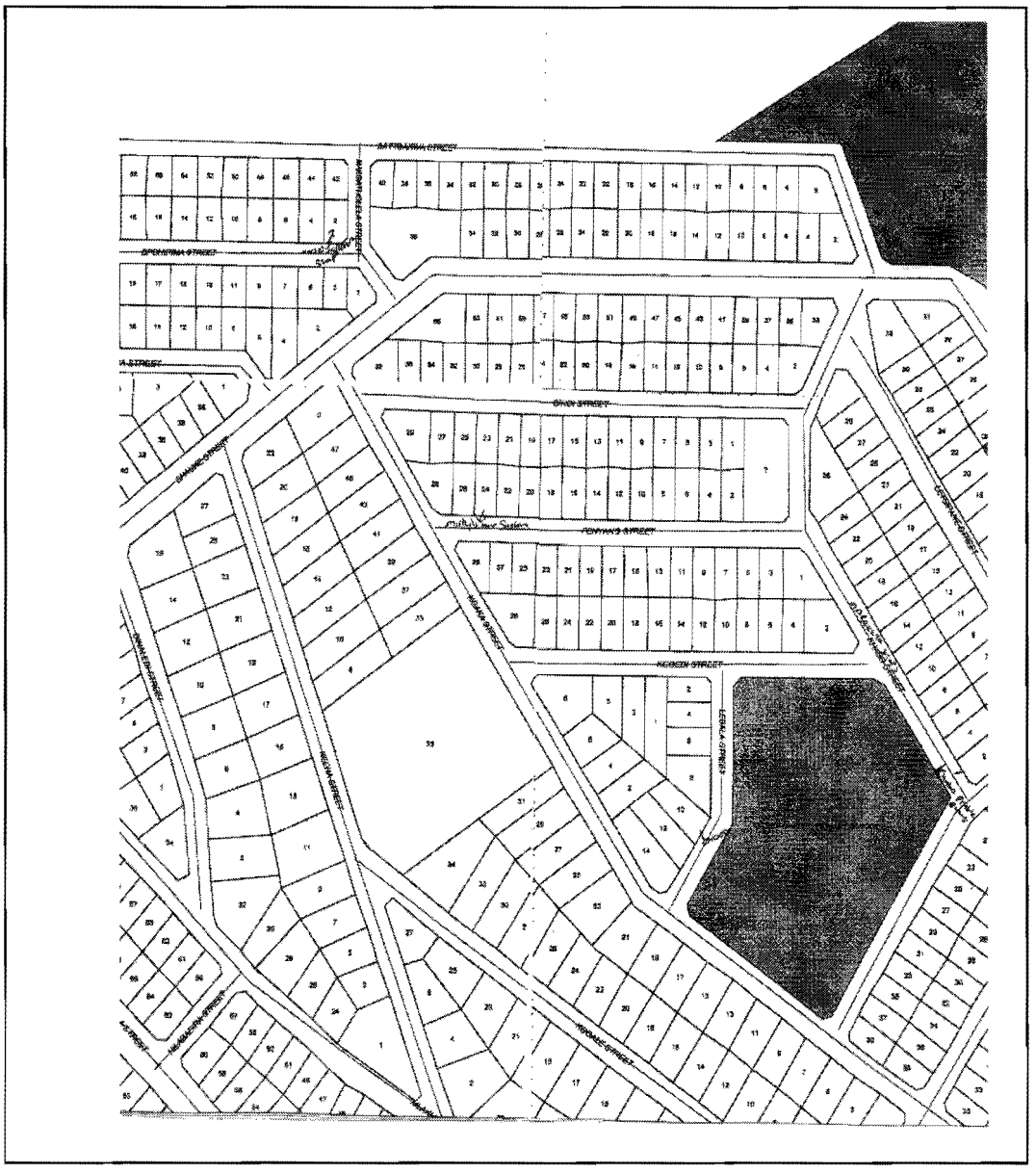

Fig 4.4 Example of maps of the formal areas given to information counsellors.

All businesses and services located during the first site survey were indicated on the second set of maps produced. The information counsellors were requested to re-visit the area. This was done to ensure that all information

was gathered and that no businesses, services etc. were missed during the initial visit. By collecting the information and entering it into a GIS it was possible to indicate the use of every stand within the formal settlements. A specific structure was given to the database, the rationale being that the user will be able to locate a business, whether it is searching by name or type.

4.4.2.2 Informal settlements

The same procedures were followed in gathering the data for the informal settlements as was followed for the formal areas. A major hindrance in gathering data for the informal areas was the lack of street addresses. No street names are available within these areas. These areas are of such a nature, that maps available are limited, making the gathering of data and referring to the location of the data in a database more difficult. Many of the informal houses do not have basic services such as running water. It was therefore decided that during the site survey, the information counsellors will not only indicate the businesses and services, but the location of communal taps should also be indicated on the database.

The spatial data covering the informal settlements showed the location of the shacks. This could thus be used as a way to indicate where the businesses and services can be found within the areas. Although some of the informal houses have numbers written on the walls, these numbers could not be linked to any of the paper maps available. Information counsellors were given maps indicating the roads and shacks, on which they indicated the location of the businesses, services and communal taps.

The residents would only be able to find businesses through the database, displayed on the maps on the screen. It was found that although the streets are not named, the residents know the area and may still be able to locate businesses.

4.5 Database design and development

The database design would contain the descriptions of the content, specifications, standards, relationships and sources of data to be incorporated. The aim of the project is to give disadvantaged communities the ability to use a GIS as a tool to find businesses, services, or residential plots within their community.

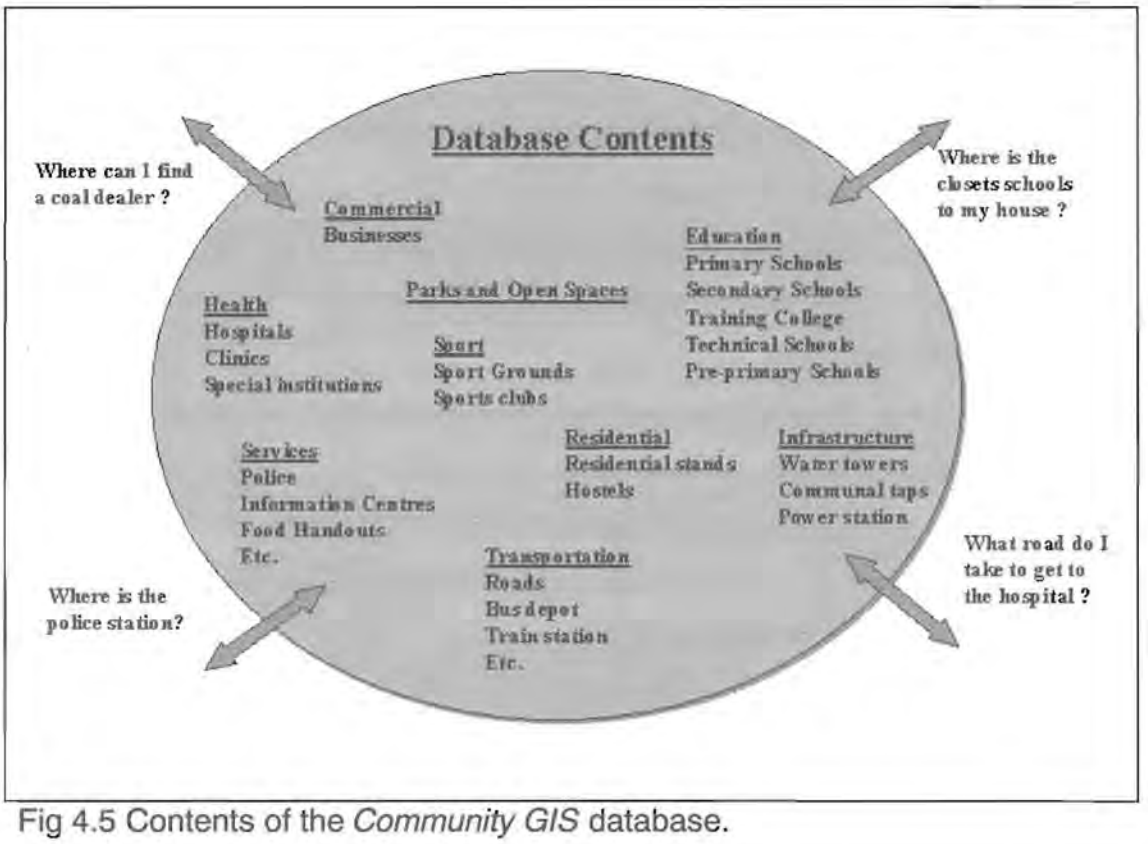

Fig 4.5 Contents of the *Community GIS* database.

From Fig 4.5 it is possible to see what information will be incorporated into the database. With all this information at hand, it is hoped that the community will have a better chance of finding the businesses, and services they need. The database was structured in such a way as to ensure that the users will be able to find the services they need, whether it is through a name search, address or the type of service it is.

The following columns were created in the database:

- **Name:** Name of the business, organisation or service.
- **Street Address:** Street address of the residential plot, business or organisation is indicated in the database. This address contained the street number and street name.
- **Sector:** All businesses, organisations and services were classed into a particular sector. This allows users to search according to specific sectors, and the identification of all organisations of a specific type. Sectors identified are:
  a) *Commercial:* All businesses, organisations etc. engaged in commerce. This only accounts for businesses located within a building whether a house or a shop. It does not include the informal trade.
  b) *Service:* Indication of services being rendered to the community. This would include pension payouts, food handouts, locations of police stations etc.
  c) *Education:* Educational facilities were identified as a separate sector. This way the user can search for all education facilities.
  d) *Health:* All health related services and organisations were allocated to this sector, such as hospitals, clinics etc. Through this all health organisations can be identified.
  e) *Infrastructure:* While structuring the database it became clear that some areas are mainly for the purpose of supplying a service to the community, but can really be placed in the commercial or service sector. These areas could normally be considered as infrastructure, such as reservoirs, power stations, and in the informal settlements street taps.
  f) *Parks and open spaces:* All open grounds as well as parks were identified, making location of these types of areas easier.
  g) *Residential areas:* all residential properties were identified. For these areas the database contains only the stand number and street address. Other details regarding these areas were excluded due to the:

- Effort involved in gathering information regarding the ownership, telephone numbers etc.
- Possible negative implications in the community, regarding privacy of individuals in the community.

h) Religion: All churches and religious buildings and organisations were assigned to this sector.

i) Culture: Selection of all cultural organisations to be found within the area.

j) Sport: This sector contains all the sport grounds, sport organisations and clubs.

- **Type:** Type within the database represents a more detailed indication of the organisation. For example the sector of a karate club would be sport, while the type would be sport club, while a sport ground will also be in the sector of sport, but the type would be sport ground.
- **Description:** The description would be what type of organisation it is. In the case of the previous example the description would be Karate club or soccer field.
- **Telephone Number:** Contact number for organisations, or services available within the community.
- **Stand number:** Stand number.
- **Suburb:** Indication of the suburb within the service or business can be located.

4.6 Summary

The process of obtaining and gathering the data needed in the database is a crucial step in the initial stage of building a system. Since such a relatively small area was involved, manual processes could be used in gathering the necessary information. For the purposes of this project data was obtained from different sources where available. Information counsellors actively

working in the Community Information Resource Center were helpful in gathering the data about the services and businesses in the community. These counsellors also served, as an additional source of information regarding the information needs of the community. Getting the information counsellors involved seemed a good way of obtaining and utilising their knowledge of the community, as well as giving them ownership of the project.

These counsellors were thus involved in gathering the information in the formal and the informal areas. The two areas were handled separately due to the complications anticipated in the informal areas, due to a lack of street names, numbers etc. While the primary focus were the businesses, services, schools, churches etc. it was decided that the location of communal taps would be included in the database for the informal settlements.

With a large number of residents not being exposed to computers, it was deemed necessary that the *Community GIS* interface should be made as easy and accessible as possible. The next chapter will focus on the interface design and the functionality incorporated.

Chapter 5: GIS User interface

5.1 Introduction

Geographical information systems are only as useful as the information that users of the system can gain from them. A major problem of most GIS related software is their user interface. If users agree on one issue, it is the lack of friendliness of GIS related software (Kraak, & Ormeling, 1996:174). With the community of Atteridgeville having limited exposure to computers and even less to GIS, a decision was made that a user interface should be designed, in such a way as to make the system more usable to the novice user. The user interface is the part of the system with which the user interacts. It is the part that is directly seen and thus "is" the system to the user. An interface encompasses the means by which people communicate and interact with the system to engage and guide what it does, and the means by which the system communicates its responses (National Research Council, 1997:3).

The importance of creating the interface enhances both the value of the system, as well as the value of the data to the user. Commercial GIS packages have different user interfaces, and many functional extensions have been added, increasing the complexity in using the system. The ease with which it is possible for a user to interact (to explore and use data) with GIS software is largely dependent on the "software interface", a combination of both the physical (active) and the visual (seeing and viewing environment). This may simply involve navigating around the system. More complex interactions might include entering a query to search a database, or viewing database records. However, beyond providing access to functionality of the GIS software itself, the same interface will ultimately be used as a viewing environment to interpret information (Green and McEwen, 1994:355). One of

the steps of the GIS implementation model is system design, specification and development. This chapter will primary focus on the development of the user interface used to make the *Community GIS* more accessible.

5.2 User interfaces

The human-computer interface is a particularly important component of a spatial information system (Cassettari, 1995:154). The user interfaces of current geographical information systems are dominated by the use of the eyes to interpret graphical output displayed on the screen, and the use of a single hand to provide computer input, typically by using a mouse. In some other information systems, a wide sensory bandwidth is used to exchange information. The limited requirements needed for interpretation and information input by users, makes it a potentially ideal system to be in communities with a high incidence of illiteracy (Sheppard, 1994:356).

The availability of technology-based information is a very important requirement for access to information at this point in time, and future technology development will undoubtedly give even more prominence to such information. However, many people do not have the aptitude, inclination or means to utilise high technological equipment directly or by themselves. These people need an interface to make the data available in a user-friendly and understandable format (Conradie, et al. 1994:13). It is important to understand that a system, such as a GIS, is not itself usable or unusable. Many factors may influence usability, from person to person depending on their abilities, willingness to try new ways of getting information, etc. To satisfy users from many different backgrounds, the interface must be aesthetically pleasing. Being able to use the GIS software, as a means to access data and information, and to analyse and visualise data are important.

The interface must therefore be user-friendly for the novice; in some cases assume that the user is not an IT specialist or computer literate; cater to

different levels of education (including people from different backgrounds) and allow for the different requirements of the users. Interfaces therefore have to cater for many different types of users – the novice, the knowledgeable, and both the frequent and infrequent user. Designing a user interface to suit all GIS users is a difficult and perhaps impossible task. Individuals may have many different characteristics; users have different backgrounds, requirements, expectations, and personal preferences. Furthermore, human perceptions are complex and are affected by many factors such as age, response time to stimuli, the brightness and saturation of colour contrast and depth. Humans also conceptualise and perceive geographic space in different ways and this will affects the way people interact with computers to solve spatial problems. In addition, 'on-screen' graphical displays may be difficult to interpret, presenting problems in the communication of the intended information (Green and McEwen, 1994:356). During the initial stages of the project, it was decided that people, especially illiterate, innumerate etc. need a user-friendly interface to make data available in such a way that it is easy to understand. A interface can shield the users from the powerful system, and can ultimately contribute towards the transformation of the GIS into real world tools for the everyday user (Poolman, 1993:104).

When designing a user interface, it is necessary to develop a model that can be used as a basis for customising the interaction between the system and the users in order for information to be presented and obtained as effectively as possible. In order to achieve this it is necessary to address the following:

- Users: Including abilities, preferences and the individual users' knowledge and skills.
- Resources: The input and output resources available, making it possible for the system to choose between different ways of providing or obtaining information.
- Activities: Address the specific and general activities of the user (Freiner, 1997:34).

Design considerations include adequate attention to individual differences among users, support of social structures, and provision of access by the elderly or illiterate (Shneiderman, 1990:1).

5.3 Types of user interface

There are three main types of user interfaces namely:

a) Command-driven interfaces.
b) Menu-driven interfaces.
c) Graphical users interfaces.

- Command-line interface is often characterised for being "user-unfriendly" because it requires users to remember long commands, special and often complicated syntax and unfamiliar technology; i.e. substantial training and memorisation is needed. Commands usually have been typed in at a command line prompt. Advantages of this type of interface are the potential for quick interaction.

- Menu interface (MI): There are numerous different types of menu-based interfaces, all variations on the same theme. Menu-driven interfaces help reduce user memory needed. Advantages include menu selection, which have been found to shorten learning curves and structures decision-making. Negative aspects include slowing down the frequent user and the consumption of screen space.

- Graphic user interface (GUI): Input and selection is via a combination of keystrokes and the use of a mouse or a pointing device. Benefits are that these types of interfaces are intuitive, reduce the learning curve, being easier to retain that textual representations, are graphically and aesthetically pleasing, and generate an overall feeling of user confidence. However, they have also a number of drawbacks, it is often difficult to find

enough different icon symbols, screen resolution may affect recognition and interpretability and icon interpretation will depend on the experience of the user.

- The trend in user interfaces is moving away from the entry of brief and user commands, or even the selection of choices from menus of options. Instead, the trend is toward an easy-to-use graphical user interface (GUI) that uses icons, bars, buttons, boxes, and other images (O'Brien, 1997:99).

5.4 Aspects important to interface design

The enhancement of the human-computer interface is a critical area to the development of integrated solutions. The interface has to address a number of issues:

- The type of users and their experiences:
  The users of the GIS software may vary from experienced to the recently trained user. Very experienced users often prefer command driven systems, since they are able to quickly and efficiently execute a series of commands (Cassettari, 1995:155). Less experienced users may, however, prefer a graphic user interface.

- The nature of the problem:
  In many GIS systems, there are various ways of solving a particular problem. An interface should be able to provide users with the information necessary to select an appropriate strategy.

- The need for different levels of interaction:
  Some functions within a system may be used frequently and will be well understood. Other functionalities will be little used and require a higher lever of support to the users.

- Issues relating to the visual impact of the interface and its usability.

  The importance of a visually acceptable interface to enhance the efficiency of the user cannot be underestimated. A common problem is the adoption of an icon-based system in which the individual icons are not intuitive and there are often to many icons for the size of the screen, leading to clutter and difficulty in interpretation (Cassettari, 1995:156).

5.5 Icons

It was necessary to consider which icons should be used, and it was decided that the icons should be simple and easily understandable and easy to remember. William Horton indicated in the Icon Book (1994:242) that the careful design of icons could bridge the barriers of language and culture. He said that well designed icons could:

- Reduce translation: The more you communicate visually, the less you must translate. Clearly designed icons reduce the amount of text that must be translated and reduces the chance of incorrect translations.
- Simplify learning: A good icon is easier to interpret and remember than a label in an unfamiliar language (Horton, 1994:242).

Until better education improves reading skills, clear and simple icons can give poor readers access to a computer system. Icons can help by:

- Reducing absolute dependence on text.
- Helping those with limited reading skills.
- Adding another channel to overcome reading disabilities (Horton, 1994:6).

It could be expected that users that are completely computer illiterate may not understand what icons are for and what their functions are. It is expected that these users should be trained and helped by the information counsellors of the Information Centre. The icons used in the *Community GIS* interface was

kept simple and to the minimum to facilitate easier learning of the icons and their functions.

5.6 Interface Design: ViewMap

The customisation of a geographical information system for a particular context of use is a major characteristic of GIS (Medyckyi-Scott and Hearnshaw, 1993:98). The principal need is to develop a style of spatial analysis that the users of GIS can use, feel comfortable with, and believe in. End-user friendliness and ease of comprehension need to be built into both the methods and the software from the beginning. The customisation would allow individual users to select their own operating strategy, choosing between menus, icons or commands.

When designing the interface for a disadvantaged community like Atteridgeville and Saulsville it is important to keep in mind that the interface must be user-friendly for the novice, in some cases assume that the user is not computer literate, cater for different levels of education, including people from different backgrounds. It was decided that the educational level of the users, as well as their previous experience or lack of experience of computers, might be overcome through the use of a customised graphic user interface.

The user interface designed for the HSRC by Southern Cross Geosystems and Calisto Software and called ViewMap. Since the *Community GIS* project added value to existing HRSC projects in the area, the interface was designed for specific HSRC projects as well as with the interface requirements needed for this study in mind. ViewMap was made available is a simple-to-use viewer of maps and spatial information. It has been developed in such a way that at the first level, maps and database information can be viewed. At the second level, more sophisticated tools such as zooming,

panning, measuring distances, data queries, changing languages, switching on map layers, examining summary statistics and printing are available.

ViewMap was designed to simplify GIS as far as possible, while keeping the data secure and facilitate access to as wide a spectrum in the community as possible. ViewMap would capitalise on the ability to use trans-lingual icons and multiple language interfaces. Data is very secure in ViewMap in that novice users cannot change the database, with that many of the difficult to understand functions usually found with geographical information systems have been excluded in the customisation.

The residents do not have to make the relevant maps of the area since these are pre-created. This way the users need only select an appropriate map, according to their needs. The interface contains the ability to change the working language to any of the official languages found in South Africa. This was done to give the users of the *Community GIS* the ability to use the software in their own language.

Fig 5.1 is an indication of what the ViewMap interface looks like when it is opened for the first time. In order to keep the interface simple, the user has only two icons that can be selected. The first icon gives the user the ability to select a map, while the second icon allows the user to install data. The ViewMap software is designed to be of use in different situations, not only for use in the *Community GIS* project. In the *Community GIS* the user only need to select the 1st option, since the data will already be installed and ready for use. In the right side of the screen there are three empty boxes, where the following is indicated: **Topic, Region** and **Map.** As previously mentioned, the community database is structured in such a way that it is possible to distinguish between businesses and cultural, educational, health facilities, etc. This was done in order to be able to call up a map regarding each of these topics as can be seen from the screen below. In order to select a topic the user clicks on the *Map* icon. As soon as the icon is selected the *Install data*

icon disappears, leaving only the one option available to the users, reducing the possibility of further confusion.

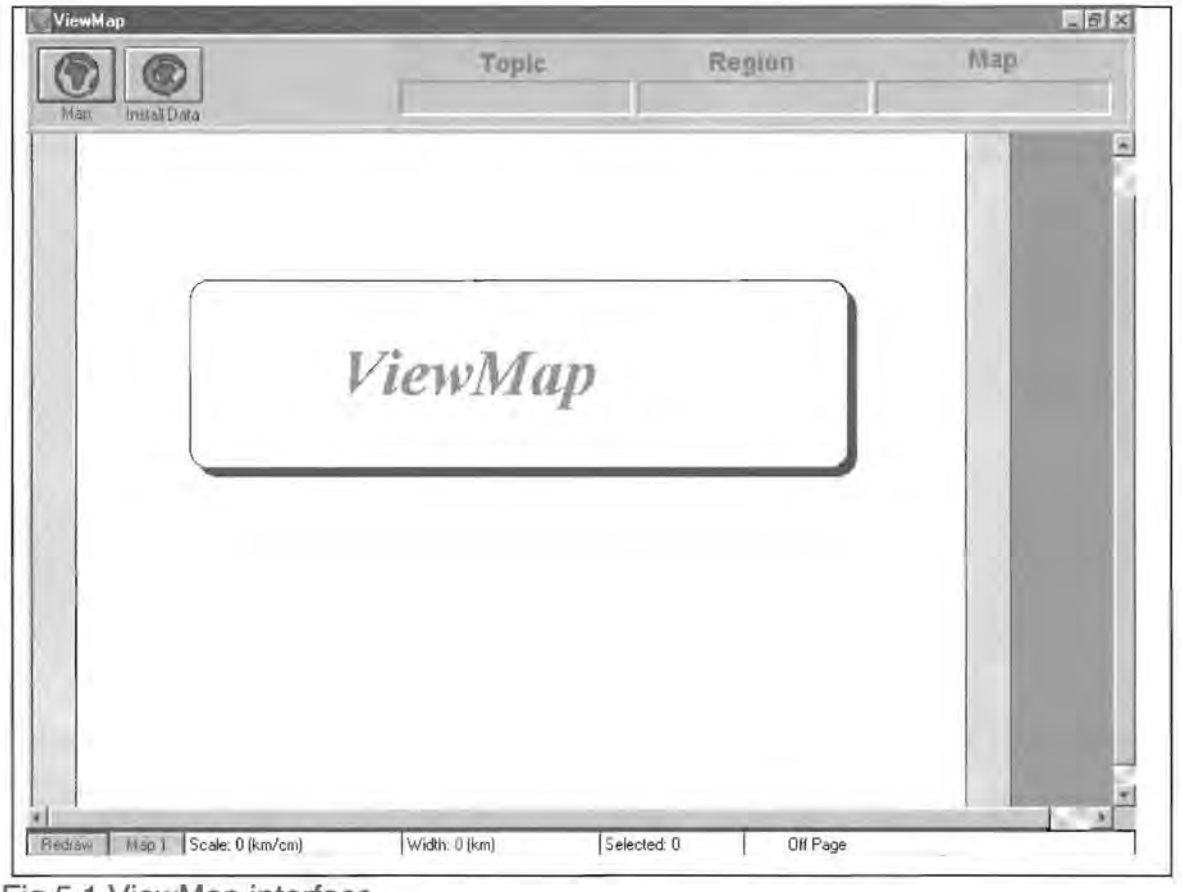

Fig 5.1 ViewMap interface.

During this process the user is required to select a topic for which more information is needed. The users can only select one topic at a time. If the user needs information about the locations of education facilities, the user must select Education from the presented list, as indicated in Fig 5.1. Clicking on the relevant topic with the mouse makes a selection. As soon as the topic is selected, it will be indicated in the Topic box, at the top of the screen. Another icon appears on the left corner of the screen appears, this is the *Go Back* icon presenting the opportunity to the user to change his/her mind and go back to reselect another topic.

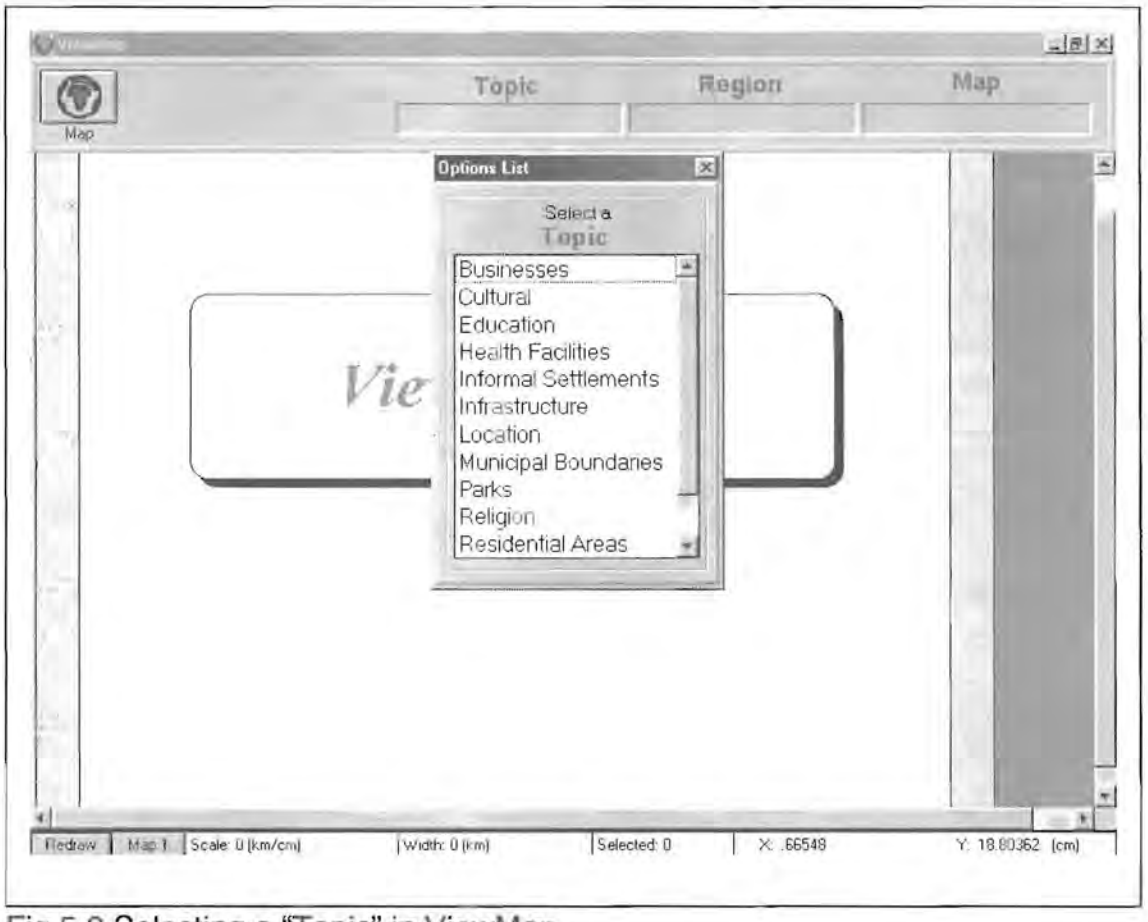

Fig 5.2 Selecting a "Topic" in ViewMap.

When the region has been selected, another box appears on the computer screen (See Fig 5.3) requesting the user to indicate for which region (area) information is required. Reasons for the request for an area will be discussed in a later chapter.

Once the region of interest to the user has been identified, it is necessary for the user to indicate what Map his or she is interested in. The map option reveals an option to refine his/her needs, for example if they are interested in Education facilities within the Oud Stad area, it can be specified in their options. The map option will present the following options from which a further selection can be made: Pre-primary schools, Primary schools, Secondary schools or Technical schools. As soon as the map option is selected or specified a map is presented as can be seen in the screen below. All the maps are structured in the same way, where they represent a specific topic,

region and map.

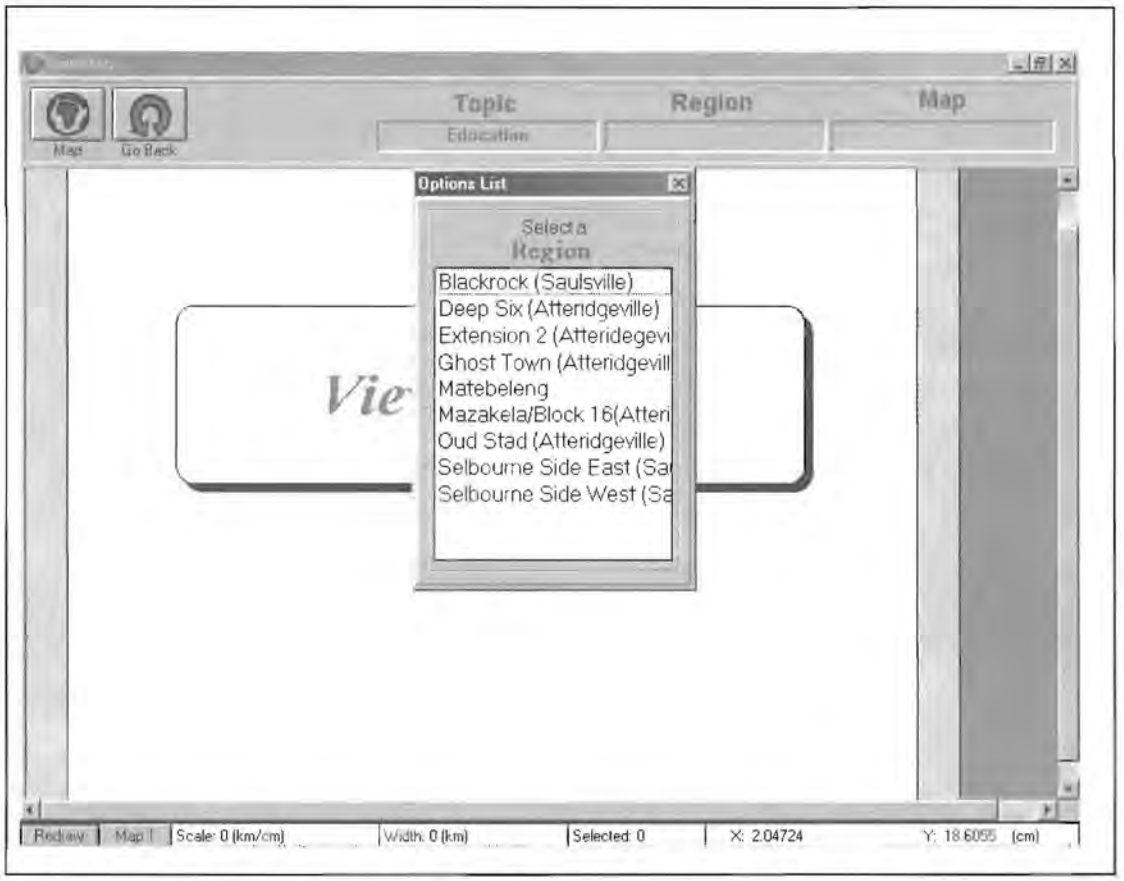

Fig 5.3 Selecting a "Region" in ViewMap.

In order to take the communities' limited exposure to computers into consideration it was decided to create maps of all different topics, for the different areas. The *Community GIS* then enables the user to select the appropriate pre-created map. The maps were pre-created with the intention to reduce the number of functions to be performed by the users in order to get a map of the topic and area of interest.

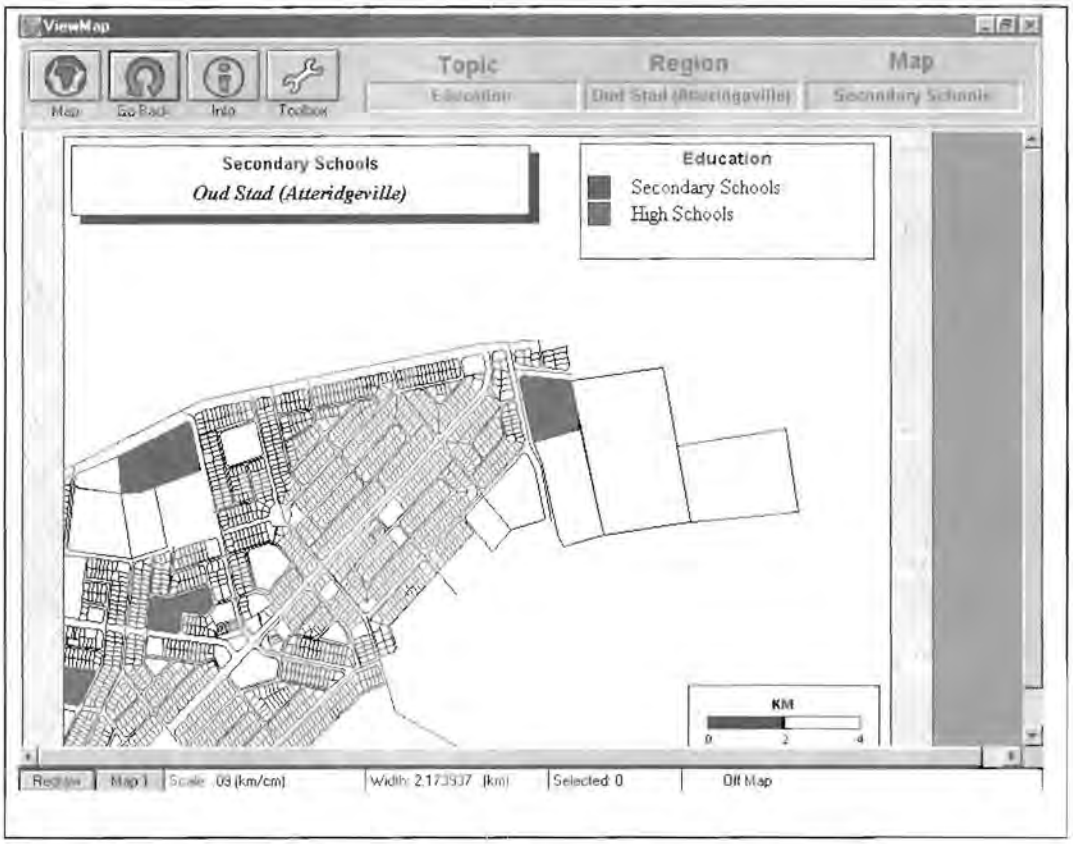

Fig 5.4 Selecting a "Map" in ViewMap.

As can be seen from the Fig 5.4, two additional icons have appeared at the top of the screen, there are now four icons in total. In order to try and keep the screen simple and uncluttered, a decision was made during the design process that icons would only appear when they are needed, and can be used. This was done to ensure that the users are not confused with icons that have no immediate use.

The information icon as seen in Fig 5.5 presents the opportunity to the user to obtain more information about a feature presented on the map. All the user needs to do is select the feature by clicking on it with the mouse. Once selected, the user clicks on the *Information* icon, which brings up a Map information box with a table that contains more information about the selected feature. The map interface contains four initial icons (Fig 5.5) that provides the user the ability to load a map, re-select a map and show additional information. With the fourth tool giving the userthe ability to enable additional

tools that can be viewed in Fig 5.6.

The four icons at the top of the screen have the following functions:

Icon	Function
	The *Map* icon is used in order to load a map.
	*Go Back* icon presents the opportunity to go back to a previous selection and to select a new map.
	*Information* icon presents the opportunity to get more information about a selected feature on the map.
	The *Toolbox* icon gives the user the option to display a toolbox, with additional functions and tools.

Fig 5.5 Icons available in ViewMap.

In the Map information box four icons can be found:

Icon	Functions
	This icon presents the opportunity to the users to close the information window.
	Some users may present the need to be able to print information, This icon presents the opportunity to print to a default printer.
	Due to the size of some databases, it was seen as necessary to give the user the opportunity to *lock* selected columns. The column must be selected and the user clicks on the icon. When the user scrolls through the database, this column will remain seen at all times.
	The users may want to print the database, but not all columns may be of interest. The *Hide selected column* icon presents the ability to the user to temporarily remove columns that are not of interest.

Fig 5.6 Icons available to manipulate database query results.

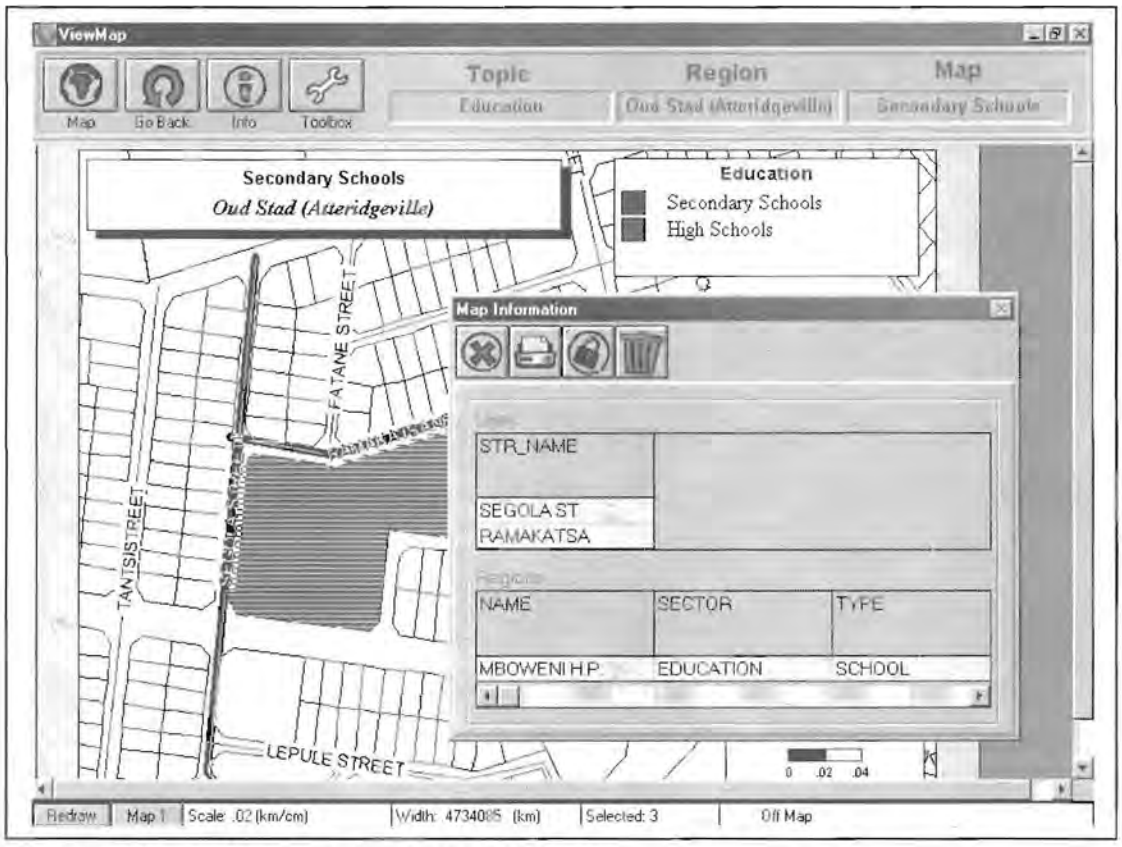

Fig 5.7 Information about selected features.

If the users selected the stand of a school, and selected the street above the school as well as to the left of the school, the information icon will present the street names as well as the name of the school in a database format to the user, as can be seen in Fig 5.7. This way information from two different layers can be selected and displayed at the same time. The selection is shown on the Map Information screen in database format. The users can modify this screen through the use of icons, which allows the users to lock or remove columns within the database, before printing the database. These functions allow the users to take the information he/she has gathered home. Software limitations only allow the column headings to be eight characters long. This may lead to some level of confusion since the users may not always understand the abbreviations that are being used to describe the column.

Another limitation of the *Community GIS* is that it gives the user the ability to change the language through which the query is done, but the results of the query in a table format remains in English.

The fourth icon that appears at the top of the screen is the *Toolbox*. In order to facilitate the more advanced use of the *Community GIS* it was deemed necessary to allow the user access to more advanced functions (other than just calling up a map). In order to keep the interface as simple as possible, the toolbox can be called up when it is needed.

Within the toolbox the following functions can be found:

Icon Function	Icon	Icon Function
Pointer tool can be used to select features on a map. **Zoom-in tool** enlarges the view of the map. **Pan tool** moves the map to view an area currently outside the area of view. **Find tool** finds a feature by name or location. **Language tool** give the user the ability to change the language of the interface. **Layers tool** gives the user the ability to change layers or add layers on the map. It presents a list of layers on the map **Create thematic map**. This tool gives the user the ability to create a thematic map.		**Measure tool,** is used to measure the distance between two or more points. **Zoom-out tool**, is used to make the view of the map smaller. **Previous view** tool shows the second to last maps that were viewed by the user. **View entire map** tool displays the entire map. **Print tool**, prints the map as it is seen on the screen. Prints to the default printer. **Summary statistics**, gives statistics of the selected objects on the map. Objects can be selected with the **Pointer tool.** **Advanced query tool,** presents the user with the ability to make more advanced queries.

Fig 5.8 Additional query icons available.

The **Pointer tool** (Fig 5.8) can be used to select objects to be found on the map area. If the user is interested in some functions and wants to have more information about it, the user can select those features by using the mouse and click on them. Users may also see the need to measure the distances between different features e.g. a residential address and a school. This is possible by using the **Measure tool** (Fig 5.8), which allows the user to

measure the distances between multiple features. The maps, as initially displayed, may not be the scale that the users want. In order to enlarge or reduce the size of the map, the users can use the **Zoom-in or Zoom-out tool** (Fig 5.8), which will present to the users the options of re-scaling the map to a usable size.

The **Pan tool** gives the user the opportunity to move the map around on the map area. It may be necessary for the users to call up this function, when a area of interest is just outside the mapping area. This gives the user the ability to shift the map into the right position. If the user made changes on the map, and realises that he/she would rather have the previous view of the map, the user can make use of the **Previous view tool** (Fig 5.8) that will take them back the previous view that was displayed in the map window. Some users may want to look for a specific business, school etc. In order to facilitate this a **Find tool** (Fig 5.8) is available to the users. This tool enables the user to type in the name of the feature that is needed. Once this feature is found, it is displayed to the user on the map window, as well as a table window. Users are given the ability to view the entire map of the area, by selecting the **View entire map tool** (Fig 5.8). Because of the space and speed problem encountered with the computer (to be discussed) the maps were split into different areas within Atteridgeville. If the users called up a map of Oud Stad (an area within Atteridgeville) the view entire map tool will show the map area of Oud Stad only and not the entire Atteridgeville/Saulsville area.

As was discussed previously, geographical information systems rely on layers to represent information of different types. Thus roads will be found on one layer, stands on another layer etc. The *Community GIS* works exactly the same. The **Select layer tool** (Fig 5.8) gives the user the ability to make layers visible or invisible. This can be of use when the map is very cluttered, with too much information presented on the same map. The user can then make a decision, as to what layers can be made invisible, in order to make the map easier to use and understand.

The **Summary statistics tool** (Fig 5.9) is also found within the same toolbox. This icon can be found where a user can access the statistics on selected objects. The nature of the *Community GIS* does not contain any information on which statistics can be applied (e.g. no population data, etc.). This feature was, however, included into the interface, to allow it to be applied to other projects and not to limit the ability to incorporate statistical information into the *Community GIS,* such as population census information.

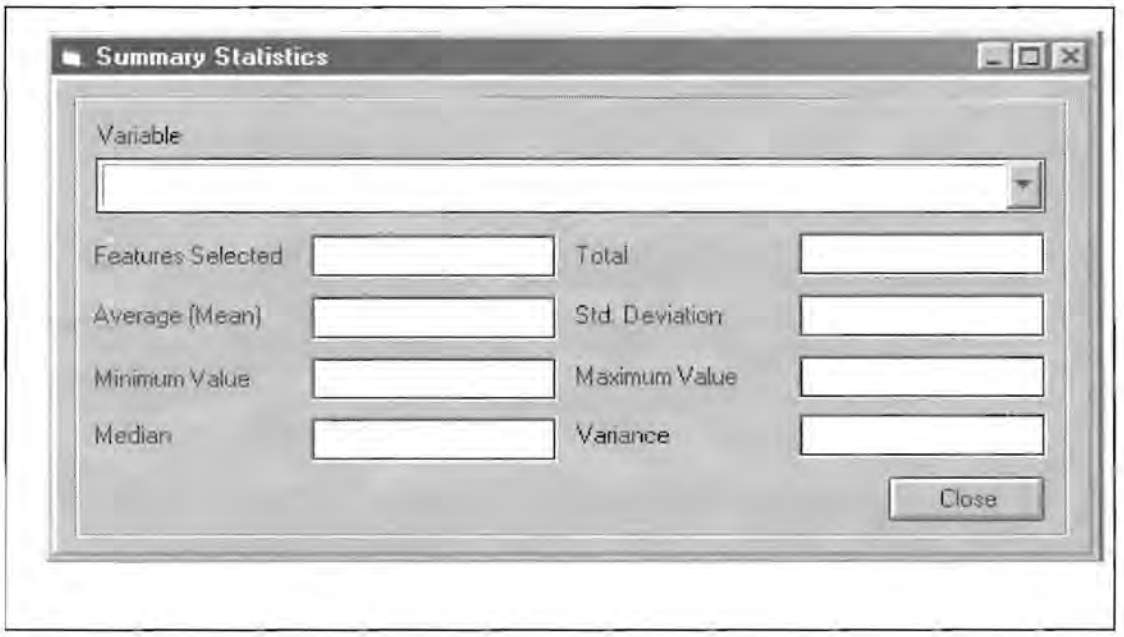

Fig 5.9 Summary Statistics.

Another function available to the user is the **Create Theme map tool** that presents the user with the ability to create a theme on the map, based on different variables represented in the database. The users will be able to indicate all education facilities according to the type of facility in a colour scheme. **The Advanced Query tool** is done in the same way as a new theme map is created. Both these functions are achieved by typing into the boxes (See Fig 5.10) the variable that the theme or query is created, the operator that the user wants to use and the value that is specified. If the user want find Pelindaba High School the variable will be Name, the operator (=) and the value will be Pelindaba High School. If the user wants to select all churches in the area, the variable will be Sector, the operator (=) and the Value will be

churches. This will then create a theme, or select the churches in the area, depending on whether the user is making a theme map or doing an advanced query.

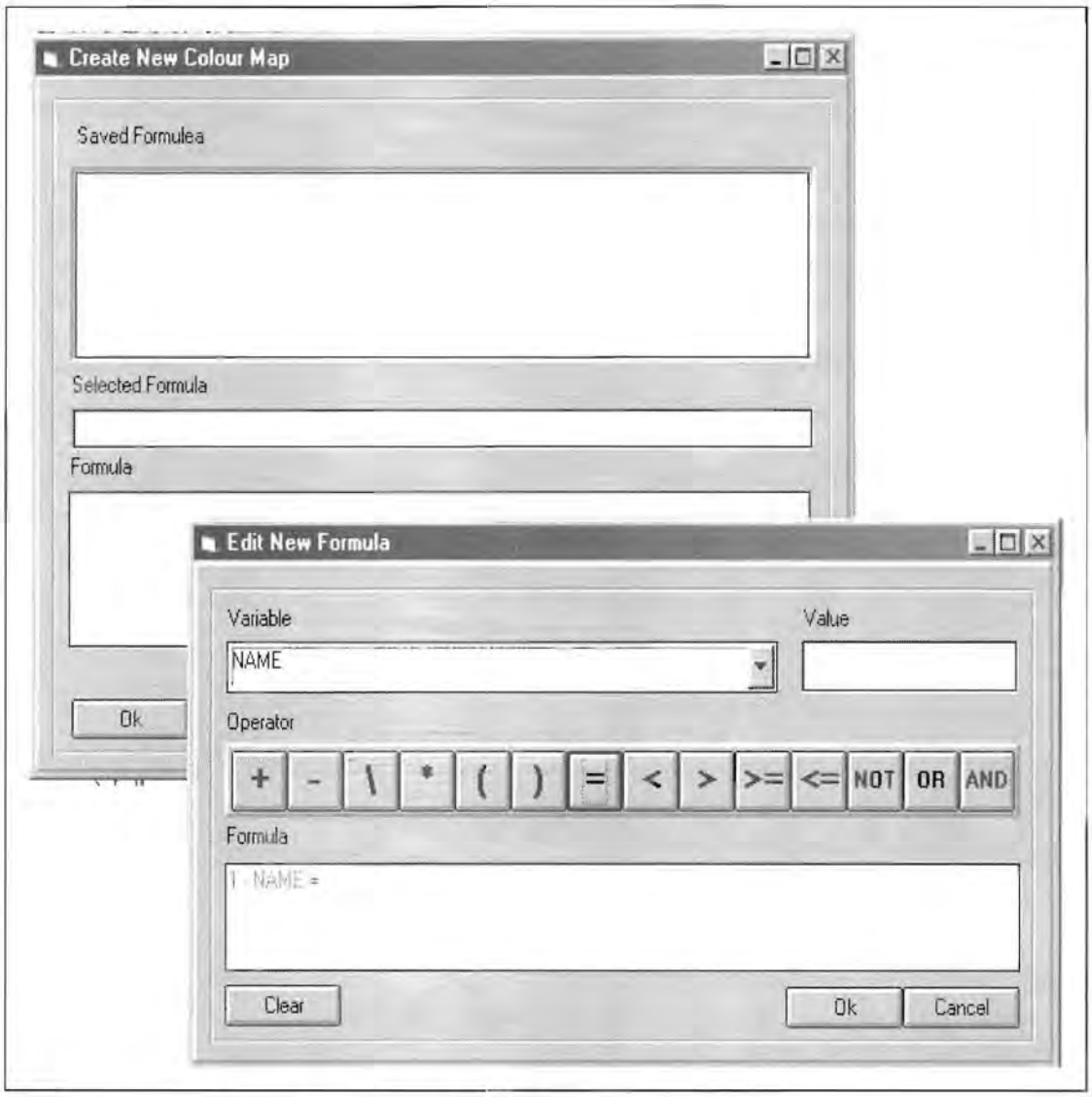

Fig 5.10 Create Map function in ViewMap.

Linguistics is one of the major bottlenecks in the introduction of information technology to developing communities. Most of the programs and manuals are written in English, while most of the users have a limited understanding of the language (Poolman, 1993:96). As was established in the Community needs survey of 1994, the community indicated that they prefer information in English, with only a small part of the community preferring it in their own

language. With the large variety of languages spoken in Atteridgeville, as is the case in most parts of South Africa, the interface was designed to give the user the ability to change the working language thereof. The user can change the language of the interface into any of the 11 official languages of South Africa as indicated in Fig 5.11. Once the language of the interface has been changed, all icon descriptions, drop-down menu's etc. are changed into the specified language, as can be seen from the screen below. Making the *Community GIS* available in all the official languages, should make the system usable to the majority of people, without excluding users based on language.

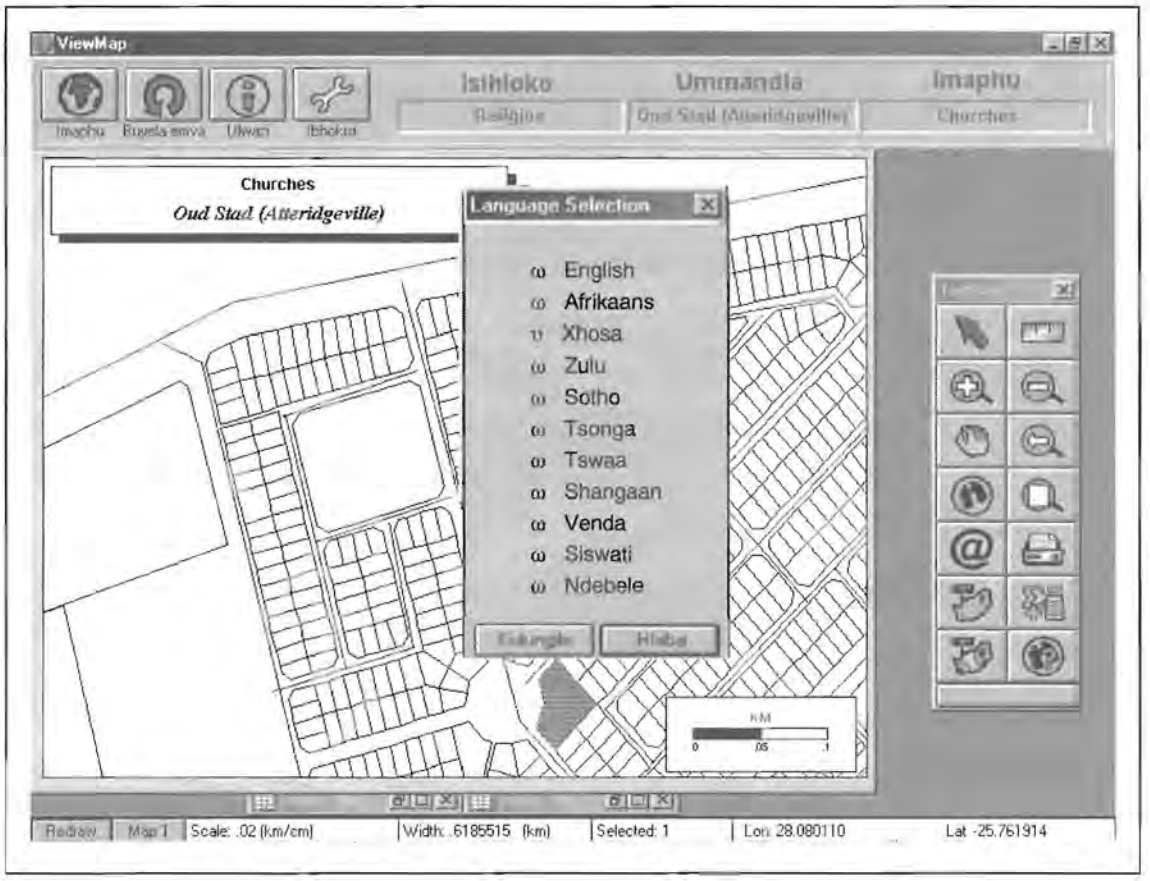

Fig 5.11 Language function in ViewMap.

5.7 Summary

The user interface design activity focuses on the interactions between the

users and the computer systems. The human-computer interface is a particularly important component of the spatial information system. Albaredes (1992) states that "traditional technology driven GIS are clearly showing limitations in terms of their usability". This leads to the development of more user-friendly GIS products, which allow even the more casual users to make use of geographical information systems. Within this project there is however, an even less experienced spectrum of users wanting to use the GIS. Some of these users are computer illiterate, as well as being illiterate, and have a fear for computer technology, making the design of the human-computer interface very important.

The design of a good GIS software interface acceptable to the majority of users is undoubtedly a difficult task. Building user interfaces that fulfil in the needs of all users, rather than a privileged subset can be a difficult task. User interfaces should adapt to the needs and abilities of the individual user and situation. An adaptive user interface would take into account factors as diverse as the users education, skills and previous experience. The system should in the end be empowering, its users should be able to accomplish more with it than without it, and should feel a sense of satisfaction in doing so.

The user interface design focuses on designing the interactions between users and computer systems. After the information has been gathered, the database designed and the user interface created, it was time to implement the *Community GIS*. The implementation process involved testing and training activities. It involved training of users in the operation and use of the new system. Thus, implementation is a vital step in ensuring the success of a new information system.

Chapter 6: System testing and evaluation

6.1 Introduction

The question arising, is what information can be considered most important and how priorities should be determined. It is often difficult to imagine how information would be used most effectively, given the capacity and needs of most of the potential users (Abbot, 1996:10). All that GIS has done is to provide a new format for the portrayal of data. With a GIS being such an alien concept to most of the residents of the community, it is not possible to determine the potential of the system through a survey or questionnaires sent out to the community prior to implementation. Due to the community not previously exposed to a geographical information system, and their limited contact with computers, it would be difficult to explain the concept, and depend on their judgement regarding the feasibility of such a system. The systems have to be made available to the community, in order to determine the success and failures of using geographical information systems for the supply of information.

The final phases in GIS implementation include installation and operation as well as testing and reviewing the system. Information systems have many stakeholders with differing views and assessment methods of user performance: system designers, system experts, management etc. Users find software unfriendly. Performance of information systems usually measures either the competence of the users seen from the system perspective or it measures the relevance of the retrieved materials as seen from the users perspective. Relevance, user satisfaction and competence all point to the performance of the information system. These are traditional measures of user performance or system effectiveness (Gluck, 1995:446). With the *Community GIS* it is expected that the system performance can be measured

by the accuracy, and time spent on tasks as the users' needs are met. Evaluation provides the means of assessing the quality, quantity, effectiveness and efficiency of actions done by the system as well as the degree of fulfilment of requests made by its systems and its users.

During system evaluation and testing the factor of ergonomics is very important. Ergonomic factors ensure that computer hardware and software are user-friendly, that it is safe, comfortable and easy-to-use. Thus, factors of performance, cost, reliability, technology, ergonomics, and support should be used to evaluate a system (O'Brien, 1997:406). The information counsellors of Legae La Kitso, with their experience and knowledge of the community played an important role in evaluating the system.

6.2 Performance

Within this study it was important to determine whether a *Community GIS* has any positive contributions to make to a community like Atteridgeville. It was thus important to not only test the systems' performance, but also the user competence level, relevance and the maintenance of the system. During the testing process the study tried to determine the system's ability to assist users in solving their information needs while testing the users ability to perform tasks. Through the testing process it was possible to determine to what extent the questions of the users were answered. Some definitions of performance:

- Execution of an action.
- Fulfilment of a claim or request.
- Ability to perform.
- Manner of action to stimuli (Webster's 9th Collegiate Dictionary, 1989).

Relevance, user satisfaction, and competence all point to performance of the information system. They are all traditional measures of user performance and system effectiveness (Gluck, 1995:446). Each of these aspects is crucial to understanding performance of information systems. They provide the

means for assessing the quality, quantity, effectiveness and efficiency of actions by the system and the users, as well as the degree of fulfilment of requests made by the system and the users. The performance of the system is tested to assess the users' ability to perform tasks and the systems' ability to assist users in solving their information needs.

6.2.1 Technology and technological problems

The community is poor and therefore the Community Resource Centre is dependant on sponsorships, and funds from external organisations for their survival. For the purposes of the project, a computer was made available for this project. It was however not possible to obtain a new computer, and an older used computer was all that was available. Due to the financial constraints of the Community Information Resource Centre, as well as the financial constrains of the project, this computer had to suffice. During the project this was stolen, including the Information Centre's telephone, fax machine and other equipment initially obtained through donations. The HSRC made another computer available, this computer had similar specifications as the initial computer used.

Due to the data being largely spatial and the database covering the entire area, problems were experienced during the performance testing of the database. With the spatial nature and large volumes of data, as well as an older generation computer the *Community GIS* was performing much slower than was anticipated.

Since it was not possible to obtain a newer generation computer to solve the problem, a decision was made to split the informal and formal areas, as well as the database, into smaller data sets. Initially the data for Atteridgeville and Saulsville were subdivided, but this did not improve the performance of the system sufficiently. The question that arose was how to split the spatial data, since the areas could not be subdivided into smaller official suburbs. The

information counsellors pointed out that the residents of the community have different names for areas, as if they are separate suburbs. A decision was made to subdivide Atteridgeville and Saulsville according to these smaller unofficial "suburbs". Fig 6.1 indicated how the different areas in Atteridgeville and Saulsville was divided. The data set of the informal areas was also subdivided into the three informal areas; Phomolong, Jeffsville and Concern.

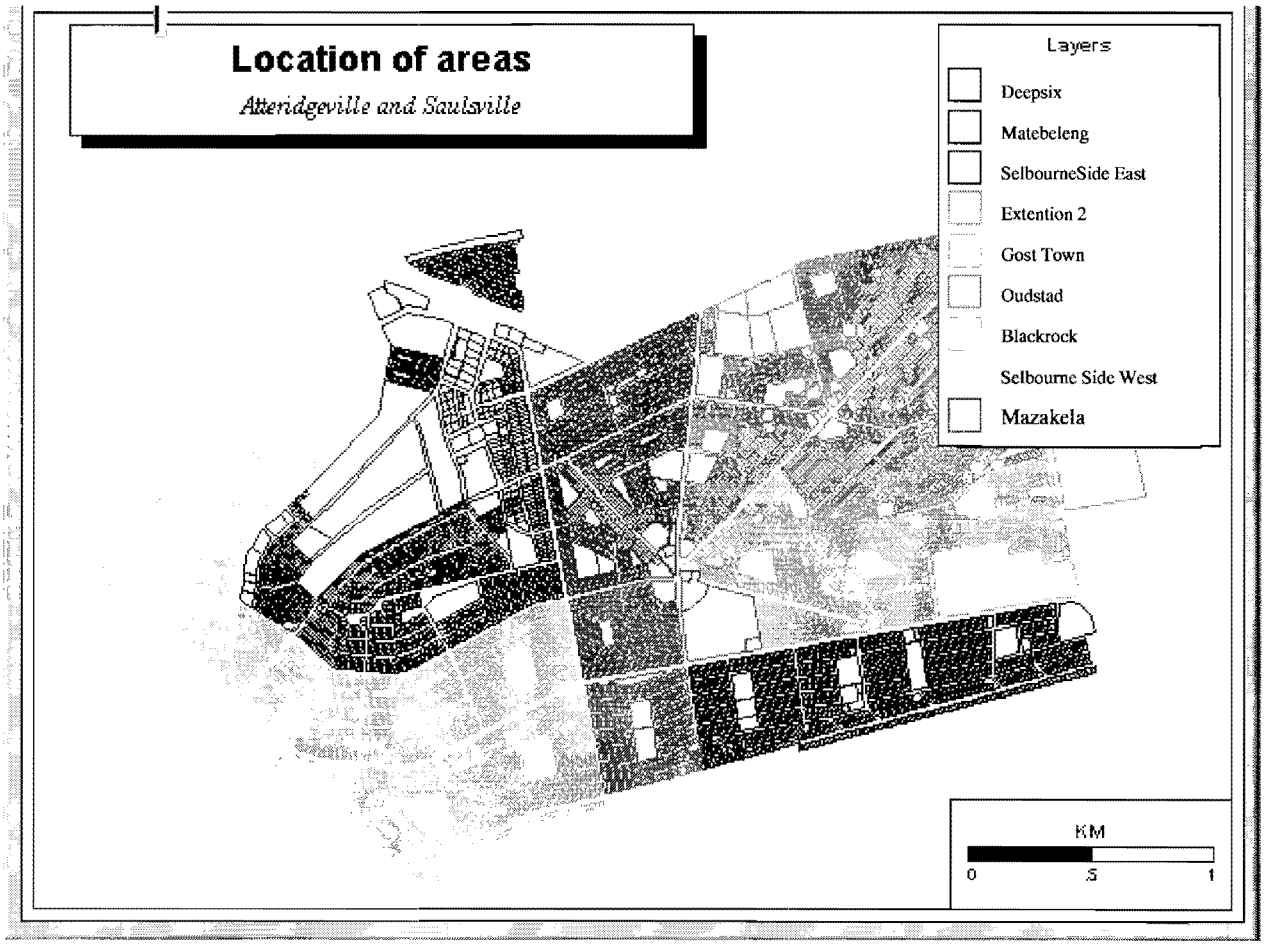

Fig 6.1 Map indicating "suburbs" in project area.

6.3 User competence

When using the *Community GIS* the user competence could be described as twofold. To a large extent the users were the information counsellors of the

Community Information Resource Centre called Legae la Kitso, using the system to answer questions of residents of the community. This was also the case where the community residents are not capable or willing to use the system themselves. Some residents were, however, willing to user the system, without previously having encountered the *Community GIS*. In these cases the ability of the users to understand the system was tested.

It was necessary to test the system in both circumstances, since that created the opportunity to test the experienced and regular users as well as the inexperienced first time user. This gave indications of the problems being experienced by both types of users.

6.4 Relevance

Users usually judge the relevance of the system according to the quality of the retrieved materials, item by item at a particular point in time as well as within a particular user context. Even a system with a 100% recall and precision may not satisfy the user. This may occur for a number of reasons:

- User mishandles the retrieved data or materials.
- The user is unable to articulate the need.
- The user is unable to evaluate the retrieved items.
- System does not contain all the needed information.
- The system data is arbitrarily organised relative to the needs of the user.

When we look at the reasons stated above, it is clear that there is a lack of consensus for the precise definition of the construct of relevance and user satisfaction.

6.5 Maintenance

A suitably trained user like the Information Counsellor of the Information

Resource Centre should do the physical management of the Community GIS. This user should have a grasp of the functions, priorities and needs of the community, and should be qualified to deal with people's considerations on user requirements. One of the most critical factors effecting the successful implementation of the *Community GIS* will be the quality of the database, the attitudes of the people involved, and the pace at which the residents and potential users of the system will be able to learn the system interface. Considering the speed at which organizations grow and the speed at which businesses start up and close down, the maintenance function may prove to be an essential function within the system.

ViewMap (see Chapter 5) as the interface used in the *Community GIS* does not allow the user to update the database in any way. The interface was designed on behalf of the HSRC, which indicated that they do not want an update function included and that they will handle all updates on behalf on the Community Centre, through a process of opening the database in AtlasGIS. Since the interface is designed with another application in mind it was decided that the update function should be excluded. For the purpose of using the ViewMap interface in the *Community GIS*, the lack of maintenance and update functions was initially not considered a major obstacle, especially since the HSRC indicated that update could be done as required. The lack of the update function also gave the opportunity to test the system with inexperienced users without the risk of accidental changes in the database.

It was found that the communities like Atteridgeville are developing and changing quite rapidly, creating the need to update the system regularly. With the information counsellors gaining more experience in the use of the system, it became clear that there is a definite need for a limited updating and data editing function, through which the system can be updated, if and when necessary. The updating and editing functions will help keep the database up to date, especially where new businesses were established, changes to telephone numbers etc.

There are two methods to ensure that the *Community GIS* is kept up to date:

- Train the information counsellors in the AtlasGIS package, giving them the ability to make the updates that would have been done by the project manager or HSRC. This will ensure that the *Community GIS* can run independent from an external organisation or,
- Change the ViewMap interface to allow the updating and editing of the database when necessary. One thing should be recognised, and that is that updating is inevitable to keep the system relevant.

The second option of including the update facility in the ViewMap interface, seem to be the easiest of the options, since the information counsellors will only need to be trained with the added facilities, and not on an entirely different system.

6.6 System testing

In order to test the system according to criteria as discussed (performance, user competence, relevance and maintenance) three testing methods were decided on:

- Observation.
- Interviews.
- Questionnaires.

6.6.1 Observation

Observation is a process of evaluation the system, though watching a person perform activities to learn about the system. The *Community GIS* was placed within the Community Information Resource Centre, and the users of the system were therefore observed at this site with the information counsellors present. While observing the users of the system it became clear that the users depend on the information counsellor for guidance and help.

Observation of the users showed that the inexperienced user seemed reluctant to master the working of the *Community GIS* on their own. This tendency may occur due to the limited exposure that the resident of the community has had to computer technology. Inexperienced users experience problems with the working of the keyboard and mouse and needed the information counsellor even before being exposed to the *Community GIS*. It became clear during the observation that the users are dependent on the information counsellor for guidance regarding the new technology as well as the system. The younger generation of users were more willing to try and find out themselves how the system works, without needing as much help from the information counsellors.

Due to the funding limitations experienced during the project, it was not possible to buy the most up-to-date computer equipment and therefore depended on donations. The equipment sourced to make the *Community GIS* available, were thus older and not as fast as would have been the case with new equipment. During observation of users it became clear that the users get easily frustrated and bored with the system when it takes too long to produce a result on a query. This phenomenon may be due to the user's lack of experience with computer technology, making it difficult for the user to anticipate what is going to happen, and therefore understanding why it may take some time to achieve the desired results. The reason for the *Community GIS's* negative impact on performance of the system is due to the speed and capabilities of the computer not being able to handle the graphical aspects of the *Community GIS* optimally. When using the *Community GIS*, users were scared of making mistakes, and were not willing to try something they were not shown by the information counsellors.

Another factor that has an impact of the usefulness of the *Community GIS* is the icons used during the interface design. Although great care has been taken in the selection of the images on the icons to make it universally understandable to users of different language groups, the users seem not to

understand the significance of what the icon represents. This may be due to the limited exposure to computers and limited understanding of the functions of icons in the system and that the icons represent functions that the system is capable of. Once the icon has been explained to the users, it seemed that users could easily recall the use of the icon. Once again the younger generation of users understood and remembered the icons better then their older counterparts.

Observation of the users showed that the way that Atteridgeville and Saulsville are split up into the "suburbs" called Oud stad, Deepsix, Gost Town etc. were causing confusion amongst the users. As indicate in a previous chapter, Atteridgeville and Saulsville are split up into smaller areas to increase the performance of the system (Fig 6.1). As previously discussed the areas are unofficial, creating some confusion due to the users having their own perceptions of the nature of the areas. In some cases the users wanted to find their residential stand on the system, they would be under the impression that he/she lived in Deep Six, while in the system it is classified under Gost Town, leading to unnecessary confusion for the user, and causing the search to be repeated for another area. It would have been better if all the information could have been kept in the same database, reducing the need for area specifics. This problem can, however, be solved with adequate computer facilities, that can handle the database size and graphics, eliminating the need to split Atteridgeville/Saulsville and the informal areas into smaller areas.

Within the *Community GIS* interface different levels of functions are available to the user. It was observed that the users have their own way of looking for information in the system. Instead of looking for their residential property by typing in the street name, they would rather look for a nearby business, and then use the PAN tool to find their stand. When some users encounter problems with the system, instead of asking for help from the information counsellor they would rather leave. This can happen because users are

scared to ask for help or they lost interest, because the *Community GIS* is not making sense to them. Through observing the inexperienced users during the use of the system, it became clear that the information counsellors would need to facilitate the process of information retrieval. The residents were observed to be constantly referring to the information counsellor for help. It was thus decided to draw on the experiences and opinions of the information counsellors to evaluate the *Community GIS* as a system through which information can be supplied to the community. Observation allowed the observer to view the use of the system, and how users go about obtaining the information. These, as well as observing which functions were being used most and how the system was being used differently by the experience and inexperienced users as well as differences between the way the system was used by literate and illiterate users. The users were observed using the system within the Community Information Resource Centre located in Atteridgeville. This ensures that people with real needs are observed using the system.

6.6.2 Interviews

The information counsellors were interviewed during an informal interview session. Although some predefined questions were asked the interview were primarily unstructured, in order to give the information counsellor the ability to give their opinion on the value, problems and abilities of the system. The information counsellors were interviewed separately and not given the opportunity to discuss the content of the interview with each other. This way their individual opinions could be determined. Both of the permanently employed information counsellors were interviewed individually, as to determine the individual's opinion without him/her being influenced by the other.

Although the project was discussed in detail with the information counsellors before the commencement thereof, the interviews revealed some misconceptions by them. These information counsellors were involved since

the beginning of the project, but although they were aware of the nature and aim of the project they imagined the *Community GIS* to be a tool not only for the supply of information, but also a tool for the prevention of crime, as well as a way to obtain technology through which they could help with the development of the community and the administration and running of the community resource centre. Both the information counsellors indicated that they expected the *Community GIS* to help the community, but they also expected that it would have a positive implication for the Information Centre in the form of increased funding and being able to sell the service. From the interviews it became clear that both the information counsellors reacted positively towards the project mainly for what it could offer the resource centre rather than what it could offer the users and the community.

The information counsellors saw a potential for improving the image of the Community Information Resource Centre as well as helping it financially. The counsellors hoped to be able to gain financial stability for the Centre, through making the information available to developers, businesses etc. at a nominal fee. From the interviews it became clear that the positive attitude regarding this project was influenced, not only by the possibility of gaining another way of supplying information to the community, but also the possibility of getting another computer for the Information Resource Centre.

Regarding the performance of the *Community GIS*, interviews indicated that the performance of the system proved to be frustrating and negatively affecting the success if the *Community GIS,* since the system took too long to answer the queries and users left or became frustrated. This tendency was also revealed during observation of the users' behaviour. When asked, the information counsellors acknowledged the fact that when there are no users around, they would close the *Community GIS* program, in order to use the computer for administration purposes etc. This increased the occurrence of users having to wait for the *Community GIS* to start, which due to the limitations in computer performance could take long, resulting in increased

frustration of the users.

The information counsellors indicated that most of the problems being experienced during the use of the *Community GIS* was related to the computer illiteracy of the majority of the users. They indicated that the users want to be able to use the *Community GIS* by themselves, but they don't know how the mouse and keyboard work. Before these users could use the system, they had to be introduced to the technology because:

- They have never worked on a computer before.
- They don't know how the mouse works and.
- The user has a fear of the technology due to not being exposed to it before. The training that the information counsellors would give the user was:
    - Introduction to the computer.
    - Basic typing skills and introduction to the mouse.
    - Show user the *Community GIS* and show them how to specify choices and how to make queries.

The information counsellors believe that the *Community GIS* helps the residents understand the computer technology better, since they get a visual response (map) to their query. They are of the opinion that the visual way in which the information is being displayed makes it easier for the residents to understand what is happening on the screen, since the ability to read is less important. It is, however, difficult to establish how successful this way of introduction to the computer technology is. Due to the easy-to-use interface of the *Community GIS* it is possible that it can serve as a good way of introducing and demystifying the technology. Residents with no previous exposure to a computer can thus learn something about a computer and how the mouse and keyboard operate on a system that does not allow for any editing, making it impossible to "break" it, while getting a visual output during the learning process.

The information counsellors indicated that users always asked them questions about the use of the *Community GIS*, and needed to be introduced to the system since most of the users showed lack of knowledge regarding the working of the mouse and keyboard. They were of the opinion that a touch screen would be better. The information counsellors indicated that the touch screen would have been better, since the working of the system would not be dependent on understanding the mouse and keyboard. It is however necessary to take into consideration during a project such as this one, what the cost of the touch screen is, as well as the ability to keep this kind of technology secure.

The information counsellors indicated that the *Community GIS*'s ability to supply information in the users' language of choice is an advantage. They did indicate that it would have been better if the associated databases could also have been in the specified language. As the system is at present, it allows for the user to navigate through the system by using a language specified by them, but as soon as a query has been made and the resulting database appears, database headings were in English. It would be easier for the user if the database column headings were also in the preferred language.

While observing the usability of the *Community GIS* it was established that the inexperienced users did not understand the icons and what they represent. The same observation was made during the interviews with the information counsellors. The information counsellors indicated that the icons make sense to the computer literate users, but that the inexperienced users have difficulty in understanding the meaning of the icons. This would thus also impact negatively on a touch screen that would focus primarily on the use of icons. According to the information counsellors it would be an advantage if the system could "say" what the meaning of an icon is when the mouse is placed on it. This would bring together the symbol represented on the icon, and the meaning thereof. This would increase the usefulness of the system, while decreasing the input needed from the information counsellor.

One of the information counsellors indicated that he would like other types of information included into the *Community GIS*, like information that shows how the area obtained its name, as well as more information regarding the communities, population etc. The other information counsellor indicated that it would have been better to include into the database the name of the owners of the residential stands as well as their telephone numbers. This was a question that was asked on the questionnaire, and most of the respondents indicated that they would not want this kind of personal detail available to everybody, largely because of security issues.

The system was designed not to allow any editing of the information. It would have been better if some level of editing was available giving the ability to the information counsellors to add names and addresses where the users wanted their details included into the database.

6.6.3 Questionnaires

Questionnaires were given to the information counsellors to be used, as a way to determine the success of the *Community GIS* in solving the information needs of the community. Where possible the questionnaires were filled in by users of the system. In cases where the user was illiterate the information counsellor asked the questions to the users and filled in the questionnaire on their behalf (See Appendix 1).

The nature of the questions covered in the questionnaires were:

- A brief description of the query.
- If ViewMap could be used to answer the query.
- If not, why could it not be used (options supplied as to why ViewMap could not be used).
- Suggestions on how to improve the *Community GIS*.
- What additional information is needed on the *Community GIS*?

- Indicate functions used to answer the query (options supplied in the questionnaire).

Questions were focussed primarily on the nature of the needs of the users, where the queries have been answered. This was to determine whether the *Community GIS* was being used for, and the problems that were being experienced. Queries varied from simple requests like:

- The location of the residential property, and location of cr•ches and nursery schools, in order to assess the viability of starting a cr•che at that home.
- Searching the database for the addresses for all churches, in order for invitations to be send out to the relevant churches.
- Location of open spaces that could be used to start a new business, and supplying the relevant street address and stand numbers.
- Location of social welfare offices, hospital garage etc. was some of the most common queries by the residents of the community.

In some cases the residents heard about the *Community GIS* and came to see if their business was on the database. In case where it was not, they requested it to be put on.

From the 50 questionnaires that were completed it became clear that the display and find tools were used the most by being used 85.71% and 71.43% respectively during queries done by users, or on behalf of the user by the information counsellors (See Fig 6.2). The printing tool was not added to the graph since the option to print was not available to the users. The printer was stolen during the project, and due to financial constraints could not be replaced. It was however indicated on the questionnaires that the users would have liked to print the results of their queries, both the maps and tables.

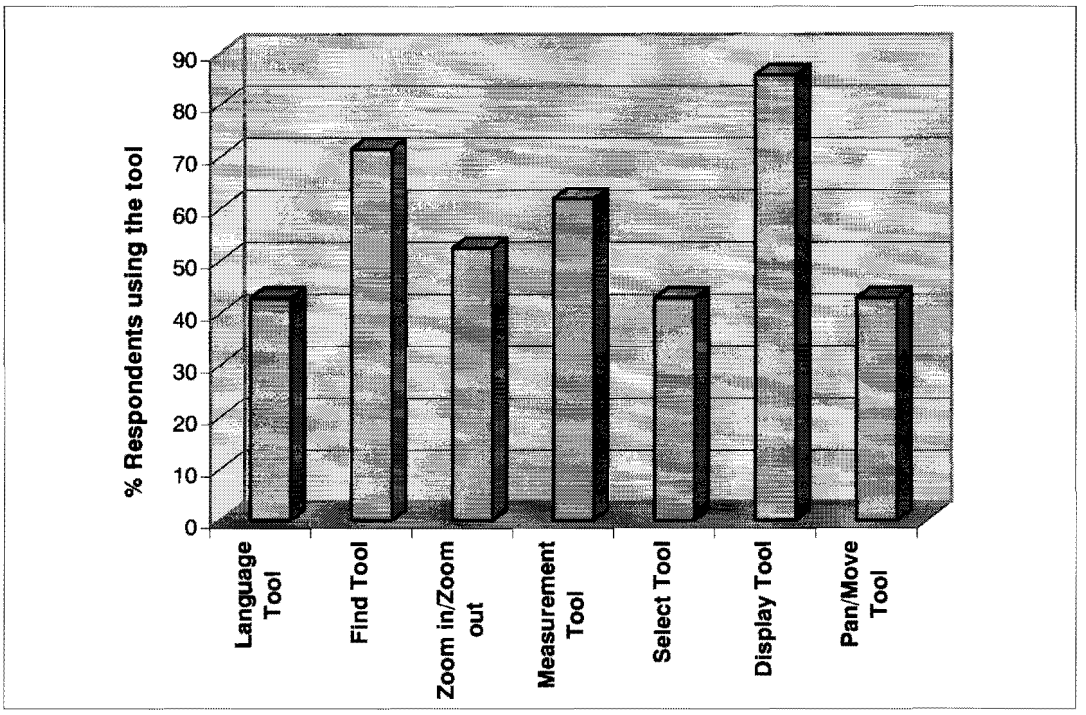

Fig 6.2 Tools used most by users.

According to the questionnaires most of the queries by the users could be answered successfully, with some queries being completed on behalf of the users by the information counsellors. Recommendations were asked from the users, as to how the *Community GIS* could be made more useful. Suggestions by some of the users indicated that it could be useful to include the surnames and telephone numbers of the residents living at each stand within the area. When this question was asked to the people visiting the Information Resource Centre the majority of residents indicated that they would not like their details displayed in the system for security purposes. Even though most people were reluctant to have their details displayed, the system should allow those users wanting their data on the system, to be added. Other suggestions varied from formal training on the *Community GIS* to placing in more accessible kiosks, everywhere in the formal and informal areas.

6.7 Summary

The project was initiated to determine whether a GIS can be used as a way to supply information to communities, and whether a *Community GIS* has any positive value for the community, and what the value of it was to the community. It is necessary to test the success of the system through an evaluation process. Through observation, interviews and questionnaires it is possible to test the system according to its performance, user competence, relevance and maintenance. This evaluation process would make it possible to determine the successes and failures of the system, as well as to enhance the understanding of the factors that make the system usable or unusable. This evaluation process indicated that users kept on referring back to the information counsellor for guidance. A decision was thus made not to only have interviews with the users, but also to the have interviews with the information counsellors, and to use their experiences regarding the community, community information needs and the system to evaluate the *Community GIS*. The knowledge that the information counsellors have with the supply of information, and their background of the community being residents of the community themselves, is a valuable asset to be used in evaluating the system. The queries handled by the information counsellors did not always have a spatial aspect for which the *Community GIS* could be used. The information counsellors did however use the opportunity to show the *Community GIS* to the resident to make them aware of the service available, as well as to see how they react to the system.

Chapter 7: Results & Recommendations

7.1 Introduction

The general aim of the research has been to evaluate the applicability of geographical information systems in the supply of information to disadvantaged communities. This has been pursued through looking at the nature of this type of information system, through analysing the needs of an identified disadvantaged community, and finally through the evaluation of the viability of a *Community GIS.* A geographical information system focussed on a specific community was created in such a way to facilitate the supply of information within that community.

Once the information is available in a GIS database, the information can be manipulated to provide answers to spatial queries not possible with other systems. However, due to the limitations in the community such as illiteracy, computer illiteracy, etc., the successful adoption of the technology depends on the existence of support structures like the information counsellors involved in the Information Resource Center, as well as an easy to use interface making the system more accessible to the inexperienced user. The *Community GIS* should not only take into account the needs of the community, but also the limitations experienced by the potential users.

Within the study it is necessary to determine whether a *Community GIS* has any positive value to the community. To establish the value of the system, it is necessary to test the system according to the performance, user competence, relevance and maintenance. These were measured through the use of a questionnaire, observation and interviews with users and the information counsellors.

7.2 Results

The results of the questions as posed in Chapter 1 is as follows:

7.2.1 Can technology enhance the understanding that illiterate and innumerate people have of their own community? And can this type of technology reduce the need for literacy in information supply?

The *Community GIS* proved to be of use to both the literate, illiterate and innumerate users within the community. The *Community GIS* presented an opportunity to many residents to obtain information in a format that they could understand. The *Community GIS* proved less successful in helping the illiterate users in their process of obtaining information. They were not always capable of doing the queries themselves, since the *Community GIS* still required some functional literacy from the user to be able to make advanced queries. Though not all the illiterate users could use the system themselves, some were able to complete the basic functions within the *Community GIS*. Where needed the information counsellors acted as an interface between the system and the illiterate users when problems occurred or assistance was required. The output produced by the *Community GIS* was in either a map format or a table. The illiterate users were for the most part spatial literate in that they could read a map and understand the output. In cases were they had a query as to where something is located; they could find it on the map. This was mostly done through the information counsellor.

The *Community GIS* has the ability to enhance the understanding that the users have of their community, in that they can have a look at it in a spatial context. This allows them to see where services and businesses are located, which would otherwise have been impossible. This can help them in decision-making regarding what businesses, schools etc. are the closest to their home, maybe impacting on travelling costs etc. and when making decisions when establishing a new business. The technology reduces the need for literacy on a very elementary level when using the system, but for the more

advanced queries and understanding of the database the need for literacy is still as critical as ever, especially when considering the output in a table format as well as during the execution of more advanced queries.

7.2.2 Are barriers built around technophobia of such a nature that GIS has little or no potential in such communities?

The *Community GIS* showed that the users and residents of Atteridgeville/ Saulsville and the informal settlements have limited access and exposure to computers and related technologies. This was expected due to the nature of the community, being poor and disadvantaged. Most users showed uneasiness when faced with this new technology, and a reluctance to use it without the presence of the information counsellor. The inexperienced user seemed reluctant to try and master the *Community GIS* without any help. During the evaluation of the *Community GIS* the younger users proved more willing to experiment with *Community GIS,* only relying on the information counsellor when experiencing difficulties. Their older counterparts relied more on the information counsellor right from the beginning, requiring more guidance and they requested explanations and training of the system.

Although most users have limited exposure to any type of computer technology, they are willing to use it and want to understand more about the possible advantages that it can have for the community. Problems experienced that were directly related to the technology, were users' inexperience with the workings of the mouse and keyboards, not understanding how the mouse and keyboard can be used to enter commands. The information counsellors played a valuable role in explaining the usage of these, helping the users to overcome their initial reluctance to use the system. Once the technology has been explained, the users seemed to overcome their initial fear of the technology and proved more willing to try things themselves. Although technophobia played an important role in the usage of the *Community GIS,* it can be overcome through a little guidance

from the information counsellor, or other members of the community that have previous experience with technology of such a nature. A minority of residents proved reluctant to use the *Community GIS* and chose to use another way of obtaining the information, either asking the information counsellor, or obtaining the information from a neighbour or friend.

7.2.3 Under which condition (if any) can GIS reach beyond the realms of the technology elite?

It is possible for GIS to reach beyond the realms of the technology elite. As is the case with the *Community GIS,* GIS can be made available to people with limited access to computer technology either through the information counsellor or the interface. The conditions under which it can be done, is by making it accessible as a kiosk within a community and by using technology like touch screens, and have support personnel in place that can help users that are experiencing problems. The visual way, in which the information is presented, makes it understandable to a large part of the community.

7.2.4 Can users help themselves, or is there a need for the presence of information counsellors with knowledge of the system?

The users of the *Community GIS,* with their limited experience of the technology mainly depend on the information counsellors for guidance when using the *Community GIS* and related technology for the first time. The counsellors provide training to the users that showed an interest in using the system by them, and help users that needed information but proved reluctant to help themselves, or could not due to limitations like illiteracy or their fear of the technology. Most of the users experienced problems with the meaning of the icons that was used in the ViewMap interface. Although the icons were chosen in such a way to make them easy to understand, users didn't understand the use or meaning of the icon. The information counsellors were therefore needed to explain to the users the meaning of the icon, and what

happens when the icon is selected. Once this had been explained the users seemed to understand and remember the meanings and uses of the icons easily. With the limited exposure that the users have to computers, the presence of information counsellors seemed important. Users that had previous experiences with computers didn't need the information counsellor for guidance. Once the community is more exposed to computers, it should be possible that they could function without the constant presence of the information counsellors. The inexperienced users needed the presence of the information counsellors to facilitate the process of information retrieval.

7.3 Recommendations

Setting up a geographical information system is expensive and time consuming. When proceeding with such a project it is critical to obtain the correct technology, that can handle the spatial data, and large databases without problems. This will eliminate the need to split the databases as was required during this study, since this can lead to unnecessary confusion to the inexperienced user. Due to the lack of computers within the project the information counsellors can also be tempted to use the system for administration purposes, creating the impression with users that the system is busy.

The ViewMap interface was designed with the idea that the integrity of the data should at all cost be insured. This was done due to the limited knowledge of users of this type of technology. This, however impacted negatively on the database since requested updates by users could not be done immediately by the information counsellor. Although the integrity of the information should be protected, the information counsellors should have the ability to make the necessary changes, without being dependent on a external organisation for this type of support. One way of ensuring that the integrity of the data is maintained is by making update functions available only when the correct password is entered.

From the needs assessment that was done within the community, residents indicated that there was a need to obtain information regarding events and activities taking place within the community. It is therefore recommended that the system should be extended to handle hypertext and hypermedia functions available as a means of interaction with the user. This would allow users to access text, sound and images regarding the feature that was selected on the map, focussing on the interaction of GIS, hypertext and hypermedia.

7.4 Future research

Future research can be focussed on:

- The way in which GIS, hypertext and hypermedia can be combined to supply an information resource that is capable to supply users with a community resource facility focussing on all aspects of the community.

- How training can be supplied to members of communities to enhance the usability of systems like GIS, not only regarding GIS but related technologies that can enhance the lives of community members.

- Considering the results of this study, how GIS can be made accessible to an even larger segment of the community, testing touch screens, placement in kiosks et cetera.

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Glossary

CAD:

Acronym for Computer Aided Design. CAD software differs from GIS in that it can only create displays but cannot analyse or process database data (Antenucci, 1991:279).

Database:

Collection of interrelated information, usually stored on some form of mass storage system. A GIS database includes data about position and the attributes of geographical features that have been coded as points, lines, areas, pixels or grid cells (ESRI, 1998:3).

Geographic data:

Any information that includes a description of a location on or near the earth's surface (McDonnel & Kemp, 1995: 43).

Geographic database:

A collection of spatial data and related descriptive data organised for efficient storage and retrieval by many users. This database includes data about the spatial location and shape of geographic features recorded as points, pixels, areas, grid cells as well as attributes.

Geographical information systems (GIS):

A computer system for capturing, managing, manipulation, analysing and displaying data, which is spatially referenced to the earth (McDonnel & Kemp 1995: 43).

A geographic information system is a decision support system that constructs and displays maps and other graphics displays that support decisions affecting the geographic distributions of people and other resources (O'Brien, 1997: 291).

Global Positioning System (GPS):

A constellation of nine satellites originally developed by the United States Department of Defence as a navigational aid that has become available for geodetic control surveying. The satellites transmit signals that can be decoded by specifically designed receivers to determine positions precisely (Antennucci, 1991: 279).

Hardware:

Any tangible or physical device used as part of a computer system, including processing units that execute programs, auxiliary storage units that maintain data and programs, and peripheral devices such as terminals, plotters and printers (Antenucci, 1991: 282).

Icon:

Icons are small figures that look like familiar devices, such as a file folder (for accessing a file), a wastebasket (for deleting a file), or scissors (for cut and past operations) and so on. Using icons helps simplify computer use since they are easier to use with pointing devices than menus and other text-based displays (O'Brien, 1997; 64).

Information:

Information is data that has be refined and organised by processing and purposeful intelligence. People provide the purpose and the intelligence that produces true information.

Information Counsellor:

Individuals responsible for facilitating communications, delivering and interpreting information (where required), and doing whatever else is necessary to support the community and individual user every step of the way.

Information systems:

An arrangement of people, data, processes and interfaces that are integrated for the purpose of supporting and improving day-to-day operations, as well as fulfilling problem-solving and decision-making information needs (Whitten & Bentley, 1998: 11).

Interviews:

Interviews are a fact-finding technique whereby information is collected from individuals face to face (Whitten & Bentley, 1998: 350).

Observation:

A fact-finding technique a person either participates in or watches a person perform activities to learn about the system (Whitten & Bentley, 1998: 350).

Questionnaires:

Special-purpose documents that allow a person to collect information and opinions from respondents (Whitten & Bentley, 1998: 350).

Users:

A user is a person, or a group of persons, for whom a system is build. System users are those individuals who either have direct contact with an information system (e.g. they use a terminal of PC to retrieve data) or use information generated by the system (Whitten & Bentley, 1998: 58).

User Interface:

User interface defines how system users directly interact with the information system to provide inputs and queries and receive outputs (Whitten & Bentley, 1998: 590).

Legae
La Kitso

1. *Date:*
2. *Consultant:*

3. *Age of client?*
4. *Gender of client?*
5. *Address of client?*
6. *Brief description of query:*

7. *Was the query addequatly addresses?* *Yes/No*

If Yes.
How?

If No, Why not?

VIEWMAP:

8. *Did the clients needs involve a consideration of the spatial structure of the township?* *Yes/No*

If Yes. In what way?

9. *Was ViewMap used to answer the question?* *Yes/No*

If Yes. How?

If No. Why not? (indicate the appropriate)

a) System crashed/System not working
b) Power failure
c) Data not availbale
d) Client unable to use Viewmap - to diffucult
e) System takes to long
f) Illiteracy of client
g) Inumeracy of client
h) Inability of the client to interprate the maps
i) Reluctency by the client to use the computer
j) The way that the maps are spit up into the different ares makes use and understanding difficult ?

10) *Suggestionas as to how ViewMap can be made more User-friendly in order to answer the query.*

11. *What additional data/information is needed on Viewmap?*

12. *Functions to be added to ViewMap.*

13. *Functions that was used to answer the query. (Indicate the appropriate)*

a) Language
b) Find
c) Zoom in
d) Zoom out
e) Ruler/Measure
f) Print
g) Select
h) Display of data in the table
i) Pan/Move map
j) Other