ADDIS ABABA UNIVERSITY

SCHOOL OF GRADUATE STUDIES

SCHOOL OF INFORMATION STUDIES FOR AFRICA

DESIGN AND PLANNING OF INFORMATION SUPPORT SYSTEM FOR THE MEDICAL UNIT OF THE ETHIOPIAN AIRLINES

A THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE DEGREE OF MASTER OF SCIENCE IN INFORMATION SCIENCE

BY

ZEMEDEBRHAN G/GIORGIS

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DECLARATION

The thesis is my original work and has not been presented for a degree in any other university.

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May 1994

The thesis has been submitted for examination with our approval as university advisors.

Prof. A. Neelameghan

May 1994

Dr. Taye Tadesse

May 1994

DEDICATED TO MY PARENTS,

G/GIORGIS ABRAHA

AND

BELAYNESH ABRAHA

ACKNOWLEDGEMENTS

It would have been impossible to propose this thesis without the assistance of various individuals and organizations, and I am profoundly grateful to all those who contributed to the accomplishment of this study.

Firstly, I would like to take this opportunity to express my sincere thanks to Professor A. Neelameghan for his many comments and suggestions on the work. Secondly, I would like to extend my gratitude to Dr. Taye Tadesse for his useful comments.

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ABSTRACT

In today's societies, the significant role of information in the overall national development process is being increasingly appreciated. The health sector is an integral part of the national economy and the prosperity of a nation greatly depends on the health of its people. People should receive adequate health services so that they can contribute their part to national development. Quality health services can only be guaranteed with qualified health professionals and these professionals depend on timely, precise and reliable information to support their work. Such information can only be obtained by establishing an effective and efficient computer-based information support system.

The work reported in this thesis is on the design and development of a computer-based information support system for the Medical Unit of the Ethiopian Airlines.

From the information obtained during the data collection process (by interviewing, perusing document collections, and observation) for this study, it was noted that all data processing and information handling activity in all the functional areas of the Medical Unit of the Ethiopian Airlines is being carried out using traditional manual

system (paper and pencil based system) which has proved to be inefficient and unsatisfactory. The inadequacies in the current situation called for a detailed study of the existing system and then design and plan for a more efficient information support system using modern information technologies to provide timely, precise and comprehensive information to the different categories of users in the Medical Unit of the Airlines.

Prospective users of the proposed system have been categorized into groups based on their information requirements and the services they render. The proposed system is subdivided into five functionally related subsystems and they are:

1. Scheduling Subsystem - which controls the registration, appointment, and scheduling of patients for treatment to the different consultation and treatment areas including General Patient Examination, Eye Treatment, Sonogram, Audiogram, Gynaecology, Cardiology, Electro-Cardiogram (E.C.G), etc.
2. Patient Records Subsystem - which is expected to handle all necessary patient information.
3. Book-keeping Subsystem - to deal with operations regarding financial transactions in the Medical

Unit.

4. Drug Status Control Subsystem - to handle the inventory control functions in the drug shop (pharmacy) of the Medical Unit.
5. Research and Referral Services Subsystem - to provide current awareness and referral services including bibliographic sources and systems, ongoing research projects of specialists on other medical/clinical/hospital units, research centres, etc.

A manual data dictionary is presented for keeping track of data definitions to provide essential information for designing different database files and data flow diagrams are used to describe the different functional areas of the proposed system.

The structure of the system is selected based on some basic factors that may affect the performance of the system and an attempt has been made to define user interface devices and modes. Some examples of program specifications and recommendations on the implementation plan of the proposed system are also presented in this study.

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INTRODUCTION

1.1 AIM OF THE WORK

The overall aim of this work is to improve the information services and management in the Medical Unit of the Ethiopian Airlines through the application of modern information technologies. Improvements in the Information Support System (ISS) in the Medical Unit will contribute toward better medical services, patient care, and management of the resources of the unit.

The techniques of data processing and information handling have been rapidly changing with the emerging information technologies. There are powerful tools helpful in managing the vast quantities of data generated by and used in, practically all areas of activities of modern society.

Information Technology (IT) covers a wide range of technologies used in the data-processing and information handling but principally includes computer technology, telecommunications technologies, electro-optic technologies, and reprographic technologies.

CHAPTER ONE

INTRODUCTION

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Information Technology (IT) covers a wide range of technologies used in the data-processing and information handling but principally includes computer technology, telecommunications technologies, electro-optic technologies, and reprographic technologies.

The application of IT to improve information support systems in the various sectors of the economy (the production, commercial, administrative, and service sectors) can contribute to the overall socio-economic development of a nation. An efficient and effective information support system can provide timely, precise, and reliable information at a reasonable cost. In this work, the term 'information support system' refers to a computer assisted information system.

1.2 JUSTIFICATION

In today's societies, the significant role of information in the overall national development process is being increasingly appreciated. The continued advancement in information technology has improved the ways and means of information generation, collection, processing and dissemination. "Today, as we are in an information society, the capacity to generate, process, store, transmit and utilize productive information will determine the social and economic development of a country" (National Science and Technology Information and Documentation Centre (NSTIDC) 1992). Information plays a vital role in every sector of social activities including business and service organizations, that is, "information being inter-sectoral, there is no sector or

economic activity that can effectively function without timely, accurate and reliable information" (NSTIDC 1992).

The prosperity of a nation greatly depends on the health of its people. People should receive effective and efficient health services so that they can contribute their part to the overall development of the nation. Improved health services can only be guaranteed with qualified health professionals and these professionals depend on timely, reliable and relevant information to support their work.

The health sector is an integral part of the national economy. The public health systems taken together with the many hospitals and clinics in the public sector organizations and in the private sector contribute to the totality of the health care system of the country. And all of them need to be effectively managed for which information support systems need to be developed and implemented.

Experiences in the developed nations and newly industrializing economies have demonstrated that the application of computers and related technologies in health care organizations (such as hospitals, clinics, pharmacies, etc.) can significantly help in solving some

of the health care problems which "... is one of the most distressing problems facing any developing nation" (Damachi, Souder and Damachi 1987).

In general, "information systems for the management of hospitals (as differentiated form the management of the national health system), cover:

- Health records
- Management of patients
- Drugs management
- Hospital/medical staff management
- Hospital equipment management
- Accommodation and food provision management, etc" (Neelameghan **1993**).

The use of micro computers now enable even small hospitals to develop and maintain information systems covering some of the above areas.

The Medical Unit of the Airlines has special responsibilities in addition to the work of other hospitals and clinics. The additional aspect is that it deals with aviation medicine in which the flight crew members (specially pilots) are to be checked periodically for their physical and mental fitness and other related

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health conditions. Their health needs to be monitored. The process of checking can be effective provided there is fast access to previous information about the crew members and this can be made possible with the introduction of computer-based information system to the working environment.

1.2.1 Current Situation in the Medical Unit

Currently, every data processing and information handling activity in the Medical Unit (MU) of the organization is being carried out using the traditional pencil and paper based system, that is, patients' files and other related documents are organized and stored in a traditional filing cabinet. These traditional systems have serious drawbacks.

Patients' case records hold valuable information needed by doctors of the hospital for comparative diagnostics, treatment prescriptions, research on specific aspects of certain diseases, for patient counselling, clinical teaching, etc. However, with the existing manual system searching for a piece of information is a major practical problem to the potential users, more specifically, health professionals and health administrators.

Other areas such as inventory control of drugs, patient registration and admission, and all the book-keeping activities in the Medical Unit are also manually handled at present and are proving to be inefficient.

As experience has shown elsewhere in the country and outside, hospital management can be more efficient and effective through the application of modern information handling methods.

1.2.2 The Proposed System

As was mentioned in the preceding section, all activities in all functional areas of the Medical Unit of the Ethiopian Airlines are being performed manually. The inadequacies of the system are having increasingly deleterious effects on the functioning and the services of the Medical Unit and concern has been expressed by health professionals, administrators and patients. The situation called for a detailed study of the existing system and then propose the design and plan for a more efficient information support system using modern information technologies to provide timely, precise and comprehensive information to the different categories of users.

1.3 SIGNIFICANCE OF THE WORK

The important benefit of introducing a computer-based information system to the unit is to facilitate the flow of information and its utilization.

The significance of the work rests on the expected advantages that can be obtained by introducing the proposed system. Some of the main advantages are:

1. Electronically filed information can be accessed at any time by users who have access right.

2. Users can have fast access to electronically filed information with the help of user-friendly interfaces. This solves the problem of not being able to find information when it is urgently required.

3. Shared access to information in electronic files can avoid wasteful duplication of efforts by ensuring that information once stored can be retrieved and reused.

4. Facilitate processing of information and computation of statistics, and presentation of the results in forms and formats convenient for application for

different purposes.

5. Composite presentations (text, graph, table, etc.) will help identify new relationships and links among the different parameters of health and disease.

6. Research can be more collaborative through "virtual teams", that is, the researchers being located in different institutions, even in other countries, but able to interact with each other through computer-mediated communications system.

7. Generally, the proposed computer-based information system is expected to secure time and cost saving in the information systems environment of the Medical Unit.

1.4 OBJECTIVE OF THE STUDY

1.4.1 General Objective

The general objective of this study is to investigate the major problems of the existing information system in the Medical Unit of the Ethiopian Airlines and, then, to design and plan an alternative information support system, a computer-aided information system which can help the potential users to make gainful decisions, improve professional efficiency and effectiveness.

1.4.2 Specific Objectives

The specific objectives in carrying out the study are:

1. To identify the potential users of information in the Medical Unit of the Ethiopian Airlines;

2. To analyze the information needs of the different categories of users and define their information requirements;

3. To examine the information system currently in use in the Medical Unit in order to define the major problems of the existing information system in the Medical

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3. To examine the information system currently in use in the Medical Unit in order to define the major problems of the existing information system in the Medical

Unit;

4. To define the major functions to be performed by the new system;

5. To decompose the main system into its components;

6. To design a prototype computer-based information system and generate different information products and services to meet the needs of users;

7. To suggest ways and means of implementing the proposed system.

1.5 METHODOLOGY

1.5.1 Methods

The study and proposals are based on the information obtained from literature survey, interviewing the prospective users, and observation.

Documents on health services and on the history of the Ethiopian Airlines were reviewed in presenting general background information on the working environment.

Based on the information gathered during the data collection process, a sample of the data dictionary required in designing prototype database files and a brief description of the logical model of the proposed system using data flow diagrams (which are among the system description techniques) are discussed in the analysis part of the study.

In designing the proposed system, the structure of the system is selected based on some basic factors (such as information policy of the Airlines, system capacity requirements, and geographical considerations) that may affect the effective performance of the system. A schematic representation of the prototype database files (using tables) is also included in the design part of the study.

1.5.2 Methods of Data Collection

In an actual system study, the data-collection about the selected attributes of the system is the first step that would provide the basis for the subsequent steps in an information system design and planning process.

The concept of "What to find" is more important than the idea of "How to find?" in a fact finding process for

system study. To find the basic facts for a system study, it is necessary to have an insight into the system. For a good understanding of the system, the following fact finding techniques were used during the data collection process:

1. Interviewing - Planned, face to face discussions were arranged with the different categories of prospective users and information was gathered using data-collection forms.

2. Perusing document collections - Browsing existing records in patient files, operational manuals, etc.

3. Observation - Onsite observation of the ongoing activities of the prospective users.

During the data collection process, information was collected on:

- The prospective users of the system
- The output requirements of the system
- The processing requirements of the system to produce the required outputs
- Sample of the actual data to be processed and

stored by the system

1.6 SOURCES OF DATA/INFORMATION

1.6.1 Institutional Sources

At the institutional level, the more important data for the study was collected from the Ethiopian Airlines, mainly, from the Medical Unit of the organization. The other sources of information include the Ministry of Health and the Black Lion Hospital.

1.6.2 Documentary Sources

The documentary sources of information for the study were patients' files, operational manuals, conference proceedings regarding information systems, computer periodicals, different books on computers and information systems.

1.6.3 Human Sources

Some managers, the prospective users of the system under discussion (i.e., doctors, nurses, laboratory technicians, druggists, etc.) were the most important human sources of information.

1.7 STRUCTURE OF THE THESIS

The thesis is organized in six chapters. Chapter one 'Introduction' covers such aspects as aim of the work, justification, significance of the work, objective and data collection methods used, etc. Chapter two presents some general background information on the working environment including historical background of western medicine in Ethiopia and a brief history of the Ethiopian Airlines and its information systems. The system analysis procedures are covered in chapter three and chapter four contains the core concept of the thesis dealing with the general system design process including choosing the system structure and database design. Chapter five presents a detailed description of the proposed system including designing user interfaces and some program specifications for the proposed system. Finally, chapter six summarizes the findings and offers suggestions on the implementation plan of the proposed system.

CHAPTER TWO

GENERAL BACKGROUND INFORMATION ON THE WORKING ENVIRONMENT

2.1 HISTORICAL BACKGROUND OF HEALTH SERVICES IN ETHIOPIA

Like in most other developing countries, the people in Ethiopia have been suffering from the prevailing health problems in the country. Although there is no current and reliable data on the health status of the population, the socio-economic status and the general trend in the country are good indicators that the development of modern health services in the country is at its early stage.

2.1.1 Traditional Medicine

Traditional methods for combating diseases and injuries were used in Ethiopia prior to the advent of western medicine and these methods are collectively referred to as Ethiopian Traditional Medicine ("Yabesha medhanit"). Traditional medicine is still in use in Ethiopia, most commonly, in the rural areas.

Some of the practitioners of traditional medicine accepted by the majority of the Ethiopian society include:

1. Those who apply medicinal herbs, usually referred to as herbalists ("Kitel betash"), to treat some prevailing diseases. A good example for this is the preparation of bitter "Kosso" to treat tape-worm infested patients.

2. Experienced people engaged in treating dislocated joints and bone-setting commonly known as bone-setters ("Wegesha").

3. The traditional birth attendants ("Yelimid awalaj"), etc.

To improve the health services in the country, the use and development of useful traditional practices in health services have to be encouraged and at the same time harmful practices should be prohibited.

2.1.2 Western Medicine

The introduction of western medical practitioners to Ethiopia dates back to the beginning of the 16th century although the contact was not on a continuous basis. That is, many foreign medical practitioners were occasionally coming to Ethiopia prior to the establishment of the first health institution of its kind by a Russian Red Cross Mission who come to Addis Ababa in 1896. The first foreign practitioner to come to Ethiopia was a Portuguese surgeon during the reign of King Libne Dengel (1520-1526) followed by a German missionary Peter Heiling who served as a court physician during the reign of Emperor Fasiledas.

After the Battle of Adwa in 1896, Emperor Menelik II invited the Russian Red Cross Mission to help his over three thousand wounded soldiers. This particular occasion gave rise to the foundation of the Russian Hospital which was the first health unit with a certain degree of permanency established at Addis Ababa in 1896 by the Russians. The Russians left Addis Ababa in 1906, and it remained without modern health services for three years until the first Ethiopian Hospital, Menelik II Hospital, was established in 1909 at the site of the old Russian Hospital.

In discussing the historical background of health services in Ethiopia, it is reasonable to mention the first Ethiopian medical doctor. The first Ethiopian physician was Dr. Workineh Martin (1866-1952) popularly known as "Hakim" Workineh. When he was three years old, he was found at the battle field after the battle of Mekdella (1868) by the British-Indian forces and was taken to India where he was adopted by an English family. Workineh was educated first in India and later in Britain sponsored by two officers, colonel Charles Chamberlain and colonel Martin, and after them he was named Charles Martin. He obtained his medical degree in 1887 from Lahore University in India, and also studied in Scotland. Dr. Workineh worked in Burma, India and Ethiopia for many years. He served in Ethiopia as an advisor, director, and physician of Menelik II Hospital as well as Emperor Menelik's personal physician.

A new chapter in the development of health services was opened with the establishment of different training centres for health professionals such as the Gondar Medical Collage, the Medical School of Addis ababa University at Black Lion Hospital, the Jimma Health Institution, etc. But much more remains to be done to alleviate the existing health problems as the number of health professionals trained from the different

To encourage effective practices in the health sectors and to integrate them into the general network of the health delivery system, an improved information support system is important so that health planners can get timely and reliable information to make effective decisions.

2.2 THE ETHIOPIAN AIRLINES

In this study the larger organizational framework (that is, the macro-organization) is the Ethiopian Airlines and the micro-organization (a subunit of the macro-organization) given special attention is the Medical Unit (MU) of the organization. The management body of the Airlines has given special attention to the area of the information systems. One of its main objectives is to upgrade and improve the utilization of information technologies and this provided an environment conducive to undertaking this study.

2.2.1 Brief Historical Background

The Ethiopian Airlines (commonly known by the name ETHIOPIAN) is one of the leading government organizations in the country and its foundation by formal proclamation dates back to the mid-1940s. Ethiopian is also a leading African passenger carrier, connecting most of the capital cities of Sub-saharan Africa and some of the major cities of Europe, Far East and Middle East.

During the inception of the Airlines in 1946, there were only 159 employees but today the number has reached nearly 4,000 personnel (this figure does not include contract workers), which makes it one of the biggest employers in Ethiopia. The major landmarks in the evolution of ETHIOPIAN are presented in table 2.1.

Date/Year	Landmark
18 Aug., 1929	Aviation technology commenced in Ethiopia by the introduction of a French manufactured single engined Potez 25 plane
1935	Ethiopia acquired a seizable fleet of airplanes
1936	Most of Ethiopian fleet were destroyed by the war with the invaders from Italy
1941	The necessary planning towards the establishment of a new and improved air transportation system began
1945	A management assistance contract was signed with the American company, Trans continental and Western Air, now Trans World Airlines (TWA)
21 Dec., 1945	The Airlines was formed by formal proclamation
1946	Operations commenced upon the purchase of six airplanes
1 Jan, 1959	ETHIOPIAN became a member of the International Air Transport Association (IATA)
1962	The Medical Unit was established
1964	ETHIOPIAN commenced a pilot training program
1970	The first Ethiopian Manager was appointed which transformed TWA's role from management to advisory
1975	TWA's contract with ETHIOPIAN terminated
1986	The assembly of Agro-Aircraft began

Table 2.1 Major Landmarks in the Evolution of ETHIOPIAN

One of the major achievements of the Airlines is that most of the main data processing and information handling activities are now computer assisted and there is a short term and long term plan to improve the effective utilization of computers and related technologies in most of the operational activities of the organization.

2.2.2 Organizational Structure of the Airlines

The Ethiopian Airlines has as its main goal to make profit by providing improved air transportation services to its customers. To prove that it has achieved its main goal, the following measurable and tangible objectives have been defined.

1. Maintain air worthy aircraft - This is the responsibility of the Technical Services Division.

2. Fill the space available - The main function of the Marketing Division.

3. Operate the aircraft - Controlled by the Flight Operations Division.

Other strategic areas hat have been incorporated to the total functional framework of the organization include:

Industrial Relations Division concerned with the management and control of medical services and personnel affairs, Finance Division which deals with financial matters, Corporate Planning and Development Division - mainly involved in long-term and short-term planning, General Counsel that supports activities related to legal affairs, etc.

A general representation of the structural framework of the macro-organization with its main functions and their hierarchical relationship is shown in Figure 2.1.

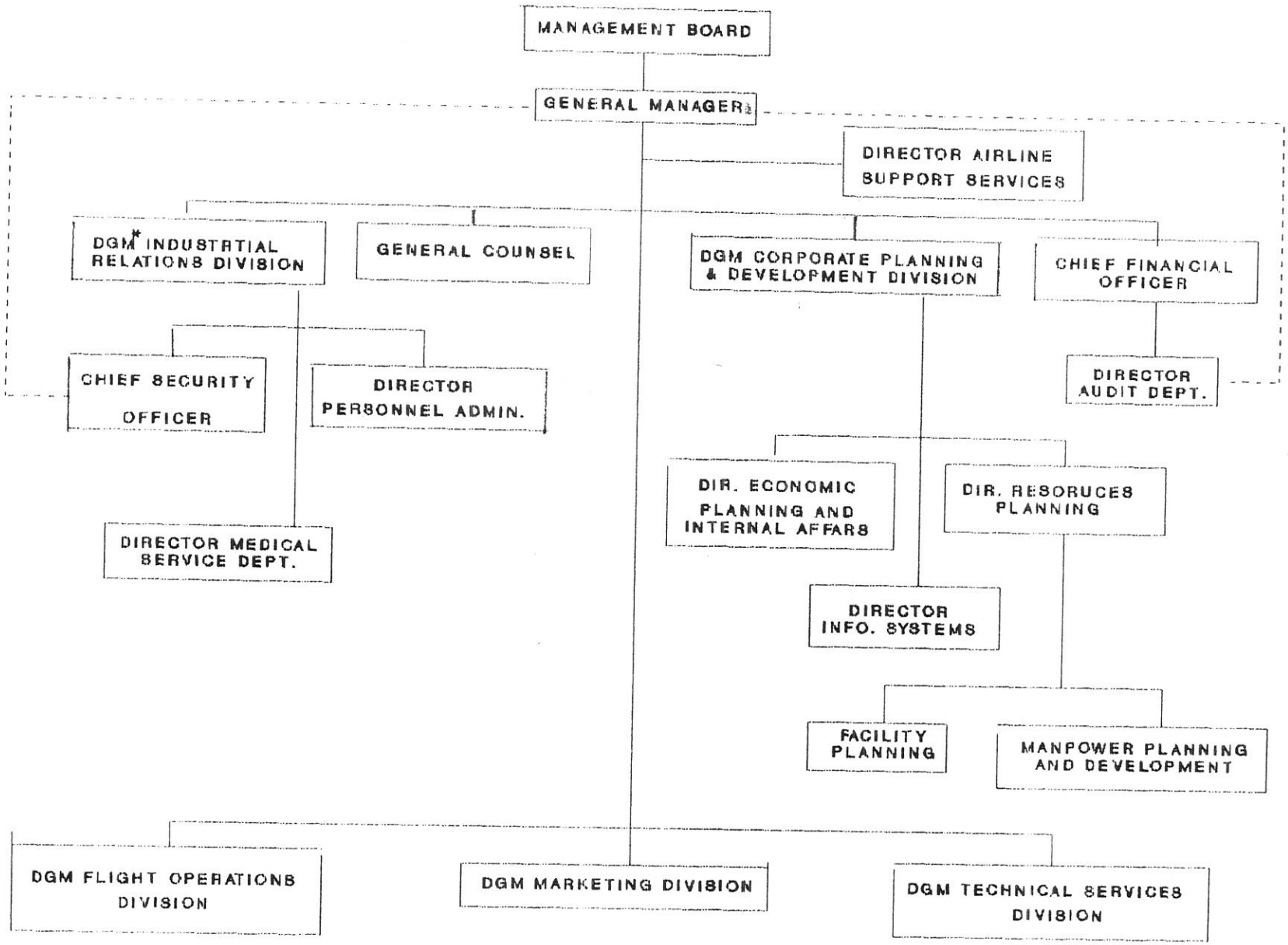

FIGURE 2.1 ORGANIZATIONAL STRUCTURE OF ETHIOPIAN AIRLINES

*DGM-Deputy General Manager

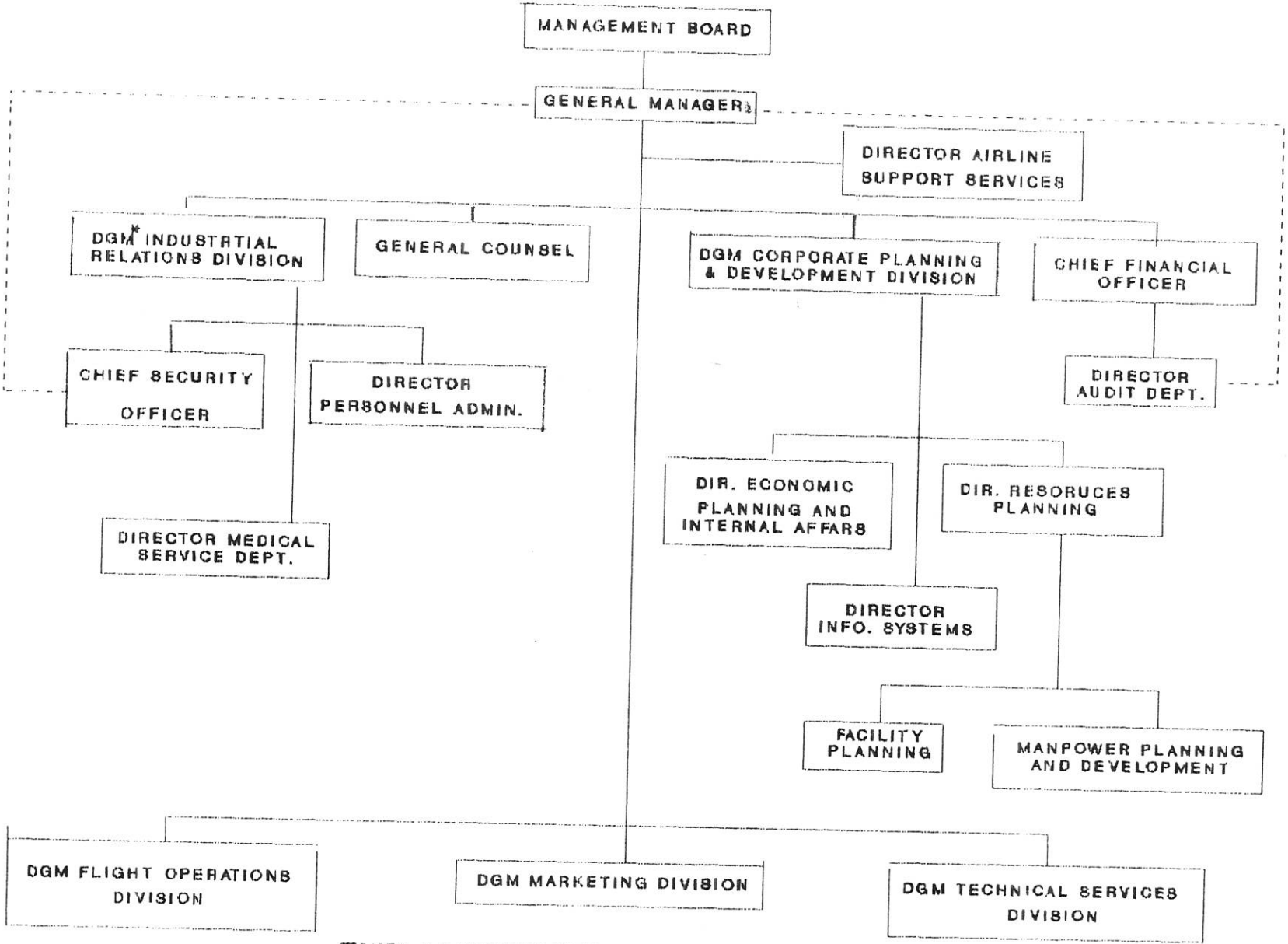

FIGURE 2.1 ORGANIZATIONAL STRUCTURE OF ETHIOPIAN AIRLINES

*DGM-Deputy General Manager

2.2.3 The Medical Unit of the Airlines

The Airline has its own Medical Unit with qualified health professionals (i.e., doctors, nurses, laboratory technicians, druggists, etc.) and it provides medical services to the employees of the organization, families of employees, pensioners, and other individuals (for example patients from other organizations such as the British Embassy, ILCA (International Livestock Centre for Africa), etc.) who have special agreement with the organization, numbering approximately over ten thousand persons.

All active employees are entitled to free medical services while families of employees and pensioners are supposed to pay on a reduced rate basis. The other individuals, on the other hand, can get medical services with full payment only.

The main functional areas in the medical unit include:

1. Patient registration, verification, and scheduling to the appropriate place. This is the task of the members of the record office staff (file clerks).
2. Patient examination usually done by the doctors.

3. Providing first aid services, special care and close follow up to patients is the main function of the nurses.
4. Laboratory test by the laboratory technicians.
5. X-Ray services provided by the radiographers.
6. Drug acquisition and distribution which is the function of druggists.
7. Book-keeping which includes verifying valid requests for refunds, billing non-employee patients, controlling the balance of budget allocated for the different functions in the medical service department, and so on.
8. Safety engineering whose main responsibility is to closely follow employees' health conditions and ensure their safety.

All the above functional areas operate under the management of the Director Medical Services and Safety Engineering who directly reports to the Deputy General Manager Industrial Relations Division.

The functional areas in the medical unit are summarized in a hierarchial chart shown in figure 2.2.

3. Providing first aid services, special care and close follow up to patients is the main function of the nurses.
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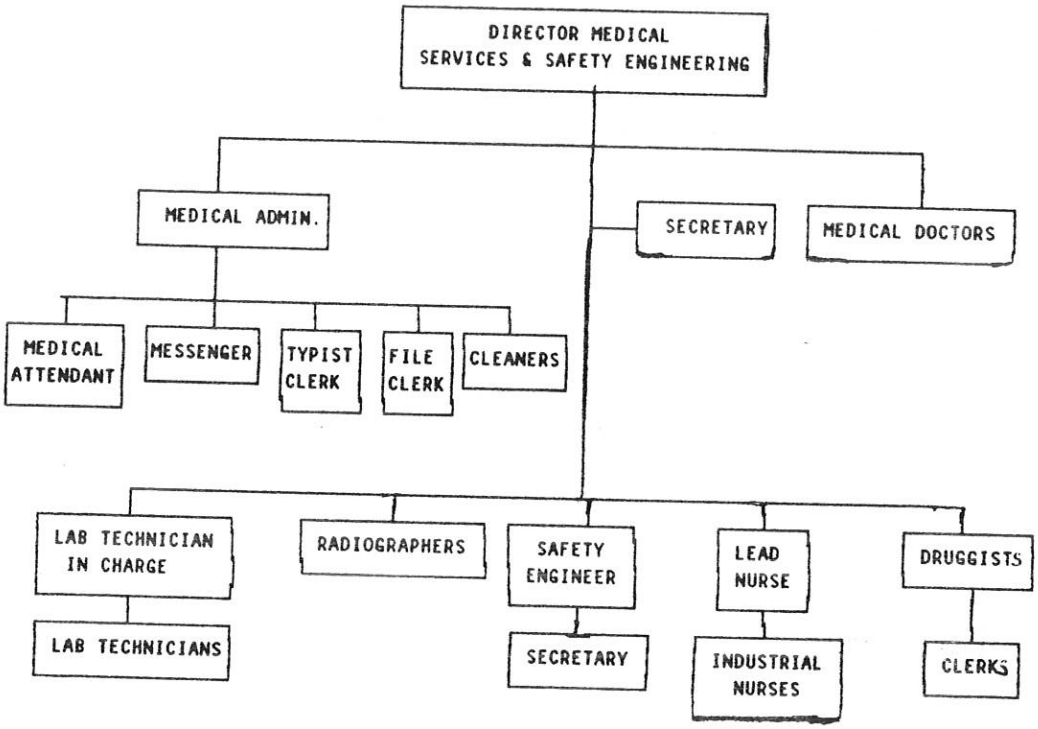

Figure 2.2 Existing Structure of the Medical Unit

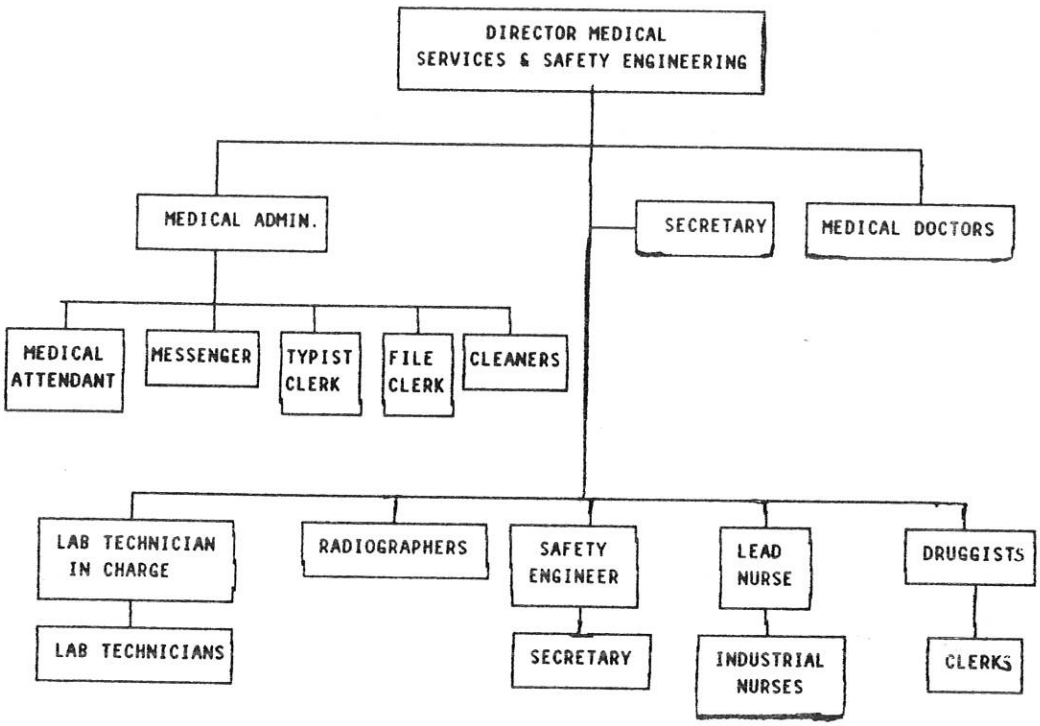

Figure 2.2 Existing Structure of the Medical Unit

2.2.4 Computers in the Airlines

The Airlines' first contact with computer-based information system can be traced back to the 1970s. At its inception stage in the organization, the utilization of computer technology was very limited, mainly for payroll transactions processing.

The Airline began to use computers extensively with the introduction of IBM-370 mainframe machines which are still in use. It is during the introduction of these machines that the Information Systems Unit (the then Electronic Data processing Department) was formed. The structure of the information systems is a centralized one being controlled and managed by the Information Systems Unit and the general objective of the centralized information systems is to support and control data processing and information handling activities of the different divisions and departments of the organization. That is, the structure of the existing computer based information systems is a centralized one running under the control of the Information Systems staff and supporting different categories of users.

2.2.4.1 The Information Systems Unit

It should be noted that the description of the existing information systems presented here does not include the Airlines' Reservation System which is totally out of the management and control of the Information Systems Unit. It is managed and controlled by an International Agency known as SITA - a French abbreviation for "Societe Internationale Telecommunications Aeronautiques".

In the hierarchical structure of the Information Systems Unit, we find the Director Information Systems at the top of the hierarchy followed by lower managers and supervisors. The Director of Information Systems is meant to report directly to the Deputy General Manager (DGM) of the Corporate Planning and Development Division. See Figure 2.3 for a brief representation of the existing structure of the Information Systems Unit.

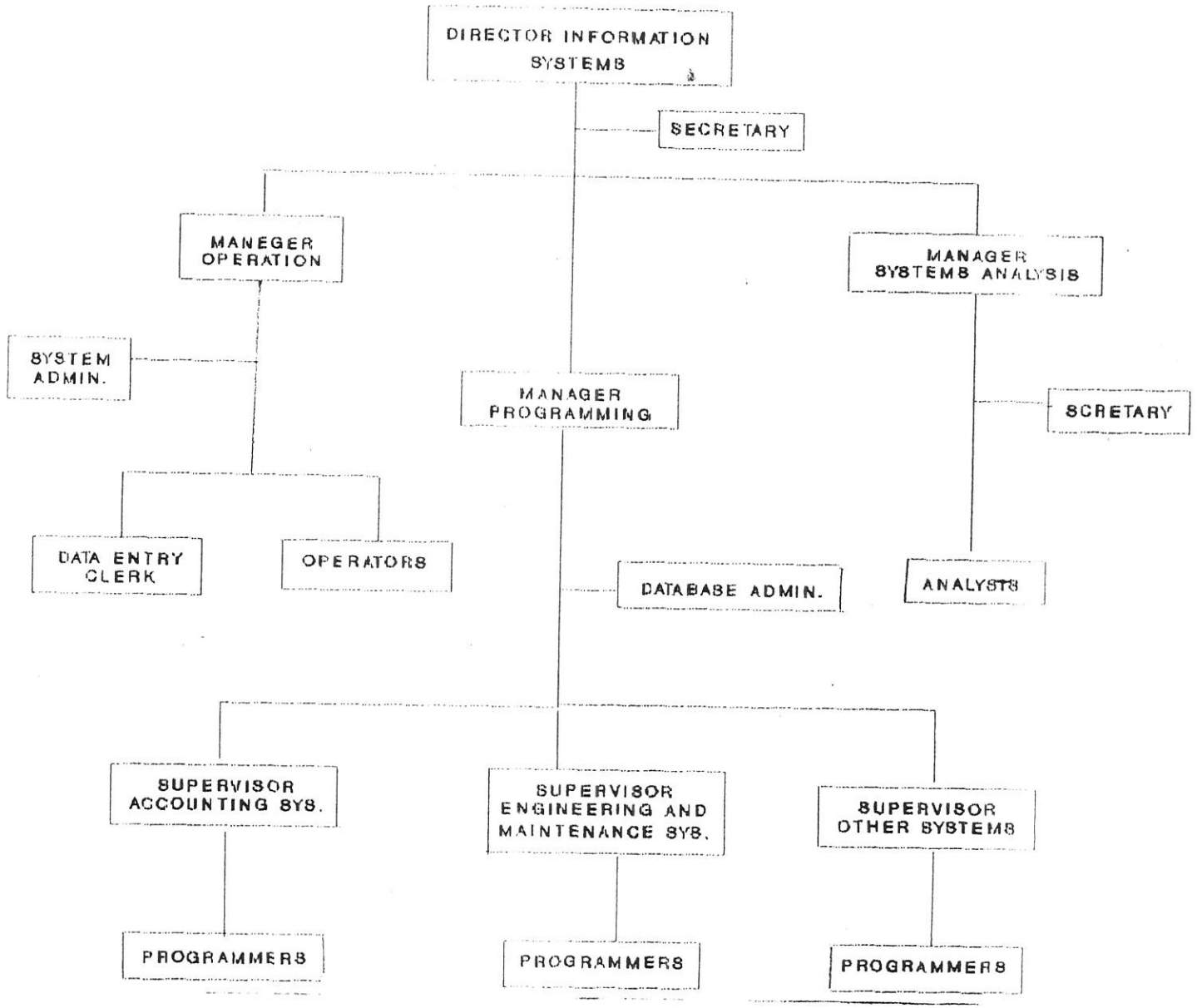

Figure 2.3 Existing Structure of the Information Systems Unit of the Airlines

As was mentioned earlier (in section 2.2.1) most of the main operational activities in the Airlines are computerized. But, this does not mean that computers are being utilized to their full potential. The reason is that there are obvious problems in the overall management and utilization of computer-based information systems.

The information systems professionals are the main engines of the organization since they are responsible for the basic information products and services needed by the different categories of end users. Value added information such as annual financial reports, manpower and facility status reports, etc. which are the basis for higher management decisions are prepared and produced by these professionals.

A critical problem that has been observed in the existing computer-based information systems environment is the capacity problem. The existing IBM-370 family mainframe machine operating with the DOS/VSE/SP (Disk Operating System/Virtual Storage Extended/Special Package) operating system was installed in the early 1980s and no upgrading has been made sofar. As it can be easily understood, and as it was observed, the existing old system which has never been upgraded for about fifteen years is not able to fulfil the capacity requirements of

the different applications in the Airlines' activities.

For this and other related reasons, some of the Airlines' activities are still being operated manually, and no further progress is expected unless the capacity problem is solved either through decentralization followed by distributed processing, or by acquiring more advanced centralized computer system with a very high capacity so that all the basic applications in the Airlines can be implemented in a single computer system.

CHAPTER THREE

SYSTEMS ANALYSIS

3.1 GENERAL INFORMATION

This chapter focuses on the general analysis part of a system study. A system is generally defined as an aggregation of components forming an organized whole under a unified control and designed for a specific purpose. The term "analysis" is generally defined as the process of decomposing anything complex into its simple constituents (or components), to examine the composition and functions of each part.

The purpose of this systems analysis is to obtain relevant information as input to the system design phase, system design being the core objective of the study (Chapter Four).

The major system for the study is the information system in the Medical Unit of the Ethiopian Airlines.

Due to time constraint, the cost benefit analysis (i.e, evaluation of return on investment) which could be done based on the expected value of the resulting applications

expressed in monetary terms and the expected cost of implementation and subsequent operations of the applications is not covered in this work. But, it is generally assumed, the trend in modern societies is that the cost of computer systems is decreasing significantly and computer-based information systems offer advantages over manual systems in terms of accuracy, relevance, and timeliness of information provision. For this reason, it is believed that the return obtainable by investing a reasonable amount of money on computerization of the information systems at the Medical Unit could be high.

Major areas that are covered in this chapter include:

- Categorizing the prospective users of the system into groups
- Identifying basic entities and their attributes
- Specifying the major functions in the Medical Unit of the Airlines
- Determining the basic requirements of the system,
- Describing the system using Data Flow Diagrams (DFDs)
- Preparing data dictionary for the proposed system, etc.

3.2 CATEGORIES OF SYSTEM USERS

Close cooperation was established with the potential users of the system during the data collection process and several individuals were involved in the process. The discussion in this section is based on the information obtained during the fact finding process using some of the fact finding methods such as interviewing, literature review, and observation (See 1.5). Users can be grouped into related categories and the main user categories in the Medical Unit are briefly discussed below.

3.2.1 Users in the Doctors Group

An important group of potential users of the information system in the Medical Unit are the doctors responsible for the treatment and care of the patients, and obviously they play a decisive role in the Medical Unit environment. Basic diagnostic activities and treatment of patients are carried out by the doctors and they need quick access to complete patient information including:

1. Reports on patient appointment schedules
2. Patient medical history - Information about the patient's own medical history such as major illnesses, hospitalizations, and operations

3. Patient social history - Medically relevant information about the patient's life such as occupation and habits
4. Patient family history - Medical information about the patient's family or ancestors which may be relevant to the patient's treatment
5. Consultation and treatment reports
6. Special Studies - Results of special treatment such as case study records
7. Medications - The medications which have been prescribed for the patient along with a list of patient's allergies
8. Vital signs - The record of the patient's blood pressure, temperature, pulse, height, weight, and other information
9. Problem list - The list of the patient's major problems for which the patient has sought treatment
10. Health maintenance status - A record of the patient's compliance with scheduled health maintenance procedures including periodic examinations, tests and immunizations
11. Laboratory data - Numeric and text results of laboratory tests, microbiology results, etc.
12. X-ray reports - X-ray examination results of the required part(s) of the body
13. E.C.G results - The results of E.C.G tests

14. Letters - The text of medical letters written or received for the patient
15. Discharge summaries - Summaries of patient hospitalization records

Such a file is built up over a period of time for each patient. And not all the details may be available or collected and recorded for each patient.

These case histories of patients are also required for research on specific diseases, in clinical teaching/ learning, etc. Therefore, the appropriate cases must be retrievable quickly in response to specific queries.

Examples of queries:

In which cases and in how many cases

- of astrocytoma patients complained of temporal headache, visual and hearing disturbance?
- of glioma or glioblastoma had previous CNS surgery?
- prolactinoma with high prolactin level and negative immunochemistry for prolactin secreting tumours?
- of optic atrophy and bilateral field defect in males above 25 years?
- X-ray skull abnormal, CT scan intrasellar, prolactin level greater than 50, consciousness level not less than 15 (GS) and transethmoidal

surgery and transphenoidal were done? And in which cases diabetes insipidus was noted as a postoperative complication?

Doctors also like to know whether a particular test or a particular type of treatment or a particular surgical procedure was carried out in particular cases and if so, what were the findings.

The workload on these users is considerably high every day. Although most of them are not using computers, they were highly motivated and very willing in providing essential information for the definition of the proposed computer-based information system.

The information gathered during the fact finding process indicates that the doctors are assisted by several professional and para-professional groups (for example, nurses, laboratory technicians, radiographers, druggists, etc.). There is a need for an up-to-date and relevant information flow among the different user groups so as to be able to perform their respective functions effectively and efficiently.

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living person - is an entity. A characteristic or property of an entity which can be used to describe the entity is known as an attribute. For example, the patient's registration number, address, age, etc. are all attributes of his/her. A given attribute is represented as a field value.

The patient's registration number field is a very important field that needs special consideration. Each patient has a unique registration number, and it is possible to distinguish between the different patients using that field. A field (or combination of fields) with unique value is called a key field of the file.

The reason for the discussion of the above terms is that the terms might be used in any phase of the rest of the system study process and it is to avoid any confusion that can arise due to misunderstanding of the terms.

The main entity types that will be considered in the design of a prototype database on patient records are patient, doctor, symptom, diagnosis, laboratory test, and staff. Each entity type and its corresponding attributes are briefly described below.

1. Patient - The patient entity has attributes like name, registration number, department (if

3.3.1 The data dictionary

A data dictionary is a repository of information about data. The main purpose of a data dictionary is to record all that is known about a field or data element (For example, its unique name, its size, the range of values it may take), including the relationship with other data elements (For example, Drug- Price-Amount = Quantity x Average-Unit-Price).

The manual data dictionary shown in Table 3.1 is prepared for keeping track of data definitions and the intention here is to provide essential information for designing the different files that will come under the database design (Chapter Four). The information summarized in the data dictionary was gathered during the data collection process by interviewing the prospective users and browsing paper forms existing in the Medical Unit used for record keeping.

Field Name	Type	Size	Description
ACCT-NO	Character	6	Account Number
BG-GST	Character	15	Bacteriology - Gram St.
BG-WTM	Character	15	Bacteriology - Wet mount
CL-DATE	Numeric	6	Date employee claimed for refund
CT-DATE	Numeric	6	Consultation & treatment date
DG-AUP	Numeric	7	Average unit price
DG-EXDT	Numeric	6	Drug expirity date
DG-ISDT	Numeric	6	Drug issued date
DG-NAME	Character	40	Drug name
DG-ORDT	Numeric	6	Drug ordered date
DG-PON	Character	6	Drug purchase order number
DG-QOH	Numeric	7	Drug quantity on hand which is the difference between quantity received and quantity issued
DG-QTY	Numeric	7	Drug quantity
DG-QTYI	Numeric	7	Drug quantity issued
DG-QTYO	Numeric	7	Drug quantity ordered
DG-QTYR	Numeric	7	Drug quantity received
DG-RCDT	Numeric	6	Drug received date
DG-STKN	Character	5	Drug stock number
DG-UOM	Character	4	Drug unit of measure (valid values is 'EACH' or 'PACK')

Table 3.1 Data Dictionary

Field Name	Type	Size	Description
EMP-CNO	Character	5	Employee's claim number for refund (If employee was treated in other health organizations)
EX-NAME	Character	30	Name of attending expert (mostly doctors)
EX-NUMR	Character	5	Expert's number or code
EX-PRSC	Character	300	Expert's prescription
EX-QUAL	Character	100	Expert's qualification
INV-NO	Character	6	Invoice number of a valid receipt brought
PA-ADDR	Character	100	Patient's address
PA-AGE	Numeric	3	Patient's age
PA_APPD	Numeric	6	Date patient appointed for consultation and treatment
PA-DEPT	Numeric	3	Patient's dept.(if employee)
PA-DIAG	Character	300	Diagnosis type investigated
PA-MSTS	Character	7	Patient's marital status
PA-NAME	Character	30	Patient's name
PA-NLTY	Character	50	Patient's nationality
PA_OCCP	Character	100	Occupation of patient
PA-REG	Character	5	Patient's registration number
PA-SEX	Character	1	Patient sex (poss. values 'F' for Female or 'M' for Male

Table 3.1 ...(continued)

Field Name	Type	Size	Description
PA-SYMP	Character	200	Symptom observed
PA-TELN	Character	10	Patient's telephone number
RC-AMT	Numeric	5	Total money received
RC_VNO	Character	7	Receipt voucher number (used in billing patients)
RC-DATE	Numeric	6	Date money was received
REF-NO	Character	4	Reference number for refund
RFD-AMT	Numeric	5	Amount claimed for refund
RG-DATE	Character	6	Patient's registration date
RS_PYMT	Character	100	Reason for payment
EN-INd	Character	200	Indications for Endoscopy Examination
FI-OSP	Character	100	Endoscopy findings of Oesophagus
FI-STM	Character	100	Endoscopy findings of Stomach
FI-PYL	Character	100	Endoscopy findings of Pylorus
FI-DBL	Character	120	Endoscopy findings of Doudenal Bulb
FI-FPD	Character	100	Endoscopy findings of the first part of Duodenum
EN-CNR	Character	300	Conclusions and recommendations after Endoscopy Exam

Table 3.1 ...(continued)

Field Name	Type	Size	Descripton
XR-CLN	Character	200	X-ray clinical notes
XR-OEX	Character	150	Object of exam. for x-ray
XR-RQB	Character	30	X-ray requested by (Name of the person who requested for x-ray)
RD-RPT	Character	350	Radiologist report
RD-NAM	Character	30	Radiologist name
EY-FVN	Character	100	Field of vision (used for eye treatment report)
EY-FUN	Character	200	Funduscopy (used for eye treatment report)
EY-IOT	Character	200	Inter Ocular Tension (used for eye treatment report)
EY-HET	Character	150	Heterophorial (used in eye treatment report)
EY-CVS	Character	100	Colour vision (used in eye treatment report)
EY-NVS	Character	100	Near vision
EY-DVS	Character	100	Distant vision
EN-NOS	Character	200	Nose (used in E.N.T treatment report)
EN-SIN	Character	200	Sinuses (used in E.N.T treatment report)
EN-ERS	Character	200	Ears (used in E.N.T treatment report)
EN-MTR	Character	200	Mouth and Throat (used in E.N.T treatment report)
EN-AUD	Character	150	Audiometry (used in E.N.T treatment report)

Table 3.1 ...(continued)

Field Name	Type	Size	Description
EN-RCM	Character	350	Recommendation and comments on eye examination results
EN-SPT	Character	30	Name of E.N.T specialist
HG-WBC	Character	8	Haematology - White Blood Cells (used in Lab-test)
HG-RBC	Character	8	Haemotology - Red Blood Cells
HG-HB	Character	7	Haematology - Hemoglobin
HG-HCT	Character	4	Haematology - Haematocrit (used in Lab, Test)
HG-GRP	Character	2	Haematology - Blood Group
HG-RHF	Character	8	Haematology - Rh Factor (used in Lab Test)
SR-VDRL	Character	2	Serology - VDRL (used in Lab Test)
SR-PGC	Character	8	Serology - Pregnancy Test
PG-STP	Character	15	Parasitology - stool parasites
PG-OCB	Character	12	Parasitology - Ocult Blood
PG-HMP	Character	30	Parasitology - Haemeparasite
UR-ALB	Character	6	Urinalysis - Albumin (used in Lab Test)
UR-SGR	Character	8	Urinalysis - sugar
UR-KTN	Character	8	Urinalysis - Ketone
UR-BLB	Character	8	Urinalysis - Bilrubin
UR-URB	Character	8	Urinalysis - Uroblinegen
UR-BLD	Character	8	Urinalysis - Blood
UR-NTR	Character	12	Urinalysis - Nitrite
UR-CLR	Character	10	Urinalysis - Colour
UR-SPG	Character	10	Urinalysis - Sp. gravity

Table 3.1 ...(continued)

Field Name	Type	Size	Description
UR-MPC	Character	7	Urinalysis - Micro Pus cells
UR-MEC	Character	7	Urinalysis - Micro Epi. cells
UR-RBC	Character	7	Urinalysis - Micro RBC
UR-AFB	Character	15	Bacteriology - AFB (used in Lab. Test)
EX-INS	Character	40	Institution to which expert belongs
EX-AGE	Character	3	Expert's age
EX-ADDR	Character	60	Expert's Address
EX-TELN	Character	10	Expert's Telephone Number
IN-NAME	Character	40	Name of Institution
IN-LOC	Character	30	Location of Institution
IN-ADDR	Character	60	Address of Institution
IN-TELN	Character	10	Telephone Number of Institution
DC-TITL	Character	50	Title of document (used for bibliographic reference)
DC-AUTH	Character	30	Author of document
DC-ISBN	Character	15	International Standard Book Number
PB-NAME	Character	50	Publishers Name
PB-PLC	Character	40	Place of Pulblication
PB-YEAR	Numeric	4	Year of Publication
PB-ADDR	Character	60	Publisher's Address
ED-NUM	Character	2	Edition number of document
VL-NUM	Numeric	2	Volume Number of document

Table 3.1 ... (continued)

3.4 SYSTEM REQUIREMENTS DETERMINATION

The actual data collection process started just after general understanding of the user environment. The discussion on the highlights of the user environment in the preceding section is not without reason. It is because most of the data elements used in the specification of the system requirements have been obtained from the potential users of information in the Medical Unit of the Airlines and their participation in the system requirements determination is very important to obtain the necessary information to be used for the system design process.

The process of defining the output requirements, and processing requirements of the system is carried out based on the information obtained from the working environment (Medical Unit) during the data collection process and these basic requirements of the proposed system are briefly discussed in the next paragraphs.

3.4.1 Output Requirements

The definition of output-information requirements is one of the major activities in information system analysis, and the major goal of an improved information system is to provide the necessary information to its potential users in response to their queries or in anticipation of their needs to assist them perform their tasks effectively and efficiently.

Detailed definition of each output and the design of specific output or report formats are discussed at the detailed system specification stage (Chapter Five). The intention here is only to highlight the major output-information requirements that are essential to form the base upon which steps like definition of requirements for input data, and the database design process will be built.

Generally, it is not necessary to define every type of output at this stage and the main objective of the output definition here is to describe the major responses and reports needed in the information systems environment of the Medical Unit. To describe the major output requirements of the medical information system under review, information has been collected on the name of the

output, data elements used in this output, event trigger which causes this output to be produced, and user group which will receive this output.

The major output requirements of the new information system in the Medical Unit are:

1. Patients' appointment reports - Generated from appointment transactions processing using appointment date and attending doctor's number as key fields.
2. General consultation and treatment report, Sonographic study report, Endoscopy examination result, X-ray examination result, laboratory test result, etc. - All resulting from patient records processing.
3. Weekly reports for valid refund claims - Produced by the refund section when weekly refund activities are complete.
4. Daily stock status report - Which can help the druggists in inventory control activities.
5. Responses to different queries - For example, information on patient's history can be displayed on a terminal because of a query input.

The basic data elements required to produce the desired outputs have been defined using the data dictionary

discussed in Section 3.3.1.

3.4.2 Processing Requirements

The processing requirements of the new system are defined based on the information obtained from the prospective users of the system. Emphasis is given here to the needed application functions but not to the specific application programs.

The major application functions of the new system are considered under the different subsystems of the medical information support system for the Medical Unit and each major subsystem is briefly discussed below.

1. Scheduling Subsystem - which controls the registration, appointment, and scheduling of patients for treatment to the different consultation and treatment areas including General Patient Examination, Eye Treatment, Sonogram, Audiogram, Gynecology, Cardiology, Electro-Cardiogram (E.C.G), etc.
2. Patient Records Subsystem - which is expected to handle all necessary patient information.
3. Book-keeping Subsystem - to deal with operations regarding financial transactions in the Medical

Unit.

4. Drug Status Control Subsystem - to handle the inventory control functions in the drug shop (pharmacy) of the Medical Unit.
5. Research and Referral Services Subsystem - to provide current awareness and referral services including bibliographic sources and systems, ongoing research projects of specialists on other medical/clinical/hospital units, research centres, etc.

The above are the required application functions that have been defined based on the information obtained from the potential users. A general statement of what processing is to be done by the system follows.

In general terms, the proposed system is required to handle and control the main data processing and information handling activities in the Medical Unit of the Airlines, and the main processing requirements of the system in performing the stated application functions are:

1. To check and validate patients' registration, by processing patient registration file, and to update the file after the required processing is complete.

2. To accept patients' medical information provided by health care providers and other professionals from data entry screens, process patient records file and update the file.
3. To accept all relevant information needed by the druggists when receiving drugs from the purchasing department and issuing drugs to patients, process stock control file and update the file.
4. To generate stock status reports of drugs by processing stock control file.
5. To accept refund information from employees who were treated outside the Medical Unit, process invoice file and update it.
6. To generate refund reports by processing the invoice file.
7. To generate health statistics reports by processing patient records files.
8. To give response to queries on patient's medical history, medical case studies, experts profiles, bibliography of medical publications, etc.

The definition of application programs that govern the different functions of the system will be dealt later in the detailed system specification (Chapter Five).

3.5 GENERAL DESCRIPTION OF THE PROPOSED SYSTEM

The main goal of the analysis phase is the establishment of the basic requirements for the system under review. Understanding of the requirements was improved as a result of the interaction with the potential users. The information obtained from the users and the working environment needs to be organized into a coherent document to be reviewed by the concerned individuals (system developers or programmers, users and their management).

This section presents a general description of the proposed system first in narrative form and then using a Data Flow Diagram.

The system will be designed to keep track of patient records. It will allow for entering patient-information, and might at the same time require the transmission of data to another application (if patient is not an employee of the Airlines) for preparation of the patient's bill. It will also offer a variety of inquiry facilities to retrieve relevant information.

All functional areas in the Medical Unit considered for the study are represented using the Data Flow Diagram

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All functional areas in the Medical Unit considered for the study are represented using the Data Flow Diagram

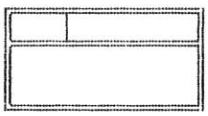
(DFD) shown in Figure 3.2.

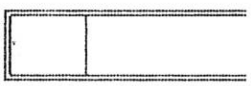
Data Flow Diagrams are among the structured tools used for documentation in the systems analysis and design process. They are graphic methods for defining inputs, processes, and outputs and for factoring systems into subsystems.

These diagrams are used to illustrate processing of data independent of the physical agents involved.

The following are the DFD symbols used to represent the activities of the Medical Unit.

1.  Represents Source or Destination

2.  Represents Processing

3.  Represents Storage (Data Store)

4.  Indicates flow of data/Information

Figure 3.1 Symbols used in DFD

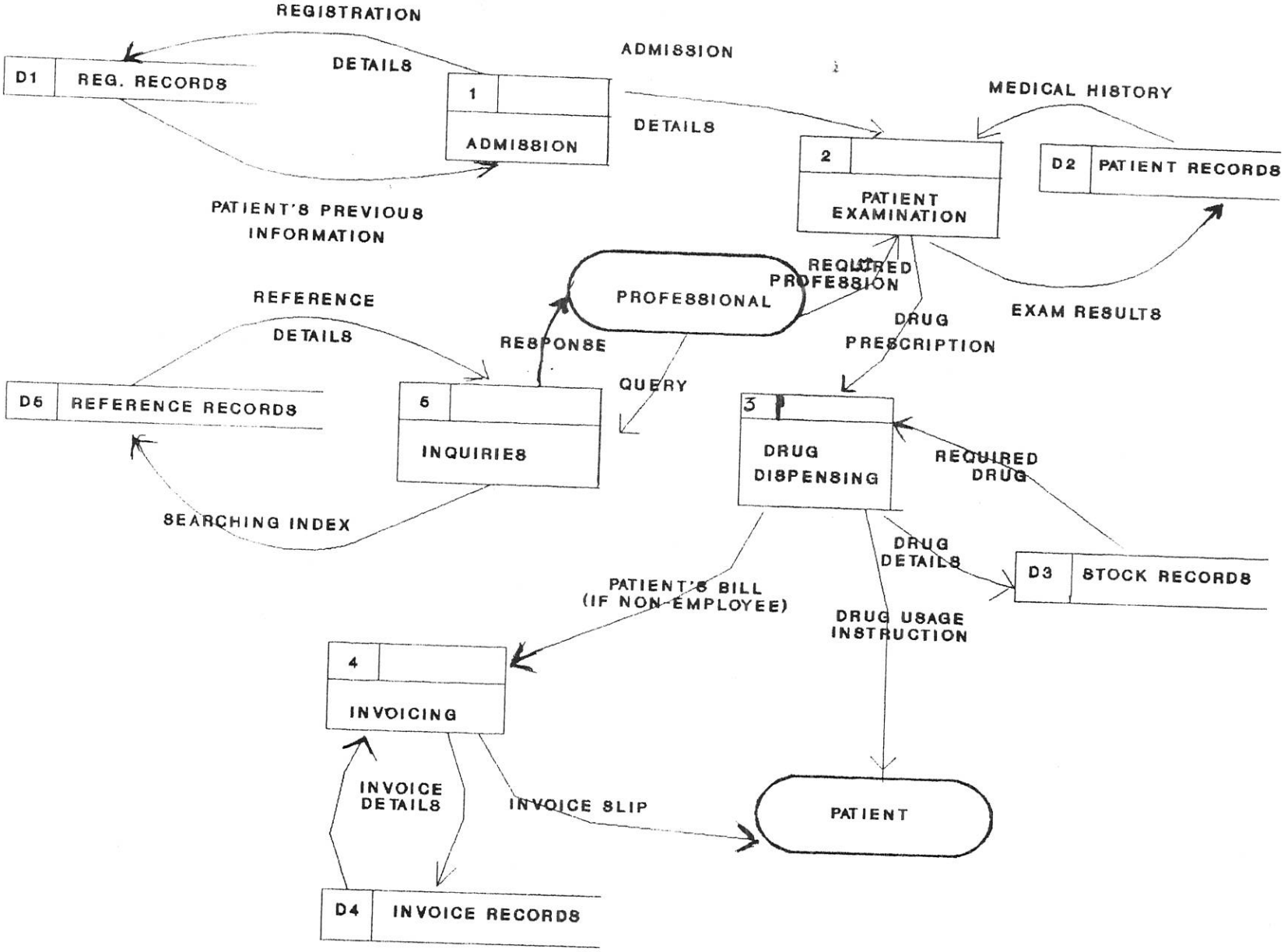


Figure 3.2 Main Activities in the Medical Unit Represented Using DFD

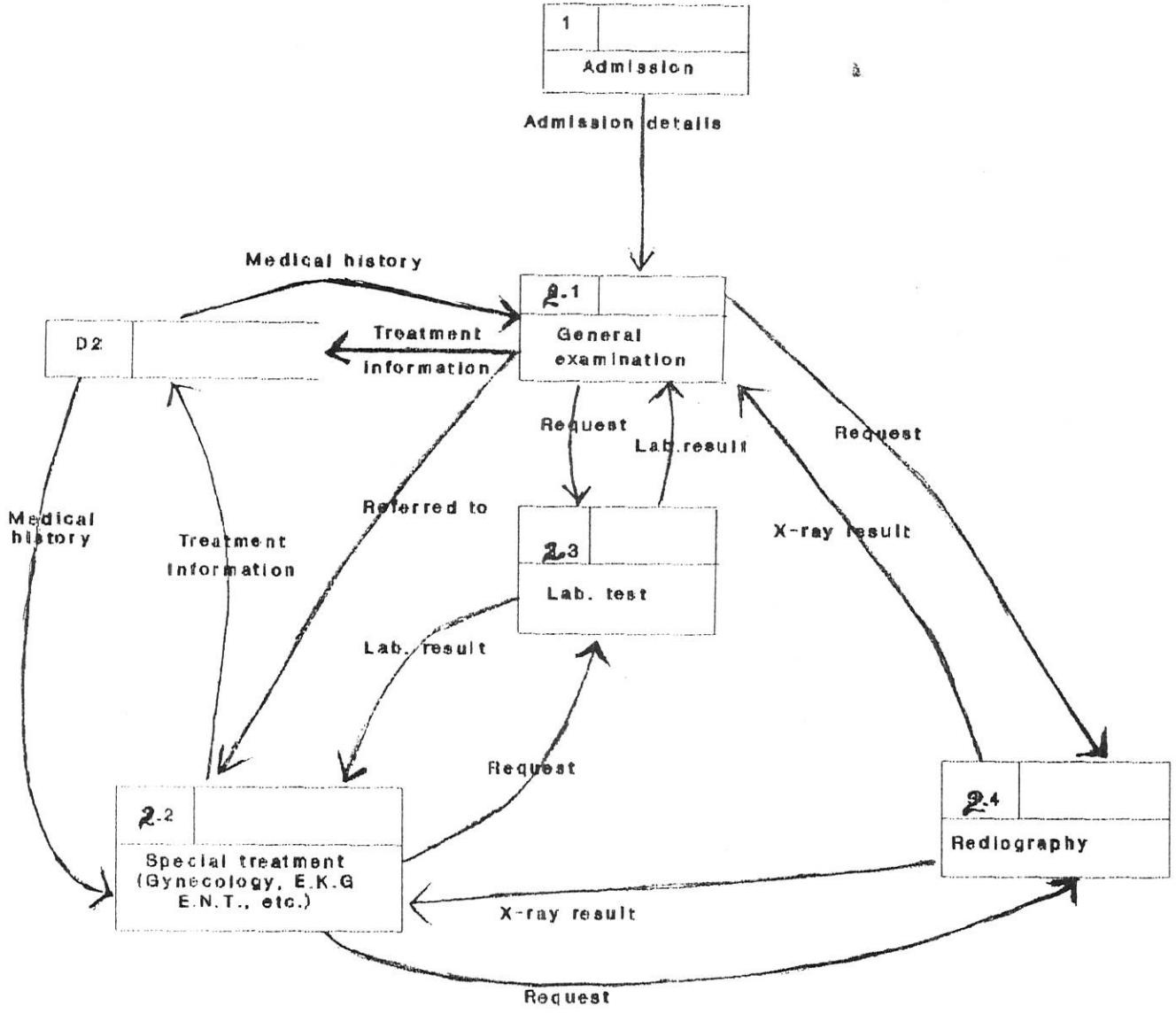


Figure 3.2 .... Continued

CHAPTER FOUR

SYSTEMS DESIGN

4.1 CHOOSING THE SYSTEM STRUCTURE

Deciding how to allocate system functions in the working environment is one of the fundamental elements in a system design process. Designing an information support system is an interactive process aimed at finding a possible solution to a predefined problem of an information system.

An information system can be designed in a centralized, decentralized, or distributed form depending on existing constraints and on the actual applications to be implemented. The current trend is oriented to distributed processing. Distributed processing generally involves the implementation of data processing tasks at remote locations connected by some form of data communication channel under a common network architecture. A distributed information system is "a coordinated set of information-processing capabilities implemented in two or more relatively independent resource centres such as computer sites, intelligent terminal locations, and so on" (Booth 1983).

There are situations in which some applications are best suited to centralized processing while others are best implemented as decentralized systems. In a centralized information system structure all information resources and processing activities are located at one site. A decentralized information system structure, on the other hand, is one in which two or more sets of processing equipment managed and controlled by the same organization are implemented at different locations but with no coordinating capabilities.

The fundamental design decision at this stage is to define how to allocate the information system functions in the Medical Unit of the Ethiopian Airlines (that is, to choose an appropriate structure for the proposed system) based on some basic factors that may influence the performance of the system. This section discusses the points that have been considered in deciding whether to centralize, decentralize, or distribute the application functions of the micro-organization under review (Medical Unit). And the existing centralized computer-based information system of the macro-organization was taken as the main point of reference in this decision.

Some good arguments for not proposing a distributed system structure at this stage are:

1. Distributed systems are relatively complex and need highly trained and skilled personnel to operate them. But, as was discussed earlier, the prospective users in the Medical Unit are not equipped with enough knowledge of computer-based information systems. Most of them are familiar only with manual operations, and they need to be trained on how to use computers. In such cases, the best way to begin training is to start from the simplest system.

2. Computerization is usually a step-by-step process and it is wise to see the information support system for the Medical Unit independently at its initial stage. As the users get experience with the utilization of computer-based systems, it will be easier to introduce the notion of distributed systems at a later stage. This can be achieved by introducing and implementing a decentralized structure at the initial stage and later linking the decentralized components to form a distributed system structure.

For these and other reasons the distributed system structure is not a candidate for the proposed system and the one which best suits for the application functions will be selected based on some basic factors.

The information system in the micro-organization under discussion is a subsystem of the total information system in the macro-organization (Ethiopian Airlines). But, the existing computer-based Information Systems Unit in the Airlines is a centralized one which does not support some of the divisions and departments in the organization (for example, the Medical Unit) for different reasons. One obvious reason is that there is a capacity problem in the existing centralized system.

Depending on some tangible factors (which will be discussed in the following sections), the structure of the proposed system is chosen to be a free standing, decentralized one. That is, it is not to be incorporated (or embedded) into the existing Centralized Information Systems Unit of the Airlines. Factors that have been considered in choosing the structure of the proposed system include:

1. The organization's new policy concerning information systems

2. Capacity requirements of the different application functions in the Airline
3. Geographical location of the Medical Unit as compared to the existing Centralized Information Systems Unit

The above factors are briefly discussed below.

4.1.1 Policy Considerations

The existing centralized computer-based system has proved to be inefficient. For this reason, the organization has been forced to revise its information policy and formulate a new policy which is expected to alleviate the prevailing problems. In the new policy, all the major divisions in the Airlines are expected to implement their own automation services. That is, the intention of the new policy is to introduce a decentralized system structure, and this policy change was taken as one of the major factors in choosing the structure of the proposed system for the Medical Unit.

4.1.2 Capacity Requirements

There is a continuous complaint from the users of the existing centralized computer-based system that the response time is very slow, and that they are not satisfied with the existing system. One aspect is that the existing system does not fulfil the capacity requirements and it fails to satisfy users' needs. Some of the reasons for this capacity problem are:

1. There are a great number of users who simultaneously access the system, and
2. The volume of transactions handled by the existing system is too high for its capacity.

In general, the capacity requirements of the applications in the Airlines are too great to be implemented in the existing centralized mainframe computer system and, therefore, a decentralized structure is preferable for the proposed system of the Medical Unit.

4.1.3 Geographical Factor

The Medical Unit of the Airlines is located at a distance from the existing Information Systems Unit (where the mainframe computer is located). Connecting terminals from such locations to incorporate the proposed system into the existing centralized one may incur high cost, resulting in additional cost for expensive telecommunications software. This indicates that centralizing the Medical Unit system into the existing could be expensive.

4.1.4 Advantages of Centralized Systems

The advantages of a centralized system are:

1. Simplifies the protection of privacy - since certain individuals may have access to secured information.
2. Supports tight managerial control - both material and human resources of such a system are concentrated in a specific central area.
3. Reduces duplication of efforts - because there is no need to duplicate the same type of data items in different sections and departments of the same organization.

4.1.5 Disadvantages of Centralized Systems

Generally, a centralized system may have the following disadvantages:

1. It is not flexible for change - A centralized system typically comprises a large number of application functions and these functions may be unrelated although they are executed on the same computer system. A system of this type can be very complex, and one of the basic rules of information systems is that the more complex a system is the more difficult to change it.
2. It is difficult to upgrade the capacity - This is so because for some computers it is mandatory to replace some existing modules when more powerful processing modules, memory modules, input/output modules, etc. are installed.
3. Slow response time for large number of terminal users - Because the time required by the system to produce the required output depends on the number of transactions being processed.
4. It is exposed to single point damage - This happens as a result of some sudden disaster in the environment of the computer centre.
5. It results in high cost of data communications (if

users are at geographically remote locations).

6. It is difficult to customize, because the process of modifying existing modules, input/output methods and formats to satisfy user needs is more difficult for complex systems.

4.1.6 Advantages of Decentralized Systems

The main advantages of a decentralized system structure are:

1. It is relatively flexible for change - because decentralized systems by their nature are modular and simple, hence, can be changed easily when the need arises.
2. The response time is relatively faster - because different categories of users can be served by different processors. That is, there are as many computer sites as necessary in a decentralized structure.
3. In relative terms such a structure is relatively less exposed to single point failure (although specific functions might be exposed to sudden damages).
4. Minimum cost of data communications (for users who are geographically dispersed).

5. The technical risks in utilization is low - since decentralized systems are simpler and user friendly.

4.1.7 Disadvantages of Decentralized Systems

The obvious disadvantages of a decentralized system are:

1. Security problem for private data/information - because computers are usually not in protected rooms/locations.
2. Duplication of effort - because duplication of data may exist in different divisions and departments of the same organization.

It can be seen that both system structures have their own specific advantages and disadvantages but the decentralized system has greater advantages over the centralized one. Based on these considerations the structure of the information support system for the Medical Unit of the Ethiopian Airlines is chosen to be a free standing decentralized one.

4.2 PROTOTYPE DATABASE DESIGN

One of the key elements in the design of a computer-based information system is the database design. This section represents the core of the study and deals with the partitioning of the database for the proposed system into manageable segments (that is, organizing the total set of data elements of the database into logically related groups) called database files.

A file can generally be defined as a set of related records belonging to individual users or user group while a database is a generalized collection of data belonging to an organization rather than to an individual user or user group (that is, a database contains all data files of a system). The concept of a database requires a special software called database management system (DBMS) to support storage of user owned data and to provide access to those data. "A database management system is a software system that manages the creation and use of databases" (Davis and Olson 1984).

A database management system provides access facilities such as access languages to users including professional users (analysts, programmers, database administrators, etc.) and end users. End users use query languages

provided by the DBMS to formulate queries while programmer users may use programming language interfaces to write instructions which can handle database access functions and perform the desired processing.

4.2.1 Grouping the Total Set of Data Elements

The first step in defining the database files is to group the total set of data elements gathered during the data collection process and included in the data dictionary presented in the analysis part into clusters that form sets of related records. Based on the information obtained from the analysis part, the total set of data elements can logically be grouped as follows:

1. Basic patient data - from which desired patient information including patients registration and scheduling, patient's medical history, laboratory test results, X-ray results, treatments given, case study records, etc. can be derived.

2. Accounting data - the data elements in this group are used to obtain information regarding all the book-keeping activities including billing non-employee patients and refunding employees who were treated outside the Medical Unit of the Airlines.

3. Stock data elements - information obtained by processing such data items can be used to control the stock status of the drugs in the drug shop (pharmacy).

4. Data elements for referral services - from which information about bibliographic references, profiles of experts, of institutions, and ongoing research projects can be obtained.

The above groups of data elements constituting sets of related records are used to define the prototype database files for the system under review.

4.2.2 Files for the Prototype Database

In designing the prototype databases, the set of total data elements is partitioned into clusters called database files. These database files intended to form sets of related records are:

1. Patient Records File (PR-FILE) - Which contains all data items needed by health care providers.

2. Accounts File (AC-FILE) - which contains information about the book-keeping activities

(refunding, billing, etc).

3. Stock Control File (SC-FILE) - which contains the necessary information about the stock status of each drug item in the Airlines' pharmacy.

4. Referral Service File (RS-FILE) - which contains information for referral services including bibliographic references, profiles of experts, profiles of institutions, and of ongoing research projects.

The different categories of user groups in the Medical Unit can obtain the information they need by processing the above database files. Some samples of program specifications for the applications to process some of the database files will be presented in the detailed system specification (Chapter Five).

4.2.3 Contents of the Database Files

This section provides a list of the field contents of each of the database files discussed in the preceding section.

1. PR-FILE content

The Character "P" is prefixed to each field name (which is not there in the data dictionary) to indicate that the field is in Patient Record File (a database file). A basic requirement of this file is that the length of the fields should be of variable length.

Field Name	Type	Size	Remark
PPA-NAME	Character	30	
PPA-REG	Character	5	Descriptor (key)
PPA-DEPT	Numeric	3	Descriptor
PPA-AGE	Numeric	3	
PPA-SEX	Character	1	
PPA-APPD	Numeric	6	Descriptor
PPA-ADDR	Character	100	
PPA-NLTY	Character	50	
PPA-OCCP	Character	100	
PEX-NAME	Character	30	
PEX-NUMR	Character	5	Descriptor
PEX-QUAL	Character	100	
PEX-PRSC	Character	300	
PPA-SYMP	Character	200	Descriptor
PPA-DIAG	Character	300	Descriptor
PCT-DATE	Numeric	6	Descriptor

Table 4.1 Patient Records File Content

Field Name	Type	Size	Remark
PRG-DATE	Numeric	6	
PPA-TELN	Character	10	
PPA-MSTS	Character	7	
PBG-GST	Character	15	
PBG-WTM	Character	15	
PEN-IND	Character	200	Descriptor
PFI-OSP	Character	100	Descriptor
PFI-STM	Character	100	Descriptor
PFI-PYL	Character	100	Descriptor
PFI-DBL	Character	120	Descriptor
PFI-FPD	Character	100	Descriptor
PEN-CNR	Character	300	
PXR-CLN	Character	200	
PXR-OEX	Character	150	
PXR-RQB	Character	30	
PRD-RPT	Character	350	
PRD-NAM	Character	30	
PEY-FVN	Character	100	
PEY-FUN	Character	200	
PEY-IOT	Character	200	
PEY-HET	Character	150	
PEY-CVS	Character	100	
PEY-NVS	Character	100	

Table 4.1 ...(continued)

Field Name	Type	Size	Remark
PEY-DVS	Character	100	
PEN-NOS	Character	200	
PEN-SIN	Character	200	
PEN-ERS	Character	200	
PEN-MTR	Character	200	
PEN-AUD	Character	150	
PEN-RCM	Character	400	
PEN-SPT	Character	30	
PHG-WBC	Character	8	
PHG-RBC	Character	8	
PHG-HB	Character	7	
PHG-HCT	Character	4	
PHG-GRP	Character	2	
PHG-RHF	Character	8	
PSR-VDRL	Character	2	
PSR-PGC	Character	8	
PPG-STP	Character	15	Descriptor
PPG-OCB	Character	12	Descriptor
PPG-HMP	Character	30	Descriptor
PUR-ALB	Character	6	
PUR-SGR	Character	8	
PUR-KTN	Character	8	

Table 4.1 ...(continued)

Field Name	Type	Size	Remark
PUR-AFB	Character	15	Descriptor
PUR-BLB	Character	8	
PUR-URB	Character	8	
PUR-BLD	Character	8	
PUR-NTR	Character	12	
PUR-CLR	Character	10	
PUR-MEC	Character	7	
PUR-SPG	Character	10	
PUR-MPC	Character	7	
PUR-RBC	Character	7	

Table 4.1 ...(continued)

2. **AC-FILE content**

The character "A" is prefixed to each field name (which is not there in the data dictionary) to indicate that the field is in Accounts File (a database file).

Field Name	Type	Size	Remark
ARC-VNO	Character	7	Descriptor
ARC-DATE	Numeric	6	Descriptor
ARC-AMT	Numeric	5	
ARC-PYMT	Numeric	30	
ACCT-NO	Character	6	Descriptor
AEMP-CNO	Numeric	5	
AREF-NO	Character	4	Descriptor
AINV-NO	Character	6	Descriptor
ARFD-AMT	Numeric	5	
ACL-DATE	Numeric	6	

Table 4.2 Accounts File Content

3. SC-FILE content

The character "S" is prefixed to each field name (which is not there in the data dictionary) to indicate that the field is in Stock Control File (a database file)

Field Name	Type	Size	Remark
SDG-NAME	Character	40	
SDG-STKN	Character	5	Descriptor
SDG-QTY	Numeric	7	
SDG-QTYO	Numeric	7	
SDG-QTYR	Numeric	7	
SDG-QTYI	Numeric	7	
SDG-QOH	Numeric	7	
SDG-PON	Character	6	Descriptor
SDG-AUP	Numeric	7	
SDG-UOM	Character	4	
SDG-ORDT	Numeric	6	Descriptor
SDG-RCDT	Numeric	6	Descriptor
SDG-ISDT	Numeric	6	
SDG-EXDT	Numeric	6	Descriptor

Table 4.3 Stock Control File Content

3. SC-FILE content

The character "S" is prefixed to each field name (which is not there in the data dictionary) to indicate that the field is in Stock Control File (a database file)

Field Name	Type	Size	Remark
SDG-NAME	Character	40	
SDG-STKN	Character	5	Descriptor
SDG-QTY	Numeric	7	
SDG-QTYO	Numeric	7	
SDG-QTYR	Numeric	7	
SDG-QTYI	Numeric	7	
SDG-QOH	Numeric	7	
SDG-PON	Character	6	Descriptor
SDG-AUP	Numeric	7	
SDG-UOM	Character	4	
SDG-ORDT	Numeric	6	Descriptor
SDG-RCDT	Numeric	6	Descriptor
SDG-ISDT	Numeric	6	
SDG-EXDT	Numeric	6	Descriptor

Table 4.3 Stock Control File Content

4. RS-FILE content

The character "R" is prefixed to each field name (which is not there in the data dictionary) to indicate that the field is in Referral Services File (a database file).

Field Name	Type	Size	Remark
RDC-TITL	Character	50	Descriptor
RDC-ISBN	Character	15	Descriptor
RDC-AUTH	Character	30	Descriptor
REX-NUMR	Character	5	Descriptor
RIN-NAME	Character	40	Descriptor
REX-NAME	Character	30	
REX-INS	Character	40	
REX-AGE	Numeric	3	
REX-ADDE	Character	60	
REX-TELN	Character	10	
REX-QUAL	Character	40	
RIN-LOC	Character	30	
RIN-ADDR	Character	60	
RIN-TELN	Character	10	
RPB-NAME	Character	50	
RPB-PLC	Character	40	
RPB-YEAR	Numeric	4	
RPB-ADDR	Character	60	
REO-NUM	Numeric	2	
RVL-NUM	Numeric	2	

Table 4.4 Referral Services File Content

CHAPTER FIVE

DETAILED SYSTEMS SPECIFICATION

5.1 DESIGNING USER INTERFACES

5.1.0 Need for User Interfaces

It is commonplace that people can get frustrated at the initial stage in using computer-based information systems. They usually need special effort to learn command languages or menu selection systems that are supposed to help them do their job. "Some people encounter serious cases of computer shock, terminal terror, or network neurosis that they avoid using computerized systems" (Shneiderman 1987). These maladies may arise from the usage of inconsistent command languages, confusing operation sequences, chaotic display formats, inconsistent terminology, incomplete instructions, and misleading error messages.

To avoid such problems, it is important to design interfaces that can easily be understood by the users. Designers have to fight on behalf of users and the human-computer interfaces should be designed to enhance the user friendliness of the system. The design of user

friendly systems can help improve learning time, performance speed, user satisfaction, etc. And this can make a substantial difference in the overall performance of the users and of the system.

Since the prospective users in the Medical Unit of the Ethiopian Airlines are not familiar with the utilization of computer-based information systems, the human-computer interfaces for the proposed system should be designed such that it is easy to use. The definition of user interfaces includes both interactive methods, and batch methods. The interactive methods are of primary importance in the case of medical information systems and batch methods can be used to generate daily, weekly, monthly and/or yearly reports to the different categories of users in the Medical Unit. But, emphasis is given here to interactive interfaces because the prospective users of the proposed system will in most cases communicate with the computer in an interactive manner.

5.1.1 Interface Devices and Methods

There are several types of interface devices such as video-display terminals (VDT), special purpose terminals, hard-copy printers, voice input and/or output devices, etc. Among these interface devices, VDT and hard-copy

printers are the primary candidates for the proposed system. VDTs are used primarily for interactive work and they should consist of, at least, display screens and keyboards. A hard-copy printer should also be offered as a device shared among several display terminals to be used for generating hard copy reports.

The display terminals recommended here will be used in two general modes namely menu selection mode and forms mode. Forms mode is also called "fill-in the blanks" or "form fill-in" because a form is displayed on the screen so that the user can fill in the required data in the blank spaces on the form (see Figure 5.1 as an example). Since this approach mostly resembles familiar paper forms, users can easily utilize it after few instructions. Another advantage of the form fill in approach is that it is more user-friendly because the full complement of information is visible, giving them a feeling of being in control of the activities.

Menu selection modes are also attractive because they can eliminate training and memorization of complex command sequences. When the menu items are written using familiar terminology, users can select an item easily and indicate their choice with few key-presses or use of a pointing device. Fig. 5.2 shows an example of menu selection mode.

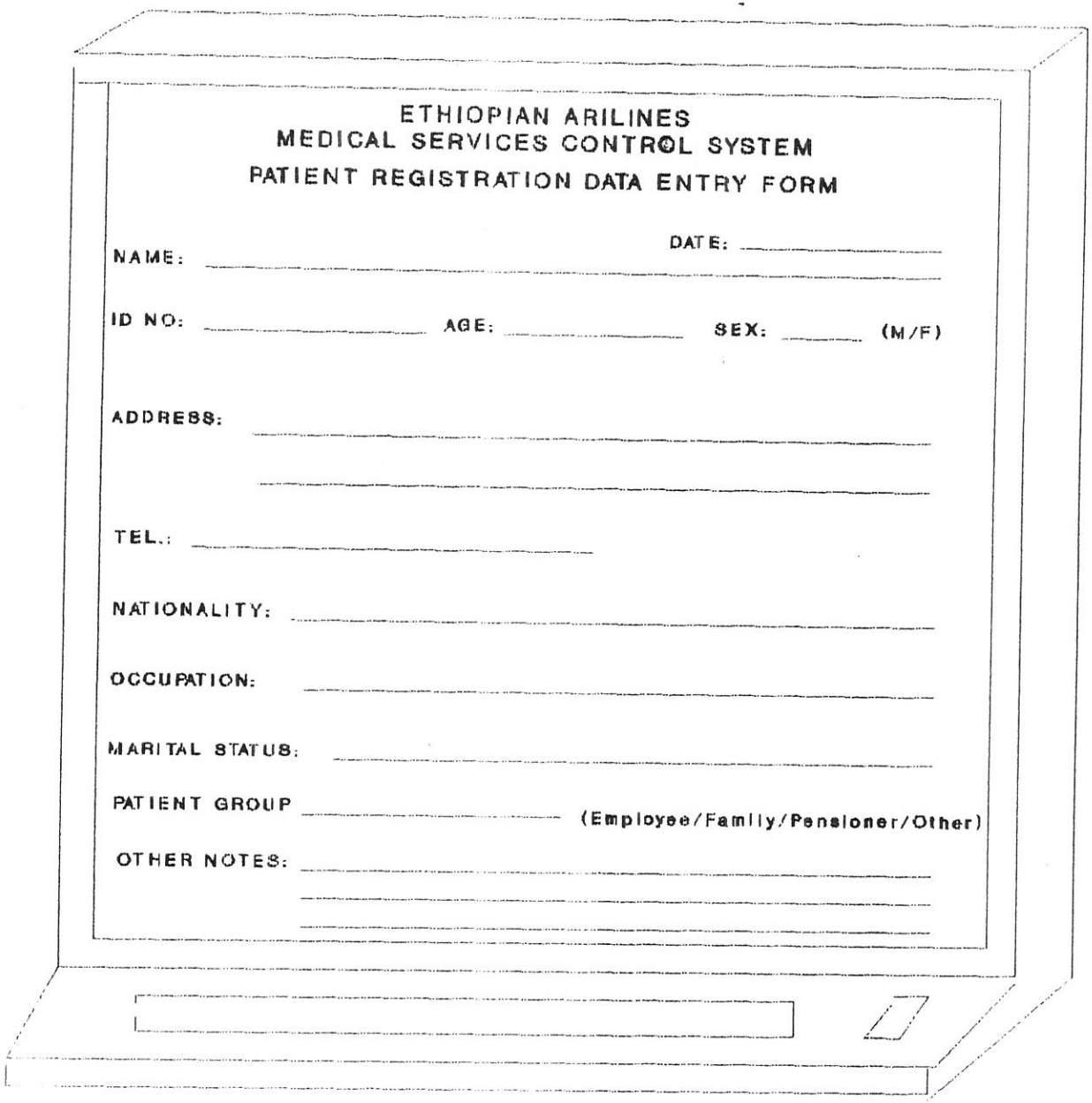


Figure 5.1 Forms-mode User Interface

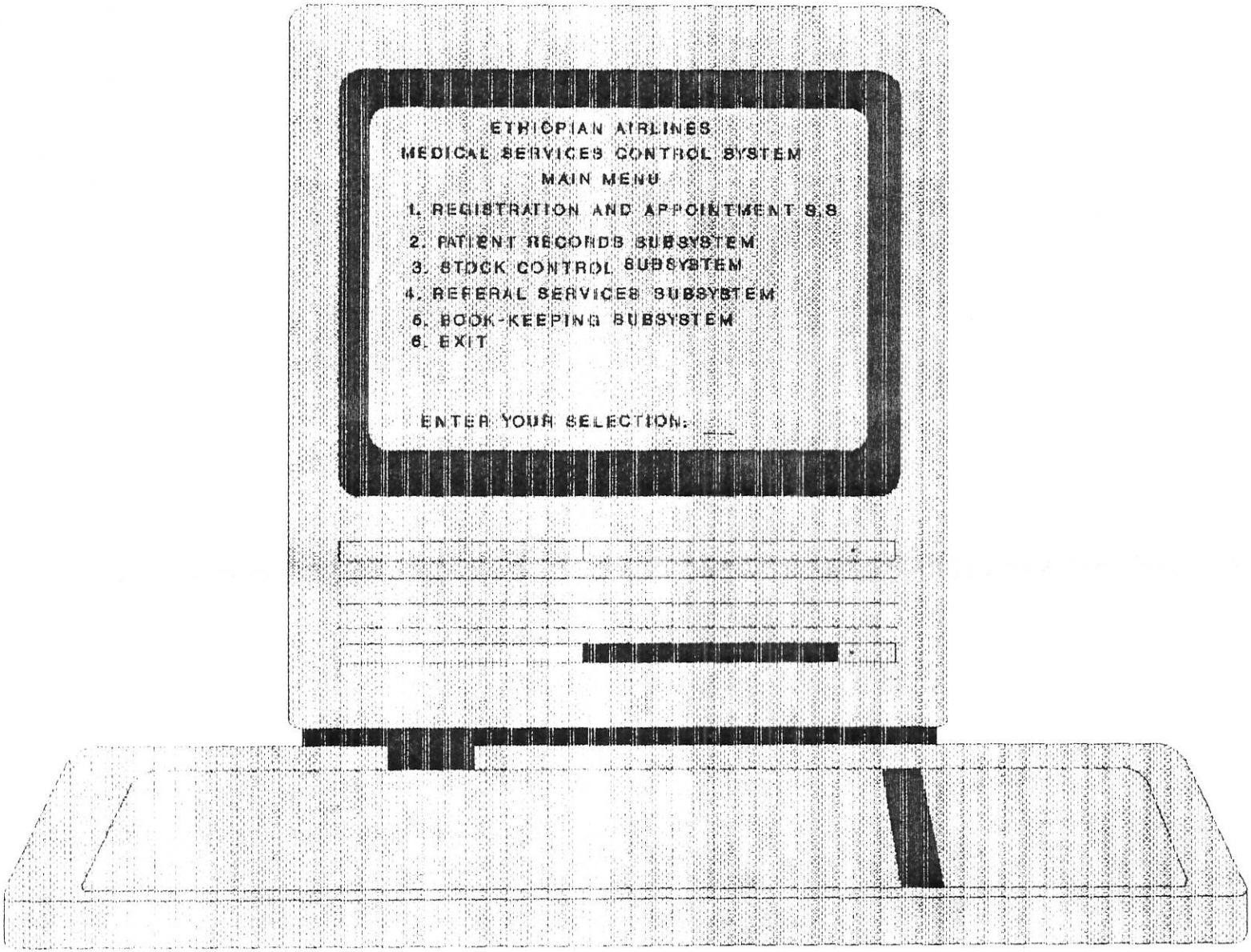


Figure 5.2 Menu-mode User Interface

5.2 PROGRAM SPECIFICATIONS

Presenting a set of specifications that define programming tasks is one of the major steps in a computer-based information system design process. A computer system is an aggregation of hardware components and software components. Hardware components include the physical items such as the central processors, input/output processors, memories, physical devices and interfaces while software components are the sets of instructions (sets of computer programs) which are designed to control and assist the operations of the computer hardware.

There are two types of software components namely system software and application software. The category of system software covers a wide range of program instructions of a general nature. Examples of system software include:

- Operating systems which control the execution of other programs,
- Database management systems,
- Compilers to translate human readable programming languages into machine readable instructions, and
- Utility programs to perform common operations. For example, a system program that provides the sorting

facility.

An application software is a computer program written for specific applications. For example, patient records processing program.

The objective of this section is to present sample program specifications for the system that may be developed in-house and used in the Medical Unit of the Airlines. The expected advantage of developing the proposed system in-house is to obtain a system that fits the specific needs of the prospective users.

To reduce complexity and enhance modifiability, the application software for the proposed system can be subdivided into functionally related modules (or programs). Some examples of program specifications for the proposed system are presented next.

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An application software is a computer program written for specific applications. For example, patient records processing program.

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To reduce complexity and enhance modifiability, the application software for the proposed system can be subdivided into functionally related modules (or programs). Some examples of program specifications for the proposed system are presented next.

5.2.1 Patient Registration Record Creation

This program is invoked by choosing an appropriate option from the selection menu to display data entry screen, validate and accept patient registration data, acknowledge any error, and create patient registration record in patient records file if error free.

1. Processing:

- Display data entry form on the screen to accept patient registration information
- Validate the input data
    - . patient registration number must be unique
    - . all data items shown on data entry form required
- Display appropriate error massage if any error is encountered
- Update patient records file (a database file)

2. Input:

- Patient registration data items keyed into the appropriate fields displayed on the data entry screen format
- Patient records database file (to check whether a record with the same registration number has already been created)

5.2.1 Patient Registration Record Creation

This program is invoked by choosing an appropriate option from the selection menu to display data entry screen, validate and accept patient registration data, acknowledge any error, and create patient registration record in patient records file if error free.

1. Processing:

- Display data entry form on the screen to accept patient registration information
- Validate the input data
    - . patient registration number must be unique
    - . all data items shown on data entry form required
- Display appropriate error massage if any error is encountered
- Update patient records file (a database file)

2. Input:

- Patient registration data items keyed into the appropriate fields displayed on the data entry screen format
- Patient records database file (to check whether a record with the same registration number has already been created)

3. Screen Lay-out:

ETHIOPIAN AIRLINES

MEDICAL SERVICES CONTROL SYSTEM

PATIENT REGISTRATION DATA ENTRY

DATE:_____(YYMMDD)

NAME: _____

ID NUMBER: _____ AGE: _____ SEX: _____ (M/F)

NATIONALITY: _____

ADDRESS: _____

_____

_____

OCCUPATION: _____

MARITAL STATUS: _____

PATIENT GROUP:_____(Employee/Family/Pensioner/Other

OTHER NOTES: _____

_____

_____

ERROR MESSAGE:

4. Output:

- Updated patient records file

3. Screen Lay-out:

ETHIOPIAN AIRLINES

MEDICAL SERVICES CONTROL SYSTEM

PATIENT REGISTRATION DATA ENTRY

DATE:_____(YYMMDD)

NAME: _____

ID NUMBER: _____ AGE: _____ SEX: _____ (M/F)

NATIONALITY: _____

ADDRESS: _____

_____

_____

OCCUPATION: _____

MARITAL STATUS: _____

PATIENT GROUP:_____(Employee/Family/Pensioner/Other

OTHER NOTES: _____

_____

_____

ERROR MESSAGE:

4. Output:

- Updated patient records file

5.2.2 Patient Consultation and Treatment Record Creation

The program is invoked by choosing an appropriate option from the selection menu to display data entry screen, accept and validate patient data, acknowledge any error, and create patient consultation and treatment record in patient records file if error free.

1. Processing:

- Display data entry form on the screen to accept consultation and treatment information
- Validate input data
- Display appropriate error message if any error is encountered
- Update patient records file

2. Input:

- Patient consultation and treatment data items keyed into the appropriate fields displayed on the data entry screen format

3. Screen Lay-out:

ETHIOPIAN AIRLINES

MEDICAL SERVICES CONTROL SYSTEM

PATIENT CONSULTATION AND TREATMENT DATA ENTRY

DATE:_____(YYMMDD)

NAME: _____

ID NUMBER: _____ AGE: _____ SEX: _____ (M/F)

MARITAL STATUS: _____

OCCUPATION: _____

ADDRESS: _____

_____

_____

SYMPTOMS: _____

_____

_____

DIAGNOSES:_____

_____

_____

PRESCRIPTION: _____

_____

_____

ERROR MESSAGE:

4. Output

- updated patient records file

3. Screen Lay-out:

ETHIOPIAN AIRLINES

MEDICAL SERVICES CONTROL SYSTEM

PATIENT CONSULTATION AND TREATMENT DATA ENTRY

DATE:_____(YYMMDD)

NAME: _____

ID NUMBER: _____ AGE: _____ SEX: _____ (M/F)

MARITAL STATUS: _____

OCCUPATION: _____

ADDRESS: _____

_____

_____

SYMPTOMS: _____

_____

_____

DIAGNOSES:_____

_____

_____

PRESCRIPTION: _____

_____

_____

ERROR MESSAGE:

4. Output

- updated patient records file

5.2.3 X-ray Examination Record Creation

The function of this program is to display data entry screen, accept and validate X-ray data, acknowledge any error, and create X-ray examination record in patient records file if error free.

1. Processing:
   - Display data entry form on the screen to accept x-ray information
   - Validate input data
   - Display appropriate error massage if any error is encountered
   - Update patient records file

2. Input:
   - X-ray data items keyed into the appropriate fields displayed on the data entry screen format

3. Screen Lay-out:

ETHIOPIAN AIRLINES

MEDICAL SERVICES CONTROL SYSTEM

X-RAY INFORMATION DATA ENTRY

DATE:_____(YYMMDD)

NAME: _____

ID NUMBER: _____ AGE: _____ SEX: _____ (M/F)

CLINICAL NOTES: _____

_____

_____

_____

OBJECT OF EXAMINATION: _____

_____

_____

RADIOLOGIST REPORT: _____

_____

_____

_____

_____

ERROR MESSAGE:

4. Output:

- Updated patient records file

5.2.4 Drug Purchase Order Creation

This program can be invoked by choosing an appropriate option from the selection menu to display data entry screen, validate and accept purchase order information on drugs, acknowledge any error, and create drug purchase order records in stock control file.

1. Processing:
   - Display data entry form on the screen to accept purchase order information
   - Validate input data
     . purchase order number must be unique
     . all data items shown on data entry form required
   - Display appropriate error message if any error is encountered
   - Update stock control file (a database file)

2. Input:
   - Purchase order information keyed into the appropriate fields displayed on the data entry screen format
   - Stock control file (to check whether a record with the same order number has already been created)

5.2.5 Drug Stock Status Reporting Program

The function of this program is to access stock control file and produce printouts of alert reports on the status of drug items in the pharmacy of the Medical Unit.

1. Processing:
   - Access stock control file
   - Obtain quantity of drugs on hand by subtracting quantity issued from quantity received
   - Match the quantity of drug on hand with the stipulated threshold stock level
   - Produce alert report on the status of drug items

2. Input:
   - Stock control file

3. Output:
   - Drug stock status alert report

4. Report format:

ETHIOPIAN AIRLINES

MEDICAL SERVICES DEPARTMENT

DRUG STOCK STATUS ALERT REPORT

STOCK NUMBER	QTY RECEIVED	DATE RECEIVED	QTY ISSUED	DATE ISSUED	QTY ON HAND	UNIT OF MEASURE
XXXXX	9999999	DD/MM/YY	9999999	DD/MM/YY	9999999	XXXX
XXXXX	9999999	DD/MM/YY	9999999	DD/MM/YY	9999999	XXXX
/	/	/	/	/	/	/
/	/	/	/	/	/	/
/	/	/	/	/	/	/
/	/	/	/	/	/	/
/	/	/	/	/	/	/
/	/	/	/	/	/	/
/	/	/	/	/	/	/
/	/	/	/	/	/	/

5.3 PROTOTYPE DATABASE OF PATIENTS' RECORDS

5.3.1 Choice of Software

For the purpose of demonstration of the operation of the proposed system, a prototype of its most important component - the patients' records database - has been designed using MicroIsis software. The reasons for the choice of the software for the prototype development are briefly mentioned below.

MicroIsis is a DBMS software package developed by Unesco and distributed free of cost to non-profit organizations especially in developing countries. Since the release of the first version of the software in December 1985, some twenty thousand copies of it are reported to be in use in different countries of the world, in Europe and developing countries in particular (International Classification 1993). MicroIsis version 3.0* supports multi-user local area network (LAN) applications. Surveys by the Pan-African Development Information System (PADIS/United Nations Economic Commission for Africa) (PADIS 1989, 1991) indicate a significant increase in use of the software in Africa. And the situation is similar in other developing regions of the world. Although Micro-Isis was initially intended and used for designing

and developing bibliographic databases, it is now being used increasingly in developing also factual databases and Object Oriented Data Bases such as patients' records databases (Neelameghan 1992). Programs are now available for converting databases developed using dBASE to ISO 2709 format and then download into MicroIsis database and vice versa. Programs are also available for converting any structured ASCII text record(s) to ISO 2709 format and then download the records into a MicroIsis database. These factors and other useful features of the software mentioned below, recommended its choice for this work.

MicroIsis is a generalized DBMS package designed for the management of machine-readable textual databases, i.e. to build, manipulate, maintain, and retrieve records from such databases. In particular MicroIsis enables:

- defining of databases containing user selected fields and data elements;
- entering new records into a given database;
- modifying, correcting and deleting records in a database;
- automatic creation of fast access files, such as inverted files (index files) for any or all of the words or combination of them in any or all of the fields in each database applying eight different indexing techniques;

- retrieval of records from a database using simple or complex (including Boolean, adjacency and other operators) search expressions;
- displaying the list of terms in the index file facilitating selection of terms to formulate search expressions;
- displaying the number of hits for each component of the search expression;
- re-execution of earlier search expressions in the same or other databases during a search session;
- displaying/printing out of records from a database as per user defined formats;
- printing out an entire database or retrieve records
  . some or all the retrieved records and/or
  . indexes of a database;
- exchanging or merging of records of two or more databases that are in compatible formats (e.g. ISO 2709 format); and
- enhancing the software's capabilities through programs written in CDS-ISIS Pascal language, for example, development, maintenance and use of controlled vocabularies, multiple databases search, retrieval and display, online public access catalogue, etc.

Version 1 of MicroIsis released in December 1985, consisted of a set of six programs that functioned separately. Subsequently modifications have been introduced on the basis of feedback from users. A major innovation was introduced in version 2.0 released in March 1989, in which all programs used for the manipulation of different tasks were integrated and main menu was provided to access the different functions (e.g. database definition service, data entry service, sorting and printing service, etc.). With the version 2.3, released in September 1989, the number of records in a database was increased to 16 million (32,000 in ver. 1) within a limit of 500 MB. New and powerful features have been added to the formatting language, such as, record linking.

The system restrictions currently in effect are:

Maximum number of databases	Unlimited
Maximum number of records in a database	16 million
Maximum record size	8000 B
Maximum number of fields defined in the Field Definition Table (FDT), excluding repetitions of repeatable fields	200
Maximum number of lines in the Field Select Table (FST)	200

Maximum Field size	8000 B
Maximum number of fields in a page of worksheet	19
Maximum number of pages in a worksheet	20
Maximum format work area	8000 B*
Maximum size of a display format	8000 B*
Maximum number of stopwords in a stopword file	799
Maximum field size in a worksheet	8000 B
Maximum number of characters in a search expression	250
Field tag number	1 to 32,767
Maximum length of sort keys	256 B
Maximum number of literals	132 B
Maximum HIT record size	4000 B*
Maximum number of instructions in an ISIS Pascal program (including all programs called by USES statement)	10000+
Maximum number of loaded programs	10
Maximum number of real constants	200
Maximum Pascal run-time stack	2000+
ISIS Pascal dynamic string area	16932+

(* applicable to version 3.0)

(+ see Expanded Memory Manager below)

MicroIsis version 3.0 supports local area network (LAN) that is, simultaneous access to a database by several users for data entry and searching. However, certain functions, such as master file backup/restore, inverted file updating and import and export of records operations may be performed by a user only if no other user is writing to the database at the same time. For ensuring this, Appropriate 'locks' are provided. Similarly, the system will not allow the modification of a record which is at the same time being modified by another user. To operate in LAN mode, parameter 14 in the SYSPAR.PAR file or parameter 0 of file DBN.PAR should be set to appropriate value [READ.ME file].

A facility is provided to redefine the graphic characters for boxes of type 1 (single line box) and of type 2 (double line box) by modifying parameters 11 and 12 respectively.

MicroIsis version 3.0 supports local area network (LAN) that is, simultaneous access to a database by several users for data entry and searching. However, certain functions, such as master file backup/restore, inverted file updating and import and export of records operations may be performed by a user only if no other user is writing to the database at the same time. For ensuring this, Appropriate 'locks' are provided. Similarly, the system will not allow the modification of a record which is at the same time being modified by another user. To operate in LAN mode, parameter 14 in the SYSPAR.PAR file or parameter 0 of file DBN.PAR should be set to appropriate value [READ.ME file].

A facility is provided to redefine the graphic characters for boxes of type 1 (single line box) and of type 2 (double line box) by modifying parameters 11 and 12 respectively.

Prameter 13 enables Expanded Memory Support. The Expanded Memory Manager (EMM) is used to expand the amount of memory available to the software. The system restrictions affected by EMM are as follows:

	Without EMM	With EMM
Maximum number of instructions in ISIS Pascal program including all programs called by the USES statement	10000	16383
ISIS Pascal Runtime stack	2000	16000
ISIS Pascal dynamic string area	16932	49500
Format work area	8000	32767

CHAPTER SIX

RECOMMENDATIONS AND CONCLUSIONS

6.1 GENERAL

The goal of this systems design and planning exercise is to propose an information support system that can be developed and implemented for the Medical Unit of the Ethiopian Airlines to provide better information services to the different categories of users. This goal can only be achieved if the prospective users and their management perceive and are convinced that the proposed system would meet their needs. For the purpose of demonstration, prototypes of some of the component databases of the proposed system have been developed.

Based on the feed back from potential users of the system, modifications can be made. A project team should then be formed to implement the modifications, if any, develop, test and implement the proposed system on a known computer configuration in the Airlines. Some of the staff will have to be trained to operate the system effectively and efficiently. Documentation and operational manuals should also be prepared. The system's operations need to be monitored so that the facilities

can be improved as necessary and any performance problems detected can be resolved.

6.2 RECOMMENDATIONS

Formation of a system development project team is recommended as a first step to carry out the effective implementation of the proposed system. The team should include information professionals (such as analysts and programmers) from the existing Information Systems Unit of the Airlines, at least one expert from consultancy service agencies, and representatives of the prospective users in the Medical Unit, as its members.

The project team will be responsible for the detailed revision (in order to correct and improve if any modification is needed), development and implementation of the proposed system. And the major tasks to be carried out are:

- Revision of the system proposal, include modifications (if any)
- Conduct of a detailed cost-benefit analysis
- Budget allocation by higher management
- Acquisition of the necessary equipment and assurance of their quality
- Decision on whether to buy or in-house development

of the application software

- Installation of the necessary equipment (hardware and system software)
- Preparation of detailed program specifications (if the in-house development option of application programs is selected)
- Developing the application programs (if in-house development is selected)
- Making necessary amendments (if the buy option of application programs is selected)
- Testing the new system and implementation of it.

6.2.1 Implementation Plan

The implementation phase is a step in the system development process in which the system is proved to be effective (tested and approved) and set into operations. That is, it is the stage at which the conceptual system is turned into reality. The end point of this stage is the handover of the operational system to its potential users.

The major steps that are recommended in this study as parts of the implementation plan are briefly discussed below.

1. This study does not cover all the required steps in a system development process. It is presented to indicate the possible solution to the existing problems of the information system in the Medical Unit of the Airlines. Therefore, the study should be revised by a system development project team formed to carry out all the detailed steps required in the development of the proposed system.

2. Appropriate hardware and software components including their accessories should be selected, acquired and installed by the system development project team members. In selecting and acquiring the necessary equipment, different suppliers should be evaluated to select the best ones in terms of system quality, capacity, cost, compatibility, period of warranty, and maintenance support after sales.

3. The phase by phase approach (as opposed to the parallel implementation approach) in implementing the different subsystems of the proposed system

should be adopted to reduce the effects of budgetary constraints and to minimize the problem that may arise in training the prospective users in the Medical Unit of the Airlines. In this case, priority should be given to the patient records subsystem.

4. The system developed by the system development project team should be tested to ensure that it works effectively before it is set into operation. Minor system modifications should be checked before the system is exposed to the users because they might be confused and frustrated by such modifications and refuse to accept it. Once the project team is confident that the performance of the system is effective, users should be involved to carry out operations.

5. The system development project team should be responsible for conducting training sessions for the prospective users of the new system and these sessions will be necessary to familiarize the users with the new system and to explain the features of the system, the benefits the system will provide and how users can interact with the system to derive benefits from it.

6.3 CONCLUSIONS

The current situation in the Medical Unit of the Ethiopian Airlines reveals that data processing and information handling activities are being carried out manually. Manual operations in the information systems environment are slow, sometimes inaccurate, and are costly if the amount of data involved is large. Such problems can be solved to an appreciable extent by the introduction of computer-based information systems. The overall aim of this study is to improve the information services and management in the Medical Unit of the Airlines through the application of information technologies. This will help physicians and other health care providers get vital and timely information to support them perform their respective functions effectively and efficiently.

The data collection process which forms the basis for the subsequent steps of the systems analysis and design exercise provided an excellent opportunity to establish good relationships with the prospective users of the proposed system. The users in the Medical Unit are grouped into related categories based on the services they render. And the major user groups include doctors, nurses, laboratory technicians, radiologists, druggists,

file clerks and book-keepers.

In the analysis part of the study, a manual data dictionary is presented for keeping track of data definitions to provide essential information for designing different database files and the functional areas considered for the study are described using data flow diagrams.

In designing the proposed system, its structure is chosen to be a decentralized one (based on some basic factors that may affect the effective performance of the system and the users). Video-display terminals and hard-copy printers are recommended as human-computer interfaces for the proposed system and the video-display terminals recommended here will be used in two general modes namely menu selection mode and forms mode.

The implementation plan of the proposed system should include activities such as the acquisition of appropriate equipment, system installation, system testing, user training, etc. And the phase by phase approach is recommended in implementing the different subsystems with priority given to the patient records subsystem.

BIBLIOGRAPHY

Abebe Rorissa. 1993. A plan for the establishment of an institute of Ethiopian studies documentation centre. MSc (I.S) thesis. SISA. Addis Ababa University. Addis Ababa.

Agarwal, R.D. 1982. Organization and management. New Delhi: Tata McGraw-Hill Publishing Company Limited.

Anderson, R.G. 1980. Case studies in systems design. Macdonald and Evans Ltd.

Atherton, Pauline. 1977. Handbook for information systems and services. Paris: Unesco.

Bhattacharyya, G. 1978. Systems approach for information professionals. Timeless Fellowship. 12: 37-45

Booth, Grayce M. 1983. The design of complex information systems: common sense methods for success. New York: CBS College Publishing.

Bradley, James. 1982. File and database techniques. New York: McGraw-Hill Book Company.

Buckland, John A. 1991. Total quality management in information services. Willesley, Massachusetts: QED Information Sciences, Inc.

Buckland, Michael. 1991. Information and information systems. New York: Praeger Publishers.

Damachi, G.D; Souder, H.R. and Damachi, N.A. 1987. Computer and computer applications in developing countries. London: Macmillan Press Ltd.

Date, C.J. 1984. An introduction to database systems. New York: Addison-Wisley Publishing company.

Davis, Gordon B. and Olson, Margarethe H. 1984. Management information systems: Conceptual foundations, structure and development. New York: McGraw-Hill Book Company.

Dejetenu Gebru, Haddis Teklemariam, Mehari Woldeab and Tewabech Bishaw. 1980. Health manpower study. Addis Ababa: United Printers.

Ferrari, Domenico. 1978. Computer systems performance evaluation. New York: McGraw-Hill Book Company.

Neelameghan, A. 1991a. "Concept categorization and knowledge organization in specializaed datanbases: a case study". International Clasification, 18:92-97.

Neelameghan, A. 1991b. International and regional information systems and networks: examples of recent experiences in developing countries. SISA. Addis Ababa University. Addis Ababa

Neelameghan, A. 1992. "Home-grown object-oriented specialized databases." In Ching-chih Chen (ed.) NIT'92: 5th International Conference New Information Technology..., Hong Kong, Nov. 30-Dec. 2. Proceedings, p. 251-284.

Neelameghan, A. 1993a. Government and administrative information systems: Overview. SISA. Addis Ababa University. Addis Ababa.

Neelameghan, A. 1993b. Information technology, quality of information service and information resources management. SISA. Addis Ababa University. Addis Ababa.

Neelameghan, A and Rahel Bekele. 1994. Design and development of object-oriented databases: application of the principles and postulates of the general theory of knowledge classification. SISA. Addis Ababa University. Addis Ababa, Ethiopia.

NSTIDC. 1992. The role of information in national development. Ethiopian Science and Technology Commission. Addis Ababa.

Physician Microsystems,Inc. 1989. Practice partner patient records user's guide. Seattle.

Rowley, Jennifer. 1990. The basics of systems analysis and design: for information managers. London: Clive Bingley Limited.

Shneiderman, Ben. 1987. Designing the user interface: Strategies for effective human computer interaction. Reading, Massachusetts: Addison-Wesley Publishing Company, Inc.

Tsichritzis, Dionysions C. 1982. Data models. Prentice-Hall, Inc.

APPENDIX 1

ADDIS ABABA UNIVERSITY

SCHOOL OF GRADUATE STUDIES

SCHOOL OF INFORMATION SCIENCE

DATA-COLLECTION FORMS

The following data-collection forms were used to collect data/information by interviewing the prospective users of the proposed system.

FORM-1 was prepared to define the major functions of the users and their information requirements only in general terms while FORM-2 was prepared to describe the data elements which make up the information received as input, used in processing, and required for output. FORM-3 was used to get user views or suggestions.

FORM-1: GENERAL REQUIREMENTS

1. Name: _____

2. Section: _____

3. Function(s) you perform. (Explain)

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

4. What are your sources of information? Explain.

5. How do you process the information? Explain.

6. How rapidly do you have to complete the process? Explain.

7. Where does the information you use come from? Where do you send you work (output) when you are through with it?

FORM-2 DETAILED DATA REQUIREMENTS

1. Name: _____

2. Section: _____

3. Function(s) you perform. (Explain)

4. What are the data elements you work with? (A data element is any item of information such as patient's name, patient's registration number, patient's address, etc.). Fill the table below to describe the necessary data elements.

Data Element	Type	Size	Description

Data Element	Type	Size	Description

FORM-3: USER SUGGESTIONS

1. Name (optional):_____

2. Section: _____

3. Functions you perform:_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

4. Explain the good points (if any) of the existing system.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

5. Explain the bad points (if any) of the existing system.

6 What do you suggest to improve the existing system? Give your opinion briefly.

APPENDIX 2

SAMPLE RECORDS FROM THE PROTOTYPE DATABASES

*** PATIENT RECORD ***

Record No.	001
Name	Bisrat Alemu Abebe
ID No.	10401
Sex	M
Age	29
Address	Higher 21, Kebele 32, House No. 457
Office Tel.	612222 ext. 394
Tel. Residence	154970
Nationality	Ethiopian
Occupation	Accountant
Chief Complaints	Cough, Fever, Shivering
Symptoms	Weight loss, Chest flaring, Chest refraction, Dullness, Decreased air entering, Tubular breath sounds on the right Apical zone
Vital Signs	Temperature 38.5°C, Pulse rate 88/min, Resp. rate 48/min
X-ray Notes	Right Apical zone Opacification
Findings	ESR 100 mm/hr, Sputum for AFB - positive
Diagnosis	Pulmonary Tuberculosis
Prescription	STM 400 mg for 2 months INH 300 mg PO daily for 1 year Rifampicin 300 mg PO daily for 1 year
Attending Doctor	Shibru Tadesse (M.D.)

*** PROFILE OF INSTITUTION ***

INSTITUTION	Central Clinic, Ethiopia
START DT	1985
ADDRESS	Box: 90412, Addis Ababa
PHONE	151030
WORK.LANG.	English, Amharic
HEAD	Teshome Beyene, Administrator
INST. TYPE	Government
OBJECTIVES	To give medical services to the society

*** PROFILE OF EXPERT ***

NAME	HAILEMARIAM LEGESSE, (M.D)
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PHONE	200924
QUALIFIC.	Gynaecology. M.D. Addis Ababa University. 1982.
WORK. LANG.	English- speak, read, write.
OTHER LANG.	Amharic- speak, read, write.