CHAPTER I
INTRODUCTION, SCOPE AND METHODOLOGY

Introduction

1.1 In today's era of industrial growth and computers, a good health is a pre-requisite to human productivity and is an essential component for socio-economic development. A healthy society is the infrastructure upon which we can build an economically viable and socially a modern society. Professional efficiency, good health and productivity are inter-related. According to Dr. Candan, former Director General of World Health Organisation (WHO), "Amongst the objectives of development are the health and productivity. They are reciprocal and complementary. Without health, productivity can hardly flourish. On the other hand, productivity may increase opportunities for better health." Presenting his report on the work of WHO in 1988, Dr. Nakajima Hiroshi, Director General of WHO said, "In essence, the WHO health ethic means that there can be no liberty, no economic development and consequently no human progress, unless we meet at least the minimum conditions of health. [1] As per the constitution of the WHO, some of the principles relevant to health care are:

1.1.1 Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.
1.1.2 Enjoyment of the highest attainable standard of health is one of the fundamental rights of every human being without distinction of race, religion, economic or social condition.
1.1.3 Health of all people is fundamental to attainment of peace and security for a country.
1.1.4 Governments have responsibility for health of their people.

1.2 The increasing awareness of health and desire for healthy living due to improved socio-economic conditions, advances in medical science
and other environmental factors have tended to increase the demand for medical-care services in such a way that gap between availability and demand has been ever widening in India. Health Survey and Planning Committee (1961), appointed by the Government of India, had made valuable recommendations for bridging this gap and providing better health-care to the people. However, recommendations made by the committee have not been implemented fully due to financial constraints, paucity of medical materials and shortage of technical manpower. It is therefore imperative, that to utilise hospital resources judiciously and to be responsive to the demand of people, hospital management must introduce modern management techniques like Management Information System (MIS). An evolutionary approach in applying these techniques in an appropriate manner will assist in improving productivity, cost-effectiveness and quality of medical-care.

1.3 Functions of Hospitals. Hospitals are among the most complex and dynamic institutions of our society. The main function of a hospital is to promote the health of the community it serves. In the latest definition by WHO "hospital is an integral part of a social and medical organisation, the function of which is to provide for the population, complete health-care, both curative and preventive and whose out-patient services reach out to the family in its home environment".[2] Hospital is an institution which provides facility for medical and nursing care for in-patients, consultancy and medical services for out-door patients and research/training for medical professionals. Indeed, modern hospital embraces all the four aspects of health namely preventive, curative, promotive and rehabilitation. The objective of any hospital is to provide health services to all the people, at all the time, at all the places. The expenditure on Government run hospitals is to be regarded as an
investment that will pay dividends in the form of reduced invalidity/unemployment, otherwise caused by sickness.

1.4 Hospital Administration. The development of socio-politico, cultural and educational systems have made people conscious of their rights and they demand that modern and best medical care should be promptly made available to them. These environment have made hospital a complex organisation. The administration of such hospitals requires blending of the technical as well as administrative competence in the right quantity, at the right time, at the right place by the right men/women and in the right way. [3] The basic purpose of a hospital is to offer "Health-care" to the visiting patient and return him as cured person (a productive unit) to the community. As such, health should not be considered in isolation from socio-economic factor. With public becoming more aware of their rights and privileges, hospital administration is often held responsible for negligence, inefficiency and misconduct on the part of its employees. The problem of hospital management is more acute and complex in developing countries like India, where needs of citizens are disproportionately more than available resources. The problem of hospital administration gets further aggravated due to lack of qualified administrators at various levels. In our country, most of the hospitals have traditional system of book-keeping and information management, which is often inaccurate, incomplete and less responsive. Consequently, decision making process is mainly a "crisis-management", where in the absence of any factual and timely information, decisions are made using human judgement, intuition and past experience.

Attributes of Management

1.5 Good management is neither maximisation of profit nor minimisation of cost. Instead, it involves getting the best "Results" out of available "Resources". In our hospitals, various resources like
medical and para-medical Staff, medicines, medical supplies, equipment and hospital facilities are the cost, while patient's health and satisfaction are the benefits. Thus hospital management is related to cost-benefit optimisation [4]. Attributes of good management are given below:

1.5.1 Identify objectives and lay down relative priorities.
1.5.2 Evolve sound plans based on accurate and detailed information.
1.5.3 Make judicious utilisation of resources through effective monitoring and control mechanism.
1.5.4 Improve standard and quality of services to provide higher satisfaction level to patients.
1.5.5 Provide appropriate career profile for the employees.
1.5.6 Ensure fair selection/promotion without bias toward caste, religion or sex.
1.5.7 Fair and judicious allocation of duties.
1.5.8 Provide redressal for grievances.
1.5.9 Corrective appraisal and performance review.
1.5.10 Delegate authority to match level of responsibility of subordinates.
1.5.11 Implement performance evaluation and appraisal.

1.6 Hospital management is like any other managerial job which involves planning, organising, directing and controlling all available resources in terms of personnel, material and funds. These functions need not be performed sequentially. However, each function affects the others and all these are inter-related to form the management process. The general concept of functional management is interactive which has been depicted in figure 1.1.

1.7 Functions of Management. No matter which organisation a manager belongs to or which management approach he adopts, he has to deal with
Figure 1.1: Functional Management concept
five basic functions of management—planning, organising, staffing, directing and controlling as depicted in Figure 1.2.

1.7.1 **Planning.** It is the thought process which involves selection of most advantageous course of action to achieve an objective. Thus planning is the primary function of management and every manager performs it prior to executing any other function.

1.7.2 **Organising.** It relates to definition of the tasks, delegation among subordinates, coordination of efforts and assignment of authority appropriate to the responsibility of getting a task executed.

1.7.3 **Staffing.** It is the process of forecasting and identifying personnel requirement. It may involve recruiting, selecting, hiring, placing, training, appraising and promoting.

1.7.4 **Directing.** It relates to guiding and supervising the subordinates and channelising their efforts through communication and persuasion in working towards organisational objectives.

1.7.5 **Controlling.** This ensures that events conform to plans. It relates to setting performance standards, measure actual performance and correct deviation to ensure that actions remain on course.

1.8 **Advances in Management.** During the 1970's there have been four major advancements which have revolutionised modern management.

1.8.1 **Information-Feedback System.** It encompasses goal seeking, self-correcting and interplay between various components of a system. Essentially, feedback system as shown in figure 1.3 is concerned with the way information is used for the purpose of control. It equally applies to hospital management, inventory control system or patient-care system. The output of such a system leads to a decision resulting in some type of action. An
Figure 1.2 : Functions of Hospital Management
Figure 1.3: Feed Back System
action will affect the output, which in turn may lead to
modification of input and another decision. This cycle carries on
in a systematic manner with a view to increase output (quality
and quantity of service) and reduce the cost involved.

1.8.2 Decision-Making. If the decisions could be based on a
policy, a procedure or a rule, they are likely to be rational,
cost-effective and give better customer satisfaction. It
particularly applies to the field of personnel management,
inventory control, patient management/billing and purchasing of
equipment/stores.

1.8.3 Management Techniques. Modern management techniques like
queuing, simulation, forecasting, inventory control, System
Analysis & Design have provided variety of powerful management
tools. MIS is an all-inclusive system for providing relevant
information to the management for effective decision-making.

1.8.4 Electronic Computer. The availability of Computer as a
management tool has widened the scope of control and
coordination in an organisation. Without computer, the vast
amount of data storage, processing and retrieval of
information would not be possible, nor could the arithmetic/
computation of complex problems could be undertaken.

1.9 Hospital Management. Today's hospitals operate in highly technical
environment, with sophisticated technology, highly potent medicines
and highly trained professionals performing intricate diagnostic tests
and procedures. Some of the hospitals like AIIMS Delhi, PGI Chandigarh,
Appolo Hospital Madras, Jaslok hospital Bombay have changed from high-
touch to high-tech institutions (physicians workshops). Hospital
management has become very demanding and challenging task, requiring
continuing application of thought and action to ensure complete
health-care to the community. Hospitals have certain unique features
which make their management different from that of any industry or business department. Unlike business organisations or an industry, simple statistics giving number of admissions, discharges, or cured are not the true index of hospital performance. Instead, it is the sympathetic and prompt treatment, good palatable diet, and clean surroundings which form basis for public opinion and efficiency of a hospital. A broad concept of hospital as a system is shown in figure 1.4. Some of the unique features of hospital management are given below:

1.9.1 Human Resources. As per Kaluzny and Associates, "the raw material of hospital's are living human beings and not lifeless material like iron, plastic, wood cement or sand. The aim of hospital services is not merely to turn-out some assured product of a given quality at a given cost, but to serve human beings in need of help." In manufacturing, we do not concern ourselves with the torture through which fibres, plastic, metals or the like are put through. However, in human services, we are definitely concerned about human response during every cut/stitch or twist of human flesh or bone/organ which is being handled. This difference has important implication in terms of ethical and social value.  

1.9.2 Right of Choice. In most of our government run hospitals, it is the patient who receives the treatment but he seldom decides his admission, unless it is an emergency case. Generally, it is the doctor in the OPD or casualty ward who determines when hospitalisation is necessary and whether spare bed is available. A doctor has been granted right to determine what tests and procedures to be performed and what hospital resources are to be utilised. It is the doctor who directs what care will be given by the nursing staff.
Figure 1.4: Hospital as a System
1.9.3 Technical Manpower. Technical manpower comprising of doctors, nurses, technicians like pharmacists, therapists, laboratory assistants are more in number than class IV employees like sweepers, washermen, peons, drivers. These highly qualified personnel tend to be autonomous in their outlook. They feel that no limit should be imposed on the amount spent to save a human life, although in a developing country having limited resources, such an attitude is unrealistic. Not only the admission of patients, their cure and stay depends upon doctor and nurses, even the recovery of charges from patient or compensation for any medico-legal case will depend upon how completely and accurately the doctors have recorded relevant information. Thus hospital administrator is generally in the predicament of keeping the doctors happy as well as exercising tight control to get maximum output from them. Most doctors and even supporting medical staff would resist any strict control. Consequently, hospital manager does not have as much influence in the hospital as his counterpart in an industry will have.

1.9.4 Professional Bureaucracy. "Mintzberg has identified that technical experts in general hospitals not only control their own work, but collectively they seek to control administrative processes that affect them".

1.9.5 Input/Output Ratio. Business organisation lays emphasis on maximisation of profit through controlled input and increased output by following standard operating procedures. However, input material to hospital are unlimited patients while its capacity to sustain patients is limited and output in the form of cured patients is dependent upon many internal/external factors. Thus management of hospital is not simple control of input/output ratio.
1.9.6 Hospitals are required to render very humanistic, personalised and timely treatment to all visiting patients. Thus work in hospital cannot be standardised like production job in an industry.

1.9.7 Hospitals has to be highly responsive to the health needs of its beneficiaries and must extend its services to the door steps of the community on call basis.

1.9.8 Treatment of each patient for the same disease need different handling by medical staff and is not fully prone to automation, as in case of an industry.

1.9.9 Workload in hospital tends to be variable and uneven, unlike industry, where production run is stable, so long equipment is serviceable and raw material is fed adequately.

1.9.10 The work in a hospital is highly specialised, heterogeneous and professional in nature. However, it requires tremendous amount of interaction and coordination between various departments/persons to provide appropriate medical-care.

1.9.11 Hospital deals with body and life of human being. As such, there is far less tolerance for ambiguity or errors.

1.9.12 The emergency nature of work in a hospital places very heavy burden of moral and functional responsibility of both hospital administration as well as staff (medical and para medical).

1.9.13 Hospital work is highly inter-dependent where individual performance is contingent to the performance of others.

Management Information System (MIS)

1.10 The term MIS can be best understood by examining separately the three words namely Management, Information and System. [10]

1.10.1 Management. Management is the scientific art of achieving the results by effectively utilising the resources. It
consists of activities carried out by managers/administrators where they plan, control, make decisions and initiate actions (orders/instructions) to ensure judicious allocation of resources to achieve organisational goals.

1.10.2 Information. Information consists of categorised and interpreted data which helps in timely and accurate decision-making by an administrator. While files, records and reports are data, the classified/extracted figures relevant to a decision-making process is termed as "Information".

1.10.3 System. A system is a set of elements, such as people, equipment/tools, procedures and concepts which are related to achieve organisational (mutual) goals.

1.11 The objective of an MIS is to provide timely, accurate and relevant information for decision-making on planning, organising and controlling major activities of an organisation (Hospital) and initiating timely and appropriate action to meet organisational (Hospital) goals/objectives. For this purpose a group of people, a set of manuals and data processing equipment (may be a computer) are utilised to select, store, process and retrieve data. Thus MIS reduces the uncertainty in decision-making by providing appropriate information to the managers, at the time they can most efficiently use it. MIS enables a decision-maker (any manager) to obtain, store, process, retrieve and display the right information at the right time for the right decision. Thus MIS is the key to efficient management of a hospital like any other organisation.

1.12 Hospital MIS. In today's managerial world of increasing complexity both in magnitude as well as in direction, the information becomes the key to management effectiveness. As such, we must give priority in designing and installing suitable Management Information System (MIS) to suit functional requirements of our
hospitals. Health Information System (HIS) was defined by "WHO" in a Conference held in Copenhagen during Jun 73, as "a mechanism for collection, processing, analysis and transmission of information required for organising and operating health services and also for research and training".

1.13 Concept of Management Information System. It is an information system that in addition to providing all necessary transaction processing for an organisation, provides information and processing support for management and decision functions. Like any other organisation a hospital also requires a mechanism for collecting, processing, storing, retrieval and disseminating information. It is important that daily transactions must be processed regularly as per standard operating procedures to ensure efficient functioning of hospital. "MIS" is an integrated, man/machine system for providing information to support the operations, management and decision-making of any hospital. Such a system may use manual method of hand calculation or mechanical means like punched card machines or it may even use advanced technology like digital computers. However, in India only few modern hospitals have employed computers for 'MIS', while manual methods for data collection, processing, storage and retrieval are commonly used in most of the Government hospitals.

1.14 Relevance of MIS. An efficient management of any organisation necessitates an effective decision making process based on quality information. The advent of computer, modern management techniques like System Analysis & Design, Operations Research (OR) and statistical methods have given birth to quantitative approach to management. This has made it possible to organise quantifiable data in the form of Management Information System (MIS) and affect timely and accurate decision-making. MIS has vast application in making our hospitals more efficient and serve better.
1.15 **Purpose.** The purpose of MIS is to raise hospital management from the level of piece-meal information, intuitive guesswork and isolated problem-solving, to the level of system insights, through timely, accurate and comprehensive information and adopt system approach. Manager of any organisation has always had "Sources" of information, it is the MIS which now provides a "System" of information. Thus MIS is a powerful tool for aiding hospital administrator in solving problems and making timely decisions. MIS provides relevant information on alternative plans and allows a manager to ask himself the question, "What will happen, if we do this—..............or that?"

1.16 **Essentials of good MIS**

1.16.1 Responsiveness to meet management requirement.
1.16.2 Accuracy and consistency of information.
1.16.3 Adequacy and comprehensiveness of information.
1.16.4 Relevance to the level of its utilisation.
1.16.5 Timely and regular flow of information.
1.16.6 Quality of information to aid decision-making.
1.16.7 Integrated approach to gather inputs from all concerned departments and timely dissemination to the appropriate levels.

1.17 **Manual Information System.** In manual system, as prevalent in most of our hospitals, management activity is over centralised. There is a pile of papers and files on the table of medical record superintendent. He can barely cope up with telephone calls and tries his best to sift through daily ward census and OPD records. Information is often incomplete, inaccurate and delayed. Consequently, Medical Superintendent and Deputy Medical Superintendent have to resort to crisis management and pick up fragmented information to cope up with daily running of hospital. This also affects long term
planning and policy formulation, since forecast are not accurate and timely. A typical manual system showing Superintendent medicals/records handling various functions is shown in figure 1.5.[11] This system has obvious handicaps and can just provide scanty information to meet day-to-day crisis. Indeed it is not a system approach, instead it is just convenient method of record keeping and there is no follow-up processing.

1.18 Scope of Study. The scope of study has been kept realistic such that proposed MIS could be implemented by any medium size general hospital (200 beds to 500 beds) with or without computer system. With suitable modification the model could be upgraded to any larger (750 beds to 1500 beds) hospital as well. Following points have been considered:

1.18.1 Minimum changes in existing forms.
1.18.2 Simple and easy to fill but adequate details in various input documents.
1.18.3 Evolutionary approach of selective automation using low-cost micro computers with commercially available software.
1.18.4 Data in respect of all dependent dispensaries (33) located in rural/urban area of Chandigarh and one PHC at Manimajra has been analysed.
1.18.5 Data in respect of family planning and welfare centre has not been analysed, since it is not directly controlled by the Medical Superintendent.

Research Methodology

1.19 General Hospital Chandigarh, like many other general hospitals does not have Proper Medical Record Department to organise MIS. Consequently, only limited information is available for analysis. Most of the records are incomplete, inaccurate and difficult to retrieve due to poor indexing and untidy storage. Despite above limitation,
Figure 1.5 Manual System
Deputy Medical Superintendent had been most cooperative in providing complete access to hospital staff and medical records. Following methodology was adopted:

1.19.1 Basic data regarding patient-care and medical supplies was extracted from summaries maintained in the office of Medical Superintendent.

1.19.2 Data in respect of financial aspects was collected through Planning Officer-cum-Accounts Officer.

1.19.3 Functioning of following OPDs, laboratories and wards was observed for four random days over two random weeks during Oct/Dec 89.

(a) General OPD covering surgery, medicine, skin and psychiatry.

(b) Eye OPD.

(c) Paediatric.

(d) Gynaeology.

(e) Dental.

(f) X-Ray.

(g) Laboratories.

(h) Male surgical ward.

(j) Female surgical ward.

(k) Emergency.

1.19.4 Stratified random samples were drawn from existing records (registers) of in-patients and out-patients covering a period of 1986 to 1989.

1.19.5 Interview and Discussion. Interviews and discussions were held with the following hospital functionaries to ascertain adequacy of existing procedures, quality and relevance of information at various levels:
(a) Director Health Services—Cum-Principal Medical Officer (PMO).
(b) Medical Superintendent-cum-Joint Director Health Services.
(c) Planning Officer-cum-Accounts Officer.
(d) Head of departments.
(e) Deputy Medical Superintendent-cum-Administrative Officer.
(f) Nursing Superintendent.
(g) Senior Dietician.
(h) Store Keepers.
(j) Medical records Superintendent.
(k) Medical Officer-in-Charge of the Emergency and Casualty ward.

1.19.6 Observations. Personal observations were made to cross check and to supplement the data collected through random sampling. For this purpose, personal visit to various services like laundry, laboratories, dietary, stores, X-Ray, OPD's and wards were made to get first hand information.

1.19.7 Documents for Study. Following documents were studied to carry out analysis of existing procedures and design input/output documents for the proposed MIS:

(a) Daily/monthly census of patients.
(b) Monthly summaries of communicable diseases.
(c) Monthly patients/load ward/OPD wise.
(d) Layout of various registers and forms currently maintained in various wards/departments.
(e) Stock registers of various stores.
(f) Issue/distribution of drugs.
(g) Scheduling of staff.
Computers and Hospital Management.

1.20 **Computer.** In today's world of modern technology, Computer has become quite indispensable management tool in all walks of life. Its use is no more limited to laboratory equipments, but extends to record-keeping, medical research analysis, decision-making and planning of medical-care. Indeed, computer is a most reliable and accurate aid for a physician or a hospital administrator. It is tireless, undemanding, unbiased and significantly very productive device for management. Computer is basically an electronic device which stores, retrieves and processes volumes of data to generate well formatted information, which aids in decision-making. Payne (1969) has defined computer as a machine which can receive, store, select, evaluate and transmit information to various users.

1.20.1 **Computer Terminology.** Computerisation is rather new for most of the medical personnel, including hospital administrators/managers in India. As such, certain basic concepts and computer terminology have been covered in succeeding paragraphs.

(a) **Micro Processor.** The basic unit in a modern computer is a micro processor, which is also called silicon chip. A Very Large Scale Integration (VLSI) type chip could have 5 mm square size, containing thousands of transistors as memory and could perform 50000 or more operations in a second.

(b) **Data.** Raw information collected about any event or object by observation or measurement is called data. For
instance, patient-data will relate to his ward—No, Name, Sex, Age, date-of-admission, date-of-discharge and diagnosis.

(c) **Information.** It is the organised data which is processed/computed in a desired format. For instance, from patient-data we may generate a list of patients suffering from a specific disease in a particular age and sex group. Such information acts as an aid to decision-making.

1.20.2 **Computer Hardware.** Computer hardware relates to electronics and electro-mechanical components of a computer. As shown in figure 1.6, a computer has four basic components which are configured to read data as input, carry out processing (computing, comparing) and display/print out information for the user [12].

(a) **Input Unit.** It consists of electro-mechanical/optical device to read/sense data from basic documents like cards/punched tape or key strokes for on-line inputs. Some of these devices are given below:

(i) Card reader (old device) is used for reading punched cards containing data in the form of rectangular punched holes/no-hole for representing '1'/'0' digits.

(ii) Key-board for direct key to magnetic disk/tape entry. This is currently in use for most of the data entry applications.

(iii) For reading pre-recorded data, we may use magnetic disc which may be a low capacity floppy, exchangeable disc-pack or winchester disk (fixed disc).
Fig 1.6 Computer Components.
(iv) Magnetic Tape drive which may have a cassette type or spool type magnetic tape is used where large pre-recorded (serial/sequential) data is required to be read.

(v) **Optical/Magnetic Card Reader.** These are the new type of devices for fast and accurate reading. These are in use for reading bank cheques, credit-cards, telephone dial cards or even daily attendance card.

(b) **Central Processing Unit (CPU).** This is the main brain consisting of one or more micro processors used for processing input (data) to produce output (information). It consists of three basic components:

   (i) **Arithmetic and Logic Unit (ALU).** The ALU is that part of computer hardware in which arithmetic (add, subtract, multiply, divide) and logical operations (True, False, AND, OR, NOT, exclusive OR) are performed under the direction of control unit. The ALU consists of number of electronic circuits called high speed memory units or registers which are used for all types of comparisons, calculations and sequencing.

   (ii) **Control Unit.** It is that part computer hardware which interprets the programme instructions and directs the sequence of operations determined by the instructions. It may be fully hard-wired logic or partly micro programmed logic using Read Only Memory (ROM). It controls flow of data from input device to ALU and from ALU to memory/output device.
(iii) **Memory.** Computer memory (also called main/ internal memory) is the work space like scratch book to carry rough calculations and hold data (information) temporarily, till it is transferred as output on suitable device. It could be made up of thousands of tiny magnetic cores or high speed transistors (micro chips), with very fast switching time. Magnetic memory is non-volatile while transistorised memory, though much faster than magnetic memory is volatile and its contents are lost if there is power failure. This memory may be augmented by auxiliary memory which is in the form of magnetic tapes/discs.

(c) **Output Unit.** It is an electro-mechanical device which receives information from the CPU and displays/prints its contents in the form that is understandable by the user. Some the commonly used output-devices are given below:

(i) **Line/Character Printer.** It is used to produce hard copy of desired output and is capable of printing 300 CPM to 600 LPM with each line having up to 160 characters or less.

(ii) **Video Display Terminal (VDT).** It is a television like screen giving visual display of information. VDT with varying size of screen from 10 inches to 25 inches and colour from monochrome (black & white) to multi-colour are being used with most of the PCs and work-stations.

(iii) **Magnetic Media.** For permanent record or re-use as subsequent input, the processed information may be recorded on magnetic media (Auxiliary Memory) or
1.21 Computer Software.[13] Computer software refers to set of programmes/instructions, procedures and associated documentation. There are two type of software which are generally referred as system-software and application software. System software consists of programmes like Operating Systems and other utilities written/supplied by the manufacturer/ supplier. These are not modifiable by the user. Application programmes are generally user written programmes which interact with hardware and system software to read (input) desired data and output required results. A list of the commonly available software which comes as a package with any PC/XT is given below:

1.21.1 **Operating system.** Operating System (OS) is the Master Control Programme which is part of System software written by specialists and it is this set of instructions which make computer hardware do any desired function. It controls input, output, computation of data as well as fault diagnostics. A user's overview of an operating system is shown in figure 1.7. Some of the commonly available OS with PC/XT and PC/AT are MSDOS, UNIX.

1.21.2 **Data Base Management Software—dBASE-III Plus.**

1.21.3 **Spread sheet (Lotus 1-2-3).**

1.21.4 **SORT/MERGE/UPDATE utility programme.**

1.21.5 **Word Star /Processor**

1.21.6 **Programming Languages.** According to John, 1985 [14], "just as Human System are able to use variety of natural languages for thought and communication, so too, computer can be programmed to behave by an increasing number of computer programming languages. Computer languages can be classified by their level. The lowest being machine language or binary language which is a combination of 1,s and 0,s. This is obviously very cumbersome for
Figure 1.7: User's overview of an operating system.
writing and updating programmes. The second category is middle level language called "Assembly Language" which is symbolic. By using mnemonics (Alphanumeric codes), programming becomes easier and efficient. However, this is machine dependent and requires high degree of expertise. This language is quite efficient and is often used for system programming and utility packages. The third category is the Higher Level Language (HLL) which is relatively machine independent and provides easy to read source code. Some of the commonly used HLL programming languages are:

(a) Basic (Beginner's All purpose Symbolic Instruction Code) was designed in Dartmouth college in 1965 as a simple on-line programming language.

(b) COBOL (Common Business Oriented Language) is English like language used for data processing, inventory and pay-roll applications.

(c) FORTRAN (FORmula TRANslator) is a scientific language used for mathematical work. FORTRAN was developed in 1960's by IBM, USA.

(d) PASCAL is named after famous scientist PASCAL. It is very powerful language which could be used both for scientific as well as business application. PASCAL was developed in late 1970's.

(e) "C"/Turbo "C" is a most powerful language capable of writing/interfacing system software and application software. "C" is more suited for graphic work and menu driven applications.

1.21.9 Data File/Data Base [15]. Data in respect of hospital material, personnel or finance is to be organised, stored and manipulated in such a manner that it can produce comprehensive
and relevant information in a short time. It has following components:

(a) **Record.** It is composed of related data items like Hospital-No, name, age, sex, ward-No. The position of data item in a record has one unique identification field like CR No, Date which is used for sequencing or searching.

(b) **File.** A collection of related records is called file. Depending upon type of application/processing, a data file may be organised as serial, sequential or random/Direct Access.

(c) **Data-Base.** The data base is a collection of inter-related data stored together with controlled redundancy to serve one or more applications in an optimal fashion. Today, it is possible to share more than one data-bases accross a LAN [16].

1.22 **Development Cycle of Computer.** The development of computers is a classic example of humankind's imagination having to wait a long time for its technology to catch up. Certain important milestones in the history of computer are given below:

1.22.1 **Abacus.** In 3000 BC, it was Babylonians who developed the Abacus. Egyptian, Greek, Arabs all needed computational device and the best that time available was Abacus.

1.22.2 **Pascal.** In 17th Century, Bliax Pascal of France developed a mechanical computational device, which used gears and boxes to do arithmetic calculations.

1.22.3 **Mark-I.** It was in 1944 that Haward Aikon with cooperation of IBM, developed mark-I which could solve mathematical calculations and trigonometric functions.
1.22.4 PCM. Towards the beginning of 19th century, French textile manufacturer, Joseph, marie developed Punch Card Machine (PCM) system.

1.22.5 Tabulating Machine. Herman Hollerith, an engineer from USA extended the idea of PCM to develop simple tabulating machine. This proved very effective way of printing calculated results and aided management in decision making.

1.22.6 Babbage. Towards the middle of 19th century, an Englishman Charles Babbage developed the concept of \textquoteleft{}Difference Engine\textquoteright{} which could compute complete calculations by using mechanical gears and levers.

1.22.7 ENIAC. First electronic computer was developed in 1950, in Pennsylvania university for military applications. It was named as Electronic Numerical Integrater and Adding Calculator.

1.23 Generations of Computer.

1.23.1 First Generation. The first electronic computer called Electronic Numerical Integrater and Adding Calculator (ENIAC) was made in USA in 1950. ENIAC used 19,000 thermionic valves, generating 150 KW of heat, occupied huge hall and needed large number of engineers to keep it going. It used machine language for programming which was very cumbersome.

1.23.2 Second Generation. Around 1952, transistor technology replaced thermionic valve, which reduced the size of computer as well as heat dissipation. These computers were smaller, more reliable, less costly and atleas 100 times faster than ENIAC. Mnemonic code in the form of \textquoteleft{}Assembly Language\textquoteright{} was used for programming and that proved to be more convenient software tool than machine language.

1.23.3 Third Generation. During 1970's, hardware technological break-through in the field of Very Large Scale Integration (VLSI)
made it possible to use micro chips as building block for computer architecture. In addition to this phenomenal development in the hardware technology, Higher Level Languages (HLL) like PASCAL and 'C' were made so versatile that system software like Operating System (OS) were written in HLL, instead of Assembly Languages.

1.23.4 Fourth Generation. During 1980’s fourth generation computers ranging from table-top micro-computer to super-micro and mini computers have flooded the market, all over the world. Personal Computer (PC) like PC/XT or PC/AT are the versions of micro computers, which are becoming common office equipment.

1.23.5 Fifth Generation. The American and Japanese are developing Knowledge Based System (KBS) which will have Artificial Intelligence (AI) and could even interact with human-being in normal spoken language. It is stated that by early 1990, computers will be able to listen and answer back in dialogue form.

Characteristics of Computers

1.24 Hunt and selling (1984) have described following characteristics of computer :-

1.24.1 Speed. Fourth generation computers can do thousands of calculations in a second and this helps in quick retrieval and processing of information. Speeds are often quoted as Millions Instructions Per Second (MIPS).

1.24.2 Storage. Computer can store millions of words of informations in auxiliary memory (magnetic disk/tape) and can even carry out calculation on hundreds of thousands of words in the internal high speed memory (Transistorised VLSI memory).
1.24.3 **Accuracy.** Computers are extremely accurate and error, if any, is due to human factor, which may occur during programming and human operations of hardware devices.

1.24.4 **Versatility.** Same computer can be used for variety of applications and limitations if any, is the ingenuity of its user. Its ability to programme same hardware for endless user applications, merely by modifying software programme provides required versatility.

1.24.5 **Automation.** Computer is programmable and once the application software has been developed and proven, the system is capable of automatic retrieval, process and storage of data and also produce well formatted information as per required interval.

1.24.6 **Diligence.** Computer does not suffer from human factor like fatigue and its performance level is consistent round the clock for any length of time.

1.24.7 **Unbiased.** It does not suffer from human bias and it continues to do processing as per given criteria, irrespective of the identity of item/person being evaluated.

**Computer Configurations for Hospital MIS**

1.25 The survey of available literature reveals that there are three main types of Computers which are being used for hospital MIS in developed countries.

1.25.1 **Main Frame Computers.** These are in the range of IBM 370, DEC-10, Cyber and are generally suitable for large hospitals like AIIMS, Delhi, PGI Chandigarh. These computers have very large memory (8 Megabytes to 64 Megabytes (MB)), high speed (4 to 30 MIPS) and comprehensive software to enable multi users environment for research scholars. It can provide real-time data handling facility to various laboratories and departments. It
could concurrently run batch job of data processing type as well as on-line multi users query system.

1.25.2 *Mini Computers*. These computers may have memory size of 1 to 20 MB with speed up to 4 MIPS. These are suitable for medium size hospitals which have 500-700 beds capacity. Their cost is lesser than that of main frame and could be afforded by state level hospitals-cum-medical colleges.

1.25.3 *Micro Computers*. These are low cost stand-alone table top computer systems, in the range of IBM-PC XT/AT. Their internal memory could be from 32K to 8 MB with speed 1 to 2.5 MIPS. According to SIMSON (1980), micro computers have changed the procedure of deciding what parts of a Hospital Information System should be computerised. Micro computers can be used as stand-alone configuration or Local Area Network (LAN). For the size of General Hospital Chandigarh 2 to 3 PC/XT/AT as shown in figure 1.8 would be adequate as first experiment and progressively this could be enlarged.

**Computer Applications**

1.26 Computer cost has tremendously dropped in last five years where a PC/XT costing Rs. 1.2 lakhs in 1984 is available for Rs 30,000 by the end of 1989. It is certainly within the reach of even 200 bedded hospital. In the developed countries, the computers have already been in use for hospital management over a decade and their experience could well be a good foundation for installation of computers in Indian hospitals. The survey during 1987-88 has revealed that some of the leading hospital like PGI Chandigarh, AIIMS Delhi have made a some beginning by introducing computer for diagnostic index system which facilitates in producing monthly/yearly statistical bulletin. There are number of software agencies offering complete solution to management problems and our hospitals could make use of such...
facilities. Some of the commonly known applications of computer in the medical field are:-

1.26.1 Medical record keeping.
1.26.2 Inventory control of medical supplies.
1.26.3 Pay-roll and planning of budget.
1.26.4 Attendance check.
1.26.5 Patient indexing and locating.
1.26.6 Diagnosis Index.
1.26.7 Hospital statistical analysis.
1.26.8 Patient monitoring in ICU.
1.26.9 Laboratory application like CT scanner, ultrasound scan.

1.27 Importance of Computer Assisted MIS.

1.27.1 The primary aim of any computerised system is to provide better information support for timely and accurate decision-making. Some of the important aspects (Griesse, 1979) are given below :-

(a) Timely delivery of relevant information to the right person, at the right time and at reasonable cost.
(b) Relieve doctors and nursing staff from laborious and repetitive jobs of book-keeping and allow them more time for actual care of the Patient.
(c) Greater accuracy and consistency of the information will improve the quality of patient care.

1.27.2 Hospital Information System (HIS) [17]. The term 'HIS' is generally referred to a computer-based 'MIS' which takes care of all the information flowing through many corridors, wards and laboratories of hospital. With the advances in management techniques there has been an effort to evolve integrated
approach to patient-cares. One such system "Health Evaluation through Logical Process (HELP) was started in 1972 by Dr Hemer Warner in Salt Lake City, USA. It now provides 550 bed tertiary care hospital with following type of information:

(a) Patient records (Demographic, past medical history, current investigations and treatment).
(b) Decision-making support.
(c) Administrative (Admission, transfers, discharges and billing) information.
(d) Research (Data base, Storage and Analysis).

1.27.3 Hospital Query System.[18] Computer Stored Ambulatory Record (COSTAR) system developed in Massachusetts General Hospital in late 1960 to overcome inherent problems of manual record keeping. COSTAR is written in MUMPS, a programming language designed for handling medical information. It can provide patient information, current state or diagnosis and treatment. Today in the western world, large number of computer software packages for PC-based Health care system are available. Even in India, number of software agencies have started entering in the field of Hospital Management.

Existing MIS

1.28 General Hospital Chandigarh does not have MIS concept. Its book-keeping and information handling is a typical age-old manual system which suffers from numerous inadequacies, inconsistencies and bottlenecks. The hospital does not have Medical Record Department (MRD) to maintain hospital statistics.

1.28.1 Draw backs of existing system
(a) Decision-making is based on gut judgement and guess-work rather than facts.
(b) Number of schemes/statements of cases are pending/delayed with UT government due to lack of supporting information.

(c) Lack of hospital statistics adversely affects forward planning and preparing accurate budget estimate.

(d) Lack/absence of administrative data due to non-qualified persons employed on specialised jobs.

(e) Financial planning is most adhoc and based on crisis management.

(f) Poor utilisation of hospital resources which include human resources as well as medical supplies.

(g) Inaccurate, incomplete and delayed reports/returns to Ministry of Health.

(h) Over/under stocking of medical supplies resulting in "date-expired" or local purchase at exorbitant cost.

(j) Lack of satisfaction and motivation in lower staff due to less effective personnel management.

Proposed MIS

1.29 It is proposed to have computer-aided unified MIS which is cost-effective and responsive to various functional needs of hospital management. It is recommended to adopt evolutionary approach where initially 2 to 3 PC-XT/AT microcomputers could be employed as local Area Network (LAN) or even stand-alone configurations as shown in figure 1.8. However, as dealing staff gains more experience while doing on-the-job training, configuration may be enhanced to 4 - 6 PC-XT/AT as shown in figure 1.9. As a first step, software package dBASE III Plus is considered adequate and has been utilised in designing sub-systems, as described in subsequent chapters.

1.30 The main components of proposed MIS have been discussed in subsequent chapters.
Dy Med Supld

PATIENT-CARE & DECISION SUPPORT

MATERIAL MANAGEMENT

ACCOUNTS & PERSONNEL

Figure 1.8 Initial configuration for Hospital MIS

Medical Record Officer/
Dy Medical Superintendent

Planning & Adm

PATIENT-CARE SYSTEM

DEcision SUPPORT SYSTEM

MATERIAL MGMT SYSTEM

DHS & MS

FINANCE SYSTEM

STORE officer

Account officer

Figure 1.9 Integrated Hospital MIS
1.30.1 MIS for Decision-making and Policy formulation - Chapter 3.
1.30.2 MIS for Patient-care - Chapter 4.
1.30.3 MIS for Personnel management - Chapter 5.
1.30.4 MIS for Material management - Chapter 6.
1.30.5 MIS for Financial management - Chapter 7.

1.31 Various inputs/outputs and structure of various data bases/files have been discussed in respective chapters. While designing data-base, it has been ensured that data fields of records could be used both for manual as well as computerised system. A self coding "case history sheet" for in-patients (Appendix 'J' of Chapter 4) as designed during above study has already been accepted and introduced by the management since Mar 1986. Although cost of one PC/XT with printer is approximately Rs 40000/- and could be afforded by any general hospital of 200 beds or more capacity, yet proposed system could be also implemented using card index/file system.

1.32 Advantages of proposed system

1.32.1 Easy to implement both by manual method as well as by employing Personal Computers(PC,s).
1.32.2 Better accuracy and consistency of information for timely decision- making.
1.32.3 An effective instrument for monitoring and control.
1.32.4 Timely and comprehensive hospital statistics for forecasting and analysis.
1.32.5 Ensures better security of sensitive data.
1.32.6 Effective integration of departmental information and timely dissemination of relevant information to all concerned.
References

4. Sahni, Ashok (Ed) "Hospital and Health Administration", Indian Society of Health Administrators, Bangalore, 1988, PP 62-64.