THE APPLICATION OF GEOGRAPHIC INFORMATION SYSTEMS (GIS) TO PROPERTY RATES ADMINISTRATION IN LAGOS MAINLAND, NIGERIA

By

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CERTIFICATION

This is to certify that the thesis: THE APPLICATION OF GEOGRAPHIC INFORMATION SYSTEMS (GIS) TO PROPERTY RATES ADMINISTRATION IN LAGOS MAINLAND, NIGERIA.

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is a record of original research carried out

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DEDICATION

To the glory of the Almighty Father in Heaven;
He alone is the God and Source of
Wisdom, Knowledge and Understanding.

To the blessed memory of my late Mother
Madam Gladys Nwaeruru;
Though unlettered, yet my first and best Teacher.
Mama, the torch you lit will never die

To the blessed memory of my late Stepmother
Madam Adaogu;
She started calling me "University man" when I was just six years old.
Mama, the dream has come true.

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ABSTRACT

Property rate is one of the major sources of internally generated revenue to the Lagos Mainland Local Government (LMLG). However, presently property rate is poorly administered in the area. This is largely as a result of certain human, logistic, technical, environmental and data/information management problems. Consequently, the Local Government loses a significant amount of money, since the annual revenue yield from property rates is often notably low.

In this research a computer-based system - PRAGIS (Property Rates Administration Geographic Information System) - was developed with a view to tackling the identified problems. Basically, the development of PRAGIS was hinged on the premise that property rates administration cannot be effectively and efficiently carried out without adequate use of relevant, accurate, timely and comprehensive geographically referenced digital information. Developing PRAGIS involved two broad tasks namely (i) gathering of relevant spatial property data from cadastral maps and aerial photographs and non-spatial property data from Valuation files, and (ii) developing a computer-based GIS to capture and manage property databases.

The techniques used in this research were found to be potentially useful for enhancing property rates administration in the following areas:

a) Proper acquisition and handling of accurate, comprehensive and up-to-date spatial and non-spatial property information.

b) Quick production and updating of reliable tax maps.

c) Reliable, quick and comprehensive valuation of rateable properties.

d) Intelligent and accurate budgeting of expected annual revenue from rates.

e) Timely provision of reliable information on the number, location, composition, distribution and payment status of both tenements and ratepayers.

f) Quick preparation and dispatch of Bills (Demand Notes), Warning Notices and Sealing Notices to deserving ratepayers.

g) Timely monitoring, detection and recording of significant changes in the property stock.

Based on the research findings, it is strongly recommended that for the administration of property rates to be smoothly conducted, and for the annual revenue yield from rates to be remarkably improved, the Lagos Mainland Local Government should urgently adopt some policy and technological reform measures. The various processes of property rate administration need to be precisely defined and a technology such as GIS which can easily integrate and manage both spatial and non-spatial property records should be implemented. However, more research needs to be done on the feasibility and viability of adopting a GIS for rates administration in the study area and beyond.

CHAPTER ONE
INTRODUCTORY

1.1 BACKGROUND OF STUDY

Tenement rate (also known as property rate or tax), is the most promising singular source of internally generated revenue to Local Government Councils. However, for tenement rate (and indeed any other type of rate) to yield high revenue it has to be properly administered. Proper administration here entails ensuring adequate geographical coverage in the discovery of rateable tenements, full identification of each tenement, accurate and equitable valuation of tenements, accurate rate-setting, early preparation and dispatch of bills to ratepayers, early and comprehensive collection of revenue, proper management and constant updating of rating information .

For rates to be properly administered, having a comprehensive, accurate, timely, and easily accessible reservoir of geographic or spatial data(along with their associated attribute data), is inevitable. This should be so because property taxation is largely a spatial activity, and as such, most of the data needed are spatial in nature.

However, the mere availability of a rich reservoir of geographic data would not necessarily ensure proper administration of tenement rates. The data must be managed in a well-organised and efficient manner. This therefore demands putting in place a suitable system or device for geographical data acquisition and handling. For the system to be said to be suitable -- that is, effective and efficient -- it must have the capacity and capability of being used to easily and accurately capture, edit, store, retrieve, update, query, manipulate, analyse, display, and output property data in various formats, and it has to do all this objectively and at a cheaper and faster rate. The suitable system of handling property records for taxation should also be flexible and dynamic as to be able to easily accommodate the frequent changes and uncertainties that often characterise the tenement rating landscape.

Currently, the administration of property taxation in Nigeria is done manually. But this manual system is very ineffective and inefficient. Consequently the yield from tenement rates in the country is usually ridiculously low. In most cases, not up to 50% of the expected annual revenue from rating is realised (Dillinger, 1992). The manual system of rates administration is fraught with a lot of flaws. For instance, the system is highly subjective, hence a significant degree of fairness and equity in tenement valuation is hardly attained. Also the manual system is often characterised by omissions and discrepancies; in some cases the appraisal of some tenements is either deliberately or inadvertently left out. Hence, records of such tenements are never in existence in tax registers, and this translates to loss of revenue to Council. In the same vein, occasionally, either by an act of omission or commission, the same set of variables and rules for valuation and rate-setting, are never applied to similar buildings located within the same rating zone. This obviously amounts to discrepancy and injustice. The manual system of preparing bills is slow and this greatly delays the collection of rates. In most cases, Council collects rates largely in arrears. The storage of precious tenement records in physical files and registers is a clumsy arrangement. More often than not, these files are not properly arranged and this makes data retrieval a most cumbersome and discouraging task. Besides, the manual system of handling data makes the processes of data updating and processing quite tasking, especially where the quantity of data to deal with is so large and complex, as is often the case with property records.

Rating offices in the country hardly, if ever, use geographically located data in form of maps, in their daily operations whereas it is impossible to intelligently administer rates without geographical information. This failure of rates administrators to adequately use map information largely accounts for the observed poor rates administration in the country.

All the above-mentioned shortcomings of the manual system of managing information for property taxation, are mostly responsible for the poor performance of tenement rating as a source of revenue to the local government. Undoubtedly, the need for a better system which equally integrates geo-coded property data for the purpose of rating, is therefore most apparent. If a more powerful information management system such as the computer-based GIS(geographical information system) is put in place it will go a long way to easing the problems of rates administration in the country.

Various computerised database management systems exist. However, it is not all of them that are suitable for handling property-related data. Many attempts have been made and are still being made in the country, to computerise property rating using conventional database management software systems, accounting and spreadsheet packages such as dBase III+(or dBase IV), Oracle, C++, Lotus 123, Excel, and so on. This is rather an unfortunate development. These software packages, powerful and good as they may be for the purpose they were designed to serve, are not really appropriate for handling property data which are mainly spatial in nature. These conventional databases are not suitable for handling property databases, since they lack the capability to store and manage data with an extent in space and time, and this is the main distinguishing factor between spatial databases and conventional databases (Kainz, 1995, p258; Adigun, 1993).

If the database for property taxation is to be suitably handled, a system that has the capabilities to accept, organise, retrieve, query, manipulate, and output geographically referenced data and its associated attributes, is most ideal.

Geographic information systems(GIS) are specifically developed to handle geographical or spatial data. Like every other space-located activity, before property taxation can be very successfully implemented, an appropriate geographic database that is managed with a GIS, is considered quite imperative. There is need therefore to closely and objectively examine how a relatively new technology such as GIS, as opposed to the currently existing manual system, can be used to assist in the proper administration of tenement rates in the country; and hence, to determine the problems and prospects of implementing the new system in a developing country like Nigeria. By extension, and equally important, there is need to analyse the likely effect which the geographically referenced information generated using GIS, would have on the administration of rates.

The overall essence of this project, therefore, is to develop a GIS-managed property database management system that could facilitate the processes of gathering, storing, retrieving, manipulating, analysing, and outputting of information on buildings in the study area, to guide rates administrators in decision making and other operations.

1.2 STATEMENT OF PROBLEM

Some years back, a concerned observer noted that "a greater number of less developed countries(LDCs) feel the need for more revenue in support of their programmes for stabilization and growth. Many of them are also keen on redistribution (of wealth) by means of taxation.

"More often than not, administrative shortcomings are a bottleneck when it comes to realizing these objectives and making the tax instrument useful for this purpose. Why is this so, and what can be done about it?"(Muten, 1981).

That the yield from rates is always low in this country, is a fact that has often been severally and variously expressed. Poor administration has often been largely blamed for the observed low yield from rates in the country (Ntamere, 1982; Dillinger, 1992). Efforts have been made in some quarters to explain the true nature of the administrative problems bedevilling rating and some remedies have also been proffered. However, no effort so far has ever been made to systematically study and explain the role of geographical information in the administration of rates. This, obviously, is a serious oversight or omission, which perhaps derives from the ignorance of both scholars and rate administrators alike, of the importance of geographically referenced information in the successful execution of the rating system. Consequently, the rate administrators hardly integrate geographically located information in the execution of rates. To rate administrators in this country, the important thing is to collect rates; knowledge about the number, location and distribution of the rateable buildings is never accorded similar importance. But this is rather a great irony since without a thorough knowledge of the quantity, locations and distribution of tenements it will be impossible to collect all the revenue collectible. The failure of rating offices to fully use maps in their operations is considered a serious aberration which carries along with it unpalatable consequences.

The spatial nature of rates administration makes it quite imperative that a great deal of map data be used. Unfortunately, this important fact is hardly realised. Consequently, no conscious effort has been made to understand the type of geographical data needed for rating, the role of such data, the problems associated with the acquisition and handling of the data, and so on. As a result, rating offices in this country hardly collect and use geographically located data in their operations. Thus rates are administered without relevant maps. This act of negligence consequently deprives the rating offices the opportunity of administering rates as knowledgeably as they should. The overall painful, though avoidable, outcome is the low level of revenue often generated.

Apart from the failure of rates administrators to use geographical data, it has also to be mentioned that the manual technique of rates administration in this country does not so much encourage the gathering, management, processing, updating and application of geographical data. In reality, it is very laborious and quite cumbersome to manually collect, process, and manage geographical data, which presently exist only in analogue form in this country.

Also the existing sources, such as maps, from which the bulk of the spatial data for rating can be gleaned, have notable shortcomings that make them not too reliable sources of spatial data for rates administration. For instance, the Nigeria cadastral map series does not cover every part of the country, especially the rural and semi-urban areas. Thus, the cadastral maps cannot be relied upon as a source of geographical data for rating in those areas not yet mapped. Besides, the existing cadastral map series and some other relevant maps, are to all intents and purposes, too old; most of the information in them are very obsolete, hence unreliable. The last cadastral map series was produced in the 1960s(about three decades ago). But changes are constantly witnessed in the property market, especially in the urban areas. Certain land parcels which, for instance, were shown on the cadastral base map as vacant plots now have structures standing on them; some buildings shown on the map as 'uncompleted' have since been completed, whereas some others have been completely pulled down and reconstructed, just as some buildings built then and used for residential purpose have been converted either partially or completely to commercial buildings. These changes are quite significant as to be ignored. But unfortunately, they have actually been ignored since no new cadastral base has been produced to capture and reflect the current situation on ground. And for not making use of the current information about property location, distribution, quantity, characteristics, accessibility, and environment -- all of which a good cadastral or township map should show -- the tenement rates offices often lose a substantial amount of revenue annually.

For instance, the results of a recent State-wide survey reveal that the Lagos State government and all the twenty LGAs lose as much as two billion naira annually on tenement rates (Ogunleye, 1997). The survey further identified some of the factors responsible for such a gargantuan loss in revenue through tenement rates. The factors included inefficient and uncoordinated mode of collecting tenement rates, inability of the government to charge and collect appropriate rates, fraudulent practices on the part of the officials involved, over-valuation of some properties, lack of public enlightenment on the payment of rates, lack of knowledge of the exact number and types of houses and the rate at which buildings are springing up within the metropolis, and failure of government officials to promptly send notice for the payment of tenement rates to the landlords.

More of the problems of tenement rates administration are discussed in Chapter Three. Suffice it to state here that for rates to be properly administered a comprehensive, accurate, timely and well-managed property database is required. The provision of such database surely requires the use of modern means of acquiring and handling geographically referenced data, such as cartographic, remote sensing and geographical information systems(GIS) techniques. Although these powerful modern information technologies are currently existing in the country to some extent, they are not yet used in property tax administration. However, to adopt these technologies into our rating system it is necessary to study the problems, prospects and modalities for their operation. These technologies work well in some countries; but the geography, orientation, spatial reasoning, and GIS resources of Nigeria and Nigerians are different.

1.3 PURPOSE OF STUDY

Basically, the purpose of this study is to ascertain the nature, problems and potential role of geographically-referenced data(maps) managed with a geographical information system (GIS) in the administration of rates. Pursuant to the above stated cardinal purpose, the research strives to meet the following objectives:

(i) To identify rates administration problems which could be tackled using map information(geographically-referenced information).

(ii) To identify the specific geographical data, (and hence types of maps), needed for rating, and how cartographic and remote sensing techniques can be used to effectively collect such data.

(iii) To design and develop an appropriate geographical database managed with a GIS, for the purpose of maps production, data processing and reports generation for effective rates administration.

(iv) To make a comparative assessment of the manual system of rating and the computerised geographical information system.

(v) To identify the potential impediments to successful large-scale implementation of GIS for the administration of property rates.

1.4 RESEARCH QUESTIONS

In order to satisfy the various objectives and, hence, the ultimate goal, of this research, some specific pertinent research questions have been mapped out to serve as guidelines and to lead to a more in-depth investigation. The questions are:

(i) Why have rates administrators in this country not been using geographically-referenced information in form of maps, in the execution of rates?

(ii) What are the particular geographical data and maps, needed for effective and efficient rates administration? Are these data and maps available and if not how can they be obtained?

(iii) What are the problems currently associated with the manual system of rates administration especially in relation to the acquisition and handling of map-based geographical data for rating, and how best can such data be acquired and managed?

(iv) To what extent is an automated (GIS-based) technique of rate administration more effective than the manual method?

(v) What are the fundamental issues in developing and implementing a GIS-managed geographical database (for generating maps) for rating in Lagos Mainland LGA, and how can such issues be properly handled?

1.5 SCOPE OF STUDY

Every geographic information system (GIS) is designed to meet the information needs of some users. Thus the functions performed by the user, and hence, the information needed by the user to perform those functions effectively, control the nature and scope of every GIS.

The primary user of the present GIS being discussed here is the Tenement Rates Office of a Local Government. This Office is solely saddled with the onerous responsibility of administering property or tenement rates. Basically, there are about five main phases or processes involved in property tax administration namely, property discovery/identification, valuation, rate-setting, billing, and rates collection. Each of the five processes requires some specific information for it to be carried out. However, it is in no way out of place for two or more processes to require or share the same piece of information.

The GIS described in this work has therefore been designed such that it could assist the Tenement Rates Office in performing more effectively and efficiently, each of the five functions in property tax execution. However, as a purely scholarly endeavour, this project was initially conceived as a demonstration study. That is, the ultimate aim of the study was to investigate the relevance of map-based geographical information in rates administration and to ascertain the possibilities of implementing GIS for rates administration in a developing country such as Nigeria.

Being entirely concerned with managing property information for rates administration, the study is mute over some other aspects of property taxation. For instance, the legal aspects, and some policy issues such as decision to increase rates, defining the tax base, determining the percentage of the capital value taxable, etc., have been deliberately left out. Such issues completely lie outside the scope of this study. Again, the Property Rates Administration Geographical Information System (PRAGIS) developed in this study is not meant to assist local government in determining whether or not a particular property conforms to building zonal codes or by-laws. Moreover, the system is not capable of assisting in the legal establishment of parcel boundaries, since it was not developed for that purpose. Suffice it however, to note here that it is still possible to design a GIS that can assist Council in any of the above-mentioned aspects that are also somewhat related to property taxation.

The PRAGIS has been developed to handle information on the following major aspects of tenement rates administration, viz:

- Maintenance of property ownership records.
- Handling of information about the distribution and location (address) properties.
- Managing information on the physical characteristics (i.e attribute data) of properties.
- Managing rental and valuation information of each property.
- Maintenance of rates payment records.
- Managing geo-referenced data for generating, updating, revising and querying property tax maps for rates administration.
- Integration of graphic (map) and non-graphic (attribute) property data.

1.6 SIGNIFICANCE OF STUDY

It was Stamper(1973, p.14) who once wondered why "We take information for granted... There is little we can do without information. There is no organisation controlling the flows of materials and energy, or the work of people and machines which does not make elaborate use of information; so why has its study been neglected?"

Hitherto, to the author's best knowledge, no study on the relevance of map-based geographical data managed with a GIS for rates administration has been conducted in this country. Digital handling of geographic data is a relatively novel practice, at least in this part of the globe. As at now, though, the proliferation of personal computers (PCs) has just started gathering momentum here. Only large establishments such as some federal parastatals, corporate organisations, and some institutions of higher learning can lay a firm claim on any large-scale use of the computer technology. In the same vein, research interests and efforts in the use of computers in handling various types of data are only gradually picking up with research into the use of computers in handling a special type of data namely, spatial data, lagging far behind.

It is believed therefore that the present study will contribute in no small measure in underlining the often neglected inevitable position map-based geographical information occupies in the administration of rates in particular, and indeed other spatially-located projects and activities in a developing country as Nigeria. The study is equally significant in that as a more or less pioneer effort, it will go a long way in highlighting the problems, prospects and applicability of cartographic, remote sensing and GIS techniques in the collection, management and dissemination of geographical data for revenue generation in this country. This point is very significant especially when one remembers that these techniques were conceived and developed in regions with cultures different from that of Nigeria. As Kainz(1995) has rightly observed, language and cultural background, which invariably influence human understanding of space, play an important role in the way people design and use GIS as a tool. It is also for this same reason of cultural variations that technological innovations are hardly universal in nature. Thus, like empirical equations, technological innovations (such as GIS), cannot easily be transported from one country to another (Burrough, 1989). The reason for this is not far fetched. According to Simonett(1983) "The solutions which need to be implemented are, in general, dependent upon local conditions and must be compatible with the cultural environment of the country (i.e. the recipient country). This environment may be radically different from the source of the technology." Consequently, it is significant to note that the introduction of GIS or database concepts into developing countries which are culturally, socially, economically and politically different from developed countries, needs to be done with care, otherwise it can be an expensive or a frustrating process (Pathirana, 1992).

In addition to the above stated significance of this study, it is hoped that the overall outcome of the study will act as a fillip and indeed a take-off point for subsequent researchers in the field of study or similar topics. Undoubtedly, the final report of the research will add to the volume of literature available not only to students, but researchers alike, in the field of geography and related disciplines, in the area of GIS applications.

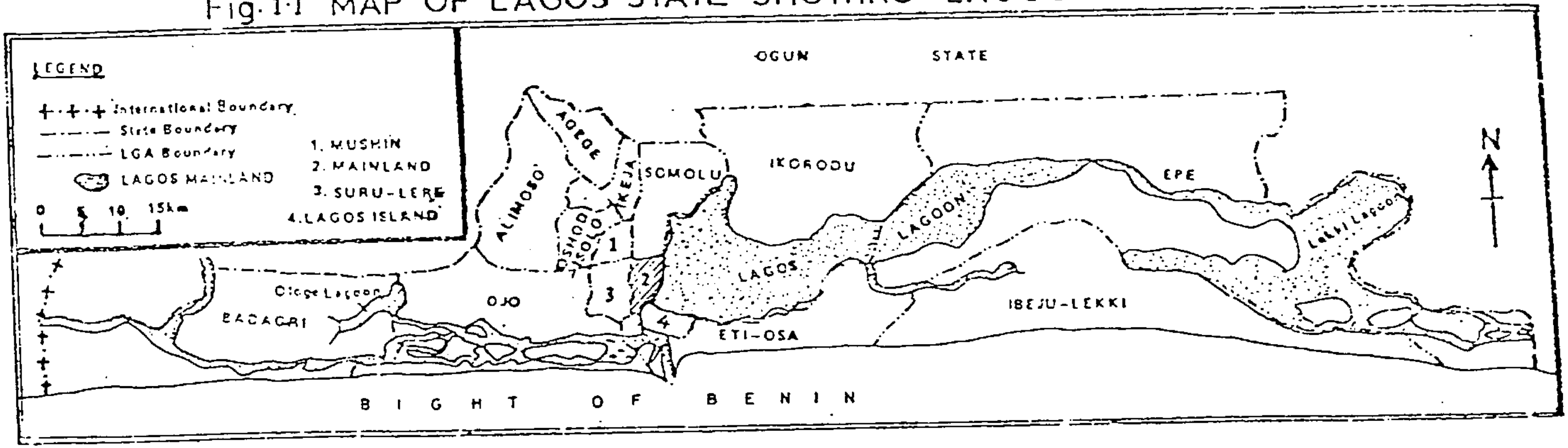
Finally, the findings of the work and other fundamental issues raised will help the Local Government in decision making and properly defining its rates administration policies, goals and activities for improved service to the public and revenue generation.

1.7 THE STUDY AREA

1.7.1 Origin

The geo-political area chosen for this study is the Lagos Mainland Local Government Area, Lagos State. It is one of the 20 LGAs, and indeed one of the oldest LGAs in Lagos State (Fig.1.1). It was created in 1977 as a separate LGA following the

Fig. 1·1 MAP OF LAGOS STATE SHOWING LAGOS MAINLAND LGA



national reform of LGAs by the Federal Government in September, 1976. The local government was carved out of the defunct Lagos City Council which composed of both the Lagos Island and the Lagos Mainland areas. However, with the creation of three new LGAs in Lagos State on August 27, 1991, the former Lagos Mainland Local Government Area was reconstituted whereby Surulere Local Government was carved out of it (Federal Republic of Nigeria Official Gazette, 2nd October, 1991; African Interpreter, December 1993).

1.7.2 Geography

Lagos Mainland Local Government Area is located within longitudes 3°22'E and 3°26'E, and latitudes 6°22'N and 6°33'N. It is bounded in the north by Shomolu LGA. The Lagos Lagoon defines its eastern borderlines. It is bounded in the south by both the lagoon and Eti-Osa LGA. Towards the west it shares common boundaries with Surulere LGA. Today, the LGA covers an area of about 15.4 km^2.

Topographically, Lagos Mainland is located in a low-lying region. It has a general elevation that is hardly more than 50m above sea level. Many parts of the Council have silty soils and swamps with considerable vegetation, especially as one approaches the bounding lagoon to the east and south (Udo, 1970).

The local government is mostly a built-up area, being a major part of the Lagos Metropolitan region. Some of the outstanding settlements in the area include Yaba, Ebute Metta, Oyingbo, Iddo, Adekunle, Sabo, Alagomeji, Akoka, Iwaya, Onike, Onitiri and Makoko. Two of these settlements namely, Alagomeji and Iwaya were particularly selected as study locations.

According to the census figures of the 1991 national population count, Lagos Mainland LGA has a population of about 281,557. This population is highly heterogeneous, being made up of people from almost all tribes and ethnic groups in Nigeria, and beyond.

1.7.3 Physical Development

The essence of discussing the physical development of the study area is to paint a picture that can vividly tell one how cosmopolitan the area is. This is very essential to property tax administration since, as Johnson (1993) puts it, "One incontrovertible fact ... is that the more cosmopolitan local government is, the more the revenue derived from Tenement Rates".

Over the years, Lagos Mainland LGA has been witnessing unprecedented physical, social and economic transformations. A lot of industries, especially services industries, are fast springing up in every nook and cranny of the Council. The wave of urbanisation and modernism is indeed sweeping hard across the area. This is attributable to a number of factors including increasing level of affluence and changing taste and preferences of the people.

The LGA itself lies squarely within the Lagos metropolitan region. With well-knit road and railway networks, the Council stands out as one of the most accessible areas in Lagos State. Most parts of the Council has well laid out streets - obviously the product of conscious physical planning and development.

Lagos Mainland LGA places a high premium on environmental cleanliness. Every year several kilometres of drains and culverts are constructed and maintained in various parts of the area. To maintain a very clean, refuse-free environment, it has contracted out the task of refuse collection and disposal to the Lagos State Waste Disposal Board which is better equipped in terms of both personnel and material to handle the disposal of solid wastes. Also, to enhance the aesthetic beauty of its physical environment, the Lagos Mainland LG occasionally embarks on the planting of ornamental trees and flowers along selected roads and round-abouts. Some flower gardens and parks have also been developed in various parts of the LGA. The installation and maintenance of street lights to give the environment a face-lift, provide security and increase the usability of streets at night, equally engage the attention of Council.

As a dynamic municipal settlement, Lagos Mainland Local Government has been witnessing radical metamorphosis in its property landscape. Changes are constantly taking place in both the number and style of buildings. This is perhaps precipitated by some factors such as increasing population, increasing interest in commercial activities, rising levels of affluence together with its attendant shift in building/accommodation tastes and preferences. The population of the Council is clearly on the ever rising side. Due to increasing population there is greater demand for housing now than before. A good number of people who work at Ikoyi, Apapa, Victoria Island and Ikeja actually live in Lagos Mainland.

Most of the buildings in the LG were, as a matter of fact, built during the colonial days. Thus, they pre-date the 1960s. But in consonance with modern day realities, a good number of these buildings have had to undergo one form of change or the other at various times. Some have had to be pulled down completely and more modern ones erected in their place. Some have in recent times been given a "modern touch" by way of renovation. Equally, most hitherto vacant plots of land within the Council are now either fully or partially developed.

The ever mounting tempo of commercial activities within the Council is equally another factor that is greatly affecting property development in the area. The community seems to be more commercially-oriented now than it used to be even in the recent past. Consequently, in a bid to accommodate the on-going upsurge in commercial activities and thus maximise profit, property owners/developers now pay greater attention to the provision of buildings for commercial and industrial purposes than for residential purposes. A profound number of residential buildings have been converted to commercial buildings. In a way, this new development may be to Council's advantage, since commercial properties generate more revenue to the Council than residential properties.

By and large, all the ever-occurring innovations so far discussed, help to transform the property environment of Lagos Mainland Local Government on a frequent basis. These changes hold some significant positive implications for tenement rating. For one, they not only go a long way to improving the quality of the physical environment, they also help to generate a large volume of vital data for property appraisal. Thus having a powerful system that can capture and manage the voluminous property data so generated is not only a necessity, but indeed a sine qua non to objective, efficient and effective administration of tenement rates.

1.7.4 Statutory Functions

The statutory functions of the Lagos Mainland Council are numerous and varied, such as health care delivery, provision of motor parks, handling of chieftaincy matters, liquor licensing and so on. However, of particular interest to us now is the administration of tenement or property rates, which is usually handled by the Tenement Rates Unit. The functions of this Unit were thoroughly reviewed with a view to ascertaining how a geographic information system (GIS) could be used to improve such functions. The following is a resumé of the responsibilities of the LG Tenement Rates office:

(a) The discovery and identification of rateable properties

(b) Proper valuation and rate-setting

(c) Preparation of property account ledgers (i.e. opening of accounts records for all assessed properties)

(d) Preparation and issuance of Demand Note and other related papers (such as Summons, Warning Notices and Sealing Notices).

(e) The collection of tenement rate from the general public (i.e. in respect of residential and commercial properties).

(f) The collection of rate from public corporation bodies and government parastatals

(g) The compilation of Federal and state government properties, and periodic review with the relevant government for purpose of claiming government's contributions in lieu of rates

(h) Granting of rebates in respects of properties occupied by foreign missions and other international organisations

(i) Compilation and processing of requests for exemption from payment of tenement rate

(j) Periodic update of property records.

The activities of the Tenement Rates Office are treated in greater details under system analysis (Chapter 3).

1.7.5 Revenue Sources

There are two broad sources of revenue to the local government, namely external and internal. The external sources of revenue consist of statutory allocations from both the Federal and state governments. The internal sources include rates, liquor licensing fees, trade licenses, outdoor advertising fees, and so on.

As already noted, the local government areas that administer tenement rating derive more revenue from this source than any other source. Table 1.1 below glaringly shows the outstanding position of rates as the most important source of internally generated revenue to Lagos Mainland Local Government. On the average the annual yield from tenement rates accounts for about 43.34% of the total internally generated revenue, every year.

Table 1.1: Lagos Mainland LG: Comparative Actual Revenue Collected (Internal)

Revenue Head	Details of Revenue	Actual Revenue 1989	%	Actual Revenue 1990	%	Actual Revenue 1991	%	Actual Revenue 1992	%	Actual Revenue 1993	%	Actual Revenue 1994	%
1002	Tenement Rates	4,680,778.52	45.02	4,795,565.74	43.32	6,257,782.29	29.84	6,617,183.88	50.95	6,601,947.28	50.82	6,766,788.91	40.11
1003	Local licences, fees and fines	3,208,246.55	30.85	3,653,167.18	33.01	3,993,438.66	19.04	3,623,540.20	27.90	3,051,903.74	23.50	3,937,289.40	23.34
1004	Earnings from commercial undertakings	1,454,985.60	13.99	1,468,456.90	13.27	4,822,344.11	23	1,020,040	7.85	3,004,564.60	23.13	4,022,898.10	23.84
1005	Rent on local government property	23,635.26	0.23	323,054.96	2.92	52,485.16	0.25	40,018.04	0.31	16.150.38	0.12	1,530,704.52	9.07
1006	Interest payments and dividends	23,080.51	0.22	310,265.78	2.80	5,346,971.56	25.50	n.a		n.a		225,000	1.33
1008	Miscellaneous	799,090.40	7.69	518,453.94	4.68	497,581.72	2.37	1,685,775.93	12.98	326,920.45	2.52	389,933.15	2.31
Total		10,397,541.84	100	11,068.964.50	100	20,970,603 50	100	12,986,558.05	100	12,991,596.45	100	16,872,614.14	100

n.a = not available

Source: Revenue Division, Lagos Mainland Local Government Area.

1.7.6 Study Locations

As already noted, two specific portions of Lagos Mainland Local Government were carved out for more intensive study. The portions of Council in question are found in the Alagomeji and Iwaya areas, respectively. The two locations are considered representative enough of typical Nigerian urban settlements which most municipal LGAs have to deal with in the process of tenement rates administration.

The first location identified in this research as the ALAGOMEJI AREA, is an example of a well-planned urban settlement. Here the road network is properly defined. The entire land area has been surveyed and divided into regular plots or parcels. Although this area was originally zoned a residential area, the situation on ground presently shows an admixture of both residential and commercial buildings -- this is quite typical of most Nigerian urban areas. Besides, almost all the types of buildings which the Tenement Rating office has to deal with exist in the Alagomeji area. Thus, one can find in this area buildings as varied as bungalows, duplexes, detached and semi-detached houses, blocks of flats, and so on.

The Alagomeji area, covering an estimated land area of 44,800m^2, is bounded on the north by Spencer Street, on the east by Herbert Macaulay Road, on the south by Hughes Avenue, and on the west by Murtala Mohammed Way (see Fig. 1.2). This area falls squarely within the residential land use zone of the LGA. This means therefore that most of the houses in the area are used mainly for domestic (residential) purposes. In point of fact, all the houses within the area in question, were originally designed and built for residential uses. However, as is characteristic of the Lagos metropolitan region, a good number of the houses in the area have either completely or partially been converted to commercial buildings. Hence, in terms of usage, three categories of buildings, so to say, can be found in this area. These are: (i) exclusively residential buildings, (ii) exclusively commercial buildings, and (iii) mixed residential/commercial buildings.

Age-wise, most of the buildings in this area have been in existence for upwards of three or more decades. Nevertheless, there is clear evidence that most of the buildings have at one time or the other been improved upon by way of renovation, to make them look more "modern". In the same token, a few of the buildings have had to be pulled down completely and a new one erected, or being erected, in their place.

All the main buildings within the selected portion of the Alagomeji area were covered in this study; each of them was closely studied in relation to tenement rating.

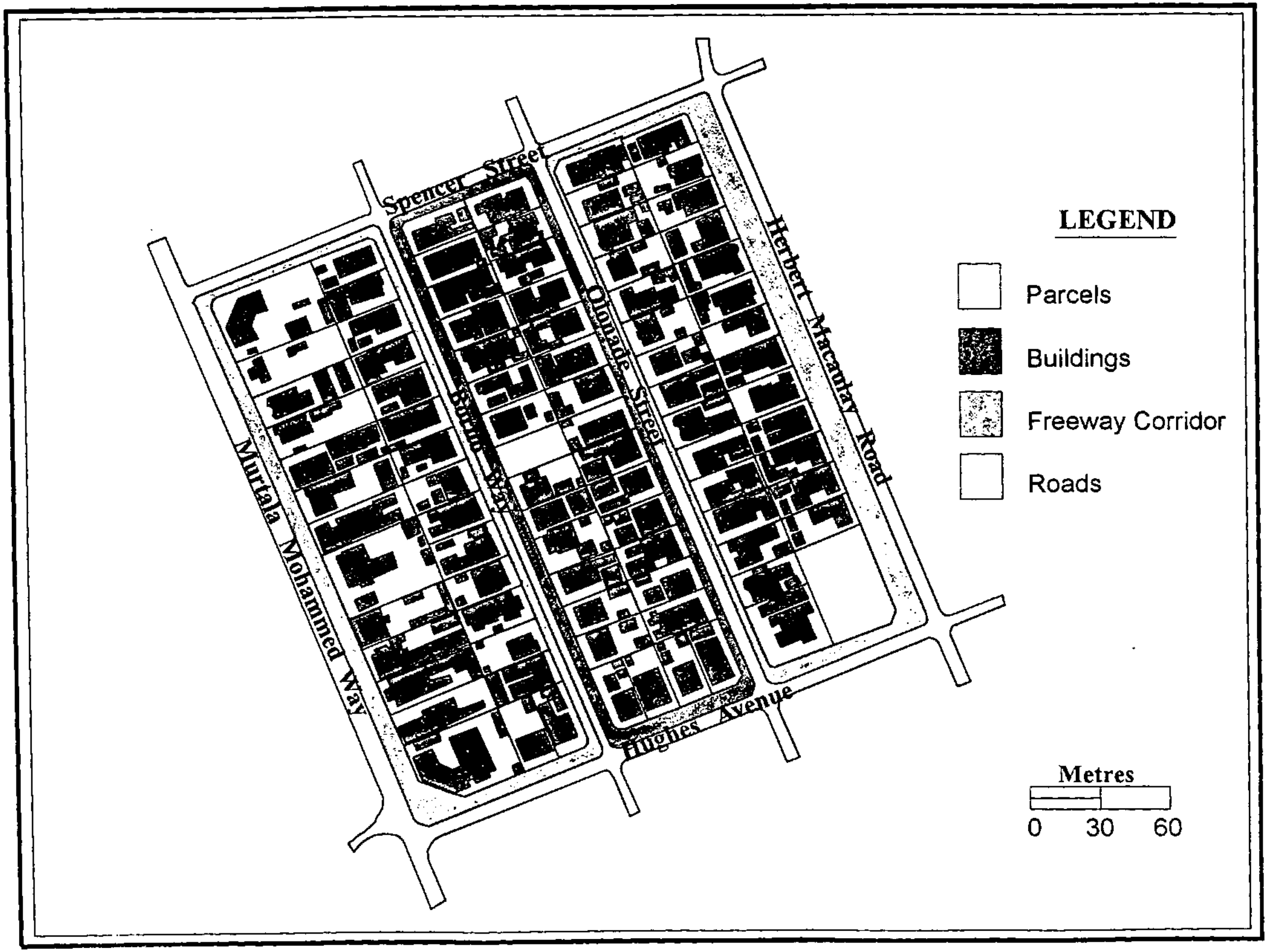


Fig. 1.2 Parcels and Buildings in the Alagomeji Location

Altogether there are 88 (eighty-eight) main buildings within the area. Table 1.2 below has been provided to show street by street distribution of the buildings.

Table 1.2: Distribution of Main Buidings in the Alagomeji And Iwaya Study Locations

Alagomeji Area	
Street	No. of Houses
Murtala Muhammed Way	11
Borno Way	28
Olonade Street	29
Herbert Macaulay Road	13
Hughes Avenue	7
Total	88
Iwaya Area	
Street	No. of Houses
Memudu Lane	10
Abiye Street	30
Ogunkoya Street	21
Ijebu Quarters	6
Total	67

The second site which we identified as the IWAYA AREA, is representative of an unplanned, semi-urban settlement (Fig. 1.3). This once swampy area is a relatively new settlement when compared to the Alagomeji area. The roads existing there now -- most of which are not yet tarred -- are not really products of conscious planning. The irregular and clustered nature of buildings in the area -- both in terms of orientation and location -- are indicative of the largely unplanned nature of the area. As a matter of fact, pockets of slums are a common sight in Iwaya. Owing to the uncontrolled manner of property development in the area, the houses in most parts of the area, are not sequentially numbered, and this makes it so difficult for rates collectors to identify the individual buildings. The streets and number of houses in the Iwaya area involved in this study are shown in Table 1.2 above.

The two locations -- Alagomeji and Iwaya -- were deliberately selected to analyse typical problems tenement rates administrators are likely to face in both urban and semi-urban areas, and hence to determine the implications of such problems for GIS development and implementation in a developing country such as Nigeria.

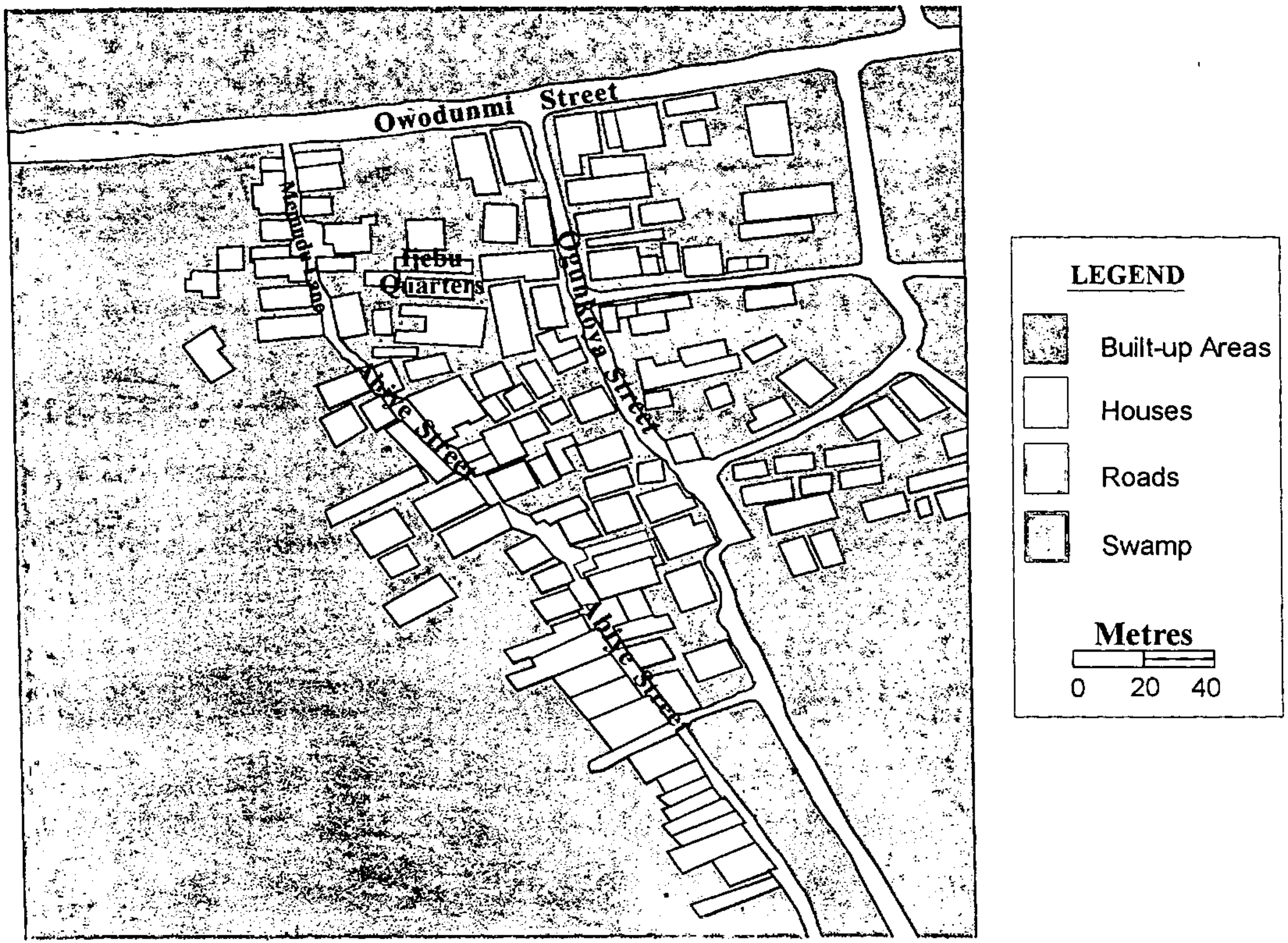


Fig.1.3 The Iwaya Study Location

CHAPTER TWO

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1 INTRODUCTION

This thesis is primarily concerned with three main issues namely, information/information systems, property tax administration and geographical information systems (GIS). Consequently, it is equally these three issues that are covered under the present review. The attempt here is not just to critically examine the views of authors on these three areas but, also to forge a link amongst the three.

The section on information/information systems tries to capture different shades of opinions on what information is, the value of information, what information systems are all about, as well as the processes and problems of information systems development, especially in Africa. This section also reviews some literature on the nature and value of geographical information. The review of Property Tax Administration revolves around issues such as the meaning of property rate, why it is levied, how it is administered, problems hindering its effective administration and suggested solutions to the identified problems. Lastly, the portion of the review which deals with GIS x-rays the origin of GIS, what it is, its various components, stages in its development and as a specialized type of information system, its application to rates administration.

2.2 INFORMATION: A DEFINITION

The meaning of information varies from person to person, and time to time. What is considered information at one level of precision, may not be considered so at another level. Similarly, what is acceptable to someone as information may not be acceptable to some other person, depending on the need for information.

Information seems to be such an elusive term that Kisiedu (1990a, p. 50) declares that "Information is a broad, inter-disciplinary sector ..., there is no common definition for it". This means therefore that the particular meaning attached to information is a function of the user. This point is even supported by Maguire (1989, p. 15) in his distinction between the terms `data' and `information'. According to him, "the term data refers to the values physically recorded by an observer ... and information refers to the meaning of those values as understood by some users".

Taking a somewhat different stand from the foregoing views is Rosove (1968) who believes that information has a definite definition. In his comparison of data and information, he submits that "A datum is a fact in isolation. Information is an aggregate of facts so organized or a datum so utilized as to be knowledge or intelligence. Information is meaningful data, whereas data, as such, have no intrinsic meaning or significance". Apparently lending credence to Rosove's voice is the Chamber's 20th Century Dictionary which partly defines information as "intelligence given (or communicated)"; which goes to say that information will remain dormant and passive unless it is transmitted to some user.

The views of both Rosove and the Chamber's Dictionary are underlined by Abate's description of information, or better still, what he calls "development information". Information, according to Abate (1990), refers to "... intelligence or knowledge that contributes to the social, economic, cultural and political well-being of society, irrespective of the form it is encrypted in (text, figures, diagrams, etc), the mode of dissemination (oral, written or audio-visual, etc), the social activity that generated it (research, administration, census, remote sensing, etc) or the organizing and disseminating institutions (libraries, documentation centres, archives, statistical offices, mapping agencies, geological surveys, computer centres, media and broadcasting services, telecommunication services)".

On his own part, De Man (1990, p. 325) simply considers information as an answer to a specific question.

From the above views on information, one can possibly extrapolate the following points namely, that information:

- is an aggregate of meaningful facts or intelligence,
- that the meanings of the facts have to be understandable to some user(s),
- that the meaningful facts or intelligence must be transmittable for it to be

considered information,

- for the meaningful facts to be meaningful indeed, it must be able to answer some specific question(s).

It therefore holds that by way of synthesis, what the authors are saying is that information is an assemblage of valuable or intelligent facts that make sense to some user to the extent that it could be used in a problem-solving environment to unravel some uncertainties.

2.2.1 The Use and Value of Information

The indispensability of information in any problem-solving environment is quite irrefutable. Information is the soul of business. Information is power. The importance of information to the smooth running of any organization is so glaring that it need not be over-emphasized. The success or failure of any policy is to a very large extent predicated upon the facts that informed such a policy. As a matter of fact, information guides, controls, and enlightens.

Ahmed A. Bassit as quoted by Kisiedu (1990a), extols the virtues of information as he notes that information is "a resource, a production factor which has its place in every system of creation, an element to be taken into account in all decision-making process(es) ..., a commodity which, unlike most others, is not exhausted with use".

Based on his ardent belief on the value and potential of information, Stamper (1973, p.14) wonders aloud why we often take information for granted. According to him, "There is little we can do without information. There is no organisation controlling the flows of materials and energy, or the work of people and machines, which does not make elaborate use of information". Reasoning along similar line of thought with Stamper, Rosove (op.cit., p.2), reflecting on the role of information, writes that "To conduct some rationally conceived endeavour, means and ends must be logically related. Information constitutes an essential link between means and ends". Equally, De Man (1990) considers information an agent of reducing uncertainties within the means-ends relationship in which managerial functions occur. It is this ability to support managerial functions that De Man considers to be the intrinsic value of information.

As a precious gem, information is now being highly sought for by all and sundry, more than ever before. It is widely believed that the technological revolution of the 1980s brought with it information revolution. Thus, as Kisiedu (1990b, p.96) puts it, information has become one of the costliest and fastest industries in modern times. This should be expected, especially in view of the fact that "Society seems to hunger for and thrive on information", (Ingalsbe, 1989).

But despite the importance of information, it is a widely held belief that African decision-makers are not sufficiently aware of the value and relevance of information in national development (Abate, 1990). This is quite disturbing, particularly when one considers the fact that "To run a successful business or organization, the people in charge must continually make decisions based on not only current information about their organization but also information about the rest of the world ... If this information is wrong, late, lengthy, or confusing, their decisions might be in error or not made at all" (Ingalsbe, op.cit.).

Nevertheless, despite the purported spate of insufficient awareness, African managers on whose onus it lies to make decisions, are said to be becoming increasingly aware of the fact that information, especially specialized information, is an indispensable factor in the development and rational use of their total natural and human resources (Kisiedu, 1990b).

2.3 INFORMATION SYSTEMS

Information, being a priceless resource, should be handled in a meaningful, systematic manner. The handling of information in any organization is an issue that should be of utmost concern. Data and information could be handled manually or automatically. However, manual handling of data is known to be fraught with a number of problems. Manual handling of data is time-wasting, expensive, laborious, lacks adequate security, and does not allow for easy access to data.

Lack of easy access to information is considered one of the greatest problems impeding the effective use of information in this part of the world. Information must not only be available, it must equally be easily retrievable and communicated for it to be useful to the user. Looking at the problem of lack of easy access to information, from a continental point of view, Kisiedu (1990b) laments that "... the increasing inaccessibility of information for viable decision-making in most African countries, because of ineffective and inefficient information handling techniques and archaic systems, is widening the gap between the `information rich' North and the `information poor' South".

Also commenting on this issue of inaccessibility of information, particularly in relation to availability of information for map making and physical planning activities, Adalemo (1982) identifies poor handling technique as a major cause. In his words, "information, valuable information, may be stored between file folders in such a manner that they are not easily retrievable and therefore become unavailable for planning or any other purposes. I suspect that our constant complaint about lack of data for planning which has now been immortalized in Stolper's coinage 'Planning Without Facts' is really not a complaint about lack of data. Rather it is an indication of the degree to which data have become inaccessible largely because of the manner in which information is stored".

It is this lack of efficient and effective system for information development and handling that has dragged African countries into the unfortunate state of being "data rich but information poor" (Kisiedu, 1990a, p. 23). The consequences of the poor state of information development have equally been exposed. For instance, expressing the necessity of information for proper urban planning and development, Paulson (1992) notes that, "a broad and reliable information base is essential if cities are to be managed effectively. Lack of information contributes to problems such as ineffective urban development programs and activities; uneconomical and badly planned investment projects; poor functioning of land markets, property tax and utility systems; and disregard of the environmental impact of development on the population". It has equally been observed that, "Public administration and economic planning, implementation and monitoring are the weakest links in the chain of government functions. Some of the shortcomings result from the inadequate availability and use of information" (Abate, 1990, p.76).

It is the need to develop information, handle it in a logical manner that makes it easily retrievable and accessible, that has given rise to the idea of Information Systems. For information to be easily available and accessible, its handling has to be machine-based. Stamper (1973, pp. 342-343) has noted that "Organisations create themselves according to their ability to use information. That ability can be enhanced by the use of machines".

Rosove (1968, p.11) defines an information system as "an integrated, multipurpose, geographically dispersed, computer-based configuration of people, procedures, and equipment designed to satisfy the informational needs of a user".

To Awad (1991, p.20), an information system may be defined as a set of devices, procedures, and operating systems designed around user-based criteria to produce information and communicate it to the user for planning, control, and performances.

The two definitions above have certain things in common, even as they try to pin-point the characteristics of information system. They both recognize an information system as being made up of different but interrelated components. Such components include people (users), equipment (devices), and procedures. The system is designed to achieve some purposes namely, to ***produce*** and ***communicate*** information needed by some users. The information thus made available is used by the user to accomplish some tasks.

Perhaps, the major flaw in the above definitions given by both Rosove and Awad is that they both failed to formally recognize data as an indispensable element of any information system. Without data there can be no information. In fact, as it is with geographical information systems (GIS), data is considered by many to be the most important and costliest aspect of information systems (Maguire, 1989; Burrough, 1986; Ezigbalike, 1994).

Basically, an information system provides the much needed data-processing capabilities and information that an organization or business needs to be informed (Ingalsbe, 1989).

An information system is always put in place to satisfy certain objectives. To Jaffe (1968, p.94) the major objectives of an information system are to bring ***relevant data*** in ***usable form*** to the ***right user*** at the ***right time*** so that they will help in the solution of the user's problems. To be able to meet these objectives, a typical information system should possess the abilities to accept, process and present data, to update and modify data, and to combine data sets originating from different sources (De Man, 1990, p.324). Shown below (Fig. 2.1) is a diagramatically representation of the sequence of functions of an information system.

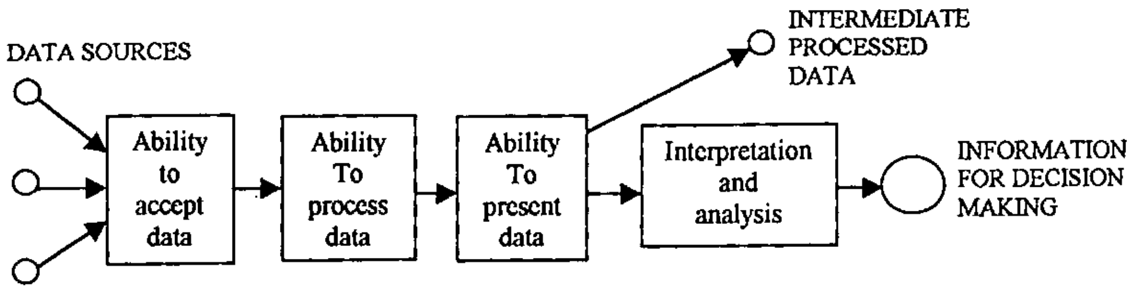


Fig. 2.1 Sequence of functions of an information system (After De Man, 1990)

A review of the life cycle of an information system indicates that it passes through five major stages from its inception until it is removed or redesigned (Ingalsbe, op.cit; Rosove, 1968). The five stages are system analysis, system design, system development, system implementation, and system maintenance.

1. System Analysis: an evaluation of the current system to determine if it should be modified or a new system developed;
2. System Design: a physical design of a proposed system is developed;
3. System Development: creating the new information system from the physical design; the programs of the new or modified system are written;
4. System Implementation: the organization installs and uses the new system;
5. System Maintenance: the system is continually monitored and adjusted until it is time for a total re-evaluation.

In a nutshell, the processes of developing a new information system include the study and analysis of its manual or semi-manual predecessor; the initial conception of the replacement system; the analysis of existing user objectives and the creation, in consultation with the user, of new objectives; the definition of the new system's operational requirements; the design of the system; the specification of its physical components; and the production of these physical components; provision for the human components of the system (i.e. personnel and organizational design); the creation of training programs and capabilities for system testing and system evaluation; overall, long-range planning for the evolutionary replacement of each system configuration by subsequent ones (Rosove, 1968, p.17).

2.4 The Nature And Value Of Geographic Information:

Geographical data (also known as spatial data, cartographic or map data) refers to data pertaining to the earth, other planets and objects in space(Peuquet, 1990). Thus, for a piece of data (or information) to qualify as a geographical data it must possess locational identity. Peuquet further identifies a number of characteristics which significantly differentiate spatial phenomena and spatial data models from one-dimensional or list-type models. One of such characteristics is that spatial entities have individual, unique definitions which reflect the entities' location in space. These definitions or locational identities are recorded in terms of a co-ordinate system such as latitude and longitude, or street address. Another unique characteristic of geographical entities and data is that there are numerous complex but definable relationships between the entities. Such spatial relationships could be defined in terms of 'near' and 'far', or 'left' and 'right', and so on.

Geographical data possess the property of multi-dimensionality. Dimensionally speaking, four categories of geographic data which portray the spatial locations and configurations of individual entities, can be recognised. The first type is point data where each discrete data element is associated with a single location in two- or three-dimensional space. The second is line data, which is a data type in which the location of an entity is described by a string of spatial co-ordinates. The third category of geographical data is polygon data. In this category the location of a data element is represented by a closed string of spatial co-ordinates. Consequently, polygon data are associated with areas over a defined space. The fourth category of geographic data is one derived from a combination of any of the three earlier mentioned. Each data element in any of the categories of geographic data types has certain characteristics called attribute descriptor data, which describe it.

Geographic data are valuable in that they help one to gain knowledge of the geography of a place. This is very important in view of the fact that geography helps to produce informed citizens that are able to form opinions and to view affairs with interest and intelligence (Cole and King, 1968). Moreover, geography is seen as standing at the core of man's quest to understand his environment and exploit the available resources in the most productive and beneficial manner (Areola, 1994).

Geographical knowledge erases locational ignorance by affording man the opportunity of appropriately identifying events and features within a spatial frame. This particular role of geographical knowledge is of absolute importance especially when it is realised that we live and operate in a world which is basically spatial in nature and we are accustomed, on a routine basis, to dealing with the complex spatial interactions that form much of our daily lives (Peuquet and Marble, 1990). It has been rightly observed that the main purpose of mapping is to present spatial features in a model-like manner for visual observation and analysis; in this way, maps silently describe the positions of things and loudly, they bring the enormous real world into our visual gaze with all things in their relative positions (Balogun, 1992). As a matter of fact, it is impossible to put together a coherent image of man's world unless the observed features are located in relation to known points (James and Martin, 1981).

Spatial distribution and relations are only described best by geographical data. Owing to the nature of spatial data, representing them in textual form often proves to be very ineffective; spatial data are not easily manipulated and understood when held in form of texts. Encrypting geographical data in map form is the most effective way of handling such data. It is only with a map that important spatial relationships and spatial form(distribution or occurrence) can best be seen and analysed (Murphey, 1961).

A map is a model of the aspect of the terrain which it represents. It distinguishes the elements of that terrain(or reality) by means of appropriate symbols, and its power of resolution of these elements varies with scale. However, a map goes further, for it models not just the elements but also their geographical relations--the distance and direction between any two elements (White, *et. al.*, 1992).

Undoubtedly, the availability or non-availability of maps may make the difference between success and failure of a project (Adalemo, 1982). For instance, the major errors in the previous censuses in this country have been traced to inadequacy of spatial information and the passive recognition of the graphicacy concept in the planning, conduct and processing of census surveys and results (Adeniyi, 1992). With the use of a series of maps the spatial dimensions of social and economic factors and how these change over time can be portrayed; this will help in achieving a visual impact which conveys information which would otherwise have been missed (Adalemo, *op cit.*).

Simply put, the map provides a unique basis for reflection, to take stock, evaluate performance, ponder on the way forward and plan for the future (Areola, 1994). Consequently, it has been pointed out that the absence or neglect of map data automatically leads to deficiencies in the fundamental principles of any project development namely, planning, design, implementation, monitoring, and maintenance (Ogunlami, 1994).

Either for the purpose of map making or for analytical purposes, geographical data becomes more accessible and useful when organised in a database form. A geographical database is an assemblage of spatial data and related descriptive data organised for efficient storage and retrieval by many users (ESRI, 1991).

Geographical data, like every other type of data, becomes more accessible and valuable when handled in an organised and harmonised manner. Although the map is the medium for representing and communicating geographical information, it is usually laborious, expensive and time-wasting to extract relevant information from analogue map sheets(Peuquet and Marble, 1990). Thus, in order to properly manage geographical data, a spatial data-handling system that makes it easier to store, retrieve, manipulate, and output the data, is a *sine qua non*. The limitations of the manual techniques of handling geographical data and the lull of the computer technology, have therefore acted as push and pull factors respectively to give birth to the now rapidly growing use of computers for automated handling of geographical data (*ibid*). The automated technique of handling geographical database is commonly known as geographical information system(GIS).

2.5 GEOGRAPHIC INFORMATION SYSTEMS (GIS)

2.5.1 Origin of GIS:

Geographical Information Systems (GISs) are a management tool. A GIS is however different from other information systems in that it explicitly focuses on spatial entities and relationships (Marble, et al, 1983). The idea of geographical information system is believed to have been conceived in the early 1960s (Maguire, 1989); while the first computer-based GISs were developed in the middle 1960s (Marble, et al, op.cit). It is a commonly held view that the Canada Geographical Information System (CGIS) was the first full-scale GIS to be implemented (Tomlinson, 1990; Peuquet and Marble, 1990;

Maguire, 1989; Antenucci, 1986; Marble, et al, 1983).

Both Maguire (1989) and Peuquet and Marble (1990) have identified some "push" and "pull" factors which created and sustained the demand for computer-based geographical information systems, at the on-set. Such factors included the limitations of the manual techniques of spatial data-handling; the great proliferation and vast increase in the quantity of data about the environment available in computer format, in recent decades; recent advances in geographical theory and techniques which make the need for sophisticated computer systems quite imperative; the multi-dimensional nature of geographical data; the maturity of the GIS technology and user appreciation of the enormous practical capabilities of such systems (Antenucci, 1986). In addition, Nappi (1990, p.30) has identified population growth and urbanization, which in turn create various types of georeferenced data, as other factors driving the need for GIS.

The core spirit or philosophy behind the GIS concept is not entirely novel. Rather, as Areola(1994, p.25) puts it, "The ascendancy of GIS in recent times, is, in fact, a rediscovery and a reaffirmation of the value of map and of the cartographic tradition in spatial decision-making." In the main, the conceptualisation and development of a GIS is guided by the spatial information theory which provides the general background for the production of tools in spatial data handling (Kainz, 1995). According to Kainz, spatial information theory provides the framework for spatial reasoning (the deduction of spatial information from spatial facts), the representation of space(i.e. the development of data models and structures to represent objects in spatial databases), and human understanding of space(the way people design and use tools, such as GIS, in spatial data handling).

Although the idea of GIS finally crystallized in the middle 1960s, so to speak, its widespread use had to tarry till the 1980s (Maguire, 1989). Today, GIS is fast becoming a household term at a rather unprecedented rate, especially in developed countries. Taking a perspective look on GIS technology in the 1990s, Frank, et al, (1991) had every cause to posit that "Within the last decade, geographic information systems (GIS) have matured from an attractive idea to an entire industry ... The issue (today) is no longer whether or not to use a GIS, but how to use it for the highest benefits".

2.5.2 What Is GIS?

Various attempts have been, and are still being made to define Geographical Information Systems (GISs). However, there is currently no universally accepted definition of GIS. This is so because, like the proverbial elephant met by some blind men, GIS has been defined from various points of view. Thus each of the available definitions tends to emphasize some aspect of GIS over the others.

Cowen (1990) in a bid to analyze the differences existing among GIS, omputer-aided design (CAD) and data base management system (DBMS), has identified four general approaches to defining GIS, as found in the literature. In Cowen's own view, none of these approaches is fully satisfactory, as each contains some notable weaknesses. The approaches are:

1. The process-oriented approach: definitions of GIS that are process-oriented, are based on the idea that an information system comprise several integrated sub-systems or components that assist in converting geographic data into useful information. For instance, Marble (1990, p.10) adopted this approach in her definition of GIS. In a nutshell, Marble recognized GIS as comprising four major components namely, a data input subsystem, a data storage and retrieval subsystem, a data manipulation and analysis sub-system, and a data reporting sub-system.

In as much as a process-oriented definition is extremely valuable from an organizational perspective, as well as for establishing the notion that a system is something that is dynamic, it should however be noted that the application of the definition is far too broad to help distinguish GIS from computer cartography, location-allocation exercises, or even statistical analysis (Cowen, op.cit).

2. The application approach: This approach, actually a modified version of the process-oriented approach, tries to define GIS according to the type of information being handled. Here, the idea is to define GIS based on whether it is for general-purpose or specialized application. The subject matter simply provides the basis for definition. Thus, under this approach, GIS is defined based on, for example, whether its subject matter is on land (Land Information System), soil (Soil Information System), urban

(Urban Information System), etc.

One good thing about defining GIS on the basis of applications or subject matter, is that it helps to underline the scope of the field. However, this approach still does not afford one the opportunity of differentiating GIS from other forms of automated geographic data processing, Cowen has noted.

3. The tool-box approach: The idea behind the toolbox approach to defining GIS has it that such a system incorporates a sophisticated set of computer-based procedures and algorithms for handling spatial data. Thompson (1992) for instance, defines GIS "as a set of tools used to solve spatial problems by working with certain kinds of data stored in database". The toolbox approach argues that the tools (procedures and algorithms) should be organized such that each sub-set of tools will meet the needs of a particular subsystem of GIS such as data input, data storage, data analysis, or data display/presentation.

4. The database approach: The database approach to defining GIS is a modification of the toolbox approach. The database approach really makes the data independent from the programs that access them (Hoxhold,1991). In this approach, GIS is defined with emphasis on the ease of the interaction of the other tools (procedures and algorithms) with the database. In line with the ideas behind the database approach, Green (1992) has defined GIS as a "computer-based tool with a database that facilitates the collection, input, storage, manipulation, query, retrieval, analysis, display and output of spatial information".

While agreeing to the fact that the technical issues surrounding database design are probably the most critical ones facing the field of GIS today, Cowen does not however see the database approach as providing any better basis for defining the field than does the toolbox approach.

Obviously not fully satisfied with any of the above-discussed approaches to defining GIS, Cowen has gone ahead to make his own submission. To him, "a GIS is best defined as a decision support system involving the integration of spatially referenced data in a problem solving environment". Cowen's emphasis here lies on integration. In his view, a GIS should be able "to combine maps with remotely sensed data and other forms of spatial data".

On its own part, Environmental Systems Research Institute (ESRI,) in its Glossary of GIS and ARC/INFO terms, defines GIS as "An organized collection of computer hardware, software, geographic data, and personnel designed to efficiently capture, store, update, manipulate, analyze, and display all forms of geographically referenced information".

An eagle-eyed look at all the definitions of GIS so far presented in this section will lead one to the fact that a GIS is designed to accept, organize, statistically analyze, and display diverse types and vast amounts of spatial information that are digitally referenced to a common co-ordinate system of a particular projection and scale (Avery and Berlin, 1985).

GIS is normally designed to handle spatial data and their related attributes. Thus, a GIS has the dual capability for both geographical information analysis and geographic (map) presentation. However, although a GIS possesses these two capabilities, it is still considered more suited for analyzing geographical data than for graphic design/drafting. This singular factor forms the main departing point between GIS and computer graphics such as automated mapping or computer-assisted-cartography (CAC) and computer-aided design (CAD) (Burrough, 1989; Croswell and Clark, 1988; Antenucci, 1986). Computer graphics systems have powerful capabilities for high quality graphics output, they are however deficient in handling non-graphic attributes (see for example, Kevany (n.d)). As a matter of fact, CAD systems are generally known to have severe limitations when it comes to analytical tasks (Cowen, 1990).

2.5.3 Components of GIS:

Every system is made up of organized interdependent components or functioning units that are linked together according to a plan to achieve a specific objective (Awad, 1991). Geographical information systems (GISs) are no exceptions; they usually comprise of certain components or subsystems, as we noted in the preceding section. That a full-fledged GIS consists of various components is not contestable; what seems to be contestable, however, is the number of components making up a typical GIS.

For instance, whereas some (e.g. Burrough, 1989) believe that a GIS has three important components, some others (e.g. Frank, et al, 1991; Marble, 1990) recognize four components. There is yet another school of thought (as represented by ESRI, 1992) which holds the view that a functional GIS must be made up of five parts.

Nevertheless, the seeming disparities in opinions as to how many components there are in a GIS, are not divisions as such. A meticulous look at the individual views of the three parties will quickly reveal that they are more or less saying basically the same thing. What really differs is the scale or resolution of consideration. For instance, the exponents of the four-component idea merely subdivided the initial three components into four; same goes for the propagators of the five-component theory, who simply subdivided the four components further into five. By and by, the notion that a GIS comprises four major components enjoys greater support than any other.

Thus, without prejudice, we can simply say that a typical geographical information system has four major components viz, the hardware, the software, the data, and the institution of personnel. The term hardware refers to the physical components of a computer system. For GIS operations the hardware components needed include the central processing unit (CPU), visual display unit (VDU), digitizer, scanner, magnetic tapes and disks, plotters and printers, and the keyboard. The hardware subsystem is used to store, process, and present data (Frank, et al, 1991).

The software is another major component of a GIS. Software is a general term referring to computer programs used to handle and analyze data inputs in order to derive some desired results. In the main, a GIS software is comprised of five modules designed to perform the following functions (Burrough, 1989; Avery and Berlin, 1985):

(i) data input and verification,

(ii) data storage and database management,

(iii) data transformation (i.e. analysis and processing),

(iv) interaction with the user, and

(v) data output and presentation.

Perhaps the most important aspect of a GIS is data (Maguire, 1989). Hinton and Grimshaw (1992) have observed that the realisation that data is one of the most important resources an organisation possesses, has been on the increase in recent years. Consequently, "emphasis has been placed on gaining maximum return from this resource, especially in those areas catered to by the GIS industry". Some estimates have it that, in terms of cost of procurement, the ratios of hardware/software/data stand at 1:10:100 (Frank, et al, 1991; Ezigbalike, 1994). Data here refers to basic or 'raw' facts about some part of reality. For a typical GIS, two separate but related data sets are maintained (Green, 1992). One is the cartographic or geographic data, which graphically describes the location and shape of map features defined by X, Y co-ordinates. The other is the attribute data, which describes the inherent characteristics of the map features. At will, the cartographic data could be linked to the attribute data, for geographical analysis and graphic display.

The institution or organization using the geographical information system is another major component of a GIS. This has to do with the people who use the system (including those Maguire (1989) has described as "liveware" - suitably qualified people necessary to operate and use computers for geographical applications), their management, methods, and connections between organizations (Frank, et al, 1991). Simply put, the institution or user in a GIS environment refers to the operators who run the computers and managers who request information from the system (Ingalsbe, 1989).

2.5.4 Applications of GIS:

The main objectives of geographical information systems as identified by Scholten and Stillwell (1990) are: (i) the storage, management and integration of large amounts of spatially referenced data, (ii) to provide the means to carry out analyses which relate specifically to the geographic component of the data, and (iii) the organisation and management of large quantities of data in such a way that the information is easily accessible to all users. Furthermore, the value of geographical information systems derives from their ability of being used to achieve increased productivity in utilizing maps and geographical information; improved geographical data management; and better strategic ways to use geographical data to support decision making (Huxhold, 1991 -- here Huxhold quoted Jack Dangermond, president of Environmental Systems Research Institute (ESRI)).

The ability of GIS to effectively handle the above-mentioned tasks makes it a most suitable means for meeting a variety of needs. GIS is being used to improve the management and use of information at all levels, including operational, managerial, and decision and policy making (Paulson, 1992). As Kasturi, *et al* (1989, p.10) have keenly observed, geographical information systems are finding many applications The list of GIS applications seems rather unending. Generally speaking, however, geographical information systems are used to tackle problems that are spatially- or geographically-related in nature. GIS application knows no territorial or geo-political bounds, just as it does not discriminate as to which spatial problems it should be applied to. The GIS technology finds application at the local, state and national governments, as well as at the international levels. In the same vein, GIS could be applied in almost every facet of human endeavour.

2.5.5 Stages in the Development of GIS:

The development of a geographical information system is a task that demands taking certain logical steps. Over the years, many GIS development models have been propounded and tried. For instance, as far back as 1972 Calkins developed the structured GIS design model. This model has since its inception 25 years ago undergone some form of modification at different times. (Because of its relevance to the present study, this model will be briefly discussed shortly). In another effort, Antenucci (1986) has proposed a 15-step GIS design and implementation model. The strategic choices approach adduced by De Man (1990) is equally worth mentioning.

By and large, the existing GIS design models have much in common. Peuquet and Marble (1990, p.321) have given what could easily pass for a general summary of all that is involved in GIS development and implementation. To them, the stages of the GIS design process can now be clearly defined and equally related to similar concepts in the field of software engineering. They identified three major processes through which the design of a complete GIS has to pass. These processes are:

(i) feasibility analysis

(ii) requirement analysis (including conceptual database design)

(iii) generation of an implementation plan which addresses such issues as system testing and acceptance, initial database creation, physical facilities, personnel and training, and administrative structures.

2.5.6 The GIS Structured Design and Evaluation Model

Conceptualized originally by Calkins in 1972, the GIS structured design and evaluation model is one of the earliest attempts made at fashioning a tool for effective GIS design. Having been modified and expanded at various times by various authors, this model stands out as one of the most comprehensive and workable GIS design models now in use. Presented here is a brief review of the model based almost entirely on its overview by Marble, et al (1983).

Figure 2.2 is a flow diagram of the revised structured GIS design and evaluation model. As the diagram clearly depicts, the model is made up of four (4) distinct but interrelated stages. These four stages are composed of twenty-eight (28) steps in all.

Stage 1 of the GIS design model, which is subdivided into nine steps, deals with systems specifications based on an evaluation of user needs. The first step involves identifying the clients (users) of the GIS, user-needs, and objectives of the system. Having fully identified the system users and objectives, a determination of the data required to meet the objectives, is made (step 2). Next, the geographic referencing system to be adopted is described and evaluated (step 3). An inventory of existing data sources and collection programmes is conducted in step 4, while step 5 sees the system designer taking inventory of the existing geographical referencing system. The description of the data set specifications, analysis capabilities/output form, and the geographic referencing system, are the main concerns of steps 6, 7 and 8, respectively. Stage 1 winds up with step 9 which involves an evaluation of the system specifications and objectives, as enunciated in steps 1 through 8. This evaluation, which should be done using effectiveness, consistency, and feasibility as criteria, is necessary to arrive at some important conclusions about the specifications and objectives.

Once the result of the evaluation of system objectives and specifications is found satisfactory, emphasis then shifts to Stage II. This stage, made up of steps 10 through 16, focuses on a description of resources and constraints present in the organization where system development is proposed. In step 10 the present computer hardware in the organization is investigated. This is done with a view to ascertaining what hardware exists, its characteristics, availability, current use, and what potential uses it has for the proposed system. In a similar token, a description of organization's present software is

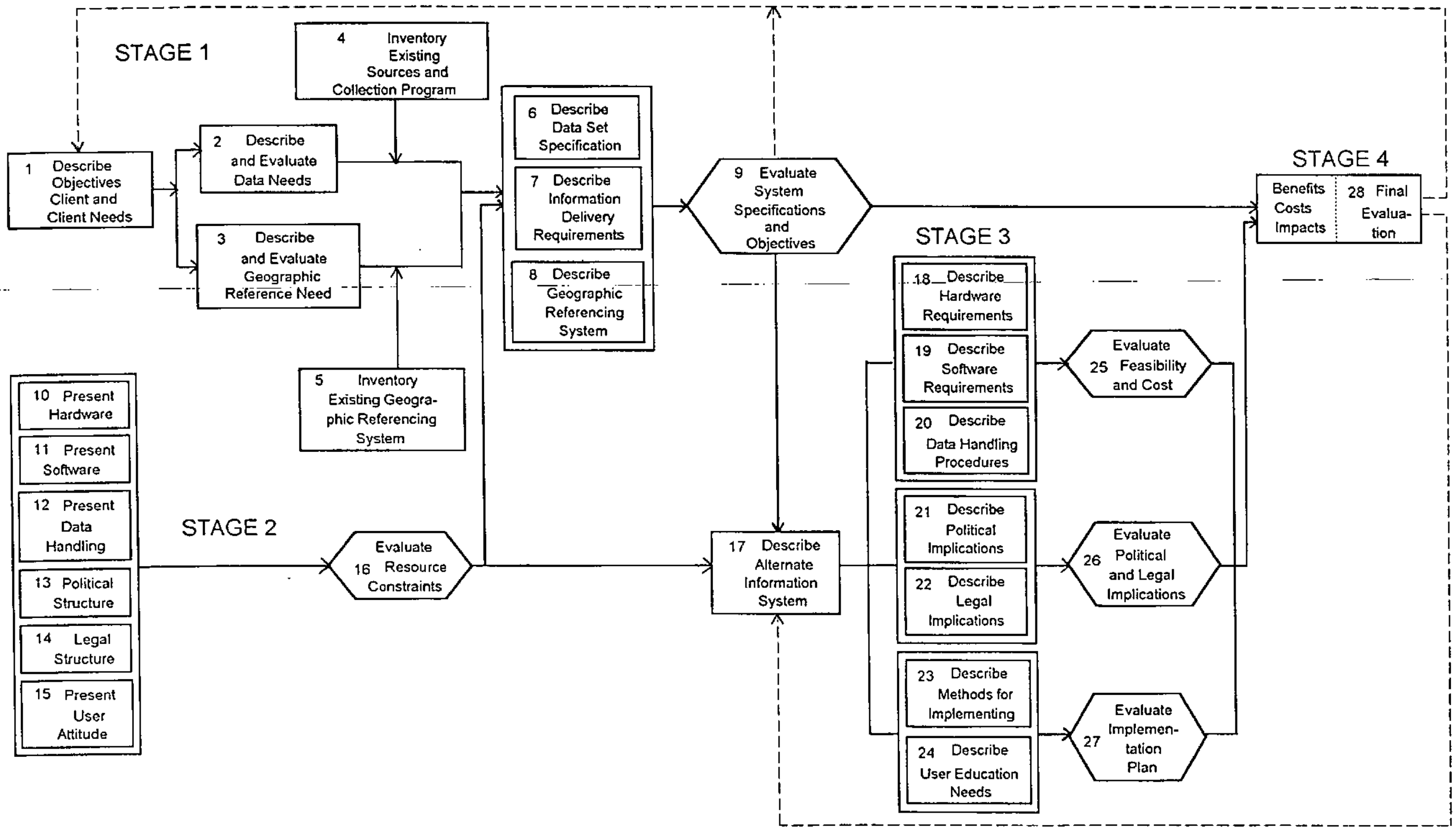


Fig. 2.2 The Structured GIS Design Model (After Marble, et. al. 1983)

made (step 11). A determination of the current data-handling capabilities and procedures within the organization is essential (step 12).

The existing political framework in an organization can constitute an important constraint on system development (Marble, et al, ibid). It is therefore necessary to analyze the present political framework in the organization for which a GIS is to be developed (Step 13). Another issue that is equally worthy of deep consideration is the legal structure affecting the organization (step 14). This may demand a determination of "what chain of authority exists for operating the proposed system", as well as establishing legal means "to give an organization control over acquisition of data for the system and to ensure data confidentiality once the data have been obtained". Assessing the attitudes and capabilities of the users of the intended GIS (step 15) is also very important, especially in view of the fact that user attitudes and capabilities may constitute a major constraint to the successful development of the system. The last operation in Stage II of the structured GIS design model is the formulation of the resource-constraint set (step 16); this is done using the outcome of the analyses carried out in steps 10 through 15.

Stage III of the GIS design model involves using the results obtained in stages I and II to generate and evaluate alternative system designs. This stage runs from steps 17 through 24. Step 17 has to do with the development of alternate information systems. In step 18 attention is focused on a description of the hardware requirements for the proposed GIS. "Several different computer hardware configurations may attain the same system goals", however, based on cost and performance certain "specific alternatives are weeded out". Similar to step 18, step 19 involves a description of the particular software requirements for the proposed GIS. One important issue here worth considering is whether the software should be developed in-house, or purchased. The description of data handling procedures for a given system alternative, is the main concern of step 20. This is done by taking into consideration the data requirements for task completion. There is always the need to "gauge the environment surrounding a given system alternative in terms of potential reactions to the system and the external conditions that will inevitably affect the system's ability to survive".

Steps 21 to 24 of the GIS design model are specifically meant to act as the "gauging" means. Step 21 involves a description of the political implications of the system. The legal implications are described in step 22. In step 23 the alternate information systems in relation to methods for system implementation, are described. Issues considered here may include "the degree of centralization proposed for the system, the institutional structure, and the operating environment in which the system will reside". Finally, there is also the need to describe alternate systems in terms of user education and training needs (step 24).

Stage IV is the final segment of the structured GIS design and evaluation model. This stage prompts an overall evaluation of costs and benefits for system selection. Steps 25 through 28 make up stage IV. The final evaluation of alternate information systems generated in steps 17 through 24 (i.e. Stage III), is done (step 25). This entails comparing the benefits, costs and impacts of the alternatives, for the selection of the system to be implemented.

2.6 PROPERTY TAX ADMINISTRATION

2.6.1 Introduction

Property tax (also known as Property Rate or Tenement Rate) as a source of revenue, especially for the urban local governments, has been in existence for several centuries. It is widely believed that the British Poor Relief Act 1601, fondly called the Statute of Elizabeth, formed the foundation of present rating system. However, Allen (1988) considers the Act a consolidating one, since prior to its enactment levies had been made over a long period for such services as relief of the poor, maintenance of highways, and so on.

Property rating was rather unknown in Nigeria until sometime after the advent of the colonial government. Probably, property rating was introduced into the country by Lord Lugard when he introduced the township ordinance that classified Nigerian towns into first, second and third class townships on the basis of their ability to shoulder municipal responsibilities (Ayeni, 1987). Property rating was first placed on the Nigeria statute book in 1915 (Allen, op.cit). In another place, however, Allen (n.d.) has argued that the modern history of rating in Nigeria commenced in 1925, while a Rating and Valuation Act was passed in 1961. The Act is said to have prepared the way for the Valuation List which eventually came into force in 1963.

Although tenement rating in Nigeria was introduced by the colonial masters, available evidence shows that for much of the colonial period, tenement rates were collected only in few urban centres, particular Lagos which was the only first class township then (Ayeni, op.cit). Ayeni's view enjoys the support of Odukoya (1988). According to Odukoya, "Before the creation of Lagos State by Decree No. 14 of 27th May, 1967, aside from Lagos Island and Lagos Mainland Local Governments which were and are still operating a rating system, property rating ... was hardly known in this country prior to the creation of the present local government system in 1976".

Perhaps one of the drawbacks to the popularity of tenement rating in the country during the colonial period, was the lack of formal laws governing the valuation and rating of property until after independence, as Ayeni (op.cit) has pointed out. The introduction of property rates in many other states of the Federation apart from Lagos State, started from 1973 (Olowu, 1982, p.292).

2.6.2 What's Tenement Rating?:

A tenement means land with building which is held or occupied as a distinct or separate holding or tenancy, but excludes land without building (Hassan, 1991; Lagos State Tenement Rates Edict, 1989). Usually, property within an urban area could at one time or another be subjected to some form of assessment or valuation. Valuation here could be taken to mean the art, or science of estimating the value for a specific purpose of a particular interest in property at a particular moment in time, taking into account all the features of the property and also considering all the underlying economic factors of the market, including the range of alternative investments (Millington, 1988, p.4). The assessment, as the above definition points out could be for various reasons, such as for compulsory purchase, insurance, sale, mortgage, rating, redevelopment, rental purposes, etc. Of course, our interest here is in valuation for rating purposes.

Through the delicate process of valuation the rate or tax to be imposed on a property is determined. A rate is any levy or tax imposed on any property on the basis of an assessment of the property (Hassan, op.cit). Tenement rate is, therefore, an annual levy imposed on land with building (Owei, 1974; Hassan, 1991). In fact, as Ogunleye (1974) explicitly put it, "The official stand is that Tenement Rates are levied on houses and not on plots". However, it should be noted that, the property tax is ultimately a tax upon person with property serving only as the basis of assessment (The New Encyclopaedia Britannica, Vol. 9, 1990; Odukoya, 1988). The tax burden is usually borne by the property owner - 'the person who controls the front door' - or in some instances the tenants.

Tenement rates are divided into two main categories namely, residential and commercial. Residential tenement rates are imposed on houses or buildings used for domestic purposes. Such buildings are usually owner-occupied, or occupied by tenants, or by both owner and tenants. On the other hand, buildings used for commercial activities are made to pay commercial property rates. There is a slight variation in the assessment of domestic buildings and commercial buildings. Thus, there is also some difference in the rates accruable to the two categories. Generally speaking, higher taxes are often imposed on commercial buildings than on residential buildings. A building may, however, double as both a residential and commercial house. In this case, the section of the building used for domestic purposes is assessed for taxation separately from the section used for business operations.

2.6.3 Steps in Property Tax Administration:

Ntamere (1982) has identified three principal steps involved in property tax administration, viz, assessment, rate setting, and collection. However, Dillinger (1992) has further broken the steps into five as follows: discovery, valuation, assessment, billing, and collection. These five stages are briefly discussed below to highlight what tenement rate administration entails.

Discovery: This has to do with identifying or finding of all taxable properties within a given geographical unit. The rating authorities should be able to promptly identify newly built or renovated buildings for valuation and assessment. The discovery process also enables the tax officials to obtain the information necessary for appraising a property.

Valuation: This is the process by which the relative value or market value (price) of a particular interest in a property (building) may be calculated. It is the duty of the valuer to use the "features of the property and also considering all the underlying economic factors of the market, including the range of alternative investments", to determine the relative value of the building.

Assessment: With the determination of the relative value of a building subject to tax through valuation, the next thing that follows is assessment. Assessment is the means by which the amount of tax or rate to be imposed on a building is calculated based on the relative value of that building.

Billing: After the rates for assessed buildings are set, the appropriate ratepayers (usually landlords, or tenants as the case may be), are informed of their liabilities. This is done by serving them (the ratepayers) demand notices.

Collection: In this final stage of property tax administration, the tax officials collect tax payments made by debtor ratepayers. Where some ratepayers fail to pay up their rates as at when due, reminders or warning notices are further sent to them. Failure to heed such warning after a stipulated time, may force Council to prosecute the defaulters by serving them with summons via the valuation court.

2.6.4 The Utility of Tenement Rates:

That property tax is a highly veritable source of revenue for local government financing, is a fact widely reported in the literature. In the 1973 Federal Government Guidelines for Local Government Reforms, it was stated in unmistakable terms that, "It must be recognised that if meaningful local government is to be expected in Nigeria, much larger financial resources are needed. In respect of local resources the only one which can be made to yield really large sum is Property Rating ..."

Property tax has been described as being highly productive of revenues (Ntamere, 1982, p.260). In the words of Olowu (1982, p.292), "The introduction of property rates in many states from 1973 meant that more urban local governments could look forward to meeting a greater proportion of their financial commitments from this source". Wraith (1972) equally recognises property rate as the most important item of "home-produced" (i.e. internally generated) revenue to the local government. That property tax is a potentially attractive means of financing municipal government in developing countries (Dillinger, 1992), is a foregone conclusion. Dillinger believes that property rate, as a revenue source, can provide local government with access to a broad and expanding tax base, and can promote broader efficiency objectives by linking the provision of municipal services more closely to their financing and rationing the consumption of municipal services by price. Tenement rate is looked upon as holding the ace for making local governments achieve financial autonomy. It has been argued that property taxation finances local government, not fully but enough to make the independence of local government meaningful (Encyclopaedia Britannica, Vol. 15, 1983). Olu-Ajayi (1991) is strongly convinced that if the collection of tenement rates alone is aggressively pursued, local governments may come to be less dependent on higher level governments thereby strengthening their efforts in their attempts to have autonomous posture.

Undoubtedly, it was the "potentially attractive" nature of tenement rate as a "means of financing municipal government" that lured Majidadi (1973) to suggest that "The significance of the property tax as a source of local tax revenue should, ..., form an important part of any recommendation one has to make for the effective and efficient delivery of services by the local governments". Majidadi goes on to say that "The degree of importance to which the local government should really become dependent upon property tax rests upon one fact, that is, lack of option. No other tax is available for productive use".

It is strongly expected that revenues from property tax on buildings will grow substantially given rapid urbanization, rising and higher income levels that will encourage the erection of better and more expensive structures (Ntamere, op.cit). This view of Ntamere enjoys the maximum support of Johnson (1993) who has observed that "One incontrovertible fact ... is that the more cosmopolitan local government is, the more the revenue derived from tenement rates".

But what makes property tax so popular amount (urban) local governments? A number of factors actually contribute to making property tax more significant than any other source of local government alternate revenue. One factor that makes tenement rate the envy of many a local government is that unlike other sources, the revenue yield from property rating is predictable. Whereas there is bound to be notable annual "shrinkages in the tax base" of other sources of revenue such as Trade Licence Fees, Advertisement Rates, Liquor Licence Fees, etc, it is not so with Tenement Rates. The predictability of revenue yield from property tax stems from the fact that real estate is highly immobile, at least in the short run. Certain economic or socio-political factors may force the migration of other revenue sources, which are more or less "floating", to other geographic areas. As it has been rightly observed, "property taxes continue in use because they are easily administered and very difficult to evade, and because the tax base - land - is a permanent and fixed resource" (The New Encyclopaedia Britannica, Vol. 9, 1990). Among others, Odukoya (1988) and Johnson (1993) have tried to establish the merits of property taxation. The table below gives a brief run-down of such advantages.

Table 2.1: Merits of Tenement Rates

S/N	Merit
1.	Rates are easy to determine and are well established
2.	Rates are relatively simple to understand
3.	The cost of collection is small relative to the revenue derived from it
4.	Property rating is simple to operate if the masses are educated about the system
5.	It is flexible to operate since the government by discretionary action or edict, can readily increase or decrease the rates charged in response to changing economic circumstances
6.	Rates are difficult (if not impossible) to evade
7.	Rates are easily perceptible, in terms of the form of demand and method of payment. This could promote accountability
8.	Rates are a tax determined locally which aids the autonomy of local government.

2.6.5 Problems of Property Tax Administration:

Despite the enviable posture of property tax as a way out of the financial quagmire local governments often find themselves, its administration is still bedevilled by several inhibiting factors. Dillinger (1992) has rightly observed that presently, yields of urban property taxes in developing countries are extremely low. What factors then account for this low yields posture?

To borrow the words of Ntamere (1982, p.261), "The major problem in property taxation centres on its administration ... Property taxation will not be easy to administer in Nigeria principally because of data and valuation problems". Again, it has been emphatically stated elsewhere that "Administrative difficulties limit what is possible in practice ... The quality of most property-tax administration is far below satisfactory levels" (Encyclopaedia Britannica, Vol. 15, 1983). Dillinger (1992), whose study on how to reform urban property tax is a more recent one, equally agrees with the view of others that in part, the low yields reflect failures in the administration of the tax.

Each of the five stages of property tax administration earlier identified, has its own problems, all of which contribute to the low performance of local government in property tax administration. For instance, as Dillinger puts it in the Executive Summary of his report, "A large proportion of properties are missing from the tax rolls, properties on the tax rolls are inaccurately valued, and collection efficiency is extremely poor".

2.6.5.1 Problems of discovery

The problem of discovering and identifying new buildings remains one of the issues militating against effective property tax administration. For instance, the Tenement Rating Office of local governments have no effective means of "knowing officially" when a new building has been constructed. There is glaring non-existence of base maps on which property discovery and identification would be based (Dillinger, 1992).

Thus, owing to the lack of appropriate tools for property discovery, hardly does the Council know the exact number of taxable properties within its geographic area of jurisdiction. This has been an age-long problem within the framework of property tax administration in Nigeria. For instance, in the research work conducted by Ahmad Abubakar in 1974 on Property Rates Administration in the then Benin City Council, poor enumeration for the discovery of taxable properties, was identified as a major problem. In his report, Abubakar (1974) noted that, "At present, one can say with some certainty, no authority can boast of knowing even something near the exact number of houses in Benin City ... Some houses were recorded without names of their owners or occupiers. More serious is the fact that some streets were left out ... There is administrative confusion in the property rates section, because the exact number of houses is unknown and some streets have not been officially named. In such situation, proper records cannot be kept".

In similar investigations conducted by Owei (1974) in the Sapele Urban District Council Area, and Ogunleye (1974) in the Ika District Council Area, inaccurate building enumeration was also identified as a serious problem that hampered property rates administration in those areas. The identification of buildings for assessment was (and, in fact, still remains) largely by accident (Owei, op.cit), or by relying on owner-declarations (Dillinger, 1992). Unfortunately, none of these techniques used in the discovery of property is effective. As a result, "A large proportion of properties are missing from the tax rolls", according to Dillinger.

Olu-Ajayi (1991) has tried to paint a more substantive picture of the problem of inadequate coverage in the discovery and identification of properties in our local governments. According to him, "It is on records here and there that about 30% of tenements in some local governments escape ratings due to poor record keeping ... It is even worse in those developing areas where records of new buildings springing up are not available". Poor record keeping was equally identified by Omofade (1991) as a major problem of rating. What this means is that, it is not all the taxable properties within the local governments that are assessed. Of course, rate can only be collected from the owners or occupiers of assessed buildings.

Poor discovery and identification of taxable properties still remains the bane of property tax administration. In 1992 William Dillinger carried out a World Bank-sponsored study aimed at finding ways of reforming urban property taxation for increased yields. The study drew practical experience from many developing countries, including Nigeria. In fact, three major urban centres, namely, Lagos, Ibadan and Onitsha were particularly considered in Nigeria. The startling revelation made by that study is that, "A large proportion of properties are missing from the tax rolls". A situation like this conveys the message of partial geographical coverage in the discovery of property within a given area. Yet, it has been said that, revenue can only be maximised if efficient coverage of areas are achieved (Fayemi, 1991).

A number of possible remedies have been adduced, to stem the problem of incomplete tax rolls, resulting from poor discovery and identification. Owei (1974) and Olu-Ajayi (1991) have both suggested a cooperative effort between the tenement rates office of local government and the town planning authority (or whatever bodies responsible for the issuance of Certificate of Occupancy (C of O), and approval of building plans). Such cooperation may enable the rates office to obtain on regular basis, information on C of O issued, building plans approved, and hence, newly completed buildings.

On another hand, better mapping, involving the production and use of "rudimentary tax maps", and the improvement of other means of acquiring accurate property descriptions, have been suggested (Dillinger, 1992; Encyclopaedia Britannica, Vol. 15, 1983). These tools coupled with constant monitoring, will not only facilitate the process of discovery and identification, but also improve the level of coverage. Tax maps, for instance, which among other things often show parcel boundaries and locations, will "enable the taxing authority to account for all the properties and identify each" (Dillinger, ibid).

2.6.5.2 Problems of valuation and rate setting:

Another set of problems affecting better administration of rates has to do with inaccurate valuation and rating. Valuation for rating itself, has been described as a tricky and complex problem (Kigera, 1973). Fernandex-Falcon, et al (1993) have indeed acknowledged that, "The property-appraisal process is not only difficult, but delicate in nature because appraisal is used to fairly distribute the tax burden". Obviously, property valuation for taxation is a task that requires proficient and dedicated man-power to undertake. Unfortunately, there seems to be a marked dearth of qualified valuers available to local government.

Valuation is a considerably subjective affair, the accuracy of valuation results being greatly dependent on the judgement of valuers. It has been bluntly stated that important aspects of rate administration, especially valuation, are a matter of judgement rather than of fact (Encyclopaedia Britannica, Vol. 15, 1983). A common experience is that some properties are either over-valued, under-valued, or left out entirely either deliberately or inadvertently. Where properties are under-valued or not valued at all, the local government obviously stands to lose. On the other hand where there is a "value judgement higher than the property owner thinks is 'fair'", he may lodge a court appeal against the assessment thereby "forcing the appraiser's office to incur costs (in time and money) to defend the value. These costs can be significant" (Rourk, 1993, p.15).

Both shortage of qualified valuers and paucity of property information are critical issues affecting valuation. This unsavoury situation has been captured elsewhere thus: "Rarely has (the valuer) had the basic information and other facilities needed ... Rarely are staff large enough to make reasonably complete coverage oftener than every four or five years. Yet the pace of change and the amount of new construction are so great as to make many assessments significantly obsolete before a new cycle can correct them. Keeping maps and records up-to-date calls for more continuing work than most (local) governments will support, though modern data-processing techniques offer hope of reducing the burden" (Encyclopaedia Britannica, op.cit).

Dillinger (1992); Fernandez-Falcon, et al (1993); and Rourk (1993) have all reported or suggested some ways of tackling the problems relating to property valuation. For instance, the use of "mass appraisal" - a simple, formula-driven valuation method that is purported to minimize reliance on the judgement of valuers and the honesty of taxpayers - has been suggested by Dillinger as a way of improving valuation accuracy. Also, the use of property tax maps, which normally provide some salient information about property, is said to be a helpful development. Many countries in the United States have been reported by Fernandez-Falcon, et al, as having adopted Geographic Information Systems (GISs) as a tool for improving property appraisal procedures; GIS can equally be used to automatically generate the all-important tax maps. As a matter of fact, in the Philippines, many taxable properties could not be included in the assessment rolls because of the absence of tax maps and other basic assessment tools, reports the Encyclopaedia Britannica (op.cit).

2.6.5.3 Problems of billing:

The effective and efficient administration of property tax are equally seriously hampered due to some problems affecting billing procedures. Billing basically involves preparing and serving ratepayers with Demand Notes to notify them of their tax liabilities, as well as subsequently serving delinquents with Warning Notices, Sealing Notices or even Summons, as the need may arise.

Owei (1974, p.15) identified some major problems, which even today, vitiate effective delivery of bills. First, there is the issue of absentee landlords/ladies. A good number of property owners do not reside in their houses. And since tenement rate bills are mostly served property owners (who in most cases bear the tax brunt), it becomes difficult to serve them Demand Notes and Warning Notices. This problem is often times further aggravated by the non-availability of a comprehensive record of the addresses of "absentee" property owners, or their care-takers, as the case may be. For instance, Dillinger (1992, p.25) has cited the case of Abidjan, Cote D'Ivoire, where an estimated forty per cent of tax bills are uncollectible because the owner's address is unknown.

There is also the problem of identification of houses where bill is to be served. This problem could be encountered in cases where building identification numbers have been defaced or completely removed. For instance, Dillinger (op.cit) reports that, "in Ibadan, Nigeria, so many taxpayers have painted over their tax identification numbers that most tax bills are undeliverable". Owei (1974), p.15) described a similar problem encountered while serving Demand Notes, Warning Notices and Summons, which makes it difficult to identify existing buildings. In his words, "In some cases, ward and plot numbers are painted on walls, buildings and on small wooden boards affixed to the walls while in other cases, they are marked with chalk. When a landlord or caretaker knows that he is owing tenement rate, he removes the ward and plot numbers on the buildings, so that it will be difficult for the council messengers to identify the buildings and serve him notices".

Another serious problem hindering effective and efficient delivery of tax bills is poor street naming and numbering. In some cases, there is confusion about names of streets; there are cases where the same street has different names, obviously unofficial ones (Abubakar, 1974, p.23). Street numbering in some cases, is quite irregular, while some buildings, especially ones located at street junctions, bear double street names and numbers. The study by Dillinger (1992) has actually revealed that "systematic house numbering systems cannot be relied upon in most developing country cities". There is no doubt that unsatisfactory street numbering and naming affect the effective delivery of tax bills. Council workers succeed in identifying some buildings only after much frantic search, while some bills are never delivered at all, since the buildings they were meant for could not be identified.

Some suggestions have been proffered as to how the billing process could be improved upon (see, for example, Dillinger, 1992; Olu-Ajayi, 1991; Akinmoladun, 1993). One activity which is commonly believed will tremendously improve the billing procedure, is computerisation, for effective records keeping and management. Computerisation is seen as the only way to have a comprehensive, up-to-date, easy to handle data/information on property characteristics and locations, parcel boundaries, names and addresses of property owners, and other related matters. Another remedy is that streets should be more systematically and comprehensively numbered for easy discovery and identification of buildings. Also, council workers who serve bills should be armed with "street maps with a functioning street address system".

2.6.5.4 Problems of collection:

The collection of tenement rates is very vital to the financial buoyancy of local governments. It is, in fact, believed that if the collection of tenement rates alone is aggressively pursued, local governments may come to be less dependent on higher level governments thereby strengthening their efforts in their attempts to have autonomous posture (Olu-Ajayi, 1991). However, despite the promising nature of property tax, its collection has always been riddled with some notable set-backs, thus leading to low yields. As Dillinger (1992, p. 24) notes in his work, "Low collection efficiency is a major constraint on the yield of the property tax, and it can offset any gains made from improving discovery and valuation. The available data suggests that typically half of current property taxes are not paid in the year in which they are due".

The collection machinery of property rates have been heavily faulted by Owei (1974) and Omofade (1991). The collection machinery are considered ineffective, due to certain inadequacies inherent in the collection procedure itself. For instance, the considerable time lag between the time a demand note is sent out and the time a warning notice is given, makes it unattainable reminding landlords constantly of their rate liabilities. Also, in some cases not all delinquent or defaulting ratepayers are served with warning notices. Again, since a ratepayer cannot be considered a defaulter until the end of the financial year, this creates a sad situation in which local government collects mostly arrears.

The existence of single collection centre has also been identified as a major factor that delays the collection of tenement rates by the local government. The current practice in almost all the local governments is for ratepayers to go to the local government headquarters to effect payment. The element of discouragement caused by distance should not be ruled out on the part of ratepayers, since a great proportion of them live far away from council headquarters.

Like in the Philippines, under-collection, resulting from inadequate collection techniques, the low pay levels of collecting officials, and a failure to apply sanctions for non-compliance, is yet another common problem of rate collection in most developing countries (Encyclopaedia Britannica, Vol. 15, 1983).

Deliberate tax evasion by taxpayers, is a big cankerworm that devastates the efficiency of the machinery of tax collection. As the Nigerian Tribune observed in its editorial of 27th April, 1987, "If there are shortcomings in the tax administration, as there certainly are, they are traceable to the tax administrators themselves. One major problem is the unholy connivance of tax administrators with taxpayers to evade tax. And because of this connivance, huge property remains untaxed ... Even though the country has a progressive and comprehensive tax policy, the incidence of evasion is a major issue that leaves the nation dry and the evaders and tax administrators fat".

Some reform strategies have been postulated towards improving the collection efficiency of property rates. Dillinger (1992, p.24) believes that, "Success at collection is essentially a matter of information management and leverage: knowing who owes what, and having the means and incentive to induce them to pay". In this respect, he has pointed out the need for data on property tax collections being organized in a way that would permit an accurate analysis of collection performance. Moreover, a very strong case has been made by Dillinger for computerizing billing and collection records - particularly in large cities.

Also, as a way of making property tax collection more efficient, Owei (1974) and Dillinger (1992) call for proper supervision of tenement rates staff and close monitoring of payments with a view to knowing what work they have done, problems confronting them, how many demand and warning notices they served each day, which landlords have rejected the tax on their property, which landlords are defaulting, and how many cases involving tenement rates come up in courts each day.

Both Owei (ibid) and Dillinger (ibid) are also of the opinion that decentralizing collection centres will help make the collection of property tax more effective and efficient. One possibility is establishing collection points in every ward of the local government. Another is allowing ratepayers to make payments in designated commercial banks; the banks will in turn deposit the receipts in the account of council. Odu (1993) believes that apart from facilitating the actual collection of rates, collection of rates via banks will help to obviate the innate tendency for fraud in the system of property rate collection.

Imposing stiff penalties on delinquent taxpayers is seen as an essential strategy to collection enforcement (Dillinger, ibid). Such penalties, it has been argued, will help achieve two things: the first is to get people to pay on time; the second is to get them to pay at all. On another hand, it is believed that if previous rates collected are used in the development of the community, taxpayers will be induced to pay, subsequently. Wraith (1972, p.130) maintains that, "people will pay cheerfully if they see results and will try to evade their obligations if they don't".

2.7 APPLICATIONS OF GIS TO PROPERTY TAXATION

The successful development and implementation of GIS for the purpose of property taxation in various places has been reported in the literature. It seems in all the cases that the main objective for acquiring and operating GIS is to manage information in such a way that the process of acquiring and manipulating data is made as simple as possible (Scholten and Stillwell, 1990). Presented here is a review of some selected cases, just to illustrate some property rating operations which GIS could be used to accomplish.

Huxhold (1991) provides a detailed discussion on some of the practical applications of the Milwaukee urban geographic information system. The Milwaukee system was installed in 1976 and has since been used in a variety of applications. In various ways the City of Milwaukee uses the system in property taxation. For instance, the city uses the system to generate assessor's maps containing graphic representations of the legal property descriptions. The assessor's plat maps are used for the assessment of properties for the purpose of taxing their owners.

The Milwaukee system also affords the city the opportunity of easily identifying the locations of all tax delinquent properties throughout the local government. By extracting all the addresses from the City Treasurer's tax delinquency database and matching them to parcel I.D. numbers in the geographic database, it becomes easy to generate a map showing the spatial distribution of all tax delinquent properties throughout the city.

Winnipeg, the capital city of the province of Manitoba, operates a city-wide integrated Land Base Information System (LBIS), reports Forrest (1993). In 1988, the city was said to have signed a five-year Memorandum of Understanding with the province of Manitoba to develop a digital property base map. To support the digital property mapping and develop digital property assessment maps, the McDonnel Douglas' (now EDS') GDS software was selected and installed by the city.

Marin County, a municipal settlement located north of San Francisco, USA, has a GIS installed mainly "to provide an inexpensive, central database retrieval and update system for all planning and permit data in the county", say Prastacos and Karjalainen (1990). The system is known as the Marin County Network System (MCNS).

The MCNS was particularly necessitated by the fact that "Data exchange between county government on one side and city/town governments on the other (was), in many cases, very low and incomplete, resulting in improper property assessments". Moreso, "the County Assessor's Office and planning agency became aware of new developments at the city level long after they were already computed. As a result, supplemental tax assessments were delayed for long periods of time, costing the cash-strapped county a lot of money ..." (ibid).

The MCNS has an on-line central database which consists chiefly of the County Assessor's `Master Property File', which contains information on owners, assessed value of land and improvements, new building permits, etc for all parcels within the county. As Prastacos and Kerjalainen report, the central database assist the county in a number of ways. For instance, the database enables the County Planning Department and Tax Assessor's Office to instantly become aware of any changes on the status of any given parcel as soon as they are recorded at the local level. Thus, given the new development the Assessor's Office can promptly embark on property re-assessments and send supplemental tax bills as soon as (or even before) property improvements are completed. Equally, the MCNS database contains a mailing label module, designed to expedite and automate the process of mailing notices and reminders to any selected parcel owners. Once the database is filtered and deserving parcels are selected, the system would automatically print mailing labels for those parcels only.

The Lillydale Land Information System is yet another classical example of successful application of GIS to property tax administration. Lillydale is a settlement located on the metropolitan fringe of Melbourne, Victoria, Australia. Gallagher (1992) shares implementation experiences of the Lillydale system.

The Lillydale system has two independent databases. These are the Land Information made up of map-based graphics, and the Property/Rating database. A mapping interface or communication link was introduced into the system to enable the integration of the two databases, at will. The linking mapping interface thus "enables queries or requests to be sent from the mapping system to the property/rating system to allow the user to retrieve information such as owner, address, rate details or other information" (ibid).

Gallagher also presents some notable achievements which have been recorded by Lillydale in property administration using its Land Information. The system enables council to interface between Land Information and Council's property/rating system for some queries and generation of property information. The system equally allows council to carry out multi-parameters searching of the map base for graphics display. In the same vein, council could obtain formatted outputs (hard copy) of graphic data (parcels) and property related information (attributes). In addition, using the system, council can automatically generate mailing lists from all levels of property enquiries. This would allow standard letters, dealing with many issues, to be sent to property owners.

The success story of GIS application to property appraisal has equally been told using the Orange County Property Appraiser's (OCPA) GIS project as an example (see Rourk, 1993). Orange County is in Florida, USA. Rourk has painted a post-implementation analytical picture of the application as well as the tangible and intangible benefits of the Orange County system.

The city of Orlando shares in the Orange County GIS project. The city particularly manipulates the permit and Certificate of Occupancy (C of O) module of the GIS to carry out property identification look up. The OCPA GIS also has a computer-assisted mass appraisal (CAMA) module. The CAMA system enables OCPA to generate appraisal map products. This way OCPA appraisers can have direct access to on-screen valuation maps, property improvement maps and to a form-based "ad hoc" plot query. This helps the appraisers to obtain better value judgements and accurate ownership information.

Using the GIS program OCPA appraisers are able to embark on a more systematic "house-to-house" appraisal of property. "This house-to-house procedure", says Rourk, "improves the quality of the assessment records by increasing their accuracy and reliability". The system also allows for more frequent review of all properties, thereby increasing the accuracy of property records held in the system.

In summary, implementing the Orange County Property Appraisal GIS has resulted in "more reliable, defensible data, decreased error rates, and increased availability of data, statistical models, and advanced choropleth mapping in a property appraisal office" (Rourk, 1993).

It should be noted that almost all the cases of GIS application to property taxation reviewed above and in other publications, have to do with the valuation of the physical land (parcel), and not the buildings on them per se. However, the PRAGIS system of this research project deals specifically with the management of information relating to individual tenements (buildings) for various purposes such as the assessment of tenements for the purpose of taxation or generation of tax maps, and so on.

2.8 THEORETICAL FRAMEWORK

The introduction of tenement rates into the local government system was predicated upon the need to have local government generate enough internal revenue for the provision of socio-ecnonomic facilities and services to the grassroot. But for the full potentials of tenement rates as a source of revenue to be harnessed, it must be properly administered.

Proper execution of tenement rates entails a whole lot of things. It calls for having comprehensive, and up-to-date records of all the taxable properties within Council. This means therefore that there must be a system based on rudimentary tax maps that allows for comprehensive discovery and identification of rateable property to ensure adequate geographical coverage. Moreover, there must be a valuation system that ensures just and easy assessment of each individual property. To this end therefore, a mass valuation system (MVS) that is formula-driven and hence minimises reliance on the oft subjective judgment of valuers, is needed for improved valuation accuracy. This requirement becomes quite critical especially when one considers the fact that apart from being a source of revenue to Council, tenement rating serves also as a means of equitably distributing the tax burden, hence wealth. Timely notification of property owners of their tax obligations through the billing process is yet another indispensable precondition for efficient and effective property tax administration. Besides, for proper execution of tenement rates to be achieved, a functional and reliable collection machinery is a must. There has to be, therefore, a rates collection monitoring system that readily identifies major delinquents and, where they can be found, enhances collection efficiency.

However, it must be stated that if tenement rates administration is to record any appreciable degree of success, the relevant information must be made readily available and also properly used. If rates administration is to be successfully accomplished, a comprehensive, accessible and reliable reservoir of geographical data is quite essential. Wherever the basic data on which the property tax is to be based is inaccessible or unreliable, base maps on which property discovery and identification would be based are non-existent; the market data on which valuations are based is unreliable, and data on property ownership is inaccessible, rates administration is bound to be extremely difficult and yields will consequently be substantially low(Dillinger, 1992).It therefore follows that, data base should be of utmost consideration, if rates are to be intelligently and appropriately administered. Ayeni(1987) strongly asserts that, "The use of modern data handling devices such as computers and development of computerised...information systems readily suggest themselves especially if all the property are to be identified, valued and the requisite rates collected."

However, for information to be useful it has to be timely, properly managed, disseminated, and easily accessible. This notion was accountable for the development of the concept of information management/information systems. Muhammed Musa-Booth, the Assistant General Manager - Public Relations of NEPA, has identified information management as the pivot of modern business environment, noting that information has to be properly managed for any business to succeed. In short, to Musa-Booth, "your ability to collate information, process it and communicate it to your customers will go a long way to determine your success or otherwise" (NEPA Review, July-September, 1996, p.14).

In view of the difficult and intricate nature of the processes of tenement rates administration, there is need for a markedly radical departure from the current manual approach as used in most developing countries such as Nigeria. The manual processes of tax administration hardly can allow for the full realisation of the goals for which rating is embarked upon. The current processes therefore need to be revolutionalised. A more scientific and technologically advanced system is , no doubt, needed. In short, there is need for a better system of property tax execution. Unarguably, "Better administration involves a number of things. One is better mapping and the improvement of other means of getting accurate property descriptions. Another is more sources of data about values and more sophisticated approaches to valuation." (Encyclopaedia Britannica, Vol. 15, 1983).

The new system being conceived as a possible replacement to the manual system, should make for a more precise, purposeful, objective, and fruitful execution of property taxation. In addition, the conceived "better" system will make for easy capture and input of property records, ensure proper and easy management of the records, provide efficient data storage/update mechanism, allow for quick retrieval, query and manipulation of property records, provide a means of timely generation of reports in various output formats (text, tables, maps, graphs, etc.). Given the present state of scientific and technological exploits, it is only a computer-based system that can match the above stated standards. This means therefore that for property taxation to be effectively and efficiently administered, a computer system, is most preferred.

The above view has at one time or the other been expressed in various quarters, by different experts. For instance, Ayeni (1987) agrees with the fact that "The use of modern data handling devices such as computers and the development of computerized urban information systems readily suggest themselves especially if all property are to be identified, valued and the requisite rates collected." Even before Ayeni wrote, Morson and Knepper (1987) had already warned that, "If tax practitioners continue to perform their services using traditional manual tools, it will not be too long before the demand for tax services far outstrips the capacity of practitioners to render them; There will simply not be enough people available to do the work." They went on to conclude that "If we in tax practice are to survive, we must maximize our use of the technology of the 80s(referring to Personal Computers)."

Thinking along the same line with Morson and Knepper, Miller and Moody (1982) have even tried to highlight some of the benefits acruable to a tax practitioner using miccrocomputers for his operations. In their words, "The arguments in favor of using computers in the tax practice remain unchanged from [twenty-three] years ago -- computers relieve the practitioner of the drudgery of error-prone number crunching, and thereby allow him to spend more time being creative (experimenting with more planning ideas and alternatives) or, at a minimum, to get more work done (or even take some time off)." Again, they solidly affirm that "The age of 'personal computing' for the tax professional has arrived. The tax practitioner needs to be more aggressive about integrating the computer into his daily professional life..."

The idea of employing computers in the processes of property taxation is a very popular and indeed plausible one . At least it will in more ways than one ease the tax practitioner's job. Nonetheless, it is stoutly believed that given the spatial nature of property information and property tax administration, it is not just any form of automated technique that will do; a special computer-based system is required. Property rate administration, like most other functions of local government, is parcel-related, hence about 60-85 per cent of the data involved are geographical in nature (De Gouw, 1990; Etc.).

An appropriate automated system for property taxation must therefore be such that will be able to accept property data held in various formats, e.g. graphics format, or attribute(descriptive) format. The system should also allow for the efficient storage, editing, update, retieval, manipulation, processing, and geographical analysis of both the graphic (cartographic) and the non-graphic (attribute) data. Moreover, it should be possible, using the system, to generate reports/outputs in various forms such as graphics (maps, diagrams, charts), tables, or texts.

The above painted picture readily suggests that the most suitable technology that can effectively be used to handle property tax administration is the GIS (geographical information systems). It should be pointed out that, a GIS is not an end in itself; rather, it is a means to an end. To put it more bluntly, as in the words of Rourk(1993), "GIS is no saviour."

Nevertheless, as Rourk also reasons, "the automation of data [especially property-related data], requires a more thorough understanding of the who's, what's, and where's associated with the data." The "where" is obviously the most critical issue in the over all processes of tenement rates execution. GIS is well equipped to tackle that question since it has to do with the phenomenon of location. Tomlinson(1968) who could be regarded as the father of GIS, says that the basic capability of GIS is that it accepts and stores all types of location-specific information, that is, any information which can be related to an area, line, or point on a map. In fact, "the underlying factor that justifies GIS use is location." (Vachon, 1993).

The goals of tenement rates administration cannot be maximized witout the use of geographical information system. The potential benefits of the application of GIS to tenement rate execution are legion and rather inestimable, especially given the fact that some of the benefits are tangible while some are intangible. One indeed cannot but agree with Rourk (1993) that the implementation of GIS for property assessment can increase public confidence in the Valuation Office. According to Rourk:

> "public confidence can be increased due to a perception that a government agency uses advanced ("state-of-the-art") technology. If, in the property assessment field, a citizen feels his property is not valued correctly and visits the assessment office, an appraiser will discuss the valuation method and results with the citizen. When the citizen is treated properly and high-tech tools are used to demonstrate both the derivation of value for his property and the equity of surrounding neighbor properties, the citizen is more likely to be satisfied with the results. He will have confidence that the appraisal staff is professional and well equipped to perform their statutory responsibilities."

Another reason one would conceptualize the use of GIS as a more suitable technological alternative for property tax administration in Nigeria is that, GIS will improve operations by making data more accessible, which results in better decision making and resource allocation (Vachon, 1993). And talking about the all important relationship between data and better decision making in relation to property rates execution, Rourk (*op cit.*) submits thus:

> "The benefits of better decision making can be understood by examining the costs associated with poor appraisals generated from erroneous data. A factual error or a judgment error can have an expensive effect in property taxation. If the error helps generate a value below that of which the property owner thinks is "fair market" value then a property owner rarely complains. Under-valuation of the property results in lost property tax revenue.
> If an error leads to a value judgment higher than the property owner thinks is "fair", then a complaint is often forthcoming. At a minimum, a phone call will be made where staff time will be required. Even if it is a simple factual error that can be corrected without field verification the process can take upwards of an hour. When a "suitable" resolution is not achieved, the property owner can appeal the assessment forcing the appraiser's office to incur costs to defend the value. These costs can be significant."

Meaningful execution of tenement rates hinges largely on the availability of geographical information: the right information must be available, at the right time, in the right quantity and quality, must be easily accessible, and must be properly managed. The right data ensures the right decision, the right decision makes for proper execution of a project, and a project properly executed culminates in achievement of set goals and objectives. "The data needed to ensure better decision making for sustainable development absolutely requires GIS technology," (Strong, 1992).

Thus far, attempt has been made to theoretically link rates administration, geographical information, and geographical information systems. The argument here is not that the provision of an organised geographical database for rates administration is an end in itself, but rather a means--an indispensable means-- to an end. To borrow the words and thoughts of De Man(1990), "The thesis that information should support managerial activities does not imply that information is a sufficient condition for good-management; information is only one factor." Effective administration of rates to boost revenue is an end, a geographical database which provides relevant spatial information is a means to that end. Without a well grounded geographical knowledge provided by maps, it will be virtually impossible for us to effectively deal with problems of the assessment and collection of taxes and rates, among other things (Mabogunje, 1982).

The key logical argument of this thesis, therefore, is that for property rates(and indeed any other type of rates) to be successfully administered efficiently and effectively, map-based geographically referenced data must be adequately used; for geographically referenced data to be properly used for this purpose, it has to be well organised in a spatial database form; and for the spatial database to yield desired results, it has to be handled and managed with a geographical information system (GIS). GIS, it is believed, will make the data more dynamic, flexible, accessible, easily manipulated and analysed, easily updated, and capable of being used to generate new map products and reports for rating and decision making, which otherwise would be difficult or even impossible to do.

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 INTRODUCTION

This research was carried out through a number of processes and techniques. Figure 3.1 illustrates the various processes and tasks undertaken. The methods adopted in analysing the existing (manual) system of property administration in Lagos Mainland and the results obtained are discussed in this chapter. Also discussed is the process-model of automated property rates database implementation which was used in this research. The techniques used for data collection, analysis and result presentation are equally discussed. In order to achieve the objectives of this research, a Property Rates Administration Geographic Information System (PRAGIS) was designed, developed and implemented. In developing the PRAGIS the modified and expanded version of the GIS Structured Design and Evaluation Model, originally developed by Calkins in 1972, was partially adopted. (A brief explanation of this model has already been provided in sub-section 2.5.6 of chapter 2).

3.2 ANALYSIS OF PROPERTY RATES ADMINISTRATION IN LAGOS MAINLAND

System analysis forms a very crucial link in the overall process of system development and implementation. Simply put, system analysis is the process of evaluating or analyzing a current system to determine if it should be modified or replaced by a new system (Ingalsbe, 1989). The analysis phase of system development tries to answer a number of preliminary questions (Rosove, 1968). Why is the system needed? What is its purpose(s)? What specific task(s) is it expected to perform? What problems is it supposed to solve? Who are the system users? What are their goals and objectives? and so on. In a nutshell, system analysis is concerned with identifying WHO need the system and WHAT the system is needed for (i.e. why the system is needed). Moreover, system analysis enables one to ascertain the information needs, as well as existing information resources of the intended users of the proposed information system. The rest

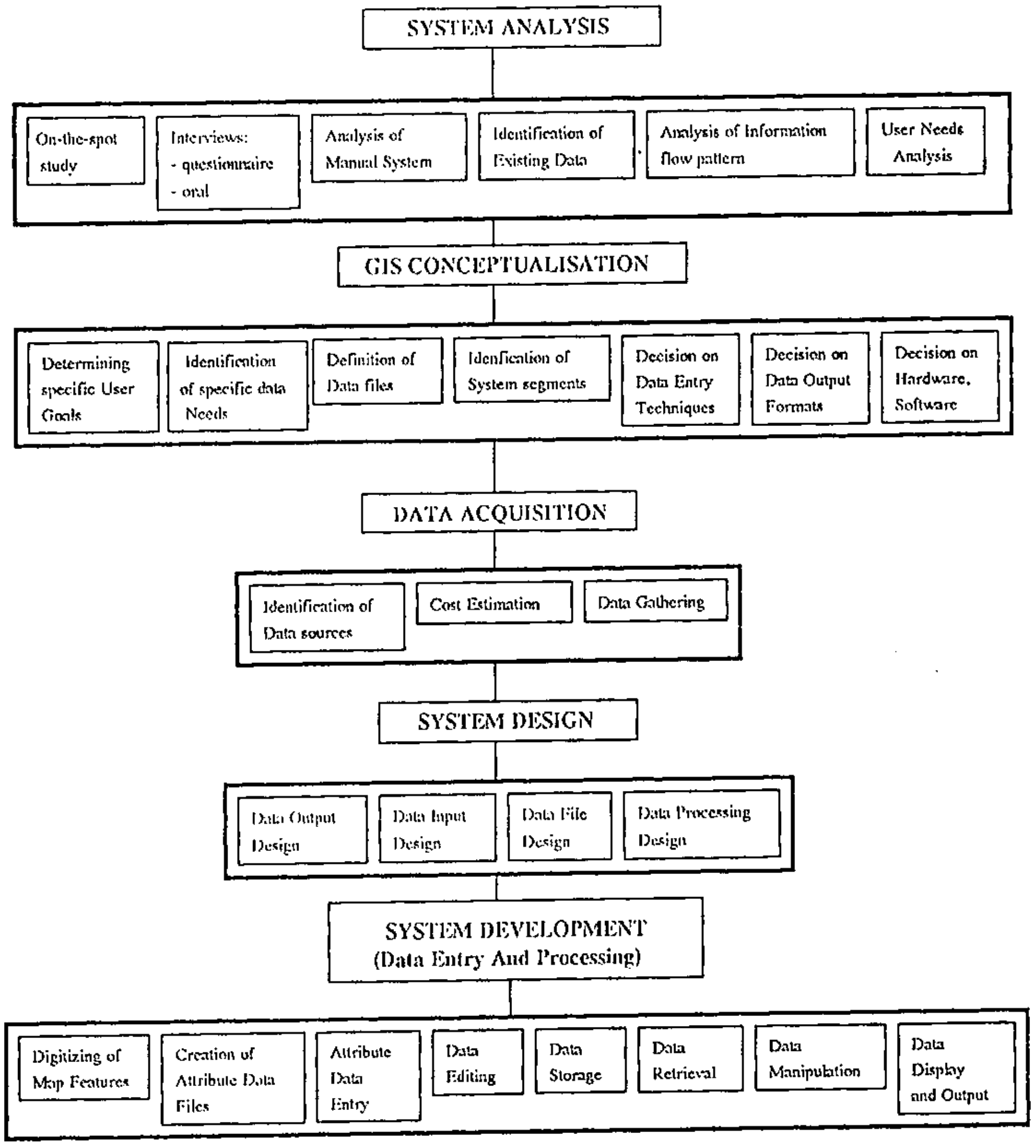


FIG. 3.1 RESEARCH METHODOLOGY

of this section is devoted to a discussion of the system analysis carried out in the Lagos Mainland Local Government in relation to property tax administration.

3.2.1 OBJECTIVES OF THE SYSTEM ANALYSIS

The administration of property tax in Lagos Mainland Local Government is a completely manual affair. Currently, no aspect of this operation is either semi- or fully-automated. The analysis was aimed at studying and understanding the manual processes of property rate execution in the Council. Also the desire to know and appreciate the problems stifling the effective operations of the Council in the area of rate administration, formed part of the prime factors necessitating the analysis. One other reason that prompted the analysis was to find out the existing information resources of council in relation to rate administration, and to ascertain the formats in which the information exists. Knowing the geographical information needs of the council with respect to tenement rate collection was equally part of the aim of the analysis. Another aim was to determine the type and scale of existing maps used in rate execution, and the manner and level (extent) to which the maps are used.

3.2.2 PROCEDURE

In analysing property rates administration in Lagos Mainland, a combination of two basic approaches was adopted namely interviews and on-the-spot assessment.

3.2.2.1 Interviews:

Both questionnaire and oral interviews were conducted among the staff of the Tenement Rates Office. The interviews were conducted to ascertain the specific functions needed to carry out for appropriate rate administration. The interviews were also conducted to know the specific geographical data and other data used by the Tenement Rates Office. The third reason the interviews were held was to understand the peculiar problems facing tenement rate administration in the Lagos Mainland Local Government Area.

3.2.2.2 On-the-Spot Assessment:

Following the outcome of the interviews conducted, it was discovered that the council follows a five-stage process in the administration of tenement rates. This is very much in conformity with the assertions of Dillinger (1992). The five stages are property discovery/identification, property valuation, rate setting, billing, and rate collection.

Understanding the tasks involved in each of the five stages and the exact manner in which council workers performed the tasks, was made a priority issue in the system analysis. Consequently, a 5-month on-the-spot study was planned and executed, to gain first-hand experience of the processes of property tax administration in the council.

The five stages involved in property tax administration are briefly discussed below. It should, however, be noted at this juncture that the operations of the Tenement Rates Office, are closely guided by the provisions of the Lagos State Tenement Rates Edict of 1989.

Stage 1: Property Discovery/Identification:

The task of property discovery involves taking an inventory of new physical developments in the property market. This task is achieved through organised property survey. Discovery of property is usually of great importance to council. This is so because the exercise yields vital property information for the purpose of valuation.

Acquiring the relevant information is a task that demands Council's Valuation Officers making necessary inquiries about the building, taking physical measurements of the building, taking inventory of the facilities available as well as the materials with which the house was built (or renovated), and also placing an aesthetic value on it based on design and finishing.

All the information thus acquired is used to either open new files (in the case of newly constructed buildings), or update the existing records of renovated or reconstructed houses. The property records are used to determine the gross value and the rateable value of each building.

Stage 2: Property Valuation:

When a newly built or renovated property is discovered, a survey or inventory of that property is made. As noted above, the survey enables the estate surveyor to acquire some vital information about a property. The records pertaining to a property are used by the estate valuer to determine the gross value of that property, for the purpose of taxing. Gross value remains the basis of valuation of all properties not only in Lagos Mainland Local Government Area, but in the whole of Lagos State.

The set of information used to determine the gross value of a property usually depends on the type of property (e.g. detached house, wing of duplex, bungalow, etc.), the use to which it is put (e.g. residential or commercial), its rental value (as approved by government), and the rating zone (neighbourhood) in which it is located.

Demonstrating with three examples will help highlight how valuation is carried out in the Council. We will try to determine the gross values and rateable values for (i) a residential building, (ii) a commercial building, and (iii) a mixed residential/commercial building.

Example 1: Assessing a Residential Property:

To value a domestic building certain information about the building are usually required. Such information include building type (e.g. bungalow, detached house, duplex, block of flat, etc); number of bedrooms, floors, flats, etc; rating zone; rental information (e.g. annual rent per room or flat, etc). Assuming the valuation officer is interested in determining the gross value of a tenement having seven (7) rooms. He will use the following procedures:

Number of rooms	=	7
Annual rent per room	=	₦480
Gross value	=	No. of rooms X rent per room/annum
	=	7 x ₦480 = ₦3,360
Gross value	=	₦3,360.

Having established the gross value, the next thing is to determine the rateable value of the property. To obtain the rateable value of the same building, all the valuation officer needs to do is to determine 25% of the gross value and deduct it from the gross value; whatever remains then becomes the rateable value. For instance, the rateable value of the property considered above will be:

Gross value	=	₦3,360
Less 25% outgoings	=	840
Rateable value	=	₦2,520

Example 2: Assessing a Commercial Building:

To appraise a commercial premises the valuer needs some basic information relating to that property. Among the information he will need are accommodation type or particulars (e.g. office, factory, shops, restaurant, warehouse/store, etc); physical dimensions of the accommodation, hence the total area. Following is the valuation of a block of six (6) office rooms, each measuring 3.03m x 2.95m.

Particulars	Dimensions	Area	@	Gross Value
Offices: 6 Nos. Rooms	3.03m x 2.95m each	$8.90m^2 \times 6 = 53.40m^2$	₦120/m^2	₦6,408

Having determined the gross value, to obtain the rateable value of this commercial building the procedure specified in example (1) above is then followed.

Example 3: Assessing a Mixed Residential/Commercial Property:

In assessing a property which has a mixed use, the valuer combines the two preceding approaches mentioned above. In this case he carries out a separate valuation of the portion of the property used for domestic purposes, and does same also for the section used for commercial purposes.

Stage 3: Rate Setting:

Rate setting is the third stage in the overall procedures of tenement rate administration. Basically, it is a process by which the actual tax payable by a property owner (for his property), is determined. The moment the rateable value of a property is fixed, the next move is to work out the tax or rate to be imposed on the building owner.

It should be noted that property tax is fixed based on the rateable value of a building, and not on the gross value.

In the Lagos Mainland Local Government Area, a property owner is made to pay 10% of the rateable value of his property. Thus, the owner of the property considered in example 1 of stage 2 above, will be liable to a tax of ₦252.00.

It is usually the duty of the valuation office to set the rate for each of the assessed property.

Stage 4: Billing:

The Billing Unit of the Tenement Rates Branch is responsible for a number of tasks. It is the responsibility of this section to prepare the bills or demand notes finally sent to ratepayers to notify them of their tax obligations and also to request them to come forward and fulfil same. Another duty performed by the Billing Unit is the writing of Reminders or Warning Notices as well as Sealing Notices to defaulting ratepayers.

Stage 5: Rate Collection:

The rates collection arm is fully devoted to property tax collection. Hence, it is the duty of this section to serve bills (especially demand notes), and to compel ratepayers to comply. However, by virtue of the nature of their duty, the rate collection staff are also somewhat involved in property discovery and identification.

3.3 PROBLEMS OF TENEMENT RATING IN LAGOS MAINLAND LOCAL GOVERNMENT AREA

Certain problems were actually identified as hampering the effectiveness and efficiency of the Lagos Mainland Local Government Area in the execution of tenement rates. The problems include shortage of staff, poor staff remuneration and general welfare, logistics problems, especially lack of vehicles for routine fieldwork. The problem of houses that have changed ownership without notification to Council is also another common problem hindering effective billing. Lack of cooperation on the part of tenants, equally hinder the smooth execution of rates. Some tenants may blatantly refuse to disclose to the rates officers, important information about their landlord or property.

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Irregular street numbering, especially in the Iwaya area, was also identified as a major problem of rate administration in the LGA. This problem makes it quite difficult, or even impossible, for the rates officers to locate certain buildings, during distribution of bills or revenue drive. Incomplete property records is yet another serious problem of rating within the Council. This problem manifests itself either in form of missing address of a house owner, or unavailability of information on certain characteristics of a building.

3.4 WHY ADMINISTER PROPERTY TAX

It was Justice John Marshall who once noted that, "the power to tax is the power to destroy". However, some years later Justice Oliver Wendell Holmes, Jr. apparently countered Marshall's view with the statement that "taxes are the price we pay for civilization".

Local government does not impose property tax on the citizens to punish them, but rather to 'polish' the services rendered to them. As with every other local government in the country, the Lagos Mainland Local Government (LMLG) embarks on the administration of tenement rates for a number of reasons.

The top-most goal of Council in collecting rates is to generate funds for effective financing of the local government. Another important goal of Council in collecting tenement rates is to bring about the distribution of wealth. In this part of the world, a man's wealth or worth is measured by the property (land and building) he owns. Moreso, it is the generally held belief that a man who owns a property enjoys more public social services than his counterpart who does not own any. Hence, it is only reasonable to make the property owner pay more for the higher level of social services he receives. And the best way to achieve this is to impose on him a property tax based on the value of his tenement. It should however be noted that, as in Butler's (1986, p.265) view, rates are not a charge for services; they are a tax on property. Thus, whereas Council provides a number of services for its citizenry, only those who own property pay rates.

3.5 PROPERTY INFORMATION RESOURCES OF LAGOS MAINLAND LOCAL GOVERNMENT AREA

Effective administration of tenement rates is impossible without a well-maintained, comprehensive and up-dated property information reservoir. Understanding the information resources of an organisation is a pre-requisite to developing an appropriate and workable information system for that organisation.

It was in regard to the above two assertions that a conscious, concerted effort was made to fathom the existing property information resources of the Lagos Mainland LGA. What follows shortly, therefore, is a synopsis of the available information used by Council in the execution of property tax. To aid better understanding, the discussion has been split into two parts. The first part dwells on geographic or cartographic information while the second centres on attribute (descriptive) information.

3.5.1 Cartographic Information:

The analysis of the existing cartographic information of Council in relation to property rates administration started with some questions considered vitally important: What maps are available? Which maps are used? What are they used for? What piece of information on the map(s) is relevant? How often are the maps used? To what level are they used? How often are they updated? Where do they get the maps? What problems do they encounter getting or using the maps? Are the available cartographic information enough? ....

Currently, there is a very low level of map use in the overall administration of property tax in the local government. As a matter of fact, only one type of map is presently available in the Council for the execution of tenement rates. The map entitled: "Administrative Map of Lagos Mainland Local Government Area", was drawn at a scale of 1:8,000, and was compiled from aerial photographs taken in 1987. The map was published by the Works Department of the local government. It was however designed and produced by Metrographics Ltd.

Basically, the Administrative map contains street names/layout, expressway/dual carriage way, major roads, electoral ward boundaries, railways, wetlands and some water bodies. Also shown on the map are locations of some prominent social amenities and infrastructural facilities such as hospital/dispensary, post/telegraph, offices, police stations, schools, hotels, churches, mosques, markets, sports centres, cinema/theatre, and industries.

To say that this administrative map is not ideal for dispensing tenement rates is merely to state the most obvious. However, the staff of the Tenement Rates Office still use this map occasionally to assist them in their revenue drive efforts. Particularly, this map is used by the staff as a street guide during the distribution of demand notes, warning notices and sealing notices. To some extent, the administrative map is also used for property discovery. Since the field workers carry this map during revenue drive, it often comes handy as a base on which to make rough indication of the location of newly discovered property. In addition, the administrative map assists the Tenement Rates Office in preparing work orders and planning revenue drive strategies. The delivery of bills to ratepayers is usually executed on a street by street basis. To ensure that no street was left out, so as to achieve adequate coverage of the entire LGA, the rates office adopts a sequential approach. By this strategy a street is attended to only after the street before it has been fully served. To maintain this orderly approach the administrative map is used to delineate the LGA into blocks of streets and then to determine the starting point and order of movement of rate workers.

Despite the fact that it is only the administrative map that was available in the tenement office, it was further discovered that this map was seldom used. The major reason adduced by the rating officers for the infrequent use of the map is that the map did not contain much of the important spatial information they need such as locations of individual parcels and buildings, street numbering, and some landmarks. As earlier stated, this map was compiled from photographs flown in 1987; but it has not been revised and updated since it was first published. Apart from shortage of funds, other major factors hampering the provision of maps for tenement rating in the LGA are failure of the Council's Executive arm to realise and recognise the cardinal role maps play in rates administration, as well as lack of any mandate to the Works department to either produce or procure the relevant maps for rating.

The valuation of a property to determine its gross value obviously requires the use of some sort of map. A tax map or even plan showing the property layout, is most desirable. As at now such maps or plans are non-existent in the local government. What this simply means is that for a property to be assessed the assessor has to be on the site to take physical measurements of the tenement and to take some counts of, for instance, the number of bedrooms, flats, etc. This was exactly what the various estate survey/valuation agencies contracted by the Lagos State Government in 1990 to re-assess all the properties in the State, did. No doubt, this must be a most cumbersome and time-wasting endeavour. One good thing about that 1990 exercise, however, is that through it current' property outlines and layout (block) plans have been generated for some of the tenements in various parts of the State. The property outlines and layouts for a good number of properties in the Lagos Mainland Local Government (LMLG) have been generated and are stored in the files also containing the valuation sheets for each property. Such files are not in the local government headquarters, they can only be found in the Valuation Office, Department of Environment, Lagos State Secretariat, Alausa, Ikeja. However, it should be noted that the scale at which the property outline and layout (block) maps were drawn was not indicated. Of course this is a very serious omission which needs to be rectified if the maps are to be used for any meaningful measurements and calculations As at now, due to the absence of scale the property outlines and block plans look more or less like `polished' sketches.

3.5.1.1 What information is lacking?

From all available indications, the LMLG is grossly lacking in cartographic information held in map format. This accounts for the observed low level of map use in the administration of property tax by the Council.

For effective and comprehensive discovery of rateable property, a functional large-scale township map is needed. Also needed is a cadastral map. These maps will assist the local government in easily tracking down new developments in the property landscape, and also to easily identify the actual location of each property. Where up-to-date township and cadastral maps exist, it would not take Council so long a time before becoming aware of the existence of a newly constructed or converted building. With these maps in place, cases of property missing from the tax roll will be minimised, if not entirely eliminated.

As already indicated, the local government needs very large scale plans for all the property in the area. The valuation office needs such plans together with the cadastral maps to make accurate measurements and counts, for proper valuation. The cadastral maps will be used to acquire information on the areal dimensions of each parcel. The plan, on the other hand, should be such that the valuation officer will be able to get from it information on number of rooms or other dwelling units, and their measurements. Where all these vital information are not handy the valuation officer would need to personally visit the building to take on-the-spot counts and measurements. This could be time-wasting.

At present, Street Guide and Township maps are glaringly missing from the cartographic base of the Council. Yet the rate collectors need such maps to enable them move more intelligently around the area. The problem of not being able to locate some property by revenue collectors is more real than apparent. Some bills or warning notices have had to be returned because the property for which they were written could not be traced. Such bills or notices are usually returned with the demoralizing inscription "UNSEEN", boldly written on them to indicate that the rate collector was unable to locate the building.

3.5.2 Attribute Information:

An attribute database basically contains information describing the characteristics of certain locational or cartographic data. A cartographic or locational data is just a graphical (map) description of some features. But such a feature has some inherent attributes or characteristics which may not be shown in graphic format. The attributes are thus presented in tabular format.

The property cartographic database of Lagos Mainland Local Government (LMLG) was discussed in the preceding section. All the locational features like parcel boundaries, property outlines, plan (block) layouts, roads, etc mentioned above as part of the cartographic database of the Council, have some attribute information with which each could be identified. The LMLG is clearly richer in property attribute information resources than in cartographic information resources.

The Tenement Rates Office maintains some vital records of each of the more than 31,500 taxable properties within the Council. Two separate files are kept for each of these taxable properties. One file harbours the Valuation Sheet, the other contains the General Rate Card. The Valuation Sheet is used to store property records and rental information used by the valuation officer to appraise a property for taxation.

Two kinds of valuation sheets are maintained. One is for residential property, and is code-named LSVO/03. The other is for non-residential or commercial property; with code LSVO/04. The files containing the valuation sheets are the *bonafide* property of the State government. Hence they are kept under the custody of the Valuation Office, Department of Environment, Lagos State Secretariat, Alausa, Ikeja. The valuation sheets are therefore not found in the local government headquarters.

The General Rate Cards, on the other hand, are the property of the local government. Thus one can have access to them at the local government headquarters. Such cards are basically used to enter records of payments made by ratepayers, although they equally contain some skeletal but vital information about a property. Unlike in the case of valuation sheets, the General Rate cards for both residential and non-residential properties are of the same format. A typical General Rates Card contains important information such as the Area Office to which a tenement belongs, name and address of property of a property owner, gross value, rateable value, tax liability, rate payment record, and so on.

Valuation Sheet (Residential Property)

Each valuation sheet for residential property can furnish a whole lot of information. It should be noted that the valuation sheet for residential buildings is divided into two major sections. The first section gives information about the main building while the second section contains information about the out building (Boys' Quarters), if any.

Valuation Sheet (Non-Residential Building)

The Non-Residential property valuation sheet bears information on both sides. The front page contains property records, while the back page carries valuation results based on the processing of the property records. The preliminary or introductory property details on the front page are similar to what we have on the valuation sheet for residential buildings.

The General Rate Card

The general rate card, a property of the local government, is designed to bear records of payments made by a ratepayer. The card could be used to enter payment records for upwards of ten (10) or more consecutive years. Each card can furnish pieces of property information.

3.6 A PROCESS-MODEL FOR PROPERTY RATES ADMINISTRATION DATABASE IMPLEMENTATION

Information is one of the most invaluable assets any organisation can possess. Doubtless, in these modern times, information is yet another factor of production. The value of information is fast appreciating with every passing moment. Organisations are becoming more and more aware of the need to have and maintain a wealth of information. Intelligent management decisions can only be made based on timely, accurate, comprehensive, meaningful and usable information.

However, for organisation to have a rich and useful information resource, this information has to be acquired and handled with utmost care and efficiency. This obviously demands putting in place a state-of-the-art information management system. To a very considerable extent, information is as reliable as the technology used to manage it. It is an irrefutable fact that computers are the most modern tools of handling and communicating information. Consequently, many organisations - both public and private - are fast embracing the computer technology for the analysis and management of their information resources.

Undoubtedly, one of the institutions in the forefront of utilizing the computer technology is the local government, especially in the more technologically advanced countries. And one area that computers are mostly used is the automation of parcel-related records. The reason for this should be easily understandable in view of the fact that between 60 and 80 per cent of the functions of the local government is said to be parcel-related. In other words, 60-80 per cent of the data used by local government is geographical or spatial in nature.

Because of their peculiarities, spatial data are often managed using special information systems namely, geographical information systems (GIS). Since most of the data/information used by local government are spatial in nature, this explains why GIS are fast becoming commonplace in local government administration, especially in developed countries.

Geographical information systems are usually developed to meet the data/informational needs of particular users. Meanwhile, "The planning and design of a GIS is common with those of any other information system or with planning and design in general and can be characterized as a sequence of decisions and choices. For example, choices have to be made concerning its mission, the users and their needs, the spatial references to be adopted (geocoding), its performance and the software and equipment to be applied" (De Man, 1990).

Several methods of designing information systems exist. However, in abstracting the Conceptual Property Rates Administration GIS Design Model which is herein discussed, the Strategic Choices approach was adopted. (For a fuller discussion on the Strategic Choices method, the interested reader can see Friend and Hickling, 1987; Sutton, Hickling and Friend, 1977; De Man, 1990). In a nutshell, the strategic choices approach looks at the process of planning and design of an information system as a sequence or inter-related decisions and choices. The chief merit of the approach lies in the fact that it is ongoing in nature and allows for adaptations. Thus, it is a flexible and dynamic method which can cope with uncertainties arising from the equally dynamic and unstable environment of the information system.

The Conceptual Property Rates Administration GIS Design Model (hereafter referred to as the PRAGIS Design Model or simply the model), was conceived to assist GIS system-developers in the planning and design of a suitable specialized spatial data-handling system for tenement rates (property tax) administration. With relevant examples, the model highlights important major steps that may be involved in the system development process. It equally gives an insight into decisions and choices that may be made as well as tasks that may be performed in the process of developing the new GIS. The overall aim of abstracting the model is to put in place a structure that could assist system-developers, in executing their job in a more intelligent, objective and quicker way. Although the PRAGIS design model is said to be for tenement rating, it is by no means limited to that function alone. As a matter of fact, the model could be used in the planning and design of not only GIS for other applications, but also other forms of information system. The truth of the matter is that the name "Property Rates Administration GIS Design Model" is given to the model simply because property rating was used to demonstrate its workability.

3.6.1 THE PRAGIS DESIGN MODEL

Figure 3.2 is a flow diagram illustrating the PRAGIS design model. As the diagram shows, the model consists of twelve (12) major steps. Each step is an activity level which may comprise of various tasks. An explanation of each of the steps is given in subsequent paragraphs. The steps, although separate, are inter-connected and inter-dependent. The model recognises the need for an interactive approach to be adopted in the planning and design of a GIS not only for tenement rate execution, but also for other applications. This is considered very necessary in view of the fact that uncertainties may be encountered in subsequent steps of the design process which may necessitate a review or modification of certain preceding steps. Hence, the model has in-built feedback loops, shown in the diagram (Fig. 3.2) with dashed lines.

It is assumed that before adopting this model for the design of a GIS, management had already approved a proposal to design a GIS to manage the geo-referenced data of the organisation.

Step 1: User Identification

Knowing the potential users of a proposed GIS is a very important preliminary step in the process of designing a geographic information. The functions of the organisation have to be properly known. The various levels of personnel within the organisation or department for which GIS is to be designed must be fully identified. This

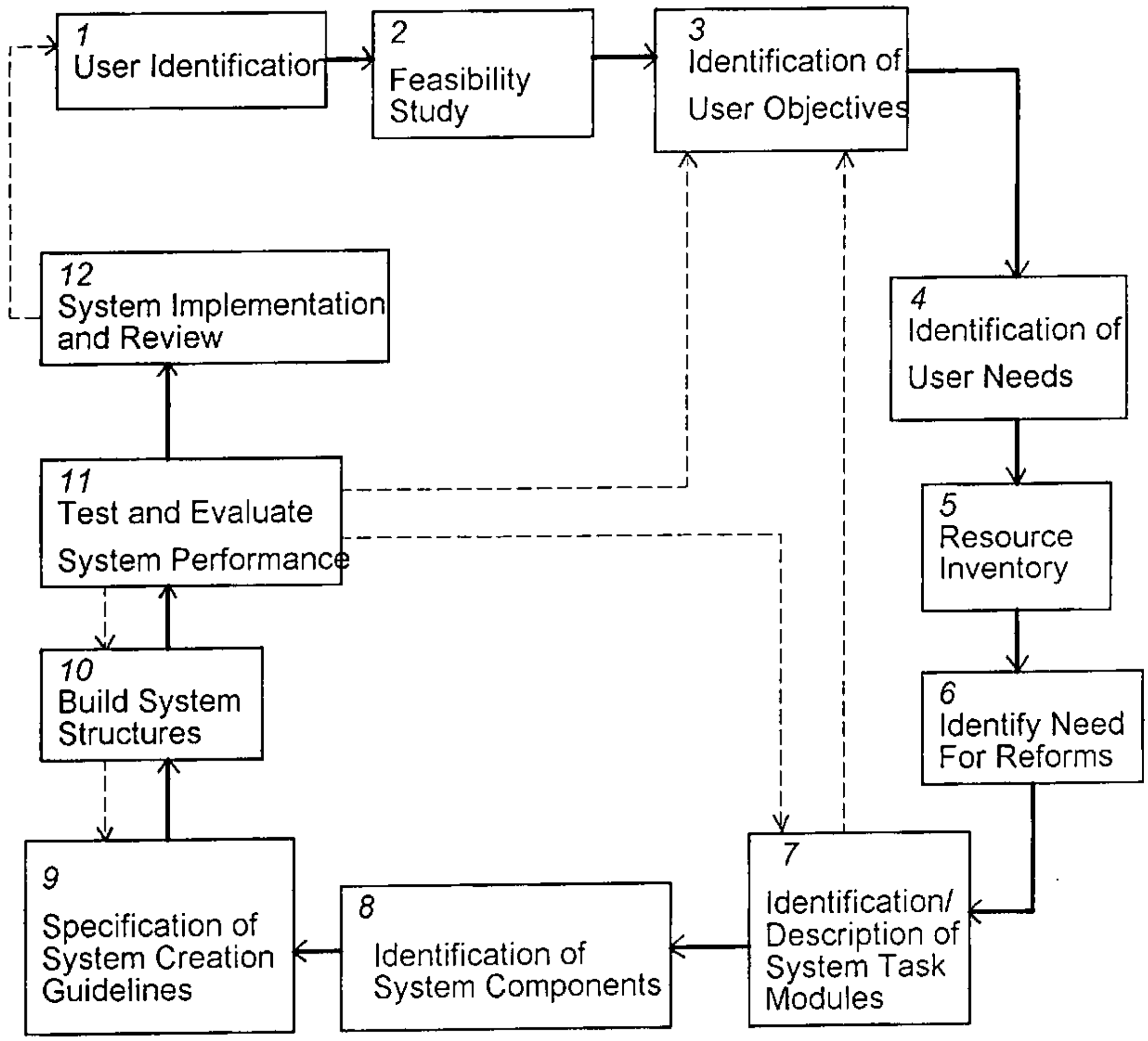


Fig. 3.2. **A Process-Model for Property Rates Administration Database Implementation.**

calls for knowing the policy makers, the management personnel, and the operations staff. In designing a GIS for tenement rate execution, for instance, user identification is an exercise that should reveal the property tax administration tasks performed by each category of staff, the objectives of property tax administration, the tenement information flow pattern, and the decision making process. Besides, user identification should be used to elicit users' conception and view of the proposed system. Are the users favourably disposed to the proposed system; is it acceptable to them? How do they think the system will assist them in achieving their objectives; what would they want the system do for them, hence what functions would they want incorporated into the system? But what do they have against the system? These and similar questions must be settled before proceeding. The task of user identification has been accomplished in chapters one and four.

Step 2: Feasibility Study

Not every project proposal that sounds plausible is feasible. Thus, when a proposal for the design of a GIS is packaged, there may be the need to ascertain the viability of such a proposal. An assessment of the human, economic and technical resources needed to actualize the proposed automation project should be undertaken. Also a preliminary analysis of the potential costs and benefits of the proposed GIS technology has to be made, bearing in mind that the costs and benefits may be tangible or intangible, short term, medium term or long term, quantifiable or non-quantifiable. In any case, the cost of hardware, software, data acquisition and conversion has to be estimated. Also, as part of the feasibility analysis, the approximate length of time required to design and develop the new system needs to be worked out. Usually, "The results of a feasibility study provide the first statement of technical and managerial guidance to be used in making plans for subsequent design works" (Jaffe, 1968). Management decision whether or not to go ahead with a proposed project often depends on the outcome of a feasibility study. Thus, the feasibility analysis has to be objective, comprehensive, accurate and quite revealing.

Step 3: Identification of User Objectives:

Identifying the objectives of the institution where a proposed GIS is to be implemented is very crucial to the successful planning and design of the system. By knowing the objectives, it will be easier to decide on the type of data-sets, hardware and software configurations to acquire and install. Also knowledge of institutional objectives will enable the system designer to design and create suitable file and database structures. Thus, the objectives which the existing system in the institution is supposed to meet have to be determined. Then a careful study of the existing system with a view to ascertaining the extent to which it meets its objectives, has to be carried out. For instance, the objectives of a local government in assessing tenements may include, identification of all rateable tenements; maintenance of accurate, comprehensive and updated data on each tenement; accurate and equitable appraisal of tenements; appropriate rate-setting; quick preparation and dispatch of bills; early collection of rates as well as ensuring adequate geographical coverage in rate collection. Having known these objectives the question then is how effectively and efficiently does the manual system of rates administration which characterizes Nigerian local governments, meet the objectives? Knowing the objectives of the potential users of a proposed system will assist the system developers in deciding on the degree of accuracy, precision, speed, quality, and capacity to build into the system. The objectives of the Lagos Mainland LG in administering property rates have been identified in section 3.3.

Step 4: Identification of User Needs:

Basically, this step demands identifying the various data elements needed by the organisation to meet its objectives. In this case, concerted effort has to be made to identify the existing cartographic and attribute data in the organisation. Also the data elements that are not available should be identified. It is equally important at this stage to ascertain what they use each data item to do (for instance, in the local government, what aspect of the tenement rate administration do they use each piece of data to accomplish?). Other important questions that should be answered at this stage are, how is data collected (what data collection techniques does the organisation make use of?); how do they achieve data input? what is the volume and quality (in terms of accuracy, precision, comprehensiveness, up-datedness) of existing data? what is the format(s) of existing data (e.g. vector or raster, tabular or graphic?); in what form do they store their data (digital or analogue?); where is the data stored (digital files, physical files, cards, or registers?); how is the data updated, and how often? how is the data retrieved? how is the data processed? how is the data output and in what formats? what outputs are often needed? what is the response time required (e.g. how often or early should bills be prepared and sent to ratepayers?); what data-handling problems currently exist in the organisation? All these questions should be adequately answered in order to properly understand the data needs of the institution where GIS is to be implemented. This particular task of user needs identification has been accomplished in section 3.5.

Step 5: Resource Inventory:

Taking an inventory of the existing resources within the organisation is a highly recommended exercise. All the data, hardware, software, personnel, accommodation, power supply, and other resources of the organisation relevant to the automation exercise should be identified and their current state and use properly documented. This step is necessary if informed recommendations towards organisational and environmental reforms are to be made (step 6). Also resources inventory will help to fish out which resources are redundant (if any), which are missing and hence needed. Inventorying the existing resources will equally prevent duplication of resources, since existing ones that meet the required standard for the new system will not be acquired again. Thus, resources inventory should be seen in this case as an important cost-saving, time-saving mechanism.

Step 6: Identify Need for Reforms:

On the basis of user objectives, and the outcome of resource inventory, the need for any organisational and environmental reforms should be identified and evaluated. The current institutional or organisational structure as well as the operational environment and legal considerations within the organisation should be determined. Based on this, it should be further determined if the current institutional, environmental and legal structures are conducive for implementing the proposed GIS or if there is need for reform. For instance, is there any need to train, retrain, or employ new staff specially for digital appraisal of tenements; any need to buy new computers, provide new computer rooms, wire or re-wire computer rooms, provide new airconditioning system, fortify computer rooms with burglary proofs; and so on. Where reform is necessary, then appropriate guidelines should be worked out, and management should be properly briefed on the implications of such reforms.

Step 7: Identification/Description of System Task Modules:

It is a reasonable practice to breakdown the tasks of a system into modules. Based on user objectives (step 3) and data needs (step 4), the various tasks which the proposed system is expected to perform should be mapped out. Then the various task modules should be individually identified and fully described. Generally speaking, about five (5) main system task modules could be identified namely,

- Module for data collection
- Module for data entry
- Module for data manipulation
- Module for data output
- Module for data updating.

Normally, the specific tasks to be executed in each module should vary from one organisation to another, although similarities of tasks cannot be ruled out among organisations that perform similar or related functions. To shed more light on system task modules, Table 3.1 has been provided (see also Chapter Four). The table specifically illustrates the various task modules and the particular tasks performed under each module, in a property appraisal (tenement rating) environment.

Table 3.1: System Task Modules for Tenement Rating

Module	Tasks
Data Collection	• Discovery of rateable tenement • Classification of tenement (e.g. residential or commercial; bungalow, block of flats, semi-detached, or detached) • Identification of tenement (address, ownership, characteristics, rating zone, rental information, etc) • Data verification and validation
Data Entry	• Map data capture (data reformatting or pre-processing, digitizing, creation of geographic files, digital data checking and editing, topology building, data storage) • Attribute data entry (minimal data pre-processing, creation of files/file structure, keying in of data, checking/editing, data storage)
Data Manipulation	• Property appraisal (calculation of gross value, outgoings, and rateable value) • Rate-setting (calculation of current tax due for payment, total tax to be paid) • Map design • Preparing bill (demand notes, warning notice, sealing notice)
Data Output	• Generating hard copy bills • Generating hard copy maps, charts
Data Updating	• Update ownership records • Digitize new parcel boundaries • Digitze new building outlines • Digitize new roads • Replace obsolete data • Enter new property attribute data • Delete obsolete data without replacement • Update payment status.

Step 8: Identification of System Components:

A system is often made up of distinct but coherently linked functional parts known as components or subsystems. Each component part performs certain aspects of the overall functions of the system. It is therefore most ideal to identify the various subsystems and even the sub-subsystems of a system before embarking on its design. Generally speaking, a typical geographical information system has four (4) major components namely, data, hardware, software and people. A fifth component, applications, is, however, also recognised in some quarters (see for example, ESRI, 1992). The important thing is not just to identify the components, but to identify the requirements and functions for each component. Let us push this point further afield still using our tenement rates administration as an example. For the data component, all the data items (both cartographic and attribute) necessary for effective and efficient property taxation have to be identified. Equally to be identified are the specific data needed to accomplish each of the tasks (step 7 above) involved in rates execution. (For instance, what specific data are needed to effect property discovery/identification, which are needed for valuation, rate-setting, etc?).

In terms of personnel, all the categories of personnel needed to actualise each of the system tasks earlier mapped out have to be identified. For instance, who should carry out the task of property discovery, or property identification? Who will handle the data entry task - for both the cartographic and attribute data - will the person to undertake the digitizing of the analogue map features equally undertake the keying in of the related attribute data or should someone else, a professional computer-literate stenographer be needed to handle the second aspect (attribute data entry)? To achieve the overall goal of system design and implementation, the right calibre of personnel must be identified and involved in pursuing each task element of the system. In general, the personnel train may include management staff, system analysts, system designers, programmers, data suppliers or vendors, data input staff, system operators (see Uluocha, 1996).

Concerning hardware, the particular computer and accessories needed must be specified along with their capacities, bearing in mind the special or peculiar demands GIS often make on hardware. Among the hardware to be specified are the type of CPU for data processing; the data input devices (digitizer, scanner, keyboard, etc); the data storage devices (magnetic tapes and disks, CD-ROM, etc); the display system (VGA, SVGA, Monochrome). Factors such as system performance, speed, volume of data to handle, type of processing to be carried out, output quality desired, cost, overall user objectives, should guide the choice of GIS hardware devices to recommend.

There are currently over a hundred GIS software packages on and off the shelves. But one cannot vouch for the efficacy of all these software. Problem may therefore arise in deciding which packages to recommend for use in implementing a GIS. Perhaps getting familiar with some of the GIS software will help reduce the problem of not being sure of which package(s) to comfortably recommend. However, before taking any decision at all to this effect, one needs to consider important issues such as the overall objectives of the user in wanting to implement GIS; the data format needed (vector or raster, or both); the type of processing to be carried out; whether the software has facilities that could support programming for data query and other logical and arithmetic operations, or in the absence of such a programming facility, whether the software can accept computer programmes written in other languages; etc. Whichever GIS software package that is to be recommended, care must be taken to ensure that it can effectively and efficiently be used to capture, edit, store, retrieve, update, query, manipulate, analyse, display and output different forms of geocoded data. Where it is known however, that none of the existing software packages can satisfactorily meet the aspirations of the system users, recommending the design of a turnkey system may not be out of place. However, it has to be first ascertained that the cost of a turnkey system is not prohibitive and hence, that the organisation can financially support such a project. Alternatively, a modification of some already existing GIS could be considered and recommended to the organisation if it is known that such modification is possible, cost-effective and can meet the needs of the organisation.

Step 9: Specification of System Creation Guidelines:

Based on the system tasks earlier identified, a comprehensive detailed set of guidelines should be mapped out on how to build various modules of the system. This, for instance, could involve specifying procedures for converting user-originated analogue input data to a digital format; making detailed specifications to be followed in creating each individual geographic or attribute data file; specifying how the system should be used for data processing to yield some desired results; and detailing how to format and print (or plot) hard copies of outputs in line with the needs of the users.

Also at this step, using an appropriate language, computer-based programs (algorithms or expressions) should be designed for various query or analytical operations. For instance, in the case of tenement rating, programs could be written for such tasks as calculating total number of bedrooms, the total annual rental value of a building, gross value, rateable value tax due for payment, and so on. A comprehensive operating instructions for the computer operators as well as a detailed programme documentation is absolutely necessary at this stage. Of course, the programs have to be tested to ensure their workability and appropriateness. This very step is further developed in chapter six.

Step 10: Build System Structures:

At this stage, having prepared a comprehensive system design specifications report, the specific actions should be used to develop the system physically. All the necessary equipment (computers and accessories) have to be assembled; the analogue data (both cartographic and attribute) have to be converted into machine-readable format; the various file structures have to be created and relevant data stored in them; the computer programs for manipulating the databases also have to be keyed in. Care must be taken to ensure that the system development specifications are followed as religiously as possible. However, the need for modification of certain specifications or aspects thereof, cannot be ruled out, as indicated in Fig. 3.1 by the feedback loop from step 10 to step 9. For instance, there could be the need to enlarge (or reduce) the width of a particular field in a file structure, or change the field status from numeric to character or date. The moment the system is considered to have been developed, emphasis should then shift immediately to the next step (11). See Chapter Four for discussions on the development of the PRAGIS used in this research.

Step 11: Test and Evaluate System Performance:

By now the complete system, so to speak, is in place, but there is need to conduct a preliminary test and evaluation of the system performance. The test should aim at ensuring that the various components of the system are functional and are harmoniously working together to keep the system running. However, where a hitch is observed, as the case may be, a review of part or the entire structural development process of the system (i.e. step 10) may be necessary. The aim should be to identify and eliminate any structural defects or stumbling blocks hampering the smooth flow of the system. In relation to the user objectives and hence, system tasks, the performance of the system components should be subjected to critical evaluation, at this stage. A system component may be functionally okay but without being able to meet the exact objectives for which it was put in place. This is where system evaluation becomes absolutely necessary to determine, based on the test results obtained, the need or otherwise, of fine-tuning system components to enable them perform in strict conformity to the main objectives for them. Where performance is found not to be quite satisfactory, there may be the need to revisit some earlier steps in the design and development processes. If the particular components of the system whose performance is suspect could be identified and hence isolated, it becomes easier effecting whatever modifications that may be necessary. Evaluating the performance of the system could be quite painstaking, yet it has to be done if the objectives of the system users are to be met - which of course is the sole reason for embarking on any system design and development. Apart from performance assessment, the system evaluation stage should equally be used to determine once again the acceptability of the system to the potential users.

Whenever the preliminary system performance assessment proves satisfactory the system implementation phase could then commence.

Step 12: System Implementation and Review:

System implementation entails installing the newly developed computer system in its operational environment. The implementation process may equally involve organising a training (or re-training) programme for the operators to get them acquainted with the new system. The final testing or evaluation of the system has to be carried out, and a conversion scheme worked out. The conversion or changeover procedure could take one or more of various forms such as direct conversion, pilot conversion, phased conversion, and parallel conversion (Ingalsbe, 1989). Management has to decide on the changeover procedure to adopt. However, before management can take this decision, it has to be made sufficiently aware of the nature, requirements, and implications of each of the conversion techniques.

Another important aspect of system implementation that has to be seriously considered is marshalling a detailed system maintenance scheme. The functionality and validity of the system has to be continuously monitored and censured until such a time when management sees the need to review the entire system or an aspect of it, for possible replacement.

The manner of presenting the steps in the model above was not intended to, and should not be conceived to, suggest any strict sequential order. In practice, some of the steps may indeed overlap, while it may be found necessary to pursue one step before another contrary to their positioning in the illustration (Fig. 3.2). The order of placement of the steps as shown in the diagram is rather a matter of convenience than being a straight-jacketed sequence. However, the positions of some of the steps are their natural positions in the process of system design and implementation. For instance, system implementation and review is usually the last step in system development.

3.7 DATA ACQUISITION

Data is generally considered to be the most important component of every Geographical Information System (GIS). Consequently, the issue of data acquisition was accorded a priority attention in the development of the PRAGIS. But before the actual gathering of the desired data could commence, certain preliminary issues had to be resolved first. Such issues bordered on identification of types, formats and scale of both the cartographic and attribute data needed, identification of sources of data, determination of data availability as well as the format and scale of existing data, estimation of cost of data acquisition, and determination of data collection techniques. Most of these issues are further discussed below.

3.7.1 Data Type

The databases in the PRAGIS have been developed based on the data requirements of the local government in the tasks of property tax administration. The databases contain property records. Basically, the property records could be differentiated into two broad but inseparable types namely, geographic (cartographic or spatial) data and attribute (descriptive or non-spatial) data. A mini-breakdown of the two classes of records further reveals that the types of data needed for property rate administration include parcel boundaries, property boundaries (outlines), parcel/property locations (cartographic data), property characteristics, annual rental information (attribute data).

3.7.2 Sources of Data

As explained above, two broad classes of data were acquired for the databases in the PRAGIS namely, cartographic data and attribute data. These two classes of data were obtained from different sources.

Cartographic Data:

The main source of data for the cartographic database for the Alagomeji Area is a single cadastral map sheet purchased at the Federal Surveys, Lagos. The map, drawn at a scale of 1:1,200, is part of the first edition of the Lagos cadastral map series. Its sheet number is 342/904/11. The photographs from which the map was compiled were flown in 1961. However, the compilation was revised up to July, 1964. The final printing of the map also took place in 1964 by the Federal Surveys.

The specific information extracted from the cadastral sheet include parcel boundaries, building locations, building outlines (dimensions), streets and street names. Aerial photographs covering the Alagomeji Area were used to update some of the information in the cadastral map. The photographs, at the scale of 1:4000, were flown in 1988 by Kenting Africa Resource Services Ltd. for the Lagos State Water Corporation. They were purchased at the Federal Surveys, Lagos.

No cadastral or township map covering the Iwaya Area is in existence. So all the data used to build the digital cartographic base for the area were acquired from an aerial photograph at a scale of 1:4000. The aerial photograph which was purchased at the Federal Surveys, Lagos, was flown by Kenting Africa Resource Services Ltd. for the Lagos State Water Corporation in 1988. The photograph showed among other things, the distribution and location of individual buildings and roads in the area.

Another source of cartographic information made use of was an Administrative Map of Lagos Mainland Local Government Area. This map, designed and produced by Metrographics Limited in 1991 at a scale of 1:8,000, shows among other things, street alignments and street names. Thus, this map was used to verify or up-date information on street names. (Actually, some of the streets in one of the study locations namely, Alagomeji, have changed names. Former Clifford Road is now Murtala Mohammed Way while Wakeman Street is now Borno Way).

The aerial photographs used in this study were interpreted at the Cartographic section of the Laboratory for Cartography and Remote Sensing (LABCARS), department of Geography and Planning, University of Lagos. The major interpretation tasks carried out are identification of the various features appearing on the photographs, and delineation of the features, especially buildings and roads. To interprete the photographs, each of them was overlaid with a sheet of clear drafting film. Features on the photograph were viewed through a 10cm-diameter table top magnifying lens with a bendable stem. Outlines of the individual features of interest were traced on the drafting film.

Attribute Data:

The attribute data used in this study came from various sources. Very useful data were garnered from the General Rate Cards maintained by the Tenement Rates Office of the Local Government. For each of the taxable properties within the council, a General Rate Card is kept. Among the information contained in the card are such vital records as property address, name of owner, property description (in terms of usage - residential or commercial), gross value, rateable value, tax due for payment, assessment number, etc. The relevant information content of the card for each of the properties covered in this study, was personally copied out (since moving the cards out of the office was not allowed). A specimen copy of the General Rate Card can be seen in Appendix B.

Just as there is a General Rate Card, there is also a Valuation Sheet for each of the rateable buildings within the local government. Two categories of valuation sheets are maintained: one for residential buildings, and another for commercial buildings. The valuation sheets are used to record property characteristics and rental information, all of which are used for property valuation. Each valuation sheet for residential property bears such information as the rating area the property belongs, the address of property, owner, occupier, area of land, date of inspection. Equally contained in the sheet are records of the characteristics of the property like the construction type, floors, ceiling, tiles, roofing, accommodation, flats, toilets, source of water supply, source of electricity, sewerage, design, finishing, repair condition, fencing, etc. The residential valuation sheet is divided into two sections: one section yields information on the main building while the other section gives information on the outbuilding (i.e. the Boys' Quarters).

The commercial property valuation sheet bears information on both sides. The front page contains property records while the back page carries valuation results based on the processing of the property records. Thus, the sheet has information on site (area, depth, frontage), services (drainage, water, electricity), construction (walls, windows, doors, floors, ceiling), accommodation (office, factory, shops, restaurant, warehouse, stores, etc), development (storey, bay), sundries (WCs, lavatory basins, lifts, central airconditioner), repair condition (good, fairly good, medium, poor), and so on.

The valuation sheets (residential and commercial) are kept by the Lagos State Valuation Office at the State Secretariat, Alausa, Ikeja. The information recorded in the valuation sheets were gathered in 1990 through a state-wide estate survey/valuation exercise carried out by the Lagos State Government through 30 private estate firms commissioned for that purpose.

3.7.3 Data Verification and Validation:

The accuracy and currency of the data content of any Geographical Information System go a long way in determining the integrity and hence reliability, of that system. In view of this fact therefore, a conscious plan and effort was made to establish the reliability of all the data gathered for this project, as described in the foregoing section. The data verification and validation exercise became particularly inevitable considering that some of the data had existed for quite a long period of time. The cadastral map data, for instance, was three decades old as at the time the map was acquired for this project. Also, the need for verification and validation was made quite imperative by the ever-changing property landscape of Lagos State generally, and Lagos Mainland LGA in particular, brought about by the interplay of social and economic forces.

The data verification and validation task was embarked upon with the aim of authenticating, or where necessary updating or even discarding, some of the data so acquired. This task was also embarked on to identify and record the street number of each of the rateable buildings in the study sites. Recording of the street numbers of the buildings was done on the cadastral map, for the Alagomeji site, and on the map generated from aerial photograph, for the Iwaya location.

The verification exercise actually entailed going to the field to see things in-situ. Both the cadastral base map, aerial photos, and the attribute data from the General Rate Cards and Valuation Sheets, were carried to the field. Information existing on the map and the attribute data were cross-checked with what actually existed on ground. The parcel locations and boundaries, building locations and boundaries, and building characteristics - were all verified. The verification itself was done through direct observation.

Some notable changes were observed in some features while some features resisted any significant change. In the Alagomeji area, the parcels' locations and boundaries were found intact. In other words, what we had on the cadastral map, in terms of parcel locations and boundaries, tallied with what was observed on ground. However, in the area of parcel status, some parcels have had their status changed. For instance, some parcels on the cadastral base as well as some on the aerial photographs that had uncompleted buildings on them as at the time the map and photos were published, now have whole buildings standing on them. On the other hand, some parcels shown on the map as being built-up, are now vacant, the building(s) that was hitherto on them having been pulled down. Interestingly, in the Alagomeji study location, the only two parcels on the 32-year old cadastral map that had a vacant status, are still vacant till date.

Apart from the changes in the status of some parcels in the Alagomeji study area, changes were equally observed in the status of some of the buildings themselves, in both the Alagomeji and Iwaya areas. As already noted, some buildings have been completed, some pulled down completely leaving only remnants of their old foundations, while some completed buildings have been abandoned, hence unoccupied. Also currently, some of the buildings are in a de-roofed state while some are being reconstructed. Incidentally, the Lagos Mainland Local Government property register does not reflect the current state of some of these buildings whose status have actually changed. However, for the sake of this project these changes were taken into consideration and are reflected in the attribute database. As will be noticed in the attribute data files, only partial records or no records at all, were entered against any of the affected buildings, depending on the present state of the building.

The information on individual building characteristics gathered from the valuation sheets were also verified and validated, although only to some extent. A thorough verification of the building characteristics, especially the internal characteristics, could not be conducted because in most cases only partial (or no) access could be gained into the buildings. Most of the occupants and landlords/ladies of the buildings in the study area were rather sceptical that the building "inspection" exercise was to gather information which government would later use to increase the property rates they were already paying. Not even the fully endorsed "Letter to Whom it May Concern" from the researcher's department could soften their fastidiousness or allay their fears that the inspection exercise was not for government taxation but purely for academic purpose.

Thus, part of the information on building characteristics was used without further verification. This however, should not cast any spell of doubt in the mind of the reader as per the reliability of the property characteristics data used in this project. These data were officially collected in the second half of 1990. And if the current state of the external characteristics of the buildings also depicts the state of their internal characteristics, one can therefore safely conclude that generally the building characteristics have largely remained status quo since 1990.

3.8 DATA ENTRY

The data entry exercise involve automating the original source documents (data). This was achieved in two major phases namely, Data Formatting and Data Capture.

3.8.1 Map Data Formatting:

Following some of the results of the data verification and validation exercise embarked upon, it became imperative that formatting, or rather reformatting the cartographic data (map) before automating them should be done. Reformatting involved editing the paper map to "knock" some of the features appearing on it into proper shape. Mostly affected in this task were the parcel boundaries some of which were either completely or partially missing in the original hard copy cadastral map. The parcels are polygonal (areal) features. But unless their boundaries were completely closed, GIS would fail to recognize them as polygons. Thus, the reformatting done here took the nature of establishing the positions of the missing parcel boundaries and then inserting such boundaries to perfectly close the parcels. The reformatting exercise was done at the Cartographic Section of the Laboratory for Cartography and Remote Sensing (LABCARS), Department of Geography and Planning, University of Lagos, Akoka.

Another form of cartographic data formatting carried out involved generating a map showing individual buildings and roads from the aerial photos, in respect of the Iwaya area. As stated earlier, no cadastral or township map covering Iwaya is yet in existence.

A detailed account of the data reformatting tasks is given in Chapter Four.

3.8.2 Data Capture:

Through formatting, the data acquired for this project were prepared for automation. The two types of data gathered were computerized. The map data was input into the computer through the electronic conversion of the analog map features into digital or machine-readable format using a digitizer. Data capture involved certain tasks. To begin with, the formatted map sheet (i.e. the map to be digitized), was taped firmly on the digitizing table, care being taken to ensure that the sheet was perfectly flat on the table. Then the digitizing tablet was configured (or initialized) so that ARC/INFO could coordinate or recognize it and accept entries from it. Having fully initialized the digitizer, a new coverage (file) was created to store the digitized map features. The features to form part of the coverage were then digitized. (For a fuller discussion on the data capture tasks undertaken in this project, see Chapter Four). The converted features were simultaneously transferred into the computer disk. The digital conversion and transfer of the cadastral map data was achieved by using an electronic digitizer consisting of a 23" by 36" digitizing table and a 16-button digitizing puck. In all, three main features namely, parcel boundaries, property (building) outlines, and roads, were digitized.

The ARC/INFO software was used to capture the map data. The entire process of data capture involved a number of tasks such as digitizing, editing, topology building and data export. All these tasks were done using the hardware and software facilities at the Remote Sensing section of the Laboratory for Cartography and Remote Sensing (LABCARS), Department of Geography and Planning, University of Lagos, Akoka. (For a descriptive account of the hardware and software used in this project, see section 3.10). Details of the map automation exercise are given in Chapter Four.

The formatted attribute data acquired for the PRAGIS project were equally automated. All the data were entered into the computer via a keyboard. A comprehensive record of the entire attribute data automation process can be found in Chapter Four while the computer hardware and software used for this purpose are discussed in section 3.10 of the present chapter.

3.9 DATA PROCESSING

The geographical database and the attribute database in the PRAGIS have been developed to be processed in a number of ways. However, the nature of processing to undertake depends on the result (output) desired. The geographical files can be merged together to produce overlays which could be used for some form of analysis. For instance, for the Alagomeji location, by overlaying the parcels layer in the PLOTMAP file with the properties layer in the PROPMAP file, it will be possible and easy to automatically count the number of buildings per parcel.

Another form of processing that could be carried out is file query. Any of the geographical files or attribute files can be queried singly or in combination with another file. For instance, a geographical file and an attribute file can be opened together and used for some query operations. A typical query action could be to point or select a map feature on the screen and then ask the system software to display any desired attribute of that feature. For example, a building on the map could be selected and then the relevant attribute file opened and queried to ascertain the usage of that building, whether commercial or residential. On the other hand, map features can be selected by specifying to the software certain conditions which the features to be selected must meet before they can qualify for selection. For instance, a condition could be specified to the software to select only parcels that are vacant, or buildings that their owners are defaulting in rate payment.

Data computation equally forms part of the data processing task of the PRAGIS project. Certain attribute files contained fields that were originally empty. Such fields were, however, later filled by automatically calculating the values of their data items.

Usually, calculating the value to be placed in a field involves the combination of the values of some other fields, for computation. To achieve the mass computation of values for some of the records and fields in a minimal time, a Mass Valuation System (MVS) was developed and used. The system contained dBase III+ computer programs which were written for the purpose of this research. The programs greatly facilitated the processing of the attribute files. For instance, with some of the programs it was possible to carry out mass appraisal of the buildings. With just one program it was possible to compute the gross value of each of the buildings all at once. Another program automatically calculated the rateable value of each of the buildings. In the same vein, a program was used to quickly generate the tax due for payment, for each building. (The various computer programs developed and used in the PRAGIS project are discussed in Chapter Four).

All the digital data processing tasks carried out in this project were accomplished using the ATLAS GIS software package. Results of the processing activities are presented in Chapter Five.

3.10 INSTRUMENTATION

This section is devoted to a description of the GIS hardware and software used in the PRAGIS project. Basically, the Personal Computers (PCs), digitizer, printer, and data-handling software packages used, are discussed.

3.10.1 Hardware Devices:

The GIS hardware facilities used in this project included two PCs, a digitizer, and a printer.

PCs:

Two Personal Computers (PCs) were used. The first machine, used for map data capture, was a 486DX PC with 33MHz speed, 4MB RAM, 170HDD, SVGA monitor and an enhanced keyboard. The second machine, which was used to automate the attribute data as well as process both the map data and the attribute data, was a 486DX having 100MHz, 8MB RAM, 260HDD, VGA monitor and an enhanced keyboard.

The Digitizer:

The digitizer is an electronic graphic data input device made up of a table and a cursor having crosshairs and buttons (keys). This device is used to input the locations of map features by recording their Cartesian X, Y co-ordinates. The very digitizer used in the PRAGIS project was manufactured by Altek, Inc., a USA-based hardware industry and has the following specifications namely, 24" by 36" digitizing table, 16-button cursor, AC 30 controller, and A1 size.

3.10.2 Software Packages:

Two different but compatible GIS software packages were used in developing the PRAGIS; one is ARC/INFO, the other is ATLAS*GIS.

ARC/INFO is a PC-based GIS software developed by Environmental Systems Research Institute, Inc. (ESRI), Redlands, California. A brief but encompassing review of the ARC/INFO software has been given by Peuquet and Marble (1990). They consider ARC/INFO to be the most successful and popular commercial GIS in the market. This view enjoys the corroboration of Vanderzee and Singh (1995), whose market survey of geographical information system and image processing software carried out in 1994 showed that ESRI was clearly the worldwide market leader. Nevertheless, the caution by Peuquet and Marble (*ibid*) that "The ARC/INFO system, despite its strong success in the contemporary market place, is not the perfect GIS", is still very much valid.

PC ARC/INFO is basically a command-oriented, vector-based, hardware-independent, non-application-specific system. It is a GIS made up of two major components namely, ARC and INFO. The ARC component is used to capture, store and manipulate map data while the INFO component is for storing and manipulating tabular attribute database relating to map features.

The Version 3.4D of ARC/INFO released in 1991, was used in this project. The ARC component of ARC/INFO was originally used to capture and store the co-ordinate values of features on the cadastral map. The map data was later exported to another GIS software namely, ATLAS GIS.

ATLAS*GIS is the second software used in this project. ATLAS*GIS is a desktop geographical information system designed and supplied by Strategic Mapping Inc. (SMI), San Jose, California. The software is capable of handling both graphic (map) and non-graphic (attribute) data. It is a user-friendly system, being menu-driven. Perhaps one of its greatest advantage over some other GIS packages is its flexibility in supporting a variety of output devices - hard copies of both graphic and attribute data could be got from ATLAS*GIS via printers and plotters. It could be rightly described as being output device-independent. This capability largely informed the decision to choose ATLAS*GIS for the final processing and outputting of data, in the PRAGIS project.

Whereas ARC/INFO was initially used to capture and store the cartographic data in this project, ATLAS*GIS was later used to store, retrieve and process the same data. In other words, the cartographic data was imported into ATLAS*GIS from ARC/INFO. Also ATLAS*GIS was used to input, retrieve, edit, store, manipulate and display all the attribute data relating to the digital map features. ATLAS*GIS Release 2.1 of 1990 is the version used in the PRAGIS project.

CHAPTER FOUR

CONCEPTUALIZATION, DESIGN AND DEVELOPMENT OF THE PRAGIS

4.1 INTRODUCTION

This chapter deals with the actual processes of conceptualizing, designing and developing the Property Rates Administration Geographic Information System (PRAGIS). Hence the broad thematic issues presented here include conceptual data modelling, logical data modelling (logical design or data structure), physical design (specifications for system building), and finally, the development of PRAGIS.

4.2 CONCEPTUAL DATA MODELING

Basically, a data model is a human conceptualization or abstraction of reality (the real world) which incorporates only those properties or attributes thought to be relevant to the application(s) at hand (Peuquet, 1990). It is usually a generalized user-understood view of the data related to particular applications (ESRI, 1991). A data model is achieved through the process of conceptual data design or modelling. A major objective of conceptual data modelling is to decide on "how the view of reality will be represented in a simplified manner but still satisfying the information requirement of the organisation concerned" (Kufoniyi, 1998).

Building conceptual models demands accomplishing five important tasks. These include (Kufoniyi, *ibid*):

(i) Identification of basic entities or objects in the envisaged information system..

(ii) Identification of related data sets.

(iii) Identification of the interrelationships among the basic objects.

(iv) Identification of constraints.

(v) Formal description of the objects, links and constraints, usually in a diagram.

Based on the five conceptual modeling steps identified above a conceptual parcel-based data model for Lagos Mainland Local Government property taxation is hereby presented. The major entities (objects) and their attributes, relationships and constraints considered vital to property taxation are outlined below. Finally, a formal diagrammatic representation of the model is presented.

(i) Basic entities (objects) and attributes:

- Land parcel (size, shape, perimeter, owner, address, status, use, number of buildings on it, parcel-id, etc).
- Building (size, shape, perimeter, owner, type, address, status, use, number of rooms, Annual Rental Value (ARV), etc).

(ii) Related data:

- Utilities (road, electricity, sewage, water).

(iii) Some Interrelationships:

- A building is located on a parcel
- A parcel is located within a block
- A block is located in a ward
- A ward is located in a rating zone
- A rating zone is supervised by a Local Government Area (LGA).

(iv) Some Constraints:

- Parcels must not overlap.
- A parcel must exclusively belong only to one rating zone.
- A building must belong only to one parcel
- A parcel may have one or more buildings on it.
- Every parcel or building must have only one street address.

(v) Formal diagrammatic representation of the above entities and their attributes, relationships and constraints. In conceptual modeling this particular task is commonly accomplished using the technique known as Entity Relationship (ER) modeling (Jones, 1997). In ER modeling the term "entity" is often used in a wide sense to mean any thing that can be distinguished from another thing, whether tangible or intangible. For example, entity could refer to a land parcel, building, road, street name, temperature, air mass, staff id number, and so on.

In the main, an ER model is usually a diagrammatic representation of some properties of certain real world phenomena and the relationships between them. The major components of an ER diagram are entities, relationships, attributes and connections. These components are usually displayed by means of certain geometric symbols. As shown in Fig. 4.1, in an ER diagram, an entity is indicated by means of a rectangle; a relationship (i.e. the relationship between one entity and another) is shown by a diamond; the attribute(s) of an entity is shown by means of an oval, while connection (for e.g. between an entity and another entity or between an entity and its attributes), is usually displayed by means of a straight line.

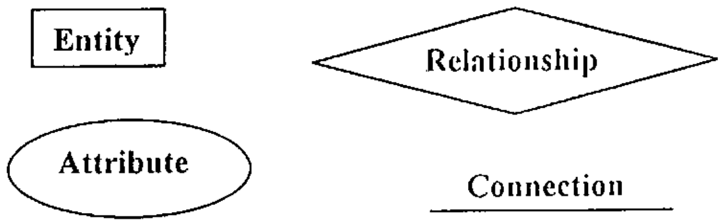


Fig. 4.1: Geometric Symbols used in Entity Relationship diagrams.

A conceptual entity relationship diagram of a parcel-based information system for local government property tax administration is shown in Fig. 4.2.

The conceptual parcel-based model may be stored in the computer using any of the basic spatial data models namely vector and tessellation (raster). The spatial data models are the modes by which the geometric components of terrain objects are formally represented digitally. In this project the vector model was used.

4.3 LOGICAL DATA MODEL (Data Structure)

The conceptual modeling process is aimed at achieving a clear representation of all entities (objects) and their attributes and all relationships between entities that are required to meet the foreseeable information storage and retrieval requirements (Jones, 1997). This normally facilitates database implementation with any of the database structures. A database structure is basically a physical organisation or arrangement of data elements assigned to files and relationships among files (ESRI, 1991). Usually, a database structure is a representation of the conceptual data model often expressed in terms of diagrams, lists and arrays designed to reflect the recording of the data in computer code (Peuquet, 1990).

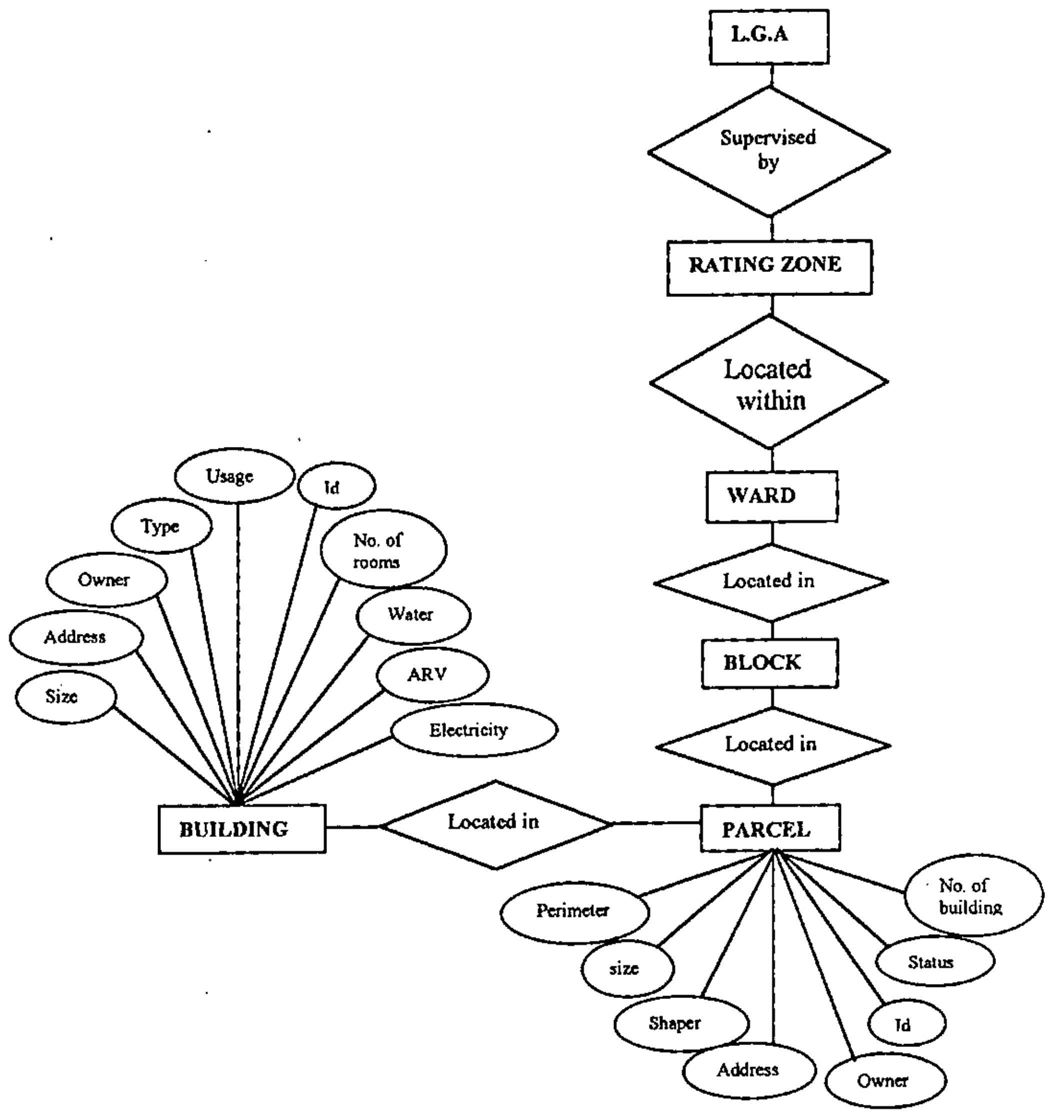


Fig. 4.2 Entity Relationship diagram of a Parcel-based Information System for Property Taxation ***(Adapted and modified from Kufoniyi (1998))***

Data structure is achieved through the process of logical design (or logical data modeling).. According to Jones (1997) "The purpose of the logical data model is to represent the conceptual model components in terms of the computational concepts of a particular type of database." In other words, logical data modeling is the process by which the conceptual data model is translated into a data structure. Normally, a data structure is built upon the data model (Peuquet, *ibid*).

Conceptual data models can further be simplified by translating or abstracting them into data structures. The commonest data structures are hierarchical, network, relational and object-oriented. Of all these the relational structure or model is the most widely used. In fact, in GIS applications, the non-spatial data are often represented by a relational database structure (Kufoniyi, 1995). The relational model was used in this project.

The basic concepts of a relational model are widely reported in literature (see for example, Date (1975); Burrough (1986); Jones (1997), etc.). Generally, a relational database structure is a two-dimensional table made up of rows (also known as tuples or records) and columns (also known as fields, attributes or domains). Each row contains a single record representing an entity or object. On the other hand, a column contains certain attribute data of the entity. In other words, the fields of a record or entity store certain attributes of the entity. The relationship between all fields and tuples in a table is called a relation. Each table (relation) is normally stored in a separate file in the computer. Such tables (relations) are usually linked by a field or primary key which is common to all the tables. Table 4.1 is a relational database based partly on the entity relationship (ER) diagram (Fig. 4.2) and the hypothetical land parcels shown in Fig. 4.3.

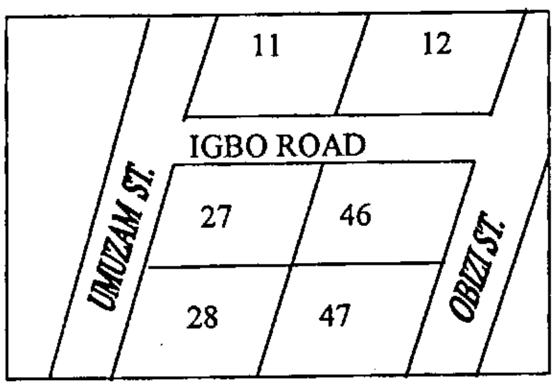


Fig. 4.3 A hypothetical Parcel Layout

Table 4.1 Parcels Attribute Data

PARCEL-ID	AREA (M2)	OWNER	ADDRESS	STATUS
11	524.25	N.O. Uluocha	1, Igbo Rd..	Built-up
12	518.18	C. Johnson	3, Igbo Rd..	Built-up
27	495.31	O. Y. Balogun	2, Igbo Rd..	Built-up
28	464.26	I. P. Igwe	14, Umuzam St..	Vacant
46	481.40	J. Eze	4, Igbo Rd..	Built-up
47	483.15	S.C. Ojo	20, Obizi St..	Built-up

4.4 PHYSICAL DESIGN SPECIFICATIONS FOR THE PRAGIS

Following the results of the system analysis, the Property Rates Administration Geographical Information System (PRAGIS) was conceived and designed. The design of the system involved drawing up a plan to guide the eventual development of the proposed GIS system, based on the identified requirements of the user - the local government. Thus, the system design process was achieved by mapping system tasks and then evolving a suitable framework for performing the tasks in order to accomplish set user objectives.

Marble, et al (1983, pp. 926-927) have identified four broad functions which any complete geographical information system performs. These functions are, in a nutshell, data input, data storage and retrieval, data manipulation, and report generation. Consequently, the PRAGIS was designed in four major separate but coherently linked stages. The stages are the input design stage, the file design stage, the processing design stage, and the output design stage. Each of these stages represents a framework of particular tasks (activities) to be performed and how the tasks are actually to be performed. By religiously executing the tasks in the various stages, the specified user objectives are achieved.

The following discussions give a closer look at each of the activity stages making up the entire PRAGIS design process.

4.4.1 OUTPUT SPECIFICATIONS

In designing the computer-based PRAGIS, the specification of the output formats was embarked upon first. This was done in full recognition of the fact that computer output is the most important and direct source of information to the user of a system (Awad, 1991, p. 293). Thus, the output (the result or end-product) desired by the system user, determines the type and volume of data to input into the system, the files/file structure to create and maintain as well as the kind of data processing to be carried out.

Specifications for outputting data[1] out of the PRAGIS are diagramatically illustrated in Fig. 4.4. To start with, the operator loads the ATLAS GIS software unto the

[1] The term 'data' is used here interchangeably with information.

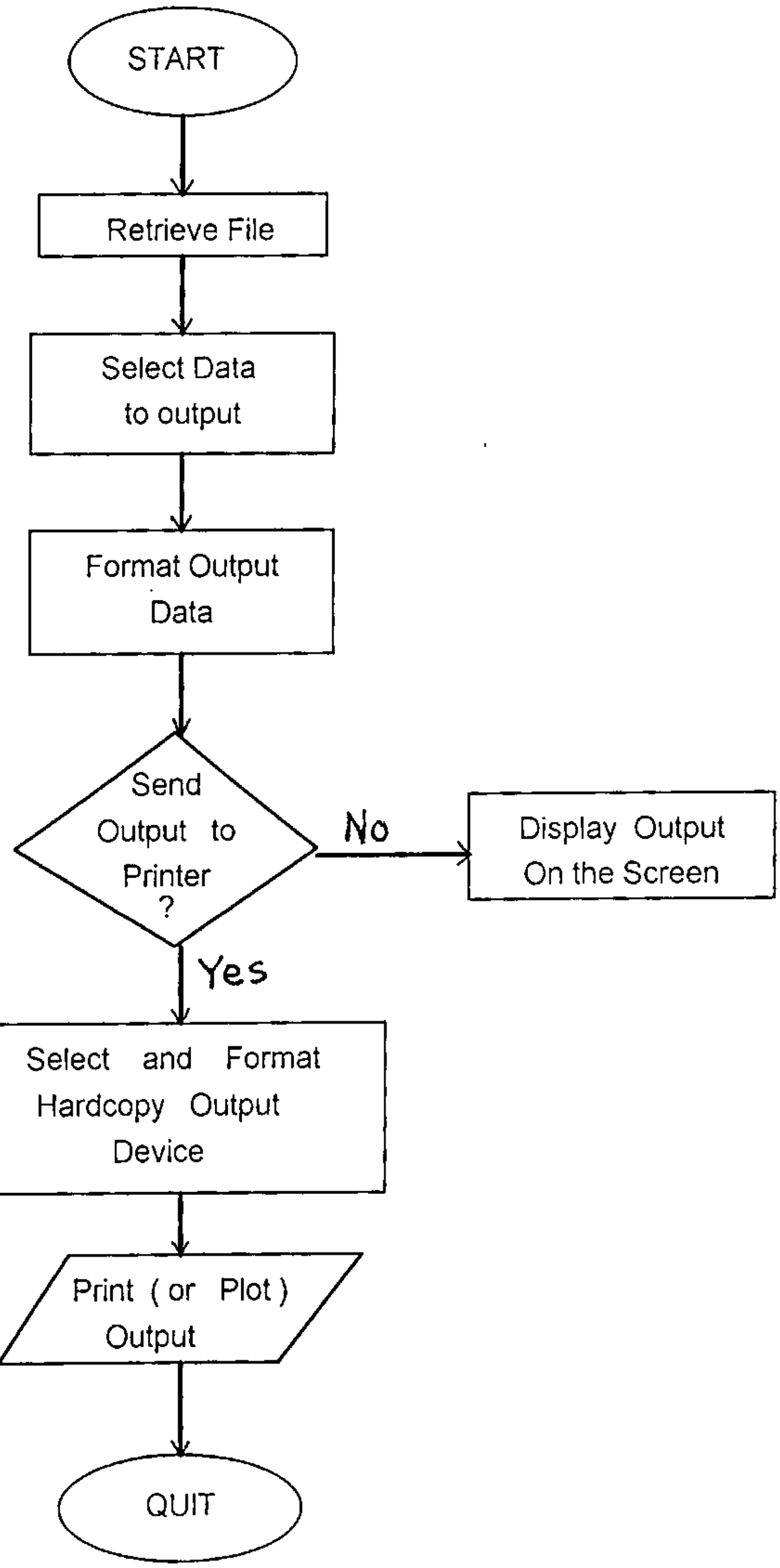


Fig.4.4 Property Data Output Activity Modules (See text for explanations)

screen. The appropriate file(s) for data output is then selected and retrieved. However, the file or combination of files to select and retrieve for data output depends on the results desired by the user. In any case, the file could be a geographic file or an attribute file or both.

Having activated the particular files to use for result output, a decision has to be made as per the form in which the output should be encrypted. The form could be graphic (map), or tabular (having rows and columns). (It should be noted that ATLAS GIS, as is characteristic of other GIS software packages, does not support the output of data in textual form). It is possible to output data in combination of graphic and tabular forms. The choice of what data output form to adopt is a matter that is determined by the needs of the user.

Step 4 of Fig.4.4 specifies the need for formatting the data before the final output. Often times, the output file may contain some data that are not actually needed in some output. It therefore becomes necessary to "suppress", "filter" or "screen out" the "unwanted" data. Again, the data in the output file may not have been presented exactly the way the user may wish to use it in the final output. With all these additional demands, it thus becomes incumbent on the system operator (who may double as the user), to prepare and present the output data the way the user would have it be. The following are some of the data formatting tasks that may be carried out for both cartographic data and attribute data outputs:

- select records to print
- select fields to print
- set margins (left, right, top, bottom)
- set number/range of pages to print
- shrink/expand page
- paper size (e.g. A3, A4)
- paper orientation (e.g. portrait, landscape)
- include title
- define heading, width, etc, for each report column
- page width (number of characters per line)
- lines per page

- include footer
- etc.

Data formatting enables the system operator to create the final report form. Once prepared, the report could be obtained as a soft copy, or in hard copy format. Thus, as shown in Step 5 (Fig. 4.4), the user of the report decides on whether or not the report should be printed out. If the decision is to have the report in soft copy format then it is displayed on the screen. On the other hand, if hard copy output is desired, the report is sent to a hard copy output device. This brings us to step 6 where an output device has to be selected. It is worth noting here that outputs from the PRAGIS system can be obtained via a printer or plotter. This is so because the supporting GIS software, i.e. ATLAS GIS, has in-built facilities that can enable a user to obtain permanent copies of reports using a printing or plotting device. In any case, whether a printer or a plotter is selected for the hard copy output, care must be taken to ensure that the selected device was properly installed and configured. Next, with the appropriate output device selected, the PRINT command in the main Menu of ATLAS GIS, can then be activated to print (or plot) the desired output (step 7). After printing, the operator exits the PRINT sub-menu and returns to the main menu to continue with some other operations, or quit ATLAS GIS (step 8).

4.4.2 DATA INPUT DESIGN

Fundamentally, the data input design process was aimed at fashioning out a means of making data entry as easy, logical and error-free as possible. Thus, as we shall see shortly, data entry specifications are marshalled out in the input design herein discussed. These tasks specifications were used as guidelines in developing the databases in the PRAGIS system.

The PRAGIS, just like any other GIS, is made up of two broad categories of data namely, cartographic data and attribute data. These two data types originally existed in various forms and on paper. Whereas the cartographic data existed in map form, the attribute data existed in both textual and tabular forms. Thus, for the purpose of capturing the source data, separate data input modules were designed for both the cartographic data and the attribute data. The two input modules are discussed below, starting with the map data input module.

4.4.2.1 Cartographic Data Entry Specifications:

Figure 4.5 is a schematic flow diagram representing the cartographic data entry activity modules designed and used in this project. From the diagram six distinct but related modules are easily discernible. These are User Requirements Analysis, Map Pre-processing, Map Digitizing, Digital Map Editing, Topology Building, and Map Data Export. The first module, User Requirements Analysis, is not particularly a part of the input design. However, it serves as a link between the earlier task of system analysis and the data input design. The module was therefore designed to act as a guide in determining the map needs of the proposed user of the PRAGIS system. The User Requirements Analysis module equally exists to assist in making decisions on the acquisition of the map data. Decisions relating to map data acquisition have been discussed under Research Methodology. Finally, based on the needs of the user, map features for automation are to be selected.

The selected map features for automation would not have existed exactly in a form that allows for their direct automation without any sort of modification. The Map Pre-processing module was therefore put in place to provide means of logically improving on the nature of the original map document before capturing it. Tasks specified in this module included determination of the quality of the map input document with a view to ascertaining the accuracy, precision, completeness, and updatedness of the data. The outcome of the data quality test was to be used as a basis for the next task in the map pre-processing module namely, reformatting of the map input document. Map reformatting is an exercise aimed at making up for the shortfalls of the original analog map. Another task forming part of the map pre-processing activity is classification of map features into areal (polygons or regions), lines (arcs), and points. Also, the classification task involved differentiating the selected map features into various coverages or layers. Next, some level of map annotation and labelling is carried out to properly identify some of the map features. Finally, the input map document is transferred to the third module, that is, the Map Digitizing module.

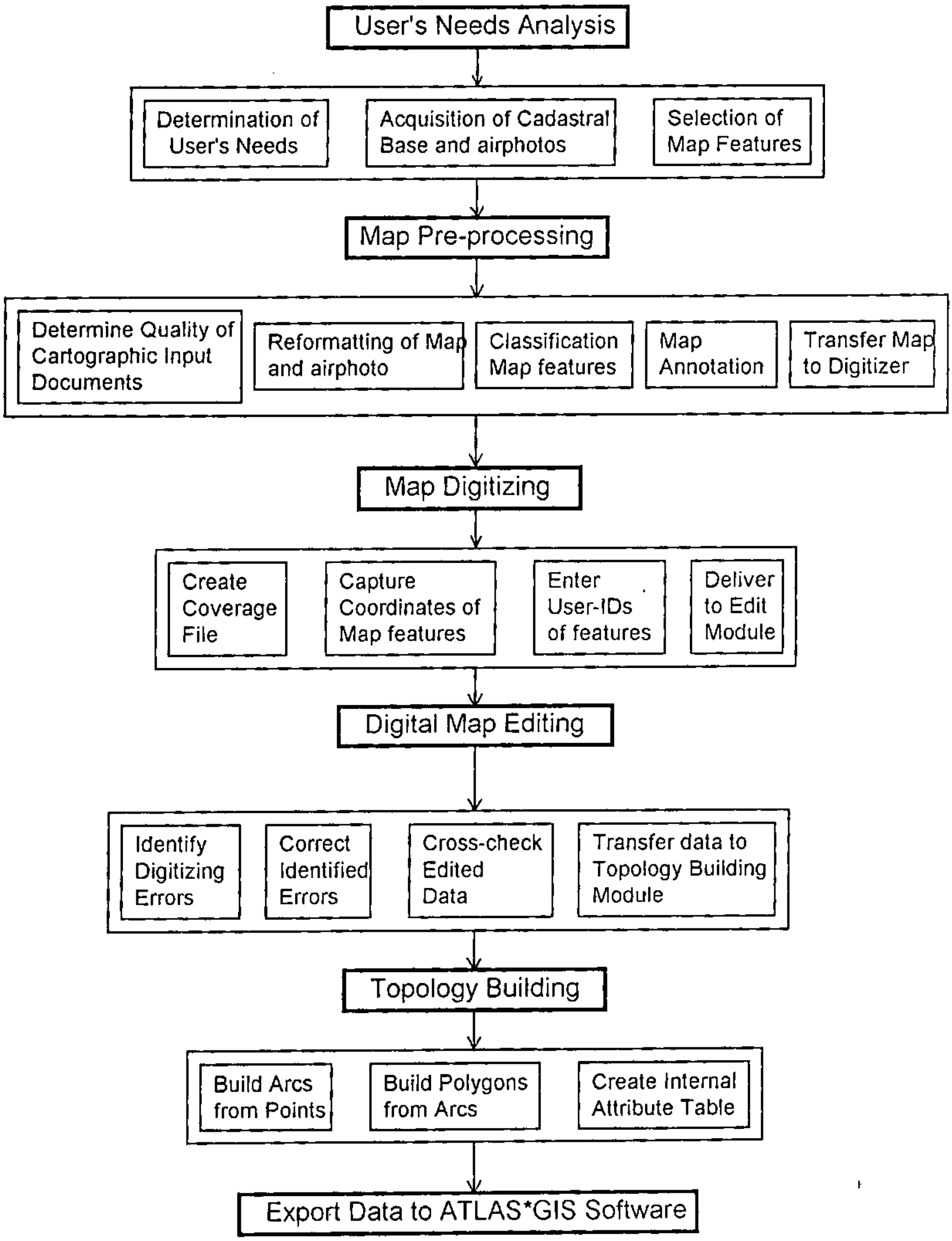


Fig. 4. 5 Cartographic Data Entry Activity Modules

The digitizing module was designed to aid the practical automation of the original paper map using the digitizer. Four major tasks are designed to be carried out under this data entry activity module. The first is the creation of map coverage files, which actually involves defining the map boundaries, naming the file and specifying the class (polygon, line, or point) to which the set of data contained in the file belongs. The next activity, as specified in the figure, is the capturing of the X, Y coordinates of the map features being converted to digital format. Closely following the digitizing exercise is the identification of individual map features by assigning a unique User-ID to each of the features. The digital map is then delivered to the next module for editing.

Digital Map Editing is a data entry module designed for activities such as the identification of digitizing errors in the map data, correction of the identified errors, cross-checking of the edited data, and transfer of the edited data to the fifth module - topology building. The aim of including the topology building module in the input data design is to guide the data entry operator in the sequence to follow in creating topologies out of the digitized data. Thus, as Fig. 4.5 shows, this module tells the operator to use the X, Y coordinate values of points (vertices) to construct arcs (lines), and to combine related arcs to form polygons. Also the automatic generation of minimal internal attribute tables of the digitized map features is achieved during topology creation.

Usually, the digital map database is ready for use in geographical analytical and query operations the moment topology building is successfully accomplished. Thus, ordinarily, topology building should have marked the end of the map data input design. However, it became necessary to include module six (6) - Data Export - in the input design since the GIS software used in automating the original map document was not intended to be used in the various map data processing activities. In fact, the PRAGIS system was conceived and designed such that the ARC/INFO software would be used for map data entry while the ATLAS GIS software was to be used in data processing operations. Thus, module 6 of Fig. 4.5 is a specification to the data entry operator to EXPORT the digitized data from ARC/INFO to ATLAS GIS.

4.4.2.2 Attribute Data Entry Design:

Activities and steps designed for the creation of the input attribute file structure and databases, are illustrated in the flow diagram below (Fig. 4.6). To open a new file, the operator has to first of all define the file, the file structure, and the file content (step 1). This step actually involves naming the new file, defining the various fields, specifying the type of each field (e.g. numeric, character, date), stating the physical size (i.e. number of characters) of each field, indicating the number of decimal points (for each numeric field), and giving a brief description of each field.

Step 2 of the attribute data entry model specifies procedures for the actual creation of a new file and its structure using the specifications in step 1. The likelihood of the just created structure containing some errors cannot be ruled out. Thus in step 3 the attribute data entry operator is advised to check and edit the fresh file structure, correcting any identified errors. As shown in the figure, editing the file structure may necessitate modifying part or even the totality of the structure.

Creating a file and its structure is basically a task executed to put in place a skeletal framework on which to "attach" or "fix" the data items in the file. Thus, when the file structure is created it remains empty until data is written into it. By choice, data could be entered into the empty structure immediately after creation, or at a later time, in which case it is saved and stored in the disk.

To write data into a file structure, it has to be first retrieved and displayed on the screen (step 4). With the structure displayed, the attribute data pertaining to the file are then entered, as step 5 demands. The attribute data are captured through the computer keyboard. Step 6 of the attribute data entry model is a module designed to remind and instruct the operator about checking and editing the data so captured. As the attribute data are entered, the need to re-define or modify some aspects of the file structure can be expected, to accommodate new developments. Thus, the entire process of checking, editing and correcting data entry errors could be repeated a number of times, as the need arises. When done with data entry and editing, the file then has to be saved and stored for some processing operations.

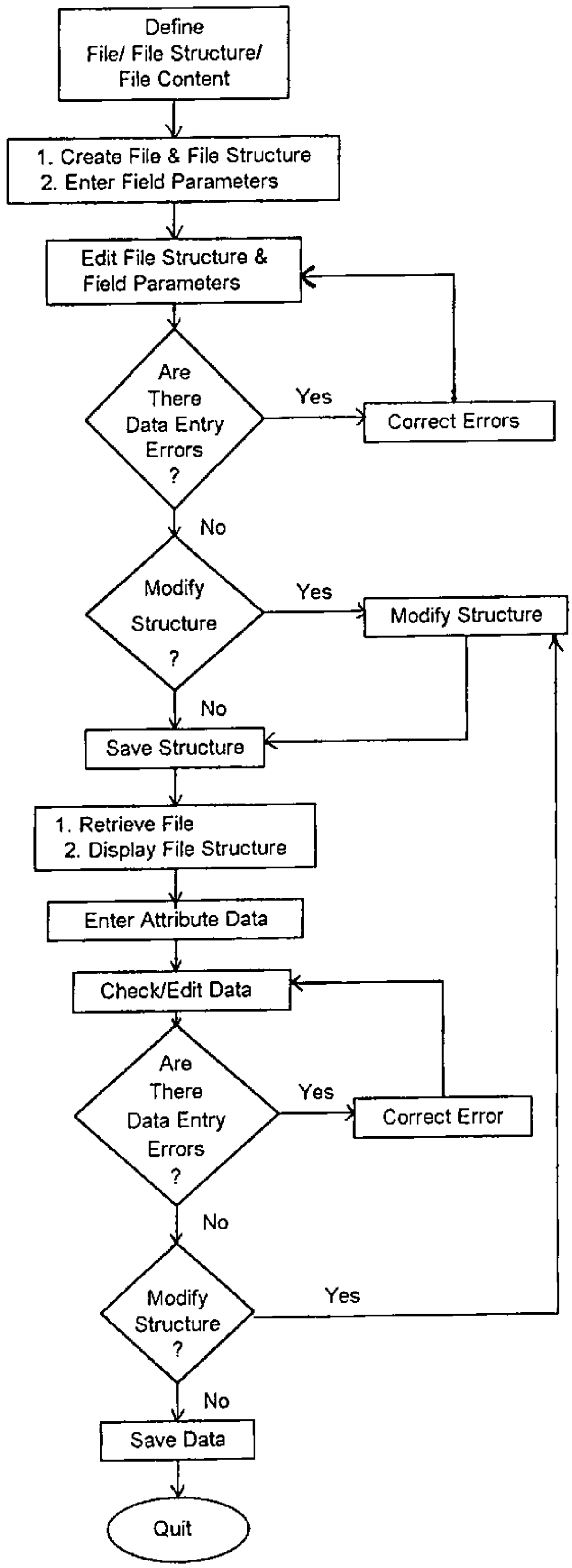


Fig.4.6 Attribute Input Data Entry Activity Modules

4.4.3 FILES DESIGN

The development of the PRAGIS was partly aimed at providing a mechanism that makes it easier and more economical for the Tenement Rates Office to store, retrieve and process property-related data. It was, therefore, realized right from the out-set that to be able to achieve this aim, a time-saving filing system has to be designed. Thus, in consideration of the outputs/output formats desired by the Rates Office, befitting file/database structures were mapped. Two broad categories of files are held in the PRAGIS namely, geographic and attribute files, each file was designed to accommodate only one subject matter.

Each individual geographic file has been tailored to contain just one thematic layer of map data. However, for the purpose of data processing, different geographic layers can be overlaid on one another and used.

Similarly, the attribute files are designed such that each file contains only related records and fields (with data items) on a particular theme. Thus, the defined information content of a file should determine the records and fields to be included in the file. Hence, following the above principle, an attribute file such as the RESIDENTIAL PROPERTY VALUATION FILE, for example, should not contain any valuation information on commercial property, as it is expected to have information on domestic buildings only. Nevertheless, just as it is possible to combine geographic files for processing, so also can attribute files be merged together for some form of data processing.

In designing the attribute files/database structure, the relational database management system (RDBMS) was adopted. Hence, the attribute data are held in a tabular (grid cell) format or structure, with each table having series of rows and columns. In every tabular file, each row corresponds to a record while each column corresponds to a field. Data items (elements) belonging to a record are entered against the appropriate fields. A typical relational database structure is illustrated in Table 4.2 below.

Table 4.2: Property Ownership Relational Structure

PROP-ID	OWNER-NAME	PROP-ADD	STATUS	USAGE
821	Dr. A.E. Mba	350, Borno Way	Occupied	Residential
611		66, Olonade Street	Abandoned	None
571	Mrs. Abayomi	293, Herbert Macaulay Rd.	Occupied	Commercial

As the above table shows, each record (row) corresponds to a map feature in the cartographic file while each field (column) corresponds to or represents a certain characteristic of the feature.

Tables 4.3 to 4.11 are file structure specifications for the geographical files and the attribute files in the PRAGIS system.

Table 4.3: Feature Types and Classes

Feature Type	Feature Class
Parcels	Polygons
Buildings	Polygons
Corridors	Polygons
Roads	Lines/Polygons

In developing the geographical files, the following specifications should be adhered to:

1. No file name should be more than eight (8) characters long.
2. At least four (4) tic points must be defined on the paper map and same digitized to serve as reference points for registering the digital map.
3. Each tic point should have a tic-id and x, y coordinates.
4. A root mean square (RMS)[2] error greater than 0.003 may be accepted.
5. Each layer should be digitized separately.
6. During digitizing, each feature should be assigned to a class as shown in Table 4.3.

General specifications for creating the attribute files:

1. No file name should be more than eight (8) characters long
2. No field name should be more than ten (10) characters long
3. All fields that will contain numeric entries to be used for analytical operations should be made NUMERIC fields (if a field contains numeric entries which will

[2]Root mean square (RMS) error is a measure of the accuracy of tic registration during digitizing. Any RMS error less than or equal to 0.003 is considered safe; however, an error greater than this figure may still be acceptable.

not be used for analytical operations that field should be designated CHARACTER).

4. Except otherwise indicated, all NUMERIC fields should have two (2) decimal points, other fields should not have any decimal point.

5. The physical size of each field should be made to correspond with the longest entry (data item) in that field.

The following are file structure specifications for each of the attribute files:

Table 4.4: PROP-OWN File Structure

Name	Type	Size	Decimal	Description
OWNER-NAME	Char	27		Name of Property Owner
PROP-ADD	Char	30		Address of Property
ZONE	Char	11		Rating Area or Zone
AGE	Char	8		Age of Building
ASESS-NO	Char	17		Assessment Number
ANAL-CODE	Num	9	0	Analysis Code
OCCUPIER	Char	15		Occupier of Building
PROP-CLASS	Char	20		Type of Property
STATUS	Char	11		Current Status
USAGE	Char	11		Current Use
OUT-BLDING	Log	1		Any Boys' Quarters?
DATE-INSP	Date	8		Last Date of Inspection
INSP-BY	Char	20		Name of Inspector

Table 4.5: COM-XTER File Structure Specifications

Name	Type	Size	Decimal	Field Description
PROP-ADD	Char	30		Property Address
FRONTAGE	Num	8	2	Frontage
DEPTH	Num	6	2	Depth
SITE-AREA	Num	9	2	Area of Site
WALL-MAT	Char	19		Wall Material
WINDOWS	Char	36		Type of Windows
DOORS	Char	36		Type of Doors
FLOOR-MAT	Char	21		Floor Material
ROOF-MAT	Char	14		Roofing Material
ROOF-TYPE	Char	13		Roofing Type/Style
CEIL-MAT	Char	17		Ceiling Material
EXT-FINISH	Char	14		External Wall Painting
INT-FINISH	Char	14		Internal Wall Painting
FLOOR-AREA	Num	10	2	Area of Floor
USAGE	Char	18		Accommodation Usage
STOREY	Char	6		Storey
DRAINAGE	Char	8		Drainage
WATER-SUPP	Char	19		Source of Water Supply
ELECTRIC	Char	7		Source of Electricity
REPAIR-CON	Char	11		Repairing Condition
WC	Char	2		W.Cs
LAV-BASIN	Char	9		Lavatory Basin
ADD-INFO	Char	30		Additional Information

Table 4.6: RES-XTER File Structure Specifications

Name	Type	Size	Decimal	Field Description
PROP-ADD	Char	30		Property Address
CONST-MAT	Char	18		Construction Material
WALL-MAT	Char	10		Wall Material
EXT-FINISH	Char	12		External Wall Painting
INT-FINISH	Char	12		Internal Wall Painting
NUM-FLOORS	Num	10	0	Number of Floors
BLOCK-FLAT	Char	10		Blocks of Flats
NUM-FLATS	Char	9		Number of Flats
FLOOR-MAT	Char	24		Floor Material
CEIL-MAT	Char	23		Ceiling Material
BATH-TILES	Char	10		Bathroom Tiles
KTCH-TILES	Char	10		Kitchen Tiles
WC-TILES	Char	10		W.C. Tiles
ROOF-STYLE	Char	13		Roofing Style
ROOF-MAT	Char	21		Roofing Material
DOORS	Char	36		Type of Doors
WINDOWS	Char	36		Type of Windows
NUM-HALLS	Char	9		Number of Halls
LOUNGE	Char	6		Number of Lounges
DINING-RM	Char	9		Dining Rooms
BREAK-ROOM	Char	10		Break Room
BED-ROOMS	Char	9		Number of Bedrooms
STUDY-ROOM	Char	10		Drawing/Study (Break) Room
KITCHEN	Char	7		Number of Kitchens
PANTRY	Char	6		Pantry
BATH-ROOMS	Char	10		Bathrooms
WC	Char	2		Number of W.Cs
PARLOR	Char	6		Parlours
TOILETS	Char	11		Toilets
WATER-SUPP	Char	19		Source of Water Supply
ELECTRIC	Char	7		Source of Electricity
SEWERAGE	Char	11		Sewerage
ROAD-SUR	Char	8		Road Surface Type
DESIGN	Char	6		Building Design
FINISH	Char	6		Finishing
REPAIR	Char	6		Repairing Condition
FENCES	Char	17		Fencing Type
HEDGES	Char	6		Hedges
DRIVE	Char	8		Drives
REMARKS	Char	20		General Remarks

Table 4.7: RES-VAL File Structure Specifications

Name	Type	Size	Decimal	Field Description
PROP-ADD	Char	30		Property Address
BED-ROOMS	Num	9	0	Rooms in Main Building
BQ-ROOMS	Num	8	0	Rooms in Boys' Quarters
TOT-ROOMS	Num	9	0	Total Number of Rooms
ARV-ROOM	Num	8	2	Annual Rental Value per Room
ROOMS-VAL	Num	9	2	Total ARV of Bedrooms
NUM-FLAT	Num	12	0	Number of Flats
FLAT-VAL	Num	8	2	ARV of Each Flat
FLATS-VAL	Num	9	2	Total Value of Flats
DETACHED	Num	11	0	No. of Detached Houses
DET-VAL	Num	8	2	ARV per Detached House
DETS-VAL	Num	8	2	Total Value of Detached Houses
BUNGALOW	Num	12	0	Number of Bungalows
BUGLOW-VAL	Num	10	2	ARV of Bungalow
GARAGE-VAL	Num	10	2	ARV of Garage
SHOP1-NUM	Num	9	0	Number of Small Shops
SHOP1-VAL	Num	9	2	ARV per Small Shop
SHOPS1-VAL	Num	10	2	Total ARV of Small Shops
SHOP2-NUM	Num	9	0	Number of Big Shops
SHOP2-VAL	Num	9	2	ARV per Big Shop
SHOPS2-VAL	Num	10	2	Total ARV of Big Shops
SHOPS-VAL	Num	9	2	Total ARV of All Shops
WKSHOP-VAL	Num	10	2	ARV of a Workshop
GROSS-VAL	Num	9	2	Gross Value of Building
OUTGOINGS	Num	9	2	25% Outgoings
RATEABLE	Num	8	2	Rateable Value

Table 4.8: COM-VAL File Structure Specifications

Name	Type	Size	Decimal	Field Description
PROP-ADD	Char	30		Property Address
NUM-FLOORS	Num	10	0	Number of Floors
GF-PART	Num	28		Ground Floor Particulars
GFOA-DIM	Num	8	2	Dimension of Ground Floor Office A
GFOB-DIM	Num	8	2	Dimension of Ground Floor Office B
GFOC-DIM	Num	8	2	Dimension of Ground Floor Office C
GFOD-DIM	Num	8	2	Dimension of Ground Floor Office D
GFOE-DIM	Num	8	2	Dimension of Ground Floor Office E
TOT-GFDIM	Num	9	2	Total Ground Floor Dimension
UNLET-GFS	Num	9	2	Unletable Ground Floor Space
GFLOR-AREA	Num	10	2	Area of Ground Floor
PER-GF	Num	6	2	Rate Per Sq.Metre of Ground Floor Space
GFGROS-VAL	Num	10	2	Gross Value of Ground Floor
FF-PART	Char	30		First Floor Particulars
FFOA-DIM	Num	8	2	Dimension of First Floor Office A
FFOB-DIM	Num	8	2	Dimension of First Floor Office B
FFOC-DIM	Num	8	2	Dimension of First Floor Office C
FFOD-DIM	Num	8	2	Dimension of First Floor Office D
TOT-FFDIM	Num	9	2	Total First Floor Dimension
UNLET-FFS	Num	9	2	Unletable First Floor Space
FFLOR-AREA	Num	10	2	Area of First Floor
PER-FF	Num	6	2	Rate Per Sq.Metre of First Floor Space
FFGROS-VAL	Num	10	2	Gross Value of First Floor
SF-PART	Num	17		Second Floor Particulars
SFOA-DIM	Num	8	2	Dimension of Second Floor Office A
SFOB-DIM	Num	8	2	Dimension of Second Floor Office
SFOC-DIM	Num	8	2	Dimension of Second Floor Office C
SFOD-DIM	Num	8	2	Dimension of Second Floor Office D
SFOE-DIM	Num	8	2	Dimension of Second Floor Office E
SFOF-DIM	Num	8	2	Dimension of Second Floor Office F
TOT-SFDIM	Num	9	2	Total Second Floor Dimension
UNLET-SFS	Num	9	2	Unletable Second Floor Space
SFLOR-AREA	Num	10	2	Area of Second Floor
PER-SF	Num	6	2	Rate Per Sq.Metre of Second Floor Space
SFGROS-VAL	Num	10	2	Gross Value of Second Floor
TF-PART	Char	17		Third Floor Particulars
TFOA-DIM	Num	8	2	Dimension of Third Floor Office A
TFOB-DIM	Num	8	2	Dimension of Third Floor Office B
TOT-TFDIM	Num	9	2	Total Third Floor Dimension
UNLET-TFS	Num	9	2	Unletable Third Floor Space
TFLOR-AREA	Num	10	2	Area of Third Floor
PER-TF	Num	6	2	Rate Per Sq.Metre of Third Floor Space
TFGROS-VAL	Num	10	2	Gross Value of Third Floor
NUM-SHOPS	Num	9	0	Number of Shops
SHOPS-VAL	Num	9	2	Total ARV of Shops
NUM-ROOMS	Num	9	2	Number of Bedrooms
ARV-ROOM	Num	8	2	ARV per Room
ROOMS-VAL	Num	9	2	Total ARV of Rooms
BQ-DIM	Num	6	2	Dimension of Boys' Quarters
PER-BQDIM	Num	9	2	Rate Per Sq.Metre of B
BQGROS-VAL	Num	10	2	Gross Value of Boys' Quarters
GROSS-VAL	Num	9	2	Total Gross Value of Building
OUTGOINGS	Num	9	2	25% Outgoings
RATEABLE	Num	8	2	Rateable Value

Table 4.9: TAX-ROLL File Structure Specifications

Name	Type	Size	Decimal	Description
OWNER-NAME	Char	27		Name of Property Owner
PROP-ADD	Char	30		Property Address
ZONE	Char	11		Rating Area
ASSESS-NO	Char	17		Assessment Number
STATUS	Char	11		Current Status
USAGE	Char	11		Current Use
DATE	Date	8		Date Bill Becomes Effective
REFERENCE	Num	10	0	Reference Number of Bill
GROSS-VAL	Num	9	2	Gross Value
RATEABLE	Num	8	2	Rateable Value
TAX	Num	8	2	Tax (Rate) for Current Year
PRE-ARREAR	Num	10	2	Previous Arrears Owed
LAS-ARREAR	Num	10	2	Last Year's Arrears
ARREARS	Num	8	2	Total Arrears Currently Owed
INTEREST	Num	8	2	10% Interest on Arrears
INSTALMENT	Num	10	2	Instalment Paid
BALANCE	Num	8	2	Balance Due for Payment
COST	Num	8	2	Cost
ADD-CHARGE	Num	10	2	Additional Charges
TOT-AMOUNT	Num	10	2	Total Amount Due for Payment
PAY-STATUS	Char	10		Current Payment Status
DUEWARNING	Log	10		Is Property Due for Warning?
DUESEALING	Log	10		Is Property Due for Sealing?
REMARKS	Char	15		General Remarks

Table 4.10: BILL File Structure Specifications

Name	Type	Size	Decimal	Description
OWNER-NAME	Char	27		Name of Property Owner
PROP-ADD	Char	30		Property Address
ZONE	Char	11		Rating Area
ASSESS-NO	Char	17		Assessment Number
USAGE	Char	11		Current Use of Property
RATEABLE	Num	8	2	Rateable Value
TAX	Num	8	2	Tax Due for Payment in the Current Year
ARREARS	Num	8	2	Arrears Owed
INTEREST	Num	8	2	10% Interest on Arrears
YEARS-ARR	Char	19		Years of Arrears
RADIO-TV	Num	8	2	Radio/TV Fee
TOT-AMOUNT	Num	8	2	Total Amount Due for Payment
DATE	Date	8		Effective Date of Demand Notice
PERIOD	Char	7		Period within which to Pay Bill

Table 4.11: STREETS File Structure Specifications

Name	Type	Size	Decimal	Description
ST-NUM	Char	6		Street Number of Building
ST-NAME	Char	21		Name of Street
ST-COND	Char	7		Road Condition
ST-SURF	Char	7		Type of Road Surface

4.4.4 PROCESSING SPECIFICATIONS

The PRAGIS system has been conceived and designed to be a problem-solving, goal-oriented system. The system is intended to serve as a tool-box that could facilitate the decision making process of Council in relation to property tax administration, by providing necessary bits of information. Thus, as earlier noted, the design modality adopted here has been chiefly patterned by the various goals of Council which the system is expected to meet. But it is one thing to design a system, and yet another thing for the system to accomplish the desired aims and objectives of the user. A successful system, it is therefore believed, is one that meets the informational needs for which it was designed. Consequently, it could be said that the efficacy, or otherwise, of a system is largely revealed when its databases are manipulated to tackle the very problems that necessitated its development.

Normally, the term data manipulation or data processing, invokes the idea of practically applying the data components of a system to solve the problems it was actually intended for. It was E.W. Zimmermann who once made the now popular statement that resources are not, they become. By adaptation one can safely say that information are not, they become. An assemblage of raw facts and figures will remain a meaningless jumble until it is refined through some form of processing. When a set of data (raw facts and figures), is processed it yields useful information.

Thus, this section discusses how a user can retrieve, process and display data using the cartographic and attribute databases in the PRAGIS. Presented here also are short and simple computer programs which have been written for manipulating the attribute data files (see Tables 4.13, 4.15 and 4.17). The programs are in dBASE III+ format. This is so because as we saw in the previous section the attribute files have a dBASE III+ structure. As will be observed shortly, each program has been designed to calculate, and hence replace, the value of a particular field. Fields or data items whose new values need to be calculated are found mostly in those attribute files for appraising property value and rate-setting. Efforts were made here to indicate fields whose values were calculated, the fields whose values were manipulated to fix the value of another field as well as an expression of how the values of fields were manipulated to get the desired value of a field.

4.4.4.1 Thematic Mapping

One of the major shortcomings of the manual approach to tenement rates administration is that maps are not produced and used. Hence, the need to generate appropriate rates administration maps using the GIS technology, formed a basic objective of this research. For this reason also, a distinct module or subsystem for creating various thematic tax maps, has been designed as part of the PRAGIS system. (For samples of some of the thematic maps that could be generated using the system see Chapter 5).

Basically, thematic maps are used to graphically display attribute (descriptive) data relating to certain geographical features in a digital map file. With these maps it becomes possible to show the spatial relationship between map features and their associated attributes. In this work, our main geographical features of interest are buildings and roads, while the attribute data could be as varied as name of owner of building, address of building, building colour, age, usage, etc., or on the other hand, name of street, type of street, address range, etc. The PRAGIS system is fashioned in a manner that allows for easy association or linking of the graphic features (buildings or roads) with their non-graphic (attribute) data. This integration is made possible via the unique User-Ids assigned to each building in the digital map file. The ID of each building is copied to every set of attribute data related to it. Thus by combining the building map file and an attribute file, various kinds of thematic maps could be generated.

With the ATLAS*GIS software one can create three (3) types of thematic maps namely:

- *Ranged Maps* (in which data is divided into distinct ranges using a variety of ranging methods. Each data range could be represented by a colour, fill pattern, line style, symbol type, etc.).

- *Proportional Maps* (which depict data by varying the percentage fill, line width, or symbol size for each feature in direct proportion to its data value).
- *Dot-density Maps* (which fill regions(areas or polygons) with uniformly sized dots. Each dot represents a specific value, and the placement of the dots shows distinct patterns (such as clustering)).

From the account above it is obvious that the Ranged mapping technique is most suitable for displaying qualitative data while the Proportional and Dot-density techniques are for depicting quantitative data. Hence, in the PRAGIS system, ranged maps could be used to illustrate building characteristics such as building type, usage, address, occupier, payment status, etc. On the other hand, either the Proportional or the Dot-density technique could be used to represent quantitative data such as the gross value, rateable value, tax liability, etc.

Steps In Composing A Thematic Tax Map

(i) Define the thematic variable(s) to map. (ATLAS*GIS can allow for the mapping of either one or two variables). The chosen variable must be one of the charasteristics of the buildings, and the variable should be existing in at least one of the attribute files. Typical variables that could be selected for mapping are property class, property use, street numbering, payment status, rate defaulters, and so on.

(ii) Having decided on what data variable(s) to map, the next thing is to select the appropriate geographic file and attribute file(s) to use.

(iii) Decide on what kind of thematic map to produce, i.e. whether a Ranged map, Proportional map, or Dot-density map. This decision will be based on the type of data to be mapped. If the data is quantitative in nature, use Ranged mapping, but if it is quantitative use Proportional or Dot-density mapping.

(iv) Establish the thematic settings, that is, specifying how variations in each variable are to be displayed on the map. Here the ranges as well as the colour or fill pattern for each range should be clearly defined.

(v) The next step is to design the thematic legend for the data variable being mapped. (NB: if two variables are involved, separate legends should be designed for each variable). Designing the legend for a data variable should involve setting different options in relation to:

- The number of columns.
- The size, order, and spacing of the legend entries.
- The style, colour, and thickness (line weight) of the legend boxes.
- The legend title and descriptions.
- The text size, colour, and font for both the legend title, and descriptions.

4.4.4.2 The Mass Valuation System (MVS)

Ordinarily, the valuation of buildings for the purpose of taxation is a complex, cumbersome, subjective and time-wasting process, especially where the individual buildings has to be assessed one after another, as is the case in the manual system of valuation. However, in order to overcome the above-mentioned problems and more, a Mass Valuation system (MVS) which is considered ideal, was developed and used in this project. With MVS it is possible to automatically appraise all buildings in a given geographical area, which share similar or some specified characteristics. It should be noted that the designing of the Mass Valuation System is based on a suggestion made by Dillinger (1992), that a mass appraisal method should be developed to ease the processes of property valuation.

The MVS technique designed and used in this research work applies only to the manipulation and analysis of the attribute data. The principle behind the use of the system is a simple one. A set of rules for performing a particular valuation task is specified, and upon the application of the rules, any property that meets certain conditions imbedded in the rules is, accordingly, automatically assessed; if all the properties meet the conditions, as the case may be, they are all assessed at once. The rules are dBase-compatible computer programs written for accomplishing the various tasks involved in property valuation. Basically, the rules, which are in form of formulas or arithmetic expressions, are made up of computer-readable mathematical notations and certain variables defining some aspects of a building. For example, the expression for calculating the total number of bed rooms in a building is

TOT_ROOMS = BED_ROOMS + BQ_ROOMS

Where

TOT_ROOMS = Total number of rooms

BED_ROOMS = Number of rooms in Main Building

BQ_ROOMS = Number of rooms in the Boys, Quarters (if any)

The possible arithmetic expressions that could be used to execute various kinds of valuation tasks are shown in Tables 4.13, 4.15, and 4.17.

The workability of the Mass Valuation System (MVS) depends on meeting certain requirements. The requirements considered in designing the MVS technique are as follows:

- Properties must be properly classified into distinct, exclusive categories.
- The parameters for appraising each category of building have to be clearly and exhaustively defined.
- Shop types should be well classified. (Hence the terms "Big Shop" and "Small Shop" as currently used by the local Government, were discarded since they are rather vague terms).
- Uniform Annual Rental Values (ARV) should be maintained for buildings in the same category.
- The percentage of unletable space for commercial properties should be precisely defined for various kinds of apartments.
- Uniform percentages for determining the Outgoings, and Tax liability should be used for each class of residential or commercial buildings.

4.4.4.3 Specifications for Processing the RES-VAL File:

The residential property valuation file (RES-VAL) has been designed to the used by a property valuer to determine the value of a domestic property, for the purpose of taxation. This file thus contains many fields whose values must be calculated by the valuer before he can finally determine both the gross value and rateable value of a domestic building. The fields content of this very file as well as a brief description of each field, has already been shown in Table 4.7. However, Table 4.12 below shows the fields in the RES-VAL file whose values need to be calculated as well as a description of each field.

Table 4.12: RES-VAL File Fields to be Computed

Field	Description
TOT-ROOMS	Total Number of Rooms
ROOMS-VAL	Total Annual Rental Value (ARV) of Bedrooms
FLATS-VAL	Total ARV of Flats
DETS-VAL	Total Value of Detached Buildings
S/DS-VAL	Total Value of semi-detached Buildings
SHOPS1-VAL	Total ARV of Small Shops
SHOPS2-VAL	Total ARV of Big Shops
SHOPS-VAL	Total ARV of all Shops
GROSS-VAL	Gross Value
OUTGOINGS	25% Outgoings
RATE-VAL	Rateable Value

To get the value of each of the fields in the table above the values of some other fields have to be manipulated together. The various fields whose values must be processed together to get the value of each of the fields in Table 4.12 are indicated in the programs (expressions) shown in Table 4.13 below.

Table 4.13: Programs for Residential Property Valuation

Field	Expression
TOT-ROOMS	BED-ROOMS + BQ-ROOMS
ROOMS-VAL	TOT-ROOMS * ROOM-VAL
FLATS-VAL	NUM-FLATS * FLAT-VAL
DETS-VAL	DETACHED * DETS-VAL
S/DS-VAL	SEMI-DETAC * S/D-VAL
SHOPS1-VAL	SHOP1-NUM * SHOP1-VAL
SHOPS2-VAL	SHOP2-NUM * SHOP2-VAL
SHOPS-VAL	SHOPS1-VAL + SHOPS2-VAL
GROSS-VAL	ROOMS-VAL + FLATS-VAL + DETS-VAL + DETS-VAL + S/DS-VAL + BUGLOW-VAL + GARAGE-VAL + SHOPS-VAL + WKSHOP-VAL
OUTGOINGS	(25\100) * GROSS-VAL
RATE-VAL	GROSS-VAL – OUTGOINGS

4.4.4.4 Specifications for Processing the COM-VAL File:

The commercial property valuation file - COM-VAL - contains some fields whose values are to be determined through the process of computation. As earlier noted, the property valuer needs this field to assess the gross value as well as the rateable value of a non-residential building. Hence, the various fields whose values are to be computed are given in Table 4.14 with a brief description of each field while Table 4.15 shows the dBase III+ expression (program) for calculating each field. (For a description of fields in each of the expressions the interested reader is hereby referred to Table 4.8).

Table 4.14: COM-VAL File Fields to be Computed

Field	Description
TOT-GFDIM	Total Ground Floor Dimension
GFLOR-AREA	Area of Ground Floor
GFGROS-VAL	Gross Value of Ground Floor
TOT-FFDIM	Total First Floor Dimension
FFLOR-AREA	Area of First Floor
FFGROS-VAL	Gross Value of First Floor
TOT-SFDIM	Total Second Floor Dimension
SFLOR-AREA	Area of Second Floor
SFGROS-VAL	Gross Value of Second Floor
TOT-DIM	Total Third Floor Dimension
TFLOR-AREA	Area of Third Floor
TFGROS-VAL	Gross Value of Third Floor
ROOMS-VAL	Total ARV of Bedrooms
BQGROS-VAL	Gross Value of Boys' Quarters
GROSS-VAL	Total Gross Value of Building
OUTGOINGS	25% Annual Outgoings
RATEABLE	Rateable Value

Table 4.15: Programs for Commercial Property Valuation

Field	Expression for Computation
TOT-GFDIM	GFOA-DIM + GFOB-DIM + ... + n
GFLOR-AREA	TOT-GFDIM - UNLET-GFS
GFGROS-VAL	GFLOR-AREA * PER-GF
TOT-FFDIM	FFOA-DIM + FFOB-DIM + ... + n
FFLOR-AREA	TOT-FFDIM - UNLET-FFS
FFGROS-VAL	FFLOR-AREA * PER-FF
TOT-SFDIM	SFOA-DIM + SFOB-DIM + ... + n
SFLOR-AREA	TOT-SFDIM - UNLET-SFS
SFGROS-VAL	SFLOR-AREA * PER-SF
TOT-DIM	TFOA-DIM + TFOB-DIM + ... + n
TFLOR-AREA	TOT-TFDIM - UNLET-TF
TFGROS-VAL	TFLOR-AREA * PER-TF
ROOMS-VAL	NUM-ROOMS * ARV-ROOM
BQGROS-VAL	BQ-DIM * PER-BQDIM
GROSS-VAL	GFGROS-VAL + FFGROS-VAL + SFGROS-VAL + TFGROS-VAL + SHOPS-VAL + ROOMS-VAL + BQGROS-VAL
OUTGOINGS	(25\100) * GROSS-VAL
RATEABLE	GROSS-VAL - OUTGOINGS

4.4.4.5 Specifications for Processing the TAX-ROLL File:

The TAX-ROLL file is the digital equivalent of the physical General Rates Card maintained by the Tenement Rates Office of the local government. As shown in Table 4.16 there are five (5) basic items in this file whose values need to be computed for.

Table 4.16: Fields of the TAX-ROLL File to be Computed

Field	Description
TAX	Tax Due for Payment in the Current Year
BALANCE	Balance Remaining After any Instalmental Payment
ARREARS	Total Arrears Owed
INTEREST	10% Interest on Arrears
TOT-AMOUNT	Total Rate Due for Payment

In Table 6.16 below, program specifications for computing the value of each of the five items mentioned above, are given.

Table 4.17: Programs for RATE-SETTING

Field	Description
TAX	(10/100) * RATE-VAL
BALANCE	TAX – INSTALMENT
ARREARS	PRE-ARREAR + LAS-ARREAR
INTEREST	(10/100) * ARREARS
TOT-AMOUNT	(TAX + ARREARS + INTEREST + ADD-CHARGE + COST) - INSTALMENT or BALANCE + ARREARS + INTEREST + ADD-CHARGE + COST

4.4.5 QUERYING THE FILES

Apart from the three attribute files treated above which could be accessed for the mathematical computation of the values of some of their fields, any of the geographical and attribute files can be retrieved and used for some query operations. The type of query to be carried out normally determines the file to be accessed. Accordingly, each of the files in the PRAGIS system has been designed to respond effectively to certain queries. It is therefore advisable for the data processing operator to familiarize himself with the information or data content of each of the files and, hence, what bits of information a file could be queried to supply.

A 6-step process for querying the PRAGIS files is given below.

Step 1: Open the Geographic File to be queried.

Step 2: Open an Attribute File that is to be queried together with the Geographic File (NB: Either a Geographic File or an Attribute File can be queried independently).

Step 3: Select the Geographic Layer to query.

Step 4: Select the Geographic Features to query (NB: You can select One, Many, or All).

Step 5: Specify the Attribute data of the selected features to display.

Step 6: Press F10 on the keyboard to finalize the query operations.

4.4.6 PRESENTING RESULTS

Processing the Geographical and Attribute Files will expectedly yield some results. Such results could be presented either in form of maps or tables, or both. Outputs like Demand Notes, Warning Notices and Sealing Notices could be obtained in tabular form. On the other hand, a number of outputs could be presented as maps. Hence, in Table 4.18 is displayed a list of maps that could be automatically generated by combining the PROPMAP or the PLOTMAP Geographical Files with some Attribute Files, for query operations.

Table 4.18: Maps Resulting from Query Operations

File Combination for Query	Maps That Could Be Generated
PLOTMAP + PLOTMAP	• Parcel Status Map
PROPMAP + PROP-OWN	• Map showing residential buildings • Map showing commercial buildings • Property (building) status map
PROPMAP + STREETS	• Street Map (showing street names and house numbering)
PROPMAP + RES-XTER	• Map showing any selected residential building characteristics
PROPMAP + COM-XTER	• Map showing any selected commercial building characteristics
PROPMAP + RES-VAL	• Map showing residential buildings having outbuildings • Map showing residential buildings having shops • Etc
PROPMAP + COM-VAL	• Maps showing some valuation information about commercial property
PROPMAP + TAX-ROLL	• Tax Map • Map showing property of defaulting ratepayers • Map showing all property due for Warning Notice • Map showing all property due for Sealing Notice.

4.5 THE DEVELOPMENT OF PRAGIS

In the previous section the design of the PRAGIS was discussed. In this section, attention is focused on the creation or production of the system using the various specifications contained in the design. Thus, the development and testing of the PRAGIS are discussed. The development of the system was accomplished in a two-step sequential process. First was the creation of the geographic database component. The second step involved producing the attribute database component. Each component, as will be seen shortly, was developed using certain appropriate tools. In either case, however, database development involved "converting user-originated inputs to a computer-based format" (Awad, 1991, p.286).

4.5.1 GEOGRAPHIC DATABASE DEVELOPMENT

The successful automation of the base maps used in this project proved a most herculean task. Each stage of the entire process of automation was quite rigorous. In all, five (5) main stages were involved. These are map reformatting, digitizing, editing, topology building, and export. The last stage - export - though would not have been necessary were it not that a GIS software, different from the one used for the map automation, was used for the cartographic processing. Whereas the PC ARC/INFO was used in digitizing the source maps, the ATLAS GIS .was used in processing the cartographic data.

4.5.1.1 Base Map Pre-Processing:

As earlier pointed out, the cadastral base acquired for the PRAGIS project did not exactly meet the required quality standard for a successful automation. For instance, some parcel boundaries were not indicated at all while some were only partially drawn. Hence, some parcel boundaries did not close. These shortcomings posed two serious consequences which could not be compromised with. These are (i) the actual parcel to which some buildings were located could not easily be ascertained, and (ii) the partial closure of some parcel boundaries made it impossible representing such parcels as polygon (area) features.

Sequel to the above-mentioned two consequences, it became absolutely necessary reformatting the cadastral base map. The reformatting took the form of establishing the missing parcel boundaries, and completely closing the partially closed ones. The former - determining the actual locations of missing parcel boundaries - was a particularly difficult task. The situation was worsened by the total refusal of the rather suspicious owners of affected parcels, to indicate, in-situ, their plot boundaries. Having no other choice, and in an apparent bid to disentangle oneself from this labyrinth, therefore, recourse was made to the adoption of a somewhat intuitive technique in subdividing the affected parcels. By this method, the missing boundary between two contiguous parcels was established using the mid-points of the bounding upper and lower line segments of the parallel baselines.

Following the above development, it is necessary to sound a note of caution here that some of the parcel boundaries are not very reliable. They, therefore, cannot be used for any legal claims to parcel ownership. However, the unreliability of some of the parcel boundaries has not in any way affected the results of this project. It must be remembered that the entire exercise is an academic one. Moreso, parcel boundaries information are not coefficients used in the valuation and assessment (rate-setting) of properties (buildings) for taxing. Parcel boundaries information become particularly useful when the issue at hand involves determining the very parcel on which a given property is located.

The second handicap necessitating the reformatting of the cadastral base map - the issue of partially closed parcel boundaries - was not as serious a problem as that of entirely missing boundaries. All the identified partially closed parcel boundaries were properly closed by using pen and ruler to extend the lines to fill the gaps.

Part of the map pre-processing exercise carried out was assigning unique label points (IDs) to the map features. Each of the parcels (plots), buildings, and roads, was assigned a unique User-ID.

4.5.1.2 Map Data Capture:

The successful reformatting of the cadastral base actually cleared the way for the map automation proper to commence. The reformatted base was first firmly secured with masking tape on a 24" x 36" digitizing tablet, ensuring that the map sheet was truly flat on the tablet.

As earlier stated, the entire length and breadth of the automation process was accomplished using the PC ARC/INFO software package, ARC/INFO is a GIS software engineering by ESRI (Environmental Systems Research Institute, Inc.), based in California, USA. The choice of ARC/INFO for the map automation was a deliberate one. This decision was predicated on two main reasons. One, both the author and some other colleagues who rendered some form of assistance during the map capture exercise, are more familiar with digitizing with ARC/INFO than with any other GIS software. The second reason is that, judging from experience, outputs of maps digitized with ARC/INFO appear comparatively better (at least in terms of quality - resolution), than most other GIS software packages. Perhaps this partly informs why ARC/INFO is one of the world's leading GIS software packages (Vanderzee and Singh, 1995, p.386).

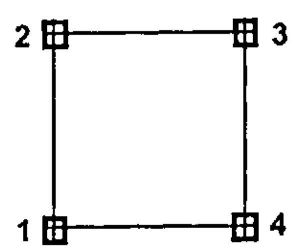
Automation of the base maps was carried out in the Remote Sensing section of the Laboratory for Cartography and Remote Sensing (LABCARS), Department of Geography and Planning, University of Lagos, Lagos. A 16-button digitizer puck was used to capture map features as a series of X, Y Cartesian coordinates.

Three types of map features were digitized. These are parcel (plot) boundaries, property (building) boundaries or outlines, and roads (streets). Each of these features was digitized as a separate coverage (layer). However, both the plot boundaries and road features are stored in the same geographic file named PLOTMAP. The recorded X, Y coordinate values of the property boundaries are stored in a separate file named PROPMAP. Although both the roads and parcels records are stored in the same file, each set of features could be displayed and manipulated separately, using the feature's unique label ID. (Unique label IDs assigned to map features in the cartographic database, and the method adopted in developing and capturing the IDs, are discussed later in this chapter).

To digitize the three coverages mentioned above the ADS (Arc Digitizing System) facility in the ARCEDIT subsystem of the PC ARC/INFO software, was used. The first step was to create a coverage using the CREATECOVERAGE command. Creating a coverage involved opening and naming a new geographic file where the automated X, Y Cartesian coordinates of a particular map feature, will be stored. Thus, for this project, two files containing geographic data, were created. These are the PLOTMAP coverage file, and the PROPMAP file.

TIC-IDs:

After creating a coverage, the next thing was to define four (4) tics on the map. A tic-id and its X, Y coordinates were entered for each tic. The tic-id was captured from the digitizer, while the X, Y coordinates were input from the keyboard. The tics serve as reference points that are used for registering a map each time there is need to add new features to a coverage. Also, the tics are used to register the map when a coverage is to be overlaid on other coverages. Thus, just one set of tic-ids was developed for all the coverages. Figure 4.7 below shows the tics and their X, Y coordinates used in registering the digital maps covering the two study locations used in this project. The tics and their geo-references are stored in the geographic files.



	ALAGOMEJI LOCATION		IWAYA LOCATION	
Tic-Id	X-Coordinate	Y-Coordinate	X-Coordinate	Y-Coordinate
1	349000	906500	355000	907500
2	349000	908000	355000	909000
3	350500	908000	356000	909000
4	350500	906500	356000	907500

Fig. 4 . 7 Tics and a Tics Attribute Table for the Study Locations

With a new coverage initialized using the CREATECOVERAGE command, and the tics and map boundaries now defined, the next line of action was to record the X, Y coordinates of the parcel coverage. This coverage, as earlier said, is named PLOTMAP. Capturing the parcel coverage involved digitizing the boundaries of individual parcels.

The ADD command in the ARCEDIT subsystem of ARC/INFO was used to digitize new arcs. The arcs were digitized interactively. In other words, the arcs were displayed on the screen simultaneously as they were being captured. This, among other things, ensured that no arcs were left out.

The parcels layer contains cartographic or locational information about the land plots within the Alagomeji area. (No parcel boundaries were captured for the Iwaya area since there is no cadastral or township map of the area in existence. As noted earlier, the map of the Iwaya location used was derived from aerial photographs). Thus, with this layer all the parcels or selected parcels, covered in the study can be displayed on the screen. A total of 90 plots are held in the parcels layer.

It should be noted that besides the locational information, a minimal set of automatically generated attribute information about each digitized map feature, is equally maintained in the geographic file. This set of attributes is known as internal attributes. Table 4.19 shows the basic internal attributes of features maintained in the geographic files.

Table 4.19: Internal Attributes of Geographic Features

Internal Attribute	Description
UNIQUE-ID	A 16-character ID which identifies the feature
PRIMARY NAME	Basic name of the feature
SECONDARY NAME	An (optional) alternative or shorter version of primary name
AREA	The area of a region (polygon) feature
PERIMETER	The perimeter of a region
LENGTH	The length of an arc (line) feature
CENTROID/SIZE	The centre and label position for each feature
ADDRESS RANGES	The left and right address ranges of street segments
STREET NAME	The name of a street or road
STREET TYPE	The class of a street (e.g. street, road, way, avenue, crescent)
PREFIX DIRECTION	Northerly direction of road
SUFFIX DIRECTION	Easterly direction of road

The roads (streets) were the next set of features to be digitized after the parcels. The Alagomeji location is traversed by six (6) road segments (see Fig.1.2) while the Iwaya location has four(4) street segments criss-crossing it (see Fig. 1.3). For each road or street segment, the from and to nodes were digitized. In this way, the roads were captured as arc features. However, the roads were equally captured as polygon features. The roads were used as both arc and polygon features for processing. The locational information on the various street and road segments are stored in the STREETS layer of the PLOTMAP geographic file. The STREETS layer can be used to display each or all of these road features in addition to their names, centroid, address ranges and length (Table 4.19).

After entering the parcel boundaries and street segments, the property boundaries (building outlines) were similarly digitized. For the Alagomeji study location, the automated boundaries of buildings were stored as a layer in the PROPMAP file. This layer contains locational information about each of the buildings (both Main and Outbuildings) within the areas covered in the study. In all, there are 209 buildings held in the PROPMAP file; this comprises 88 main buildings and 121 outbuildings made up of boys' quarters, security posts, stores and garages. On the other hand, for the Iwaya area a total of 141 buildings were digitized and stored in the IWAYA geographic file.

4.5.1.3 Label IDs Entry:

A label point was placed within each of the polygon features digitized. The label points were used to assign numeric User-IDs to the features. Thus each polygon has a unique ID with which it could be identified. The unique label ID is equally used to relate or link additional external attribute data to the feature it represents.

Unique label IDs were added to the digitized features while still under the ARCEDIT subsystem of ARC/INFO. The ADD command, which is a sub-menu under the EDITFEATURE LABEL menu of the ARCEDIT subsystem, was used. The ADD command allows one to digitize new labels. The label point for each map feature was defined using the appropriate keys on the digitizer puck. In all, four classes of features were assigned with label points. These are the parcels, roads, public corridors, and buildings.

Parcel Labels:

The parcels (in the Alagomeji area) were assigned label IDs ranging from 01 for the first parcel to 90 for the last parcel.

Property Labels:

For the Alagomeji area, each of the buildings digitized was assigned a 3-digit User-ID. The label IDs of the buildings were tied or related to the parcel IDs. This methodology was adopted so that by looking at the label ID of a property one can automatically tell the particular parcel to which the property belongs. Some parcels have more than one property on them. Care was therefore taken to ensure that the property labelling system used will at the same time be used to reflect the number of buildings in each parcel.

The first two digits of a property stand for the parcel in which the property is located while the last digit indicates the position of the property in the parcel. For example, the label ID 751 stands for building number 1 in the parcel identified with the unique User-ID 75. Also the following range of property IDs: 091, 092, 093, 094, 095 tells one that there are five (5) properties in the parcel with label ID 09. Table 4.20 is a further illustration of the labelling pattern adopted in this work, for the Alagomeji area.

Table 4.20: Parcel and Property ID Labelling Pattern

Parcel ID	Property ID	No.of Properties in Parcel
01	011, 012, 013, 014	4
16	161	1
44	441, 442, 443, 444, 445	5
84	811, 812	2

It should also be noted here that in giving User-Ids to the properties in each parcel, the number 1 was assigned to the main building while other buildings such as boys' quarters, stores, etc, were assigned numbers such as 2, 3, 4, and so on. Hence, the label IDs 011, 101, 181, 771, all stand for the main building in the parcels with label IDs 01, 10, 18, and 77, respectively.

Public Corridor Labels:

The Alagomeji location is made up of three blocks of parcels, as shown in Fig. 1.2. The blocks are defined by the street network running through the neighbourhood. Now, each block, in accordance with urban planning conventions, has a free-way corridor encompassing it. Property developers are never allowed to encroach into the corridors since they are meant for public use, e.g. for the construction of drains.

Following the digitizing of the parcel boundaries and the road segments, the free-way corridors were automatically created - they were not deliberately digitized. And since every feature appearing in a map coverage has to be given a label ID, each of the corridors was equally assigned a unique 4-digit label ID. The three corridors have IDs 3001, 3002, and 3003, respectively. The first digit 3 which is common to all of them only indicates that there are three corridors in the area covered, while the last digits 1, 2 and 3 are for the first, second, and third corridors, respectively.

Roads Labels:

As already mentioned, the roads in the study locations were captured as both individual arcs and as a single polygon feature. As a polygon feature, one User-ID was assigned to the roads in each of the locations. The roads in the Alagomeji area can be identified with the number 600 while the roads in the Iwaya area are identified with the code number 400. The first digit in each ID is quite indicative; it shows that there are six and four roads/streets running through the Alagomeji and Iwaya study locations, respectively.

But as individual arc features, the roads have been assigned IDs ranging from 6001 to 6006. Each of the roads or streets in the Alagomeji Area together with its unique ID is shown in Table 4.21 below.

Table 4.21Streets and Their Unique User-IDs

Street	User-Id
Murtala Mohammed Way	6001
Borno Way	6002
Olonade Street	6003
Herbert Macaulay Road	6004
Hughes Avenue	6005
Spencer Street	6006

4.5.1.4 Feature Checking and Editing:

After labelling, the digitized map features were checked and edited. Checking was an exercise carried out on the digital spatial data to detect any errors that may be present in the data. The checking and editing was not a one-shot exercise. Rather, an interactive procedure was adopted. This became so necessary because, true to what Rhind (1977, p.83) once said, not all errors could be detected or removed in one phase and, in addition, changes to the data sometimes produced new errors. Checks were carried out to be sure that all the features that needed to be digitized were actually digitized, that no unwanted feature was digitized, that each of the polygons closed properly, that there were no sliver polygons (unwanted overlaps), gaps, overshoots (dangling arcs or nodes), pseudo nodes. A check was equally initiated to find out if all the map features had a User-ID each, and that the User-IDs were actually the correct ones intended to be there.

The digitized map coverages were checked separately, one after another. Later they were overlaid on each other and another round of checks conducted on the overlay. The EDITPLOT menu in PC ARC/INFO software was used to display digitizing errors present in each of the coverages.

After making series of checks on the digital map data the following errors[3] were discovered by ARC/INFO:

- pseudo node
- overshoots (dangling arcs/nodes)
- sliver polygons (unwanted overlapping polygons).

Pseudo Nodes: Nodes are used to mark the beginning and the end points of an arc feature. If two, and only two arcs intersect at a node, that node is referred to as a pseudo node. Thus, if an arc which is intended to be a single, contiguous arc is split into smaller discrete arcs, by a node, that node is a pseudo node. (However, pseudo nodes do not always signify an error in the digitized work, since they may be intentionally added to split arcs). A typical pseudo node error is illustrated in Fig. 4.8.

[3]For a fuller discussion on these errors and more, the interested reader can consult either the PC ARC/INFO STARTER KIT, PC ARCEDIT, or A Glossary of GIS and ARC/INFO Terms - all published by Environmental Systems Research Institute (ESRI), Inc., Redlands, California, USA. Much of the discussions on digitizing errors presented here are based on these publications.

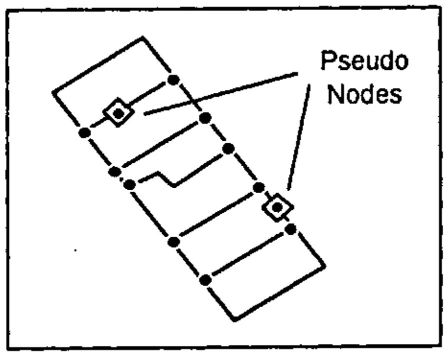


Fig.4.8 Pseudo Nodes

Dangling Nodes: A dangling node is the "dangling" endpoint of a dangling arc (an arc that does not connect to any other arc). A dangling node usually signifies the presence of one of three possible errors namely, (i) that a polygon does not close properly (undershoot), (ii) that arcs do not connect properly, or (iii) that an arc was digitized past its intersection with another arc (overshoot) (See Fig. 4.9). In this work only overshooting arcs were identified and corrected. (It should be noted that it is not in all cases that dangling nodes constitute errors in the digitized work).

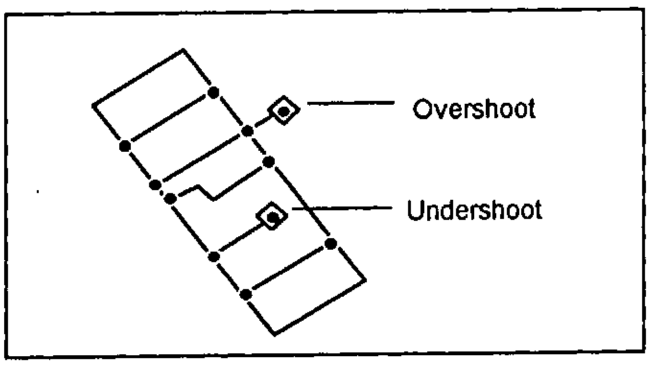


Fig4.9 Dangling Nodes

Sliver Polygons: A sliver polygon is an additional, small areal feature which may occur along the common borders of polygons when two (or more) polygon coverages are overlaid on each other. A sliver polygon usually indicates that the polygons being overlaid are indeed overlapping each other (Fig. 4.10). In this work, when the initially digitized property layer was overlain the parcel layer some sliver polygons were seen present. They were later removed. Sliver polygons may result when, among other things, the individual map coverages being overlaid are not properly registered. A word of caution necessary here is that sliver polygons do not necessarily indicate an error. However, where they are not intended to be part of the work, as in this project, they constituted errors, and as such were removed.

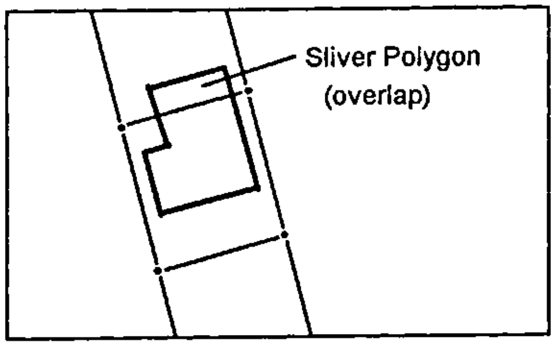


Fig. 4.10 A Sliver Polygon

Editing of Features:

All the checking and editing exercise carried out was done under the ARCEDIT subsystem of PC ARC/INFO software. As mentioned earlier, the EDITPLOT command was used to check and display errors in the coverages. Also, as has already been noted, the checking and editing was done iteratively and interactively. Iteratively, each error was edited as soon as it was revealed through checking. And since, as in some cases, a single phase of checking and editing could not remove all the errors identified, it became necessary repeating the whole process over and over again, until all the errors were taken care of. Moreso, after each round of checking and editing, the previously edited data were re-checked to ensure that no new errors were introduced following the latest editing task executed. Where fresh errors were detected, they were corrected. Interactively, the checking and editing was done on-line; the coverage being checked or edited was simultaneously displayed on the screen. This in no small measure facilitated the checking and editing of the digitized map data.

The detected digitizing errors mentioned earlier were removed one after the other. Removing the dangling arcs/nodes as well as fuzzy coordinates[4], was the first editing task

[4]Fuzzy coordinates are coordinates (or vertices) that are unnecessarily too close to other coordinates, or coordinates whose presence along an arc is of no use.

undertaken. The CLEAN mode of ARC/INFO was used to accomplish the removal of the unwanted arcs, nodes and vertices (coordinates). Before removing the errors CLEAN was used to create an "outcover" or new storage destination where the edited version of each of the initial coverages (uncover), will be stored. Thus a new coverage name had to be given to each of the former coverages. For instance, the coverage PLOT was given the name PLOTCL for the outcover, while the outcover name given to PROP was PROPCL.

After creating and naming the new temporary storage location for the cleaned copy of each coverage, the next editing task was to define a dangle length[5] and a fuzzy tolerance[6] level for the dangling arcs and fuzzy coordinates, respectively. Considering the scale of the cadastral base map - 1:1,200 - the dangle length was set at 0.001 while the fuzzy tolerance level was also set at 0.001. The implication of this setting is that any dangling arc shorter than 10m, and any fuzzy coordinate less than 10m away from other coordinates, respectively, would be removed during CLEAN operations. Figure 4.11 illustrates a dangling arc and node before and after correction.

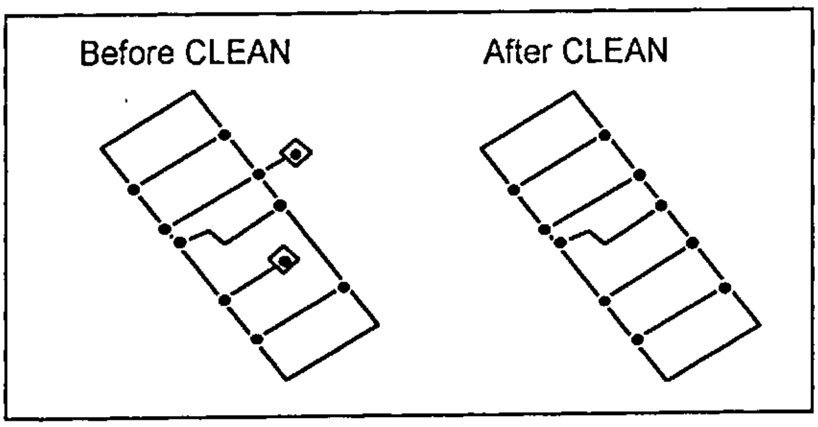


Fig. 4 : 11 Dangling Arcs and Nodes: Before and After Correction

The pseudo nodes contained in the digitized map coverages, as revealed by EDITPLOT, were removed using the ADS (Arc Digitizing System) command. Since the

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[5]A dangle length is the minimum length allowed for dangling arcs during the CLEAN process. Dangling arcs shorter than the specified dangle length are removed by CLEAN (ESRI, 1991).

pseudo nodes were few, each of the affected arcs was deleted and then re-digitized as one arc. Figure 4.12 below shows pseudo nodes before and after correction.

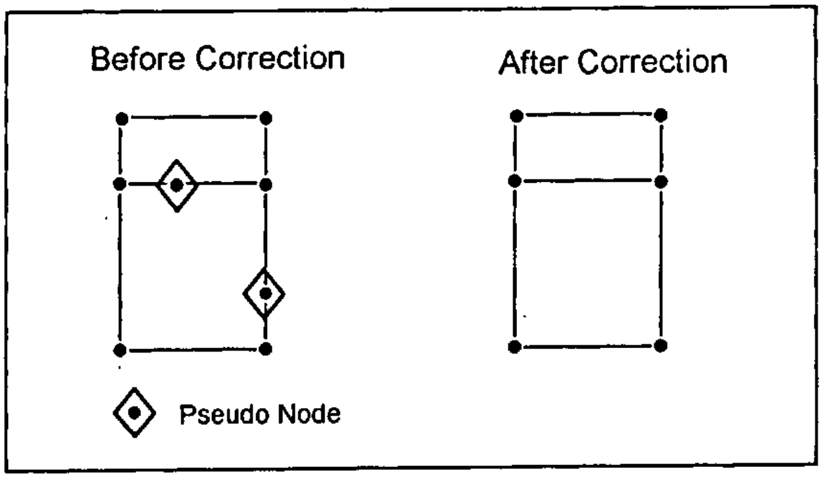

Fig.4.12 Pseudo Nodes: before and after Correction

Sliver polygons present in the digitized work were made manifest following the overlay of the PROP and PLOT coverages. Since such overlaps were not needed, they were physically removed using the mouse. This was done under the MOVE option of the EDITFEATURE ARC command. Editing the sliver polygons involved adjusting vertices of the overlapping polygons. To move a vertex, it was first selected by clicking the left mouse button over it. A new location for the selected vertex was then defined, and the vertex moved to the new location. This way, all the sliver polygons were removed. In the diagram below (Fig. 4.13) a sliver polygon before and after removal, is illustrated.

[6]Fuzzy tolerance is a parameter set during CLEAN operations that removes coordinates within the minimum distance of other coordinates as the coverage is processed (ESRI, 1991).

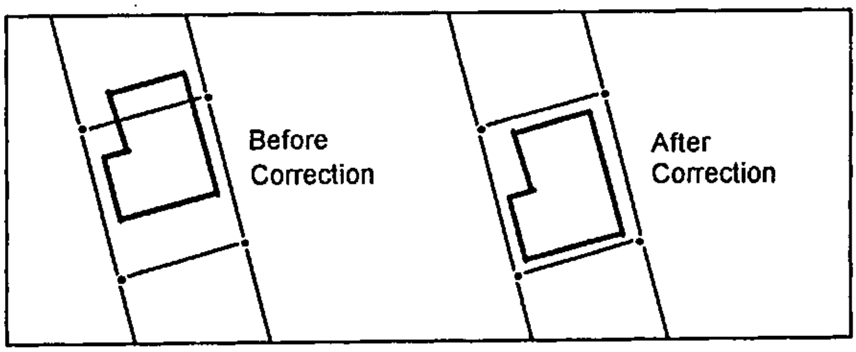

Fig4.13 Sliver Polygon: before and after Correction

4.5.1.5 Topology Building:

Having detected and corrected all the digitizing errors in the automated coverages, the feature topology[7] and feature attribute tables were then created. The CLEAN command which is resident in the ARCEDIT facility of PC ARC/INFO, was used to generate feature topology for each of the map features.

In building topology, CLEAN integrated related geographical elements and established a common relationship amongst them. In this way, related nodes were linked together to form arcs, a set of related arcs were connected or tied together to form one recognizable entity namely, a polygon. Each polygon - comprising many connected arcs - is identified with a label point and its associated User-Id. It should be noted that by the rule of adjacency, part of the arcs of a polygon can equally form part of the arcs making up another adjacent or contiguous polygon.

Building the topological relationships between coverage features, enabled ARC/INFO to recognize and hence treat each feature as a separate or single entity. Thus, with the feature topology already created, CLEAN then automatically generated a limited internal feature attribute table (FAT) for each of the two coverages (PLOT and PROP). The feature attribute table contains information on the area, perimeter, and user-ID of each of the polygon features. Two of these parameters namely, area and perimeter, are internal properties of a polygon, they cannot be changed. The User-ID parameter is user-defined, hence it can be replaced, if desired.

[7]The term "topology" as used here refers to the way which geographical elements are linked together (Burrough, 1989), or as ESRI (1991) put it, "The spatial relationships between connecting or adjacent coverage features".

Creating feature topology is not always an error-free assignment. Consequently, after building the feature topology for the coverages, it became necessary to also evaluate the exercise for any possible errors. Specifically, the polygons generated were scrutinised for node errors and label point (User-ID) errors. Fortunately, none of these errors was identified, thus signifying the success of the whole exercise.

4.5.2 DEVELOPMENT OF THE PROPERTY ATTRIBUTE DATABASE

It has been noted earlier that GIS systems often require two classes of data for effective functioning. One class is the geographic (cartographic) data for graphics processing and output. The other class is the attribute (descriptive) data for the processing and outputting of the characteristics relating to features in the geographic data. Again, it has been mentioned that there are two types of attribute data namely, internal data and external data. The internal attributes are those innate traits of map features used to identify them. Internal attributes are automatically generated and stored in the geographic file when map elements are digitized. They may include, for instance, the length (and, in some cases, width) of a road or any other linear feature, the area and perimeter of an areal feature, etc.

On the other hand, external attributes are additional characteristics of map features supplied by the database developer and stored in a separate attribute file. These attributes are used to convey useful information about map features; to display the map in different ways; and in performing queries and sophisticated analytical operations (ATLAS-GIS User's Guide: Strategic Mapping, 1990).

The graphics (map) data entry exercise conducted in this project has already been explained in the preceding section (4.5.1). Presently, attention is focused on the entry of those attributes pertaining to each of the map features digitized namely, parcels, buildings and roads.

In section 4.4, the design of the structure and content of the various external attribute files used in the PRAGIS project, was discussed. Here, emphasis is on the physical creation of those attribute files based on the specifications contained in the design.

In the physical creation of each of the attribute files, a six-step approach was adopted. The flowchart in Fig. 4.6 is a diagrammatic representation of the steps. As could be seen in the diagram step 1 of the entire process entails defining the structure and information content of an attribute file. This step had already been taken care of in section 4.4.3. Suffice it here to mention that this initial step was undertaken to define certain parameters forming part of the file structure/content. In a nutshell, the parameters defined included field names, number of characters making up each field name, the physical size of each field (i.e. the number of letters or characters in a field's entry), the number of decimal places for each numeric field, the field type (e.g. numeric, character, date, logic), and a brief description of the field.

4.5.2.1 File Structure Creation:

Step 2 of the attribute database development model is the actual creation of files in consonance with the specifications mapped out in step 1. Important operations carried out here included the opening and naming of a new file. Usually, upon the creation of a new file, ATLAS GIS (the software used in developing and managing the database), displays a form where some other parameters of the new file are entered from the keyboard.

Apart from opening the new file, another important task carried out in this step was the creation of the file structure. This activity involved keying in the file structure elements such as field names, field type, number of decimal places, field size, and field description. A typical file structure is shown in Table 4.22 below.

Table 4.22: Structure of the Property Ownership Attribute File

Field	Type	Decimal	Size	Description
PARCEL-ID	Char	0	2	Parcel ID
PROP-ID	Char	0	3	Property ID
OWNER-NAME	Char	0	21	Name of Property Owner
PROP-ADD	Char	0	32	Address of Property
ZONE	Char	0	1	Rating area or zone
AGE	Char	0	8	Age of Building
ASSESS-NO	Char	0	15	Assessment Number
ANAL-CODE	Char	0	14	Analysis Code
OCCUPIER	Char	0	13	Occupier(s) of building
PROP-CLASS	Char	0	14	Type of Property
STATUS	Char	0	11	Current status of building
USAGE	Char	0	11	Use of Property (domestic or Commercial)
OUT-BLDING	Char	0	3	Boys' Quarters
DATE-INSP	Date	0	8	Last date building was inspected
INSP-BY	Char	0	18	Person who inspected building

4.5.2.2 Editing of File Structures:

Checking and editing the file structure after creation was a most crucial operation that was undertaken (step 3). All the entries in every file structure were individually checked for any possible data entry errors. Generally, about seven (7) types of errors were identified in the file structure entries. Table 4.23 contains a list of the errors. A careful look at the errors in the table will unveil the fact that the errors are rather human errors - errors emanating from punching the wrong button on the keyboard or making the wrong selection (as in the case of field type selection). A few wrong field names were entered, some fields were entirely omitted while some entries were wrongly spelt. In some cases also a wrong choice of field type was discovered to have been made. For instance, instead of identifying a field as a NUMERIC field it was identified as a CHARACTER field. The error of entering the wrong decimal points against a field was no less a mistake that was equally made in some instances. Under-sizing, or in some cases over-sizing, of some fields was yet another kind of error committed during the file structure creation exercise. A field whose entry is made up of 10 (ten) characters, for example, is under-sized if a value of 9 (nine) or a lower value is entered in the SIZE column of the file structure; the same field is over-sized if a value of 11 (eleven) or more was entered. Wrong or improper description of some fields was equally identified as one of the common errors made in developing the field structures.

Table 4.23: File Structure Development Errors

S/N	Errors
1	Wrong Field Name
2	Wrong Field Type
3	Error in number of Decimal points
4	Under- or Over-sizing of Fields
5	Wrong Field Description
6	Spelling Errors
7	Omission of Fields

All the above detected file structure development errors were rectified. As indicated in step 3 of Fig. 4.6, each file structure was subjected to more rounds of checking/editing after correcting any identified error. The essence of this iterative process was to ensure that no detected error was left unadjusted. This approach became necessary in view of the fact that one single step of error correction could not ensure the total eradication of all the identified errors. More so, cross-checking the edited structure became inevitable since in a bid to correct errors earlier made, subsequent errors could be introduced into the structure.

Incidentally, correcting the errors necessitated a modification of each file structure. The modification task was to enable a file assume the new and desired structure. Where the structure of a file was found in good shape, it was not modified. However, whether or not a file structure was modified, it was saved into a disk location as a separate file, after creation.

4.5.2.3 Attribute Data Entry:

Immediately after creation or at a later time, a file structure could be retrieved and displayed, for further improvement. This formed the main task performed in step 4 of the attribute file development process. When a file structure is developed it is usually empty, since no records (data) had yet been entered into it. The file structure thus presents a skeletal framework on which to "attach" the records and their related data. Hence, when an empty attribute file structure is retrieved and displayed by ATLAS GIS it usually takes a format like the one shown in Table 4.24.

Table 4.24: An Empty Attribute File Structure

PROP-ID	PROP-OWNER	PROP-ADD	USAGE	TAX-DUE	DATE

The most arduous task in the process of attribute database creation was performed in step 5 which involved entering records and their corresponding data items under the various fields. Depending on the volume of data to input and the typing speed of the data-input operator, this stage could be quite time-consuming. Contributing significantly to protract the data entry time in this step was the occasional need to pause and modify some aspects of a file structure.

Indeed, some of the errors pointed out in step 3 above, the correction of which necessitated a modification of some fields in the file structures, did not become evident until the entering of data into the structures commenced. Two file structure errors that particularly became important at this stage were wrong field type and under- or over-sizing of field. Fields that were supposed to be CHARACTER fields but which were mistakenly developed as NUMERIC, were at this stage detected consequent upon the refusal of such fields to accept CHARACTER data entered against them. Such fields had to be changed from NUMERIC to CHARACTER before data could be entered against them.

Similarly, that certain fields were actually under-sized (or over-sized, as was the case in some areas), only became apparent as data was being keyed into such fields. Take, for instance, the case of a field such as PROP-OWNER (Name of Property Owner), whose physical size had initially been defined as 17. However, during data entry it was discovered that there was a property owner by name ONYEBUCHI OKORONKWO (a name whose physical size is 19, including the empty space in-between the first name and the surname). Definitely, the initially defined field SIZE cannot take the entire name of this landlord as it can only take ONYEBUCHI OKORONK. In this case, the SIZE field of the file structure had to be modified by increasing it to 19 (or indeed any value that could conveniently accommodate the longest name in the property owners list).

What follows next is a description of the data content, volume and use of each of the attribute files in PRAGIS.

1. The Parcels Attribute File

The parcels attribute file, also known as PLOTMAP, contains additional information about each parcel within the Alagomeji study site. The file has been developed such that it could be used to display, query and update the characteristics of individual parcels in the PLOTS layer of the geographic file. The parcels can be accessed to get information on the area, perimeter as well as current status of each individual parcel (i.e. whether built-up, partially-built, or vacant). Also, this file can furnish information on the number of buildings on each plot. The file contains 90 (ninety) records and 7 (seven) fields.

2. The Property Ownership Attribute File

The property ownership file (Appendix B) is used to store vital information on the ownership of each of the 71 (seventy-one) main buildings in the Alagomeji area covered in this study. This file, named PROP-OWN is made up of 71 records and 17 fields. Among others, the file is capable of furnishing the user with current information on the owner, address, occupier, age, status, usage, and land area of each of the properties. Equally, information on the assessment number, analysis code, inspection date and rating zone of each property, can be got from this file. Being an input data file, PROP-OWN can be used for querying and updating the property ownership information as may be contained in the file. Thus, with this file, Council can easily keep track of changes in the ownership records of properties in the area. It should be noted, however, that this file cannot be used for any analytical operations, since it does not contain any fields that can allow for such.

3. Residential Property Attribute File

The physical characteristics of individual domestic properties covered in this study, are stored in the RES-XTER file. (See Appendix C). Also information on the amenities available in each property as well as the aesthetic condition of the property, form part of this file. Thus, with RES-XTER, one can at a glance get all the descriptive information about any of the domestic buildings in the study area. For instance, with this file, the user can easily acquire such information as the construction material, design, repair condition, amenities (water, electricity), number of bed rooms, kitchenette, roofing style/material, ceiling type/material, wall finishes, W.Cs, to mention but a few. With RES-XTER it therefore becomes easier to query and update individual attributes pertaining to any of the residential buildings under study. However, this file is not meant for analytical operations. In terms of volume, the residential property attribute file (RES-XTER) contains a total of 62 (sixty-two) records and 46 (forty-six) fields.

4. Commercial Property Attribute File

Commercial/industrial properties often have some features distinguishing them from domestic properties. For this reason, therefore, it became necessary creating and maintaining a separate attribute file for commercial properties in the PRAGIS. This file, named COM-XTER, has been carefully designed and developed to supply vital information on the physical characteristics and facilities within each of the 9 (nine) commercial properties covered in this study (Appendix D). With this file it is possible to get detailed information about each of the properties in relation to construction (walls, windows, doors, floors, ceiling), development (storey, bay), accommodation type (office, factory, shops, restaurant, warehouse, stores, workshops, etc), services (drainage, water, electricity), repairing condition, and sundries (W.Cs, lifts, lavatory basins, central airconditioning). The COM-XTER file can be used to query and update the information on any of the commercial properties appearing in the Property Layer of the geographic file. A total of 29 (twenty-nine) fields are maintained in the COM-XTER for each of the 9 (nine) records in the file.

5. Residential Property Valuation File

The residential property valuation file - RES-VAL - is one of the two attribute files designed and dedicated to the valuation and assessment of buildings. The other one is COM-VAL, for non-residential property appraisal. The RES-VAL file is aimed at assisting the valuer to easily fix the gross value, percentage outgoings, and rateable value of individual domestic buildings. All the necessary information needed by the valuer to objectively value a domestic property are, therefore, contained in this file. (For a sample of this file see Appendix E) Among the pieces of attribute information in this file are annual rental value (ARV), number of bedrooms, accommodation type (e.g. duplex, bungalow, semi-detached house, flats, etc), type and number of shops (for domestic properties having shops/stores), and so on. The residential property valuation file (RES-VAL) was designed to be formula-driven. Some short, dBase III+ compatible programs (expressions) have been written for determining the value/content of some fields. For instance, different programs exist for calculating Gross Value, Percentage Outgoings, Rateable Value, etc. A full account of the programs or expressions for manipulating different files for valuation, rate-setting and billing, can be found in section 6.5 of chapter 6. Suffice it here to say that the programs can be used to manipulate a single record at a time, or used for batch processing (e.g. mass appraisal of properties). The RES-VAL file contains thirty-two (32) fields and sixty-two (62) records.

6. Commercial Property Valuation File

Every bit of information necessary for the successful valuation of each of the non-residential buildings in the study area, is contained in the commercial property valuation file named COM-VAL. Each of the various data items in this file was carefully chosen in line with the peculiarities of commercial buildings found in the area. Every individual non-residential property was separately studied to draw out those physical characteristics that would enable the valuer to properly fix an appropriate value for the property. Among other things, the COM-VAL file stores information on the usage (e.g. factory, offices, shops, warehouse, etc) of each commercial property; the number of floors, the total number of offices per floor, the areal dimensions of each office space, the total areal dimension of office spaces per floor, the amount of unletable space per floor, effective area of each floor, amount payable per unit floor area, gross value of each floor, total gross value for entire building, 25% outgoings, and rateable value.

Some commercial buildings in the study area have residential apartments in them. In this study, such buildings were still recognized as commercial. However, their residential components were equally taken care of in developing the commercial property valuation file. Thus, COM-VAL also contains bits of information on the physical characteristics of residential accommodation found in some commercial buildings.

The COM-VAL file contains information covering each of the nine (9) commercial properties. It equally stores sixty (60) data items (fields) for each of the buildings (records). In terms of usage, the COM-VAL file can be used for a number of operations including calculation of the unletable space, floor area, gross value, rateable value, and so on. A sample of the information content of the COM-VAL file is shown in Appendix F .

7. The General Rates File

The general rates file is meant to serve as the tax toll; in fact, the file is rightly named TAX-ROLL. This file (see Appendix G), provides the assessor with information for setting the rate (tax) payable by the ratepayer of any given property covered in this study. Besides, the file is designed to furnish the Tenement Rates Office with current information about the payment standing of every property - residential and non-residential. For instance, with this file Council will be able to know the rate payable on a property in the current rating year, when the payment is due, whether the payment has been effected, and if so, whether the payment was made in full or an instalment was paid, and if an instalment hence the balance due for payment. Thus, the TAX-ROLL file will enable Council know if rate payment in respect of a property is up to date, or if the ratepayer is in default. With this file, therefore Council can easily up-date her property rate payment records and also identify defaulting ratepayers due to be served Warning Notices or Sealing Notices, as the case may be. Being the general tax register, so to say, the TAX-ROLL file contains payment information on all the seventy-one (71) rateable properties covered in this study. A total of thirty (30) fields with their associated data items are in this file, for each of the seventy-one records.

8. The Demand Note File

The Demand Note file, otherwise known as BILL in the PRAGIS system, contains those bits of information needed by the Billing Unit of the Tenement Rates

Office to finally prepare fresh annual bills sent to property tax-payers. A sample of this file is shown in Appendix H. The bills are to notify taxpayers of their indebtedness to Council and hence request them to come and pay their taxes within the maximum time stipulated in the bill. Therefore, forming part of the information content of this file are issues such as the rateable value of a property, tax (rate) due for payment in the current year, previous arrears owed (if any), years of arrears, total amount due now for payment as well as the date from which bill or demand note becomes effective and the allowable time period within which to redeem debt. The BILL file, like the following two files discussed next, can be used by Council to maintain and operate mailing list for bills sent to ratepayers. Each of the rateable buildings in the study area is covered in this file under twenty (20) fields. This file can be used to update the TAX-ROLL file.

9. The Warning Notice File

Warning Notices are usually sent to ratepayers who are indebted to Council over a considerable period of time. A warning notice reminds a ratepayer of his long, over-due debt and requests him to hasten up and clear his debt within a stipulated length of time or face some punishment as may be meted out by Council. The WARNING file was therefore conceived, designed and developed to contain names of property owners/ratepayers deserving to be served with Warning Notices. Thus, this file is only limited to the category of defaulting ratepayers whom the Tenement Rates Office has considered worthy of being served with Warning Notice. Consequently, the number of records (delinquent taxpayers) in this file is never constant, it should vary with time and events. When new delinquents are detected their names are included in the list while the records of hitherto defaulting ratepayers who have cleared their debts, are expunged from the file. The records of debtor taxpayers included in this file should be extracted from the TAX-ROLL file. The data items in the WARNING file are only those needed by the Rates Office to prepare Warning Notices. The file, therefore, contains such data items as name of property owner (ratepayer), property address, arrears owed, amount due for current year, total amount due for payment and the period of time covered by the notice. In all, there are eleven (11) fields in the file.

10. The Sealing Notice File

Some ratepayers even after being served with Warning Notices may still refuse to settle their outstanding rates. In that case, Council, in consonance with the provisions of the 1989 Lagos State Tenement Rate Edict section 34(2)(3)(4), may issue a Sealing Notice to such defaulting taxpayers. Thus, automation of the Sealing Notice was equally considered of paramount importance in this project. The SEALING file has therefore been created to facilitate the issuance of such notices to deserving ratepayers. The file should contain only records of those taxpayers whose property Council considers necessary to be sealed up, due to their too long a period of indebtedness.

In terms of fields content, the SEALING file is akin to the WARNING file. There is however, significant variation in the values of the data items appearing in both files. There are ten (10) fields in the file. It is worth noting here that like in the case of the WARNING file, the records in the SEALING file are not meant to be constant, they are expected to change from time to time, as new defaulters are fished out and old ones clear their debts.

11. The Streets Attribute File

The STREETS file in PRAGIS has been created to contain vital information on each of the road or street segments in the study locations. The file, thus, can furnish such information as name of street, type (e.g. road street, avenue, way, crescent), condition (e.g. poor, fair, good), surface type (e.g. tar, gravel, earth), street (house) numbering (A sample is shown in Appendix 1). In combination with the geographical files, Council can use the STREETS file to generate street maps showing locations of individual houses as well as the house numbers. Such maps will facilitate the distribution of Demand Notes, Warning Notices and Sealing Notices, and also aid Council in revenue drive. The file contains seventy-one (71) records and ten (10) fields.

4.5.2.4 Attribute Data Editing:

The data items entered into each of the eleven attribute files discussed above were scrutinized after entry. Despite the minimal editing and modification that was iteratively done during the data entry exercise, the checking/editing proper of the attribute data keyed in, was still executed. (Step 6 of the Attribute Data Development Model). Two types of possible errors were at this stage hunted for, for correction. These are file structure errors and data entry errors. The file structure errors checked for here are similar to the ones discussed earlier. At this stage, however, only one file structure error featured prominently namely, over-sizing of certain fields.

On the other hand, three data entry errors were commonly detected; these are spelling errors, wrong entries, and omissions. The errors were not only detected, they were equally corrected. The over-sized fields were pruned down to size to release more storage space in the computer hard disk; wrong entries were deleted and replaced with the correct data; incorrectly spelt entries were rectified while omitted records/data items were subsequently entered.

For each attribute file created the entire process of data checking/editing was carried out repeatedly to totally obliterate or at least reduce to the barest minimum, all file structure and data entry errors. It should be noted that as shown in the flowchart in Figure 4.6, every round of checking and editing conducted, possibly led to the modification of some component of the file structure. (Some of the errors that could not be detected and hence corrected, during the development of the Attribute Database were detected and corrected during Data Manipulation).

CHAPTER FIVE

RESEARCH FINDINGS AND DISCUSSIONS

5.1 INTRODUCTION

This chapter outlines and discusses the findings of this work. A comparative analysis of the manual and the automated (PRAGIS) rating systems is presented. Both the actual and potential benefits of administering tenement rates using the PRAGIS, are highlighted.

5.2 FINDINGS AND DISCUSSIONS

5.2.1 *Data Collection And Maintenance:*

The manual system of collecting and managing property data for the purpose of rating is fraught with many shortcomings. A significant percentage of the available data was found to be inaccurate. For instance, some buildings which are partly used for commercial purpose were recorded as purely residential buildings (See Table 5.1). Lack of comprehensive geographical coverage in the discovery and identification of tenements for taxation is yet another major problem. In a number of cases, rateable properties were found missing from the Valuation List. Records of 16(sixteen) out of the 88(eighty-eight) buildings within the Alagomeji study location were conspicuously missing, no files existed for them, hence no revenue is derived from such rateable buildings. Figure 5.1 clearly shows the 16 rateable buildings missing from Council's Valuation List. Unfortunately, the manual system of property records collection in which maps are never used, lacks the capability of easily detecting missing records from the Tax Roll or Valuation List. But this is not so with the automated system which utilizes maps. In fact, the 16 buildings whose records were earlier reported missing were detected when the buildings in one of the digital files in the system were displayed and queried for certain attribute information. Hence, the automated system, unlike its manual counterpart, quickly reveals any missing information in the property records.

Table 5.1 Mixed Use Properties Incorrectly Recorded by Council as Purely Residential

PROPERTY ADDRESS	COMMERCIAL FACILITY AVAILABLE
273, Herbert Macaulay Road	1 Shop
277, Herbert Macaulay Road	2 Shops
279, Herbert Macaulay Road	2 Shops
289, Herbert Macaulay Road	2 Shops
291, Herbert Macaulay Road	1 Shop
296, Herbert Macaulay Road	1 Shop
5, Hughes Avenue	4 Shops
11, Hughes Avenue	1 Shop
344, Borno Way	Mechanic Workshop
352, Borno Way	1 Shop
367, Borno Way	2 Shops
304, Murtala Muhammed Way	7 Shops; Mechanic Workshop

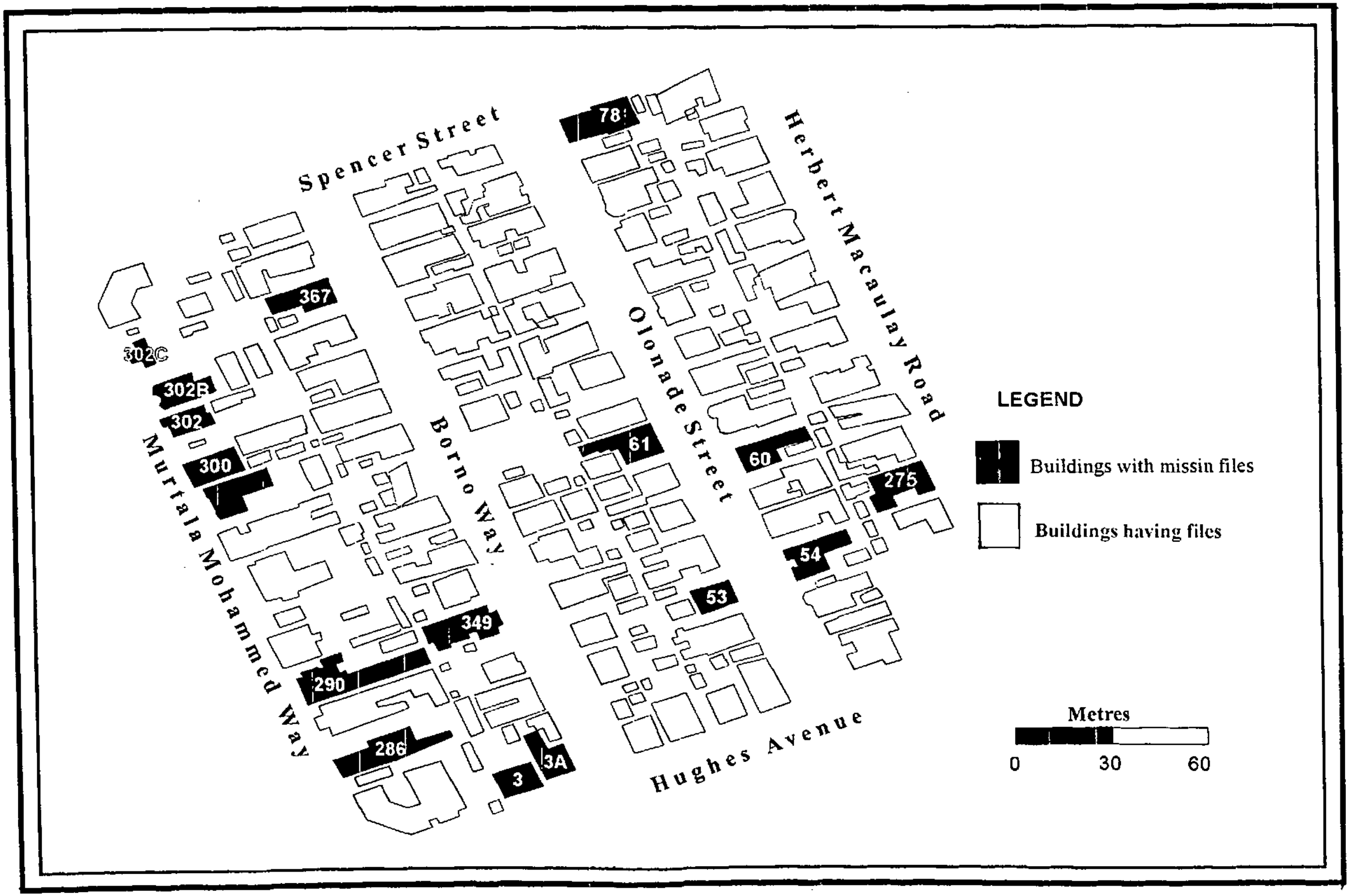

Fig. 5.1 Buildings whose files are missing in the Alagomeji Area

Another major problem of the existing technique of data collection is that it is attribute data-oriented. Consequently, the technique allows for the collection and maintenance of only the attributes or characteristics describing the buildings without gathering the graphic components of the buildings themselves. As a result of this the rating office completely lacks cartographic products showing the spatial locations, distribution and relationship of the buildings as well as the actual sizes of the buildings (in terms of area of building). As a matter of fact, the Council does not have information on the size of each of the buildings in the Alagomeji and Iwaya study locations.

However, this research employed Cartographic and remote sensing techniques in the collection of data. Both cadastral map and aerial photographs were used to gather relevant geographic data. Hence, the all important graphic data which hitherto was neglected, was gathered and used in this research. By employing the cartographic and/or remote sensing technique it becomes easier to collect both the graphic(map) data and the associated attribute(descriptive) data that may be needed for successful rates administration. Figures 5.1 to 5.9 were generated using the PRAGIS and they contain very useful graphics information which the Local Government could employ in rates administration. Also based on the digital cartographic data existing in PRAGIS some important rate-related attribute data could be generated and presented in tabular format. For example, the PRAGIS maintains a record of the actual sizes of both the parcels and buildings in the Alagomeji site (Table 5.2), as well as the sizes of the buildings in the Iwaya location (Table 5.3). Equally shown in Table 5.2 is the number of buildings on each parcel, the area of each building, the total area of the buildings (i.e. the total amount of land occupied by buildings on each parcel), the area of the parcel, and the amount of vacant space available for further development on each parcel.

The manual system does not allow for constant updating of property records with ease. Hence the Council maintains and uses obsolete data for some buildings. For instance, Table 5.4 shows buildings with invalid usage data in Council's Valuation List. Whereas Council's records indicate that these buildings are residential buildings and are still in use, the PRAGIS records (based on fieldwork carried out to ascertain the current usage status of buildings in the study locations), show that these particular buildings are

Table 5·2 Number of Buildings and Amount of Vacant Space on each Parcel

PARCEL ADDRESS	PARCEL AREA (M^2)	AREA OF BUILDING1 (M^2)	AREA OF BUILDING2 (M^2)	AREA OF BUILDING3 (M^2)	AREA OF BUILDING4 (M^2)	AREA OF BUILDING5 (M^2)	TOTAL AREA OF BUILDINGS (M^2)	AMOUNT OF VACANT SPACE ON PARCEL (M^2)
284, MM Way	1361.15	565.76	47.867	16.777			630.404	730.746
286, MM Way	716.906	310.493					310.493	406.413
288, MM Way	752.059	469.818					469.818	282.241
290, MM Way	768.165	401.187	60.61				461.797	306.365
292, MM Way	716.971	197.93	27.667	57.908			283.505	433.466
294, MM Way	315.553	151.925	48.079	9.87	24.398	52.203	286.475	29.078
296, MM Way	751.823	438.526					438.526	313.297
298, MM Way	772.294	227.526	90.954				318.48	453.814
300, MM Way	763.871	182.638	189.921	6.587	35.917	33.129	448.192	315.679
302A, MM Way	776.332	126.403	59.299	11.649			197.351	578.981
302B, MM Way	742.095	176.063	94.122	67.811			337.996	404.099
304A, MM Way	852.717	65.347	31.002				96.349	756.368
304B, MM Way	1523.32	262.86	19.376	40.023	74.736	8.228	405.223	1118.097
371, Borno Way	496.546	158.386	28.463	13.327			200.176	296.37
369, Borno Way	470.929	272.992					272.992	197.937
367, Borno Way	518.856	190.173	21.756	16.61			228.539	290.317
365, Borno Way	467.921	275.539					275.539	192.382
363, Borno Way	524.256	267.828	25.01				292.838	231.418
361, Borno Way	494.598	261.616	17.085				278.701	215.897
359, Borno Way	495.485	216.975	10.722	13.107			240.804	254.681
357, Borno Way	495.488	130.19	29.34	18.461	20.867		198.858	296.63
355, Borno Way	464.145	263.206					263.206	200.939
353, Borno Way	558.313	210.770	23.205	31.235			265.21	293.103
351, Borno Way	478.824	178.972	15.415	19.059			213.446	265.378
349, Borno Way	515.91	260.891	11.782				272.673	243.237
347, Borno Way	502.396	108.039	8.277	5.882			122.198	380.198
345, Borno Way	497.41	266.394	77.875				344.269	153.141
3, Hughes Av.	522.612	147.667	29.932				177.599	345.013
3A, HughesAv.	488.313	168.556	63.049				231.605	256.708
5, Hughes Av.	475.906	126.15	38.737	13.422	16.48		194.789	281.117
7, Hughes Av.	494.629	202.413	12.145				214.558	282.071
334, Borno Way	505.274	127.831	34.862	31.625			194.318	310.956
336, Borno Way	478.051	127.105	39.751	16.327			183.183	294.868
338, Borno Way	494.227	205.76	65.071				270.831	223.396
340, Borno Way	589.357	196.679	15.122	14.895			226.696	362.661
342, Borno Way	406.487	147.694	92.14				239.834	166.653
344, Borno Way	508.463	126.414	23.503	41.29			191.207	317.256
346, Borno Way	481.404	0.00					0	481.404
348, Borno Way	505.975	148.24	26.455	13.917			188.612	317.363
350, Borno Way	490.727	185.638	33.294				218.932	271.795
352, Borno Way	493.617	294.549	8.515				303.064	90.553
354, Borno Way	492.827	277.347					277.347	215.48
356, Borno Way	483.156	271.765	52.61				324.375	158.781
358, Borno Way	496.679	265.528	9.623				275.151	221.528
360, Borno Way	496.087	202.669	22.503				225.172	270.915

Table 5·2 ***Contd.***

PARCEL ADDRESS	PARCEL AREA (M^2)	AREA OF BUILDING1 (M^2)	AREA OF BUILDING2 (M^2)	AREA OF BUILDING3 (M^2)	AREA OF BUILDING4 (M^2)	AREA OF BUILDING5 (M^2)	TOTAL AREA OF BUILDINGS (M^2)	AMOUNT OF VACANT SPACE ON PARCEL (M^2)
77, Olonade St.	481.211	212.305					212.305	268.906
75, Olonade St.	464.435	220.466	50.26				270.726	193.709
73, Olonade St.	507.196	204.22	18.759	19.315			242.294	264.902
71, Olonade St.	487.818	295.729					295.729	192.089
69, Olonade St.	489.648	248.258					248.258	241.39
67., Olonade St.	488.056	272.667					272.667	215.389
65, Olonade St.	502.839	163.806	64.479				228.285	274.554
63, Olonade St.	483.802	190.915	23.456	11.051			225.422	258.38
61, Olonade St.	504.621	218.202	86.695				304.897	199.724
59, Olonade St.	501.162	182.829	75.202				258.031	243.131
57, Olonade St.	492.056	173.131	60.388	12.221	38.101		283.841	208.215
55, Olonade St.	497.726	284.705					284.705	213.021
53, Olonade St.	493.521	130.418	50.789	25.884			207.091	286.43
51, Olonade St.	486.337	266.129					266.129	220.208
9, Hughes Av.	492.998	131.339	22.174	9.859	23.87		187.242	305.756
11, Hughes Av.	482.958	211.796	46.177				257.973	224.985
13/15, Hughes Av.	933.141	251.781	119.486				371.267	561.874
52, Olonade St.	485.875	208.231	16.265	23.327			247.823	238.052
54, Olonade St.	495.16	214.898	37.657				252.555	242.605
56, Olonade St.	516.37	279.227					279.227	237.143
58, Olonade St.	484.256	253.8					253.8	230.456
60, Olonade St.	504.414	189.13	37.884				227.014	277.4
62, Olonade St.	517.291	258.239	47.606				305.845	211.446
64, Olonade St.	481.5	222.863	55.865				278.728	202.772
66, Olonade St.	488.125	118.451	23.39	60.167			202.008	286.117
68, Olonade St.	537.713	128.538	18.514	16.09			163.142	374.571
70, Olonade St.	517.751	214.103	46.355				260.458	257.293
72, Olonade St.	534.213	128.28	25.5	32.077			185.857	348.356
74, Olonade St.	521.156	230.699	14.813	42.306			287.818	233.338
76, Olonade St.	538.006	161.728	36.704	30.595	17.76		246.787	291.219
78, Olonade St.	505.448	264.068	21.254				285.322	220.126
297, Herbert M. Rd.	455.306	219.377	29.455				248.832	206.474
295, Herbert M. Rd.	534.273	139.408	18.104	16.212			173.724	360.549
293, Herbert M. Rd.	501.423	202.183	30.315				232.498	268.925
291, Herbert M. Rd.	520.325	181.805	73.511				255.316	265.009
289, Herbert M. Rd.	523.692	228.337	57.225				285.562	247.13
287, Herbert M. Rd.	514.955	190.117	70.763				260.88	254.075
285, Herbert M. Rd.	501.601	141.257					141.257	360.344
283, Herbert M. Rd.	500.056	274.753	29.835				304.588	195.468
281, Herbert M. Rd.	529.341	216.725					216.725	312.616
279, Herbert M. Rd.	514.781	231.385	26.097	21.888			279.37	235.411
277, Herbert M. Rd.	491.712	217.807	76.055				293.862	197.85
275, Herbert M. Rd.	521.821	239.914	21.055	39.423			300.392	221.429
273, Herbert M. Rd.	511.935	157.776	24.891	19.944			202.611	309.324
271, Herbert M. Rd.	1522.68	0.00					0	1522.68

Table 5.3: Area of Buildings in the Iwaya location

ID	AREA(cm²)	HOUSECODE	ADDRESS	LABEL ID
IWAYAR10	986.731			92
IWAYAR100	1317.369			125
IWAYAR101	1188.914			53
IWAYAR102	827.807	5b	ABIYE	45
IWAYAR103	1088.411	10	OGUNKOYA ST.	60
IWAYAR104	2484.805	5b	ABIYE STREET	52
IWAYAR105	1026.392			124
IWAYAR106	1890.032			136
IWAYAR107	3924.169	5a	ABIYE STREET	43
IWAYAR108	1914.119	10	OGUNKOYA ST.	59
IWAYAR109	1487.309			132
IWAYAR11	4192.781			91
IWAYAR110	1120.502			131
IWAYAR111	4313.27	6	ABIYE STREET	51
IWAYAR112	2046.914			130
IWAYAR113	2687.914	11	OGUNKOYA ST.	65
IWAYAR114	1638.361			138
IWAYAR115	1863.321			135
IWAYAR116	2501.865	12	OGUNKOYA ST.	64
IWAYAR117	3869.303			134
IWAYAR118	1586.211			58
IWAYAR119	489.943			137
IWAYAR12	1194.021			95
IWAYAR120	3917.479	8d	ABIYE STREET	57
IWAYAR121	3479.566	10b	ABIYE STREET	50
IWAYAR122	1740.093			63
IWAYAR123	3559.045	13	OGUNKOYA ST.	68
IWAYAR124	1665.348			140
IWAYAR125	3996.624			67
IWAYAR126	1950.246	10	ABIYE STREET	62
IWAYAR127	1914.673			139
IWAYAR128	1545.231	9	ABIYE STREET	56
IWAYAR129	3450.169	14	OGUNKOYA ST.	70
IWAYAR13	104451			1000
IWAYAR130	3137.513	15	OGUNKOYA ST.	73
IWAYAR131	1467.845	12	ABIYE STREET	66
IWAYAR132	3726.896	10a	ABIYE STREET	61
IWAYAR133	1468.04	16	OGUNKOYA ST.	72
IWAYAR134	1863.827	14	ABIYE STREET	69
IWAYAR135	1850.146	18	OGUNKOYA ST.	75
IWAYAR136	2847.459	16	ABIYE STREET	71
IWAYAR137	5055.899	18	ABIYE STREET	74
IWAYAR138	1766.268	20	OGUNKOYA ST.	77
IWAYAR139	2794.611	17	OGUNKOYA ST.	81
IWAYAR14	3394.766			7
IWAYAR140	3276.396	20	ABIYE STREET	76
IWAYAR141	2655.646	22	OGUNKOYA ST.	80
IWAYAR142	3312.992	22	ABIYE STREET	78
IWAYAR143	4717.561	24	ABIYE STREET	79
IWAYAR144	36022.18			1000
IWAYAR145	3610.43	26	ABIYE STREET	82
IWAYAR146	1638.728	28	ABIYE STREET	83
IWAYAR147	1404.417	30	ABIYE STREET	84
IWAYAR148	1579.109	32	ABIYE STREET	85
IWAYAR149	2121.347	34	ABIYE STREET	86
IWAYAR15	3926.55			6
IWAYAR150	1965.674	36	ABIYE STREET	87
IWAYAR151	3825.082	38	ABIYE STREET	88
IWAYAR152	3109.309	40	ABIYE STREET	89
IWAYAR153	2357.168	42	ABIYE STREET	90

Table 5.3 contd.

IWAYAR16	734711.1			2000
IWAYAR17	1396.862			3
IWAYAR18	2088.398			97
IWAYAR19	634.18			1
IWAYAR2	207769.4			1000
IWAYAR20	2307.372			4
IWAYAR21	2511.079			2
IWAYAR22	4019.744	1	OGUNKOYA ST.	98
IWAYAR23	5340.395			101
IWAYAR24	1149.312			5
IWAYAR25	2397.721	2	OGUNKOYA ST.	13
IWAYAR26	1700.002			100
IWAYAR27	2581.085	VI	IJEBU QUARTERS	12
IWAYAR28	2400.446	3	OGUNKOYA ST.	99
IWAYAR29	2976.636	3	MEMUDU LANE	10
IWAYAR3	160912.4		ROADS	500
IWAYAR30	2320.068			103
IWAYAR31	2366.174	I	IJEBU QUARTERS	11
IWAYAR32	1281.536			8
IWAYAR33	1348.685			102
IWAYAR34	899.048			107
IWAYAR35	2328.636			108
IWAYAR36	965.153	2	MEMUDU LANE	9
IWAYAR37	1196.836	5	MEMUDU LANE	141
IWAYAR38	2864.408	5	OGUNKOYA ST.	104
IWAYAR39	4018.149	7	OGUNKOYA ST.	18
IWAYAR4	3911.263			1000
IWAYAR40	661.798			105
IWAYAR41	492.72			110
IWAYAR42	1155.367	4b	MEMUDU LANE	16
IWAYAR43	2185.617	4a	MEMUDU LANE	15
IWAYAR44	174.901			106
IWAYAR45	2087.732	V	IJEBU QUARTERS	17
IWAYAR46	523.646			109
IWAYAR47	1368.09	4c	MEMUDU LANE	14
IWAYAR48	1019.543			20
IWAYAR49	56536.46			1000
IWAYAR5	37589.02			1000
IWAYAR50	9453.646			1000
IWAYAR51	2445.465	III	IJEBU QUARTERS	21
IWAYAR52	4551.411			26
IWAYAR53	2252.69	6	MEMUDU	19
IWAYAR54	2327.18	4	OGUNKOYA ST.	27
IWAYAR55	1993.83			114
IWAYAR56	2523.286	9	MEMUDU LANE	23
IWAYAR57	1472.901			113
IWAYAR58	552.48			112
IWAYAR59	6111.985	IV	IJEBU QUARTERS	25
IWAYAR6	68503.93			1000
IWAYAR60	846.392			111
IWAYAR61	930.156			24
IWAYAR62	1437.168			115
IWAYAR63	2925.532	8	MEMUDU	22
IWAYAR64	2912.065	7b	MEMUDU LANE	28
IWAYAR65	1447.089			33
IWAYAR66	1168.395			118
IWAYAR67	1684.596			117
IWAYAR68	855.164			29
IWAYAR69	998.785	9	OGUNKOYA ST.	39
IWAYAR7	1651.278			94
IWAYAR70	1778.27			32

Table 5.3 contd.

IWAYAR71	3970.803			116
IWAYAR72	3004.313			123
IWAYAR73	1417.335			38
IWAYAR74	1159.678			31
IWAYAR75	1808.238			37
IWAYAR76	2499.691	2a	ABIYE STREET	30
IWAYAR77	165592.7			1000
IWAYAR78	2655.788			128
IWAYAR79	5626.233			36
IWAYAR8	4338.343			96
IWAYAR80	961.771			42
IWAYAR81	973.682			120
IWAYAR82	2113.898	6	OGUNKOYA ST.	49
IWAYAR83	873.342			119
IWAYAR84	886.129			41
IWAYAR85	1461.474	2b	ABIYE STREET	35
IWAYAR86	1819.097			122
IWAYAR87	2278.016			127
IWAYAR88	892.08			48
IWAYAR89	2310.831			34
IWAYAR9	3563.543			93
IWAYAR90	1714.281			126
IWAYAR91	1462.84			47
IWAYAR92	2904.374	4	ABIYE STREET	40
IWAYAR93	2400.639			46
IWAYAR94	1171.17			133
IWAYAR95	2600.766	8	OGUNKOYA ST.	55
IWAYAR96	1528.496			121
IWAYAR97	1365.936			54
IWAYAR98	969.256	3	ABIYE STREET	44
IWAYAR99	2027.549			129

Table 5.4 Buildings with invalid Usage data in Council's Valuation Records

BUILDING ADDRESS	USAGE (Council records)	USAGE (PRAGIS records)	CURRENT STATUS
51, Olonade St.	Residential	None	Uncompleted
55, Olonade St.	Residential	None	Pulled down
65, Olonade St.	Residential	None	Pulled down
66, Olonade St.	Residential	None	Abandoned
351, Borno Way	Residential	None	De-roofed
369, Borno Way	Residential	None	De-roofed
5, Hughes Avenue	Residential	None	Uncompleted

not currently in use. In fact as Table 5.4 indicates, some of the buildings are currently de-roofed, abandoned, pulled down, or unoccupied.

Apart from maintaining obsolete data for some of the buildings, it was equally discovered that Council did not have certain relevant pieces of information for some parcels or buildings. Table 5.5 shows both Council's and PRAGIS information on the area of individual parcels in the Alagomeji location. However, it should be noted that Council does not have information on the size of some parcels. Similarly, Council does not have information on the size of any of the buildings under study, but the PRAGIS could be used with ease to generate such information, as already shown in Tables 5.2 and 5.3.

In the manual system of rate administration property information are collected and lumped together; this makes it very difficult to access, query, analyse, or manage such data. But in the PRAGIS attribute property information are stored and maintained in thematic files format. The files could easily be accessed, queried or analysed individually or in combination of any two, depending on the nature of the operation to be executed and the result desired. Information could be output, at will, from any of the files. For example, Table 5.6 shows property ownership information generated from the Ownership File; Table 5.7 shows some rental information output from the Tax Roll File; Table 5.8 shows some residential building characteristics printed from the Residential Property Characteristics File; while Table 5.9 indicates some valuation information of selected residential buildings - this table was produced from the Residential Valuation File.

Under the existing manual system, data is stored in analogue files and registers. This has notable shortcomings. Firstly, it is not very easy retrieving important data from files especially where the files are haphazardly arranged. At times certain relevant files or documents in them may be misplaced, damaged or lost. Moreover, physical filing consumes a lot of office space. For instance, each of the over 33,500 tenements in the study area has a separate valuation records file and a General Rates Card maintained for it. This means that the rating office will be having over 33,500 valuation records file and an equal number of General Rates Card stored in its apartment. Undoubtedly, the overall physical space those files and Cards occupy is quite considerable. Equally, data stored in flat files, registers and cards lack adequate security against unauthorised users.

Table 5.5 PRAGIS Parcel Area Versus Council Parcel Area

PARCEL ADDRESS	PRAGIS PARCEL AREA(M^2)	COUNCIL PARCEL AREA(M^2)
77, Olonade St.	481.211	465
75, Olonade St.	464.435	450
73, Olonade St.	507.196	468.1
71, Olonade St.	487.818	454.51
69, Olonade St.	489.648	465
67., Olonade St.	488.056	468.1
65, Olonade St.	502.839	468.1
63, Olonade St.	483.802	468.1
61, Olonade St.	504.621	n. a.
59, Olonade St.	501.162	454.51
57, Olonade St.	492.056	468.1
55, Olonade St.	497.726	468.1
53, Olonade St.	493.521	n. a.
51, Olonade St.	486.337	468.1
9, Hughes Av.	492.998	452.45
11, Hughes Av.	482.958	531.19
13/15, Hughes Av.	933.141	866.88
52, Olonade St.	485.875	480.5
54, Olonade St.	495.16	n. a.
56, Olonade St.	516.37	480.5
58, Olonade St.	484.256	480.5
60, Olonade St.	504.414	n. a.
62, Olonade St.	517.291	471.2
64, Olonade St.	481.5	471.2
66, Olonade St.	488.125	465
68, Olonade St.	537.713	465
70, Olonade St.	517.751	480.5
72, Olonade St.	534.213	480.5
74, Olonade St.	521.156	480.5
76, Olonade St.	538.006	465
78, Olonade St.	505.448	n. a.
297, Herbert M. Rd.	455.306	525
295, Herbert M. Rd.	534.273	450
293, Herbert M. Rd.	501.423	439.5
291, Herbert M. Rd.	520.325	450
289, Herbert M. Rd.	523.692	480
287, Herbert M. Rd.	514.955	525
285, Herbert M. Rd.	501.601	486.40
283, Herbert M. Rd.	500.056	577.21
281, Herbert M. Rd.	529.341	450
279, Herbert M. Rd.	514.781	390
277, Herbert M. Rd.	491.712	495
275, Herbert M. Rd.	521.821	n. a.
273, Herbert M. Rd.	511.935	450
271, Herbert M. Rd.	1522.68	n. a.

Table 5·5 *Contd.*

PARCEL ADDRESS	PRAGIS PARCEL AREA(M^2)	COUNCIL PARCEL AREA(M^2)
284, Murtala Mohamed Way	1361.15	1500.08
286, Murtala Mohamed Way	716.906	n. a.
288, Murtala Mohamed Way	752.059	684
290, Murtala Mohamed Way	768.165	n. a.
292, Murtala Mohamed Way	716.971	693.12
294, Murtala Mohamed Way	315.553	1386.24
296, Murtala Mohamed Way	751.823	684
298, Murtala Mohamed Way	772.294	693.12
300, Murtala Mohamed Way	763.871	n. a.
302A, Murtala Mohamed Way	776.332	693.12
302B, Murtala Mohamed Way	742.095	696.16
304A, Murtala Mohamed Way	852.717	n. a.
304B, Murtala Mohamed Way	1523.32	1386.24
371, Borno Way	496.546	459
369, Borno Way	470.929	453
367, Borno Way	518.856	459
365, Borno Way	467.921	450
363, Borno Way	524.256	453
361, Borno Way	494.598	459
359, Borno Way	495.485	n. a.
357, Borno Way	495.488	459
355, Borno Way	464.145	450
353, Borno Way	558.313	n. a.
351, Borno Way	478.824	450
349, Borno Way	515.91	n. a.
347, Borno Way	502.396	450
345, Borno Way	497.41	450
3, Hughes Av.	522.612	n. a.
3A, Hughes Av.	488.313	n. a.
5, Hughes Av.	475.906	449.25
7, Hughes Av.	494.629	480.5
334, Borno Way	505.274	482.16
336, Borno Way	478.051	585.67
338, Borno Way	494.227	383.75
340, Borno Way	589.357	530.04
342, Borno Way	406.487	429.66
344, Borno Way	508.463	475.54
346, Borno Way	481.404	485.06
348, Borno Way	505.975	460.5
350, Borno Way	490.727	460
352, Borno Way	493.727	476.46
354, Borno Way	492.827	268.6
356, Borno Way	483.156	455.49
358, Borno Way	496.679	471.96
360, Borno Way	496.087	468.49

Table 5.6 Property Ownership Information

OWNER	ADDRESS	ZONE	AGE	ASSESS NO.	OCCUPIER	CLASS	STATUS	USAGE
Mr M.A. Sanwo	58, Olonade St.	Yaba	66 Years	09/02/0054/058	Owner	Bungalow	Occupied	Residential
J.H. Martins	357, Borno Way	Yaba	66 Years	09/02/0012/357	Owner	Bungalow	Occupied	Residential
Mr Odunjo	59, Olonade St.	Yaba	40 Years	09/02/0054/059	Owner/Clinic	Semi-Detached	Occupied	Residential
Mr Oshindero	77, Olonade St.	Yaba	53 Years	09/02/0054/077	Owner	Bungalow	Occupied	Residential
Rev. O.A. George	56, Olonade St.	Yaba	59 Years	09/02/0054/56	Owner	Bungalow	Occupied	Residential
Mr Olugbode	76, Olonade St.	Yaba	46 Years	09/02/0054/076	Owner	Bungalow	Occupied	Residential
Mr Awo Bolaji	355, Borno Way	Yaba	56 Years	09/02/0012/355	Multi-Tenanted	Bungalow	Occupied	Residential
Mr Aboyade	74, Olonade St.	Yaba	66 Years	09/02/0054/074	Tenants	Bungalow	Occupied	Residential
Mr O.B. Ogunbefun	347, Borno Way	Yaba	61 Years	09/02/0012/347	Owner	Bungalow	Occupied	Residential
Hope Rising & Funds Society	345, Borno Way	Yaba	61 Years	09/02/0012/345	Tenants	Bungalow	Occupied	Residential

Table 5·7 Rental Information of Some Property Owners

OWNER	ADDRESS	PROPERTY CLASS	STATUS	USAGE	GROSS VALUE (N)	RATE-ABLE (N)	TAX (N)	PAYMENT STATUS	REMARKS
Mrs Abayomi	293, Herbert Macaulay Rd.	Detached (2-floor)	Occupied	Commercial	32,688	24,516	2,452	Instalment	
Mr Oshindero	77, Olonade St.	Tenement bungalow	Occupied	Residential	3,360	2,520	252	Instalment	
Mr Olugbode	76, Olonade St.	Bungalow	Occupied	Residential	4,800	3,600	360	Non-Paid	Due for warning
Mr Aboyade	74, Olonade St.	Tenement bungalow	Occupied	Residential	7,960	5,970	597	Paid	
Miss G.A. Baptist	75, Olonade St.	Detached bungalow/Flats	Occupied	Residential	12,200	9,150	915	Paid	
Mrs L.A. Oyewole	291, Herbert Macaulay Rd.	Bungalow	Occupied	Residential	5,040	3,780	378	Non-Paid	
Chief A.O. Oresanya	360, Borno Way	Tenement bungalow	Occupied	Residential	5,760	4,320	432	Paid	
Mr D.A. Fajana	358, Borno Way	2-floor Tenement	Occupied	Residential	7,680	5,760	576	Paid	
M.O. Dada	73, Olonade St.	Tenement bungalow	Occupied	Residential	5,760	4,320	432	Instalment	
Mr Ipaye	371, Borno Way	Tenement bungalow	Occupied	Residential	2,400	1,800	180	Non-Paid	
Mr Adebulewo	289, Herbert Macaulay Rd.	Tenement bungalow	Occupied	Residential	7,200	5,400	540	Non-Paid	Due for warning
Mr A.A. Babalola	72, Olonade St.	Tenement bungalow	Occupied	Residential	3,360	2,520	252	Paid	
Mrs Amosu	356, Borno Way	Detached	Occupied	Residential	6,000	4,500	450	Instalment	
Mr E.E. Falashe	369, Borno Way	Tenement bungalow	De-roofed	None					
Mrs E.I. Ogunnaike	71, Olonade St.	Tenement bungalow	Occupied	Residential	8,640	6,480	648	Paid	
J.K. Randle	287, Herbert Macaulay Rd.	Block of flats	Occupied	Residential	12,240	9,180	918	Non-Paid	
Mr Shotayo	70, Olonade St.	Tenement bungalow	occupied	Residential	5,280	3,960	396	Non-Paid	
Chief J.A. Omolabi	304, Murtala Muhammed Way	1-floor storey	Occupied	Residential	12,600	9,450	945	Instalment	
Ibo Thrift Society	354, Borno Way	2-floor Tenement			7,200	5,400	540	Instalment	
Mr J.A. Smith	69, Olonade St.	Tenement bungalow	Occupied	Residential	5,280	3,960	396	Paid	
Mr O.E. Awoliyi	285, Herbert Macaulay Rd.	Detached bungalow	Occupied	Residential	2,880	2,160	216	Non-Paid	Due for warning
Mr Ogundipe	68, Olonade St.	Tenement bungalow	Occupied	Residential	2,400	1,800	180	Paid	
Mrs Morenike Johnson	352, Borno Way		Unoccupied	None					
M.A. Idowu	365, Borno Way	Bungalow	Occupied	Residential	8,640	6,480	648	Paid	
Dr A.E. Mba	350, Borno Way	Detached	Occupied	Residential	12,000	9,000	900	Instalment	
Mr Sawyer G. Darid	64, Olonade St.	4-floor storey	Occupied	Commercial	54,047	40,535	4,054	Instalment	
Mr Odusanya	363, Borno Way	Bungalow	Occupied	Residential	6,240	4,680	468	Instalment	
Mr Dacosta	65, Olonade St.		Pulled Down	None					
Mrs Olakunbi Bucknor	281, Herbert Macaulay Rd.	Detached bungalow	Occupied	Residential	4,800	3,600	360		

Table 5.8 Some Characteristics of Residential Buildings

AREA	PROPID	PROP ADDRESS	CONST. MATERIAL	WALL MATERIAL	EXTERNAL FINISHING	INTERNAL FINISHING	NO. OF FLOORS	BLOCK FLAT	NO. OF FLATS	FLOOR MATERIAL	CEILING MATERIAL	BATH TILES
1888.48	671											
1826.168	91											
2538.517	661	58, Olonade St.	Brick	Rendered	Tyroline	Emulsion				Strip(Cem. Screed)	Boarded(Timber)	
1300.113	211	357, Borno Way	Brick	Rendered	Emulsion	Emulsion				Strip(Sand Screed)	Boarded(Hardboard)	
2398.327	881											
1827.609	551	59, Olonade St.	Conc. Block	Rendered	Emulsion	Gloss	2			Terrazo	Boarded	X
2121.84	461	77, Olonade St.	Brick	Rendered			1			Strip(Cem. Screed)	Boarded	
2274.275	81	298, Murtala Muhammed Way										
1264.328	371	344, Borno Way	Brick	Rendered	Emulsion	Emulsion				Strip(Screed)	Boarded(Timber)	
2792.584	651	56, Olonade St.	Brick	Rendered	Emulsion	Emulsion	1			Strip(Cem. Screed)	Boarded(Asbestos)	
1613.587	751	76, Olonade St.	Brick	Rendered	Emulsion	Emulsion				Strip(Cem. Screed)	Boarded Timber	
4384.105	71	296, Murtala Muhammed Way	Brick/Conc Block	Rendered	Emulsion	Emulsion				Strip(Cem. Screed)	Boarded Timber	
2632.667	221	355, Borno Way	Brick	Rendered	Emulsion	Emulsion				Strip(Cem. Screed)	Boarded	
1578.052	891	273, Herbert Macaulay Rd.	Brick	Rendered	Emulsion	Emulsion	1			Strip(Cem. Screed)		
1477.961	361	342, Borno Way	Conc. Block	Rendered	Gloss	Gloss	2			Mastic Tiles	Boarded	X
1733.146	561	57, Olonade St.	Conc. Block	Rendered	Gloss	Gloss	1	1	1	Boarded(Cem. Screed)	Boarded(Asbestos)	X
1967.297	351	340, Borno Way	Brick	Rendered	Emulsion	Emulsion				Strip	Boarded	
2150.64	641											
2848.879	571	55, Olonade St.	Brick	Rendered	Emulsion	Gloss	2			Strip(Cem. Screed)	Boarded	
2107.436	231											
3154.731	61	294, Murtala Muhammed Way	Conc. Block	Rendered	Emulsion	Gloss	2			Terrazo	Boarded(Timber Strip)	X
2056.222	341	338,Borno Way	Conc. Block	Rendered	Gloss	Gloss				Strip	Boarded(Timber)	
1789.946	241	351, Borno Way	Brick	Rendered						Strip(Cem. Screed)	Boarded(Polished Timber	
2082.437	631	52, Olonade St.	Brick	Rendered	Gloss	Gloss	1			Mastic Tiles(Ceramic)	Boarded Timber	X
1304.131	581											
2609.381	251											
1272.773	331	336, Borno Way	Brick	Rendered	Emulsion	Emulsion				Strip	Boarded(Timber)	
2660.669	591	51, Olonade St.										
2513.751	621	13/15, Hughes Avenue	Brick	Rendered	Emulsion	Emulsion				Strip(Cem. Screed)	Boarded(Asbestos)	X
1978.726	51	292, Murtala Muhammed Way	Rein. Conc.	Rendered	Emulsion	Texcote	3	2	4(DUPLEX)	Strip/Terrazo/Mosaic		Ceramic
2305.747	741	74, Olonade St.	Brick	Rendered	Tyroline	Emulsion				Terrazo	Boarded(Hardboard)	
1275.328	321	334, Borno Way	Conc. Block	Rendered	Tyroline	Emulsion	2	X	4	Strip	Boarded	X
4013.703	41											
1081.214	261	347, Borno Way	Brick	Rendered						Strip(Sand Screed)	Boarded(Timber)	
2114.944	611	11, Hughes Avenue	Concrete Block	Rendered	Rendered		2			Strip(Screed)	Boarded	
2204.568	471	75, Olonade St.	Brick/Conc. Block	Rendered	Emulsion	Emulsion	2	X	2	Cem Screed/Terrazo	Boarded(Timber)	
4691.241	31	288, Murtala Muhammed Way	Concrete Block	Rendered	Emulsion	Texcote	1			Strip(Cement Screed)	Boarded(Asbestos/ Celote	X

Table 5.9 Some Valuation Information of Residential Buildings

PROPERTY ADDRESS	BED ROOMS	BQ ROOMS	TOTAL ROOMS	ARV OF ROOM	ROOMS VALUE	NO. OF FLATS	FLAT VALUE	FLATS VALUE	DETACHED
58, Olonade St.	5	12	17	480	8160			0	
357, Borno Way	12	0	22	540	11880			0	
69, Olonade St.	8	0	8	600	4800			0	
77, Olonade St.	7	0	7	480	3360			0	
344, Borno Way	5	2	7	480	3360			0	
56, Olonade St.	5	3	8	480	3840			0	
76, Olonade St.	10	0	10	480	4800			0	
355, Borno Way	12	0	12	480	5760			0	
273, Herbert Macaulay Rd.	6	0	6	480	2880			0	
342, Borno Way	11	6	17	480	8160			0	
57, Olonade St.	3	6	9	600	3600	1	5000	5000	
340, Borno Way	3	2	5	480	960			0	
55, Olonade St.	16	0	16	480	7680			0	
294, Murtala Muhammed Way	6	4	10	480	1920			0	1
338,Borno Way	8	2	10	480	4800			0	
361, Borno Way	7	0	7	420	2940			0	
62, Olonade St.	3	1	4	480	480			0	
336, Borno Way	7	3	10	480	4800			0	
13/15, Hughes Avenue	4	4	8	480	1920			0	
74, Olonade St.	5	2	7	480	960			0	
334, Borno Way	12	0	12		0	4	4800	19200	
347, Borno Way	5	2	7	480	3360			0	
11, Hughes Avenue	17	0	17	480	8160			0	
75, Olonade St.	7	0	7		0	2	3600	7200	
288, Murtala Muhammed Way	0	10	10	480	4800			0	
345, Borno Way	8	0	8	480	3840			0	
291, Herbert Macaulay Rd.	9	0	9	480	4320			0	
6, Hughes Avenue	4	2	6	480	2880			0	
360, Borno Way	9	3	12	480	5760			0	
358, Borno Way	16	0	16	480	7680			0	
73, Olonade St.	4	8	12	480	5760			0	
371, Borno Way	3	2	5	480	2400			0	
289, Herbert Macaulay Rd.	12	0	12	480	5760			0	
72, Olonade St.	5	2	7	480	3360			0	
366, Borno Way	4	0	4		0			0	1
369, Borno Way	7	2	9	480	960			0	
71, Olonade St.	18	0	18	480	8640			0	
287, Herbert Macaulay Rd.	9	3	12	480	1440	3	3600	10800	

On the other hand, all the pieces of cartographic data and their associated attribute data acquired for this research were automated, using a geographic information system (GIS). Using this system drastically minimises the data storage problems associated with the manual system. For instance, with the automated system it is possible to have a back-up copy of all the files; hence even in case of accidental loss of data stored in the harddisk a duplicate of it will still remain. The manual system lacks the capability of creating and maintaining back-ups. Also the automated system makes it easier to retrieve and open files and to access their data content. In fact, it takes only about fifteen seconds to retrieve and open a large file containing so many records in the automated system using the keyboard; this time is lesser if a mouse is used.

The case of file misplacement is not a common feature of the digital system. The files are arranged in alphabetical order and each file is automatically returned to its position after use. The position of a file can only be moved if the file is renamed. Also, unlike the manual system of data storage, the digital system achieves a very significant level of space economy; the computer space required to store the data elements is comparatively very small. On the average, each of the rateable buildings appearing in the cartographic file together with its attribute component, occupy a computer storage space of only 103.6875 bytes.

With the computerised system it is possible to ensure the confidentiality of data items. This is achieved by passwording, that is, locking up the files so that only authorised users (those who have the 'key' to unlock the files) can have access to the data content of any of the files.

5.2.2 Valuation And Rate-setting

Ordinarily, the valuation and assessment of tenements for the purpose of rating or taxation, is a complex and tasking operation. Usually, the characteristics of a property as well as the appropriate rental value are used to appraise the property and fix the requisite tax. The manual technique of property valuation and rate fixing is quite laborious and time-consuming, especially where the number of properties to appraise is very large -- as is often the case. Usually each individual property has to be separately treated. Apart from not being fast, the manual system of valuation, is characterised by high level of subjectivity which often results in the over-valuation or under-valuation of certain properties. For instance, some of the variables that were supposed to be used in appraising a building may be omitted either deliberately or by accident. Consequently, that building would not yield the actual rate it was supposed to. For example, a building having 5 rooms but which was appraised based on 4 rooms will only attract a tax for a building of 4 rooms instead of the actual number 5. Cases of improperly assessed buildings abound in the Council's Valuation register. Table 5.10 shows some of the buildings under study which were incorrectly valued by Council owing to one omission or the other. The reasons why the buildings were erroneously valued are indicated. Also shown in the Table are the correct (PRAGIS) values for the affected buildings.

In the course of analyzing the existing (manual) system of property valuation, some discrepancies were observed. For instance, discrepancies were seen in the application of the mandatory 25% outgoings. Either by omission or commission, the rateable values of some property were determined after deducting 20% instead of 25%, from the gross values of the affected property. What this means in effect is that two buildings, for instance, having the same gross values will have different rateable values, since 20% outgoings was applied to one and 25% outgoings applied to the other. The owner of the property in which 20% outgoings was deducted from its gross value, will definitely pay more than his counterpart having 25% outgoings deducted from his property's gross value.

Another area of inconsistency in the use of the 25% outgoings that was observed has to do with its application to buildings having mixed uses (i.e. buildings partly used for domestic purposes and partly for commercial activity). For some property under this category, the practice was to determine separately the gross value for the portion used for residential purposes, and the gross value for the section used for commercial activity. The two gross values (for both residential and commercial sections) are then combined. 25% of the grand gross value is then worked out and deducted from it, to get the rateable value.

Nevertheless, the story is not exactly the same for some other property in this very category (mixed uses). In this case, the gross value of the portion of the building used for domestic purposes is determined and 25% outgoings deducted from it. The gross value

Table 5.10 Some Buildings Incorrectly Valued by Council

BUILDING ADDRESS	COUNCIL GROSS VALUE (₦)	COUNCIL TAX (₦)	PRAGIS GROSS VALUE (₦)	PRAGIS TAX (₦)	DIFFERENCE IN TAX (₦)	REMARKS
273, Herbert Macaulay Road	4,080	306	4,560	342	36	1 room @ ₦480 was omitted by Council in the valuation
277, Herbert Macaulay Road	3,600	270	4,320	324	54	1 Shop @ ₦720 was omitted by Council
279, Herbert Macaulay Road	12,000	900	12,960	972	72	2 rooms @ ₦480 omitted by Council
285, Herbert Macaulay Road	2,880	216	4,320	324	108	6 rooms @ ₦720 were assessed as bedrooms instead of as offices, which they are used for.
287, Herbert Macaulay Road	10,800	810	12,240	918	108	3 BQ @ ₦480 rooms omitted by Council
291, Herbert Macaulay Road	4,080	306	5,040	418	112	2 rooms @ ₦480 were omitted by Council
295, Herbert Macaulay Road	3,360	252	3,600	270	18	1 Shop valued at ₦480 instead of ₦720
294, Murtala Mohammed Way	12,000	900	13,820	1,036	136	4 BQ rooms @ ₦480 were omitted by Council in the valuation
302, Murtala Mohammed Way	6,000	450	6,480	486	36	1 room @ ₦480 was omitted by Council
304, Murtala Mohammed Way	11,160	837	12,600	945	108	3 BQ rooms @ ₦480 were omitted by Council
340, Borno Way	2,520	189	3,120	240	51	3 Bungalow rooms were valued at ₦480 each instead of ₦720 each
350, Borno Way	12,000	900	14,400	1,080	180	1 room @ ₦2400 was omitted by Council
363, Borno Way	5,280	396	6,240	468	72	2 BQ rooms @ ₦480 were omitted by Council
76, Olonade St.	4,800	360	6,000	450	90	The value (₦1200) of the food canteen in this premises was not added by Council
5, Hughes Av.	7,680	576	8,160	612	36	1 room @ ₦480 was omitted by Council
13/15, Hughes Av.	5,520	414	5,420	407	-7	3-bedroom bungalow @ ₦3600 + 4-bedroom BQ @ ₦480 = ₦5420 not ₦5520
					TOTAL 1,210	Council loses this amount due to improper valuation

of the portion used for commercial activity is also fixed and 25% outgoings deducted from it. The two gross values (?)[1] are then added up and the resulting grand gross value still subjected to another 25% outgoings reduction. Whatever remains then becomes the rateable value of that property. There is a somewhat over-reduction in this case.

Some form of discrepancy was equally detected in the use of the annual rental values for different categories of dwelling units (See Table 5.10). There is a range of annual rental values attached to each dwelling type. For instance, a single tenement room may have a rental value ranging between ₦480 and ₦540, per annum. The rental value is one of the coefficients used in working out the gross value of a tenement. However, for some inexplicable reasons, so to say, the gross values of some tenements were determined using the lower value of the range of rental values for that type of property. On the other hand, the upper value of the range was used for some other property still within the same type of accommodation. Thus, two bungalow buildings, for instance, having similar characteristics and the same number of rooms, and located within the same rating zone, will have different gross values, and hence rateable values, since they were assessed using different annual rental values per room. This makes for inconsistency.

Apart from the above-mentioned discrepancies, certain omissions were equally observed in the appraisal of tenements. Some residential buildings have records indicating that some portion of the building was being used for commercial activity. However, it was clearly observed that the commercial portion of some residential buildings having such facility, was completely left out in the appraisal (See Table 5.10). Such a building was therefore treated as though it was an entirely residential apartment. In this case, there was apparent loss of revenue to Council over the unassessed commercial portion of the domestic building.

Obviously, the above-mentioned discrepancies and omissions simply indicate the presence of large scale subjectivity, which of course does not allow for equitable taxation of properties. As Huxhold (1991, p.187) has emphatically observed, "The primary purpose of assessing property is to provide for a fair and equitable taxation of the land (tenement) for producing the revenue needed to run local government. Fair and equitable

[1] This question has already been discussed in the preceding section.

taxation requires that properties having similar characteristics (size, location, type of building, age, income-producing potential, etc) also have similar taxes levied against them".

The problem of slow rate and subjectivity, as exemplified by omissions and discrepancies in property appraisal are well taken care of by PRAGIS -- the automated system of rating. In order to overcome these two major problems, thus making the valuation and rate-setting faster, accurate and objective, a mass-valuation technique was adopted. The technique is formula-driven. Through mass valuation all the properties in the same category are collectively valued at once to determine their individual gross value when the relevant formula is activated. Also a single formula is used where the same appraisal rule applies to all the properties in the tax roll, as in the case of determining rateable value (which is gross value minus 25% of that value), or in fixing the rate payable (which is 10% of the rateable value). The principle behind the use of the mass valuation method is a simple one. A set of rules is specified and any property that meets the conditions of the rule is, accordingly, automatically assessed; if all the properties meet the rule all of them are assessed at once. (See Tables 4.13, 4.14, 4.15, 4.16, and 4.17 for the computer programs used by PRAGIS for mass valuation).

The mass valuation technique is therefore a radical departure from the grossly time-wasting, subjective and highly error-prone manual system in which properties even in the same category are appraised one by one. Mass valuation makes property valuation quicker and objective, and ensures that no property in the tax roll is left unassessed except a decision was deliberately taken to assess only certain selected properties. Also since the system is formula-driven the case of omitting certain rateable variables in the appraisal of any property is eliminated. Equally eliminated is the ugly incidence of discrepancies, thus ensuring that similar properties attract similar rates. Hence, it should be noted that apart from making the valuation process relatively faster, the mass-valuation technique used in this research makes valuation more accurate and equitable as it greatly reduces cases of bias and subjectivity.

However, the overall effectiveness and efficiency of the mass valuation method depends to some extent on the fidelity of the system programmer and the absence of human interference with the programs(expressions) when they are operational. All the necessary variables must be built into a formula-program for a particular function for that program to be able to cover all the tenements in that category, else there may still be cases of omissions. Also to avoid discrepancies the values of any variables in a program must not be altered and then the altered version later used to appraise some aspects of certain selected buildings. If the formula-programs are allowed to run without any human interference they will produce accurate, uniform and equitable results.

5.2.3 Billing And Collection:

The billing process of rates administration involves preparing and sending Demand Notes, Warning Notices, or Sealing Notices to ratepayers to notify them of their tax liability. Billing is one of the most tortuous aspects of rates administration. Usually, after a property is appraised and the appropriate rate subsequently fixed, this rate is written into the Tax Roll. From here the bill for each building is prepared.

Preparing bills manually has its own attendant problems. In the first place, it is quite cumbersome and time-wasting to prepare bills manually; hence bills are never sent to ratepayers in good time. For instance, in the study area, Lagos Mainland LGA, only 300 bills on the average are prepared and sent out each day within the billing period. Thus, for the over 33,500 bills which the LGA needs to prepare at the beginning of each year, as much as 112 days(31/2 months) or more would be needed to prepare the bills. Normally, bills are supposed to get to ratepayers within the first four weeks of the year. However due to the delay in preparing bills, occasioned by the slow manual system employed, some ratepayers do not receive their annual bills till about April or May. The consequence of this is that the rating office often receive rate payments mostly in arrears, since most bills are never paid in the current fiscal year.

The manual processing of bills also discourages prompt sending of Warning Notices and Sealing Notices to deserving ratepayers. Depending on their degree of delinquency, defaulting ratepayers are supposed to be served Warning Notice or Sealing Notice, as the case may be. However, these notices are seldom served. The reason for this is two-fold in nature. Firstly, it is not easy detecting delinquent ratepayers; some of them are never detected until after some years. Secondly, to prepare the notices, which at times may be voluminous, is a task that over-bears much on the billing officers who equally have the preparation of bills to grapple with. Thus a situation exists where a ratepayer may be indebted to Council for as much as four to five years without any action been taken against him.

Another major problem associated with the manual technique of billing has to do with man's infallibility. At times due to human errors the amount(tax) recorded in the Tax Register from which bills are prepared, may not be the exact amount written in the bill sent to a ratepayer. The amount in the bill may be lower or higher than the one in the register. Where the amount is lower, the rating office loses revenue, but if it is higher the affected ratepayer may, out of suspicion, contest it, thus delaying payment, thereby denying Council of revenue in the meantime.

A very serious problem that equally faces manual billing and collection of rates is inability to deliver some bills. Occasionally, some bills are undelivered because the affected buildings could not be located. Such bills are usually returned to the rating office with the bold inscription "**Undelivered**".

The above problems of billing and collection were taken into consideration while conceiving the idea of a GIS-based rates administration here in Nigeria. With the PRAGIS, bills (Demand Notes) are automatically generated. (See Appendix J for a sample of Demand Note produced using PRAGIS). Depending on the speed and endurance level of the computer printer used, several thousands of bills can be produced each day. This, no doubt, will ensure that bills are prepared and delivered promptly. Also since the bills are automatically generated from the digital tax file the case of a different amount from what is in the tax register being written on the bill, is never experienced. Thus the issue of the rating body losing revenue as a result of crazy bills is reduced to the barest minimum if not completely eliminated.

The PRAGIS, unlike its manual counterpart, encourages and facilitates the preparation and sending of Warning Notices (see Appendix K) and Sealing Notices (see Appendix L), to defaulting taxpayers. By querying the digital tax payment file defaulters can easily be detected. A map which vividly shows the location and distribution of the delinquent ratepayers can equally be generated (See Fig. 5.2). The appropriate Notices can then be prepared and hard copies obtained and dispatched to the various taxpayers involved.

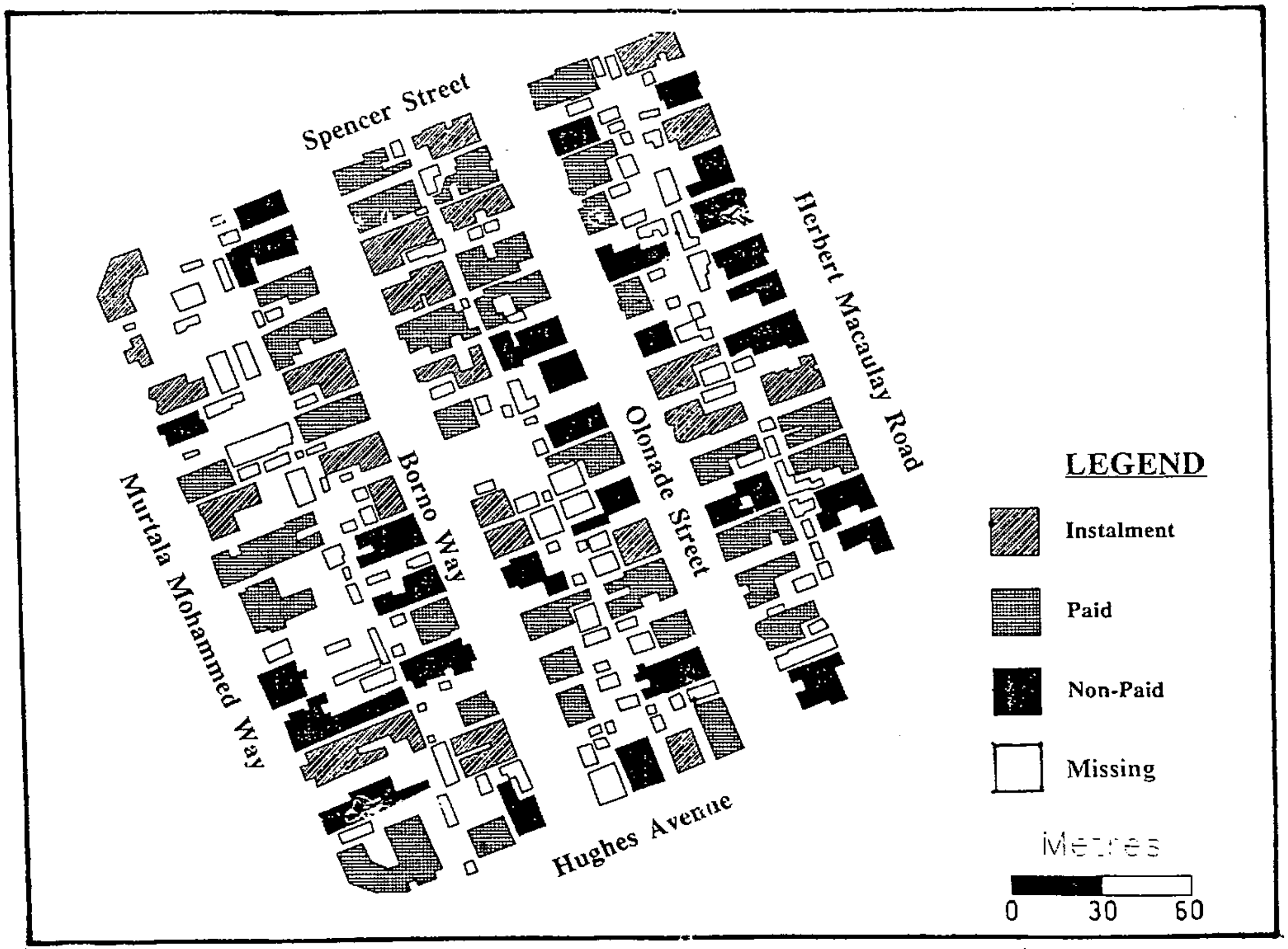

Fig. 5.2 Payment status of buildings in the Alagomeji Area

The problem of having bills undelivered for not being able to locate the buildings, is purely a geographical problem. It is a problem that can be solved by equipping tax collectors(or bills distributors) with a street map that shows each individual building, street name, and house numbering. Hence, the GIS-based rates administration system has been fashioned to automatically generate street maps that can guide tax collectors in the delivery of bills and revenue drive. (See Figs. 5.3 and 5.4)

5.2.4 Thematic Map Generation:

One of the major shortcomings of rates administration in the study area is the failure of Rates Offices to use appropriate maps. Tax (rate) maps are simply non-existent here. One of the major objectives of this work therefore, was to develop an automated system that could be used to capture, store, retrieve, query, manipulate, process, update and output geographically referenced data in form of maps, for rates administration. The PRAGIS has therefore been developed to generate the following thematic maps, samples of which are shown. The maps are:

* Map showing the locations and boundaries of parcels (Fig. 1.4)
* Map showing locations of individual rateable buildings (Figs. 1.4 and 1.5)
* Street map showing house numbering (Figs. 5.3 and 5.4)
* Map showing locations of delinquent ratepayers (Fig. 5.2)
* Map showing buildings due for warning or sealing (Fig. 5.5)
* Map showing current status of each rateable building (e.g. occupied, abandoned, de-roofed, etc.) - Fig. 5.6
* Map showing current usage of each building (e.g. residential, commercial) - Fig. 5.7
* Map showing the class of each building (e.g. bungalow, duplex, etc.) - Fig. 5.8
* Map showing the number of buildings on each parcel (Fig. 1.4).

In addition to the above-mentioned merits of the automated geographically referenced information base for rates administration, the system was also found to be capable of being used by a Rates Office to accomplish the following:

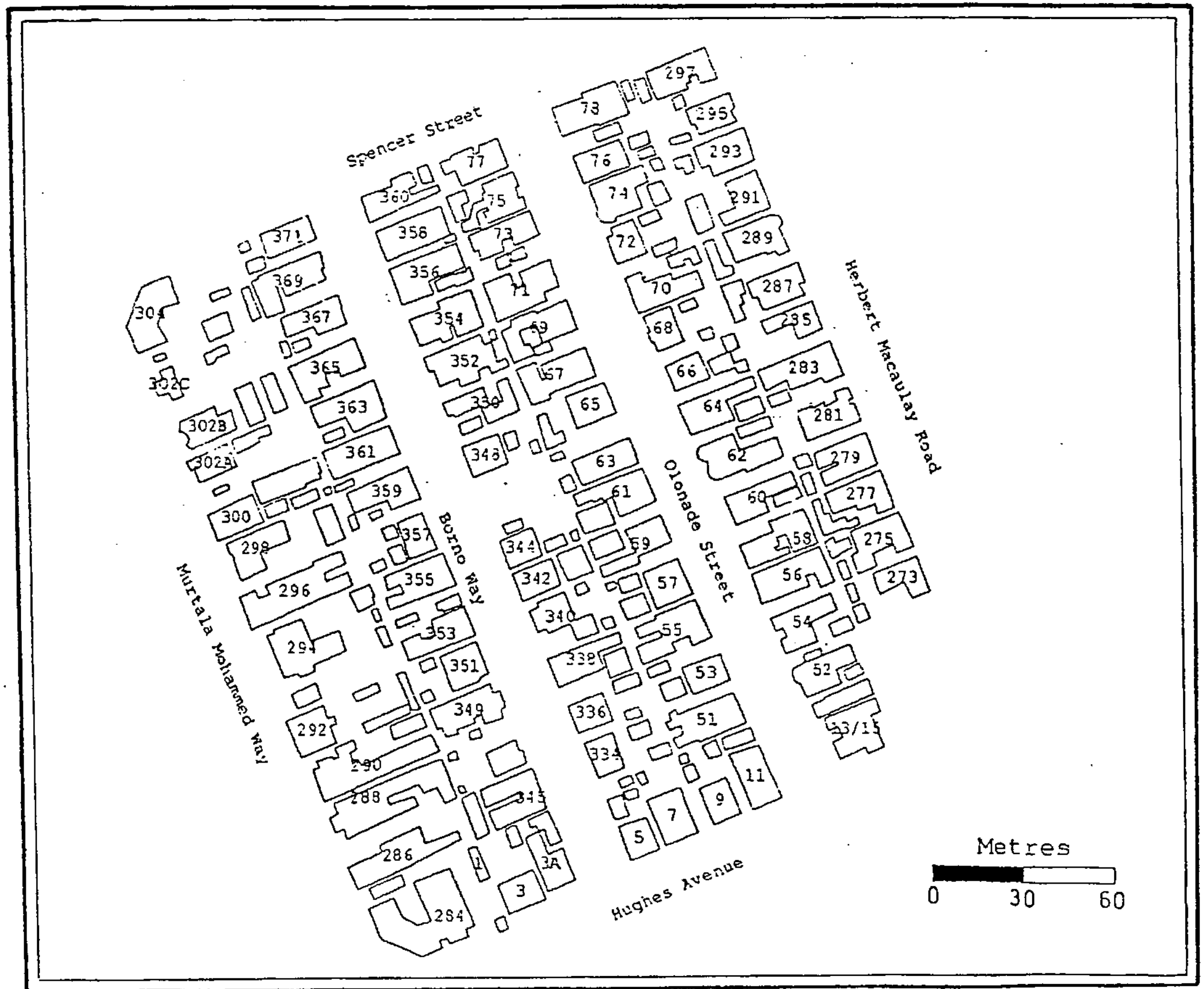

Fig. 5·3 Street numbering in the Alagomeji Area

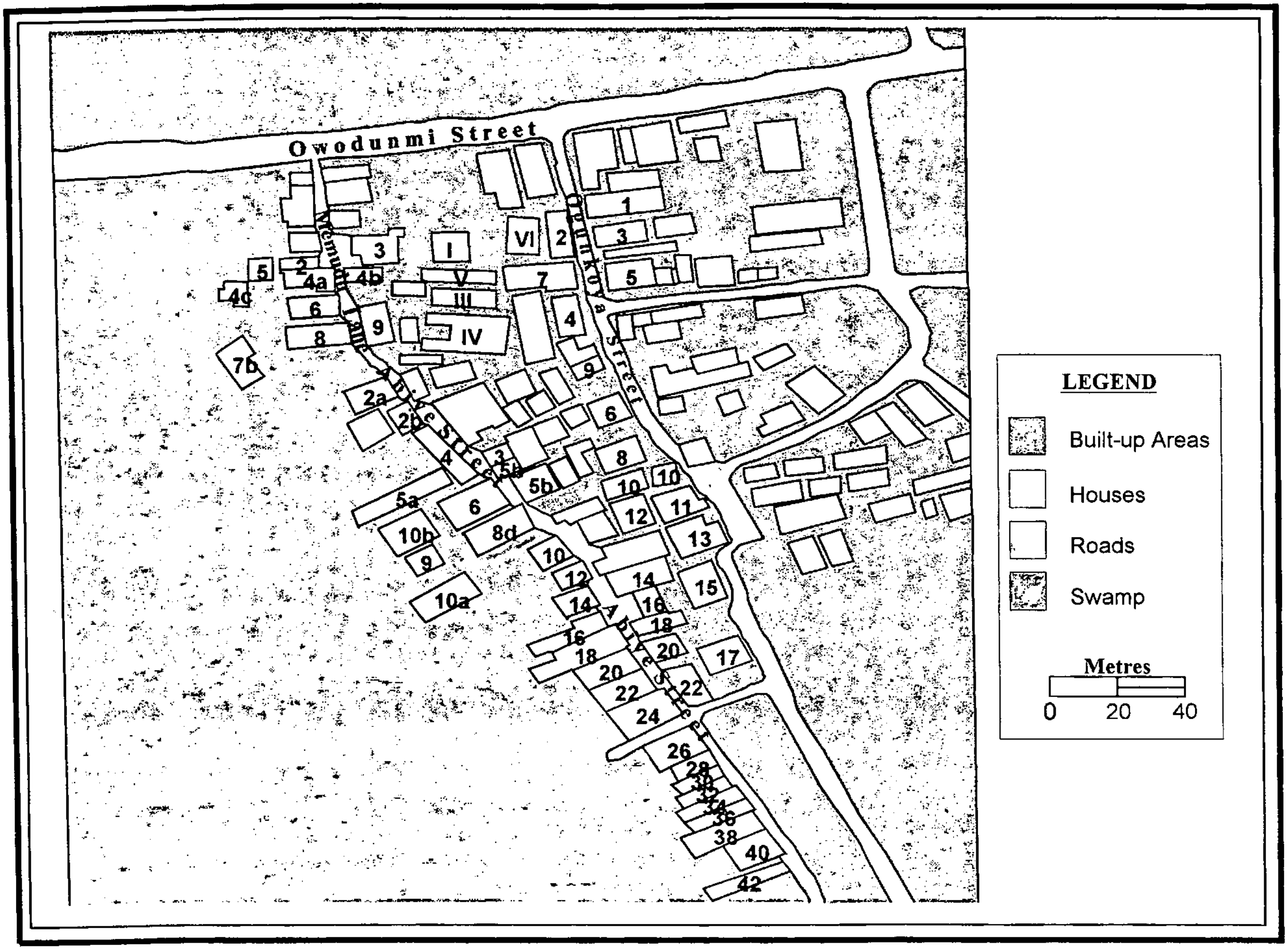

Fig. 5.4 House numbering in the Iwaya Location

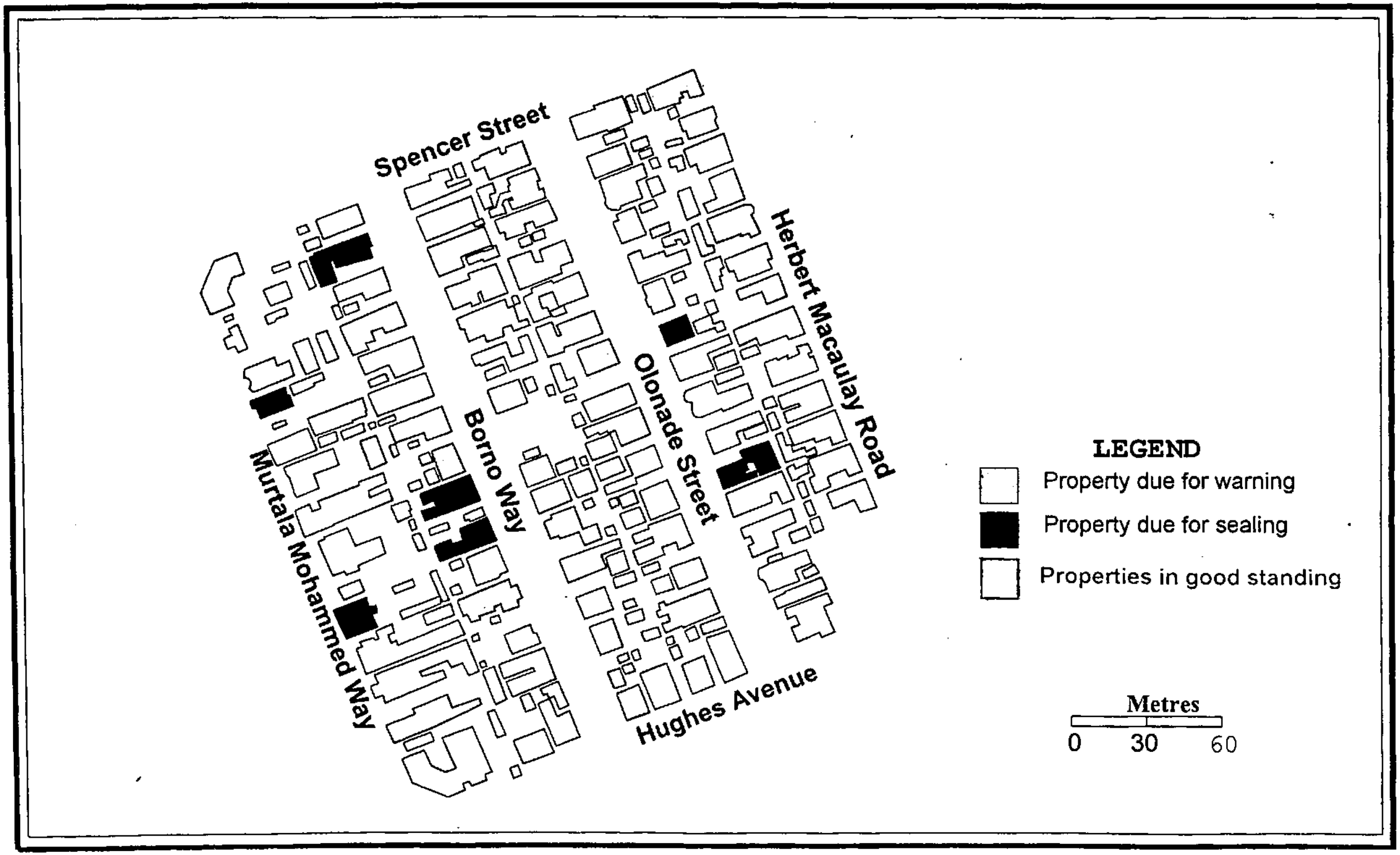

Fig. 5.5 Properties due for warning or sealing in the Alagomeji Area

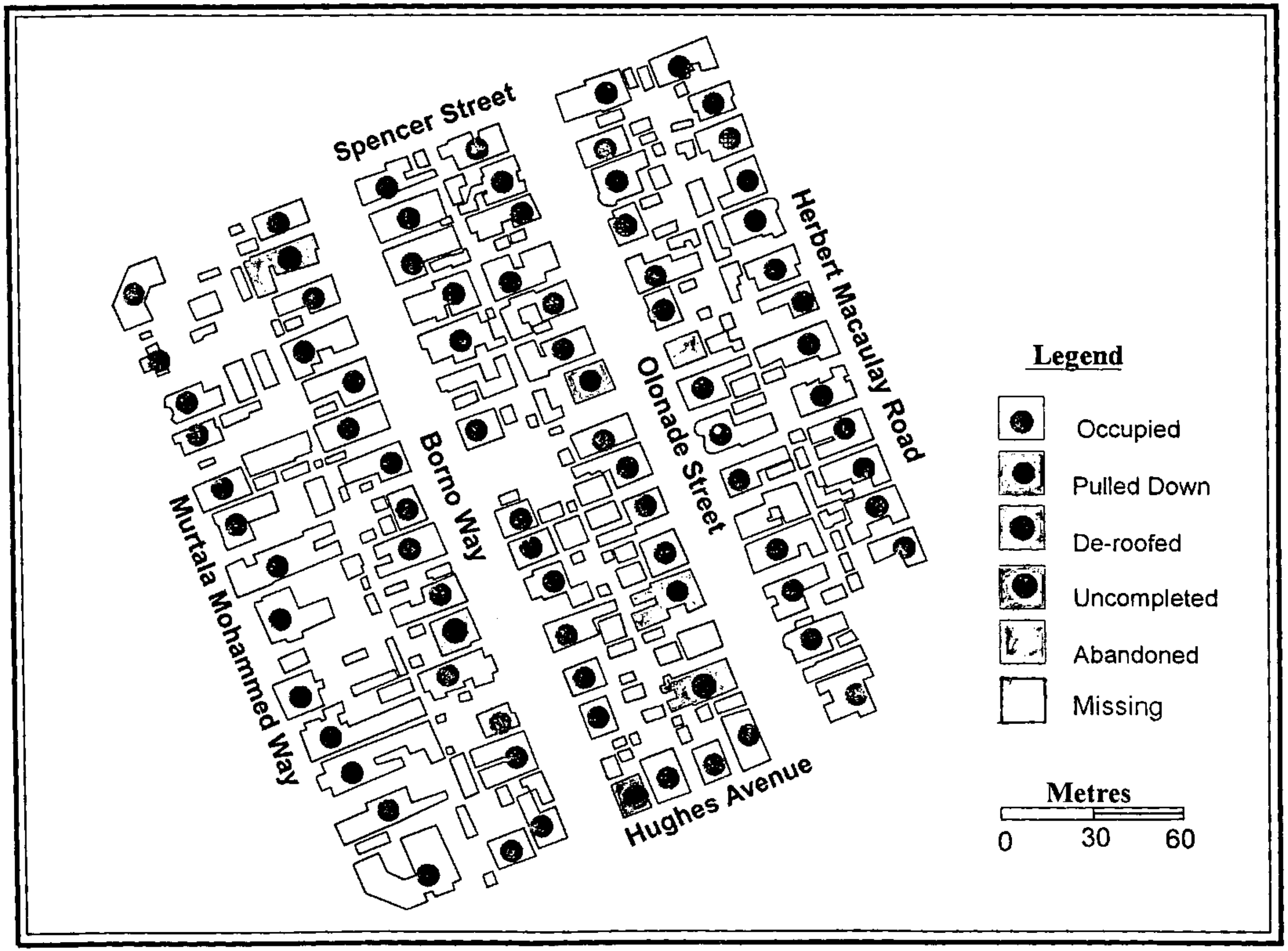

Fig. 5.6 Property status (Alagomeji Area)

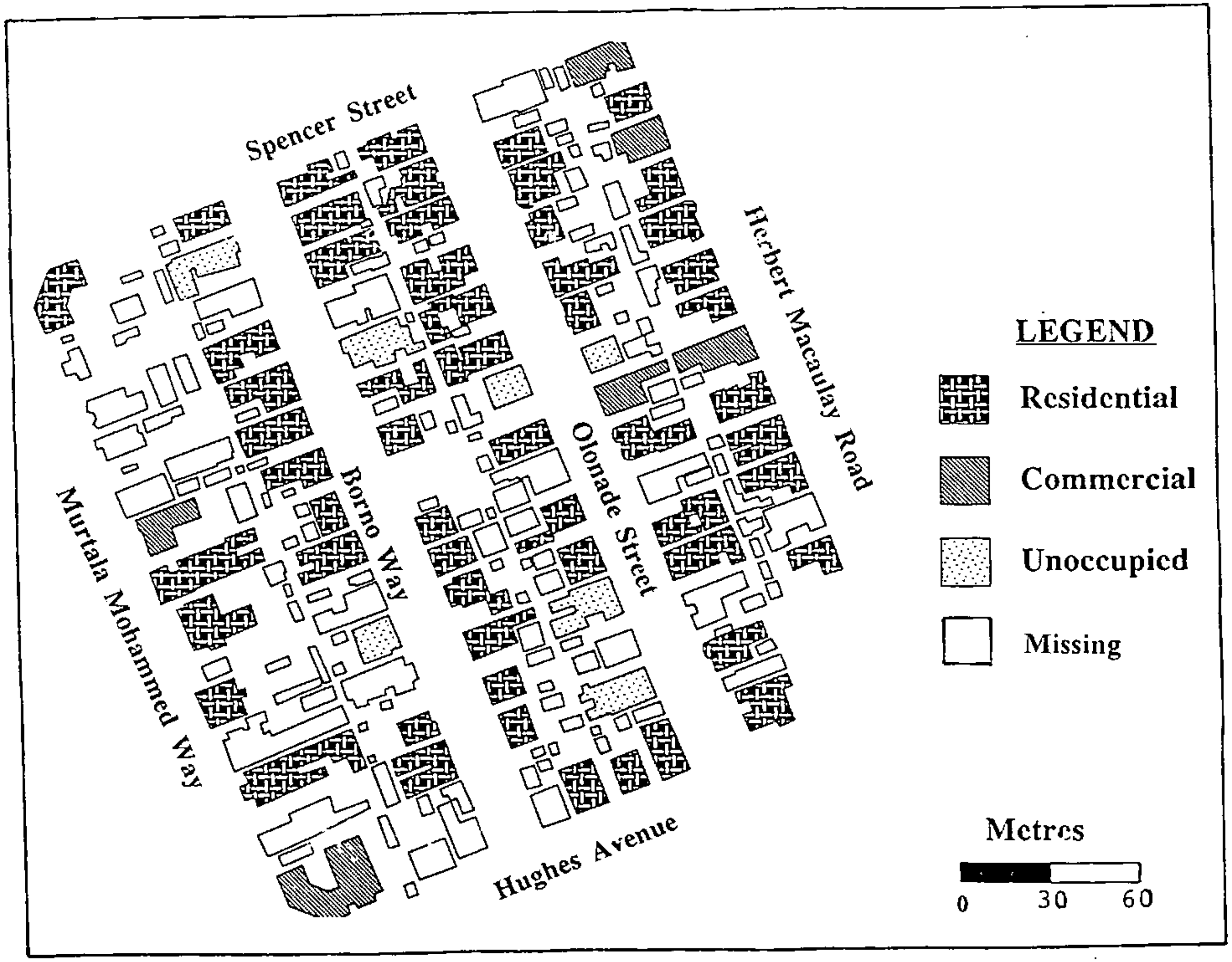

Fig. 5.7 Property usage (Alagomeji Area)

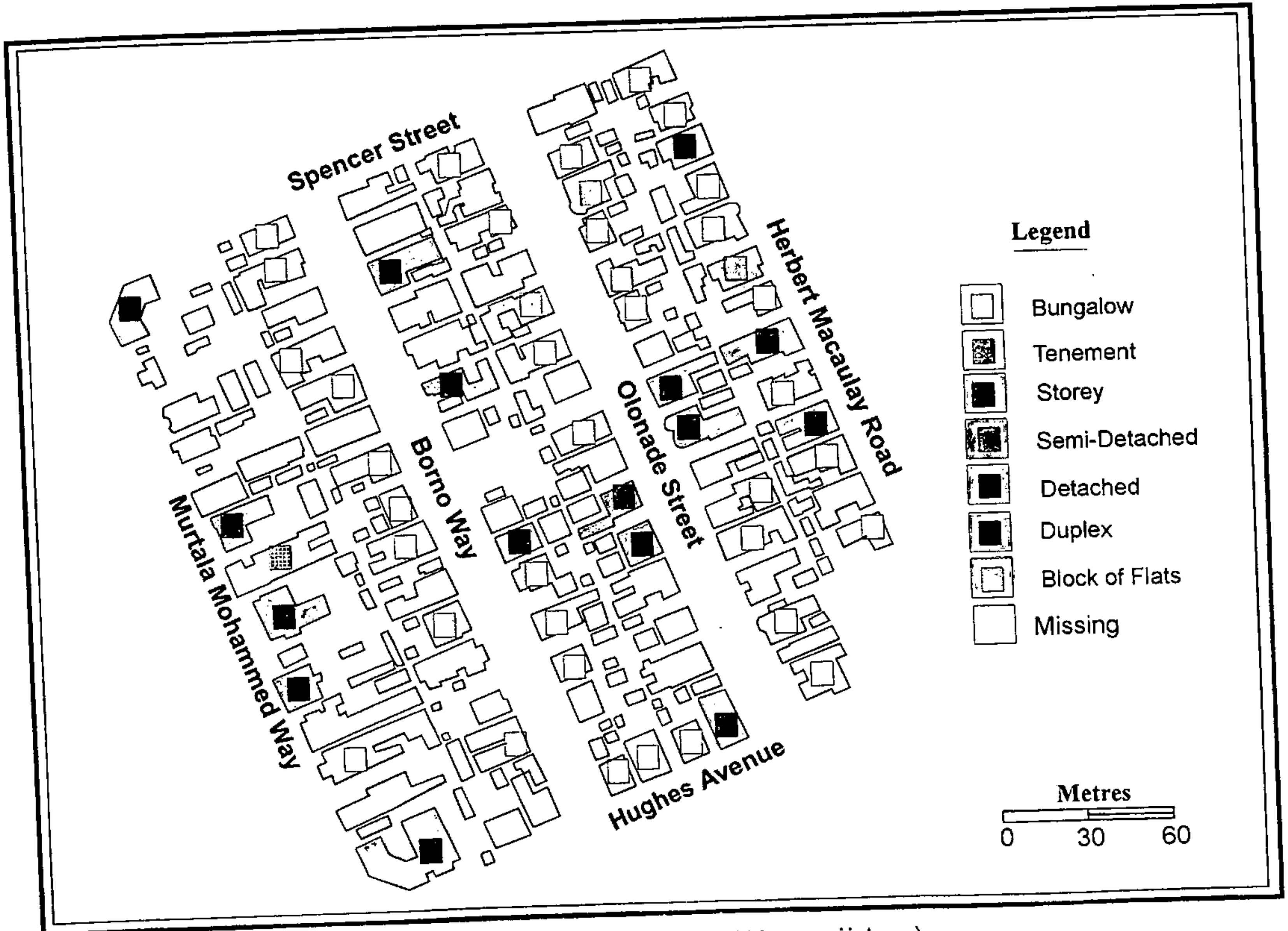

Fig. 5.8 Property class (Alagomeji Area)

5.2.5 Workload sharing:

With the system it becomes easier for the Tenement Rates office to share the task of bill distribution and revenue collection among its field workers. By displaying the property map of the desired area on the screen a simple command can then be issued requesting the system to equitably delineate the entire area into smaller units among the workers (Fig. 5.9). Each worker will then be confined to a specific geographical area. Thus by being used in sharing and balancing billing and revenue collection workload, the system will enhance the effective monitoring of revenue collectors. Since each collector will be assigned to a defined geographical area, it then becomes easier to closely supervise them while at the same time encouraging accountability on their (collectors') part.

5.2.6 Performance Assessment:

Using the geographical database, performance assessment maps can be generated periodically. For instance, a map could be produced which shows the tenements whose owners have been served with bills, or the ones from whom rates have been collected. (See Fig. 5.2). Such a map will provide Management with quality information with which to monitor and appraise billing and revenue collection performance against set targets and hence promptly address any observed shortcomings in performance.

5.2.7 Detecting Missing Property Records:

The system can now afford Rating Offices the opportunity of detecting tenements not having any records in the Tax Roll or Valuation List. A map that vividly reveals such tenements can be generated. (Fig. 5.1).

5.2.8 Annual Budgeting:

Assisting the Rating Office in intelligent annual budgeting, is also one of the potential benefits of the new system. For instance, the various types of tenements in a selected area can be determined, and based on appropriate rateable variables of buildings the amount from each class of building can easily be approximated. Then the estimates

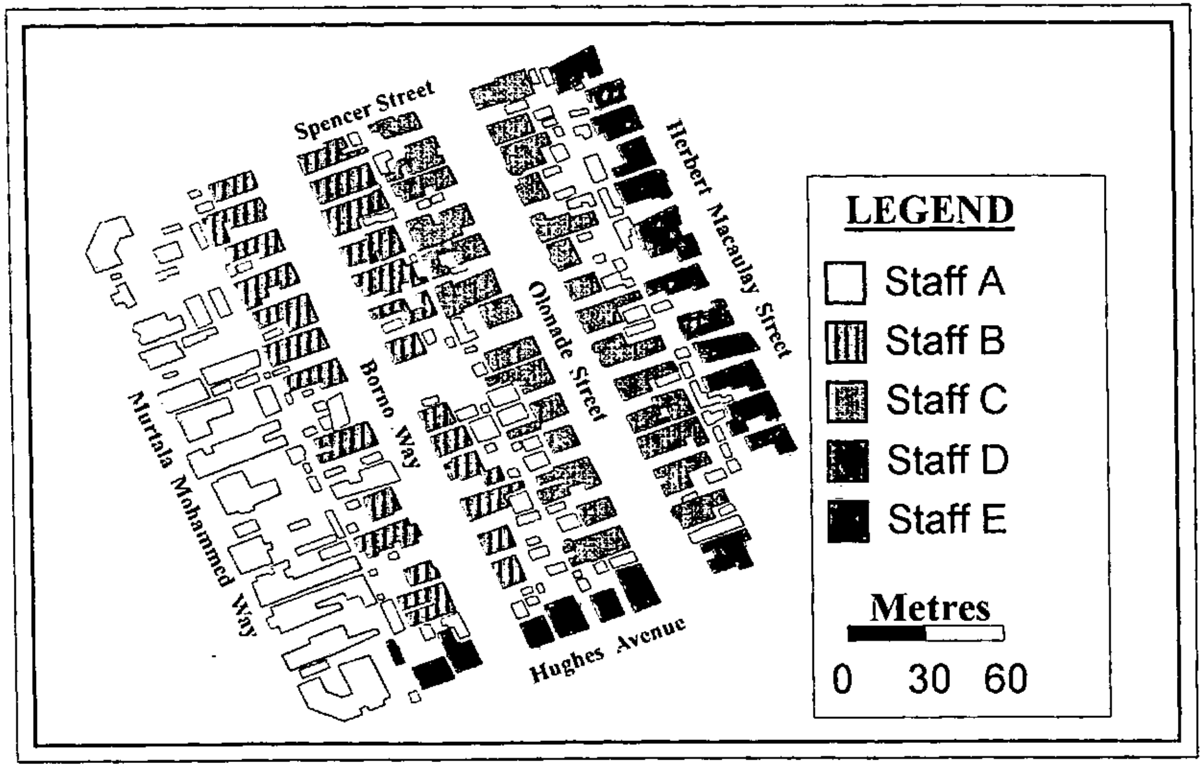

Fig. 5.9 Workload sharing (Alagomeji Area)

for the various classes can be aggregated to derive the expected overall revenue from that area in the year.(See for example, Tables 5.11 and 5.12).

5.2.9 Property Inventory:

With the automated system a street map showing the location and address of each building in a given area, can easily be produced. The map will enable bill distributors and rates collectors to quickly locate individual buildings, and indeed to locate all buildings. When buildings are easily located, time is saved. Bills are served at a faster rate and early enough too. Consequently, taxpayers will expectedly start responding in good time, to make payments. The earlier bills are dispatched, the earlier rates are, most likely, paid. Also by being able to locate all buildings and hence serve them with bills, the tendency to improve revenue yield is practically increased. If certain ratepayers are not served with bills due to inability to locate them, they will not bother to pay rates, as is currently the case.

5.2.10 Property Records Maintenance:

The system proves to be a flexible and veritable tool which the Rating Office can use for the maintenance of comprehensive, up-to-date and accurate property records for the purpose of rates administration. Thus with it the Office can embark on regular map updating. Changes which significantly affect rates administration take place quite often. For instance, there may be change in property ownership, change in property address as a result of change in street name and/or street renumbering, change in property usage e.g. converting a building from residential to commercial or erecting a new shop in front of a building, or a change in property status e.g. a property being abandoned, de-roofed, etc. Whatever the nature of the change, the important thing is that it should be recorded as promptly as possible in the property map. Although this was never done before, it is now possible to do it using the automated system. With the geographic and attribute databases in place, it would be easier for the Rating office to promptly update its records and automatically carry out a re-valuation of the rateable tenements at will, to reflect new developments.

Table 5.11 Expected Total Revenue(Tax) From Residential Tenements

OWNER	ADDRESS	USAGE	TAX(₦)
	295, Herbert Macaulay Rd.	Residential	252
Mr Oshindero	77, Olonade St.	Residential	252
Mr Olugbode	76, Olonade St.	Residential	360
Mr Aboyade	74, Olonade St.	Residential	597
Miss G.A. Baptist	75, Olonade St.	Residential	915
Mrs L.A. Oyewole	291, Herbert Macaulay Rd.	Residential	378
Chief A.O. Oresanya	360, Borno Way	Residential	432
Mr D.A. Fajana	358, Borno Way	Residential	576
M.O. Dada	73, Olonade St.	Residential	432
Mr Ipaye	371, Borno Way	Residential	180
Mr Adebulewo	289, Herbert Macaulay Rd.	Residential	540
Mr A.A. Babalola	72, Olonade St.	Residential	252
Mrs Amosu	356, Borno Way	Residential	450
Mrs E.I. Ogunnaike	71, Olonade St.	Residential	648
J.K. Randle	287, Herbert Macaulay Rd.	Residential	918
Mr Shotayo	70, Olonade St.	Residential	396
Chief J.A. Omolabi	304,Murtala Muhammed Way	Residential	945
Mr J.A. Smith	69, Olonade St.	Residential	396
Mr O.E. Awoliyi	285, Herbert Macaulay Rd.	Residential	216
Mr Ogundipe	68, Olonade St.	Residential	180
M.A. Idowu	365, Borno Way	Residential	648
Chief S.A. Adeosun	67, Olonade St.	Residential	396
		TOTAL	10359

Table 5.11 *Contd.*

OWNER	ADDRESS	USAGE	TAX(N)
Dr A.E. Mba	350, Borno Way	Residential	900
Mr Odusanya	363, Borno Way	Residential	468
Mrs Olakunbi Bucknor	281, Herbert Macaulay Rd.	Residential	360
Alhaji Shekoni	361, Borno Way	Residential	810
Mr S.A. Johnson	348, Borno Way	Residential	216
A.Odeleye	279, Herbert Macaulay Rd.	Residential	972
Mr Balogun Asani	62, Olonade St.	Residential	792
Chief Oladapo	63, Olonade St.	Residential	432
Mr Abatan	359, Borno Way	Residential	324
Mr Falaye	277, Herbert Macaulay St.	Residential	324
Mr M.A. Sanwo	58, Olonade St.	Residential	612
J.H. Martins	357, Borno Way	Residential	891
Mr Odunjo	59, Olonade St.	Residential	1055.25
Mr G.B.K. Delima	344, Borno Way	Residential	387
Rev. O.A. George	56, Olonade St.	Residential	288
Alh. A.M. Lawani	296, Murtala Muhammed Way	Residential	
Mr Awo Bolaji	355, Borno Way	Residential	432
	273, Herbert Macaulay Rd.	Residential	306
Alhaji Omotayo	342, Borno Way	Residential	612
Mr J.O. Shoyingbe	57, Olonade St.	Residential	645
Mr Roseq Eli	294, Murtala Muhammed Way	Residential	1044
Mrs Falase	338,Borno Way	Residential	360
Mr F.E. Pereira	52, Olonade St.	Residential	504.75
Mrs Kofo Williams	336, Borno Way	Residential	360
Mr B.K. Sutherland	13/15, Hughes Avenue	Residential	414
Mobil Oil Producing(Nig)Ltd	292, Murtala Muhammed Way	Residential	
Mr O.B. Ogunbefun	347, Borno Way	Residential	252
Mr Simeon Sanusi	11, Hughes Avenue	Residential	702
Mr Odumosu	288, Murtala Muhammed Way	Residential	900
Hope Rising & Funds Society	345, Borno Way	Residential	288
Mr Abiola Ojo	9, Hughes Avenue	Residential	480.6
		TOTAL	16131.6

Table 5.12 Expected Total Annual Revenue (Tax) From Commercial Tenements

ADDRESS	USAGE	RATEABLE	TAX(N)
59, Olonade St.	Commercial	10,552.50	1,055.25
298, Murtala Muhammed Way	Commercial	12,000.00	1,200.00
9, Hughes Avenue	Commercial	4,806.00	480.60
297, Herbert Macaulay Rd	Commercial	10,491.00	1,049.10
284A, Murtala Muhammed Way	Commercial	22,410.00	2,241.00
283, Herbert Macaulay Rd.	Commercial	48,582.22	4,858.22
64, Olonade St.	Commercial	40,534.95	4,053.50
293, Herbert Macaulay Rd.	Commercial	24,516.00	2,451.60
		TOTAL	17,389.27

5.2.11 Quick Detection of Defaulting Ratepayers:

The delinquent ratepayers maps produced using the PRAGIS could greatly assist the Tenement Rating Office in knowing the number, locations and geographic spread of ratepayers indebted to the LGA at any point in time. Ordinarily, it takes the LGA a considerable length of time to detect delinquent ratepayers; thus some ratepayers are known to owe the LGA for upwards of four or five years before they are detected. This encourages rate evasion and amounts to denying the LGA of the much needed fund for the provision of social amenities. However, by having at its disposal a map showing delinquent ratepayers at any desired time, the LGA now can promptly detect and tackle the problem of defaulting ratepayers.

Table 5.13 contains a summary of the manual method versus the PRAGIS technique of rating.

TABLE 5.13 SUMMARY OF MANUAL VERSUS GIS METHODS OF RATING

MANUAL SYSTEM	GIS TECHNIQUE
Does not make use of maps	Generates new map products for rates administration (See Figs. 5.1 to 5.9)
Certain rateable characteristics of buildings are often omitted during valuation	The Mass Valuation system (MVS) used which is formula-driven, greatly reduces cases of omissions
Discrepancy in the use of variables for valuation and rate-setting, hence similar buildings in the same rating zone never attract similar rates	With the MVS, buildings in the same rating zone having similar rateable characteristics are automatically assigned similar rates
Over-valuation or under-valuation of buildings due to human errors and subjectivity	The system makes tenement valuation and rate-setting more objective and equitable since human interference is minimised
The system is slow and highly labour-intensive, especially in terms of valuation of buildings, rate-setting and billing	The system greatly eases the tasks of tenement valuation and rate-setting; also makes it possible to automatically generate bills at a very fast rate
Does not encourage frequent updating of property records	Can easily be used to revise tax maps and update property records as frequently and promptly as significant changes are observed
Data storage is inefficient and ineffective--it is usually ill-organised and haphazardly done	Organises property records in database format
Data retrieval could be quite cumbersome and unnerving due to poor organisation of data files; it often takes considerable amount of time to search for and locate files for data retrieval	Stores property records in a well-organised manner that makes it very easy to locate, retrieve and query data files
Property records lack adequate security from unauthorised user, theft or loss due to fire mishap or even the destructive activities of termites	Has facilities for locking up or backing up data to prevent it from being used by unauthorised users, or getting totally lost due to theft or damage
It is usually difficult detecting any missing piece of property data	Quickly reveals buildings with incomplete records or ones without any records in the database
Defaulting ratepayers(especially those due for a Warning Notice or Sealing Notice, as the case may be) are not easily detected	Can easily be used to display the locations and distribution of delinquent ratepayers qualified to be served with Warning Notices or Sealing Notices

5.3 Maps And Rates Administration:

As part of the objectives of this study, the rates administration problems which maps can be used to solve as well as the types of maps needed, were investigated. Basically, to the rates administrators, maps will serve two major roles, namely data communication and analysis. The map is a most veritable tool which could be used to graphically describe the locations, boundaries (areal dimensions), spatial distribution and spatial patterns of parcels and tenements. The above pieces of information are critical to the success of rates administration. With such information at his disposal, a rates administrator will be able to conveniently and assuredly know the locations of tenements, the composition of tenements (e.g. residential, commercial, or bungalows, detached buildings, semi-detached buildings, duplexes, etc.), and the spatial distribution of tenements. Equally, the mapped information will greatly assist rates administrators to intelligently carry out quality assessment of tenements, e.g. determining the age or environmental, finishing and repair conditions, of buildings. The tax(rate) map can also furnish quantitative information which could be used in quantitative assessment of tenements; for example the map could display the various types or classes of tenements in a given geographical location and the number of tenements in each category can easily be determined.

Also the map could be used to communicate the results of property valuation, analysis and synthesis. The maps shown in this Chapter attest to this very fact. Table 5.14 summarises the types of rates administration maps that would be needed as well as the functions of such maps. In addition to the map functions outlined in Table 5.14 maps were also found to be capable of being used to tackle the following problems which greatly hinder effective and efficient rates administration in the study area, namely:

-- Irregular street numbering.

-- Incessant cases of street re-numbering and/or re-naming.

-- Change in property use status (usually from residential to commercial use).

-- Indiscriminate removal of landmarks with which rates collectors identified certain buildings.

-- Double identity of some buildings located at street intersections.

-- Irregular or ill-defined street network pattern and alignment - a problem that hinders easy routing during bills distribution and rates collection.

TABLE 5.14 MAPS NEEDED FOR RATES ADMINISTRATION

TYPES OF MAPS	USES
Planning Maps	-- For delineating rating areas -- For estimating overall bill distribution and revenue collection workload to be done. -- For workload sharing -- For estimating time required to cover the entire rating zone. -- For estimating number of personnel needed for timely bill distribution and revenue collection within the targeted time period. -- For cost estimation.
Valuation Maps	-- For enumerating number of rooms, flats, offices, etc. per building. -- For measuring floor area of rooms, offices, etc. -- For calculating area of a building .
Implementation Maps	-- For comprehensive and accurate identification and discovery of buildings. -- For complete geographical coverage in the delivery of bills. -- For easy and thorough revenue drive. -- For constant updating of map-based property data. -- For prompt response to queries by ratepayers.
Presentation Maps	-- For showing level of performance in bills distribution or revenue collection at any given time. -- For displaying location and distribution of delinquent ratepayers. -- For illustrating variations in any selected thematic variable of buildings - for example showing variations in property class, status, usage, and so on.

CHAPTER SIX

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 SUMMARY

The focus of this research was on property rates administration in Lagos Mainland Local Government (LMLG). The main aim of the work was to identify the environmental, technical and data/informational management problems hindering the effective and efficient administration of tenement rates in the area with a view to developing and testing a GIS-based property rate administration system to tackle the identified problems. The following major problems were identified as significantly affecting the administration of rates in Lagos Mainland LGA:

i) Shortage of relevant and up-to-date information on existing rateable properties.

ii) Lack of information on some rateable properties.

iii) Lack of enabling infrastructure for quick, objective, equitable and comprehensive property valuation.

iv) Lack of geographically-referenced street network data.

v) Poor collection and management of property data and other related data.

vi) Staff inadequacy.

vii) Inability to promptly detect major changes in some rateable properties.

viii) Lack of a mechanism for prompt up-date of property data/information.

ix) Lack of reliable maps for rates administration.

x) Inability to promptly carry out a re-valuation of properties that underwent major modifications.

The above problems were found to have some significant consequences as far as property rate administration in LMLG was concerned. For instance, as a result of the problems the following were observed:

a) Owing to human subjectivity and other shortcomings, certain properties were not correctly valued. They were either under- or over-valued;

b) Certain properties still retained their old gross values despite the fact that such properties had been either renovated, reconstructed or converted from residential to commercial use (or vice versa),since after they were last assessed;

c) Owing to lack of geographically-referenced street address information, certain properties could not be located and served with bills. Hence the bills for such properties were usually returned to the Rates Office with the inscription "UNSEEN" disappointedly written on each of them;

d) Owing to shortage of staff coupled with the manual technique operated, the preparation and dispatch of bills to ratepayers was usually slow, hence prolonged. Some ratepayers hardly received their annual bills till around June or July. (Under normal circumstance, ratepayers are supposed to receive their bills within the first four or five weeks of the current year);

e) Due to lack of effective mechanisms for promptly detecting major changes in certain properties and lack of means of constant updating of property records, some newly developed properties were hardly valued and included in Council's Master Valuation List. The valuation of such properties often had to wait till the next State-wide property survey and re-valuation exercise was carried out. (This exercise is supposed to take place in Lagos State on a five-yearly basis. The last one was carried out in 1991, hence 1996 was to have witnessed another one; however till date no other State-wide property survey and re-valuation has been carried out since after 1991);

f) Defaulting ratepayers are not easily detected;

g) The overall consequence of the problems of rates administration in Lagos Mainland LGA is low annual financial returns from tenement rates. Over the years, the actual revenue yields from rates have often fallen short of the expected or budgeted amount.

In view of the identified major problems of rates administration and their attendant consequences in LMLG, a GIS-based technique was developed with a view to tackling the problems. The system, which is computer-based, is referred to as PRAGIS -- Property Rates Administration Geographic Information System. PRAGIS was developed based on the argument that property tax (rate) administration cannot be effectively and efficiently carried out without adequate use of relevant, accurate, timely and comprehensive geographically referenced digital information. Basically, the development of PRAGIS involved two broad tasks namely:

i) Gathering of relevant spatial property data using cartographic and remote sensing techniques, and non-spatial property data from existing property registers.

ii) Developing a computer-based GIS to capture and manage the property databases for rates administration.

Summary of Major Research Findings

The major findings of this research include the following:

1. The Lagos Mainland LGA administers property rates basically for two main reasons namely to generate revenue for development and to encourage the distribution of wealth.

2. The manual system of rates administration is characterised by certain shortcomings such as:
   - Slowness in the valuation of properties as well as the preparation and dispatch of bills to ratepayers.
   - Subjectivity in the valuation of properties.
   - Unclear definition of certain rateable properties. For instance the terms 'big shop' and 'small shop' are not clearly defined. Hence the same shop a valuer may consider as a big shop another valuer may consider it as a small shop.
   - Discrepancies in property valuation.

- Omission of certain properties or variables during the valuation exercise.
- Lack of an effective mechanism for managing and up-dating property records.
- Lack of a mechanism for prompt detection of defaulting ratepayers.

3. Property rate is poorly administered in LMLG, consequently the annual revenue yield from tenement rates in the area usually falls below the expected amount.

4. The poor administration of rates in the study area is attributable to certain identified factors as discussed at the beginning of this chapter.

5. The tenement rates administration in the study area was carried out without adequate use of map information and other relevant spatial data. Consequently, the Rates Office lacked accurate geographic information on the location and distribution of various types of rateable properties in the LGA. The implication of this is that the LGA often failed to generate revenue from certain buildings through tenement rating.

6. The failure of the Rating Office to use appropriate maps for rates administration was due to three main reasons namely:
   - Lack of funds.
   - Lack of cartographic manpower and equipment.
   - Failure of Rates officials to realize the potential cardinal role maps play in rates administration.

7. A combination of cartographic and remote sensing techniques makes it easier and more reliable to acquire timely, accurate and comprehensive spatial property data for rates administration.

8. A map-based property database managed with a GIS is very useful to property rates administration. In this research the PRAGIS developed and used was found capable of being used by the Rates Office to accomplish a number of important tasks as listed in Table 6.1.

9. For property rates administration to be effectively and efficiently embarked upon, certain maps are necessarily needed. For the LMLG the particular maps identified as needed for rate administration include planning, valuation, implementation and presentation maps. The specific uses of each of these maps have already been outlined in Table 5.14.

6.2 IMPLICATIONS OF FINDINGS

The findings of this research have some policy, technological and research implications. The implications are briefly discussed below.

6.2.1 Policy Implications

In view of the key role information plays in the effective and efficient administration of tenement rates, there is need for a definite policy pronouncement on the acquisition and management of accurate, comprehensive and timely property data. The problem of lack of fund for the acquisition of maps for rates administration should be properly addressed. Also the various categories of rateable property need to be clearly defined in concrete terms and the parameters upon which their valuation is to be based precisely specified. This will discourage unnecessary discrepancies in valuation and hence ensure that similar properties within the same neighbourhood or zone attract similar rates. Including the lay-out plan in the valuation file of each building should be made a policy issue. This will equally help in providing the geometric information needed for the valuation of buildings. By and large, the various processes of property tax administration must be reformed and more precisely outlined.

TABLE 6.1 Summary of the Potential Benefits of the PRAGIS

- Makes it faster to appraise buildings.
- Allows for mass assessment of properties.
- Reduces human errors in property assessment.
- Ensures equity and fairness in assessment of properties.
- Removes discrepancies.
- Reduces cases of omissions (all the variables needed to assess a building are taken into consideration during property appraisal).
- Ensures uniformity in assessment (buildings having similar characteristics are automatically assigned similar values).
- Encourages and facilitates frequent data up-dating.
- Makes it easier to add new records.
- Makes it easier to access and retrieve files and display records.
- Makes it easier to delete obsolete and redundant property records.
- Ensures completeness and comprehensiveness of the Valuation List (no rateable property is left out, and no relevant information pertaining to a property is left out).
- Provides a means of preparing bills very fast. This literally reduces the time it takes to dispatch bills, thus ensuring that ratepayers start responding on time.
- Makes it possible to keep payment records accurate and up-to-date.
- Reduces the workload of the staff of the Tenement Rates Office.
- Affords Council opportunity of obtaining new products – various kinds of thematic property tax maps could be generated at any desired scale.
- Makes files handling less cumbersome.
- Assists Management to expedite decision making by providing timely and accurate information.
- Makes property data processing easy.
- Can arouse public confidence in valuation results (There is this psychological feeling that every thing done with the computer is correct, hence not questionable). Such confidence will go a long way in reducing the likelihood of ratepayers contesting or even refusing to pay bills sent to them.
- The system ensures higher productivity.
- Provides quality on-line information about each rateable building.
- Useful for equitable sharing of workloads amongst rates collectors.
- Has an in-built rate collection performance assessment module.
- Can be used to easily detect the location and distribution of delinquent ratepayers.
- Can effectively take care of the problem of shortage of qualified valuers.
- Can be used by Council to properly estimate the annual revenue derivable from tenement rates

6.2.2 Technological Implications

It is obvious that the manual system of property rates administration which is currently being operated in the study area, is fraught with notable shortcomings. thus the performance of tenement rate as a source of revenue often falls below expectation. There is therefore a glaring need for technological reforms to enhance rates administration. The required technologies must be capable of being used to acquire and manage the spatial and non-spatial data needed by the Rates Office. In view of this therefore, the computer-based geographic information system (GIS) must be adopted and implemented by the Rates Office.

6.2.3 Research Implications

There is need for more purposeful and comprehensive research on the appropriate reform measures that could be adopted to make property rate administration more result-oriented, less cumbersome and less expensive. Also the feasibility and viability of implementing a GIS-based rates administration system needs to be thoroughly investigated.

6.3 CONCLUSIONS

The idea behind the development of the PRAGIS(Property Rates Administration GIS) system was predicated upon the premise that effective and efficient administration of property tax largely depends on the availability of a comprehensive, up-to-date, reliable digital geographical database which is managed by a computer-based technology such as GIS. The outcome of the project has really shown that baring certain data, technical, institutional and economic problems in a developing country such as Nigeria, it is both feasible and indeed desirable to locally adopt and use cartographic and remote sensing techniques in tenement rates data collection, and to manage the data using the GIS technology, to facilitate the execution of property rates as well as other rates charged by Local Governments and other organisations such as NEPA and Water Corporations For the purpose of property rates execution the cartographic and remote sensing techniques make it easier to collect a set of spatial data that is accurate, timely, and comprehensive. On its own part, the GIS technology will make rates administration to follow a logical, well-defined sequence; make the processes of assessing sources of revenue much faster; ensure all time availability of reliable data for rate assessment; greatly reduce subjectivity in rate assessment thereby ensuring consistency, justice and equity; enable the Rating Office to obtain hard copy output data in a combination of various formats(graphic and tabular); quicken the billing and collection processes; and importantly, aid Council in making intelligent decisions towards better customer services and revenue generation.

However, for the cartographic, remote sensing, and GIS technologies to be successfully applied in Nigeria on a large scale for rates administration and indeed other applications, the conducive environment has to be created. That desired conducive environment would have been established if a high degree of awareness of the utility of these techniques is attained; the importance of map-based geographical information in projects execution is widely realised; accurate and up-to-date base maps, aerial photographs and remote sensing imageries covering the entire country are made available and at an affordable price; and the relevant human resources developed.

6.4 RECOMMENDATIONS

The following suggestions and recommendations are hereby made towards the development of a full-fledged GIS for successful rates administration:

- The Nigerian Cadastral map series should be revised and published at larger scales with property boundaries clearly defined.
- Block Plans of all rateable properties within every municipal Council should be drawn to facilitate property assessment for the purpose of rating.
- Residential, commercial, and industrial buildings, as well as shops and other rateable structures should be clearly defined and classified into distinct groups or types for easy and equitable assessment using the GIS technology.
- Each property rating zone should be encouraged to acquire and maintain accurate and comprehensive property survey records for every rateable building. Based on this, a Digital Property Database(DPD) should be developed.
- Every Local Government Area (LGA) in the country should re-number the streets in its domain in a sequential order, to ensure easy identification of houses.

- Local Governments should fund the production of Assessor's Maps and Tax Maps, for effective assessment of tenements and hence revenue generation.
- The practice of property rates administration in the country should be properly harmonized, whereby basic rating standards should be set for the entire country.
- Much awareness needs to be created among Local Government administrators and other agencies involved in the administration of various types of rates, of the efficacy, thus, wisdom in adopting the GIS technology in their rating operations. This could be, achieved through conferences, seminars, demonstration workshops, and so on.
- Universities and other institutions of higher learning in this country should introduce GIS programmes at the diploma, undergraduate and postgraduate levels to train the man-power needed for successful and sustainable implementation of GIS projects.

6.5 SOME CRUCIAL ISSUES IN SUSTAINABLE GIS DEVELOPMENT FOR PROPERTY TAXATION

Before GIS can be successfully developed and implemented for property taxation in the country, certain critical issues, especially as it relates to data acquisition and maintenance, must be adequately taken care of. Some of such issues are discussed below.

a) There is need for comprehensive discovery of all rateable properties within a Local Government. Every building subject to taxing should appear in the Property Tax Register or the Valuation List. Except such an exhaustive list exists it will be impossible to use GIS to assess every rateable building and subsequently collect all the requisite rates.

b) Every rateable building discovered should also be clearly identified. Identifying a building would involve gathering all the necessary information about that building and its environment, which would subsequently be used to place some monetary value on it for the purpose of taxation. The importance of having complete and up-to-date information about every taxable building cannot be over-emphasized (See for example, Ayeni, 1987).

c) Rateable structures such as buildings, shops and workshops are still ill-defined and classified. This makes it difficult for GIS to more precisely assess the structures using the Mass Valuation System (MVS). There is, therefore, every need for a proper and exclusive classification of all taxable properties into various distinct categories.

d) The particular property characteristics to be used in assessing individual properties within each category of property should be precisely defined. Similarly, other variables or parameters, such as annual rental values (ARV), which are not innate characteristics of buildings but which are also used in property assessment, should be well spelt out for each category.

e) The array of houses in each street segment should be numbered in a regular pattern, making sure that each house (especially those located at street intersections), has only but one number or address with which to identify it. Proper street naming and numbering, which unfortunately is lacking in some of our urban centres, is necessary for quick automatic address-matching using GIS.

f) The Local Government needs to maintain the block plan (ground layout) of each building within its geographical area of jurisdiction. A block plan should contain graphic information on the number, size, distribution and orientation of the apartments in a building. These information are very vital to property rating. The block plans of all the buildings could be used to develop a digital cartographic database for thematic mapping. In addition (or alternatively), accurate, comprehensive, and timely cadastral and township maps of our urban settlements should be produced. These maps should, among other things, show both plot(parcel) boundaries and outline of the individual building(s) on each plot.

6.6 SOME GENERAL ISSUES IN GIS IMPLEMENTATION IN NIGERIA

As part of the findings of this research the following were identified as bottlenecks that could hamper speedy and widespread application of the GIS technology in not only the administration of rates but also some other activities, in the country:

(a) There is currently an observed low level of awareness of the relevance of the cartographic, remote sensing and GIS techniques.

(b) Some of the existing data for implementing a GIS have notable shortcomings. For instance, some of them are not' geo-coded or geographically referenced, whereas the creation and operation of a GIS assumes the availability of geo-coded information (Baldina, *et. al.*, 1995).

(c) The problem of data obsoleteness is yet another. The cadastral map used in this study, for example, was produced some 30 years ago, hence a lot of the data items contained in it is outdated(The outdated data were however updated using a more recent aerial photograph and through field compilation).

(d) The cost of acquiring spatial data in form of maps , air photos, orthophotos, and imageries is rather exorbitant. A single standard sheet of a 1:1,200 cadastral map costs ₦100 while a copy of a 23cm X 23cm 1:4,000 aerial photograph sells for as much as ₦200. These prices are considered prohibitive especially when one puts into consideration that zillions of these map and air photo sheets are often required when embarking on a large scale GIS project.

(e) The existing data for implementing GIS are available only in analogue form, there is yet lack of digital map data as well as attribute data. Hence, one has no choice but to build the necessary database right from the scratch. But this could be expected to be quite laborious. Moreover, the financial cost of converting spatial data from analogue to digital is very high.

(f) Currently, since the use of automated spatial data as well as the GIS is very low, an exorbitant start-up cost for the implementation of GIS, could be expected. Besides, the cost of GIS hardware and software is still on the high side in this country.

(g) There is currently a dearth of qualified GIS personnel in Nigeria. Both management and technical human resources for successful and sustainable GIS implementation are grossly in short supply.

(h) Due to the lack of awareness of the usefulness of the GIS technology, securing public or corporate sponsorship for GIS researches and application projects, is yet an uphill task.

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Appendix A

DEPARTMENT OF GEOGRAPHY/PLANNING
UNIVERSITY OF LAGOS

Dear Respondent,

The researcher is a Ph.D. student of the above named institution. His major interest is to develop a Geographic Information System (GIS) suitable for the smooth running of the functions of the local government. The essence of this research is to create a computerized geographically referenced databank which will provide the local government with accurate, timely, and easily accessible information to support decision making, resource management, mapping operations, and tenement rates administration.

Please, endeavour to answer the questions as accurately as possible, since each piece of information given will go a long way in determining the efficiency or otherwise, of the proposed databank. Be rest assured that all the answers given will be handled with utmost confidence.

- Nna O. Uluocha
(Researcher)

PERSONAL DATA

Name (optional) ....

Department/Unit ....

Position ....

ORGANIZATIONAL STRUCTURE/FUNCTION

1. What is the organisational structure of the Department?

....

2. What are the specific functions performed by each unit of the Department? ....

....

....

....

....

....

DATA NEED

3. Generally, what kind of data does the Department need in order to function?

(i) Historical data
(ii) Geographic data
(iii) Legal data
(iv) Economic data
(v) Other (specify) ....
....

4. With examples, state the specific type of data or information needed by each unit to carry out any of the functions listed in (2) above.

....

....

....

....

5. As a department/unit do you always get enough data to enable you carry out your functions? (Please answer in relation to both data quantity and quality, as well as the accessibility and timeliness of the data) ....

....

....

DATA GATHERING

6. How do you gather your data? ....

....

....

....

7. From what sources do you get your data? Name the type of data collected from each source.

....

....

....

8. (a) How do you update your data resources? ....

....

....

(b) How often do you do the updating? ....

....

9. Enumerate the problems of data gathering which you often encounter.

....

....

DATA STORAGE

10. Where do you store your data?

- (i) File jackets
- (ii) Computer disks
- (iii) Other (specify) ....

11. Do you sort your data before storage? If so, by what means?

- (i) Manual
- (ii) Electronic (use of computer)
- (iii) Other (specify) ....

12. What problems of data storage do you often experience?

....

....

DATA PROCESSING

13. How do you process and analyze your data?

- (i) Manually
- (ii) Electronically (using computers)
- (iii) By the use of calculators
- (iv) Other (specify) ....

14. What are the problems associated with the data processing technique you use?

....

....

....

DATA OUTPUT

15. In what form(s) do you normally display your information after data processing?

(i) Tabular form
(ii) Textual form
(iii) Maps
(iv) Statistical diagrams/graphs
(v) Engineering designs
(vi) Other (specify) ....

DATA USE

16. Does your unit/department have a databank? ....

17. Which other unit(s)/department(s) within the LG do you share data and/or functions with?

....

18. Do you combine different data sets for your operations? If 'yes' specify the data sets you normally combine and state the functions you perform with them. ....

....

....

GENERAL

19. Would you encourage the LG to computerize its operations?

Yes/No
If 'yes' which aspects of the functions of your unit/department will you like computerized? ....

....

....

20. If the local government decides to establish a computer-based databank, what information vital to the operations of your unit/department will you like included in such a databank?

....

....

....

21. Briefly state the problems associated with information which you usually face.

....

....

....

APPENDIX B: Property Ownership Attribute Information.

OWNER NAME	PROPERTY ADDRESS	ZONE	AGE	ASSESS. NO.	ANAL_CODE	OCCUPIER	PROPERTY CLASS	STATUS	USAGE	OUT_ BLDING	DATE INSPECTED	INSPECTED BY
Mr M.A. Sanwo	58, Olonade St.	Yaba	66 Years	09/02/0054/058	1001	Owner	Bungalow	Occupied	Residential	Yes	19/06/1990	G.O. Ogunkanmi
J.H. Martins	357, Borno Way	Yaba	66 Years	09/02/0012/357	1001	Owner	Bungalow	Occupied	Residential	No	8/6/90	G.O. Ogunkanmi
Mr Odunjo	59, Olonade St.	Yaba	40 Years	09/02/0054/059	1001	Owner/ Clinic	Semi- Detached	Occupied	Residential	Yes	21/06/1990	O.O. Eludire
Mr Oshindero	77, Olonade St.	Yaba	53 Years	09/02/0054/077	1001	Owner	Bungalow	Occupied	Residential	No	18/06/1990	O.O. Eludire
Mr O. Onile-Ere	298, Murtala Muhammed Way	Yaba		09/02/0048/298	2008	Nimwmlex Ltd	Storey	Occupied	Commercial	No	17/08/1990	Tunde Osho
Mr G.B.K. Delima	344, Borno Way	Yaba		09/02/0012/344	1001	Family	Bungalow	Occpuied	Residential	Yes	11/6/90	Olaleye
Rev. O.A. George	56, Olonade St.	Yaba	59 Years	09/02/0054/56	1001	Owner	Bungalow	Occupied	Residential	Yes	19/06/1990	G.O. Ogunkanmi
Mr Olugbode	76, Olonade St.	Yaba	46 Years	09/02/0054/076	1001	Owner	Bungalow	Occupied	Residential	-	18/06/1990	G.O. Ogunkanmi
Alh. A.M. Lawani	296, Murtala Muhammed Way	Yaba		09/02/0048/296	1001	Owner	Tenement	Occupied	Residential	No	16/08/1990	Tunde Osho
Mr Awo Bolaji	355, Borno Way	Yaba	56 Years	09/02/0012/355	1001	Multi- Tenanted	Bungalow	Occupied	Residential	No	11/6/90	O O. Eludire
	273, Herbert Macaulay Rd.	YAba		09/02/0026/273	1001	Tenants	Bungalow	Occupied	Residential	No	14/08/1990	Obi Ezeru
Alhaji Omotayo	342, Borno Way	Yaba		09/02/0012/342	1001	Owner	Storey	Occupied	Residential	Yes	11/6/90	E.F.Olaleye
Mr J.O. Shoyingbe	57, Olonade St.	Yaba		09/02/0054/57	1001	Tenants	Detached	Occupied	Residential	Yes	19/06/1990	
Mrs B.S.A. Wright	340, Borno Way	Yaba		09/02/0012/340	1001	Owner	Bungalow	Occupied	Residential	Yes	11/6/90	Olaleye
Chief J.O. Soyingbe	55, Olonade St.	Yaba		09/02/0054/55		None		Pulled Down	None	No	19/06/1990	O.O. Eludire
Mr Roseq Eli	294, Murtala Muhammed Way	Yaba		09/02/0048/294	1001	Owner	Detached	Occupied	Residential	Yes	17/08/1990	Tunde Osho
Mrs Falase	338,Borno Way	Yaba		09/02/0012/338	1001	Tenants	Bungalow	Occupied	Residential	Yes	11/6/90	Olaleye
Isaac John	351, Borno Way	Yaba		09/02/0012/351	1001	Unoccupied	Bungalow	De-roofed	None	No	10/9/90	O.O.Eludire
Mr F.E. Pereira	52, Olonade St.	Yaba	66 Years	09/02/0054/052	1001	Owner	Bungalow	Occupied	Residential	Yes	17/06/1990	G.O. Ogunkanmi
Mrs Kofo Williams	336, Borno Way	Yaba		09/02/0012/336	1001	Owner	Bungalow	Occupied	Residential	Yes	11/6/90	Olaleye
	51, Olonade St.	Yaba		09/02/0054/51		None		Uncompleted	None	No	18/06/1990	O.O. Eludire
Mr B.K. Sutherland	13/15, Hughes Avenue	Yaba		09/02/0027/013/15	1001	Owner	Bungalow	Occupied	Residential	Yes	18/06/1990	Tunde Osho
Mobil Oil Producing (Nig)Ltd	292, Murtala Muhammed Way	Yaba		09/02/0048/292	1001	Multi- tenants	Duplex	Occupied	Residential	-	16/08/1990	Tunde Osho
Mr Aboyade	74, Olonade St.	Yaba	66 Years	09/02/0054/074	1001	Tenants	Bungalow	Occupied	Residential	Yes	18/06/1990	G.O. Ogunkanmi
Mrs Philips	334, Borno Way	Yaba		09/02/0012/334	1001	Tenants	Block of Flats	Occupied	Residential	No	11/6/90	Olaleye
Mr O.B. Ogunbefun	347, Borno Way	Yaba	61 Years	09/02/0012/347	1001	Owner	Bungalow	Occupied	Residential	Yes	11/6/90	
Mr Simeon Sanusi	11, Hughes Avenue	Yaba		09/02/0027/011	1001	Tenants	Storey	Occupied	Residential	No	18/06/1990	Olaleye
Miss G.A. Baptist	75, Olonade St.	Yaba		09/02/054/075	1001	Owner/ Tenants	Block of Flats	Occupied	Residential	No	3/9/90	Obi Ezeru
Mr Odumosu	288, Murtala Muhammed Way	YAba		09/02/0048/288	1001	Tenants	Bungalow	Occupied	Residential	No	17/08/1990	Tunde Osho
Hope Rising & Funds Society	345, Borno Way	Yaba	61 Years	09/02/0012/345	1001	Tenants	Bungalow	Occupied	Residential	No	11/6/90	G.O. Ogunkanmi
Mr Abiola Ojo	9, Hughes Avenue	Yaba		09/02/0027/009	1001	Ojo & Ojo & Co.	Bungalow	Occupied	Residential	Yes	18/06/1990	Olaleye
Chief(Mrs)Awodeinde	7,Hughes Avenue	Yaba		09/02/0027/007	1001	Tenants	Bungalow	Occupied	Residential	Yes	18/08/1990	Olaleye

APPENDIX C: Some Residential Property Attributes.

AREA	PROPID	PROP ADDRESS	CONST. MATERIAL	WALL MATERIAL	EXTERNAL FINISHING	INTERNAL FINISHING	NO. OF FLOORS	BLOCK FLAT	NO. OF FLATS	FLOOR MATERIAL	CEILING MATERIAL	BATH TILES
1888.48	671											
1826.168	91											
2538.517	661	58, Olonade St.	Brick	Rendered	Tyroline	Emulsion				Strip(Cem. Screed)	Boarded(Timber)	
1300.113	211	357, Borno Way	Brick	Rendered	Emulsion	Emulsion				Strip(Sand Screed)	Boarded(Hardboard)	
2398.327	881											
1827.609	551	59, Olonade St.	Conc. Block	Rendered	Emulsion	Gloss	2			Terrazo	Boarded	X
2121.84	461	77, Olonade St.	Brick	Rendered			1			Strip(Cem. Screed)	Boarded	
2274.275	81	298, Murtala Muhammed Way										
1264.328	371	344, Borno Way	Brick	Rendered	Emulsion	Emulsion				Strip(Screed)	Boarded(Timber)	
2792.584	651	56, Olonade St.	Brick	Rendered	Emulsion	Emulsion	1			Strip(Cem. Screed)	Boarded(Asbestos)	
1613.587	751	76, Olonade St.	Brick	Rendered	Emulsion	Emulsion				Strip(Cem. Screed)	Boarded Timber	
4384.105	71	296, Murtala Muhammed Way	Brick/Conc.Block	Rendered	Emulsion	Emulsion				Strip(Cem. Screed)	Boarded Timber	
2632.667	221	355, Borno Way	Brick	Rendered	Emulsion	Emulsion				Strip(Cem. Screed)	Boarded	
1578.052	891	273, Herbert Macaulay Rd.	Brick	Rendered	Emulsion	Emulsion	1			Strip(Cem. Screed)		
1477.961	361	342, Borno Way	Conc. Block	Rendered	Gloss	Gloss	2			Mastic Tiles	Boarded	X
1733.146	561	57, Olonade St.	Conc. Block	Rendered	Gloss	Gloss	1	1	1	Boarded(Cem. Screed)	Boarded(Asbestos)	X
1967.297	351	340, Borno Way	Brick	Rendered	Emulsion	Emulsion				Strip	Boarded	
2150.64	641											
2848.879	571	55, Olonade St.	Brick	Rendered	Emulsion	Gloss	2			Strip(Cem. Screed)	Boarded	
2107.436	231											
3154.731	61	294, Murtala Muhammed Way	Conc. Block	Rendered	Emulsion	Gloss	2			Terrazo	Boarded(Timber Strip)	X
2056.222	341	338,Borno Way	Conc. Block	Rendered	Gloss	Gloss				Strip	Boarded(Timber)	
1789.946	241	351, Borno Way	Brick	Rendered						Strip(Cem. Screed)	Boarded(Polished Timber	
2082.437	631	52, Olonade St.	Brick	Rendered	Gloss	Gloss	1			Mastic Tiles(Ceramic)	Boarded Timber	X
1304.131	581											
2609.381	251											
1272.773	331	336, Borno Way	Brick	Rendered	Emulsion	Emulsion				Strip	Boarded(Timber)	
2660.669	591	51, Olonade St.										
2513.751	621	13/15, Hughes Avenue	Brick	Rendered	Emulsion	Emulsion				Strip(Cem. Screed)	Boarded(Asbestos)	X
1978.726	51	292, Murtala Muhammed Way	Rein. Conc.	Rendered	Emulsion	Texcote	3	2	4(DUPLEX)	Strip/Terrazo/Mosaic		Ceramic
2305.747	741	74, Olonade St.	Brick	Rendered	Tyroline	Emulsion				Terrazo	Boarded(Hardboard)	
1275.328	321	334, Borno Way	Conc. Block	Rendered	Tyroline	Emulsion	2	X	4	Strip	Boarded	X
4013.703	41											
1081.214	261	347, Borno Way	Brick	Rendered						Strip(Sand Screed)	Boarded(Timber)	
2114.944	611	11, Hughes Avenue	Concrete Block	Rendered	Rendered		2			Strip(Screed)	Boarded	
2204.568	471	75, Olonade St.	Brick/Conc. Block	Rendered	Emulsion	Emulsion	2	X	2	Cem Screed/Terrazo	Boarded(Timber)	
4691.241	31	288, Murtala Muhammed Way	Concrete Block	Rendered	Emulsion	Texcote	1			Strip(Cement Screed)	Boarded(Asbestos/ Celote	X

APPENDIX D: Some Commercial Property Attributes.

ID	AREA	PERIMETER	PROP. ID	PROPERTY ADDRESS	FRONT-AGE	DEPTH	SITE AREA	WALL MAT.	WINDOWS	DOORS	FLOOR MAT.	ROOF MAT.
PROPMAPR118	1827.609	243.165	551	59, Olonade St.				Blockwall	Glazed Metal	Flush Plywood	Terrazo	C. Iron Sheet
PROPMAPR120	2274.275	227.496	81	298, Murtala Muhammed Way	15.2	45.6	693.12	Blockwall (Rendered)	Swing Crittal-Hope	Swing Crittal-Hope/Panel Flush	Cement Screed	
PROPMAPR195	1314.702	146.366	601	9, Hughes Avenue	15.4	29.38	452.45	Brickwall	Glazed Casement	Flush Plywood		C. Iron Sheet
PROPMAPR2	2191.495	228.455	771	297, Herbert Macaulay Rd	15	35	525	Brick	Glazed Wooden Casement	Battened/ Flush/Alum./ Framed/ Glass	Cement Screed	
PROPMAPR207	5661.722	417.338	11	284A,Murtala Muhammed Way	15.2	30.4	462.08	Blockwall (Rendered)	Steel Glazed Casement	Battened/ Flush Type	Cement Screed	
PROPMAPR64	2747.05	253.987	841	283,Herbert Macaulay Rd.	15	30	450	Sandcrete Blocks	Aluminium/ Sliding/ Louvres	Plywood Flush	Cement Screed/ Terrazo	
propmapR70	652.523	119.512	121	302B, Murtala Muhammed Way	15.2	45.8	696.16	Blockwall (Rendered)	Crittal-Hope/Glazed Sliding	G.S.T./Flush Type	Cement Screed	
PROPMAPR73	2228.875	241.855	691	64, Olonade St.	15.2	31	471.2	Blockwall	Glazed Metal	Battened Timber/Flush Roller Shutter	Cement Screed	
PROPMAPR9	2020.795	190.579	791	293, Herbert Macaulay Rd.	14.65	30	439.5					

APPENDIX E: Some Residential Property Valuation Information

PROPERTY ADDRESS	BED ROOMS	BQ ROOMS	TOTAL ROOMS	ARV OF ROOM	ROOMS VALUE	NO. OF FLATS	FLAT VALUE	FLATS VALUE	DETACHED
68, Olonade St.	5	12	17	480	8160			0	
357, Borno Way	12	0	22	540	11880			0	
59, Olonade St.	8	0	8	600	4800			0	
77, Olonade St.	7	0	7	480	3360			0	
344, Borno Way	5	2	7	480	3360			0	
56, Olonade St.	5	3	8	480	3840			0	
78, Olonade St.	10	0	10	480	4800			0	
356, Borno Way	12	0	12	480	5760			0	
273, Herbert Macaulay Rd.	6	0	6	480	2880			0	
342, Borno Way	11	6	17	480	8160			0	
57, Olonade St.	3	6	9	600	3600	1	5000	5000	
340, Borno Way	3	2	5	480	960			0	
66, Olonade St.	16	0	16	480	7680			0	
294, Murtala Muhammed Way	6	4	10	480	1920			0	1
338,Borno Way	8	2	10	480	4800			0	
361, Borno Way	7	0	7	420	2940			0	
62, Olonade St.	3	1	4	480	480			0	
336, Borno Way	7	3	10	480	4800			0	
13/16, Hughes Avenue	4	4	8	480	1920			0	
74, Olonade St.	5	2	7	480	960			0	
334, Borno Way	12	0	12		0	4	4800	19200	
347, Borno Way	5	2	7	480	3360			0	
11, Hughes Avenue	17	0	17	480	8160			0	
76, Olonade St.	7	0	7		0	2	3600	7200	
288, Murtala Muhammed Way	0	10	10	480	4800			0	
346, Borno Way	8	0	8	480	3840			0	
291, Herbert Macaulay Rd.	9	0	9	480	4320			0	
6, Hughes Avenue	4	2	6	480	2880			0	
360, Borno Way	9	3	12	480	5760			0	
358, Borno Way	16	0	16	480	7680			0	
73, Olonade St.	4	8	12	480	5760			0	
371, Borno Way	3	2	5	480	2400			0	
289, Herbert Macaulay Rd.	12	0	12	480	5760			0	
72, Olonade St.	5	2	7	480	3360			0	
368, Borno Way	4	0	4		0			0	1
369, Borno Way	7	2	9	480	960			0	
71, Olonade St.	18	0	18	480	8640			0	
287, Herbert Macaulay Rd.	9	3	12	480	1440	3	3600	10800	

APPENDIX F: Some Commercial Property Valuation Information.

ADDRESS	NO. FLRS.	GF PART	GFOA DIM	GFOB DIM	GFOC DIM	GFOD DIM	GFOE DIM	TOT GFDIM	UNLET GFS	GFLOR AREA	PER GF	GFGROS VAL	FF PART
59, Olonade St.	2	Waiting Room / Consulting Room	12.16	12.16	11.26	10.8	0	46.35	0	46.35	100	4635	Residential
298, Murtala Muhammed Way	2	Offices											
9, Hughes Avenue	1	Offices								53.4	120	6408	None
297, Herbert Macaulay Rd	1	Offices/Shops	177.3	7.64	7.64	0	0	192.58	17.73	174.85	80	13988	None
284A, Murtala Muhammed Way	2	Offices/ Residential									1800	18000	
283, Herbert Macaulay Rd.	4	Car Park / Reception/ Library	59.67	73.93	0	0	0	133.6	0	133.6	120	16032	Offices/Classrooms
302B, Murtala Muhammed Way	2	Reception/ Offices	15.31	11.84	11.84	11.84	11.84	62.67	0	62.67	100	6267	Office/Waiting Room/Reception
64, Olonade St.	4	Pattonis Restaurant	218.4	0	0	0	0	218.4	43.68	174.72	80	13977.6	Offices
293, Herbert Macaulay Rd.	2	Food Bar	181.6	0	0	0	0	181.6	18.16	163.44	80	13075.2	Offices/Residential

APPENDIX G: General Rates Information

OWNER_NAME	PROPERTY ADDRESS	ZONE	ASSESS_NO	USAGE	RATEABLE	TAX	ARREARS	INTEREST	YEARS_ARR	RADIO/TV	TOTAL AMT.	DATE	PERIOD
Mr M.A. Sanwo	58, Olonade St.	Yaba	09/02/0054/058	Residential	6120	612		0					
J.H. Martins	357, Borno Way	Yaba	09/02/0012/357	Residential	8910	891		0					
Mr Odunjo	59, Olonade St.	Yaba	09/02/0054/059	Residential	10552.5	1055.25		0					
Mr Oshindero	77, Olonade St.	Yaba	09/02/0054/077	Residential	2520	252		0					
Mr O. Onile-Ere	298, Murtala Muhammed Way	Yaba	09/02/0048/298	Commercial	12000	1200		0					
Mr G.B.K. Delima	344, Borno Way	Yaba	09/02/0012/344	Residential	3870	387		0					
Rev. O.A. George	56, Olonade St.	Yaba	09/02/0054/56	Residential	2880	288		0					
Mr Olugbode	76, Olonade St.	Yaba	09/02/0054/076	Residential	3600	360		0					
Alh. A.M. Lawani	296, Murtala Muhammed Way	Yaba	09/02/0048/296	Residential				0					
Mr Awo Bolaji	355, Borno Way	Yaba	09/02/0012/355	Residential	4320	432		0					
	273, Herbert Macaulay Rd.	Yaba	09/02/0026/273	Residential	3060	306		0					
Alhaji Omotayo	342, Borno Way	Yaba	09/02/0012/342	Residential	6120	612		0					
Mr J.O. Shoyingbe	57, Olonade St.	Yaba	09/02/0054/57	Residential	6450	645		0					
Mrs B.S.A. Wright	340, Borno Way	Yaba	09/02/0012/340	Residential	1890	189		0					
Chief J.O. Soyingbe	55, Olonade St.	Yaba	09/02/0054/55	Unoccupied				0					
Mr Roseq Eli	294, Murtala Muhammed Way	Yaba	09/02/0048/294	Residential	10440	1044		0					
Mrs Falase	338,Borno Way	Yaba	09/02/0012/338	Residential	3600	360		0					
Isaac John	351, Borno Way	Yaba	09/02/0012/351	Unoccupied	2205	220.5		0					
Mr F.E. Pereira	52, Olonade St.	Yaba	09/02/0054/052	Residential	5047.5	504.75		0					
Mrs Kofo Williams	336, Borno Way	Yaba	09/02/0012/336	Residential	3600	360		0					
	51, Olonade St.	Yaba	09/02/0054/51	Unoccupied				0					
Mr B.K. Sutherland	13/15, Hughes Avenue	Yaba	09/02/0027/013/15	Residential	4140	414		0					
Mobil Oil Producing(Nig)Ltd	292, Murtala Muhammed Way	Yaba	09/02/0048/292	Residential				0					
Mr Aboyade	74, Olonade St.	Yaba	09/02/0054/074	Residential	5970	597		0					
Mrs Philips	334, Borno Way	Yaba	09/02/0012/334	Residential	14400	1440		0					
Mr O.B. Ogunbefun	347, Borno Way	Yaba	09/02/0012/347	Residential	2520	252		0			252		
Mr Simeon Sanusi	11, Hughes Avenue	Yaba	09/02/0027/011	Residential	7020	702		0					
Miss G.A. Baptist	75, Olonade St.	Yaba	09/02/054/075	Residential	9150	915		0					
Mr Odumosu	288, Murtala Muhammed Way	YAba	09/02/0048/288	Residential	9000	900		0					
Hope Rising & Funds Society	345, Borno Way	Yaba	09/02/0012/345	Residential	2880	288		0					
Mr Abiola Ojo	9, Hughes Avenue	Yaba	09/02/0027/009	Residential	4806	480.6		0					
ief(Mrs)Awodeinde	7,Hughes Avenue	Yaba	09/02/0027/007	Residential	4860	486		0					
	297, Herbert Macaulay Rd	Yaba	09/02/026/297	Commercial	10491	1049.1		0					
s L.A. Oyewole	291, Herbert Macaulay Rd.	Yaba	09/02/026/291	Residential	3780	378		0					
Mr Falase	5, Hughes Avenue	Yaba	09/02/0027/005					0					
Mr. Lookman Ajose	284A,Murtala Muhammed Way	Yaba	09/02/0048/284	Commercial	22410	2241		115.2					
Chief A.O. Oresanya	360, Borno Way	Yaba	09/02/0012/360	Residential	4320	432		0					
Mr D.A. Fajana	358, Borno Way	Yaba	09/02/0012/358	Residential	5760	576	1192	119.2	2 years	20	1907.2	1/1/96	7 Days
M.O. Dada	73, Olonade St.	Yaba	09/02/0054/073	Residential	4320	432	1808	180.8	4 Years	20	2440.8	1/1/96	3 Days
Mr Ipaye	371, Borno Way	Yaba	09/02/0012/371	Residential	1800	180		0					
Mr Adebulewo	289, Herbert Macaulay Rd.	Yaba	09/02/026/289	Residential	5400	540		0					
Mr A.A. Babalola	72, Olonade St.	Yaba	09/02/0054/072	Residential	2520	252		0					
Mrs Amosu	356, Borno Way	Yaba	09/02/0012/356	Residential	4500	450		0					
Mr E.E. Falashe	369, Borno Way	Yaba	09/02/0012/369	Unoccupied				0					
Mrs F.I. Ogunnaike	71, Olonade St.	Yaba	09/02/0054/071	Residential	6480	648		0					
J.K. Randle	287, Herbert Macaulay Rd.	Yaba	09/02/026/287	Residential	9180	918		0					
Mr Shotayo	70, Olonade St.	Yaba	09/02/054/070	Residential	3960	396		0					
Chief J.A. Omolabi	304,Murtala Muhammed Way	Yaba	09/02/0048/304	Residential	9450	945		0					
Ibo Thrift Society	354, Borno Way	Yaba	09/02/0012/354		5400	540		0					
Mr J.A. Smith	69, Olonade St.	Yaba	09/02/0054/069	Residential	3960	396		0					
Mr O.E. Awoliyi	285, Herbert Macaulay Rd.	Yaba	09/02/026/285	Residential	2160	216		0					
Mr Ogundipe	68, Olonade St.	Yaba	09/02/0054/068	Residential	1800	180		0					
Mrs Morenike Johnson	352, Borno Way	Yaba	09/02/0012/352	Unoccupied				0					
	295, Herbert Macaulay St.	Yaba	09/02/026/295	Residential	2520	252		0					
M.A. Idowu	365, Borno Way	Yaba	09/02/0012/365	Residential	6480	648		0					

APPENDIX H: Billing Information

OWNER_NAME	PROPERTY ADDRESS	ZONE	ASSESS_NO	USAGE	RATEABLE	TAX	ARREARS
Mr M.A. Sanwo	58, Olonade St.	Yaba	09/02/0054/058	Residential	6120	612	
J.H. Martins	357, Borno Way	Yaba	09/02/0012/357	Residential	8910	891	
Mr Odunjo	59, Olonade St.	Yaba	09/02/0054/059	Residential	10552.5	1055.25	
Mr Oshindero	77, Olonade St.	Yaba	09/02/0054/077	Residential	2520	252	
Mr O. Onile-Ere	298, Murtala Muhammed Way	Yaba	09/02/0048/298	Commercial	12000	1200	
Mr G.B.K. Delima	344, Borno Way	Yaba	09/02/0012/344	Residential	3870	387	
Rev. O.A. George	56, Olonade St.	Yaba	09/02/0054/56	Residential	2880	288	
Mr Olugbode	76, Olonade St.	Yaba	09/02/0054/076	Residential	3600	360	
Alh. A.M. Lawani	296, Murtala Muhammed Way	Yaba	09/02/0048/296	Residential			
Mr Awo Bolaji	355, Borno Way	Yaba	09/02/0012/355	Residential	4320	432	
	273, Herbert Macaulay Rd.	Yaba	09/02/0026/273	Residential	3060	306	
Alhaji Omotayo	342, Borno Way	Yaba	09/02/0012/342	Residential	6120	612	
Mr J.O. Shoyingbe	57, Olonade St.	Yaba	09/02/0054/57	Residential	6450	645	
Mrs B.S.A. Wright	340, Borno Way	Yaba	09/02/0012/340	Residential	1890	189	
Chief J.O. Soyingbe	55, Olonade St.	Yaba	09/02/0054/55	Unoccupied			
Mr Roseq Eli	294, Murtala Muhammed Way	Yaba	09/02/0048/294	Residential	10440	1044	
Mrs Falase	338,Borno Way	Yaba	09/02/0012/338	Residential	3600	360	
Isaac John	351, Borno Way	Yaba	09/02/0012/351	Unoccupied	2205	220.5	
Mr F.E. Pereira	52, Olonade St.	Yaba	09/02/0054/052	Residential	5047.5	504.75	
Mrs Kofo Williams	336, Borno Way	Yaba	09/02/0012/336	Residential	3600	360	
	51, Olonade St.	Yaba	09/02/0054/51	Unoccupied			
Mr B.K. Sutherland	13/15, Hughes Avenue	Yaba	09/02/0027/013/15	Residential	4140	414	
Mobil Oil Producing(Nig)Ltd	292, Murtala Muhammed Way	Yaba	09/02/0048/292	Residential			
Mr Aboyade	74, Olonade St.	Yaba	09/02/0054/074	Residential	5970	597	
Mrs Philips	334, Borno Way	Yaba	09/02/0012/334	Residential	14400	1440	
Mr O.B. Ogunbefun	347, Borno Way	Yaba	09/02/0012/347	Residential	2520	252	
Mr Simeon Sanusi	11, Hughes Avenue	Yaba	09/02/0027/011	Residential	7020	702	
Miss G.A. Baptist	75, Olonade St.	Yaba	09/02/054/075	Residential	9150	915	
Mr Odunosu	288, Murtala Muhammed Way	YAba	09/02/0048/288	Residential	9000	900	
Hope Rising & Funds Society	345, Borno Way	Yaba	09/02/0012/345	Residential	2880	288	
Mr Abiola Ojo	9, Hughes Avenue	Yaba	09/02/0027/009	Residential	4806	480.6	
Chief(Mrs)Awodeinde	7,Hughes Avenue	Yaba	09/02/0027/007	Residential	4860	486	
	297, Herbert Macaulay Rd	Yaba	09/02/026/297	Commercial	10491	1049.1	
Mrs L.A. Oyewole	291, Herbert Macaulay Rd.	Yaba	09/02/026/291	Residential	3780	378	
Mr Falase	5, Hughes Avenue	Yaba	09/02/0027/005				
Mr. Lookman Ajose	284A,Murtala Muhammed Way	Yaba	09/02/0048/284	Commercial	22410	2241	
Chief A.O. Oresanya	360, Borno Way	Yaba	09/02/0012/360	Residential	4320	432	
Mr D.A. Fajana	358, Borno Way	Yaba	09/02/0012/358	Residential	5760	576	1192
M.O. Dada	73, Olonade St.	Yaba	09/02/0054/073	Residential	4320	432	1808
Mr Ipaye	371, Borno Way	Yaba	09/02/0012/371	Residential	1800	180	
Mr Adebulewo	289, Herbert Macaulay Rd.	Yaba	09/02/026/289	Residential	5400	540	
Mr A.A. Babalola	72, Olonade St.	Yaba	09/02/0054/072	Residential	2520	252	
Mrs Amosu	356, Borno Way	Yaba	09/02/0012/356	Residential	4500	450	
Mr E.E. Falashe	369, Borno Way	Yaba	09/02/0012/369	Unoccupied			
Mrs E.I. Ogunnaike	71, Olonade St.	Yaba	09/02/0054/071	Residential	6480	648	
J.K. Randle	287, Herbert Macaulay Rd.	Yaba	09/02/026/287	Residential	9180	918	
Mr Shotayo	70, Olonade St.	Yaba	09/02/054/070	Residential	3960	396	
Chief J.A. Omolabi	304,Murtala Muhammed Way	Yaba	09/02/0048/304	Residential	9450	945	
Ibo Thrift Society	354, Borno Way	Yaba	09/02/0012/354		5400	540	
Mr J.A. Smith	69, Olonade St.	Yaba	09/02/0054/069	Residential	3960	396	
Mr O.E. Awoliyi	285, Herbert Macaulay Rd.	Yaba	09/02/026/285	Residential	2160	216	
Mr Ogundipe	68, Olonade St.	Yaba	09/02/0054/068	Residential	1800	180	
Mrs Morenike Johnson	352, Borno Way	Yaba	09/02/0012/352	Unoccupied			
	295, Herbert Macaulay St.	Yaba	09/02/026/295	Residential	2520	252	
M.A. Idowu	365, Borno Way	Yaba	09/02/0012/365	Residential	6480	648	
	283,Herbert Macaulay Rd.	Yaba	09/02/026/283	Commercial	48582.22	4858.22	
Chief S.A. Adeosun	67, Olonade St.	Yaba	09/02/0054/067	Residential	3960	396	
Canon T.A.J. Oluwole	66, Olonade St.	Yaba	09/02/0054/066	Unoccupied	2520	252	
Dr A.E. Mba	350, Borno Way	YAba	09/02/0012/350	Residential	9000	900	
Mr Sawyer G. David	64, Olonade St.	Yaba	09/02/0054/064	Commercial	40534.95	4053.5	
Mr Odusanya	363, Borno Way	Yaba	09/02/0012/363	Residential	4680	468	
Mr Decosta	65, Olonade St.	Yaba	09/02/0054/065	Unoccupied			
Mrs Olakunbi Bucknor	281, Herbert Macaulay Rd.	Yaba	09/02/0026/281	Residential	3600	360	
Alhaji Shekoni	361, Borno Way	Yaba	09/02/0012/361	Residential	8100	810	
Mr S.A. Johnson	348, Borno Way	Yaba	09/02/0012/348	Residential	2160	216	
A.Odeleye	279, Herbert Macaulay Rd.	Yaba	09/02/026/279	Residential	9720	972	
Mrs Abayomi	293, Herbert Macaulay Rd.	Yaba	09/02/026/293	Commercial	24516	2451.6	
Mr Balogun Asani	62, Olonade St.	Yaba	09/02/0054/062	Residential	7920	792	
Chief Oladapo	63, Olonade St.	Yaba	09/02/0054/063	Residential	4320	432	
Mr Abatan	359, Borno Way	Yaba	09/02/0012/359	Residential	3240	324	
Mr Falaye	277, Herbert Macaulay St.	Yaba	09/02/026/277	Residential	3240	324	

APPENDIX I: Streets Information

STREET NO.	STREET NAME	ST. CONDITION	ST. SURFACE
60	OLONADE STREET	GOOD	TARRED
300	MURTALA MOHAMMED WAY	GOOD	TARRED
58	OLONADE STREET	GOOD	TARRED
357	BORNO WAY	GOOD	TARRED
275	HERBERT MACAULAY ROAD	GOOD	TARRED
59	OLONADE STREET	GOOD	TARRED
77	OLONADE STREET	GOOD	TARRED
298	MURTALA MOHAMMED WAY	GOOD	TARRED
344	BORNO WAY	GOOD	TARRED
56	OLONADE STREET	GOOD	TARRED
76	OLONADE STREET	GOOD	TARRED
296	MURTALA MOHAMMED WAY	GOOD	TARRED
355	BORNO WAY	GOOD	TARRED
273	HERBERT MACAULAY ROAD	GOOD	TARRED
342	BORNO WAY	GOOD	TARRED
57	OLONADE STREET	GOOD	TARRED
340	BORNO WAY	GOOD	TARRED
54	OLONADE STREET	GOOD	TARRED
55	OLONADE STREET	GOOD	TARRED
353	BORNO WAY	GOOD	TARRED
294	MURTALA MOHAMMED WAY	GOOD	TARRED
338	BORNO WAY	GOOD	TARRED
351	BORNO WAY	GOOD	TARRED
52	OLONADE STREET	GOOD	TARRED
53	OLONADE STREET	GOOD	TARRED
349	BORNO WAY	GOOD	TARRED
336	BORNO WAY	GOOD	TARRED
51	OLONADE STREET	GOOD	TARRED
13/15	HUGHES AVENUE	GOOD	TARRED
292	MURTALA MOHAMMED WAY	GOOD	TARRED
74	OLONADE STREET	GOOD	TARRED
334	BORNO WAY	GOOD	TARRED
290	MURTALA MOHAMMED WAY	GOOD	TARRED
11	HUGHES AVENUE	GOOD	TARRED
75	OLONADE STREET	GOOD	TARRED
288	MURTALA MOHAMMED WAY	GOOD	TARRED
345	BORNO WAY	GOOD	TARRED
9	HUGHES AVENUE	GOOD	TAREED
7	HUGHES AVENUE	GOOD	TARRED
297	HERBERT MACAULAY ROAD	GOOD	TARRED
291	HERBERT MACAULAY ROAD	GOOD	TARRED
5	HUGHES AVENUE	GOOD	TARRED
286	MURTALA MOHAMMED WAY	GOOD	TARRED
3A	HUGHES AVENUE	GOOD	TARRED
1	HUGHES AVENUE	GOOD	TARRED
284	MURTALA MOHAMMED WAY	GOOD	TARRED
3	HUGHES AVENUE	GOOD	TARRED
360	BORNO WAY	GOOD	TARRED

APPENDIX J: Sample of a Demand Note

LAGOS MAINLAND LOCAL GOVERNMENT

....AREA OFFICE

IN RESPECT OF PREMISES SITUATED AT

ALL CHEQUES ARE TO BE ADDRESSED TO LAGOS MAINLAND LOCAL GOVERNMENT

DEMAND NOTE

FOR GENERAL RATE

FIRST & FINAL NOTICE

1ST JAN. - 31ST DECEMBER 19 (12 MONTHS)

DATE	ASSESSMENT NO.	DESCRIPTION OF PROPERTY	RATEABLE VALUE CAPITAL VALUE	AMOUNT DUE FOR CURRENT YR	ARREARS CREDIT C/F	10% INTEREST ON ARREARS	YEARS OF ARREARS	TOTAL AMOUNT DUE NOW FOR PAYMENT

The LAGOS MAINLAND LOCAL GOVERNMENT under the LOCAL GOVERNMENT Law 1989 Cap 6 demands payment of TENEMENT RATE on the above Property at the approved rate in respect of the financial year 1st January........... Amount shown in Column 9 and arrears (if any) of the former rate is now due from you. Payment of the amount demanded (Column 9) is to be made at .... Local Government not later than 30 days from the date of the demand note. If payment is not made within ONE MONTH of the date of this demand legal proceedings may be taken immediately. Payments must not be made to any individual Officer. Payment by cheque should be endorsed "Commission to Drawer's Account" with the name and address of the Drawer at the back of such cheque.

HOURS OF PAYMENT
Mondays to Fridays: 7.30am to 3.30pm

All enquiries to the Council Treasurer, LAGOS MAINLAND LOCAL GOVERNMENT.
PLEASE PRODUCE THIS DEMAND NOTE INTACT AT THE TIME OF PAYMENT

APPENDIX K: Sample of a Warning Notice.

LAGOS MAINLAND LOCAL GOVERNMENT

Tenement Rate Section,
Finance Department,
Lagos Mainland Local Govt.,
198, Herbert Macaulay St.
Yaba.
.... 19 ....

FINAL REMINDER FOR THE YEAR, 19.....

....
....
....
....

Dear Sir/Madam,

WARNING NOTICE
TENEMENT RATE ARREARS/CURRENT

This is to remind you that the sum of N.................. is still outstanding as arrears/ current on Tenement Rates on the above property as at ....1998 within the Mainland Local Government Area.

This letter is being served on you as a FINAL REMINDER and as a follow up to an earlier Demand Note served.

You are therefore strongly warned to settled the amount due within SEVEN DAYS in order to avoid any embarrassment.

Please treat as VERY URGENT.

Yours faithfully,

Council Treasurer.

Place of Payment:
Lagos Mainland Local Govt.,
198, Herbert Macaulay Street,
Yaba.

Hours of Payment:
7.30am - 3.30pm

APPENDIX L: Sample of a Sealing Notice.

LAGOS MAINLAND LOCAL GOVERNMENT

Tenement Rate Section,
Finance Department,
Lagos Mainland Local Govt.,
198, Herbert Macaulay St. Yaba.
.... 19 ....

....
....
....
....

Dear Sir/Madam,

SEALING NOTICE
TENEMENT RATE
ASSESSMENT NO.

It has become necessary to invite your attention to rate due on the above property. At the commencement of the rating period, a Demand Note showing the sum of........................ due as rates was served on you and now that no positive step has been taken to effect settlement, I am to remind you of the provisions in the Tenement Rate Edict 1,2 Section 34 (2), (3) and (4).

2. In this circumstance if the amount now outstanding is not cleared on or before................................... the provisions of the Edict as indicated above shall be applied WITH IMMEDIATE EFFECT and without any further notice, YOUR PROPERTY SHALL BE SEALED ON...

ARREARS - 1997.............................
CURRENT - 1998............................
TOTAL : ....

Yours faithfully,

Council Treasurer.

LAGOS MAINLAND LOCAL GOVERNMENT
198, HERBERT MACAULAY STREET, YABA
Hours of Payment:
7.30am - 3.30pm.