UNIVERSITY OF GHANA

DEPARTMENT OF ECONOMICS
COLLEGE OF HUMANITIES

COST AND BENEFIT ANALYSIS OF THE ELECTRONIC MEDICAL RECORDS SYSTEM IN THE UNIVERSITY OF GHANA HOSPITAL

PRESENTED BY

ASAMOAH MUSTAPHA NANA KWAKU

A PROJECT WORK SUBMITTED TO THE DEPARTMENT OF ECONOMICS, UNIVERSITY OF GHANA-LEGON IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF A BACHELOR OF ARTS DEGREE IN ECONOMICS

DECLARATION

I hereby solemnly declare that this project work entitled "the cost and benefit analysis of Electronic Medical Records System in the University of Ghana hospital" submitted to the Department of Economics, is a record of original work done under the supervision of Dr. Frank Agyire-Tettey, lecturer, University of Ghana and this project work is submitted in partial fulfillment of the requirement for the award of a Bachelor of Arts degree in Economics. The results contained in this project work has not been submitted to any other University or institute for the award of any degree or diploma.

DEDICATION

This work is dedicated to my family and friends for immensely supporting us throughout my course of work. May God richly bless them and enlarge their territories.

ACKNOWLEGEMENT

To begin with, I give an unending thanks to the Almighty God for his protection and the strength he has provided us all in order to complete this project work. In performing my assignment, I had to take the help and guideline of some respected persons, who deserve my greatest gratitude. The completion of this project work gives us much pleasure. I would like to show my gratitude to Dr. Frank Agyire-Tettey for giving us a good guideline for this project through several consultations. I would also like to extend my deepest gratitude to all those who have directly and indirectly guided us in writing this project work.

I also thank Mr. Francis Amoah, head of the University of Ghana hospital account unit, Mr. Ignatius Offei, head of the University of Ghana hospital records unit and Mr. Dominic Adjei-Kyereh, accountant of the University of Ghana hospital for the assistance they gave for the successful completion of this project work. I also thank the entire staff of the University of Ghana hospital and the University of Ghana Computing System (UGCS) for their significant role during my data collection.

Many people, have made valuable comments and suggestions on this proposal which gave us an inspiration to improve my project work. I extend my profound gratitude to you all. May God Bless you.

ABSTRACT

Information security in respect to patients' records are very important in any hospital, be it a government or private hospital. The University of Ghana hospital as the sole provider of health services to employees, dependants and students of the University of Ghana and individuals in the immediate environs of the University of Ghana aims at progressive and sustainable transformation of University health services into a vibrant centre of excellence and pivot for public health sector development. In view of this, the management of the University of Ghana and the University of Ghana hospital try to put in place many measures to make this aim a reality. To achieve this aim, it is needed that the University of Ghana hospital provides proper and efficient record keeping system to enable the hospital render good healthcare service. In line with this, the University of Ghana management together with the management of the University of Ghana hospital decided to implement the Electronic Medical Record Keeping System in the hospital. This project work seeks to determine the viability of the implementation of the Electronic Medical Record System in the University of Ghana hospital. In determining the viability of the project, the Net Present Value (IRR), Internal Rate of Return (IRR) and the Benefit Cost Ratio (BCR) are used as investment criteria. Using the Net Present Value (IRR), gives a positive Net present Value in sum of **GH₵3, 063,955.637**, also Internal Rate of Return (IRR) gives us a rate of **28.06** percent which is greater than the market discount rate (monetary policy rate) of **22.5** percent**.** Additionally, the Benefit Cost Ratio (BCR) of **4.55** is greater than 1, thus the stream of benefits from the implementation of the Electronic Medical Record System is greater than the cost over its lifetime. Therefore implementation of the Electronic Medical Record System is worthwhile and both private and government hospitals in the country can also implement it.

TABLE OF CONTENTS

ACRONYMS AND ABBREVIATION

BCR	Benefit Cost Ratio
CBA	Cost and Benefit Analysis
EMR	Electronic Medical Records system.
HIS	Hospital Integration System.
IPMC	Intercom Programming and Manufacturing Company limited
IRR	Internal Rate of Return
NPV	Net Present Value
PVB	Present Value of Benefit
PVC	Present Value of Cost
SN	Staff Nurse
UGCS	University of Ghana Computer System

CHAPTER ONE

INTRODUCTION

1.1 Background Information

Over the years, documentation of patients' details and diagnosis were done manually by the use of paper (textbooks) by many government and private hospitals worldwide. These documents are either kept or stored in the hospitals or given to patients to carry them to their respective homes. The paper-based keeps lab reports, patient charts, radiology reports, medical histories and other important patient information. Due to the many challenges imposed by the paper-based record keeping, the Electronic Medical Record System was introduced.

The idea of recording patients' information electronically instead of on paper has been around since the late 1960's, when Larry Weed introduced the concept of the Problem Oriented Medical Record into medical practice. Until then, doctors usually recorded only their diagnoses and the treatment they provided. Weed's innovation was to generate a record that would allow a third party to independently verify the diagnosis. Today, it is easy to think of the Electronic Medical Record System as a substitute for paper record keeping and little else. When properly implemented, this model provides a more effective means of communication among members of the healthcare team while facilitating the coordination or preventive care and maintenance.

In order to provide better services to patients, the Electronic Medical Record System (EMR) is a tool that provides the platform from which new functionality and new services can be provided for patients. Technology had entered most medical offices during 1990 and computers were being used to a limited degree for record keeping purposes. But, it wasn't until the age of the internet

that large-scale change became far more visible. Even in its early stages, the internet became a vital tool for recording and transferring prescription histories and other medical records. Finally, within the last decade or so, most major medical systems in the developed world could easily communicate with each other when needed.

Today, medical records are increasingly paperless, although some private practices continue to use a combination of paper and computerized records. Patient medical records are more accessible than ever before with data technology becoming increasingly portable and comprehensive. Current refinements in the medical records industry are aimed at the continued specialization of systems to further streamline workflows, boost productivity and improve doctor-patient interactions as it is done in the University of Ghana hospital.

The University of Ghana hospital, popularly known as the Legon hospital was built and commissioned in 1957 and is officially owned by the University of Ghana. It was established almost the same time as the University was located in Achimota School West Compound. It was put under the charge of Dr. A.B. Boyd (a Scottish Doctor) who was assisted by one staff nurse (SN). The hospital started as a clinic sharing all facilities in common with the Achimota Hospital. In 1959, five (5) personnel consisting of a doctor and four nurses moved from Achimota to start work at the then University College hospital. The facilities of the hospital grew over time to include Maternity Ward and Staff Quarters. The hospital is currently situated at an easily accessible area behind the Legon Police Station at 12.6 kilometers off the main Accra – Aburi road. It is a quasi-government hospital with a bed capacity of 130 comprising of General Wards, Maternity Wing, Casualty and Emergency Ward, Pediatric Unit, Dental Unit and Operating Theatre.

The hospital was originally established to cater for the health needs of the student population, employees of the University and their dependents. In 1976/77 as the community started developing, the inhabitants of its fast-growing environs began to seek health care from the hospital. In recognition of the change in the function of the University hospital in 1976/77, the Ministry of Health (MOH) readily accepted to assist the hospital yearly with drugs, diagnostics medical equipments and medical laboratory instruments. This arrangement worked quite well until 1986/87 when the" cash-and- carry" system was introduced and the assistance to the hospital ceased. The hospital readily offered its services to these people as there was no other hospital in the whole Legon vicinity. With time, the hospital has assumed the functions of a District hospital and has a wide catchment areas.

The University of Ghana hospital has also established a Primary Health Care outreach programme aimed at teaching and advising students, pregnant women, nursing mothers and the general public about personal hygiene, good diet, child care, including immunization against childhood communicable diseases, family planning and school health services.

The University hospital can therefore be viewed as part of the hierarchy for the delivery of health services in the Greater Accra Region, a region with a population currently estimated at about 5 million. The main referral point for the hospital is the Korle-Bu Teaching hospital and 37 Hospital. The hospital has introduced specialist consultancy services. In view of this, referral to Korle-Bu and 37 is very minimal. When the hospital was first established in 1957, the students' population was only 240. There has been tremendous increase since then.

By means of the vision of the University hospital "Progressive and Sustainable Transformation of University Health Services into a Vibrant Centre of Excellence and Pivot for Public Health Sector Development", the hospital strives to improve their services any possible means. This

ultimately led to the implementation of the Electronic Medical Record Systems in the hospital as a way of improving the services rendered by the hospital.

The missions of the hospital are;

- To enhance the health status of all employees, dependants and students of the University of Ghana by providing them with world class Medical Services of the highest quality.
- To enhance the health status of the communities in University of Ghana's immediate environs by providing affordable client focused quality health services.
- To strategically position the University Health Services in Medical Training and Collaborative Research for Capacity Building.
- To collaborate with all public Universities across the length and breadth of the nation in the establishment of a vibrant national University Health services for Ghana.

The hospital management committee set up by University Council is the policy making body of the Hospital. The hospital is headed by the Director of University Health Services.

The hospital provides services including out-patient department, in-patient services, maternal care, pharmacy, radiography (x-ray & radiology), ultrasound scanning, laboratory services, surgery, obstetrics and gynaecology, public health services, dental care, eye care, accident & emergency services and laundry services.

Also the specialist clinics the hospital has includes surgery, obstetrics and gynaecology, paediatrics, internal medicine, diabetics, dermatology, e.n.t and orthopedics.

1.2 Problem statement.

The University of Ghana hospital is really committed to enhancing the health status of all employees, dependants and students of the University of Ghana by providing them with a world

class Medical Services of the highest quality. With this, the hospital implements projects to enhance the quality of their medical services. According to the administration of the hospital, individuals in the immediate environs of the University of Ghana also visit the hospital for health services. This creates lots of difficulty with respect to record keeping using the manual system. This causes patients in some cases to loss their records because it gets missing in a pile of records which contributes to incorrect diagnosis. Further, files of patients are kept in shelves and are exposed to dusts. Searching for information of patients in files from the shelves is stressful and time consuming and there is a high chance of losing information of patients. Data entering becomes cumbersome with the traditional (manual) way of keeping medical record and eventually work output is minimal.

These problems of the administrative difficulty of the traditional way of keeping records in University of Ghana hospital in addition to the hospital's vision led to the introduction of the Electronic Medical Record System. This study seeks to analyze the costs and benefits associated with the Electronic way of keeping records.

1.3 Research questions

This part of the study reveals some of the questions that are mostly asked by people. Most of these questions will be answered by the end of this study. Some of the questions being asked by individuals with regards to the Electronic Medical Record Systems are as follow:

- How does the Electronic Medical Record System work?
- How is the Electronic Medical Record System moving in line with the mission and vision statement of the hospital?

- How does the Electronic Medical Record System improve health care delivery in the hospital?
- Considering the costs and benefits, is the Electronic Medical Record System project viable and how is this an improvement on the manual system.
- How does the hospital keep Electronic Medical Record System from unauthorized disclosure (confidentiality) and measures put in place to assess the integrity of the Electronic Medical Record System?

1.4 Objective of the Study

The main aim of this study is to investigate the costs and benefits of implementing the Electronic Medical Record System in the University of Ghana hospital.

In the process of achieving this objective, I shall also find out the various appraisals that were carried out for the implementation of the system.

Some of the specific objectives include finding the importance of Electronic Medical Record System to the hospital and also knowing the measures put in place to use the system to ensure good health care delivery.

1.5 Hypothesis

A hypothesis test is a statistical test that is used to determine whether there is enough evidence in a sample of data to infer that a certain condition is true for the entire population. A hypothesis test examines two opposing hypothesis about a population: the null hypothesis and the alternative hypothesis.

The Null Hypothesis;

The null hypothesis is the statement that is always the case until enough evidence proves otherwise. It is usually a statement of “no effect” or “no difference”. Specifically to my study, the null hypothesis will be, the cost and benefit associated with the implementation of the Electronic Medical Record System are not significantly different.

The Alternate Hypothesis;

The alternate hypothesis is the statement been tested, It is usually a statement of “there is an effect” or “there is a significant difference”. Specifically to my study, the alternate hypothesis will be, the cost and benefit associated with the implementation of the Electronic Medical Record System are significantly different.

1.6 Significance of the Study:

This study is designed in order;

- To help arrive at the reasons for subscribing onto electronic data-base system for record keeping.
- To identify the cost elements of adopting the electronic medical record keeping.
- To identify the benefits of adopting the electronic medical record keeping.
- To draw comparative analysis between manual and electronic systems of record keeping.
- Before and after data can help us know the work output per time (hour) in each case. (Before-Manual; After-Electronic)

To conduct a feasibility review for implementation purposes in other identified hospitals. That, is to help understand why it should be recommended or not.

1.7 Structure of the study.

Under the structure of the study I talk about the methodology, Data source, investment criteria and organization of the study.

1.7.1 Methodology

The study is based on the Electronic Medical Record System in the University of Ghana hospital and in expressing the cost-benefit analysis to determine the viability of the Electronic Medical Record System project, several investment criteria and data collection methods are used,

1.7.2 Data Source

The cost and benefits analysis of the Electronic Medical Record System in the University of Ghana hospital study, will combine data collected from both primary and secondary sources. The primary data will consists of both the quantitative and qualitative data which will be collected during the interaction with patients and some working staff of both the University of Ghana hospital and University of Ghana Computing System. This will include semi-structured interviews with working personnel at the records department at the University of Ghana hospital and patients on their assessment of the Electronic Medical Record System in the University of Ghana hospital. I will also interview the head of the administration department of the University of Ghana hospital to have his say or knowledge of the Electronic Medical Record System and how it can help improve healthcare delivery in the hospital. Also staff members of the University of Ghana Computing System will be interviewed since they are in charge of the management of the Electronic Medical Record System in the University hospital. The secondary data sources will

include information obtained from literatures on the Electronic Medical Record System acquired from the internet, other research materials and books pertinent to this project.

1.7.3 Investment Criteria

To choose a project, you have to show whether the project is viable or not. This is done by using various investment criteria for the purpose of this study to help determine the viability of the project. For the purpose of my study, Net Present Value, Internal Rate of Revenue and Benefit Cost ratio criteria would be used in the evaluation of the implemented Electronic Medical Record System project and this is the relative value of the project with regards to the cost and benefit associated with it.

1.7.4 Organization of study

In this very chapter, I considered the background information of the project, the statement of the problem, research questions, the objective for the study, and significance for conducting this study and the methodology to be used and how the study will be organized.

However, this study is sorted into five chapters. Beginning is chapter one which contains the introduction to the project, which is made up of, *Background of the project*: This part is vital since it gives some historical information about the project, *Problem Statement*: This discusses the notch of difficulties I have identified that necessitated for the study. It likewise uncovers the condition of the place and the earnestness of the study, *Research questions*: This section encompasses different inquiries that guide my study, *Objectives of the review*: This comprises the reason for my study, *Significant of the study*: How advantageous the study will be after it has been done, *Methodology*: Under this section, I discuss the investment criteria and the source of data that are

joined in analyzing the project and *Organization of the study*: This gives the content of the study. Chapter two talks about the elements of project appraisal. This involves financial appraisal, technical appraisal, economic appraisal, commercial appraisal, institutional appraisal and socio-cultural appraisal. Chapter three talks about the elements of costs and benefits associated with the project. This features real direct tangible costs, real direct intangible costs, real direct tangible benefits and real direct intangible benefits as well as real indirect tangible costs, real indirect intangible costs, real indirect tangible benefits and real indirect intangible benefits. In chapter four, I do evaluation of the project. The evaluation incorporates; Methodology: I consider in details the investment criteria to be used in analyzing the viability of the project, *Proper Evaluation*: Various formulae from literature around the world are utilized as a part of assessing the viability of the project using the costs and benefits outlined in chapter three. At long last, in chapter five, I summarize, finish up and make essential recommendations about the project.

CHAPTER TWO

ELEMENT OF PROJECT APPRAISAL

2.1 Introduction

This chapter discusses the elements of appraisal for the project. Project Appraisal is a structured process of assessing a given project and evaluating its content to approve or reject the project or it can be said as conducting a feasibility analysis of the project. It is an attempt to justify the project through analysis, which is a way to determine project feasibility and cost-effectiveness. It frequently includes looking at various options which is done by utilizing economic appraisal or some other decision analysis techniques.

Appraising a project means evaluating the proposed solution against its ability to solve the known problem or need, hence appraisal is done to know how much resources have been invested in a project and in return the extent to which the project will solve the identified problem. In this study, the researchers are going to use different elements of appraisal to assess the viability of the Electronic Medical Record Systems in the University of Ghana hospital before resources were committed to it. The elements of appraisal that I am going to talk about are: Financial, Technical, Economic, Commercial, Institutional and Socio-cultural Appraisals.

2.2 Financial Appraisal.

Financial appraisal is the value of money over time. In general, one of the very significant factors that a project team should precisely prepare is the financial viability of the entire project. This analysis questions whether the University of Ghana hospital would fund the project from internal sources or external sources and whether this external resources would be borrowed and if it is

borrowed, would the hospital be able to pay back the loan with its accrued interest or would the external resources be a grant from the government, University of Ghana or from any other source or whether the hospital would co-fund the project with an outside donor. These were some of the things that were talked about before the Electronic Medical Record Keeping Systems was implemented. According to the University of Ghana hospital, the means of the finance of the Electronic Medical Record Keeping Systems project include a procurement fund from the University of Ghana internally generated fund. The board of directors of the University in close doors meeting with the administration of the hospital came up with a decision to fund the project from the University's internally generated fund which was validated by a Memorandum of Understanding (MOU) between the two parties.

2.3 Technical Appraisal

Technical appraisal is a detailed study to ensure that a project is (i) soundly designed, (ii) properly engineered and (iii) follows accepted standards. These considerations differ from project to project. But, in any case, the emphasis is on the inputs needed for the project and the resulting outputs of goods & services

Technical appraisal of a project aims at clearly spelling out the correct technical design details which includes details such as size, location, timing and technology. This also analyzes the availability of raw materials and their source identified, availability of power, availability of skilled man power, engineering facilities, and maintenance for the installation of the Electronic Medical Record Systems. This analysis is important since its worth lies in planning the exercises, documentation process, risk minimization process and to get approval. During the implementation

of the Electronic Medical Record Systems at the University of Ghana hospital, the major phases and issues assessed included;

1. A meeting between the University hospital and the University of Ghana Computing System (UGCS) to decide on the firm to provide the software. The meeting concluded on the overall nature of the system. They have the component of the system in mind, on what they need for the project to be implemented. The technical team in the University of Ghana Computing System designed a comprehensive outlook of the project stating the necessary technical equipment needed for the project.
2. Upon agreement in a Memorandum of Understanding, advertisement was placed out requesting potential companies to bid for the contract.
3. The contract was awarded to Ebizframe RX HIS through a procurement arrangement between IPMC and the University hospital.
4. There was also a close interest of the University of Ghana computing system (UGCS). The University of Ghana computing system was and is still in charge of laying of the fibre and providing the computer hardware components of the system.
5. The system is not an off-the counter purchase but designed to meet the requirements and provisions made by the hospital.

The software provider was in charge of training and retraining of workers to meet the technical knowledge required to operate the system.

2.4 Economic Appraisal

In achieving value for money and satisfying public accountability requirements, economic appraisal is a key tool and this is the systematic process applied to a project that takes into account

a wide range of costs and benefits, for which a monetary equivalent can be estimated. Economic appraisal is a key for satisfying requirements for decision accountability and achieving value for money. Hence for the purpose of m study, I assess the value of the Electronic Medical Record System at the University of Ghana hospital in monetary terms to identify all the costs and benefits resulting from the project. Costs and benefits are valued according to their economic cost or "opportunity cost" and this is done on the basis of Cost Benefit Analysis (CBA) which attempts to quantify all the costs and benefits in money terms.

The implementation of the Electronic Medical Record System at the University of Ghana hospital will have impacts on health care and employment be it positive or negative. This is seen in the dimension of the hospital employing people to operate the system due to the technicality of the system or reducing employment to facilitate the system which is going to affect the nation as a whole. The Electronic Medical Record Systems at the University of Ghana hospital will increase the number of patients attended to in a day.

The economical appraisal also assesses other economic impact by Electronic Medical Record System like time. Relatively, before the implementation of the Electronic Medical Record Systems at the University of Ghana hospital, it took longer times for staff in the records department to locate previous folders/records of patients but since the introduction of the Electronic Medical Record Systems at the University of Ghana hospital, staff working at records department of the University hospital can now locate folders or past records of patients with just a click on a computer and this saves time for other productive activities.

2.5 Commercial Appraisal

Commercial appraisal considers the elements that can help sell the project to the outside world that is to say to hospitals that have not implemented the Electronic Medical Record Systems yet. Commercial appraisal considers the scope of the project in the market, how user friendly it is, the future demand for the project in other hospitals and the latest information availability in all areas. This appraisal also assesses the current market scenario, which enables the project to get adequate demand. Distribution, estimation and advertisement factors are also considered.

For the purpose of this study, Commercial appraisal aims to establish whether the Electronic Medical Record Systems at the University of Ghana hospital will be viable in a commercial sense though it is a social project. The Electronic Medical Record Systems at the University of Ghana hospital over its useful life is expected to increase the revenue of the hospital in the sense that it increases the cost of health care delivery in the hospital and from such a point of view can earn sufficient revenue to cover its cost and yield an acceptable financial rate of return. Commercial appraisal is undertaken for the Electronic Medical Record Systems at the University of Ghana hospital to establish its viability via examination of projected cash flows, management and marketing arrangements and marketing here is basically concerned with how the public can be made aware of the existence of Electronic Medical Record Systems at the University of Ghana hospital.

With respects to marketing the Electronic Medical Record Systems at the University of Ghana hospital, the University hospital management can release information about the EMR system to the general public via social media outlets, through channels like the print media, radio announcements and the multimedia about the EMR system project. The technicians involved in

the implementation of the EMR system project can also spread the idea to the general populace since they have the technical understanding of the EMR system. And finally the patients who come from all walks of life and have had the firsthand experience of the use of the Electronic Medical Record Systems at the University of Ghana hospital can also help in selling the project to people within and outside the University of Ghana hospital community.

Now, for the cash flows of the project, the University of Ghana hospital includes some added charges to the total fee charged to patients in the hospital due to the Electronic Medical Record Systems in place at the hospital which helps smoothens healthcare delivery. These charges include an initial payment of GHC 30 for opening of account for the patient. The account is a unique portal that allows the patient to access his/her medical records at any point in time. It comes with the system generated unique number that identifies the patient base on demographic data initially stored in the system.

Also, the Electronic Medical Record Systems at the University of Ghana hospital needs technological company for the installation, running and maintenance of the system. The company responsible for that is Ebizframe RX HIS. I realized that experts for that company are directly involved in the control of the system and not the University hospital alone as in the case of other activities.

Finally some of the devices used by operators of the system include desktops computers, internet connection, printers, and scanners among others. There is a reduction in the use of stationeries such as pens, paper (A4 sheets). This reduction is anticipated to reflect in the budgetary statement captured in the annual report of the hospital.

2.6 Institutional Appraisal

Institutional Appraisal is a form of appraisal which examines the institutional environment within which the project will be executed. This appraisal normally covers the project itself, its organization, management, staffing policies and procedures, government policies, socio-cultural environment and developments in the global system.

The Electronic Medical Record Systems is used in a health community that is the University of Ghana hospital. The location of the University of Ghana hospital makes it useful for use by the general public and the introduction of the system has resulted in increased use of the hospital by the General Public. Hence the implementation of the Electronic Medical Record Systems at the University of Ghana hospital positively will impact on the activities of the hospital and help it to achieve its goal of enhancing the health status of the communities in the immediate environs of the University of Ghana by providing affordable client focused quality health services hospital and providing first class heath care delivery to patients and as well avoiding unnecessary loss of records in the future. The Electronic Medical Record Systems which is used in a health community, which is the University of Ghana hospital is managed by the University of Ghana Computing System (UGCS) which will be responsible for the provision of guidance to the staff of the hospital to make them use the system effectively and efficiently. In addition, the UGCS will be responsible for the maintenance of the system.

On maintenance, University of Ghana hospital must have an up-to-date access management plan that lists the functional requirements for access management systems, as well as standard operating procedures that address contingencies for security issues that may arise. Access management policies and procedures should be built on the results of a system-wide analysis. it is important for

University of Ghana hospital to protect the lifespan of the Electronic Medical Record Systems , therefore, it is necessary for a proper maintenance schedule by way of updates, wear and tear (depreciation) of the system, new security checks and review, etc.

2.7 Socio-Cultural Appraisal

Socio-cultural appraisal seeks to examine if the cultural activities of the community conflict with the EMR system project's objectives and also, if this is in line with the government agenda. This appraisal takes into account whether changes in government will affect the stability, continuity or sustainability of the project. This is fundamentally concerned with how the project will improve, conform or contradict with the culture of the University of Ghana hospital and its community at large.

In view of this, the implementation of the Electronic Medical Record Systems at the University of Ghana hospital will improve health care delivery at the hospital which is in line with the vision of the hospital. This is seen in terms of the reduction in time it takes to search for past records of patients and the reduction in loss of patient records in the future and provides security to regular patients of the hospital in the fact that their record will always be kept intact.

Also change in government or change in government policies, agents and institutions did not affect the implementation of the Electronic Medical Record Systems and will not affect the continuous usage of the system in the near future because the University of Ghana hospital is not fully under the control of the government.

As can be seen, the various forms of appraisals in relation to the project are discussed in these chapters. These appraisals are financial, technical, economic, commercial, institutional and socio-cultural appraisals.

CHAPTER THREE

ELEMENTS OF COSTS AND BENEFITS

3.1 Introduction.

This chapter captures the diverse cost and benefits associated with a project since every project is associated with advantages and disadvantages. Equally, the implemented Electronic Medical Record Systems at the University of Ghana hospital is embodied with some costs and benefits.

Costs-Benefits Analysis (CBA), encompasses a systematic process for calculating and comparing benefits and costs of a decision, policy (with particular regard to government policy) or (in general) project hence all costs and benefits emanating from a project are identified to know how viable the project is. Benefits are defined as all possible advantages (pros) that result from the execution of the project. This is anything that contributes to the objective of the project. Cost on the other hand are all possible disadvantages (cons) that are incurred from the start-up stage to the implementation stage. This can also be seen as anything that reduces an objectives of the project. Also, since Cost-Benefit Analysis remains a policy assessment tool that attempts to quantify in monetary terms the value of all policy impacts (favourable; benefits and unfavourable; cost) to society where market prices are easily determined and shadow prices are used in determining the non-market prices. Shadow price is the estimated price of a good or service for which no market price exists, that is the price that is computed to replace existing market prices due to the fact that market prices may be deemed inappropriate or there is no price.

In CBA, some costs and benefits are tangible while some are intangible. It is also, either direct or indirect to the project. For the Electronic Medical Record Systems project in the University of

Ghana hospital, I will study Real Direct Tangible, Real Direct Intangible, Real Indirect Tangible and Real Indirect Intangible on both cost and benefit.

3.2 Benefits.

Benefits are all possible advantages (pros) of the Electronic Medical Record Systems to the University of Ghana hospital and the society at large. The benefits of the Electronic Medical Record Systems reflect improvement in societal welfare as a result of its implementation. The number of benefits associated with the implemented Electronic Medical Record Systems includes the following;

3.2.1 Real Direct Tangible Benefit

Real direct tangible benefits attempt to measure fund inflows which are closely or directly related to the setting up of the projects and its implementation. They reflect direct improvement in societal welfare as a result of the project implementation. These kinds of benefits are tangible because they can be quantified in monetary terms at the existing market prices. The direct tangible benefit of the implemented Electronic Medical Record Systems to the University hospital and the University hospital community include the following;

Incomes for employed skilled workers

The implementation of the Electronic Medical Record System will need skilled staff to operate the system. The skilled staff will range from the doctors, office workers (ranging from those who work at the administration, through to the record room to the mortuary) and nurses among others who will contribute to the successful operation of the Electronic Medical Record System. To estimate the incomes of employed skilled workers, I was not given any figures from the accounts office of

the University hospital because the workers are being paid by government but I sought people's view and also browse the internet for current wage to public servants and used the minimum wage as well. Incomes are summarized below:

Table3.1 Estimated Income of each employed worker per month

Description	Amount (GH₵)
Senior Doctors	3,970
Junior Doctors	2,500
Senior Office workers	4,200
Junior Office workers	500
Senior Nurses	1,600
Junior Nurses	900

Authors' compilation

The values in the table above are values for a month but according to various literatures around the world, income of government workers grows as economic growth rate increases. Therefore, in my computation for the benefits in the subsequent years the income will change. The wages of these workers annually are shown in the table below.

Table3.2 Income for employed workers

Description	Monthly Salary GH₵	Annual Salary GH₵
Senior Doctors	3, 970	47,640
Junior Doctors	2,500	30,000
Senior Office workers	4,200	50,400
Junior Office workers	500	6,000
Senior Nurses	1,600	19,200
Junior Nurses	900	10,800
TOTAL	**13,670**	**164,040**

Authors' compilation

Reducing costs through decreased paperwork (stationary)

The implementation of the Electronic Medical Record System in the University of Ghana hospital decreases the amount of money budgeted for stationery each year because of the decreased use of paper folders for record keeping at the hospital. According to the accountant of the University of Ghana hospital, the budget allocated for stationery has reduced immensely from about GH₵100,000 to GH₵65,000 (a reduction of about GH₵35,000) annually due to the implementation of the Electronic Medical Record System. The amount of GH₵35,000 is a benefit and assumed constant over years since there is no way paper folder usage will be used while the Electronic Medical Record System is still in place.

Revenue from charges due to the availability of the system

Ideally, a new patient of any hospital pays a little amount of money at the record unit for a folder. The introduction of the Electronic Medical Record System didn't abolish this practice. Hence any new client of the hospital still pays the initial folder fee which is currently GH₵30. It was very difficult to get the number of new patients from the records unit of the University of Ghana hospital, but after talking to staff members from the record unit, they said, on the average new clients per month are 45 and average new clients per year are 600.

Table3.3 Revenue from folder charges

Description	**Amount paid per person(GH₵)**	**Average number**	**Total Amount (GHS₵)**
New client per month	30	45	1,350
New client per year	30	600	18,000

Authors' compilation

3.2.2 Real Direct Intangible Benefit

These are benefits which are closely related to the implementation of the Electronic Medical Record Systems but cannot be quantified in monetary terms by the existing market system. They constitute a direct improvement in the community's welfare but cannot be valued by the existing market prices. The direct intangible benefits associated with the implemented Electronic Medical Record Systems are as follows

Ensuring privacy and security of patient data records

By implementing the Electronic Medical Record System, it can be said that the University hospital is improving on its security system as people with bad intentions cannot easily get access to patient records at the University hospital as compared to the situation without the Electronic Medical Record System where someone might easily get access and change records of patient without being traced. This contributes to the high level of security in the University hospital. As a result of the restriction created by the implementation of the Electronic Medical Record System, the activities of people with bad intentions will reduce. Clients of the University hospital are mostly those who fall victim to these attacks. This benefit can be quantified by comparing the amount that will be paid to employ other methods other than implementing the Electronic Medical Record System to ensure excessive security of patient records in the hospital like employing security men to always guard the records room to avoid unauthorized people to break into the room. The information from the security office shows that, it will cost an average amount of GH₵450 to employ one security man for the job and assuming that 3 security personnel are employed to run shift to achieve a high level of security of patients' records in the hospital assuming the Electronic Medical Record System is not implemented. This will sum up to GH₵450*3=GH₵1,350. Hence, the Electronic

Medical Record System will generate a value of GH₵1,350 as ensuring high level of security of patients' record in the hospital.

Helping staff to improve productivity

As the implementation of the Electronic Medical Record System will improve the general productivity of the staff members, in that one worker at the records department can now on the average attend to more patients as compared to the era of the manual medical record keeping. This evidently improves productivity. The productivity of workers can be quantified by using shadow prices. In this study I suppose that averagely, a staff at the records unit can attend to 75 clients on a very busy day and that each client will rather spend GH₵120 per month to be attended to quickly at different hospitals rather than the University hospital. Then each client will be willing to pay GH₵120*12= GH₵1,440 per year. This will make a total amount of GH₵1,440*72= GH₵108,000 within a year. Therefore, the fact that Electronic Medical Record System will improve productivity will add a value of GH₵108,000 to the aim of the University hospital.

3.2.3 Real Indirect Tangible Benefit.

Real Indirect Tangible Benefit are the gains that accrue to the implementation of the Electronic Medical Record Systems which are not directly or closely related to the objective of the project but can be quantified in monetary terms. These are benefits of the introduced Electronic Medical Record Systems that contributes to the improvement in the welfare of society indirectly. These indirect tangible benefits include;

Increases patient participation in the hospital.

It is no doubt that the implementation of the Electronic Medical Record System will result in an increased number of patient who participate in the hospital since patients know that their record are better kept and secure. People will also be attracted to the University hospital due to the confidentiality nature of the Electronic Medical Record System. This increased participation of patient created as a result of the implementation of the Electronic Medical Record System will relatively lead to an improvement in rendering health services and can contribute to economic growth since lecturers, students and individuals in the immediate environs of the University of Ghana will averagely have no health problems, hence increases their productivity since the health of individuals influences their productivity in their respective work places. In this project I assume that, averagely there has been an increase in participation by 1300 patients per year since the introduction of the Electronic Medical Record System. Also I assume since students pay GH₵245 as part of their school fees for medical care for the year, patients spend on average GH₵245 for health services in the University hospital per year. This in turn reveal that the University hospital add a value of GH₵245*1300= GH₵318,500 because of the increase in patient participation in the hospital.

Reducing cost of compiling heath statistics to government.

In every country, the government compile data on the health status of its citizen to compute various health statistics. And this is also true for the Government of Ghana. The government through the University of Ghana collect data pertaining to health from the University hospital. This data compilation process was very tiresome during the days of the manual record keeping due to the many challenges it faced which usually led to high cost of data collection for health statistics. However, the introduction of the Electronic Medical Record System has also solved most of the

challenges faced by the manual system hence this has also led to significant reduction in the cost associated with data collection. The government also requires data on all participating patients in the hospital and the University also needs data on health status of its student and staff which is generally collected when student are admitted fresh into the University and staff employed fresh in this University. According to the staff at the University hospital, and summaries from University of Ghana annual budget, the cost of compiling data on health status of students, staff of the University and individuals in the immediate environs of the University of Ghana, for the University of Ghana and the government at large has reduced by GH₵8,000 per year since the introduction of the Electronic Medical Record System 2015.

3.2.4 Real Indirect Intangible Benefit

Real Indirect Intangible Benefit are the advantages that accrue to the Electronic Medical Record Systems project which are not directly/closely related to the setting up and implementation of the project and cannot be quantified in monetary terms. They constitute indirect improvement in societal welfare as a result of the implementation of the Electronic Medical Record System but cannot be measured in monetary terms. Such benefits include;

Saves time in respect to searching for patients' record.

The implementation of the Electronic Medical Record System will reduce the enormous amount of time used in searching for patients record which was a problem associated with the manual record keeping system which was initially in place in the University hospital which delayed University hospital staff from attending to clients. As a result, precious time is wasted and this negatively affects productivity. This also leads to long queues at the record unit. Hence to quantify this, patients were asked how much they would pay in order to dodge the long queues. Majority

suggested they would pay an extra GH₵20 to dodge the long queues. Let's assume 5 patients pay an extra GH₵20 each day. The total value will be GH₵20*5= GH₵100 per day. Hence, there entire year will be GH₵100*365.25days= GH₵36,525.

Exposure to technology

The Electronic Medical Record System is purely and extremely based on modern technology. The process and operation of the Electronic Medical Record System is very technical and requires modern technology, equipment and machinery before it can be implemented and after it has been implemented. The implementation of the Electronic Medical Record System has exposed the University hospital community and its environs to new and modern level of technology present in advanced country as it is not popular in this country. It will also contribute to the technological know-how on rendering health services using advanced technology. Other hospitals both private and public can learn from this as it is serving as a good example for other hospitals in the country. Assuming initially, the University hospital will pay staff an extra sum of GH₵70 to move old records from the records room to the permanent storage room per each weekend when that tasked is done during the days of manual record keeping. And assuming normally only 4 personnel does that job, the total cost was GH₵70*4= GH₵280 per each weekend to the University hospital and also assuming this was done 13 weekends in the year then total cost per year is GH₵280*13= GH₵3,640. However, exposure to EMR system will demand no cost such as the one described associated with the manual system. This means the total of GH₵3,640 serves as a benefit due to the implementation of the EMR system.

Improvement in infrastructure.

After the system was implemented in December 2015, the Electronic Medical Record System was one of the first of its kind in Ghana. The installation of the Electronic Medical Record System is an important step towards improving the level of security of patients' records in the hospital. The Electronic Medical Record System complements the numerous facilities of the University of Ghana hospital and contributes towards the aim to strategically position the University Health Services in Medical Training and Collaborative Research for Capacity Building. This is an important contribution, good hospitals have good record keeping history. In addition, the implementation of the Electronic Medical Record System will also result in the construction of other peripheral infrastructure like provision of plants for supply of electricity when there is a power outage which leads to a provision of health services non-stop. In attempt to quantify this, I deliberate on how the improved infrastructure in the University hospital will attract new client to switch from their hospital to the University of Ghana hospital. Let's presume the improved infrastructure resulting from the implementation of the Electronic Medical Record System pulls 600 new clients per year and each client pays an amount of GH₵300 on the average making a total of GH₵300*600= GH₵180,000 revenues to the University hospital for the year. Therefore, the aim of the Electronic Medical Record System has indirectly added such a value to the University hospital.

Table3.4 General Summary of Tangible Benefits for a year

Description	Amount (GH₵)
Incomes for employed skilled workers	164,040
Reducing costs through decreased paperwork	35,000
Revenue from charges due to the availability of the system.	18,000
Increases patient participation in the hospital.	315,000
Reducing cost of compiling heath statistics to government.	8,000
TOTAL	**540,040**

Authors' compilation

Table 3.5 General Summary of Intangible Benefits for a year

Description	Amount (GH₵)
Ensuring privacy and security	1,350
Helping staff to improve productivity	108,000
Saves time	36,525
Exposure to technology	3,640
Improvement in infrastructure.	180,000
Total	**329,515**

Authors' compilation

3.3 Cost

Cost are all possible disadvantages (cons) of the Electronic Medical Record Systems to the University of Ghana hospital and the society at large. The costs of the Electronic Medical Record System relate to the negative impacts that society suffers resulting from the implementation of the

project. These contribute to a reduction in the welfare of society as result of the implementation of the Electronic Medical Record Systems. The cost associated with the implementation of the Electronic Medical Record Systems include the following.

3.3.1 Real Direct Tangible Cost

Real Direct Tangible Cost attempts to measure fund outflows which are directly related to the setting up of the Electronic Medical Record Systems and its implementation. These cost are tangible because they can be valued at given market prices. They constitute direct reduction in societal welfare. Some of the possible direct tangible costs associated with the implemented Electronic Medical Record Systems include the following.

Installation cost

The installation cost are the costs associated with the commencement of the project. Just like any other project, the University hospital will incur some cost during the installation of the Electronic Medical Record System. The components of the University of Ghana hospital's Electronic Medical Record System installation cost structure include, the cost of the software and general preparation cost for the successful implementation of the Electronic Medical Record System. According to the accountant of the University hospital, the total installation cost was GH₵103, 312

Labour cost

Another direct tangible cost associated with the implementation of the Electronic Medical Record System was the cost that will be incurred on labour. This is an operational cost associated with the project. The service of labour comes at a cost as the reward of labour is wage. Also the Electronic Medical Record System is part of the whole system of the University and it is being managed by

personnel in UGCS. Also these individuals were used during the implementation of the Electronic Medical Record System. In total 5 individuals from the UGCS were used over an estimated 13 month period. This individuals each received GH₵450 per month. Hence over the 13 month period, amount per each individual was 13*GH₵450= GH₵5,850. So the total labour cost was GH₵5,850*5= GH₵29,250.

Cost of machinery and equipments

These are the cost of inputs and materials that were used in the implementation of the Electronic Medical Record System. Also they are the main equipment that will ensure the proper functioning of the system as a whole. These equipment and machinery include: additional computers (monitors system units) to facilitate the implementation of the Electronic Medical Record System, optic fibre and a plant to provide electricity whenever there is a power outage. The total cost of equipment and machinery is summarized below

Table3.6 Cost of equipment and machinery

Item	Unit Price(GH₵)	Quantity	Total Cost(GH₵)
Computers	580	35	20,300
Optic fibre	194,274	-	194,274
Plant	41,000	1	41,000
Total Amount			**255,574**

Authors' computation

3.3.2 Real Direct Intangible Cost

Real Direct Intangible Cost are costs which are closely related to the setting up of the Electronic Medical Record System project and its implementation but cannot be quantified in monetary terms.

Yet, these costs reflect direct reduction in societal welfare. The real direct intangible cost associated with the implemented Electronic Medical Record System include the following,

Congestion in respect to time spent going to see the doctor.

After the implementation of the Electronic Medical Record System, it has been identified that the waiting time for going to see a doctor has increased significantly. This is due to the fact that, doctors are very slow in typing of their reports and this in turn leads to massive congestion in waiting to see a doctor which is a waste of time. In this study, I assume that patients spend on average 1 hour more in going to see the doctor. Here, I quantify this by assuming that, the opportunity cost of the extra 1 hour used in doctor is GH₵3.42/8hours= GH₵0.4275 considering the daily minimum wage is GH₵3.42. If each patient spends 1 extra hour in seeing the doctor each day, for the year GH₵0.4275*365.25days= GH₵156.144375. Hence, the value of time wasted in a year is GH₵156.144375.

3.3.3 Real Indirect Tangible Cost

Real Indirect Tangible Cost are costs of the implemented Electronic Medical Record Systems project which are not closely related to the setting up of the project and can be quantified in monetary terms at the existing market prices. These costs are costs of the implemented Electronic Medical Record Systems which are not directly related but reflect indirect reduction in societal welfare. Real indirect tangible cost related with the implemented Electronic Medical Record Systems includes the following;

Cost of maintenance

It is very prudent to take into account additional expenses that will be incurred to ensure the smooth and effective operation and maintenance of the project. With the Electronic Medical Record System, funds will be set aside to cater for depreciation of machines, equipment and the overall improvement in the system. That is the purchase and replacement of machines and equipment and general upgrade of facilities used and the upgrade of the software used. According to the hospital accountant, the cost of maintenance is $15,000. Converting to Ghana cedis, the value is $15000*4.3750= GH₵65, 625.

Contingency and Miscellaneous costs

There are always uncertainties in the precise amount and content of all estimated costs. There is therefore the need to cater for these uncertainties. In addition, there are unforeseen circumstances that can affect the project if it is operating. These circumstances are unpredictable and hence must be taken care off. For the Electronic Medical Record System, these unforeseen circumstances include hack attempts, attack by virus and power outage among others. This is another indirect cost that will be incurred during the life span of the project. Miscellaneous cost associated with the EMR system may include cost of utility bills (electricity charges), purchasing of fuel for the plant when the light goes off and any other cost that may arise such as replacing Wi-Fi connectivity. In this study, the contingency and miscellaneous costs in relation to the Electronic Medical Record System is estimated at 2% of the entire reported cost from the University hospital which was given as GH₵396,586 by the University of Ghana hospital accountant. Hence the amount of 0.2*396,586= GH₵7,931.72 is taken as contingency and miscellaneous cost for the entire year.

Cost of training and retraining staff.

After the implementation of the Electronic Medical Record System, staff members were retrained to facilitate the use of the Electronic Medical Record System. This retraining of staff also came at a cost which it is appropriate for it to be included in this study. According to the University hospital accountant, the total cost incurred in retraining staff was GH₵8, 450.

3.3.4 Real Indirect Intangible Cost

Real Indirect Intangible Cost are costs of the implemented Electronic Medical Record Systems project which are not closely related to the setting up of the project and cannot be measured in monetary terms at the existing market price. They reflect the cost associated with the implemented Electronic Medical Record Systems that contribute to indirect reduction in societal welfare but cannot be quantified by the prevailing market prices. These real indirect intangible cost associated with the Electronic Medical Record Systems include,

Opportunity cost of implementing the EMR

The opportunity cost of implementing the Electronic Medical Record System is the alternative use of the amount used in its implementation. The implementation of the Electronic Medical Record System involves a huge capital outlay. Part of this cost could be used to motivate the staff members in the record unit to take better care of patients' record. This can be done by increasing their salary with a margin of 5% of their monthly salary. This is in line with the theory of efficiency wage, which states that, 'as wages of staff members unit increase, they intend working harder to improve security of patient records in the hospital'. Hence considering the wage of personnel in the records unit as GH₵500 as given by the accountant of the University of Ghana hospital. The opportunity

cost of implementing the Electronic Medical Record System can be calculated as follows, 0.05*GH₵500= GH₵25 per staff member in records unit. Therefore, since the records department has 7 personnel in total, the total opportunity cost in this study is GH₵25*7=GH₵175. Hence, for the year the total opportunity cost will be GH₵175.

Table3.7 General Summary of Tangible Cost.

Description	**Amount (GH₵)**
Installation cost	103,312
Labour cost	29,250
Cost of machinery and equipments	255,574
Cost of maintenance	65,625
Contingency and Miscellaneous costs	7,931.72
Cost of training and retraining staff	8,450
Total	**470,142.72**

Compiled by Authors

Table3.8 General Summary of Intangible Cost.

Description	**Amount (GH₵)**
Congestion in respect to time spent going to see the doctor.	156.144375
Opportunity cost of implementing the EMR	175
Total	**331.144375**

Compiled by Authors

Table3.9 General Summary of Initial Cost of the Project.

Description	Amount (GH₵)
Installation cost	103,312
Cost of machinery and equipments	255,574
Opportunity cost of implementing the EMR	175
Total	**359,061**

Compiled by Authors

Table3.10 General Summary of Operational Cost.

Description	Amount (GH₵)
Labour cost	29,250
Cost of maintenance	65,625
Contingency and Miscellaneous costs	7,931.72
Cost of training and retraining staff	8,450
Congestion in respect to time spent going to see the doctor.	156.144375.
Total	**111,412.8644**

Compiled by Authors

In conclusion, I have carefully outlined the elements of costs and benefits associated with the implementation of the Electronic Medical Record System at the University of Ghana hospital. It has been estimated that, the real cost associated with the project is **GH₵470, 473.8644** and the benefit to be realized amounts to **GH₵869, 555**. Taking a quick look at the costs and benefits shows that the project will result in an increase in the welfare of society. Yet, it is necessary that I estimate the present value of the project by discounting all costs and benefits associated with the

project over the project's lifetime in order to determine the viability of the project. This is considered in the next chapter.

CHAPTER FOUR

PROJECT EVALUATION

4.1 Introduction

The central idea of this chapter is to assess the attractiveness and efficacy of the implementation of the Electronic Medical Record Systems in the University of Ghana hospital. Basically, the attractiveness of a project is dependent on the anticipated costs and benefits that come with the project, hence to get on with implementation of the Electronic Medical Record Systems in the University of Ghana hospital, it is important to evaluate the expected costs and benefits from the project to know its viability and efficiency level.

This chapter is actually the selection part of how to appraise quantitative or monetary aspect of the implemented Electronic Medical Record Systems in the University of Ghana hospital. It addresses the question – is the project worthwhile? In project appraisal, this part is very vital in accepting or rejecting the project based on the outcomes of the project. Determination of the worthiness or otherwise of the project will be based on any of the following investment criteria models for evaluating a project including Net Present Value(NPV), Internal Returns Ratio(IRR), Payback Period, Benefit Cost Ratio(BCR), Accounting Rate of Returns and Domestic Resource Cost. In this study I use the Net Present Value (NPV), Internal Returns Ratio (IRR) and Benefit Cost Ratio (BCR) to determine the worthiness of the project.

4.2 Investment Criteria

4.2.1 Net Present Value (NPV)

Time is an important factor in making decision on the project/program choice. The idea of net present value (NPV) is therefore to try to express all future values in terms of the present. The Net Present Value (NPV) of a project is the present value of the expected cash flows, less the present value of the cost of the project. It can also be said to be the difference between the cost of investing in a project and the expected cash that is going to flow after the project has been accomplished.

The formula for the discounting process is:

$$\sum_{t=0}^{n} \frac{(B_t - C_t)}{(1+k)^t}$$

Where B_t = benefit at time t

C_t = cost at time t

$1 / (1+k)^t$ = discount factor

k= discount rate

NPV can be simplified and represented by the formula below,

$$NPV = (B_0-C_0) + (B_1-C_1)/ (1+ d) + (B_2-C_2)/(1+d)^2 +\ldots + (B_t-C_t)/ (1 + d)^t$$

Where t is time, B_i is benefit at time t, C_i is cost at time t and d is the discount rate.

Justification for NPV

The benefit cost ratio is used because;

- It takes into consideration the time value of money
- Profit and difficulties of profit measurements are excluded.
- Takes into consideration the cost of capital and the risk inherent in making projections about the future.

Decision rule for NPV

If the Net Present Value of all cash flows is positive at a specific minimum rate of return, the actual rate of return from the project exceeds the minimum desired rate of return. On the contrary, if the Net Present Value for all cash flows is negative, the actual rate of return from the project is less than the minimum desired rate of return. Hence accept project if NPV is positive and reject if otherwise. The project is expected to last for a long period of time but for the purpose of my study I assume the project will last for 10 years.

4.2.2 Internal Returns Ratio (IRR)

The internal rate of return can be defined as the discount rate at which the Net Present Value of a project is zero. Thus, it is the discount rate at which the Net Present Value of the costs of a project equals the Net Present Value of the expected future benefits of the project. This can come about when I equate the discounted value of the net benefits of the project or the net present value of the benefits of a project to the initial (cost) capital outlay. After that I solve the resultant equation for the discount rate IRR. But, based on the complex nature of solving NPV=0 and the long term nature of the EMR project, this simple and popular formula is used.

$$IRR = R_l - \{[(R_l - R_h)]*NPV_l] / (NPV_l + NPV_h)\}$$

where R_h is the higher discount rate with the lower NPV

R_l is the lower discount rate with the higher NPV

NPV_h is the absolute value of the NPV associated with the higher discount rate or absolute value of the negative NPV

NPV_l is the NPV for the lower discount rate.

IRR Decision Rule

The decision rule associated with this technique is to accept a project if the IRR exceeds the discount rate or the market interest rate (d) and reject if the IRR is less than the discount rate or the market interest rate (d). This shows that the investment is worthwhile. Also, when I am faced with mutually exclusive projects, I should choose the project with the highest IRR. The IRR is a project's expected rate of return. If it exceeds the cost of capital, then shareholders' wealth is increased by the project. The project is expected to last for a long period of time but for the purpose of my study I assume the project will last for 10 years.

Justification of IRR

The IRR is used in this study since it assesses the future returns of an investment project in percentage measure. It actually comes with the following advantages;

- Considers both the magnitude and the timing of cash flows. This means that the IRR considers the time value of money.
- It tells whether an investment increases the firm's value.
- It considers all cash flows of the project.
- It considers the risk of future cash flows through the cost of capital in the decision rule.

4.2.3 Benefit Cost Ratio (BCR)

A Benefit cost ratio (BCR) is a technique used in the formal discipline of cost-benefit analysis that attempts to summarize the overall value for money of a project. BCR is the ratio of the benefits of a project or proposal, expressed in monetary terms, relative to its costs, also expressed in monetary terms. All benefits and costs should be expressed in its discounted present value.

The Benefit-Cost Ratio is the ratio of discounted benefit to discounted cost of a project. This is the present value of all future benefits divided by the present value of the total cost involved in the implementation of the project. BCR can be represented by the formula below;

$$\text{BCR} = \frac{Present\ value\ of\ Benefit}{Present\ value\ of\ Cost} \quad or \quad \sum_{t=0}^{n} \frac{B_t}{(1+d)} / \sum_{t=0}^{n} \frac{Ct}{(1+d)} t$$

Where, B_t is Benefit in period t

Ct is Cost in period t

n is expected lifespan (number of years) of project

d is discount rate

$1 / (1+d)^t$ is the discounting factor.

Justification for BCR

The benefit cost ratio is also used because;

- It also considers the time value of money.
- It is suitable for a project with longer lifespan

- It is easy to compute and apply.

Decision rule for BCR

If the BCR is greater or equal to 1, then the project is worthy and should be implemented. This is due to the fact that the present value of benefit exceeds or is equal to the present value of cost. On the other hand, when BCR is less than 1, then the project should not be undertaken. This implies that the present value of costs exceeds the present value of benefits.

4.3 Choice of discount rate

The discount rate could be seen as the rate of interest that could be earned from the implementation of other or alternative projects. Thus it is the opportunity cost of capital. Some measures like the commercial banks' interest rates, Prime Rate, Treasury bill Rate, Monetary Policy rate, Inflation rate and the Inter-Bank rate can be used as the market discount rate. In this study I will use the Monetary Policy rate as my market discount rate.

4.4 Analysis of projected costs and benefits

It is imperative to examine the cost and benefit structure of the project in calculating the Net Present Value (NPV), Internal Returns Ratio (IRR) and the Benefit Cost Ratio (BCR). Such analysis helps to group the costs and benefit into years where they will be discounted over the lifespan of the project and years where there is no discounting. In this study, I will consider two types of cost. These are costs expected to be incurred during the implementation of the project (initial cost) and those that will be incurred during the estimated life span of the project (operational cost). The benefits considered will be benefits that the implementation of the project brought about. In this chapter, I assume that, benefit and cost will increase constantly by **5.17%** (see appendix) every year in the lifespan of the project.

The table below is the tabulation of the tangible and intangible benefit and cost elements of the project from chapter 3 are;

Table4.1 General Summary of Benefits.

Description	Amount (GH₵)
Real Tangible	540,040
Real Intangible	329,515
Total	**869,555**

Compiled by Authors

Table4.2 General Summary of Cost.

Description	Amount (GH₵)
Real Tangible	470,142.72
Real Intangible	331.144375
Total	**470,473.8644**

Compiled by Authors

Table4.3 General Summary of Initial Cost and Operating Cost.

Description	Amount (GH₵)
Initial Cost	359,061
Operational Cost	111,412.8644
Total	**470,473.8644**

Compiled by Authors

4.5 Computation of NPV, IRR and BCR

Here, the future values of benefits and costs over the lifespan of the Electronic Medical Record System are calculated to examine its feasibility. For a genuine computation of the NPV, IRR and the BCR to be done, the following assumptions should be considered:

- The implemented Electronic Medical Record System is a long term project, for that matter, a time period of 10 years will be used for the study of costs and benefits evaluation.
- In computing the expected or future benefit and cost values associated with the project, I use these formulae; $B_t = (B_{t-1} \times r) + B_{t-1}$ and $C_t = (C_{t-1} \times r) + C_{t-1}$ respectively. Where, B_t is the benefit in year t, B_{t-1} is the Benefit in year t-1 and r is the average economic growth rate C_t is cost in year t, C_{t-1} is the cost in year t-1
- I assume a constant annual growth rate in benefits and costs by **5.17%** over the projects life. This will be seen in the appendix at the end. Since this is a long-term project, there is a growth rate attached to it and this is calculated after the first year.
- In this study, the Monetary Policy rate will be used in discounting costs and benefits for the calculation of NPV. This is because my project is a social project and Monetary Policy rate reflects societal preferences of the value of money since the BoG takes into account social factors in determining the policy rate. This rate forms the basis upon which commercial banks and other financial institutions fix their base value which in turn determines the market interest rate. The monetary policy rate also plays an important role in determining all other rates including the interest rate hence affecting money supply, Per Bank of Ghana (BoG) pronunciation, the monetary policy rate stands at **22.5** percent. The monetary policy rate is used in this study because if the University should have used the amount allocated for the Electronic Medical Record Systems to pursue another project or

investment, the amount the University will receive in returns could be revealed by the monetary policy rate.

For the IRR calculation, the lower rate I will be using is **15** percent and the higher rate will be **30** percent**.** These rates are used in the study because my benefits and cost values are higher and also because IRR is sensitive to the scale of the project. That is the IRR tends to overestimate the value of benefits for short term projects but projects with longer gestation periods tends to suffer when the IRR is used.

4.6 Evaluation, Results and Investment Decision

Now, considering the above assumptions and the formulae given for the IRR and BCR, the computations will be displayed as follows,

4.6.1 Computation of NPV

The net present value using the monetary policy rate of 22.5% as the discounting rate is

Present Value of Benefit (PVB) =**GH₵3, 926,046.439**

Present Value of Cost (PVC) = **GH₵862, 090.802**

Net Present Value (NPV) = **PVB – PVC**

Net Present Value (NPV) = **GH₵3, 926,046.439 - GH₵862, 090.802**

Net Present Value (NPV) = GH₵3, 063,955.637.

Considering the decision rule, since my NPV which is **GH₵3, 063,955.637** is positive, I accept the project which is the implementation of the Electronic Medical Record System in the University

of Ghana hospital is worthwhile. (Computations of the values used in these calculations can be seen in Appendix II).

4.6.2 Computation of IRR

Net Present Value with a low discount rate for the computation of IRR (15%)

Present Value of Benefit (PVB) = **GH₵4, 141,380.065**

Present Value of Cost (PVC) = **GH₵889, 680.7025**

Net Present Value for lower rate (NPV_l) = **PVB – PVC**

Net Present Value for lower rate (NPV_l) = **GH₵4, 141,380.065 - GH₵889, 680.7025**

Net Present Value for lower rate (NPV_l) = GH₵3,251,699.363

Net Present Value with a high discount rate for the computation of IRR (30%)

Present Value of Benefit (PVB) = **GH₵965, 984.8641**

Present Value of Cost (PVC) = **GH₵482, 829.066**

Net Present Value for higher rate (NPV_h) = **PVB – PVC**

Net Present Value for higher rate (NPV_h) = **GH₵965, 984.8641 - GH₵482, 829.066**

Net Present Value for higher rate (NPV_h) = GH₵483,155.7981

$IRR = R_l - \{[(R_l - R_h)*NPV_l] / (NPV_l + NPV_h)\}$

IRR = 0.15 - {[(0.15 – 0.30)*GH₵3,251,699.363] / (GH₵3,251,699.363 + GH₵483,155.7981)}

IRR = 28.06%

Considering the decision rule, since my IRR is **28.06** percent exceeds the discount rate or the market interest rate (monetary policy rate) which is **22.5** percent**,** I accept the project which is the implementation of the Electronic Medical Record System in the University of Ghana hospital is worthwhile. (Computations of the values used in these calculations can be seen in Appendix III and Appendix IV).

4.6.3 Computation of BCR

$$\text{BCR} = \frac{Present\ value\ of\ Benefit}{Present\ value\ of\ Cost}$$

$$\text{BCR} = \frac{\mathbf{3{,}926{,}046.439}}{\mathbf{862{,}090.802}}$$

BCR = 4.55 (2 d.p)

Considering the decision rule, since my BCR is **4.55** which is greater than 1, I accept the project which is the implementation of the Electronic Medical Record System in the University of Ghana hospital is worthwhile. (Computations of the values used in these calculations can be seen in Appendix V).

Finally, based on the decision rules of NPV, IRR and BCR respectively, which state that, the project should be accepted when the NPV is positive for a project, also the project should be accepted when the IRR is greater or equal to the market discount rate (monetary policy rate) and

when the BCR is greater than 1. From the results above, my NPV is **GH₵3, 063,955.637** which is positive, my IRR is **28.06** percent which is greater than the **22.5** percent discount rate (monetary policy rate) and the BCR is **4.55** which is also greater than **1**. The three investment criteria signal that the expected or future benefits outweigh the expected or future costs associated with the project. Therefore, the implementation of the Electronic Medical Record System in the University of Ghana hospital is worthwhile.

In this chapter, I considered the following investment criteria NPV, IRR and BCR, which I used to decide whether to accept or reject the project. In the subsequent chapter, I am going to summarize, do a conclusion and give some recommendations.

CHAPTER FIVE

SUMMARY, RECOMMENDATIONS AND CONCLUSION

5.1 Summary

The problem of privacy and security of patients' records and their adverse effects on patients from the immediate environs of the University of Ghana compelled the University management to team up with the University hospital management to embark on an initiative that will ensure privacy and security of patient records in the University hospital. This was also necessary because of the need to modernize and improve the efficiency of record keeping in the University hospital. The EMR system project was identified based on the Felt Needs Approach of identifying a project. The EMR system project is expected to improve the efficiency of medical record keeping and improve health care delivery in the University hospital starting from enhancement of the privacy and security of patient records in the University of Ghana hospital.

It has been proved that the implementation of the Electronic Medical Record System is a viable project through the investment criteria used. The implementation of the Electronic Medical Record System will not only ensure privacy and security of patient records in the University hospital but will also result in improvement in the quality of health care delivery and productivity of workers in the hospital. This is because implementation of the Electronic Medical Record System will result in the University hospital being exposed to high level of technology. It implementation also saves time in respect to searching for patients' record in the record room of the hospital and improve efficiency as it will result in a reduction of costs through decreased paperwork.

In addition, there are several benefits and cost both direct, indirect, tangible and intangible that resulted from the implementation of the Electronic Medical Record System. These benefits

include, incomes for employed skilled workers, reducing costs through decreased paperwork, revenue from charges due to the availability of the system, ensuring privacy and security of patient data records, helping staff to improve productivity, increases patient participation in the hospital, reducing cost of compiling heath statistics to government, saves time in respect to searching for patients' record, exposure to technology and improvement in infrastructure as considered in this study. The costs associated with the EMR system include, installation cost, labour cost, cost of machinery and equipment, congestion in respect to time spent going to see the doctor, cost of maintenance, contingency and miscellaneous costs, cost of training and retraining staff, and opportunity cost of implementing the Electronic Medical Record System.

5.2 Limitations of the Study

My study "Cost and benefit analysis of the Electronic Medical Record System in the University of Ghana hospital" is a novel research undertaken at the University of Ghana hospital and this CBA study is the first of its kind in Ghana since the Electronic Medical Record System is not popular in the country. However, there are a lot of research work done on the Electronic Medical Record System in respect to information security but almost none done in respect to cost and benefit analysis. Hence during the course of this study I encountered a lot of difficulties. Some of this difficulties include;

- Difficulties in planning how to go about my study during the initial stages.

As said earlier, the study "Cost and benefit analysis of the Electronic Medical Record System in the University of Ghana hospital" is a novel research undertaken at the University of Ghana hospital and this CBA study is the first of its kind in Ghana since the Electronic Medical Record System is not popular in the country and since it is the first time we students of Economics

Department are doing a research of this magnitude, I encountered difficulties during the planning of the whole study at the initial stages. I spent three weeks on planning of the study alone.

- Difficulty in Accessing Information

The EMR system project in the University of Ghana hospital happens to be a technical project. For that matter, I needed a reliable information that will give the efficacy of the project. There was a problem of getting information from some of the offices and staff members of the University hospital and UGCS. Some senior staff members in the hospital complained about them having troubles like mine in seeking for some of the same information I needed for their own work purpose. I was a little fortunate to get information from the records unit, administrative unit, and account unit of the University hospital and some offices of UGCS among others. But getting some of the information was very difficult. For instance, when I needed information on the average time that a patient spends queueing to go and see the doctor, I had to visit the hospital daily for a week to actually observe and record the times for ourselves and use the average of those times collected to help estimate the cost associated with Congestion with respect to time spent going to see the doctor. I also had to use the internet to assess some of my information which I thought reduces the reliability of my work. In all, accessing information from some offices in the University of Ghana hospital and UGCS was tiresome. In view of this, I used information available to us from survey of patient responses, views of staff members of the University hospital and the internet for most of my information.

- Time Constraint

Mainly, I am in this community as students but I discharge a lot of responsibilities in addition to my academic work. Some of these responsibilities include, religious activities, social hall marks,

examinations etc. Assessing the cost and benefits of the Electronic Medical Record System at the University of Ghana hospital needed much time because of the high attention it needed and a desire from us to do a decent job since this is the first study of its kind but I had to combine this project work with other activities. In most cases, I had to skip lectures and meet some people for information. Even meeting ourselves to plan towards the project was a problem because all of us did have different lecture schedules.

- Quantifying the intangible benefits and cost associated with project

The time constraint, limited access to information and the nature of my work been the first of its kind made it difficult for us to quantify some intangible benefits and costs. For instance, I was unable to add monetary value to how Electronic Medical Record System has improved the overall quality in health care delivery as one of the intangible benefits so I ended up taking it out of the work.

5.3 Conclusion

The implementation of the Electronic Medical Record System will positively affect the level of privacy and security of patients' record in the University of Ghana hospital. This has also led to a decrease time used to search for patients' record. In the study, both the qualitative and quantitative investment appraisals have been used. The commercial, economical, technical, socio-cultural, institutional and financial aspects of the project have been duly discussed. This revealed that, the project will add value to the objectives, mission and vision of the University hospital and the University at large. In the cost benefit analysis, the Electronic Medical Record System was evaluated quantitatively by using Net Present Value (NPV), Internal Rate of Return (IRR) and Benefit Cost Ratio (BCR) to determine the viability of the Electronic Medical Record System. The

NPV gave a value of **GH₵3, 063,955.637,** IRR gave a value of **28.06** percent and the BCR of the project gave a value of **4.55.** In view of the decision rule of the NPV, IRR and BCR, the NPV is positive, the IRR is greater than the market discount rate (monetary policy rate) of **22.5** percent**,** the BCR is also greater than **1**. I then concluded that the implementation of the Electronic Medical Record System at the University of Ghana hospital is viable and can be done by other hospitals in the country especially large government hospitals to improve health care delivery. Based on the values derived for the NPV, IRR and BCR, I assure major stakeholders of the University of Ghana hospital that the implementation of the Electronic Medical Record System will yield positive net benefit that will improve the quality of healthcare service delivered by the hospital if the Electronic Medical Record System is properly maintained after it has been implemented. Also several advantages can be referred to the project. These include providing accurate, up-to-date, and complete information about patients at the point of care. This also results in helping provide more effective diagnosis of patients, reduce medical errors, and provide safer care. Therefore, there will be improvement in health care delivery in the University of Ghana hospital.

5.4 Recommendations

Based on my major findings on the Cost-Benefit Analysis above, I would like to put forward the following recommendations

- Due to the long term nature of the project, even if there are no short-term gains, it is advisable to have such a system in place because it guarantees long-term gains.
- The technological changes all over the world call for technological measures in resolving problems. With that, the Electronic Medical Record System is really a good initiative in ensuring that patients' records are kept properly and secured over a long period of time in

the University of Ghana hospital. As a result, it is advisable for other hospitals in the country to have the Electronic Medical Record System implemented.

- Since I recommend the Electronic Medical Record System to hospitals in the country, I encourage that the design, implementation, and use of Electronic Medical Record System need to take into account the special needs of patients for access to health information and the vigorous protection of confidentiality of those information. Also I recommend that hospitals preparing to use the Electronic Medical Record System be active participants working with their vendors to design displays and other aspects of the system to their own needs. For example, hospitals could create committees made up of a few staff members from different units (nurses, doctors, and IT specialists) to determine how to customize their Electronic Medical Record System for their own needs.
- High level of inconvenience can be caused when going to see the doctor, which is the long queues which gives rise to congestion. I therefore recommend that the number of doctors on duty at any particular point in time should be increased as compared to the number being made available now.
- I also recommend to the department of Economics that the duration of the study should be extended to one academic year so that an in-depth study can be made. This is to say, the groupings from the department should be done earlier so that I get enough time to offset the time constraint as said in the limitations.
- The right to Information Bill should be passed by parliament of Ghana to facilitate quick access to information on major projects initiated by public and private hospitals but this bill should protect the privacy of patients' records. This will ensure easy access to

information from the University of Ghana hospital by both students and the general public for academic purposes.

- Finally, I recommend that, for the sake of future studies concerning costs and benefits with respect to Electronic Medical Record system, researchers should set an analysis period with careful consideration since different results may be found if the analysis period is varied and hence the results must be interpreted with careful consideration.

REFERENCES

Anthony E. Boardman, David H. Greenberg, Aidan R. Vining, and David L. Weimer, (1996) Cost – Benefit Analysis: Concepts and Practice, 1st Edition.

Anthony E. Boardman, David H. Greenberg, Aidan R. Vining, and David L. Weimer, (2001) Cost – Benefit Analysis: Concepts and Practice, 2nd Edition, ISBN 0-13-087178-8

Baum W.C and Tolbert S.M. (1985) Investing in Development: Lessons of the World Bank Experience (Oxford: Oxford University Press, P: 8.

Choudhary, S. (1988) Project Management, New Delhi: Tata McGraw Hill, P: 3.

Economic growth rate of Ghana from 2000 to 2017; www.theglobaleconomy.com (World Bank)

Government, Ghana; Bank of Ghana (2015)

Government, Ghana; Fairwages (2009)

Government, USA; HealthIT.gov (2016)

Harrison, F.L. (1992), Advance Project Management, Metropolitan, New Delhi, p.13.

Jennifer Greene, Andrew Stellman(2007). "Head first PMP," *O'Reilly*.

John Filicetti (August 2007), *PMO and Project Management Dictionary*

Prasanna Chandra (1988), Projects, Preparation, Appraisal, Budgeting and Implementation

Tau, Menes; GrandmotherAfrica (2013)

University of Ghana Hospital history www.ug.edu.com

WageIndicator 2017 - Mywage.org/Ghana - Specialist medical practitioners

Wiley; Wiley Online Library (2012)

APPENDICES

Appendix I

ECONOMIC GROWTH IN GHANA FROM 2000 to 2017

YEAR	ECONOMIC GROWTH RATE (%)
2000	3.7
2001	4
2002	4.5
2003	5.2
2004	5.6
2005	5.9
2006	6.4
2007	4.35
2008	9.15
2009	4.85
2010	7.9
2011	14.05
2012	9.29
2013	7.31
2014	3.99
2015	3.8
2016	4.5
2017 First quarter	4.1
TOTAL	108.59
AVERAGE	**5.17**

SOURCE: www.theglobaleconomy.com (world bank)

Appendix II

TABLE A: Present Value of Costs and Benefits using selected discount rate of 22.5% for the computation of NPV

Year(t)	Benefit $B_t = (B_{t-1} \times r) + B_{t-1}$ r = 5.17%	Cost $C_t = (C_{t-1} \times r) + C_{t-1}$ r = 5.17%	Discount Factor $1/(1+d)^t$ d = 22.5%	Present Value of Benefit	Present Value of Cost
0	0	359,061	1	0	359,061
1	869,555	111,412.8644	0.816326531	709,840.8163	90,949.27706
2	914,510.9935	117,172.9095	0.666389005	609,420.0706	78,082.73857
3	961,791.2119	123,230.7489	0.543991024	523,205.7864	67,036.42128
4	1,011,515.818	129,601.7786	0.444074305	449,188.1843	57,552.81981
5	1,063,811.185	136,302.1906	0.362509637	385,641.8066	49,410.85764
6	1,118,810.224	143,349.0138	0.295926234	331,085.2965	42,420.7338
7	1,176,652.712	150,760.1578	0.241572436	284,246.8622	36,419.49857
8	1,237,485.657	158,554.458	0.197201989	244,034.6326	31,267.25448
9	1,301,463.666	166,751.7235	0.160981215	209,511.2026	26,843.89505
10	1,368,749.337	175,372.7876	0.131413237	179,871.781	23,046.3057
TOTAL				**3,926,046.439**	**862,090.802**

Appendix III

TABLE B: Present Value of Costs and Benefits using selected high discount rate for the computation of IRR

Year(t)	Benefit $B_t = (B_{t-1} \times r) + B_{t-1}$ r = 5.17%	Cost $C_t = (C_{t-1} \times r) + C_{t-1}$ r = 5.17%	Discount Factor $1/(1+d)^t$ d = 30%	Present Value of Benefit	Present Value of Cost
0	0	359,061	1	0	359,061
1	869,555	111,412.8644	0.512820513	445,925.641	57,134.80226
2	914,510.9935	117,172.9095	0.262984878	240,502.5624	30,814.70335
3	961,791.2119	123,230.7489	0.13486404	129,711.0487	16,619.39663
4	1,011,515.818	129,601.7786	0.069161046	69,957.49227	8,963.394604
5	1,063,811.185	136,302.1906	0.035467203	37,730.40747	4,834.257491
6	1,118,810.224	143,349.0138	0.018188309	20,349.26644	2,607.276206
7	1,176,652.712	150,760.1578	0.009327338	10,975.0377	1,406.190967
8	1,237,485.657	158,554.458	0.00478325	5,919.203663	758.4056617
9	1,301,463.666	166,751.7235	0.002452949	3,192.423844	409.0334536
10	1,368,749.337	175,372.7876	0.001257923	1,721.780592	220.605376
TOTAL				**965,984.8641**	**482,829.066**

Appendix IV

TABLE C: Present Value of Costs and Benefits using selected low discount rate for the computation of IRR

Year(t)	Benefit $B_t = (B_{t-1} \times r) + B_{t-1}$ $r = 5.17\%$	Cost $C_t = (C_{t-1} \times r) + C_{t-1}$ $r = 5.17\%$	Discount Factor $1/(1+d)^t$ $d = 15\%$	Present Value of Benefit	Present Value of Cost
0	0	359,061	1	0	359,061
1	869,555	111,412.8644	0.826446281	718,640.4959	92,076.74744
2	914,510.9935	117,172.9095	0.683013455	624,623.3136	80,030.67379
3	961,791.2119	123,230.7489	0.56447393	542,906.0653	69,560.54497
4	1,011,515.818	129,601.7786	0.46650738	471,879.5943	60,460.18621
5	1,063,811.185	136,302.1906	0.385543289	410,145.2636	52,550.39492
6	1,118,810.224	143,349.0138	0.318630818	356,487.4165	45,675.41349
7	1,176,652.712	150,760.1578	0.263331254	309,849.4345	39,699.86145
8	1,237,485.657	158,554.458	0.217629136	269,312.9341	34,506.06967
9	1,301,463.666	166,751.7235	0.17985879	234,079.6801	29,991.7632
10	1,368,749.337	175,372.7876	0.148643628	203,455.8673	26,068.04741
TOTAL				**4,141,380.065**	**889,680.7025**

Appendix V

TABLE D: Present Value of Costs and Benefits for the computation of BCR

Year(t)	Benefit $B_t = (B_{t-1} \times r) + B_{t-1}$ $r = 5.17\%$	Cost $C_t = (C_{t-1} \times r) + C_{t-1}$ $r = 5.17\%$	Discount Factor $1/(1+d)^t$ $d = 22.5\%$	Present Value of Benefit	Present Value of Cost
0	0	359,061	1	0	359,061
1	869,555	111,412.8644	0.816326531	709,840.8163	90,949.27706
2	914,510.9935	117,172.9095	0.666389005	609,420.0706	78,082.73857
3	961,791.2119	123,230.7489	0.543991024	523,205.7864	67,036.42128
4	1,011,515.818	129,601.7786	0.444074305	449,188.1843	57,552.81981
5	1,063,811.185	136,302.1906	0.362509637	385,641.8066	49,410.85764
6	1,118,810.224	143,349.0138	0.295926234	331,085.2965	42,420.7338
7	1,176,652.712	150,760.1578	0.241572436	284,246.8622	36,419.49857
8	1,237,485.657	158,554.458	0.197201989	244,034.6326	31,267.25448
9	1,301,463.666	166,751.7235	0.160981215	209,511.2026	26,843.89505
10	1,368,749.337	175,372.7876	0.131413237	179,871.781	23,046.3057
TOTAL				**3,926,046.439**	**862,090.802**