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**“SOLID WASTE REVENUE MANAGEMENT INFORMATION SYSTEM FOR  
METROPOLITAN ASSEMBLIES IN GHANA”**

**(A CASE STUDY KUMASI METROPOLITAN ASSEMBLY - KMA)**

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## DECLARATION

I hereby declare that this study was under taken independently and it is my original work.

It is not replication of any work either published or unpublished. All references made in this study are duly acknowledged. Finally, all aspects of this study have been discussed with and approved by my supervisor, Prof. Vasko Fournadjiev.

KNUST

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I declare that this dissertation was written under my supervision and that the student has been consistent in his interaction with me for guidance and direction. He has my consent to present it for assessment.

Signature .....

Date .....

**PROF. VASKO FOURNADJIEV**

**(SUPERVISOR)**

## DEDICATION

I dedicate this research project to the following wonderful persons in my life:

- My parents Yahaya Amadu and Habiba Issah
- My wife, Saeeda Allaru and my son Hidir Abubakari

# KNUST





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IN THE NAME OF ALLAH THE MOST GRACIOUS, THE MOST MERCIFUL.

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I also want to thank and acknowledge the following people without whose prayers, pieces of advice, patience and guidance this study would not have been completed:

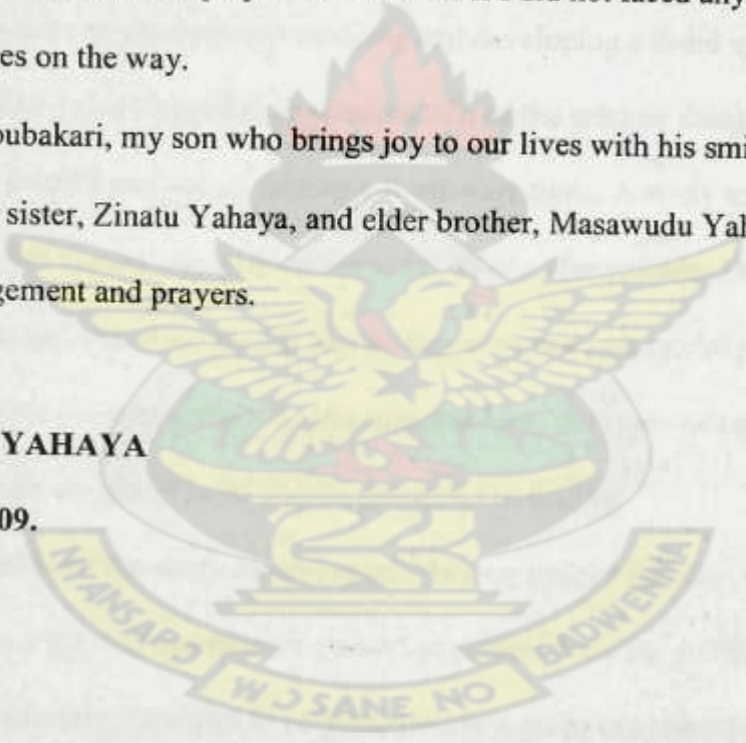
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## ABSTRACT

The increasing cost of rendering Waste Management Services (WMS) to the people of Kumasi has become an issue of concern to the city authority, Kumasi Metropolitan Assembly (KMA). As a result, a City-wide waste collection levy scheme was formulated to generate revenue from the public to sustain the financing of high cost of rendering the services. The effective implementation of this scheme requires a reliable information system to manage data pertaining to the scheme. The system has not been available over the years.

This research project involved studying and developing a Solid waste revenue management system to facilitate the implementation of the scheme using Visual basic 6.0, SQL Server DBMS and Set up factory 6.0 software tools. A study to determine the requirements for the system was carried out at the Waste Management Department (WMD) of KMA; and the areas mainly focused on were the managerial processes involved in the policy implementation, data requirements, the types of reports required and how to estimate weight of solid wastes generated in the city.

The results from the study are to capture data on property in the city, record WMS rendered to a specific community, record payments from the public, generate reports and give estimates of waste to be generated in a given community.

It is expected that the completed project should support and facilitate the implementation of the Waste collection levy policy. Other expected benefits are; to save time searching for data, to support revenue generation and its management, to aggregate large amounts of data in various ways useful for planning and decision-making, to increase the capacity for record keeping in terms of space and cost, to reduce significantly the cost of managing data manually and to generate more revenue by replicating this system in other Metropolitan/Municipal District Assemblies in Ghana.



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### **List of Abbreviations**

DBMS - Database Management Software

KMA - Kumasi Metropolitan Assembly

LAN - Local Area Network

MCM - Management Control Maintenance

WMD - Waste Management Department

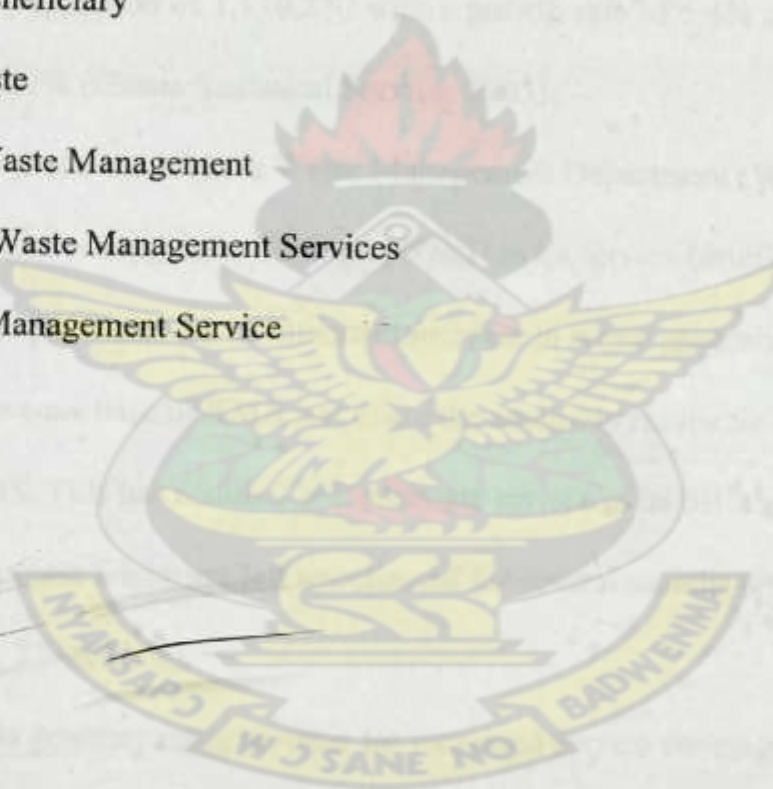
SB - Service Beneficiary

SW - Solid Waste

SWM - Solid Waste Management

SWMS - Solid Waste Management Services

WMS - Waste Management Service





## Chapter One

### Introduction

The Kumasi Metropolitan Assembly (KMA) is one of the ten highest political authorities in Ghana charged with the responsibility of running the affairs of the Kumasi city. Kumasi is the second largest city and located at the central part of Ghana. It covers a total surface area of about 254 sqKm. According to 2000 population census, the city has a minimum population of 1,170,270 with a growth rate of 5.4% as compared to the national rate of 2.7% (Ghana Statistical Service, 2005).

Over the years, the KMA's Waste Management Department (WMD) has been rendering free waste management services (WMS) to its service beneficiaries (SB's). The increase in population with its attendant increase in waste generation coupled with the dwindling revenue base of KMA has made the assembly incapable of meeting the high cost of WMS. This has resulted in inadequate service to its SB's in the city leading to mountains of refuse which are left uncollected for several months (Personal Communication, 27/08/2008).

In order to generate more revenue for increased service coverage, the KMA has decided to introduce a City-wide Waste Collection Levy scheme where beneficiaries of its services are expected to pay a levy depending upon the types of WMS they enjoy.

Under the programme, the Kumasi Metropolis has been divided into ten zones with variable housing characteristics. Each zone is supposed to have a separate comprehensive register to facilitate WMS delivery and the collection of the levy from the SB's by authorized private WMS providers. However, the effective implementation of this policy requires a reliable computerized Information System which has not been in existence over the years.



The design and the development of an automated system is a solution to addressing this problem. With the proposed system in place, the policy implementation will be more effective and efficient as most of the managerial tasks shall be handled electronically. It is hoped that the project will support KMA objectives of generating more revenue for increased service coverage in the city.

### 1.1 Problem Definition

In the past, the people of Kumasi city have been enjoying free waste management services at the expense of the central government through KMA. The increase in waste generation as a result of rapid population growth has raised the cost of waste management services to the extent that central government budget allocation alone cannot fund the service cost. This resulted in inadequate service delivery leading to mountains of refuse which are left uncollected. To address this problem, the assembly introduced a city-wide waste collection levy program where every household is expected to pay a levy for the wastes the house holds generate. The program is expected to generate revenue to support the central government budget allocation for increased service coverage and qualitative service delivery.

To implement the program, the city shall be divided into a number of zones; each zone into communities and each community into sub-areas or major locations where the houses will be identified. At the end, a comprehensive database system is needed to manage data on these houses for effective, efficient and easy implementation of the program. This database system is not in place leading to a delay in a full scale implementation of the program across the city.



There is therefore the need to have an automated revenue management system to facilitate the implementation of the new City-wide Waste Management Levy policy of KMA. Data to be captured from the zones are independent of the zones. So, one zone will be used as a case study to gather data on the zone's variable housing characteristics. The data will be fed into the system to generate a register for the private WMS to do effective service delivery and levy collection.

## **1.2 Research Objective and Research Questions**

### **Objective**

The objective of this project is to design and develop an automated revenue management Information System for the WMD of KMA.

### **Research questions**

1. Can the managerial processes in the city-wide waste management levy policy implementation be automated?
  - a. What kind of ICT infrastructure is required?
  - b. Who and how the proposed automated system can be managed?
2. What are the benefits to be derived if the proposed system is implemented?

## **1.3 Project Justification**

The main aim of this project is to ease the implementation of the City-wide waste management levy policy. This could be achieved through the development of an automated system to support the policy implementation.

At the moment, such system is not in existence for city authority to start the implementation of the policy. Looking at the register each zone is supposed to have and

the huge amount of data to be gathered on all houses or buildings or property in the city; and each building with its distinct characteristics, it is simply impossible for them to manage the data manually.

Also, it is expected that the WMD handles this policy implementation with its staff who are already engaged in their normal job descriptions. So, without any automated system in place to support them, it is will be difficult for the policy to be implemented in a full scale and the resulting effect is that the city shall continue to accommodate mountains of refuse which are detrimental to the city dwellers' health.

In Ghana, there are ten regions and each region has a capital city managed by metropolitan assemblies. Each of the metropolitan assemblies has waste management division which is capable of implementing the same policy. This means that the project can be replicated in all the assemblies.

#### **1.4 Research Methodology**

To model the development lifecycle of the project, Waterfall model shall be used. The model is designed to be used on large scale projects. The model begins with what is to be done and how it can be done. This is followed by a step that actually does the project. After that a test is conducted to find out whether user requirements have been satisfied (Bahrami, 1999).

According to Bahrami (1999), the waterfall model is the best way to manage a project that is well understood. The model assumes that the proposed system's requirements are known before its design begins. Also, the requirements should remain unchanged over the development cycle so that the whole project meets delivery-time or dead line.



Therefore, waterfall model shall be used to model the lifecycle of the research project since requirements for the proposed system, as shall be stated later, are known and shall remain unchanged over the period of the research. Also, the project is constrained by time as the author is expected to complete by 20<sup>Th</sup> July, 2009.

The waterfall model illustrated in Figure 1.4.1 shall be used to provide a structure in which the system will be designed.

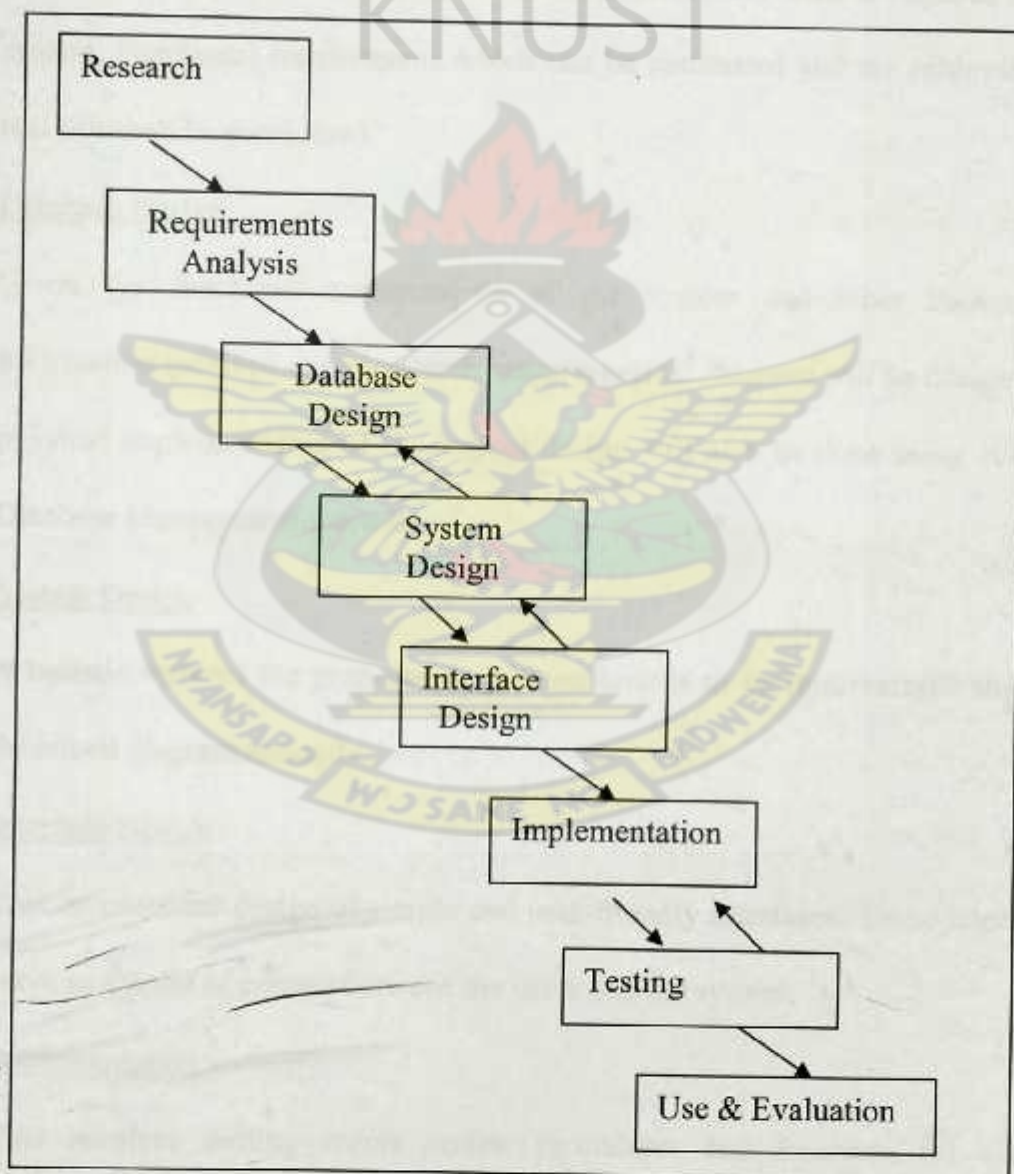


Figure-1.4.1—Waterfall Model

- Research

An interview shall be conducted to understand the Waste management levy policy and its implementation. Also, Secondary data and other interviews shall be conducted to gather more information for better understanding of the scope of the research project.

- Requirement Analysis

Problem analysis shall be conducted to fully understand what is required of the system. Functional requirements which can be automated and are achievable in real life shall be considered.

- Database Design

Given the functional requirements of the system and other background information gathered at the research stage, a logical database will be designed. A physical implementation of the logical design will also be done using suitable Database Management software.

- System Design

A holistic view of the proposed system on how is to be implemented shall be described diagrammatically.

- Interface Design

This involves the design of simple and user-friendly interfaces. These interfaces serve as a point of contact between the users and the system.

- Implementation

This involves writing secure codes, procedures and functions for correct implementation of algorithm needed for the system's functionalities.



- Testing

After the implementation, a test on the system will be conducted to ensure that the system is adequately freed of errors. The system will also be tested to ensure that it functions as expected.

- Use and Evaluation

The system shall be installed for use to find out whether its expected functionalities are met.

### **1.5 Outline of the document**

Chapter 1 gives an introduction of the research project including the problem definition, research questions, research objectives, research project justification and the methodology of the research. Chapter 2 discusses the sources and the composition of solid waste; and funding of solid waste management services. It also explains the city-wide waste collection levy policy of KMA, the existing systems and other works related to this research project. Chapter 3 describes the processes of waste management department of KMA and examines the possibilities of automating activities of the processes. Chapter 4 describes the design of the new system where process modelling was used in modelling the processes to be automated. The functional and non-functional requirements of the new system as well as designs of the database backend and system interfaces were discussed. Chapter 5 examines the implementation of the designs in chapter 4. Chapter 6 evaluates the newly developed system, answers the research questions and presents directions for future developments.

## Chapter Two

### Literature Review

#### 2.1 Sources and Composition of solid wastes

Generally, waste represents an enormous loss of resources which are in the form of material and energy. Quantities of waste can be seen as an indicator of a society's efficient resource utilization (Pongracz, 2002).

The characteristics and the composition of solid wastes differ according to the source from which they are generated (Tchobanoglous et al. 1993 cited in Armijo de Vega 2002). It is in line with this assertion that Hofny-Collins (2006) classified solid wastes broadly in terms of their generating sources. The classifications are as follows:

1. Domestic waste:

It is waste generated as a result of household activities. This typically consists of left-overs from food preparation, sweepings, fuel burning, garden waste, and discarded items such as old clothing, furniture, packaging, newsprint.

2. Commercial Waste:

Refers to waste from shops, offices, kiosks, restaurants and markets. This typically consists of packaging material, food waste and street sweepings. The composition of this waste does not differ much from domestic waste except that the paper and plastic content is higher. The market waste has a high proportion of organic material.

3. Industrial waste

This is waste comes from establishments such as government buildings, schools, hospitals, military bases and religious buildings. Generally, the composition is similar to that of commercial establishments except that it can also contain



hazardous wastes. Some hospital wastes in particular are of this nature. Wastes from hospitals and laboratories that can contain dangerous pathogens (e.g. human parts, cotton wool, syringe etc.) are disposed of on site by burial or incineration

#### 4. Industrial Solid waste

This waste is generated from industries. The industrial activities determine the composition and the volume or quantity of this waste. It may be waste from breweries, sawmills, mining, construction, and food processing. A greater proportion of the waste is similar to the waste generated by the commercial sector, involving organic waste, plastic, metal and paper items. Some industrial wastes arise from chemical processes and mechanical operations and fall into the category of hazardous waste.

### 2.2 Funding Solid Waste Management

Presently, waste management in the Kumasi metropolis is funded by the central government. The government funds are increasingly becoming inadequate in servicing the cost of waste management services. This is due to the increase in solid waste generation caused by increase in population growth and high rates of migration from rural areas to the city. The World Bank Country Director, Isaac Divan, advised the local government authority to adopt “pollutant pays” principle to help reduce the burden of government for bearing the full cost of sanitation ([www.ghanaweb.com](http://www.ghanaweb.com), 27<sup>th</sup> March, 2009).

The average monthly service cost of solid waste management in Kumasi city which covers both collections and disposal was about GH¢720,000. This figure far

exceeds the assembly's budget dependent on the government. As a result of this coupled with irregular release of funds by the government, the assembly has accumulated debts to waste collection contractors making waste management service delivery unsustainable in the city. ([www.ghanaweb.com](http://www.ghanaweb.com), 10<sup>th</sup> March, 2009).

In an attempt to create a sustainable Waste Management System, the KMA introduced a partial cost recovery system known as the Kumasi City-wide Solid Waste Management Levy Scheme, which involves the collection of subsidized user fees from Service beneficiaries. According to solid waste manager at WMD, the scheme charges 30% of the amount needed to manage the waste in the Kumasi. This research project aims at developing a computerized revenue management system to ease the full scale implementation of the scheme.

As part of the scheme, the KMA introduced "pay-as-you-dump" waste management service. With this arrangement, service beneficiaries are made to pay an amount of 10 Ghana pesewas before dumping at communal refuse transfer stations. The "pay-as-you dump" service has improved sanitation condition in selected communities in which it is being piloted; and is expected to recover 50% of service cost (TV3 Afternoon news, 29/3/2009). The scheme is expected to do well because the residents of Kumasi are willing to contribute financially to a privatized system of service delivery provided they will receive quality services (Post, 1999).

### **2.3 City-Wide Waste Collection Levy Scheme**

Solid waste management is quite an enormous task which requires adequate technical and financial resources to accomplish satisfactorily. Unfortunately, the city authority is constrained by financial resources leading to limited service coverage and



general poor record of service delivery. Central government bears the full cost of sanitation and her budget or funds are gradually losing ground to the high cost of waste management services.

In order to generate more revenue to support increased service coverage, the KMA decided to introduce a City-wide Management levy which requires service beneficiaries (house hold) to pay a small and affordable fee to the city authority for the waste they generate. Under the program, the city is divided into ten zones with variable housing characteristics. Each zone is to have a separate register to facilitate a discreet franchise package for private sector service delivery and incremental cost recovery. In each zone, communities and sub-areas within each community are identified and classified as first, second and third classes. This will aid the program implementers to determine the most suitable type of service to render to a specific community. Three types of services will be rendered and are listed as follows: door-to-door, communal service and improved communal service.

Door-to-door Collection will take place at areas where the condition of road network is relatively better to facilitate movement by collection vehicles. Communal Collection system will be offered in areas where accessibility is a problem. In these areas there is limited access to the collection points due to poor condition of road network. Improved Communal collection system shall involve the use of smaller communal containers (between  $1\text{m}^3$  and  $2\text{m}^3$  capacity) located at closer walking distances (up to 50m) for beneficiaries to access. It will take place in areas where the condition of the road network is fair enough to provide reasonable access to the collection points.

A city wide housing data collection is undertaken. The housing data will facilitate the preparation of Zonal Register for each of the ten zones. Each register will identify the houses under the three categories of service i.e. door-to-door, communal and improved communal. From this, the potential revenue from each zone shall be established and matched against the service cost which will then facilitate the determination of subsidy required under each zone.

The service beneficiaries (house hold) shall pay different amount as fees depending upon the type of service they receive and the class of the community in which they find themselves. The beneficiaries shall pay monthly fees to the service providers who in turn report back to the KMA through its WMD. Data to be managed under this program is huge and cannot be managed manually. There is the need for a database system to manage the data and also handle some managerial processes involved in the program implementation. Processes which have the possibility of being automated are those this research project aims at. Currently, such system is not in place and is hindering full scale implementation of the program.

#### **2.4 Presentation of The existing system**

KMA like any other institution uses computer systems to process data into information for use. Almost all of the computers are using Window based operating systems since users of the computers are highly inclined to the Microsoft products. Word processing is done using Microsoft word, excel, power point, access, etc which are all part of the Microsoft office package. There are also disparate Local Area Networks in some of the department including Accounts, Waste management and IT departments. The LAN's are not connected together to form one big network.



There are two main application systems in KMA: Accounting and Property Rate systems. The accounting system being used is named as Data Flow Accounting System (DFAS) which was developed by Heinz Integrated Systems in 2005. The main purpose behind the use of this system is to manage daily accounting transactions within KMA and to generate accounting reports like trial balance, final accounts and other account related reports.

Before the adoption of the DFAS application, a Disk Operating System (DOS) based accounting system (DB Flex) was used. DB Flex system was developed by Ananse Systems. It was used for some time after which it paved way for the DFAS system. The management switched to the new system after they were convinced that the old system was no longer reliable due to the persistent and increased problems it posed to the users. The DFAS system is used by the accounts department.

Property Rate System is a system KMA uses to manage property rate which is one of its major sources of revenue. The system was also developed by Heinz Integrated Systems in 2007. The landed property owners in the Kumasi city pay annual fee to the city authority after receiving a bill with the stated amount. The system issues the bills, manages the payments made by the property owners and generates required reports to the authority.

Taxi Licensing System is another program used to manage database of all taxis operating in the Kumasi city. The Taxi system was developed by SAG's Systems in 2008.

All the application systems mentioned above are window based and are running at the head office of the KMA. The front and backend of the systems are Microsoft

Visual basic 6.0 and Microsoft SQL server respectively. The three companies which developed the application systems are all based in Ghana.

At the Waste Management department, there is no single application program developed to meet any specific needs within the department. For instance, lack of such system has hindered full scale implementation of the City-wide waste Collection levy scheme. Absence of an application system to support the scheme has created a gap which this research project seeks to fill. There are a number of computer systems for word processing. Microsoft word, excel and power point are the most used. Initially, management of the department thought of using Microsoft excel to support the scheme in order to get their required reports. Later, through the advice of an Information Technology specialist it became clearer to the management that MS Excel is not flexible enough to play that supportive role to the scheme. This explains how this research project began.

## **2.5 Related Works and Justification for the project**

### **Related works**

Teemu, Jari, Harri and Olli (2005) developed a computerized vehicle routing software to optimize vehicle routes and schedules for the collection of municipal solid waste across a defined road network. Their work was a case study in two regions of Eastern Finland which showed a remarkable cost reduction compared to the situation when the design of collection routes was done manually.

ORWARE is another tool for waste management. ORWARE is a model which stands for ORganic WASTE REsearch. It is a computer-based model developed by four different research institutions in Sweden. The model was developed for calculation of



substance flow, environmental impacts and the cost of waste management. It consists of a number of separate sub-models which can be combined to design a waste management system. Each sub-model can be described as a real life process in waste management as in waste collection, transport, disposal or incineration.

Udo-Inyang and Arsankan (2002) created a database application to help building contractors to decide on a disposal method with least cost for construction and demolition (C&D) wastes. The application system calculates and compares all cost components involved in each of the disposal methods of C&D wastes to determine the one with minimum cost. Sending C&D wastes for recycling and to a landfill or transfer station are the disposal methods they considered.

Mufeed (2007) conducted a study to analyze the Municipal Solid Waste Management (MSWM) activities in Delhi city of India. Mufeed investigated the current problems and proposed guidelines to improve the MSWM system. As part of the study, a computer program was developed to handle, update and organize a large amount of data pertaining to MSWM. A computer model was also used to predict MSW generation, collection, disposal, recycled and treated capacities, electricity generated from MSW and the fund required for MSWM in Delhi.

Chang and Wang (1996) developed an innovative Decision Support System tool in their study. It is a problem-structuring tool for the management planning of solid waste collection, recycling and incineration systems. The tool has powerful inbuilt modules which constitute essential functions of integrating the various systems in waste management planning.

Kgathi and Bolaane (2001) in their paper "Instruments for sustainable solid waste management in Botswana" identified regulatory measures, environmental



education, and economic instruments of property rates, service levy, and sanitation fees; as the current instruments of Botswana's solid waste management. However, the paper argued that the instruments are not environmentally protective enough and therefore suggested alternative ones such as solid waste collection and disposal levies, deposit refund schemes and product levies.

Reschovsky and Stone (1994) investigated the use of market incentives to encourage household waste recycling. They examined how quantity-based pricing of waste disposal affects household recycling behaviour when used by itself or in conjunction with curbside pickup of recyclables or mandatory recycling laws. The study showed that curbside pickup had the greatest effect on reported recycling behaviour even though higher waste-disposal prices might alter the finding.

Tadessea, Ruijsb and Hagose (2008) conducted a survey of households in Makelle city of Northern Ethiopia to determine the factors that affect household waste disposal decision making. The factors were determined after analyzing data from the household survey. The result of the survey showed that demographic features such as age, education and household size had an insignificant impact over the choice of alternative waste disposal means, whereas the supply of waste facilities significantly affects waste disposal choice. Also, inadequate supply of waste containers and longer distance to these containers increase the probability of waste dumping in open areas and roadsides relative to the use of communal containers. Higher household income decreases the probability of using open areas and roadsides as waste destinations relative to communal containers.



## Justification for the project

There are several studies conducted on the solid waste regarding its minimization, generation, recycling, disposal, effective planning and management, cost of management and its environmental impact. There are also computer applications on the subjects to provide solutions to the solid waste related problems.

However, the studies conducted and the applications developed previously are not directly linked to how revenue should be generated from the people based on the type of waste management services they are provided. Also, the context within which the previous applications were created might not suit the context within which KMA wants its new policy on Waste collection levy scheme to be implemented. It is therefore the objective of this project to develop a database application system to support adequately the policy implementation of KMA.



## Chapter Three

### Processes of Waste Management Department

The WMD carries out a number of activities or tasks which are related to one another and collectively aim at achieving a common goal of the department and the KMA at large. The activities were identified through interviews and observations. The activities can be grouped into processes. Each process has inputs, outputs, activities or functions, actors or performers of the functions and links to other processes. The inputs and outputs of the processes describe the exchange of information or data between two processes since an output of a process can be an input of another and vice versa.

#### 3.1 Process Description

The following are the six processes identified in the department:

Administrative, Record Keeping, Revenue Generation, Outsourcing, Maintenance and Public Education and feed back processes.

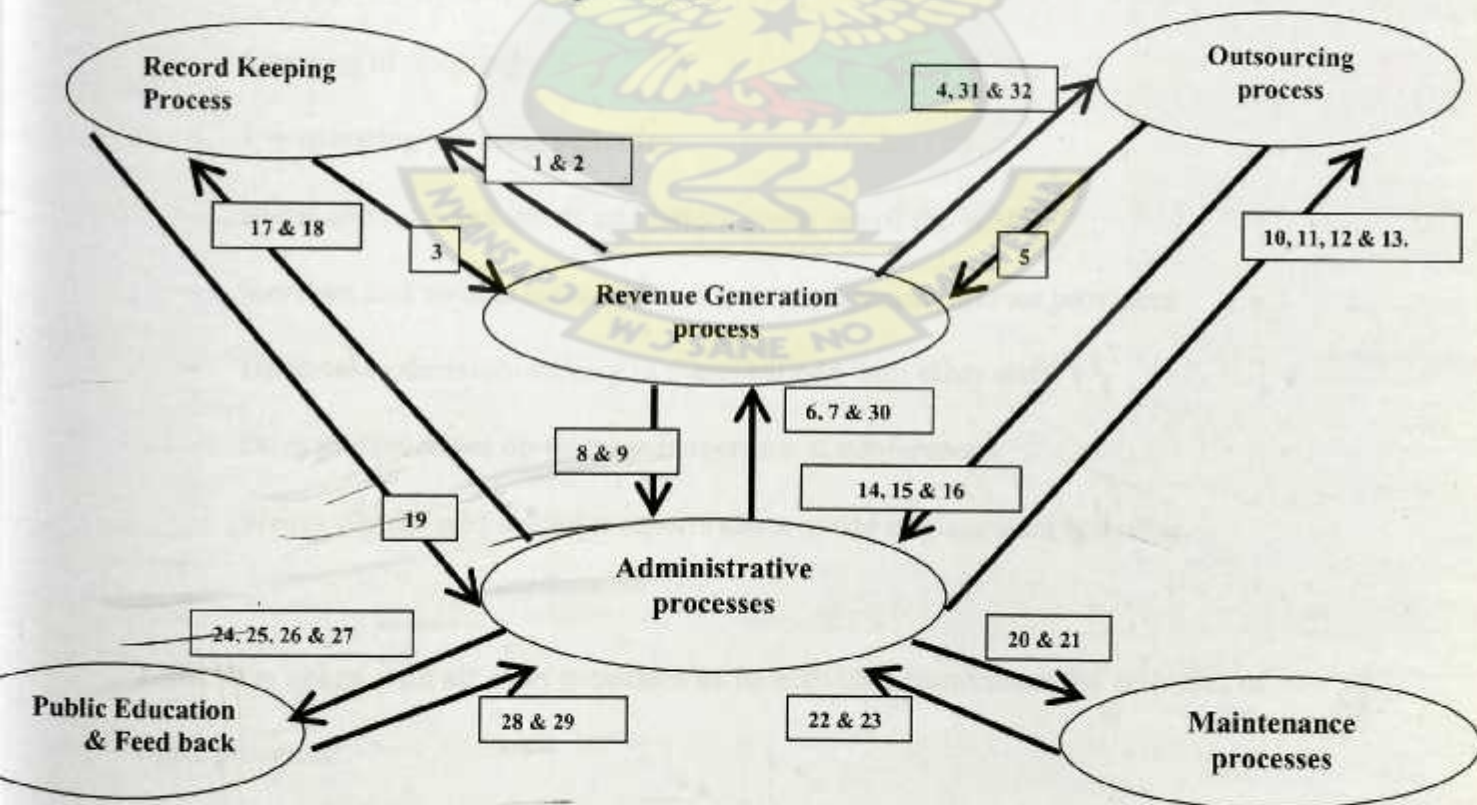


Figure 3.1.1: - Processes of waste management department and their links



### **Administrative process**

It consists of day-to-day activities to ensure the smooth running of the department as a unit within the KMA. These activities are mostly coordinated by the director of the department. The activities include the following:

- meetings
- planning
- signing of document
- review and award of contracts to other waste management service providers
- Decision-making
- Presentations about waste management at conferences.
- Writing of reports

**Actor:** Director

Director is responsible for the following:

- Chairing of meetings
- Coordinating planning activities
- Signs contract documents and letters going out of the WMD
- Reviews and awards contracts to waste management service providers
- Undertakes decision-making in consultations with other staff
- Does presentations on waste management at conferences
- Writes regular and irregular reports about waste management activities.

**Link:** It is linked with all other processes as its activities coordinates the activities of other processes.

### **Inputs and their source processes.**

- ✦ 8 - Provision of progress or financial reports – Revenue Generation process
- ✦ 9 - Suggestions as to how to improve revenue mobilization – Revenue Generation process
- ✦ 14 - Information on the service providers – Outsourcing process
- ✦ 15 - Contract documents - Outsourcing process
- ✦ 16 - Feedback on monitoring and supervision of service providers – Outsourcing process.
- ✦ 22 - Irregular request for financial resources for purchasing of spare-parts and other tools – Maintenance process
- ✦ 23 - Provision of reports to the effect that faulty vehicles and equipments have been repaired – Maintenance process
- ✦ 28 - Report on public complaints about WM issues. – Public education & feedback process
- ✦ 29 - Report on public view on quality of service delivery – Public education & feedback process.
- ✦ 19 - Provision of Information or reports – Record Keeping process

### **Outputs and their destination processes.**

- ✦ 6 - Request for reports – Revenue Generation process.
- ✦ 7 - Presentation of approved fees with respect to the types of services to render – Revenue Generation process.
- ✦ 10 - Information on the expected capacity of private service providers – Outsourcing process



- ✦ 11 - Information on the expected services to render and other job descriptions – Outsourcing process.
- ✦ 12 - Inputs into contract agreements – Outsourcing process.
- ✦ 13 - Guidelines for monitoring of service providers – Outsourcing process.
- ✦ 20 - Request for recommendations pertaining purchases of vehicle and equipments – Maintenance process.
- ✦ 21 - Complaints of faults in vehicles and other equipments – Maintenance process.
- ✦ 24 - General public information about sanitation and WMS – Public Education and feed back process.
- ✦ 25 - Policies on sanitations and WMS – Public Education and feed back process.
- ✦ 26 - KMA byes – laws on sanitation – Public Education and feed back process.
- ✦ 27 - Information on general cleaning of the city and communal labour. – Public Education and feed back process.
- ✦ 17 - Information about what to record –Record Keeping process.
- ✦ 18 - Request for information. –Record Keeping process.
- ✦ 30 - Policy guidelines on Waste collection levy – Revenue generation process

### **Record keeping process**

This involves keeping of records for administrative purposes. They also keep records of houses and other property within the city. Most of these records are paper-based and are not in better format to avail any meaningful and comprehensive information for decision-making.

The process entails the following activities:

- Planning on how to get the data
- Sending men on the ground for data collection
- Capturing and Storing data
- Retrieval of data

**Actors:** Field staff, data entry clerk

Field Staff is responsible for the following:

- Plans to know the schedules and the amount of resources (labour, vehicle and money) needed to get the task of gathering data from the public successfully done.
- Going out to the public for interviews to get the required data

Data entry clerk is also responsible for the following:

- Captures to store data into excel
- Organizes and keeps the papers containing the data collected by field staff.
- Retrieves stored data for other reporting.

**Link:** Linked to administrative and revenue generation processes.

**Inputs** and their source processes:

- ✚ 17 - Information about what to record – Administrative process.
- ✚ 18 - Request for information – Administrative process.
- ✚ 1 - Records of payment by service beneficiaries – Revenue Generation process.
- ✚ 2 - Data on house stock – Revenue Generation process.

**Outputs** and their destination processes:

- ✚ 3 - Financial reports – Revenue Generation process.



- ✚ 19 - Provision of information or reports – Administrative process.

### **Internal Revenue Generation process**

It is a key process aimed at generating more funds from the public to augment the inadequate central government fund to support the core business of rendering waste management services to the people of Kumasi metropolis. It sensitizes the public about the need to support the department financially so that it can render quality waste management services to help eliminate mountains of refuse and filth engulfing the city.

#### **Activities:**

- a. Public sensitization for cooperation and involvement.
- b. City demarcation and taking proper records of house stock
- c. Indication of the types of WM Services to be rendered at each demarcated area.
- d. Specification of fees to be paid by the inhabitants of an area
- e. Monthly Billing
- f. Recording of fees paid
- g. Report Generation

**Actors:** Public relation officer, Field staff and Accountant

Public Relation officer:

- Sensitizes the public to cooperate and involve themselves in the waste management activities by paying their fees.

Field staff:

- demarcates the city and takes records of house stock
- Recommends and indicates the types of waste management services to be rendered at each demarcated area.

Accountant shall:

- Specify the fees to be paid by the inhabitants of a community based on the type of service they receive and the class of the community.
- Bill beneficiaries of the WMS
- Collect and record monies from the private service providers
- Prepare financial reports

**Link:** It is linked to the following: Administrative process, Record keeping process and **Outsourcing process.**

**Inputs and their source processes:**

- ✦ 3 - Financial reports – Record Keeping process.
- ✦ 5 - Submission of collected payment from service beneficiaries – Outsourcing process.
- ✦ 6 - Request for reports – Administrative process.
- ✦ 7 - Presentation of approved fees with respect to the types of services to render – Administrative process.
- ✦ 30 - Policy guidelines on Waste collection levy – Administrative process

**Outputs and their destination processes:**

- ✦ 1 - Records of payment by service beneficiaries – Record Keeping Process
- ✦ 2 - Data on house stock and demarcations– Record Keeping Process.
- ✦ 4 - Approved fees for the various types of services to be rendered – Outsourcing process.
- ✦ 8 - Provision of progress or financial reports – Administrative process.
- ✦ 9 - Suggestions as to how to improve revenue mobilization– Administrative Process.



- ✚ 31 - Service bills contained in zonal registers. – Outsourcing process
- ✚ 32 – Receipts of payments to service beneficiaries – Outsourcing process.

### **Outsourcing process**

Is a process that allows other private WM service providers to render their services to the public on behalf of the Waste Management Department. The department does not have adequate resources in terms of labour, vehicles and equipments to handle waste management alone within the fast growing city and its attendant increase in waste generation. Hence, the need for this process.

#### **Activities:**

- a. Identifying capable private waste management service providers
- b. Establishment of contracts with the private service providers
- c. Assigning them to specific demarcated areas to render services
- d. Collection of fees paid.
- e. Monitoring and controlling of the private service providers' work.

**Actors:** Director, Field staff and WM service providers.

#### **Director:**

- Identifies capable private service WM service providers for specific duties.
- Establishes contract with the private service providers in consultation with the field staff
- Responsible for the monitoring and controlling of the service provides' work.

**Field Staff:**

- Assigns service providers to specific demarcated areas to render services.

**Private Service providers:**

- Render services of waste collections and disposal
- Collect monies from their service beneficiaries as paid fees
- Record the collected amount of money in books
- Submit the monies and their records to the account staff

**Links:** Linked to Administrative process and Internal revenue generation process.

**Inputs and their source processes:**

- ✦ 4 - Approved fees for the various types of services to be rendered – Revenue Generation process.
- ✦ 10 - Information on the expected capacity of private service providers – Administrative process
- ✦ 11 - Information on the expected services to render and other job descriptions – Administrative process.
- ✦ 12 - Inputs into contract agreements – Administrative process.
- ✦ 13 - Guidelines for monitoring of service providers – Administrative process.
- ✦ 31 - Service bills contained in zonal registers. – Revenue Generation process
- ✦ 32 - Receipts of payments to service beneficiaries – Revenue Generation process.

**Outputs and their destination processes:**



- ✦ 5 - Submission of collected payment from service beneficiaries – Revenue Generation process.
- ✦ 14 - Information on the service providers – Administrative process
- ✦ 15 - Contract documents - Administrative process
- ✦ 16 - Feedback on monitoring and supervision of service providers – Administrative process.

### **Maintenance process**

Is a kind of daily activities carried out on the vehicles and the equipments of the KMA to ensure that they are in good shape for use. Reports of drivers and care takers of these equipments are considered in the maintenance process. The process also avails to the management some recommendations on the purchase of new vehicles and equipments.

#### **Activities:**

- a. Taking of drivers and care-takers' complains.
- b. Diagnosing of the problem
- c. Fixing the problem through repairs or component replacement
- d. Testing of the vehicle and equipment
- e. Recommendation for new purchases
- f. Giving technical advice on the use of vehicles and equipments

#### **Actors: Fitting staff**

- Takes reports on the faulty vehicles from the drivers
- Diagnosing and fixing of the problem
- Tests repaired vehicle

**Link:** Maintenance process is only linked to the administrative process

**Inputs and their source processes:**

- ✚ 20 - Request for recommendations pertaining purchases of vehicle and equipments – Administrative process.
- ✚ 21 - Complaints of faults in vehicles and other equipments – Administrative process.

**Outputs and their destination processes:**

- ✚ 22 - Irregular request for financial resources for purchasing of spare-parts and other tools – Administrative process.
- ✚ 23 - Provision of reports to the effect that faulty vehicles and equipments have been repaired – Administrative process.

**Public Education and feed back**

It educates the public on the activities of the Waste management department, through the media, and on the need to keep the city clean for good health. The process also affords the public the opportunity to give feedback to the management on the kind of services they receive. That is whether it is good, bad or they receive no services at all. Through this feedback aspect of the process, the public can give suggestions and ideas to the management for considerations.

**Activities:**

- a. Radio programs
- b. Impromptu responds to the FM stations about waste management
- c. TV programs



- d. Articles to the press
- e. Dissemination of information on communal labour
- f. Presentations at conferences
- g. Alerting service providers based on the received feed back.

**Actors:** Director, Public relation officer

Director:

- Presentations about waste management at conferences
- Alerting service providers on the concerns of their beneficiaries regarding waste collection and disposals.
- Giving impromptu responds to the FM stations about waste management.
- Writing of articles about waste management.

Public relation officer:

- Disseminates information on communal labour pertaining to general cleaning of the environment.
- Participates in radio and TV programs to discuss issues of waste management.

**Link:** Education and feedback process is also linked to the administrative process.

**Inputs** and their source processes:

- ✦ 24 - General public information about sanitation and WMS – Administrative process.
- ✦ 25 - Policies on sanitations and WMS – Administrative process.

✦ 26 - KMA byes – laws on sanitation – Administrative process.

✦ 27 - Information on general cleaning of the city and communal labour –  
Administrative process.

#### **Outputs and their destination processes:**

✦ 28 - Report on public complaints about WM issues. – Administrative process

✦ 29 - Report on public view on quality of service delivery – Administrative  
process.





### **3.2 Comments on the existing system**

A study carried out has revealed that KMA has three database applications which are running at Accounts and Information Technology departments.

However, the Waste Management Department cannot boast of one application system to support its waste management activities. Processes at the WMD have been manual and possess a number of disadvantages. These include inefficient process execution, inconsistent records, delay in searching for records and difficulty in presenting reports due to inconsistencies. Another disadvantage is the fact that the waste collection levy policy implementation was delayed as huge data involved in the implementation cannot be handled manually.

Even though the existing application systems are functioning without any problem, they cannot support the new policy direction of the city authorities pertaining to waste management. The functionalities of the application systems are not in any way linked to the waste management services to be able to specify fees to service beneficiaries depending upon the status of their communities and the type of services they receive. Community based solid waste estimation, provision of Zonal registers of variable housing characteristics, just to mention a few, are all lacking in the existing application systems. In short, there is no application program to support the scheme.

It is the objective of this study to present a database system to facilitate the implementation of the city-wide waste collection levy scheme.

### 3.3 Possibility of Processes automation

Six main processes have been identified at the Waste Management department of KMA and each of them is made up of a number of activities as explained above. The processes are as follows:

1. Administrative process
2. Record Keeping process
3. Internal Revenue Generation process
4. Outsourcing process
5. Maintenance process
6. Public Education and feed back process

It is realized that none of the processes can have all of its activities fully automated as they require some unpredictable human interventions and discretions which shall be very difficult to automate.

The activities of some of the processes can be automated whilst others cannot be automated. Activities of each of the processes are going to be examined to understand whether they can be automated or not.

#### **1. – Administrative process**

##### **a. meetings**

The director and the other staff of the department meet at certain known times to deliberate on issues relating to waste management, human resource affairs and any other matters that are of concern to them. This activity cannot be automated because it involves bringing out ideas which are discussed to get the best out of it.



Proceedings at the meetings are not structured for it to be automated.

This activity cannot be automated!

b. Planning

The WM department plans ahead of time what it wants to do within a year. Because it undertakes its activities as different projects headed by different persons or group of persons, the director coordinates their planning activities so as to come out with one big plan with their accompanying budgets for approval. So, the planning activity cannot be automated.

c. Signing of document

This activity cannot be automated because most of the documents which need to be signed are paper based. Even though, the paper can be scanned and signed electronically in some kind of web based application, the recipient of that signed document may not accept it as a genuine document since they do not trust it. This problem can also be attributed to the fact that the use of ICT in Ghana has not reached a level where an electronically signed document can be trusted. This activity cannot be automated!

d. review and award of contracts with other waste management service providers

The review and award of contracts cannot be automated. This is because in reviewing or awarding contracts, the two parties sit together and go through some documents. They discuss the document thoroughly, agree, disagree and even build consensus at certain portions of the documents which shall bind them. The department most often goes through these discussions with at least one service provider. The discussion is full of uncertainties; hence the activity cannot be automated.

e. Decision-making

This cannot be automated because decision-making involves a lot of unpredictable factors like reasoning and thinking of current situations and what is to be done; as well as taking into consideration inputs or pieces of advice from other persons. Even though there are decision support systems which help in making decisions, their outcomes (decisions) are so in binary form that they lack flexibilities due to the absence of exceptions leading to other alternatives as we do have in the case decisions coming from humans. This activity cannot be automated!

f. Writing of reports

Writing of reports cannot be automated. This is because the reports are not structured as computer generated reports. Most of



them are in the form progress reports of the various projects the department undertakes, annual reports, and other reports indicating some one's promotion or demotion, or reports highlighting theft cases or security concerns in the department, etc.

This activity cannot be automated!

From the above discussion, none of the activities of the *Administrative* process can be automated with ease without serious difficulties.

## **2 -- Record keeping process**

Activities:

### **a. Planning on how to get the data**

This activity is about how to plan time lines and organize a team of men to be sent to the ground with the needed resources for data collection. The activity cannot be automated since is about planning and organization of men which does not follow any logical sequence of steps for possible automation. The activity cannot be automated!

### **b. Sending men on the ground for data collection**

Sending a team of persons on the ground for data collection is a physical task which cannot be automated. This is because the team physically interacts with the public to create a good rapport for the questions they ask in order to get the right data are well

answered. Also, their physical observations aid them to get the data they want. The activity cannot be automated!

c. Capturing and Storing data

This activity can be automated since the data collected by the team of persons are more organized and structured. The activity can be automated!

d. Retrieval of data

Retrieval of data activity is taken after the capturing and storing data activity is done. Since the latter activity is logically organized and structured, it paves way for the former activity to be carried out. Therefore, retrieval of data can also be automated.

### **3 -- Internal Revenue Generation process**

Activities:

a. Public sensitization for cooperation and involvement.

This activity cannot be automated because is about one's ability or the skill to educate and convince the public to understand the need for them to support waste management activities with their monetary resources for sustainable cleaned environment for good health. In my opinion, it will be very difficult to automate human skills which are hidden in the inner self of the person. The activity cannot be automated!

b. City demarcation and taking proper records of house stock



Physical demarcation of the city cannot be automated. However, having in records that the city is demarcated into a number of zones and taking records of house stock within the zones can be automated. This means that the automation is only handling the logical aspect of the demarcation and not the physical aspect. The activity can be automated!

- c. Indication of the types of WM Services to be rendered at each demarcated area.

This activity can be automated because it is about having in records that a specific type of WM services is rendered at a logically demarcated area or community. The activity can be automated!

- d. Specification of fees to be paid by the inhabitants of an area

This activity seeks to specify a fee to a specific area or a community for service beneficiaries in that community to pay. The fee is determined by the type of the services rendered in that community and the class (1<sup>st</sup> class, 2<sup>nd</sup> class, etc) of the community. This activity is purely record based and can therefore be automated.

- e. ~~Monthly Billing~~

Is an activity which uses various fees specified at activity d (specification of fees) above to bill owners of the house stock every month for payment. The owner of a house or a building shall be

known in logical records. Therefore the activity can be automated since it is about updating existing logical records with fees.

f. Recording of fees paid

Is about recording the fees a service beneficiary has paid to the WM service providers in support of the waste management service in the Kumasi metropolis. This activity basically entails retrieving the record of a service beneficiary and indicating that he or she has fully or partially paid the fee they are expected to pay. Since the retrieval of record activity can be automated then the recording of fees activity can also be automated. The activity can be automated!

g. Report Generation

This activity is responsible for generating financial reports to know those who have or have not paid their fees, those who have made advanced payment and the expected amount from the public. This report emanates from recording fees and monthly billing activities which can be automated. Therefore, the report generation activity can also be automated.



#### 4 – Outsourcing process

##### Activities:

a. Identifying capable private waste management service providers

This activity seeks to identify private service providers with the required capacity to deliver quality services. The department advertises the job descriptions for private service providers to apply for them. The activity cannot be automated since it requires a skilled team of persons to evaluate all those service providers who apply in order to select the best among the lot. The activity cannot be automated!

b. Establishment of contracts with the private service providers

In this activity, service level agreement (SLA) is signed between the WMD and the service providers. In signing this agreement, a very specific role each party is expected to play is clearly stipulated without any ambiguities so that it can serve as a control on both parties. Writing of SLA requires a human skill which cannot be automated. Hence, the activity cannot be automated

c. Assigning contracted service providers to specific demarcated areas to render services.

Physically assigning or showing contracted service providers the specific communities within which they should operate cannot be automated. However, having in records that service provider A is assigned to a community X can be automated. Therefore, the

logical assignment of a service provider to a specific demarcated area can be automated. The activity can be automated!

d. Collection of fees paid

In this activity, the service providers physically collect monies from the service beneficiaries and record them as payment made. The service providers render services to the beneficiaries. This brings them closer to the beneficiaries and therefore better persons to collect payment on behalf of WMD. After taking the monies, they submit them to the WMD. This activity cannot be automated because the activity is more physical in nature.

e. Monitoring and controlling of the private service providers' work.

This activity ensures that the service providers provide the required waste management services to the beneficiaries. Their services are critically examined to ensure that it is inline with what has been clearly stated in the SLA. In a situation where quality of service is compromised, the attention of the service providers is drawn for them to improve upon it. However, if they fail to improve the quality of service the necessary actions are taken in accordance with what has been stated in SLA. This activity cannot be automated because it entails a lot of interpretations of situations and application of human discretions in resolution of issues. The activity cannot be automated!



## **5 – Maintenance process**

### **Activities:**

#### **a. Taking of drivers and care-takers' complains.**

The drivers and the care-takers of the vehicles and equipments report faults to the fitting staff in an informal way. That is they report faults by word of mouth. There is no written document of faults. The fitting staff, drivers and the care-takers prefer the informal way of reporting to the formal way since is fast and affords them the opportunity to fully understand the problem.

This activity can be automated. However, taking their preferences into consideration and the fact that reports on fault have to be typed in an automated system before they are read to understand the problem may be considered by users of the system as impediments. In the end, they will revert back to their informal way of reporting thereby rendering the system useless and unproductive. Therefore, in my opinion not automating this activity will be a good idea. The activity cannot be automated!

#### **b. Diagnosing of the problem**

This activity cannot be automated since fitting skill is required before a fault in a vehicle or equipment can be diagnosed. This skill cannot be automated. The activity cannot be automated!

#### **c. Fixing the problem through repairs or component replacement**

This activity cannot be automated because it requires some physical actions of loosening and tightening bolt and nuts, lifting of components, greasing of parts, etc.

The activity cannot be automated!

d. Testing of the vehicle and equipment

This activity cannot be automated since it entails physical actions of sparking the engine, driving and the like to ascertain whether reported fault has been fixed or not. The activity cannot be automated!

**6 -- Public Education and feed back process**

- Radio programs and TV programs are activities which cannot be automated. This is because radio and TV are existing media through which the WMD is invited to participate in the deliberation of issues pertaining to waste management issues. Also, radio and TV are not owned by WMD.

- Impromptu responds to the FM stations about waste management

Sometimes, FM stations call the director of waste management department for clarification of issue pertaining to waste to know how the department plans to resolve.

- Writing of articles to the press for publication, presentations at conferences, dissemination of information on communal labour and alerting service providers of the need to improve their services based on the feed back received from the public



are activities which cannot be automated the activities are about dissemination of information to the public. The activities under this process cannot be automated!

### **3.4. Summary on possibility of process automation**

The activities of all the identified processes were examined to understand whether they can be automated or not. Some of the activities cannot be automated because they are so physical in nature and require human interventions in terms of intelligence, discretions and reasoning. It is also realized that none of the activities of Administrative and Public Education and feedback processes can be automated. The activities of some of the processes which can be automated are listed as follows:

#### **1 - Record keeping process**

- a. Capturing and Storing data
- b. Retrieval of data

#### **2 - Internal Revenue Generation process**

- a. City demarcation and taking proper records of house stock
- b. Indication of the types of WM Services to be rendered at each demarcated area.
- c. Specification of fees to be paid by the inhabitants of an area
- d. Monthly Billing
- e. Recording of fees paid
- f. Report Generation

#### **3 - Outsourcing process**

- a. Assigning contracted service providers to specific demarcated areas to render services.

The following diagrams create a picture of activities and processes to be automated:

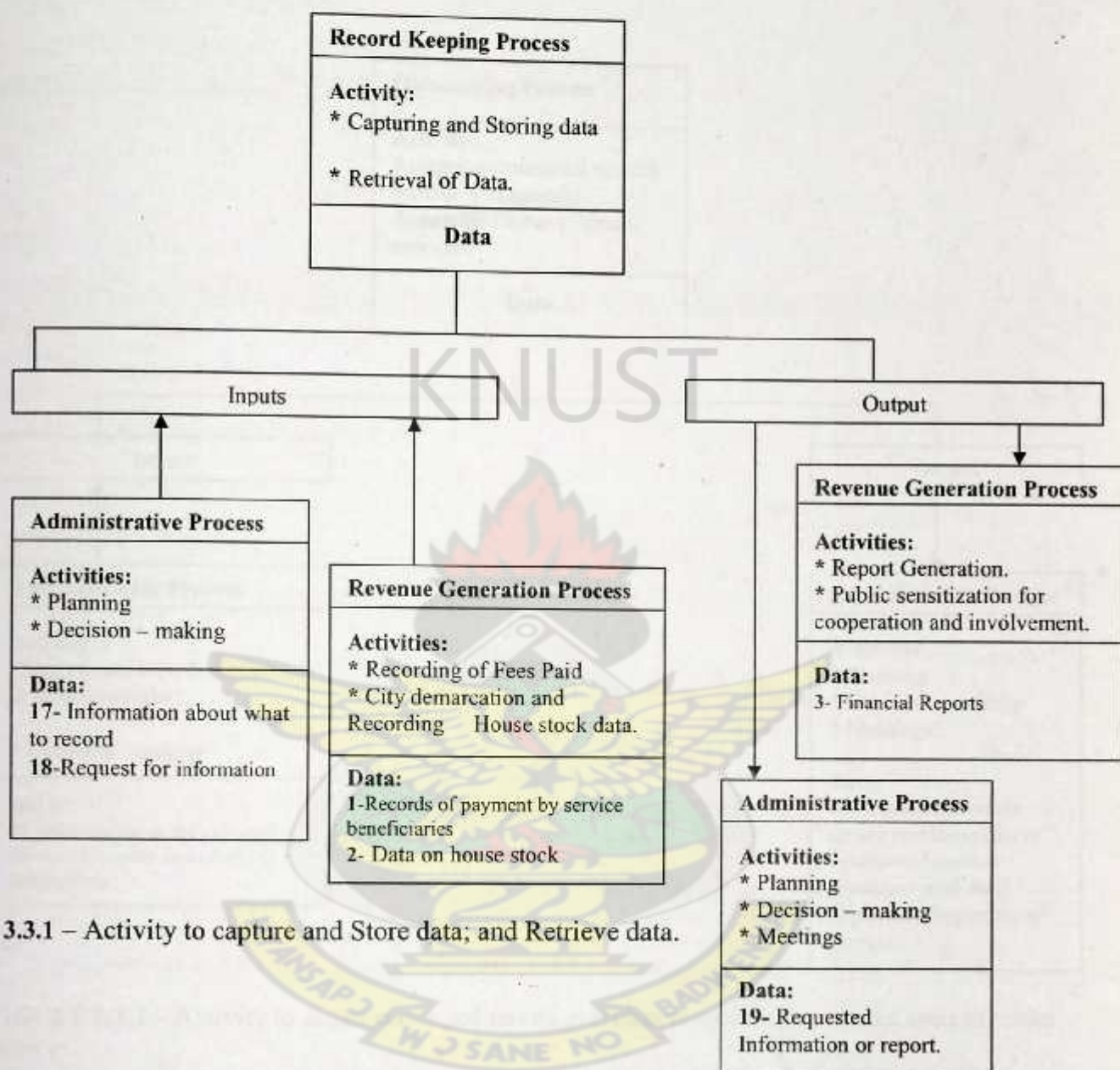
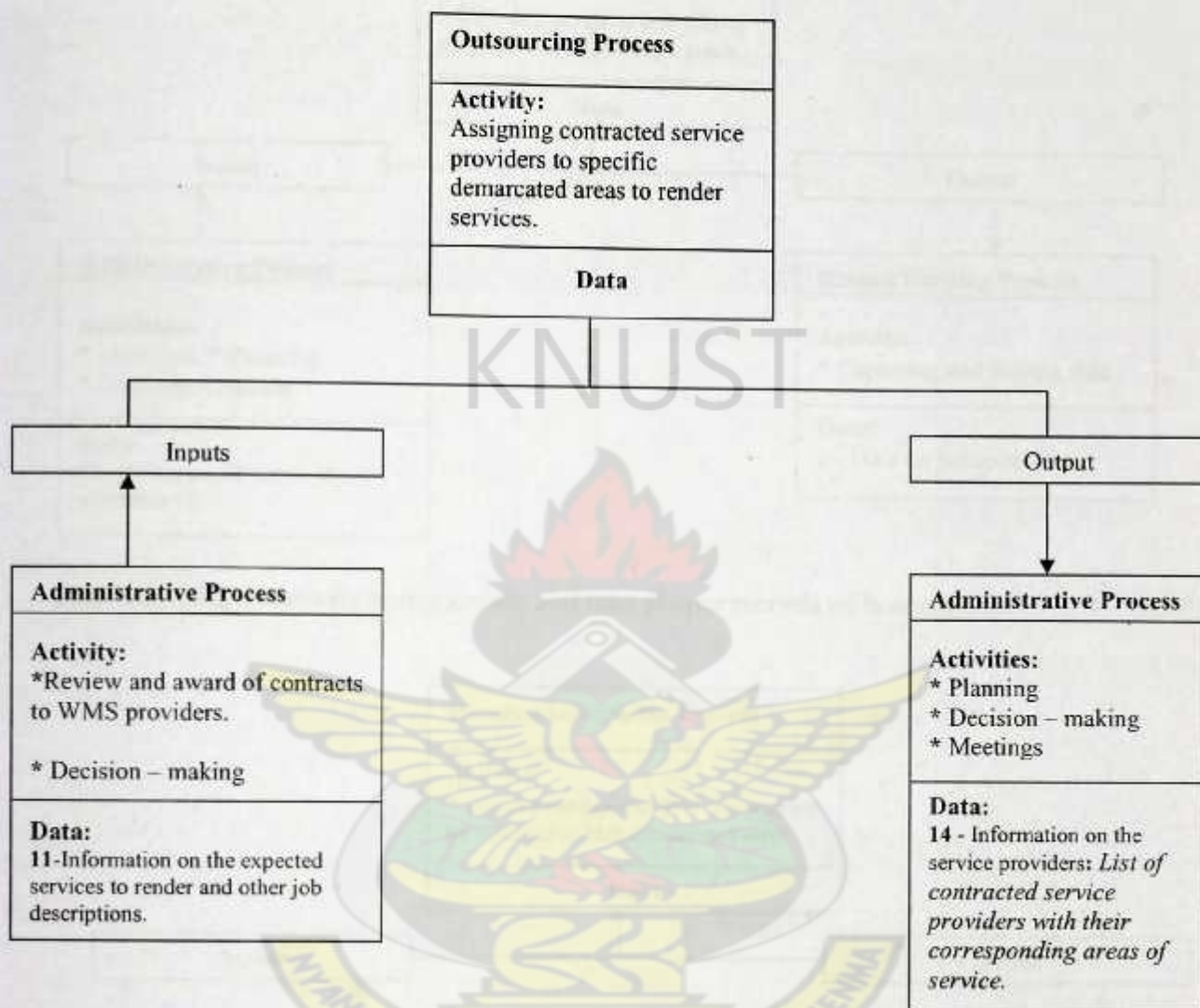


FIGURE 3.3.1 – Activity to capture and Store data; and Retrieve data.





**FIGURE 3.3.2** – Activity to assign contracted service providers to specific demarcated areas to render services.

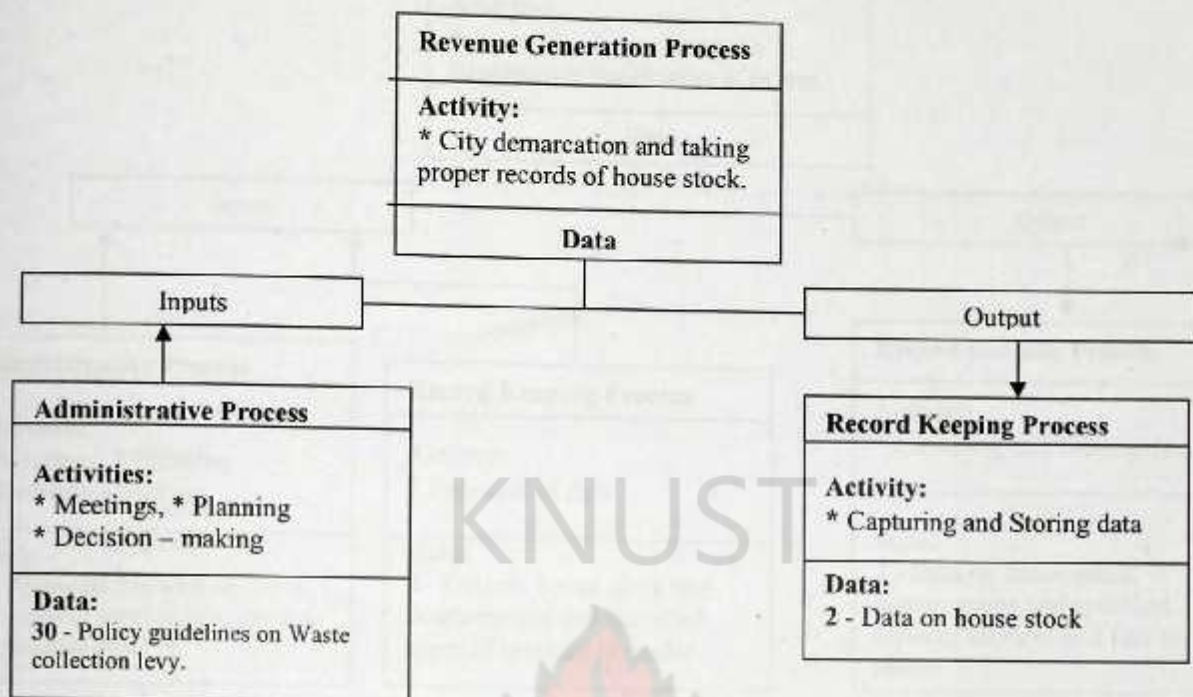


FIGURE 3.3.3 – Activity to demarcate and take proper records of house stock.

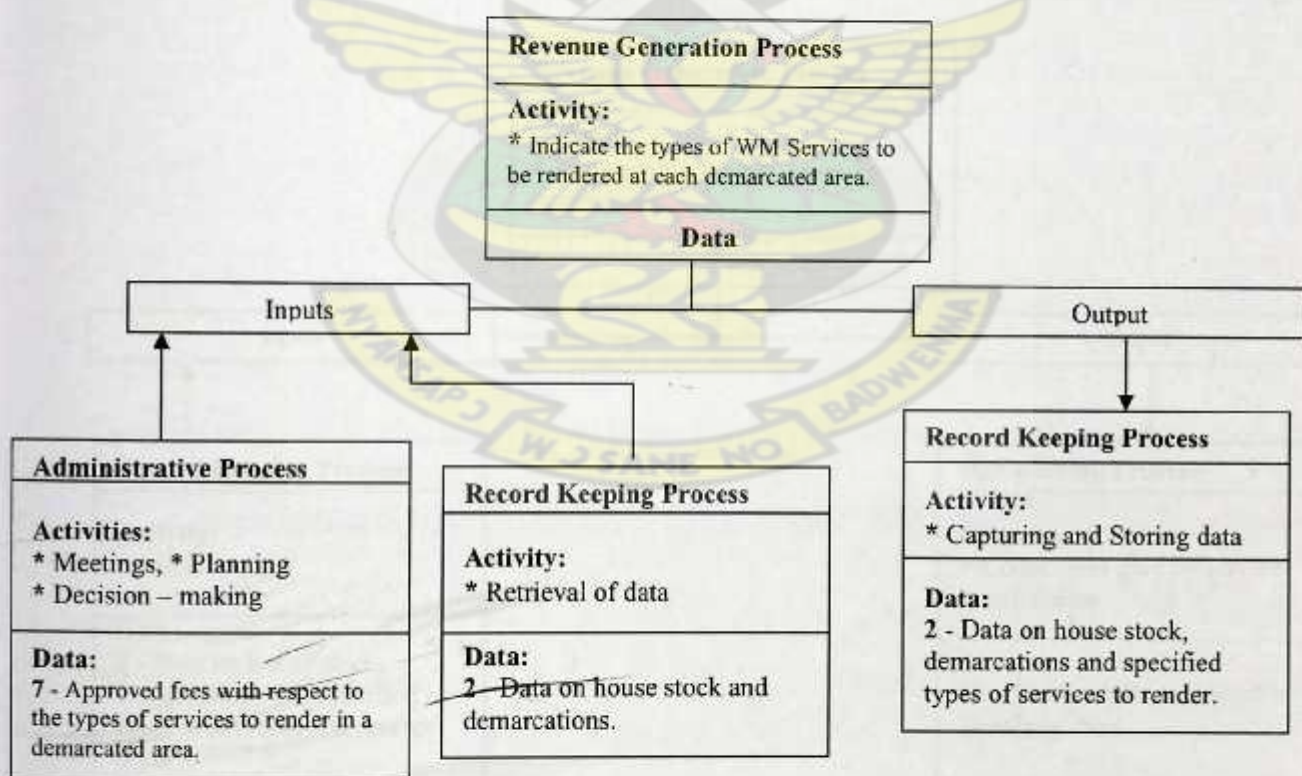


FIGURE 3.3.4 – Activity to indicate the types of WM Services to be rendered at each demarcated area.



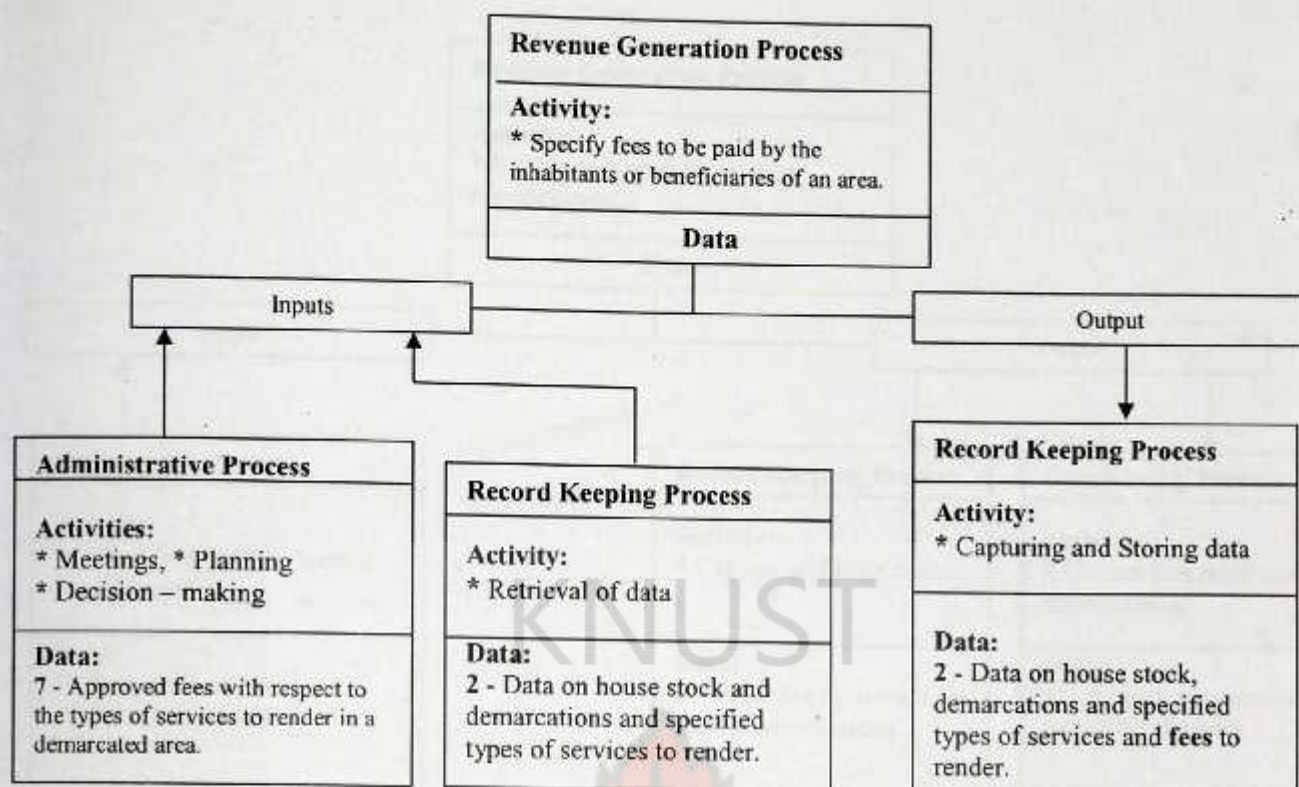


FIGURE 3.3.5 – Activity to specify fees to be paid by the inhabitants or beneficiaries of an area.

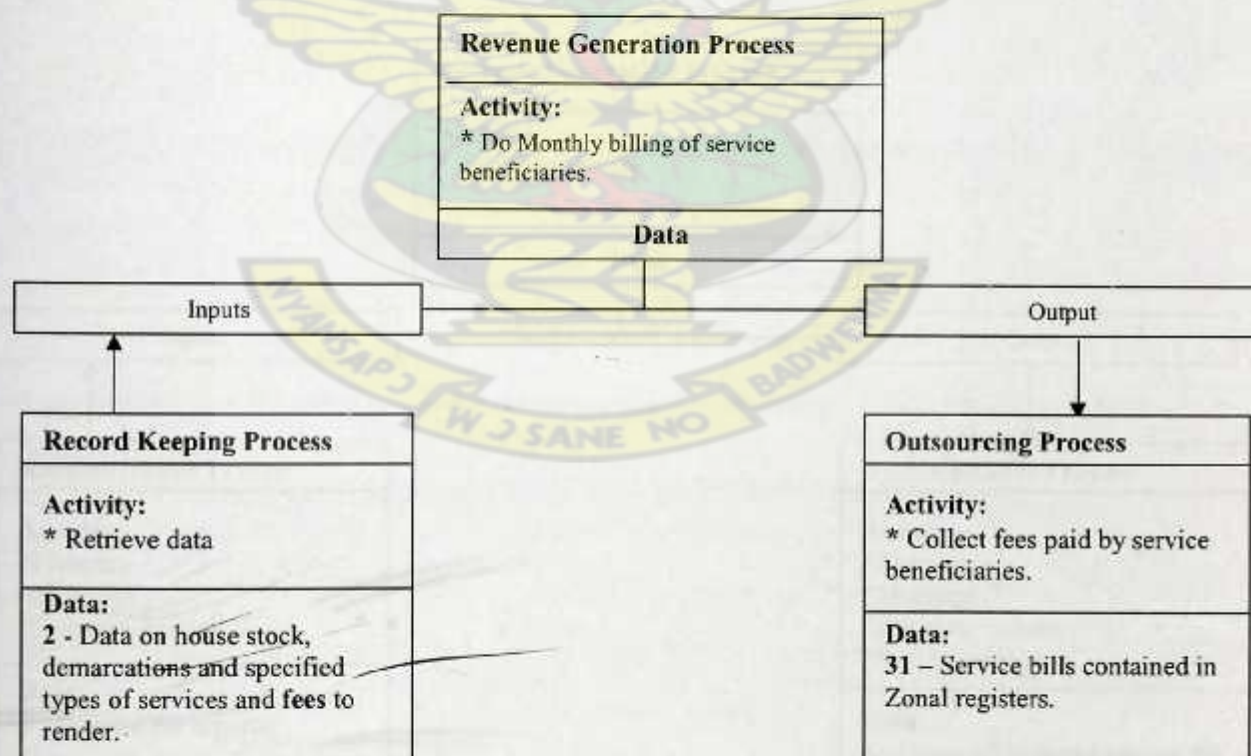


FIGURE 3.3.6 – Activity to bill service beneficiaries monthly.

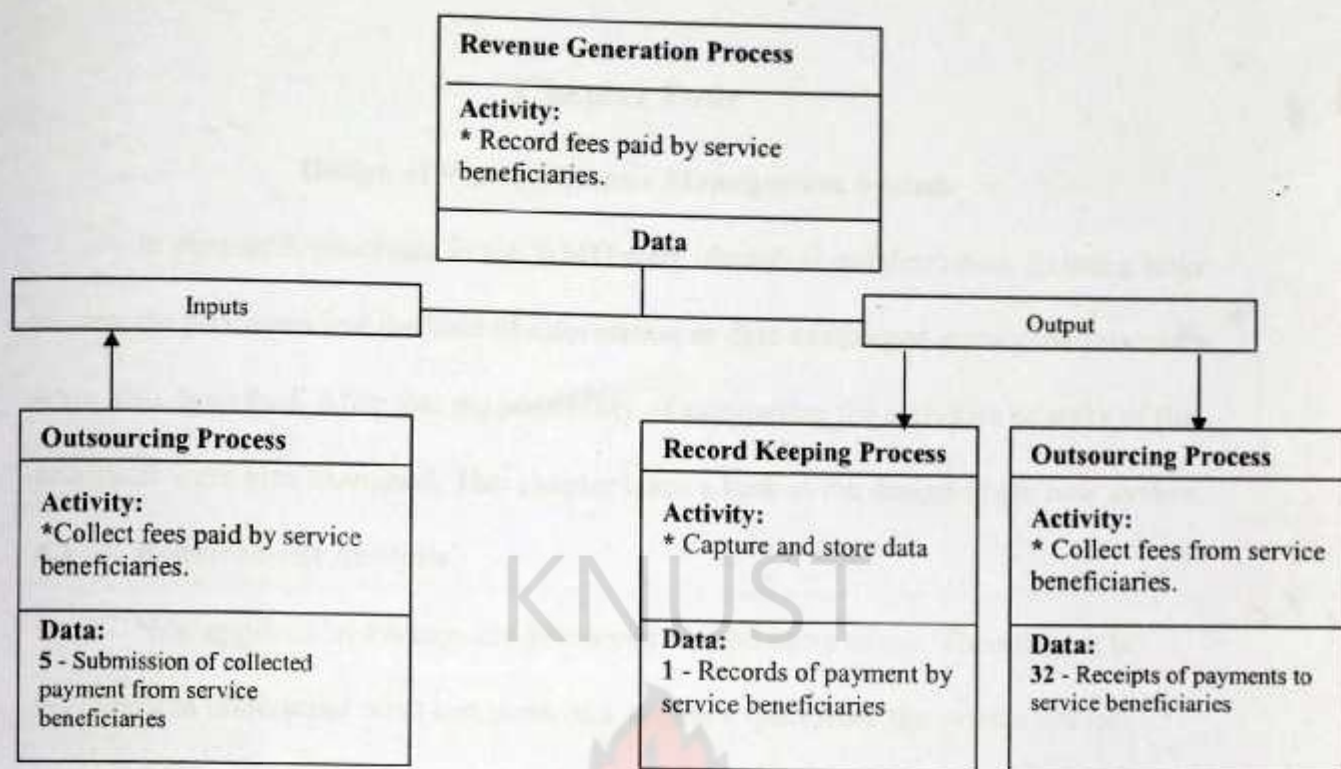


FIGURE 3.3.7 – Activity to record fees paid by service beneficiaries.

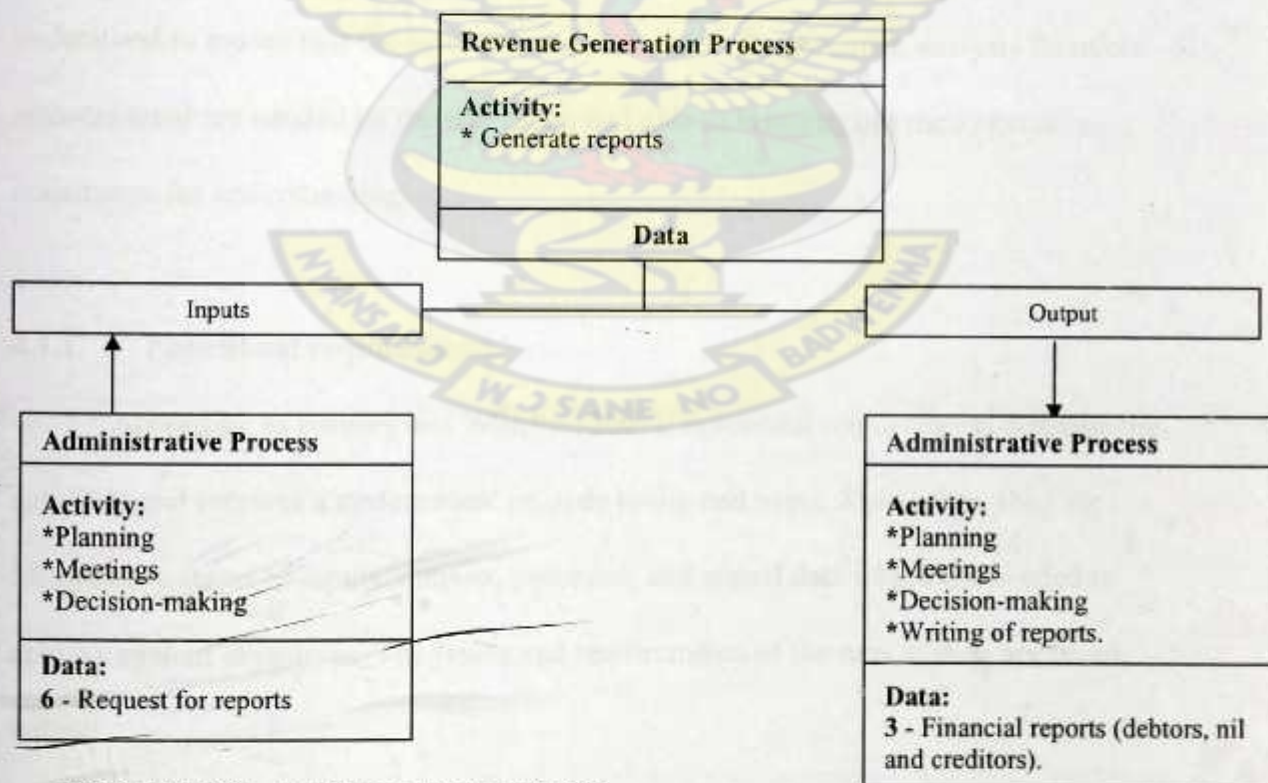


FIGURE 3.3.8 – Activity to generate reports.



## **Chapter Four**

### **Design of Waste Revenue Management System**

In chapter 3, processes in the WMD were identified and described. Existing links among the processes and the kind of information or data exchanged among the processes were also described. After that the possibility of automating the activities or tasks of the processes were also examined. This chapter takes a look at the design of the new system.

#### **4.1 Requirement Analysis**

New application systems are developed for end users to use. Therefore, it is necessary to understand what end users of a system expect from the system before looking at how it is to be developed. Overall attributes or qualities of a new system which create good atmosphere for the end user to achieve what they want should be examined. Constraints which are likely to affect the new system should also be understood to ensure that the new system meets them. Requirement analysis therefore answers what are needed by the end users; and aids in bringing out the systems' constraints for understanding.

##### **4.1.1 Functional requirements**

According to Bentley and Whitten (2007), functional requirements describe the activities and services a system must provide to the end users. Most often, they are identified in terms of inputs, outputs, processes and stored data which are needed to achieve system objectives. The functional requirements of the new system are listed below:

1. To create an unified database to keep information about the following:

- City demarcations (Zones, Communities and sub areas)
- Community classifications or ranks (1<sup>st</sup> class, 2<sup>nd</sup> Class , 3<sup>rd</sup> class, etc)
- House stock in the city.
- Waste management service types to be rendered.
- Payment types
- Contractors
- Dustbins
- Rate of solid waste generation in the city of Kumasi.

2. To allow WMD to specify fees to be paid by the beneficiaries depending upon the class of the community and the type of services to be enjoyed by the beneficiaries. Three WMS shall be rendered and are arranged in order of preference as follows: door-to-door, improved communal and communal services. The choice of a service is determined by the class of the community and how organized the community is. Communities shall be tagged as first, second and third class based upon how best they are organized in terms of their buildings' lay out and easy accessibilities of their road network. First class communities shall receive the most preferred type of service and eventually pay the highest fees. Second and third class communities shall enjoy the next services and pay relatively lower fees in that decreasing order. Therefore, the system should allow the WMD to specify different fees for different communities.

3. To allow monthly billing or update of beneficiaries' accounts with the specified fees. Under the "City-wide waste collection levy" scheme, each service



beneficiary's account shall be updated with the fees specified for the community in which they find themselves. This will help the WMD to figure out and penalize those who default payments for the waste management services they enjoy.

4. To capture payments (and to issue receipts) made by the people living in various communities.
5. To report on the total revenue expected from the beneficiaries, both in amount and in percentages, based on the fees specified for various communities.
6. To report beneficiaries who refuse to pay their fees even though they continue to enjoy services rendered by WMD.
7. To estimate total solid waste generated by the people in various communities to aid proper planning on solid waste collection. The product of the rate of waste generation and the population of a given community can give an estimate of the total waste generation for the community. The system shall be fed with an updatable rate of waste generation for the city which is about 0.6 kg/day/person. From the records captured and stored in the database of the system, an estimated total population of a given community can be computed by the sum of the integer values of *number of persons in the building* field. A simple product of the specified rate (0.6 kg/day/person) and the sum of the number of persons gives an estimate of how much solid waste a community can generate. At least, this functionality can help ~~WMD~~ to plan for the waste collection.
8. To provide a register of domestic houses, shops, schools and other property or buildings in the Kumasi metropolis.
9. To allow users to search for a house record or any other building's record.

#### 4.1.2 Non – functional requirements

Non - Functional requirements are requirements which are not directly concerned with the specific functions a system must provide. Most of them relate to a system as a whole rather than to individual features of the system. They describe the context of the system functionalities and the additional constraints that affect their execution (Schulz, 2002). They place restrictions on the system being developed, the process of its development, and specify external constraints that the system must meet (Kotonya & Sommerville, 1998). The non-functional requirements of the new system include the following:

1. To support multiple administrators and authorized users with different privilege levels.
2. The proposed system should be distributable over a network
3. The system should be user friendly and easy to learn
4. Inputs into the system should be adequately validated.
5. The system should be scalable and fast in execution.
6. The development constraints includes the following:
  - a. Difficulty in getting access to users for interviews and confirmations due to their tight schedules.
  - b. Difficulty in commuting between workplace and the project sites due to high traffic jam.
  - c. All project work must be completed by the 20<sup>th</sup> July, 2009.



#### **4.2 How the new system works**

The new system is designed to support the City-wide Waste collection levy scheme of KMA. The absence of computerized system to support the scheme drives the need for the development of this new system. The functionalities of the system are closely related to the way management of KMA expects the scheme to operate. This is how the new system works.

A user starts the system. The system starts after a user has been authenticated and other settings or constant values are loaded. City demarcations like zones, communities, sub-areas as well as other relevant characteristics of property or buildings are captured. Next, records on house stock in the city are also captured into the system. The different types of WMS and contractors are assigned to specific communities. The choice of service and contractors are determined by the rank of the communities. Different fees are specified to communities based on the types of services and the rank of the communities. After monthly billing, payments made by service beneficiaries are recorded after which required reports are printed for the management.

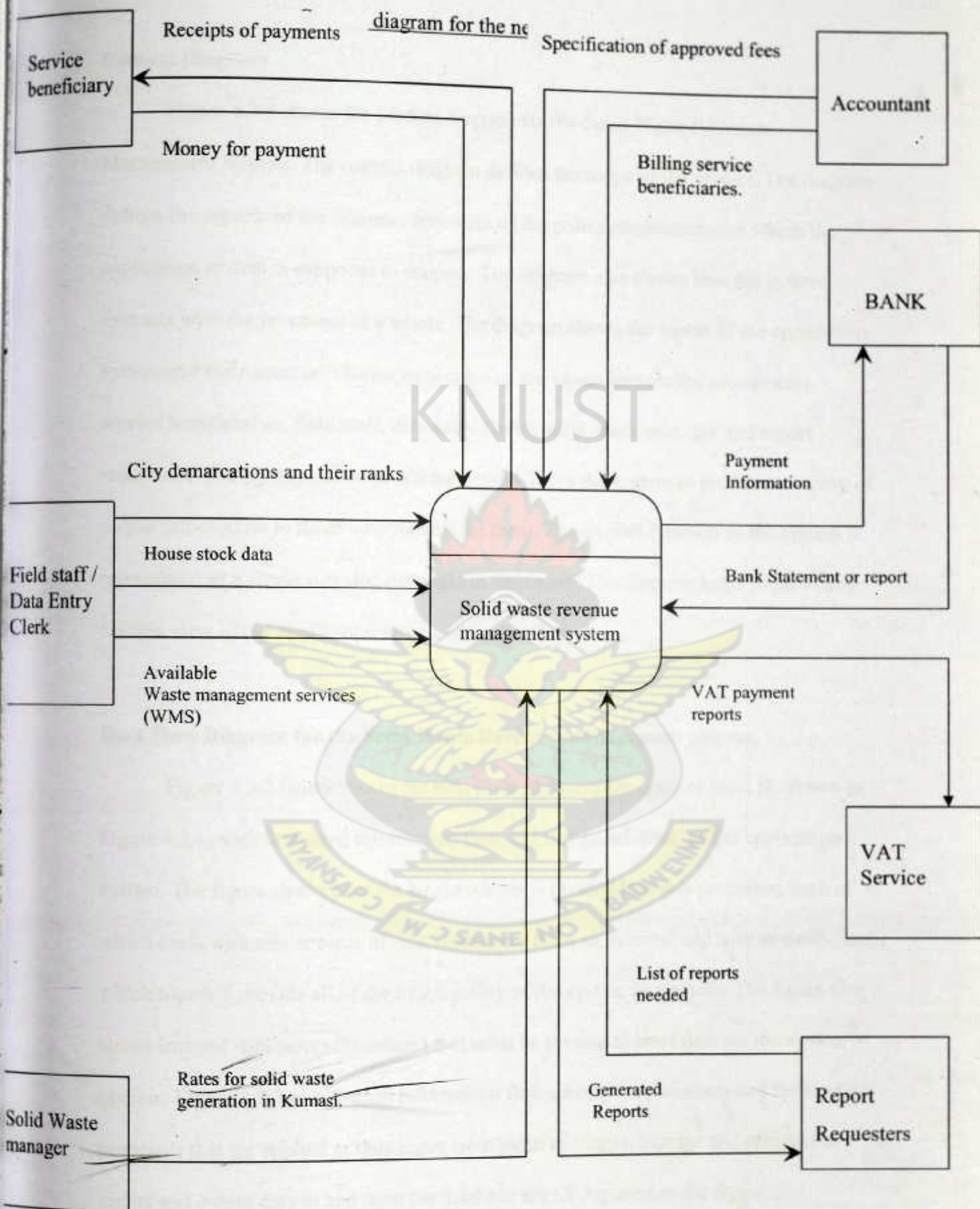
### 4.3 Modelling the new System using Process modelling

The Waste Revenue Management system is composed of processes or functions which capture inputs, manipulate, store and share data between the system and its environment.

Data flow diagram (DFD) is used to graphically represent how the new system operates. DFD is a graphical tool that shows the activities performed by the system, the flow of data in the system, the relationship among the data flows and how processed data is stored at specific locations. In modelling the Waste Revenue Management system, a context diagram for the system is drawn as shown in Figure 4.3.1. It is an aspect of DFD which gives a holistic picture of the new system and shows all the external entities that receive information from or contribute information to the system. The context diagram is further decomposed into sub-processes to provide a logical view of the system as shown in Figure 4.3.2.







**FIGURE 4.3.1** – Context Diagram for the solid waste revenue management system.

## **Context Diagram**

Figure 4.3.1 shows the context diagram for the Solid Waste Revenue Management System. The context diagram defines the scope of the project. The diagram defines the aspects of the business processes of the policy implementation which the application system is supposed to support. The diagram also shows how the system interacts with the processes as a whole. The diagram shows the inputs of the application system and their sources. The major sources of the inputs include the accountants, service beneficiaries, field staff, data entry clerks, solid waste manager and report requesters. The inputs, shown as labeled arrows, drive the system to produce a variety of output information to those who request for them. The overall function of the system is represented as a single rounded rectangle in the figure. The diagram helps to provide a holistic view of the application system being developed.

## **Data Flow Diagram for the Solid Waste Revenue Management System.**

Figure 4.3.2 below shows the next level of Parent Diagram or level O, shown in Figure 4.3.1, with increased information flow and functional detail of the application system. The figure shows how the single system is divided into sub-processes, each of which deals with one or more of data flows to or from an external end user or entity, and which together provide all of the functionality of the system as a whole. The figure also shows internal data stores (Database) that must be present to store data for the system to operate. Figure 4.3.2 also depicts information flow among the processes and the kind of processes that are applied as data move from input to output. Storage and retrieval of inputs and output data to and from the database are all depicted in the figure.



# DATA FLOW DIAGRAM

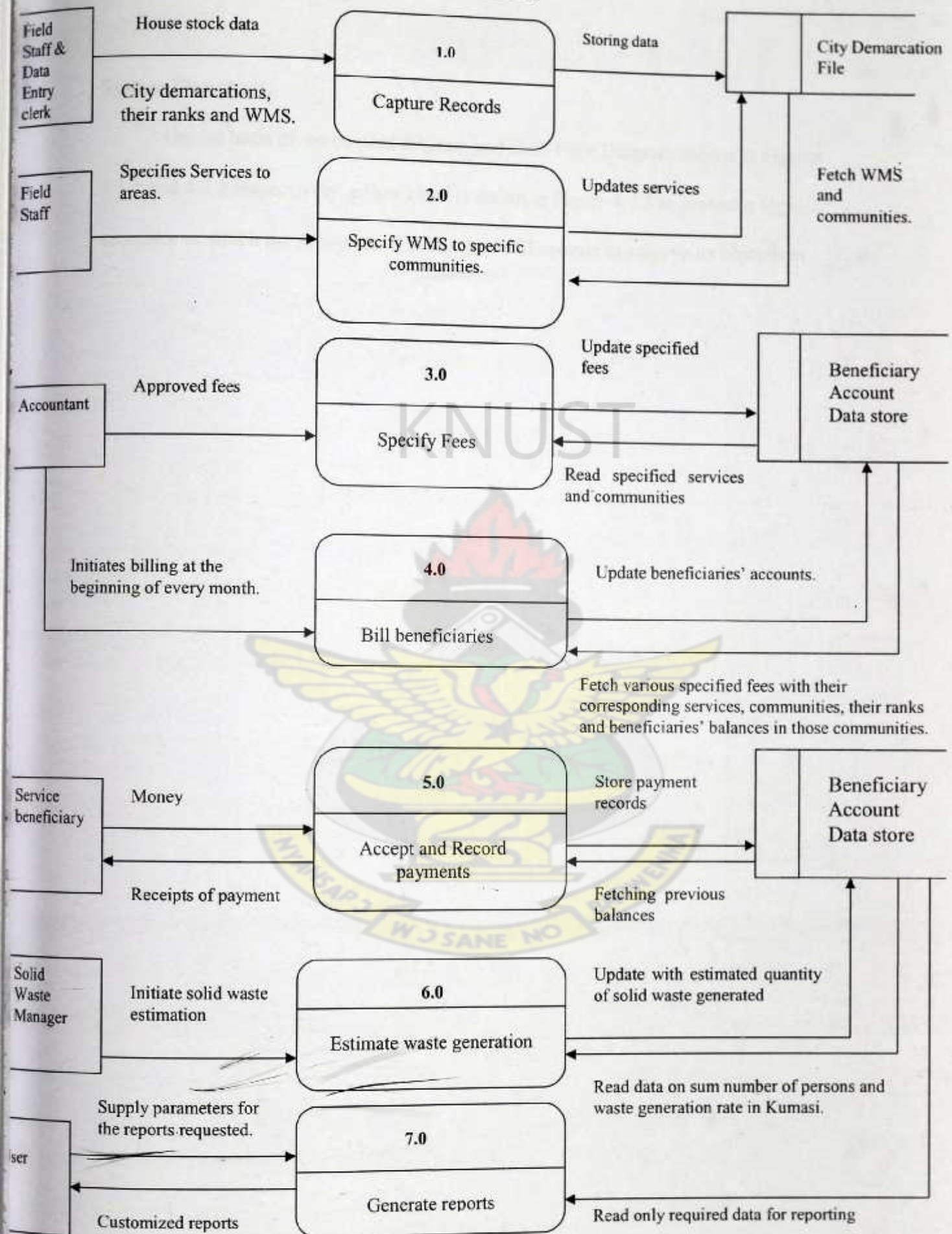
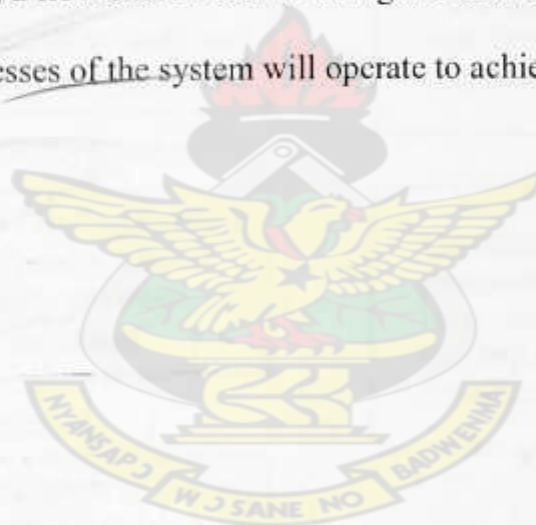


FIGURE 4.3.2 – Data Flow Diagram for the solid waste revenue management system.

### **System Flowchart.**

On the basis of the context diagram and Data Flow Diagram shown in Figures 4.3.1 and 4.3.2 respectively, a flow chart is drawn in Figure 4.3.3 to present a logical sequence in which the processes of the system will operate to achieve its objectives.





# SYSTEM FLOWCHART

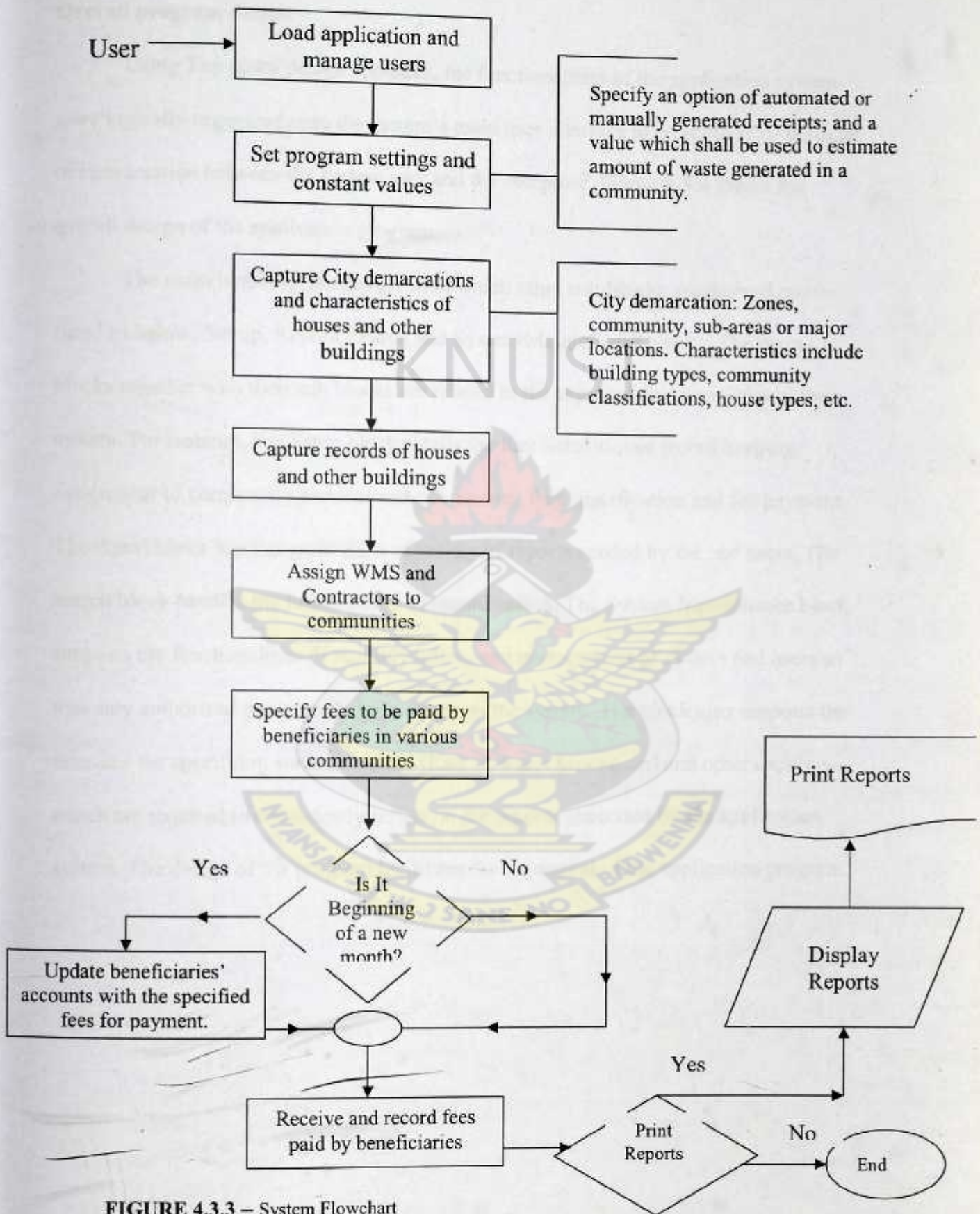


FIGURE 4.3.3 – System Flowchart

## Overall program design

Using Top down design approach, the functionalities of the application system were logically organized onto the system's main user interface to promote easy dialogue or conversation between the system user and the computer. Figure 4.3.4 shows the overall design of the application program.

The main blocks of the design from which other sub-blocks are derived can be listed as below: Set up, Report, Search and System Maintenance blocks. The main blocks together with their sub blocks are related to the expected functionalities of the system. For instance, the Setup block entails the functionalities of record keeping, assignment of community services and contractors, fees specification and fee payment. The report block handles generation of variety of reports needed by the end users. The search block handles the functionality of record search. The System Maintenance block supports the functionalities of monthly billing and management of system end users so that only authorized persons can have access to the system. The block also supports the interface for specifying constant values (Rate of waste generation) and other captions which are required to consistently reflect on the reports generated by the application system. The design of the program facilitates the expansion of the application program.



## OVER-ALL PROGRAM DESIGN

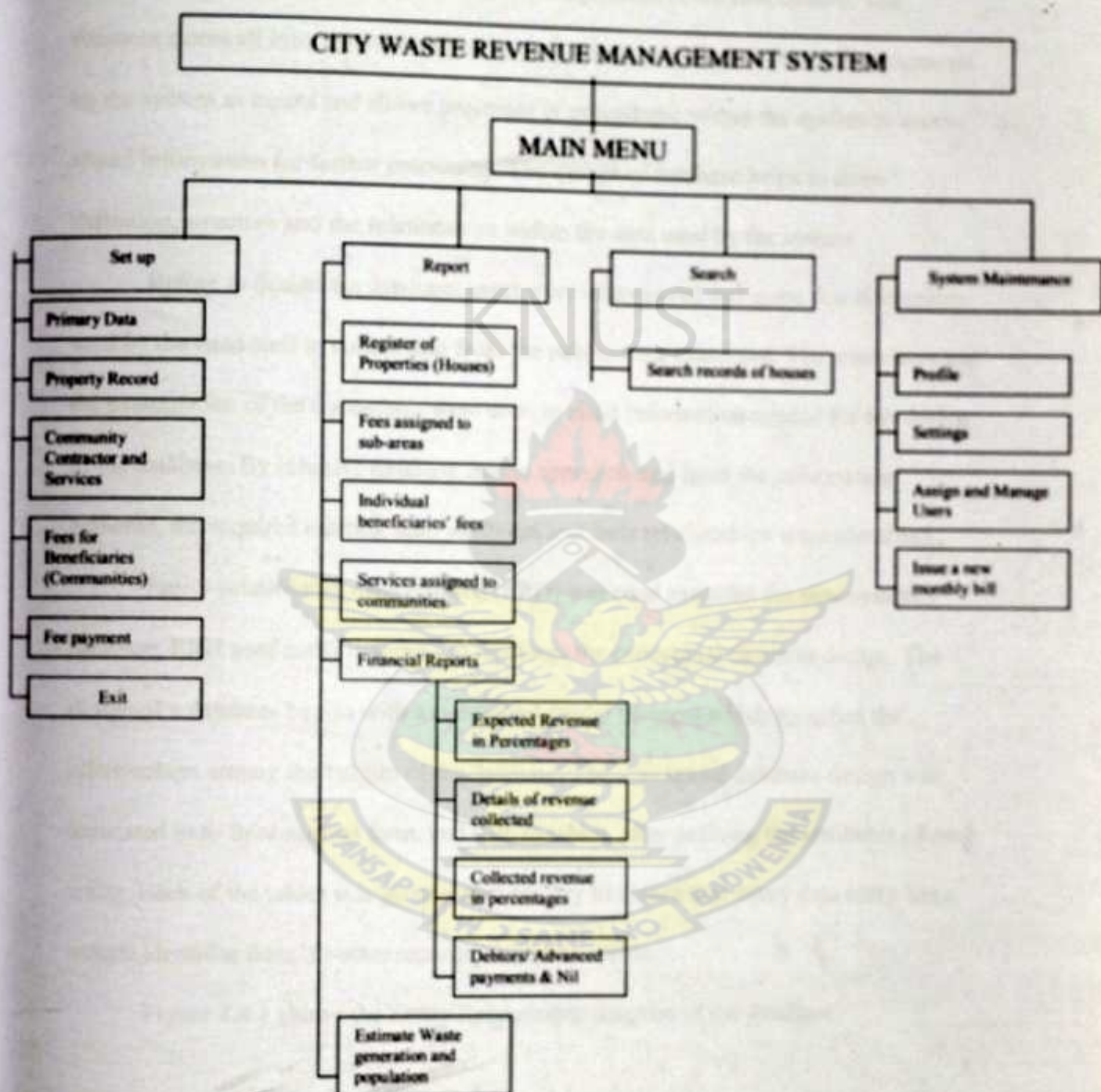


FIGURE 4.3.4 – Overall design of waste revenue management system.

#### 4.4 Design of database

Database backend is one of the main components of the new system. The database stores all information required by the system to operate. It stores data captured by the system as inputs and allows processes or procedures within the system to access stored information for further processing. The design of database helps to show definition, structure and the relationships within the data used by the system.

Before to design the database, users were interviewed and some few documents used by the field staff to collect data from the public were examined. The interviews and the examination of the documents were done to elicit information needed for the design of the database. By intuitive database design approach and from the information gathered, the required entities, their attributes and their relationships were identified.

Entity-relationship diagramming (ERD) was used to model the new system's database. ERD uses entity diagrams to represent the conceptual database design. The design of a database begins with a conceptual model (design) which specifies the relationships among the entities of the database. The conceptual database design was translated in to third normal form, and then to tables, after defining the attributes of each entity. Each of the tables was given a primary key to ensure that every data entry has a unique identifier from all other records in the same table.

Figure 4.4.1 shows the Entity Relationship diagram of the database.



Entity Relationship Diagram for the Revenue management system.

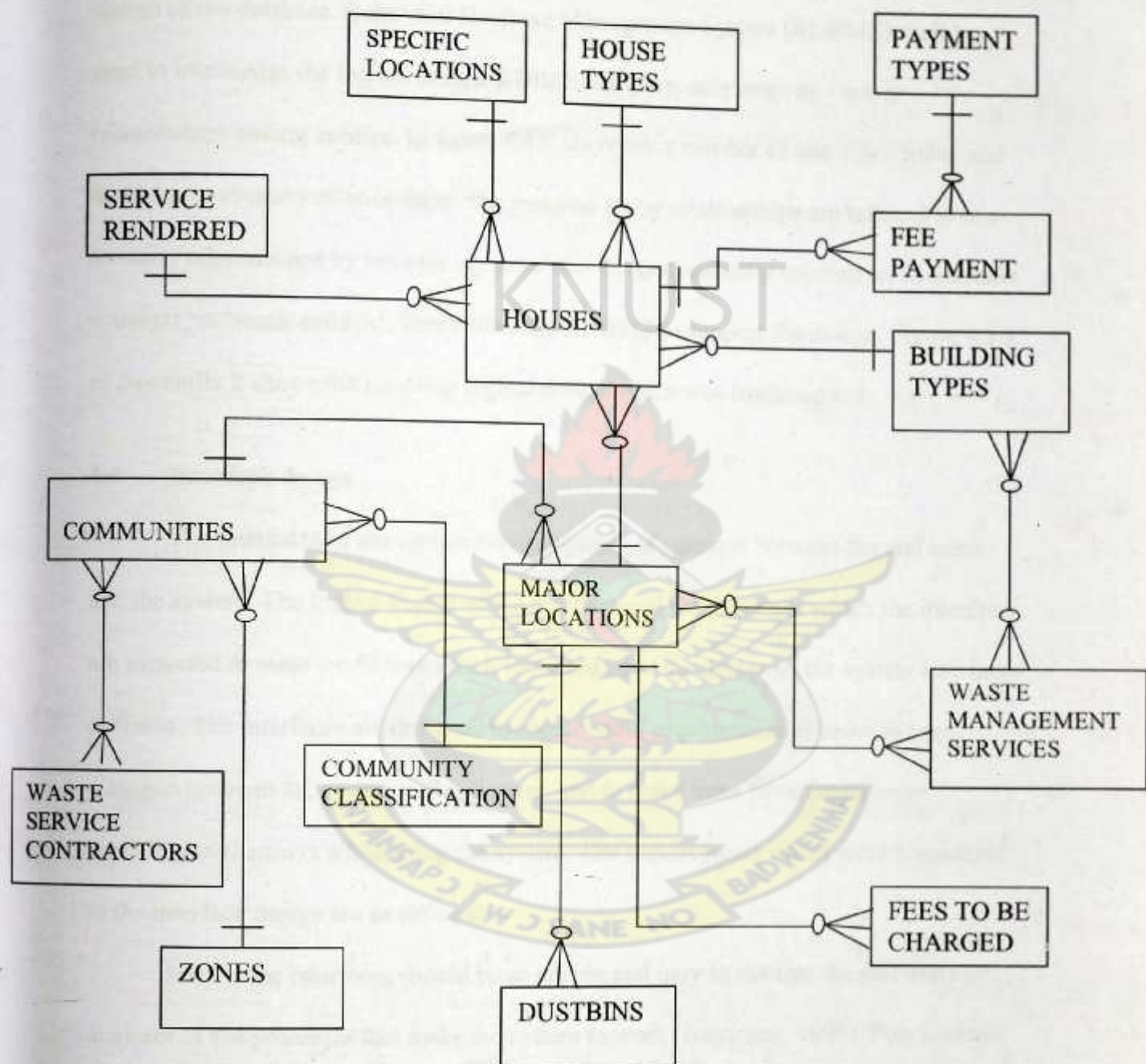


FIGURE 4.4.1 – Entity Relationship Diagram for the Solid Waste Revenue management system

#### 4.5 Analysing the relationships

In section 4.4, entity relationship diagram was used to model the conceptual design of the database. Relational Database Management System (RDBMS) shall be used to implement the logical design. RDBMS supports only one – to – many relationships among entities. In figure 4.4.1, there are a number of one – to – many and three many-to-many relationships. The many-to-many relationships are reduced to one-to-many relationships by introducing three new entities normally referred to, in database concepts, as 'weak entities'. This allows the RDBMS to support the design. Figure 4.5.1 of Appendix 2 shows the resulting logical design which was implemented.

#### 4.6 Interface design

The interfaces of the system serve as points of contacts between the end users and the system. The logical design of the database and requirements which the interfaces are expected to meet are factors which impacted upon the design of the system interfaces or forms. The interfaces are designed to meet certain requirements in order to ease dialogue between the system and end users; and to make them (interfaces) more appealing to the users while using the system. The requirements which were considered in the interface design are as follows:

Firstly, the interfaces should be so simple and easy to use that the end users are unaware of the processes that make the system to work (Baharami, 1999). Few controls are mounted on the interfaces with simple phrases to describe them. This helps the end users to use the system with minimal amount of training.

Secondly, the design should allow a user to be in control of the system. The interface should be forgiving so that users' wrong actions can be easily reversed. Users'



actions that are destructive or may result in loss of data should be adequately confirmed before they are executed. The design of the interface should be consistent and visual enough so that users can see how to proceed (Baharami, 1999).

Thirdly, the design should enable users to be aware of what to do next. This can be achieved by providing information or instructions to the user on what to do. For example, telling a user what the system expects, telling a user that data has been entered correctly, that a task was completed or not completed and explaining to the user the reason for a delay in processing (Bentley & Whitten, 2007).

Also, the interface must be designed to receive very small amount of data inputs into the system. This reduces the amount of work an end user has to do and provides the opportunity for the inputs to be adequately validated.

Finally, there should be one main interface for the whole system so that all other interfaces can be logically organized and mounted onto that interface for easy presentation to the system user. The main form should be equipped with menus and sub-menus to help locate various interfaces. To optimize the use of the interfaces, fully normalized tables with similar structure, in the logical database design, should be grouped and linked to one interface. This helps to make the system compact and allows users to achieve a lot on a single interface. Figure 4.6.1 of Appendix 1 shows the main form. The other forms or interfaces of the system can be found in Appendix 1.

## Chapter Five

### Implementation of Waste Revenue Management System

In Chapter 4, what end users expect from the new system in the form of functionalities was described. Also, processes of the new system were modelled graphically using Data Flow Diagrams. This was followed by the logical design of the database which serves as a backend to the system to store all information required by the system to operate. Interfaces of the system which serve as points of contacts with end users were also designed. This chapter examines the physical implementation of the logical designs or models of the new system.

#### 5.1 Overview of Implementation

The implementation of the system was done on a Pentium IV Lap top computer loaded with Windows XP Professional Operating System. The machine has an Intel processor; 702MB RAM and operates at the speed of 2.80GHz. All software tools needed for the implementation of the system are all compatible with the Windows XP Operating System. The software tools used in the implementation process included Microsoft Visual Basic 6.0 Studio, SQL Server DBMS, Crystal Report 8.5 and Set up Factory software.

The implementation of the solid waste revenue management system started with the database backend. SQL Server DBMS was selected and installed on the Pentium IV computer. Tables and their attributes were created to physically implement the logical database design of the system.



The next step was to write secure codes of the new application. Before that Visual Basic 6.0 programming language was chosen and installed. Visual Basic 6.0 was chosen because it is a language the author understands very well. The coding of the main application started. Log in and the main interfaces were designed and coded. A communication link or a connection was set up between the application program and the database backend so that there would be free exchange of data or information.

The codes of the system were organized into procedures and functions which helped in identifying errors or program bugs. Structured Query Languages (SQL) which is specifically designed to manipulate database information was also used. Statements of SQL like "Insert", "Select", "Delete" and "Update" were used to manipulate records in the database. The Insert statement was used to append single or multiple records into tables. Select statement was also used to retrieve a set of records from the database based on certain criteria for further processing. Delete statement was used in the application to remove or clear records from certain tables. The content of tables is modified using the update statement. Apart from the procedures and functions used within the application system, stored procedures which are executed by the SQL Server DBMS were also used.

These stored procedures are triggered by the application system but are executed by the DBMS which houses the database. This helps the application to run faster since those stored procedures are executed at the database level.

Testing is done on any successfully coded interfaces, procedures and functions before coding the next interfaces. The testing of the code blocks helped in disclosing program errors before the entire application was completed. Detected errors were fixed and re-tested until no errors were detected.

Another interface concerned with the security of the system was looked at. It manages users and assigns them privileges with which they could use the system. The interface was coded to allow an administrator to create more group accounts for users. Also, the coding of the interface was done so that a user holding a group account can be assigned additional privileges to make the user stand unique among their peers.

Report preparation is another aspect of the implementation aimed at displaying processed outputs of the system to the end users. Crystal Reporting tool 8.5 was installed. This software tool was then linked to the database and all the necessary reports were designed, prepared and tested outside the application system. The prepared and tested reports were linked to the report interfaces from the application system. End users get access to the reports through these interfaces. The interfaces take specifications or criteria from users and return customized reports to them. After a successful test of the whole application system, Set up Factory software tool was used to package the system for easy installation.

In summary, the implementation started with the physical database backend, coding of the interfaces of the application, unit testing, preparing and linking reports to the application and undertaking final and holistic test of the solid waste revenue management system. Finally, the system was packaged for easy installation.

## **5.2 Physical Design of Database**

In the logical database design, data needed to be stored were determined in cooperation with end users. Dependencies in the data were identified and represented in a conceptual schema using Entity Relationship Diagram. The data was then arranged in



logical structures and mapped into the storage objects like tables which are supported by the relational DBMS during implementation.

The physical design of the database examined how the physical configuration of the logical database design was specified on the storage media. Firstly, SQL Server DBMS was installed on a computer. Tables in the logical design were created and given unique friendly names for easy identification. Primary keys and other data elements with their corresponding data types were specified for each table. The relationships among the tables were also configured. Figure 4.5.1 shows the relationships among the tables. Finally, some views and stored procedures were created in the DBMS. A view is like a table which contains related records of a number of normalized tables joined together as one. The views and the stored procedures were later used by the application program.

### **5.3 Unit and System testing**

Testing the application system is another important part of the development process. Unit testing was carried out first before system testing was conducted. In general, testing an application program aids in detecting errors in the program code so that they can be fixed to allow smooth execution of the program. To minimize the frequency of errors, written blocks of codes were tested in discrete manner during the implementation process. This helped in reducing the occurrence of errors encountered in the major system testing process.

In system testing, the whole application was tested with data to ensure that the required functionalities of the system are correct. The data used in the testing process was gathered from one of the ten zones into which the city was demarcated. This is how the testing process started. Firstly, all the interfaces of the system were tested one after

the other. Particular attention was paid to ensure that adequately validated inputs were accepted by the interfaces. The test conducted on the interfaces also involved adding, editing and deleting information from the database. In editing a record, the record is filtered out so that it can be edited. The various parameters used in filtering a record were also tested.

The second stage of testing centred on the display of outputs of the system to the end users. Testing in this stage involved passing various parameters or criteria to the report interfaces and viewing assorted customized reports.

The final stage of the test involved finding out whether the applications system can run on a Local Area Network (LAN) or not. Also, a test was conducted on users' group and individual accounts to ensure that users do not go beyond their privileges but enjoy exactly what are assigned them.

#### **5.4 Test results**

Generally, the outcome of the testing process was successful except that some few errors showed up and were successfully fixed. In the first stage of the testing, three categories of errors were detected. The first one was that data types of certain variables declared in the program code did not match with those of other variables from which they received values. As a result, error prompt captioned "Data type mismatch" was shown during the testing process. This problem was solved by re-declaring some of the variables and using appropriate functions to convert the variables into appropriate data types. The second category of errors was that values in some text boxes were not validated. They were detected and properly validated. Finally, it was also detected that



certain Cancel command buttons on some interfaces were not coded and were coded and tested.

The second stage of testing found that the content of some few reports displayed remained the same even though different parameters or criteria were passed. After careful examination of two reports where one displays dynamic content and the other does not, it was found out that an option in the Crystal Report Software tool was left unchecked. The option is "Save Data with Report". By default, the option is checked when a new report is prepared. The option is checked to mean that data shown in the report is saved together with the report lay out or structure so that anytime it is opened the same content is shown. The problem was resolved by un-checking the option for all affected reports. Apart from this problem, every other thing tested in this stage was successful.

The final stage of testing was also successful as users were able to access the system over the LAN and carried out some transactions. However, a little problem was encountered when users tried viewing reports over the network. The reports pop up and vanish quickly without staying. After consulting a number of developers on this issue, it came out that the solution to the problem was to install Crystal Report Software on each client computer. The software was installed on two computers and the reports were viewed correctly. It is a little worrying to continue installing the software before a client can view a report. Luckily, one of the developers (Mr. Yusif Ahmed) whom was contacted provided an alternative solution which proved to be relatively much better. The developer provided a copy of a folder containing a set of Dynamic-link Library (DLL) files of the Crystal Report software. The files were copied into System32 folder of the Windows XP operating system and the application system displayed the reports

correctly without any problem. Management of users through group and individual accounts was also successful since the application program restricted users to their specified privileges and denied them access to other privileges which do not belong to them.

## **5.5 Management of the new system**

The management of the new system is a key component of its successful implementation and utilization in KMA. The ever changing requirements of end users of the system, its reliability coupled with the rapid changes in computing field and the fact that it is unreasonable to assume that software testing will uncover all latent errors in the software system drive the need for the management, control and maintenance of the automated software systems (Pressman 1987; Looijen 1998).

Managing the application system should be of collective effort involving the management of KMA, the developer of the system and other end users of the system. The end users perform physically the real business processes related to the implementation of waste collection levy policy. The new system plays a supportive role in this regard.

In managing, controlling and maintaining the system, the software will be used by the management, the developer and end users; to execute their business processes, print required reports and take note of latent errors which were uncovered during testing process. New requirements for the system including functional modifications and enhancements will be noted. The management collates and forwards to the developer all reports pertaining to these latent errors and the new requirements from end users so that



solutions are provided. As a result, relationships are created between the system and its users where solutions to the problems, emanating from the system, are provided.

There are other external influences which cannot be left out in managing the automated system and the policy implementation at large. The external influences are related to the developments and events which take place outside the real business processes of KMA, the utilization of the new system and its management. An example of the external influence is political influence. The central government can stop or delay the policy and the system implementation for fear of losing power especially if the opposition parties begin to campaign on political platforms that they can manage the solid waste problem without asking the public to contribute. The second example is economical influence. The economic conditions of the country and the people should be considered when specifying fees for the service beneficiaries so that the fees can be very affordable and generally acceptable. Legislative influence is the third example. KMA should adequately back their policy implementation with resolutions so that defaulters can be forced to pay. Failure to consider this influence can result in total collapse of the project implementation as beneficiaries can refuse to pay their fees and go unpunished. Another influence that can be thought of is technological influence. Technological developments lead to new hardware, software and communication facilities which, in the long run, render the new system obsolete; especially if the technological influence is not considered in managing the new automated system.

In summary, it is not reasonable enough to rely solely on technical expertise to have this new system successfully implemented but also consider other equally important management issues pertaining to the system and the overall policy

implementation. Figure 5.8.1 below describes graphically how the automated system can be managed in the context of management paradigm.

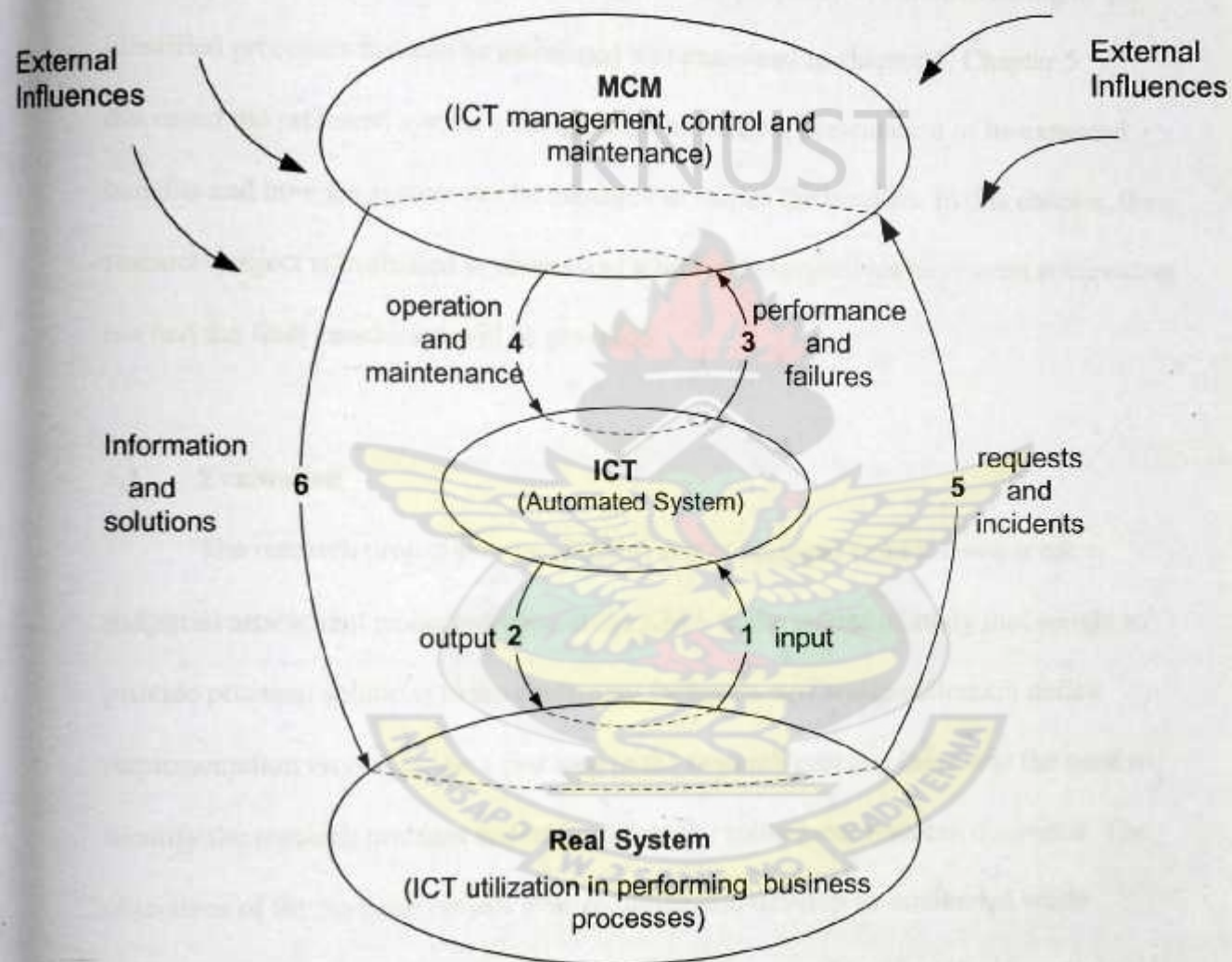


FIGURE 5.8.1 - Management paradigm (Looijen, 1998)



## Chapter Six

### Conclusion

In chapter 3, the business processes pertaining to the implementation of “city-wide waste collection levy scheme” were identified, described and the possibilities of automating them were discussed. The design of the proposed system consisting of the identified processes that can be automated was examined in chapter 4. Chapter 5 discussed the proposed system’s design implementation, presentation of its expected benefits and how the system can be managed to realize the benefits. In this chapter, the research project is evaluated to understand whether the objectives have been achieved or not and the final conclusion will be provided.

#### 6.1 Evaluation

The research project presented in this report emerged from a seven-week industrial attachment embarked upon at the KMA in the course of study that sought to provide practical solutions to the challenges facing its new waste collection policy implementation city-wide. As a first step in the research process, there was the need to identify the research problem and to formulate the subsequent research questions. The objectives of the research project were to design and develop an automated waste revenue management information system for KMA to ease its policy implementation. It is the opinion of the author that this project meets the objectives.

The development of the application program evidenced by the reports generated ~~from the~~ program functionalities answers the first research question to the fact that managerial processes in the city-wide waste management levy policy implementation

can be automated. The application program developed also shows that it is the kind of Information and Communication Technology infrastructure that is needed to support the implementation of the policy.

The project matches the requirements of the end users stated in chapter 4. The design and implementation of a backend database fulfils the requirement of **creating a unified database** to keep data on houses or buildings in the city and other relevant information.

The system fulfils the requirement of allowing **fees to be specified for beneficiaries to pay**. The interface designed to support this allows the fees to be specified based on the rank of the community and the kind of service rendered in that community.

The interface designed is used to update beneficiaries' individual accounts with the fees specified at the beginning of every month. The design of this interface allows for customization where accounts of beneficiaries in selected communities can be updated. This satisfies the requirement of **monthly billing of beneficiaries** with specified fees.

The requirement to **capture payments** made by service beneficiaries was also fulfilled as there is an interface for fee payment which issues a receipt after successfully saving a payment transaction.

The system uses the values of the table (Houses table) to predict the population of a community. The product of the estimated population and the rate of solid waste generation, accessed from the database, provides an estimate of the total weight of solid wastes generated from that community. This fulfils the requirement of **estimating solid waste generation**. A report, shown in Figure 5.6.9 of Appendix 4, shows the estimate of



total weight of solid waste generated in a community. This report also affirms the fulfillment of the requirement. It was later suggested that the algorithm for estimating solid waste generation can be enhanced by using population distribution, household life style data and previous waste collection information.

The requirement to allow **searching of house records** is fulfilled because the system has an interface which allows users to search for records with different parameters. The parameters are the contact persons' names, phone numbers, house or property number, number of persons in a property and a street name along which a property being searched can be found. The result of the search operation is organized into reports which can be printed out as hardcopy. The interface is shown in Figure 4.6.11 of Appendix 1.

The requirements related to report generation have also been fulfilled. For instance, the requirement to **report on the total revenue expected** from the beneficiaries, both in amount and in percentages, based on the fees specified for various communities was fulfilled by the generation of the report shown in Figure 5.6.4 of Appendix 4. Another report generated by the system, and shown in Figure 5.6.8 of Appendix 4, fulfils the requirement of **reporting beneficiaries who have finished paying or have refused to pay their fees** even though they continue to enjoy services rendered by WMD. Finally, the requirement to provide a **register of domestic houses, shops, schools and other property or buildings** in the Kumasi metropolis has been fulfilled by a report generated from the system and shown in Figure 5.6.1 of Appendix 4. Apart from the stipulated reports-related requirements, five additional reports were designed to be generated from the system. The additional reports are shown in Figure 5.6.7 and Figures 5.6.2-5.6.5, all of Appendix 4.

The expected impact or benefits of the new system developed under this research project were stated to answer the research question related to it. Also, a discussion on whom and how the solid waste revenue management system is to be managed was done to ensure its successful implementation and utilization.

## **6.2 Expected benefits of the system**

The development of the Solid Waste Revenue Management System to support and ease the implementation of "City-wide waste collection levy" scheme of KMA fulfil the objectives of this research project. This new system can serve as a role model in areas where city authorities, charged with the responsibility of waste management, can begin to inculcate into people minds the need to support waste management services financially.

This will help strengthen the revenue base of city authorities to support increased service coverage and to provide quality services in order to maintain clean environment for all.

Expected benefits of the application system are; to reduce significantly the cost of managing data manually, to save time searching for data, to support revenue generation and its management, to aggregate large amounts of data in various ways useful for planning and decision making, to increase capacity for record keeping in terms of space and cost, and to encourage other city authorities in Ghana to seek for public financial support towards waste management which is a major problem in the country, by showing them financial reports from the system on what can be achieved, especially if the public is well educated.

It is hoped that if KMA succeeds in implementing this policy (Waste Collection levy) and avails factual evidence from the application system on revenue generated from



the public towards waste management coupled with positive feed back from service beneficiaries on the quality of service, other authorities will not hesitate in adopting this new system for the same benefits.

### **6.3 Direction for the further development of the system**

In this project, an application program has been successfully designed and developed to provide the expected functionalities to the end user, KMA. However, there are possible future developments that could be implemented into this system.

Firstly, it should be possible to add into the system a component that could support the use of e-switch device for electronic payment. The e-zwich device is a hand held biometric device for electronic payment. The use of the device is gaining ground in Ghana and therefore the likelihood of service beneficiaries wanting to pay through that means. It should be possible for KMA fee collectors to use the device to collect fees and download the records automatically into this system.

Secondly, another possible development could be to implement a web application to upload on to the KMA website the bills or the current balances of service beneficiaries for them to access over the internet. This will save cost of sending bills to thousands of beneficiaries; and decongest KMA premise of beneficiaries who want to know their current balance.

Finally, the system could be expanded to include a visual plan or a digitized map of the city so that records of houses or buildings can be tied to their picture for easy identification and location by fee collectors.

#### 6.4 Final Conclusion

This research project showed that the formulated research questions aimed at solving the problem of KMA, pertaining to its policy implementation, have been answered as follows:

1. The project has demonstrated that the managerial processes in the city-wide waste collection levy policy implementation can be automated.
2. The project has shown that the newly built database application program is the kind of ICT infrastructure needed to ease the implementation of the policy. The database application system was designed and developed using other software tools consisting of Microsoft Windows XP Operating System, SQL Server DBMS, Visual Basic 6.0, Crystal Report tool 8.0 and Setup Factory 6.0. Setup Factory 6.0 is a Windows software development tool used to create compact software installers through CD-ROM, internet and Local Area Networks.
3. The project has also shown that the newly developed system needs to be managed, controlled and maintained for its successful implementation and utilization. These tasks should be handled by the management of KMA, the developer of the system and other end users.
4. The research project also highlighted the fact that the automated system can be managed by implementing Management, Control and Maintenance (MCM) paradigm of an Information System.
5. Expected benefits of the automated system if implemented, as highlighted by this research project, are as follows:
  - a. To save time searching for data



- b. To support revenue generation and its management
- c. To aggregate large amounts of data in various ways useful for planning and decision-making
- d. To increase the capacity for record keeping in terms of space and cost
- e. To reduce significantly the cost of managing data manually
- f. More revenue can be generated by replicating this system in other Metropolitan/Municipal District Assemblies in Ghana.

This research project has also recommended that the following future developments can be integrated into the system:

1. Development of a component or a module to support e-zwich device for electronic payment as its use is gaining ground in Ghana.
2. Development of a web application to upload onto KMA websites the beneficiaries' bills for them to access via internet. This will help save cost and to help decongest KMA's premise of beneficiaries who shall troop in to know their bills.
3. Expansion of the system to include visual plan or a digitized map of the city for easy identification and location of a house or any property.

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## APPENDICES



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***Appendix A1: Interface Design***

Form1 (frmMain) Figure 4.6.1 is the main form. It is displayed after the new system is started and a user is authenticated. It has main menus and sub-menus which when clicked opens other forms.

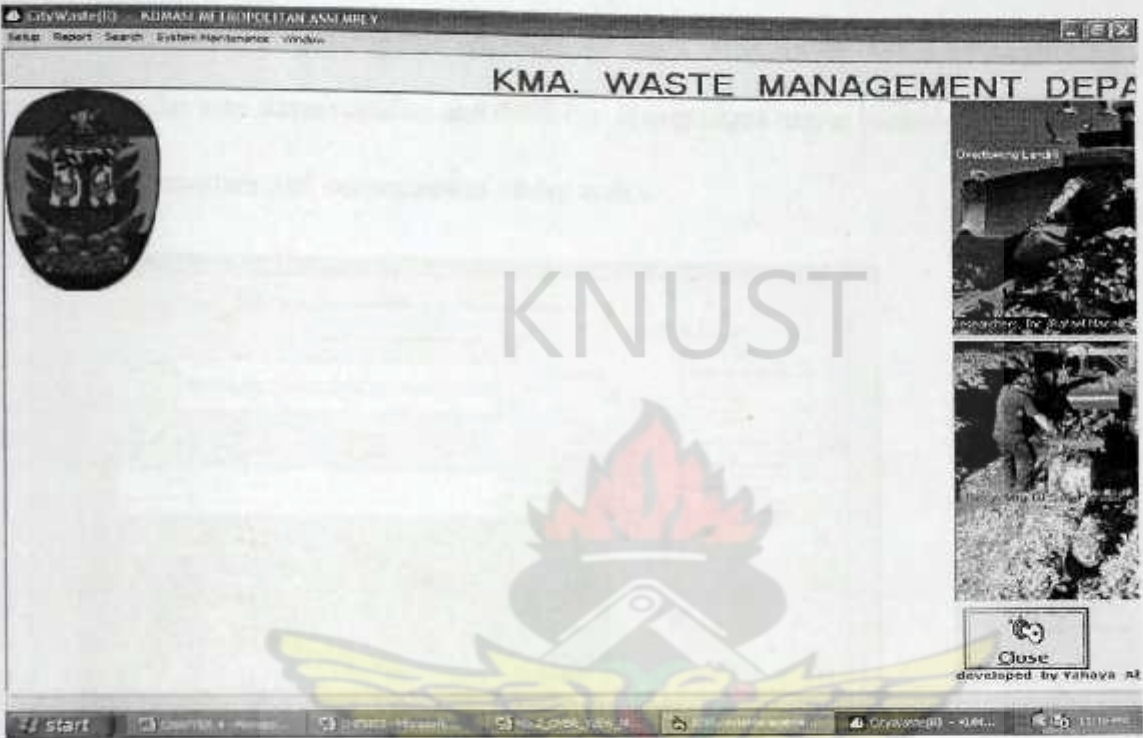


Figure 4.6.1 – Main form of waste revenue management system (Form 1).



**Form2 (frmSetUp)** - It opens after clicking on the "Primary Data" sub-menu of Figure 4.3.4. The interface has two tabs numbered 1 and 2. Tab 1 is used to capture basic information into nine fully normalized tables. This information serves as building blocks for other information or records to be captured using other forms. Tab 2 also manages records on the city demarcations and dustbins. It organizes major locations or sub-areas under communities and communities under zones.

CityWasteDB

1 -- Primary Data 2 -- Communities And Major Locations

Community Classification

Code: [ ] Name: [ ]

Select An Option

- 1 - Building Types
- 2 - Communication Class
- 3 - Containers
- 4 - House Types
- 5 - Payment Types
- 6 - Service Handled
- 7 - Service Types
- 8 - Specific Locations
- 9 - Zones

Code	Name	1st Class	2nd Class	3rd Class
CC001				
CC002				
CC003				

Buttons: New, Save, Cancel, Delete

Figure 4.6.2 – Interface of Tab 1 of Form 2

CityWasteDB

1 -- Primary Data 2 -- Communities And Major Locations

Zones

Code: [ ] Community Name: [ ] Community Classification: [ ]

Select An Option

- 1 - Communities
- 2 - Major Locations
- 3 - Dustbins

Buttons: New, Save, Cancel, Delete

Code	Community Name	Comm. Classification	Zone Name
CM1	ASAFI	2nd Class	SUBINKESE
CM10	ADUM99	2nd Class	SUBINKESE
CM100	APFUL NAWANTA	2nd Class	SUBINKESE
CM101	ABOABO	2nd Class	ASAWASE
CM102	ADUKROM	2nd Class	ASAWASE
CM103	ANWOMASO	2nd Class	OFORIKROM
CM104	ASAWASE	2nd Class	ASAWASE
CM105	SAWABA	2nd Class	ASAWASE
CM106	BOADI	2nd Class	OFORIKROM
CM107	KYIDYA	2nd Class	OFORIKROM
CM108	ASOFI/ORE MAMPONG	2nd Class	ASAWASE
CM109	AKETAGI	2nd Class	OFORIKROM
CM11	MPATASIE	2nd Class	BANTAMA
CM110	YENYAWSO	2nd Class	MANKYIA

Buttons: New, Save, Cancel, Delete

Figure 4.6.3 – Interface of Tab 2 of Form 2

**Form3 (frmHOUSES)** – This interface is used to capture house stock records of the city. It is opened after clicking on the “Property Records” of Set up main menu. It is designed to capture, edit and filter or search for records. The basic units of records captured by this interface come from the information captured by Form 1.

**Houses** | Houses, Shops, Schools, Hospitals, Clinics, Industries, etc...

**Building Location**

Zone:

Community:

Major Locations:

**House Type** **Building Type** **Specific Location** **Sen. R. Or Green Belt**

Old House No.  New House No.  Contact Person / Title / Captain  No. Of Poles  Phone No. (Home)  Street Name

House ID	Contact Person	House No.	New House	No. Of Poles	Street Name	Phone No.
PC101-306	YAW ADANKWAH	PLT 2 BLK B	56	3	GYENYASE RD	
PC101-307	J. N. ADAMAHICA	PLT 3 BLK D	54	22	GYENYASE RD	
PC101-308	WIDA APPAH KUBI	PLT 5 BLK B	50	5	GYENYASE RD	
PC101-300	AMA SERWAH	PLT 6 BLK B	48	8	GYENYASE RD	
PC101-487	ANTWI EGASIAKO	PLT 1 BLK B	58	11	GYENYASE ROAD	

Figure 4.6.4 – Form 3



Form4 (frm2CommServicesNContractor) – The interface is used to assign waste management services to communities where the services shall be rendered. Contracted service providers are also assigned to communities, using the same the interface, to render services meant for those communities. The form is opened when a user clicks on the “Community Contractors and Services” sub menu.

**CityWaste(R)**  
Community Services And Contractors

Zones: ASAWASE  
Community: ASAWASE  
Service Type: DOOR-TO-DOOR

Code: Major Location / Sub - Area: Service Type

Code	Major Location / Sub - Area	Service Type
2006144	ASAWASE SUB AREA - (ASAWASE) - ASAWASE	DOOR-TO-DOOR
2006145	K - LINE - (ASAWASE) - ASAWASE	DOOR-TO-DOOR
2006146	NEW ZONGO - (ASAWASE) - ASAWASE	DOOR-TO-DOOR
200649	A - LINE - (ASAWASE) - ASAWASE	DOOR-TO-DOOR
200650	B - LINE - (ASAWASE) - ASAWASE	DOOR-TO-DOOR
200651	C - LINE - (ASAWASE) - ASAWASE	DOOR-TO-DOOR
200652	D - LINE - (ASAWASE) - ASAWASE	DOOR-TO-DOOR
200653	E - LINE - (ASAWASE) - ASAWASE	DOOR-TO-DOOR
200657	J - LINE - (ASAWASE) - ASAWASE	DOOR-TO-DOOR

Buttons: View, Save, Cancel, Delete

Figure 4.6.5 – Form 4

Form5 (frmFeePAYMENT) – Payments made by service beneficiaries are recorded using this interface. It is designed to search for records with more than one criterion. It provides description of figures, entered as payment, in words to aid users to be sure of what they are keying into the system. The interface generates a receipt after submitting a transaction.

CityWaste(R) - Fee Payment

**Building Location**

Zone: SUBINXXXX  
Community: ADUM99  
Comm. Classif.: 2nd Class  
S. Area In a Comm.: ADUM SUB AREA  
Service Type: DOOR- TO-DOOR

**Building Description**

House Type: DOMESTIC  
Building Type: SINGLE  
Specific Location: NONE  
Service R. Or Code Code: RESIDENCE

**House Details**

Old House No.: OTA 26  
New House No.:  
Contact Person/Time: GRACE BOATENG  
No. Of Persons: 6  
Street Name:  
Contact No. / Remark: ADUM SANTIA

Enter Your ID:  
Clear PCI-3000 Find

**Payment**

Payment Type: CASH  
Show Receipt: ☐  
Amount Paid: 2.5  
Receipt Number: System Generated  
Serial Number: N/A

**Fee Details**

Monthly Fee Charge: GHC 2.50  
(Amount In Words) Two Cedis And Fifty Pusewas.  
GHC 2.50  
February-2009

Buttons: Save

Options: ☐ Community Classif. ☐ Type of Building

Figure 4.6.6 – Form 5



Form6 (frm2CommServicesNContractor) – This interface is used to specify fees to a community based on the type of service it enjoys and one of the following options: the classification or rank of the community and the type of building owned by a service beneficiary. The interface is designed to have two tabs to handle the options. The interface is opened after clicking on the “Fees for Beneficiaries” sub menu.

Figure 4.6.7 – Interface of Tab 1 of form 6

Figure 4.6.8 – Interface of Tab 2 of form 6

Structure of Report Interfaces (Form7) – Report interfaces display processed data or outputs of a system as reports. The interfaces are designed to have a consistent structure. Each interface consists of a title bar, view option, parameter and control sections. The view option section indicates whether to view a whole or a portion of the report. The parameter section aids the user to select parameters or criteria which the report should meet. This section is activated when a portion of the report is needed. The control section contains a button which when clicked displays the reports. The structure can be seen in Figure 4.6.9.

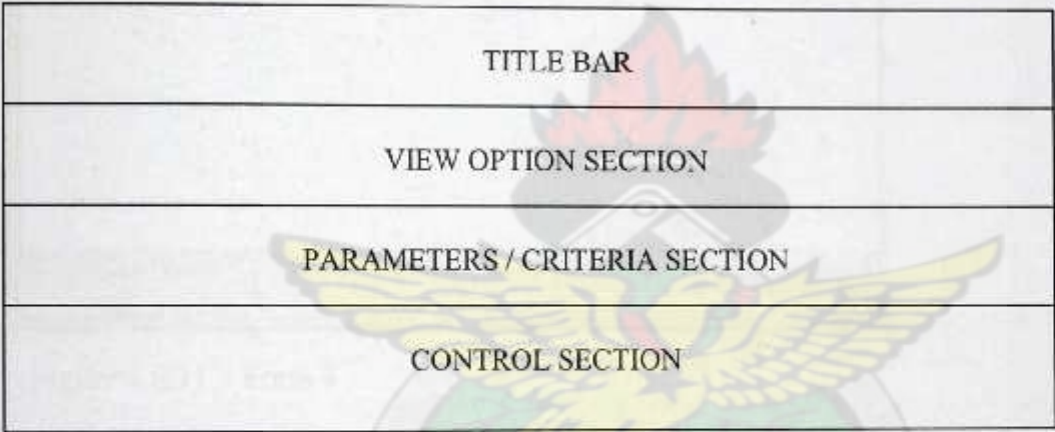


Figure 4.6.9 – Structure of Report Interface



Figure 4.6.10 – Report Interface



**Form8 (frmAdvancedSearchHOUSES)** – The interface is opened after clicking on the “Advanced Search on House types” sub-menu of Search main menu. It is used to search for records of various types of houses in the city. Resulting records from the search are organized into reports for printing.

CityWaste(0) : Advanced Search [Houses , Shops , Schools , Clinics , Hospitals , Banks , etc. . . ]

Enter Your Surname Or Other Name

Contact Person

Phone No.(Remark)

Street Name

Old Mbr.

New Mbr.

Est. Pop.

Choose an option @@@

☒ Normal Search

☐ Advanced search

Service Code

Service Code	House Type	Building Type	Specific Local	Some Items S	Contact Person	Phone No (R)	Street Name
<input type="checkbox"/> PC101-306	DOMESTIC	SINGLE	@NONE@	RESIDENCE	YAW ADANK		GYENYASE R
<input type="checkbox"/> PC101-307	DOMESTIC	SINGLE	@NONE@	RESIDENCE	J. H. ADABAH		GYENYASE R
<input type="checkbox"/> PC101-308	DOMESTIC	SINGLE	@NONE@	RESIDENCE	VIDA APPAH		GYENYASE R
<input type="checkbox"/> PC101-309	DOMESTIC	1 - STOREY	@NONE@	RESIDENCE	AMA SERWAH	UNCOMPLETE	GYENYASE R
<input type="checkbox"/> PC101-487	DOMESTIC	SINGLE	@NONE@	RESIDENCE	ANTWI BOAGL		GYENYASE R

Number of records found = 5

Print

Report

Clear

**Form9 (frmProfile)** – The interface is used to capture names and other captions which are required to constantly appear on top of every reports generated by the system. Changes in these captions are effected through the interface which automatically reflects in all system generated reports. This eases replication of the system in other municipalities.

Figure 4.6.12 – Form 9

**Form10 (frmSettings)** – It is used to store some settings and other constant values for the system use. For example, the rate of waste generation is needed by the system for estimating the amount of solid waste generated by city. The values and the settings are updatable.

Figure 4.6.13 – Form 10



Form11 (frmManageUSERaCCounts) – It is used to manage users by creating user accounts and giving them the necessary privileges to use the system. The interface shall be used by an administrator who will manage both individual and group accounts of users.

CityWaste(R) Manage User Accounts

Capture Staff Record | Create User Account | **Create Group Privileges** | Assign Privileges

Create My Group Privilege - Name | **Set Up The Group With Privileges**

Group Name:

Group Description:

☒ Turn Filter On

Group Number	Group Name	Description
5	Developer	He is the one who designed the program
6	Administrator	They have access to every part of the program
8	DATA CLERK	THEY SHALL BE DOING DATA ENTRIES

Save Cancel Help

Figure 4.6.14 – Interface for managing user accounts (form 11).

Form12 (frmBILL\_BENEFICIARIES) – Is used to bill individual service beneficiaries with the fees specified for the communities in which they find themselves. It is designed to allow customized billing where selected beneficiaries can be billed. This will help start the implementation of the “City-wide waste collection levy scheme” community by community and eventually engulf the whole city. Also, the design of the interface supports billing of all service beneficiaries in the city at one time. The interface is displayed after clicking on “Issue A New Monthly Bill” sub-menu of System Maintenance main menu.

The screenshot shows the 'CityWaste(R)' application window with the title '1 Issue Bills / Update Beneficiaries' Accounts'. The interface includes a 'Zone' dropdown menu set to 'ASOKWA', a 'Update All Icons' checkbox, and a 'Clean The Grid...' button. Below these are two columns: 'Community' and 'Major Location / Sub Area'. The 'Community' column lists DOMPOASE, KODIEKROM, A-TINSAN, and ASOKWA. The 'Major Location / Sub Area' column lists ASOKWA SUB AREA, ASOKWA RESIDENTIAL AREA, EXTENSION, and ASOKWA OLD TOWN. To the right, the 'Issue Bills (Fees): A' section contains four radio button options for setting bills based on community classification, building type, or specific zone/community. Below this is a 'Specify Settings: B' section with four radio button options for issuing bills to all members of a specific zone, selected community, selected sub-area, or specific property owner/beneficiary. At the bottom left, there is a 'Write how a specific Beneficiary...' section with a 'Find a specific beneficiary...' button. At the bottom right, there is an 'Adjusted Amount(Real)' input field. The bottom of the window features a 'Buttons' section with 'Back', 'Save', and 'Cancel' buttons. A table at the bottom displays beneficiary data:

Zone Name	Community	Major Location	Based On
D No PC1-1000 - GRACE BOATI House No. DTA 26 -- 11		N/A	Comm. Classifi
D No PC1-1001 - HELLEN FOSU House No. DTA 25 -- 11		N/A	Comm. Classifi

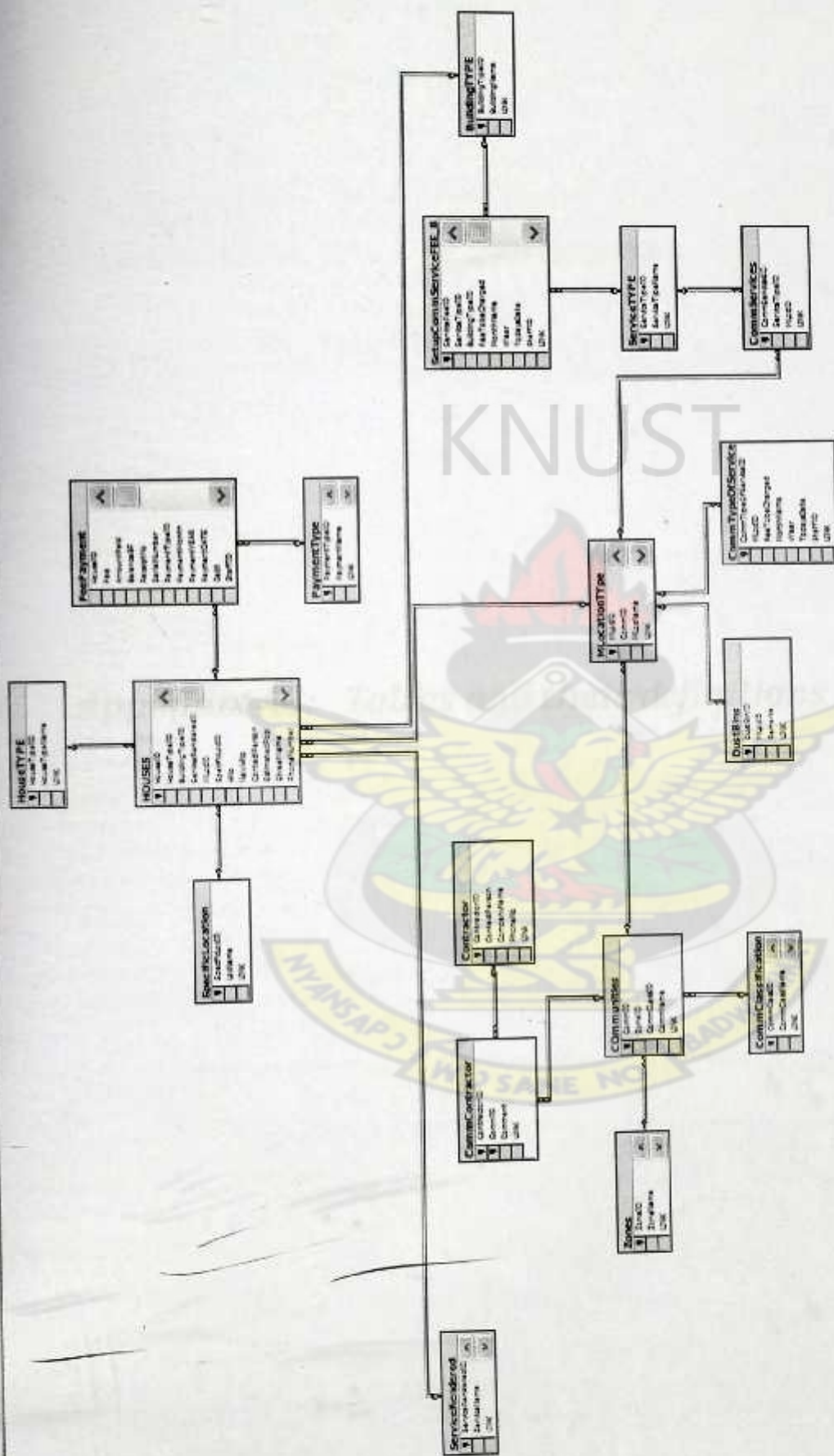
Figure 4.6.15 – Form 12



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***Appendix A2: Fully Attributed Data Model of the System.***



**FIGURE 4.5.1 – Fully Attributed Data Model Showing relationships of entities**



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## ***Appendix A3: Tables and their definitions***

The tables and their related attributes and data types are shown below:

**(a) HouseType**

The HouseType table shows different types of houses or property or buildings. For example, school, domestic house, hospital, church etc.

	Column Name	Data Type	Length	Allow Nulls
	HouseTypeID	varchar	5	
	HouseTypeName	varchar	25	✓
	LINK	varchar	2	✓

**(b) SpecificLocation**

Table showing specific locations of a house or building.

	Column Name	Data Type	Length	Allow Nulls
	SpecificLocID	varchar	5	
	LocName	varchar	25	✓
	LINK	varchar	2	✓



**(c) Houses**

Table showing records of various houses and other buildings in city.

	Column Name	Data Type	Length	Allow Nulls
🔑	HouseID	varchar	20	
	HouseTypeID	varchar	5	
	BuildingTypeID	varchar	5	
	ServiceRenderedID	varchar	10	
	MLocID	varchar	10	
	SpecficLocID	varchar	5	✓
	HNo	varchar	15	✓
	NewHNo	varchar	15	✓
	ContactPerson	varchar	50	✓
	EstimatedPop	varchar	5	✓
	StreetName	varchar	25	✓
	PhoneNumber	varchar	50	✓
	CurrentBALANCE	numeric	9	✓
	MonthlyAmtFEE	numeric	9	✓
	MonthYear	varchar	50	✓
	PaymentSTATUS	varchar	20	✓
	LINK	varchar	2	✓
	IsUpdateSuccessful	varchar	5	✓

**(d) PaymentTypes**

Table showing various modes of payment of fees by beneficiaries.

	Column Name	Data Type	Length	Allow Nulls
🔑	PaymentTypeID	varchar	5	
	PaymentName	varchar	20	✓
	LINK	varchar	2	✓

### (e) Feepayment

Table showing records of payments made by service beneficiaries

	Column Name	Data Type	Length	Allow Nulls
	HouseID	varchar	20	✓
	Fee	varchar	15	✓
	AmountPaid	numeric	9	✓
	BalanceBF	numeric	9	
	ReceiptNo	varchar	50	✓
	SerialNumber	varchar	50	✓
	PaymentTypeID	varchar	5	✓
	PaymentMonth	varchar	15	✓
	PaymentYEAR	varchar	5	✓
	PaymentDATE	smalldatetime	4	✓
	Debt	numeric	9	✓
	StaffID	varchar	10	✓
	AmountInWORDS	varchar	250	✓
	LINK	varchar	2	✓

### (f) ServiceRendered

Table showing a list of services rendered or goods sold in particular buildings or houses.

	Column Name	Data Type	Length	Allow Nulls
🔑	ServiceRenderedID	varchar	10	
	ServiceName	varchar	30	✓
	LINK	varchar	2	✓



### (g) BuildingType

Table showing various types of buildings or houses. Example 2-Storey, 3-storey houses, etc.

	Column Name	Data Type	Length	Allow Nulls
	BuildingTypeID	varchar	5	
	BuildingName	varchar	25	✓
	LINK	varchar	2	✓

### (h) Zones

Table showing a list of zones into which Kumasi City was demarcated.

	Column Name	Data Type	Length	Allow Nulls
	ZoneID	varchar	5	
	ZoneName	varchar	30	✓
	LINK	varchar	2	✓

### (i) Communities

Table showing a list of communities within each zone.

	Column Name	Data Type	Length	Allow Nulls
	CommID	varchar	10	
	ZoneID	varchar	5	✓
	CommClassID	varchar	5	✓
	CommName	varchar	30	✓
	LINK	varchar	2	✓

### (j) MLocationTypes

Table showing a list of sub-areas or major locations within each community of a given zone.

	Column Name	Data Type	Length	Allow Nulls
	MLocID	varchar	10	
	CommID	varchar	10	✓
	MLocName	varchar	30	✓
	LINK	varchar	2	✓

### (k) Contractors

Table showing a list of private waste service providers.

	Column Name	Data Type	Length	Allow Nulls
🔑	ContractorID	varchar	5	
	ContactPerson	varchar	50	✓
	CompanyName	varchar	50	✓
	PhoneNo	varchar	30	✓
	LINK	varchar	2	✓

### (l) CommContractors

Table showing private waste service providers assigned to a particular community.

	Column Name	Data Type	Length	Allow Nulls
🔑	ContractorID	varchar	5	
🔑	CommID	varchar	10	
	Comment	varchar	300	✓
	LINK	varchar	2	✓

### (m) CommClassification

Table showing status or ranks for communities in zones.

	Column Name	Data Type	Length	Allow Nulls
🔑	CommClassID	varchar	5	
	CommClassName	varchar	20	✓
	LINK	varchar	2	✓

### (n) CommServices

Table showing waste management services rendered in sub-areas of a community.

	Column Name	Data Type	Length	Allow Nulls
🔑	CommServicesID	varchar	10	
	ServiceTypeID	varchar	5	✓
	MLocID	varchar	10	✓
	LINK	varchar	2	✓



### (o) ServiceType

Table showing various types of waste management services provided by WMD and private service providers.

	Column Name	Data Type	Length	Allow Nulls
PK	ServiceTypeID	varchar	5	
	ServiceTypeName	varchar	30	✓
	LINK	varchar	2	✓

### (p) CommTypeOfServiceFEE

Table showing fees payable by service beneficiaries. The fees are appended to the sub-areas of communities in which service beneficiaries are located. Fees specified in this table are based on the type of waste management service rendered and the status or rank (1<sup>st</sup> class, 2<sup>nd</sup> class, 3<sup>rd</sup> class, etc) of the community.

	Column Name	Data Type	Length	Allow Nulls
PK	CommTypeOfServiceID	varchar	10	
	MLocID	varchar	10	✓
	FeeToBeCharged	numeric	9	✓
	MonthName	varchar	15	✓
	vYear	varchar	5	✓
	TodaysDate	varchar	15	✓
	StaffID	varchar	10	✓
	LINK	varchar	2	✓

**(q) Dustbins**

Table showing records of dustbins.

	Column Name	Data Type	Length	Allow Nulls
🔑	DustBinID	varchar	10	
	MLocID	varchar	10	
	Remarks	varchar	50	✓
	LINK	varchar	2	✓

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**(r) SetupCommServiceFEE\_B**

This table shows fees payable by service beneficiaries. The fees in this table are specified based on the type of waste management services rendered and the building type of a house. That is, a service beneficiary is charged fees depending upon the type of service they enjoy and whether their buildings are first-storey, second or third storey building and etcetera.

	Column Name	Data Type	Length	Allow Nulls
🔑	ServiceFeeID	varchar	10	
	ServiceTypeID	varchar	5	✓
	BuildingTypeID	varchar	5	✓
	FeeToBeCharged	varchar	15	✓
	MonthName	varchar	10	✓
	vYear	varchar	5	✓
	TodaysDate	varchar	15	✓
	StaffID	numeric	9	✓
	LINK	varchar	2	✓



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***Appendix A4: System outputs as reports***

(a) Register of property

A document containing records of houses and other buildings in the city.

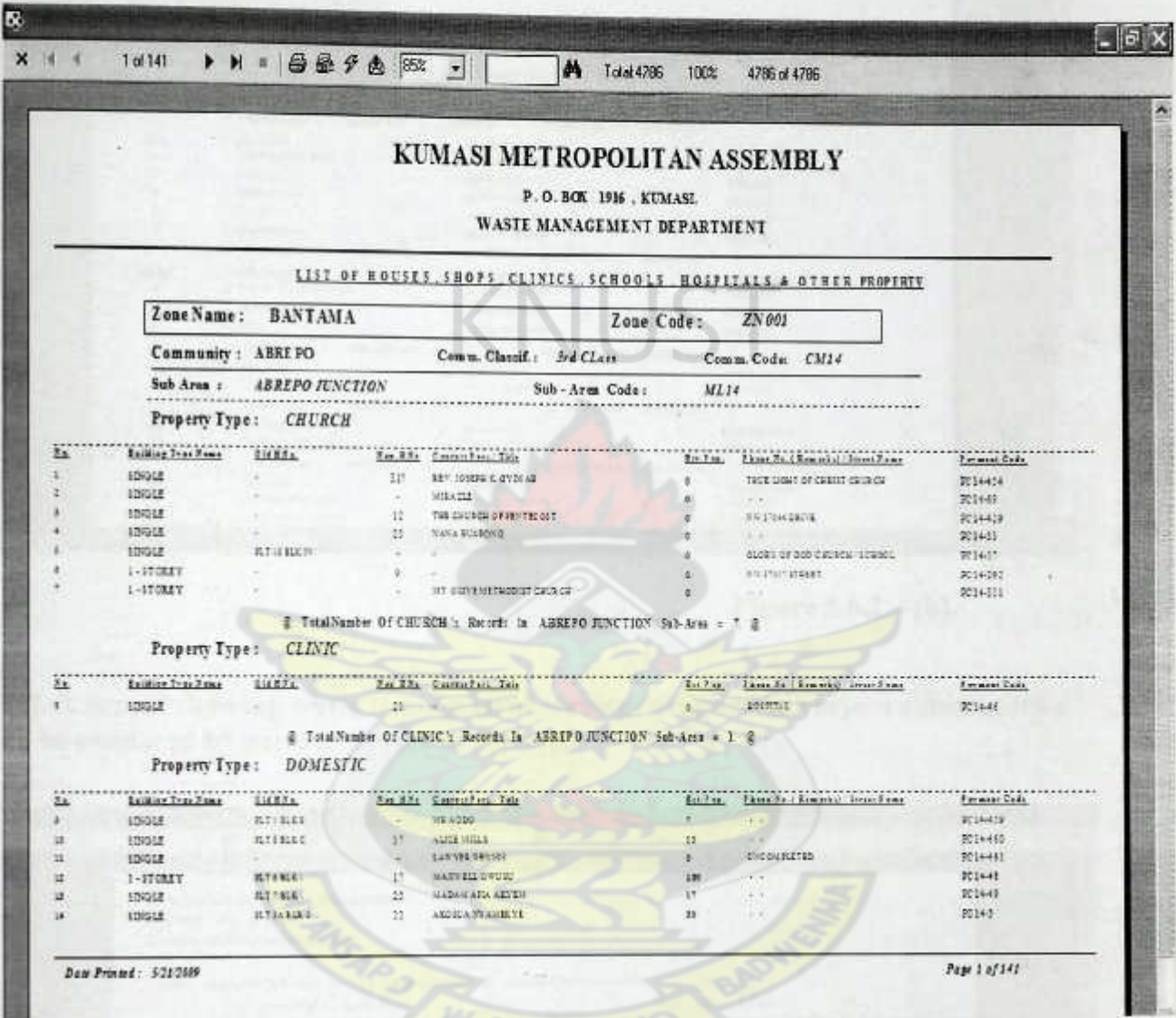


Figure 5.6.1 – (a).



(b) A report showing fees specified for various communities.

KUMASI METROPOLITAN ASSEMBLY  
P. O. BOX 1014, KUMASI  
WASTE MANAGEMENT DEPARTMENT

FEES ASSIGNED TO OR SPECIFIED FOR BENEFICIARIES RESIDING AT VARIOUS SUB-AREAS

Comm Name	ASAWASE	Zone Code	2008
Community	ABOASO	Comm. Class: 1	3rd Class
No.	Sub-Area	Service Type	Fee Charged
1	ARGASO EXTENSION	DOOR-TO-DOOR	GHS2.00
2	ARGASO NO. 1	DOOR-TO-DOOR	GHS1.00
3	ARGASO NO. 2	DOOR-TO-DOOR	GHS2.00
4	MAKMA	DOOR-TO-DOOR	GHS2.00
5	NEDEPASHI	DOOR-TO-DOOR	GHS2.00
Community	ADUKROM	Comm. Class: 1	3rd Class
No.	Sub-Area	Service Type	Fee Charged
6	ADUKROM SUB AREA	DOOR-TO-DOOR	GHS2.00
7	AKRAFU	DOOR-TO-DOOR	GHS2.00
8	YOLA	DOOR-TO-DOOR	GHS2.00
Community	ADUMASA	Comm. Class: 1	3rd Class
No.	Sub-Area	Service Type	Fee Charged
9	ADUMASA SUB AREA	DOOR-TO-DOOR	GHS2.00
Community	AKUREM	Comm. Class: 1	3rd Class
No.	Sub-Area	Service Type	Fee Charged
10	AKUREM SUB AREA	DOOR-TO-DOOR	GHS2.00
Community	APRADE	Comm. Class: 1	3rd Class
No.	Sub-Area	Service Type	Fee Charged
11	APRADE NEW SITE	DOOR-TO-DOOR	GHS1.00
12	APRADE OLD TOWN	DOOR-TO-DOOR	GHS2.00

Figure 5.6.2 – (b).

(c) A report showing waste management services assigned to various communities to be rendered by private service providers.

KUMASI METROPOLITAN ASSEMBLY  
P. O. BOX 1014, KUMASI  
WASTE MANAGEMENT DEPARTMENT

LIST OF SERVICES ENJOYED BY THE BENEFICIARIES IN VARIOUS COMMUNITIES

Comm Name	ASAWASE	Zone Code	2008
Service Type Name	DOOR-TO-DOOR		
Community	ABOASO	CH101	Comm. Class: 1 3rd Class
No.	Sub-Area	Service Name	Sub-Area Code
1	ARGASO EXTENSION	DOOR-TO-DOOR	SL101
2	ARGASO NO. 1	DOOR-TO-DOOR	SL102
3	ARGASO NO. 2	DOOR-TO-DOOR	SL103
4	MAKMA	DOOR-TO-DOOR	SL104
5	NEDEPASHI	DOOR-TO-DOOR	SL105
Community	ADUKROM	CH102	Comm. Class: 1 3rd Class
No.	Sub-Area	Service Name	Sub-Area Code
6	ADUKROM SUB AREA	DOOR-TO-DOOR	SL106
7	AKRAFU	DOOR-TO-DOOR	SL107
8	YOLA	DOOR-TO-DOOR	SL108
Community	ADUMASA	CH103	Comm. Class: 1 3rd Class
No.	Sub-Area	Service Name	Sub-Area Code
9	ADUMASA SUB AREA	DOOR-TO-DOOR	SL109
Community	AKUREM	CH104	Comm. Class: 1 3rd Class
No.	Sub-Area	Service Name	Sub-Area Code
10	AKUREM SUB AREA	DOOR-TO-DOOR	SL110

Figure 5.6.3 – (c).

(d) A report showing expected revenue both in actual and percentages

KUMASI METROPOLITAN ASSEMBLY  
P.O. BOX 1914, KUMASI  
WASTE MANAGEMENT DEPARTMENT

TOTAL REVENUE EXPECTED FROM BENEFICIARIES IN VARIOUS ZONES

May-2009

No.	Zone Name	Total Revenue Expected	Total Percentage	Exp. Rev. Per Month	Monthly %	Outstanding Bal.
1	ASA WASE - ZONE	GHS 622.00	100%	GHS 622.00	100%	GHS 0.00
2	ADENSA - ZONE	GHS 0.00	0%	GHS 0.00	0%	GHS 0.00

(A) A Report viewed at Zone level

KUMASI METROPOLITAN ASSEMBLY  
P.O. BOX 1914, KUMASI  
WASTE MANAGEMENT DEPARTMENT

TOTAL REVENUE EXPECTED FROM BENEFICIARIES IN VARIOUS COMMUNITIES

Zone Name : ASA WASE

Zone Code : Z001

May-2009

No.	Community	Comm. Class	Revenue Expected	Percentage	Monthly Exp. Rev	Monthly %	Outstanding Balance
1	ABOABO	3rd Class	GHS 1,861.91	20.64%	GHS 1,861.91	20.64%	GHS 0.00
2	ADUKROM	3rd Class	GHS 1,043.79	11.57%	GHS 1,043.79	11.57%	GHS 0.00
3	ADUSASA	3rd Class	GHS 87.88	0.71%	GHS 87.88	0.71%	GHS 0.00
4	AKYESI	3rd Class	GHS 409.35	4.54%	GHS 409.35	4.54%	GHS 0.00
5	APRAHE	3rd Class	GHS 807.38	8.97%	GHS 807.38	8.97%	GHS 0.00
6	AYAWASE	3rd Class	GHS 2,437.55	26.97%	GHS 2,437.55	26.97%	GHS 0.00
7	AYESI	3rd Class	GHS 787.89	8.71%	GHS 787.89	8.71%	GHS 0.00
8	AYIKUMASE	3rd Class	GHS 787.79	8.71%	GHS 787.79	8.71%	GHS 0.00
9	PAKOTO	3rd Class	GHS 131.79	1.45%	GHS 131.79	1.45%	GHS 0.00
10	KANABIA	3rd Class	GHS 897.78	9.87%	GHS 897.78	9.87%	GHS 0.00
11	ESPEYIDOM	3rd Class	GHS 77.58	0.85%	GHS 77.58	0.85%	GHS 0.00

Grand Total From Various Communities Combined = GHS 9,021.36 GHS 9,021.36

(B) A Report viewed at Community level

KUMASI METROPOLITAN ASSEMBLY  
P.O. BOX 1914, KUMASI  
WASTE MANAGEMENT DEPARTMENT

TOTAL REVENUE EXPECTED FROM BENEFICIARIES RESIDING IN VARIOUS SUB AREAS

Zone Name : ASA WASE

Zone Code : Z001

May-2009

Community : ABOABO

Comm. Class : 3rd Class

No.	Sub-Area	Sub-Area Code	Total	Percentage	Exp. Rev. Per Month	Monthly %	Outstanding Balance
1	ABOABO EXTENSION	SL002	GHS 1,043.79	11.57%	GHS 1,043.79	11.57%	GHS 0.00
2	ABOABO RD 1	SL003	GHS 169.39	1.88%	GHS 169.39	1.88%	GHS 0.00
3	ABOABO RD 2	SL004	GHS 104.27	1.15%	GHS 104.27	1.15%	GHS 0.00
4	MEHUPATEM	SL005	GHS 179.41	1.98%	GHS 179.41	1.98%	GHS 0.00
5	MAJESIA	SL006	GHS 9.82	0.11%	GHS 9.82	0.11%	GHS 0.00

Community : ADUKROM

Comm. Class : 3rd Class

No.	Sub-Area	Sub-Area Code	Total	Percentage	Exp. Rev. Per Month	Monthly %	Outstanding Balance
1	ADUKROM SUB AREA	SL007	GHS 943.79	10.44%	GHS 943.79	10.44%	GHS 0.00
2	AKYAPU	SL008	GHS 87.70	0.97%	GHS 87.70	0.97%	GHS 0.00
3	KIDIA	SL009	GHS 18.24	0.20%	GHS 18.24	0.20%	GHS 0.00

Community : AYAWASE

Comm. Class : 3rd Class

No.	Sub-Area	Sub-Area Code	Total	Percentage	Exp. Rev. Per Month	Monthly %	Outstanding Balance
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(C) A Report viewed at Sub-Area level

Figure 5.6.4 – (d)



(e) A report showing details of revenue collected.

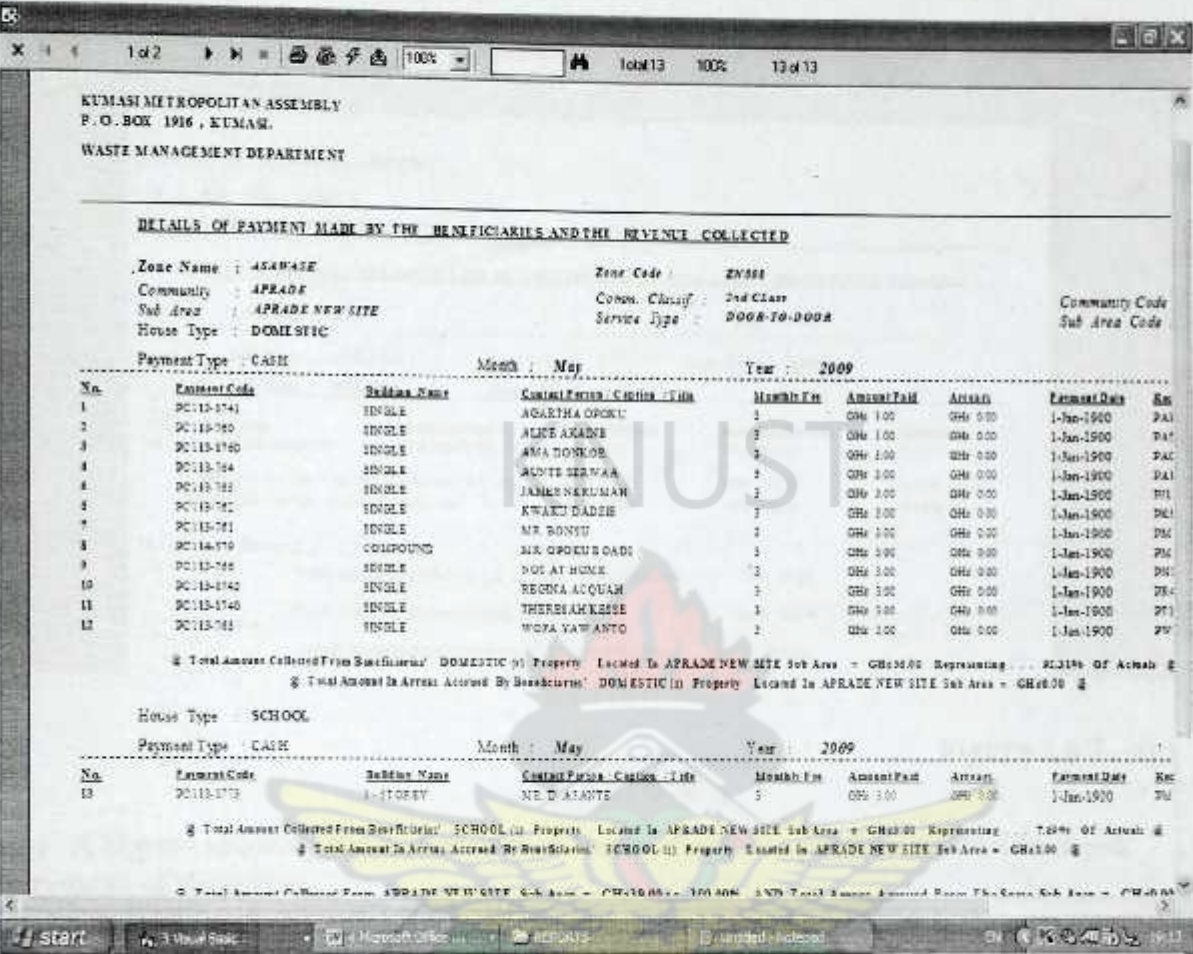


Figure 5.6.5 – (e)

(f) A report showing receipt of payment

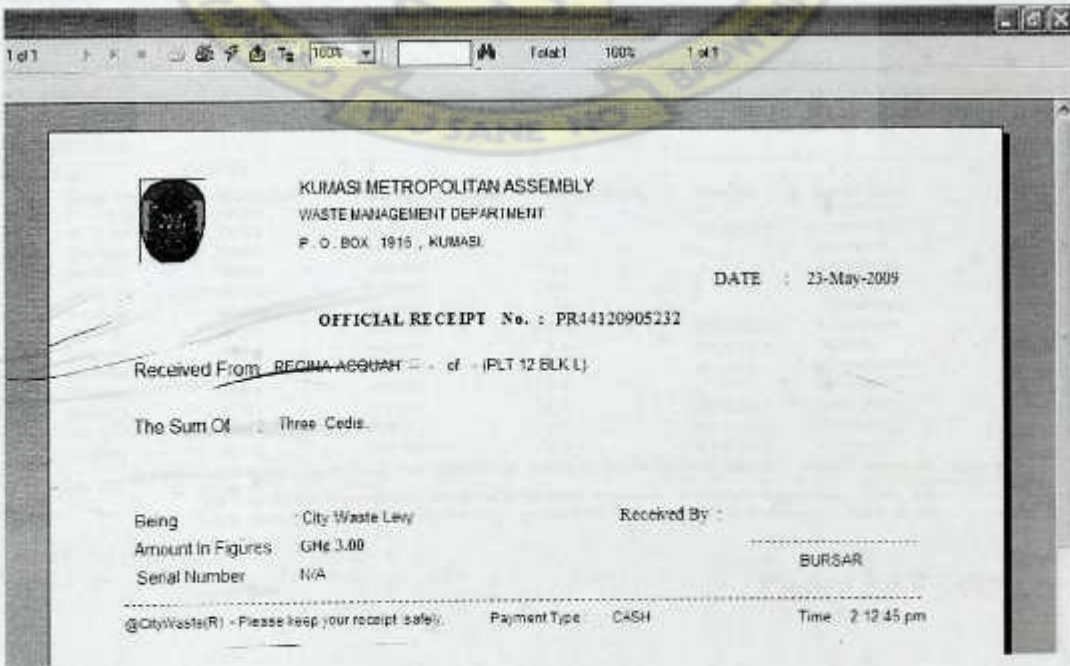


Figure 5.6.6 – (f)

(g) A report on revenue collected as a percentage of expected total revenue.

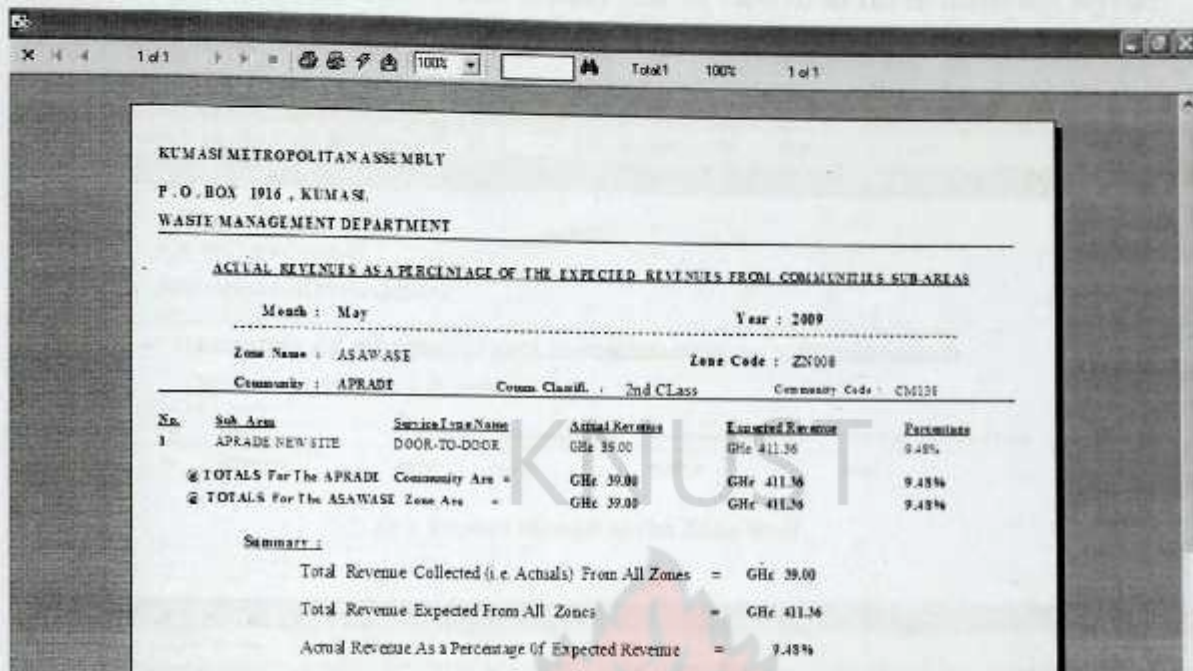


Figure 5.6.7 – (g)

(h) A report showing list of debtors or those who have paid or made advanced payment of their fees.

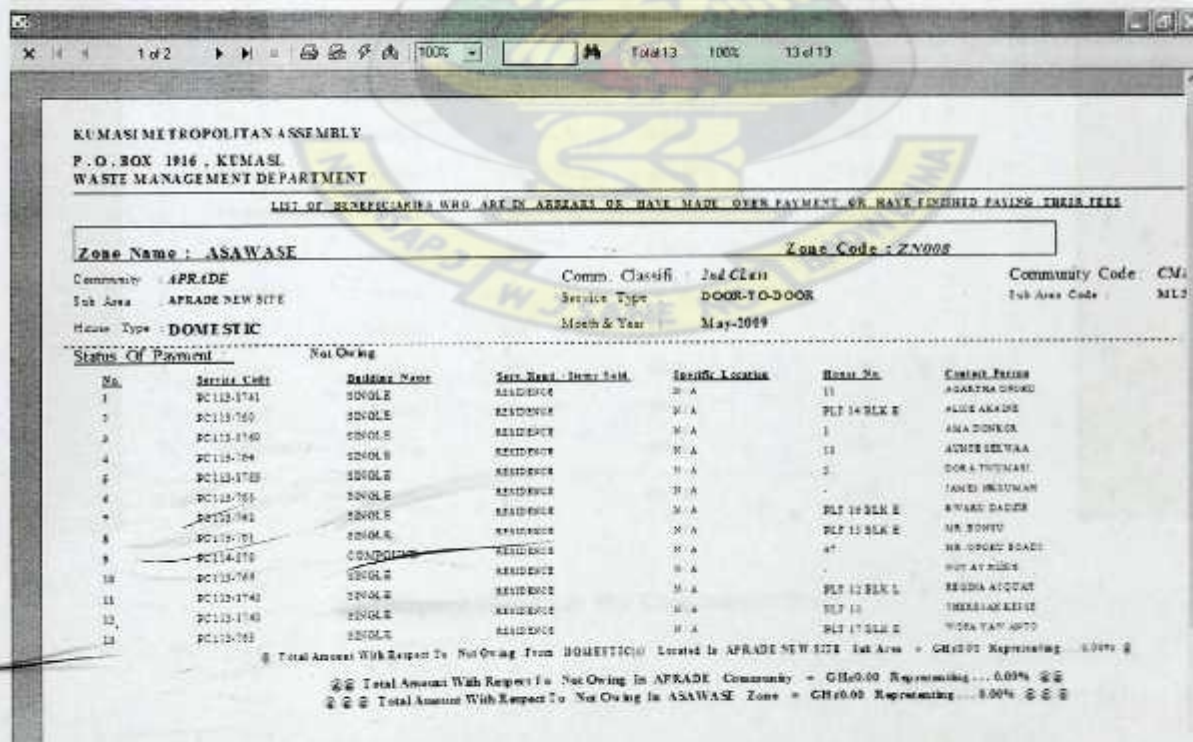
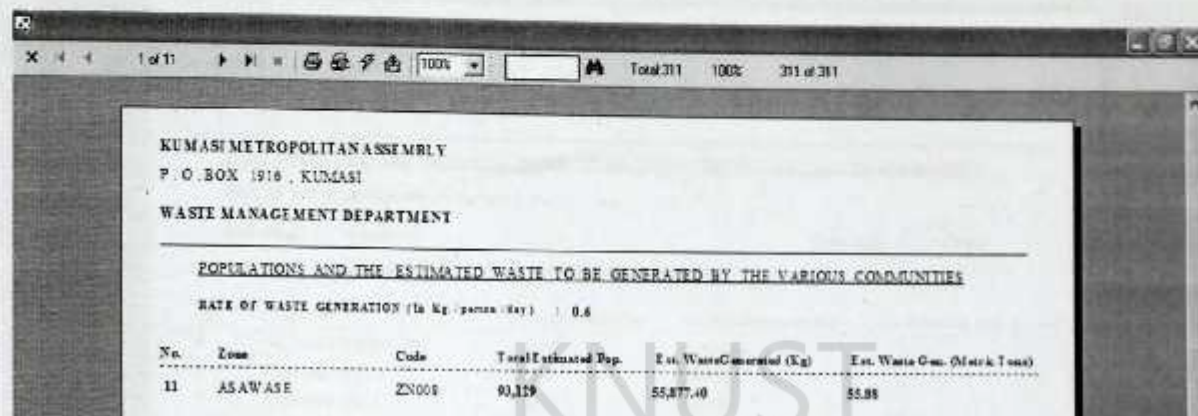


Figure 5.6.8 – (h)



- (i) A report showing estimated weights of solid wastes generated by the people living in various communities. This report can be viewed at three different levels: Zone, community and sub-area levels.



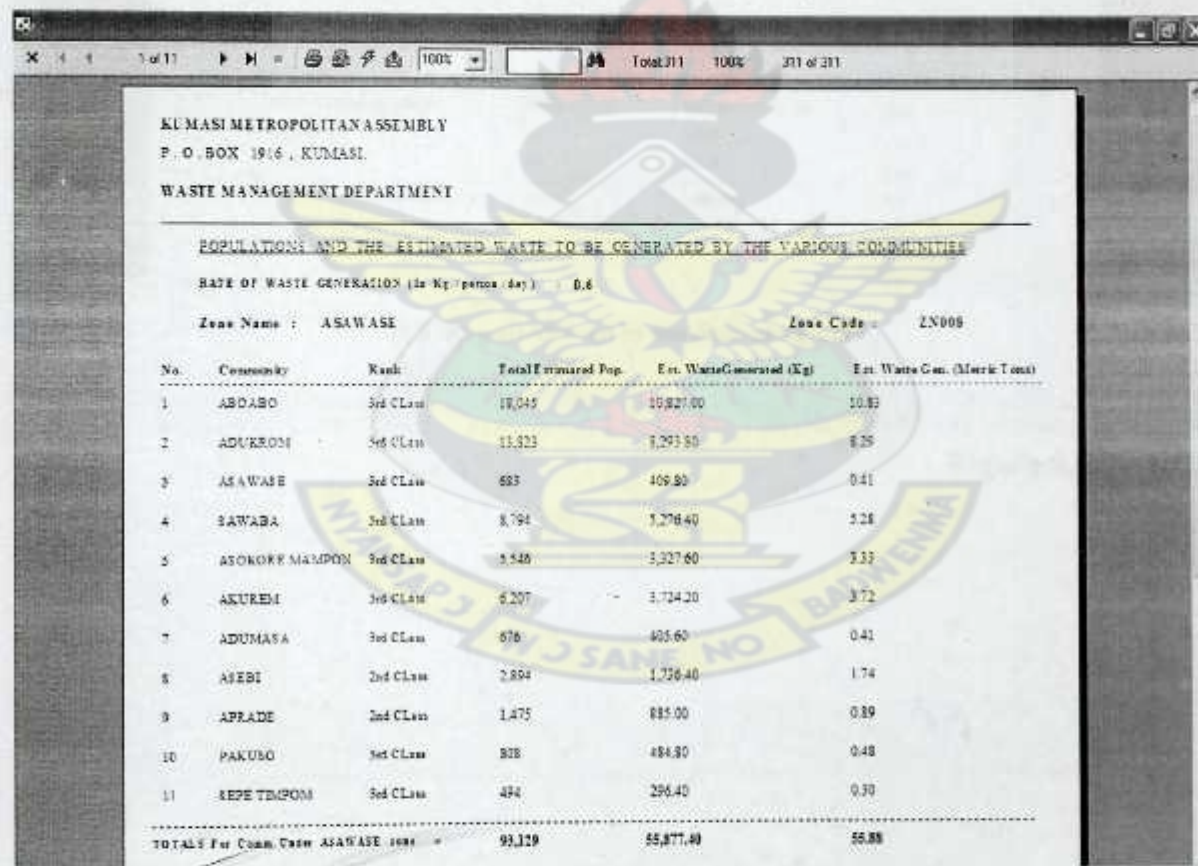
KUMASI METROPOLITAN ASSEMBLY  
P. O. BOX 1916, KUMASI  
WASTE MANAGEMENT DEPARTMENT

POPULATIONS AND THE ESTIMATED WASTE TO BE GENERATED BY THE VARIOUS COMMUNITIES

RATE OF WASTE GENERATION (in Kg/person/day) : 0.6

No.	Zone	Code	Total Estimated Pop.	Est. Waste Generated (Kg)	Est. Waste Gen. (Metric Tons)
11	ASA WASE	ZN008	93,129	55,877.40	55.88

(A) Report viewed at the Zone level



KUMASI METROPOLITAN ASSEMBLY  
P. O. BOX 1916, KUMASI  
WASTE MANAGEMENT DEPARTMENT

POPULATIONS AND THE ESTIMATED WASTE TO BE GENERATED BY THE VARIOUS COMMUNITIES

RATE OF WASTE GENERATION (in Kg/person/day) : 0.6

Zone Name : ASA WASE      Zone Code : ZN008

No.	Community	Rank	Total Estimated Pop.	Est. Waste Generated (Kg)	Est. Waste Gen. (Metric Tons)
1	ABDABO	3rd CLass	19,045	19,827.00	19.83
2	ADUKROMI	3rd CLass	11,323	9,293.50	9.29
3	ASA WASE	3rd CLass	693	409.80	0.41
4	BARABA	3rd CLass	8,794	1,276.40	1.28
5	ASOKORE NAMPOM	3rd CLass	5,546	3,327.60	3.33
6	AKUREM	3rd CLass	6,207	3,734.20	3.72
7	ADUMASA	3rd CLass	676	405.60	0.41
8	ASEBI	2nd CLass	2,894	1,736.40	1.74
9	APRADE	2nd CLass	1,475	885.00	0.89
10	PAKUSO	3rd CLass	808	484.80	0.48
11	KEPE TROM	3rd CLass	494	296.40	0.30
TOTALS For Comm. Under ASA WASE 1099			93,129	55,877.40	55.88

(B) Report viewed at the Community level

Figure 5.6.9 – (i)

KUMASI METROPOLITAN ASSEMBLY  
P. O. BOX 1816, KUMASI  
WASTE MANAGEMENT DEPARTMENT

POPULATIONS AND THE ESTIMATED WASTE TO BE GENERATED BY THE VARIOUS COMMUNITIES

RATE OF WASTE GENERATION (In Kg. per person per day) = 0.6

Zone Name : ASAWASE      Zone Code : ZN008

Community : ABOABO      Community Rank : 5-6 CLAS

No.	Sub-Area	Total Estimated Pop.	Est. Waste Generated (Kg)	Est. Waste Gen. (Metric Tons)
1	ABOABO EXTENSION	18145	10,887.00	10.83
2	ABOABO NO. 1	3819	2,291.80	2.17
3	ABOABO NO. 2	10774	6,464.40	6.48
4	MENPEASEM	1439	863.35	0.90
5	MAJEMEA	170	90.00	0.08
Total For ABOABO Community =		34884	20,496.48	20.48

Community : ADUKROM      Community Rank : 2nd CLAS

No.	Sub-Area	Total Estimated Pop.	Est. Waste Generated (Kg)	Est. Waste Gen. (Metric Tons)
6	ADUKROM SUB AREA	13622	8,173.20	8.29
7	AKRAFU	724	434.40	0.43
8	NIMA	554	332.40	0.33
Total For ADUKROM Community =		14,861	8,938.80	9.04

Community : ASAWASE      Community Rank : 3rd CLAS

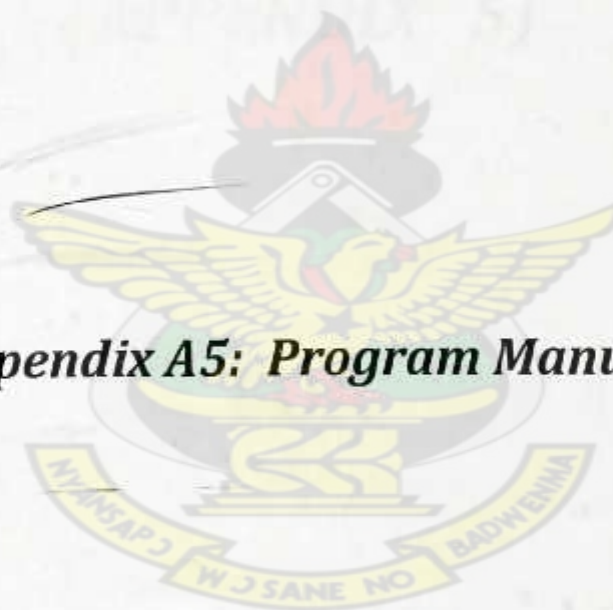
(C) Report viewed at the Sub-area level

Figure 5.6.9 – (i)



KNUST

***Appendix A5: Program Manual***



# ***PROGRAM MANUAL***

***(APPENDIX 5)***

**KNUST**

**FOR**

***SOLID WASTE REVENUE MANAGEMENT  
APPLICATION SYSTEM***

**OCTOBER, 2009**