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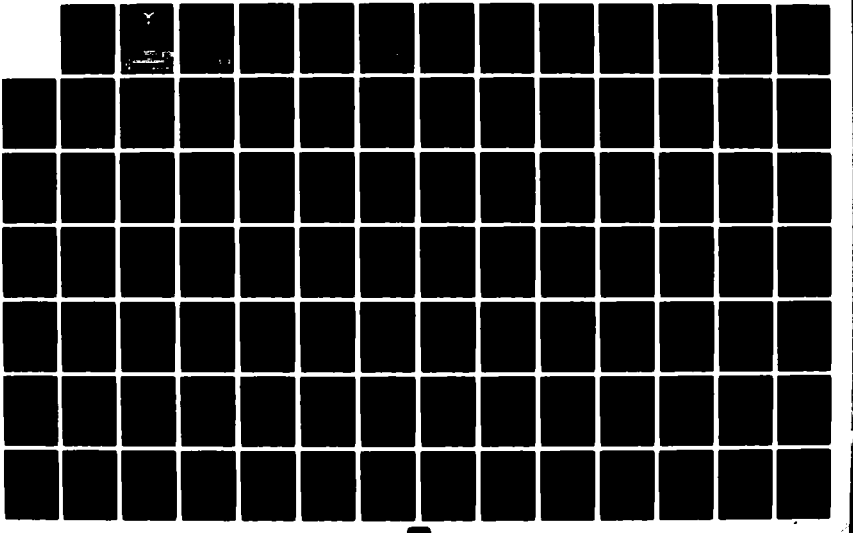

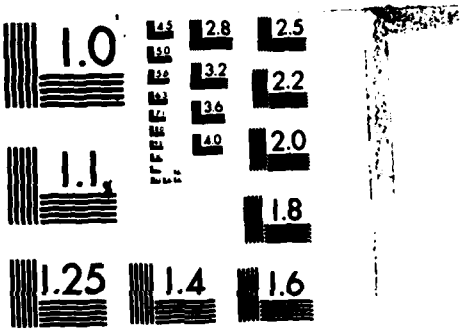

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THESIS

AFIT/~~MA/GCS/~~83D-2

STEPHEN G. HULL
CAPT USAF

ANALYSIS OF ADMINISTRATIVE INFORMATION FLOW IN A MILITARY MEDICAL CENTER PURSUANT TO DESIGN OF A DATA BASE MANAGEMENT SYSTEM THAT WILL ULTIMATELY SUPPORT A HOSPITAL INFORMATION SYSTEM

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ANALYSIS OF ADMINISTRATIVE INFORMATION FLOW IN A MILITARY MEDICAL CENTER PURSUANT TO DESIGN OF A DATA BASE MANAGEMENT SYSTEM THAT WILL ULTIMATELY SUPPORT A HOSPITAL INFORMATION SYSTEM

THESIS

Presented to the Faculty jof the School of Engineering

of the Air force Institute of Technology

Air University

in Partial Fulfillment of the

Requirements for the Degree of

Master of Science

by

Stephen G. Hull, B.S.

Capt USAF

Graduate Computer Science

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PREFACE

The need for a centralized data base and data management system has long been recognized by the medical community as essential for efficient operation in the face of an ever increasing patient needs and treatments and the associated administrative load. Until the completion of this thesis, Wright-Patterson Air Force Base - Medical Center (WPAFB-MC) had been unable to begin the groundwork for a solution to their information management needs because of other problems associated with completely modernizing the Medical Center's data automation program.

To initiate a project of this magnitude to completion and at the same time produce results which are accurate, useful and meaningful to WPAFB-MC required the combined efforts of many people. Grateful appreciation is extended to the WPAFB-MC Data Processing Department and the heads of all the hospital directorates and divisions who willingly and supportively participated in the data analysis interviews.

Heartfelt thanks is given to my thesis advisor Dr. Henry Potoczny and to committee member Maj. Chuck Lillie who provided tremendous moral support, innumeralbe impartial evaluations and recommendations and managed to keep me on track.

Special gratitude is extended to two people who,

without their help, this project probably could not have been completed on time. Maj. C. Modliszewski and Mr. Raymond E. Girard spent many hours helping me understand the data needs of WPAFB-MC.

Finally, I owe a measureless debt to my wife, Kathleen, and daughter, Stacy, without whose support, encouragement and understanding on the home front I would have never completed the paper presented.

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ABSTRACT

A partial centralized relational data base in third normal form was designed for use by the staff of the United States Medical Center Wright-Patterson. Information requirements were gathered by means of an in-depth data/information analysis at the directorate and division level, and used as the basis of the design. Provided with the design is a detailed data dictionary and an implementation plan.

As a result of certain facts gathered during the data/information analysis, several management and organizational recommendations were made to the Medical Center. The aim of these recommendations was to make the implementation and management of the data base easier, cheaper and responsive to the users.

I. INTRODUCTION

OBJECTIVES

The intent of this thesis is to develop a detailed method for specifying, implementing, and demonstrating a conceptual model of the administrative portion of Wright Patterson AFB - Medical Center (WPAFB-MC). The schema has been developed in a style that can be generalized to other areas of the hospital so as to cultivate a Hospital Information System (HIS). If such a process is pursued, it is advisable to incorporate the administrative module presented in this paper as the basic step.

The areas examined in the hospital for this report are: Patient Affairs, Plant Management, Resource Management, Administrative Office, Directorate of Hospital Services and Department of Nursing. These areas were selected because of commonality of data and relative stability of information flow. It is hypothesised that through careful analysis of these data elements and their flow, insight can be gained in the issues that pertain to the development of a Data Base Management System (DBMS). The issues refered to are:

- The information system requirements of WPAFB-MC
- The development of a Data System for improving the efficiency of the hospital
- Cost benefits of such a system
- Type of DBMS that will work on existing hardware

BACKGROUND

In the last few years, the application possibilities for data processing in the hospital environment has considerably increased owing to the advent of the computer. Recognizing this need the Department of Defense (DOD) purchased hardware along with proprietary software to aid the military hospitals in meeting their information support needs. This provision of support is no small undertaking when one reviews the tasks defined by AFR 169-6 for a medical center.

> An area medical center is a large hospital designated by the Surgeon General, USAF, and staffed and equipped to provide:
> (1) Medical and dental care for authorized personnel.
> (2) The widest range of specialized and consultative support for all Medical Treatment Facilities within the area, as outlined in the consolidated mission statements for area medical centers published by HQ USAF/SGHM.
> (3) Postgraduate education in health professions.
> (4) Physical evaluation board referral service. An area medical center is the primary Air Force hospital in its area. It performs three principal functions - patient service, education, and research. In the first function, the experience of its staff and the variety of its supporting equipment and other resources provide a capability for definitive care to patients referred by smaller facilities in the area, patients from other area medical centers, and paitients regulated from worldwide sources by the Armed services medical regulating office (ASMRO). In the second function, it conducts an extensive education program in health care sciences and a consultant program for regional hospitals. In the third funciton, it carries out health research projects necessary to support the education program.

However, the provided software could not handle the tasks set forth for a medical center. It merely became a

collection of inflexible routines. This condition lasted until October of 1977 when a assemblage of operational and strategic computer groups met and developed new software and software policies that would be more responsive to the needs of the medical information environment. This improvement was confirmed by unofficial records to have increased functional users by thirty per cent.

But despite the changes the use of the computers is still limited to specialized report routines that are unique to the owning office. In some cases the transition from manual record keeping to automated record keeping has never occurred. As a result massive duplication of data, data types, and human effort are continually occurring. This translates to less than optimum use of resources and thus waste in manpower and dollars.

To relieve this thriftless condition a single integrated data base must be planned and implemented. It must be specifically designed for modular implementation so as to eventually support a total HIS.

PRESENT SYSTEM

As was stated in the BACKGROUND section the computer system that exists at WPAFB-MC has undergone some changes (for the better) over the past few years. In fact the system(s) that exist today provide many enhancements and cost savings to the military that would not have been possi-

ble otherwise. Some of these positive aspects are:

1) Word processing capability that reduces throughput times of reports and correspondence by approximately forty percent.

2) Increased awareness of manhour savings realized through the use of electronic transfer of data.

3) Intrinsic administrative off-shoots such as statistical inputs.

4) User defined formatting.

5) Improved discipline for dynamic standardization of data.

Even with these gains in information capability the demands on the computer center keep increasing. This is propagated by the attitude that the computer is the answer to hospital work areas that are pressured by increasing work loads while being required to operate under constraints of cost and manpower budgets. These loads are generally in the form of increase reporting regulations, administrative demands for increased productivity and reporting, and/or improved services. (Ref 20, P 21)

Because of these demands the productivity and caliber of work developed in the center is being prematurely taxed to its limits. This in part is due to the practice in the Department of Defense Tri-Service Medical Information Systems Agency (TRIMIS) of procuring stand alone systems that retain for the vendor all his proprietary rights.

> An approach often used involved the selection and purchase of stand-alone systems which apply to specific functional areas. There are numerous systems available to aid hospital management in the so-called business aspects of the health care

> institution. These systems generally contain applications software dealing with patient accounting, general ledger/responsiblility reporting, cost allocation (for cost accounting purposes), inventory reporting, property ledger, accounts payable, personnel records, accounts receivalble functions, and payroll functions. Other stand-alone systems generally procured by hospitals include clinical laboratory systems, patient monitoring systems, automated medical history taking systems, EKG analysis packages, patient appointment systems, and other highly specialized sub-systems packages to meet specific functional requirements within a hospital. The individual hospital generally has no opportunity to change programs or modify procedures. (13-16)

This is not a unique practice for medical institutions as reported by Barnett and Zielstorff. "... Its primary purpose is an ancillary area support system, which is aimed at improving the information-related activities of individual service units such as the pharmacy, the clinical laboratories, the radiology department, or the admitting office" (Ref 4, p 157). A second type of system employed at the WPAFB-MC is a transactional system, which is "primarily concerned with financial management and concentrates on recording the use of services or goods for the purpose of billing" (Ref 4, p 157).

Inherent in this approach to data processing is the hierarchial summarization of the world. Such a methodology is not only wasteful in terms of memory and logically questionable, but also quarantees data inconsistency (Ref 13, p 32). These inconsistencies are in part due to the duplication of data in specific files that are structured to particular applications. Thus when updates are made a lack of

agreement in data entries begins to occur because it applies only to one specific file rather then all files containing that data item.

These problems of questionable logic, data inconsistency, duplication of data, and the inability of the user community to treat the existing data as a general resource all of the time, keeps the users from interfacing with the data. Thus an inward spiral is established which will prematurely limit the data processing function to concentrate on data processing rather than on service delivery. (Ref 8, p 3)

It is the issue of service and the need to satisfy user needs and functions in the organizational environment which are the true context for a data base management system. (Ref 8, p 14)

By establishing a hospital DBMS the flexibility a Hospital Information System requires will be permitted. Thus, problems previously elicited will be significantly reduced, if not eliminated.

GENERAL GOALS SYSTEM WILL MEET

Data bases have many straight forward benefits that have an immediate appeal: the ability to share data, reduce redundancy, and eliminate inconsistency, are some of the obvious.(Ref 13) These benefits follow from the fact that there is a need to store data only once. It was a review of

these benefits that formed the basis of the general goals and requirements that the ultimate HIS will meet. A listing of these goals are:

1. Consistency and non-redundancy
   The information should be organized to minimize complications arrising from needless repetitions and lack of agreement.

2. User-oriented
   The system should be oriented to medical and administrative professionals. It must be natural and simple for the user to submit requests for information.

3. Efficiency
   Due to frequent changes in patient condition, personnel, and logistic support information may become obsolete rapidly. The value of information depends on timeliness. Efficient storage, retrieval and manipulation schemes are required.

4. Standardization
   Because HIS's are complex, the cost of development and maintenance is high and can be justified only with a large volume of data. Standardization of information format would allow sharing and merging of systems within and among hospitals.

5. Modularity
   It is desirable that the system be modular so that it can be tailored to meet the different requirements of individual hospitals.

6. Reliability
   Hospitals are operational twenty-four hours a day and computer system availability must be maximized. Recover capability must be provided so brief failure will not reduce the quality of work within the hospital.

It is essential that any information design of a DBMS in support of a Hospital Information System be carried out with consideration of the above factors.

OVERVIEW - A CONCEPTUAL FRAMEWORK

Experience and research have shown that in any develop-

ment process for information systems it is important to identify clearly the potential users of the information and the uses to which it will be put. This is a fundamental step that is often ignored. This oversight often gives misleading results which end in a discrediting of the entire computer operation. To avoid such a blunder in this project this thesis will rely on a break down of information proposed by a prominent authority in the field of management science, Robert Anthony. His position is that there are several distinct classes of information required for any organization: strategic planning, management control, and operational control.

A. STRATEGIC PLANNING

Strategic planning is the process of deciding on objective of the organization, on changes in these objectives, on the resources needed to attain these objectives, and on the policies that are to govern the acquisition, use, and disposition of those resources.

With reference to WPAFB-MC, strategic planning activities include decisions on program objectives, service facility locations, target population definitions, long-range budgeting and fore casting, resource allocation decisions and policy options. This type of planning is dependent on external sources such as demographic studies, estimates of costs and other factors involved in feasibility studies.

B. MANAGEMENT CONTROL

Anthony suggests that management control is the process by which managers assure that resources are obtained and used effectively in the accomplishment of the organization's objectives. This definition is intended to convey three key ideas. First, the process involves managers, people who get things done by working with other people. Second, the process takes place within a context of objectives and policies that have been determined in the strategic planning process. Third, the criteria relevant for judging the actions taken in this process are effectiveness and efficiency. With reference to WPAFB-MC management control activities include the determining of staffing and capacity requirements, performance monitoring, target-setting, short-term budgeting, and the training of new personnel to meet standards of quality in performance.

As opposed to information used in the strategic planning process, a management control system may be usefully conceived based primarily on internal operating data. An example of a Statistical DBMS used for management control purposes is a utilization system. Such a system would encounter records of patient visits to tabulate utilization of provider personnel and medical technology. The information would then be used to make adjustments in staffing and equipment requirements.

C. OPERATIONAL CONTROL

Mr. Anthony describes the third class of activities within an organization as operational control, that is, the process of assuring that specific tasks are carried out effectively and efficiently. As the definition suggests, the focus of operation control is on individual tasks or transactions; scheduling and controlling individual jobs as contrasted with measuring the performance; procuring specific items for inventory as contrasted with the management of inventory as a whole; specific personnel actions as contrasted with personnel management, etc. An example of the operational control activities at WPAFB-MC would include scheduling of visits, inventory control, patient record maintenance, accounting systems, and staff scheduling.

This report will deal primarily with development for the operational control area. One reason for this is that operational control decisions are programmable in the sense that decision rules can be specified which produce an optimum relationship of resource inputs (e.g., WPAFB-MC personnel, administrative tasks) to outputs (e.g., patient care). (Ref 1)

II. THE COLLECTION PROCESS

OVERVIEW

When one sets out to design a data base that will be implemented into a DBMS, it seems like, at first blush, a moderate undertaking. All one has to do is develop relations and normalize them to at least third normal form (3NF) so as to insure that insert, update and delete anomalies do not occur. (If the terms 3NF, normalize, relations, etc. are not familiar to the reader please refer to glossary in the appendix.) The next obvious step is to choose a DBMS that will support the relations developed. But this is not all that is involved in the data base development process. It is merely the tip of the data iceburg. The part of the process that is not apparent and needed to crack the data iceburg is the methodology used to ascertain what data exists in the iceburg or in a more familiar term the organization. The method employed should, at some pre-set stopping point, be able to identify data elements and the relations they compose. It should also identify the information connectors that model the flow of information throughout the organization under investigation. It will also demonstrate inter and intra information flow of functional areas that comprise the organization and of functional areas themselves.

PRIMAL PHASE

To begin such a process it is necessary to gain some

idea of the dimension that the data the organization (under review) generates and uses. In the case of WPAFB-MC this required face to face interviews with the head of the Medical Information System, the Associate Medical Center Administrator and the Medical Center Administrator. This meeting established that the implementation of a DBMS would be beneficial to the WPAFB-MC and should be undertaken. This is the inaugural step.

But despite vicinal backing there is one other area of concern that must be evaluated and that is the present and future programs of the Department of Defense. This level must be evaluated and coordinated with to ensure that any local design can be done in concert with their efforts.

As covered in Chapter 1 the DOD agency governing WPAFB-MC is the TRIMIS office. It was determined that some inputs from their agency would be of use in developing information flow patterns. Unfortunately it was felt that their ideas on DBMS's were limited and relied too heavily on their subcontracted consultant firm "Libra Technology". This is typical of most bureaucratic institutions be they civilian or military.

The final part of the primal phase involved casual discussions with the potential users who are intended to be incorporated into the data base. Since this is the first contact the data base designer has with future users it is essential that the discussion be limited to an overview of

what a DBMS is and the potential use it has to them. The key is to create an interest on the part of the user. So, it is advisable to limit terminology to a vernacular that computer illiterates can visualize physically. The example used in this study involved a file cabinet. The cabinet was referenced as the computer. The file folders inside were described as the file structure/relations that either currently exist or would be defined. The documents inside the folders were described as the data elements/attributes. And, the process of interaction with the files/relations in the cabinet/computer to extract viable information was depicted as what the DBMS would do if designed properly. The entire encounter should be limited to a time span of fifteen to twenty minutes.

CANVAS PHASE

Since the initial contact with the users can be completed in one to two days there is little loss in momentum in gaining insight into the information flow of the hospital. Thus after all designated functional areas have been contacted it is necessary to develop an appointment sequence which will allow checks on information provided by the functional areas. The process used in this paper relied on contacting department supervisors and asking two general questions - "Tell me in simple terms what your office does that contributes to the hospital being able to meet its mission goal?" and "Of the subunits that make-up your functional area give me a brief description of the impact if it,

the sub-area, no longer exists?" . These questions will help to identify jobs that deal solely with planning or controlling and thus save time since these are areas that do not belong in this data base management system.

DATA COLLECTION METHODS

The following paragraphs will illustrate the data collection techniques used in the development of the proposed DBMS. The examples presented deal with data collection in clinics, plant management, wards, etc. The methods employed are not limited to the examples shown but only demonstrate the techniques that should be applied in a data collection throughout the hospital. These methods were applied with minor adjustments in all of the functional areas outlined in Chapter 1. As an added note the methods demonstrated can apply to any Military Treatment Facility (MTF) with consideration given to the individual capabilities of the MTF and the function of that medical facility. Additional constraints such as time and money will also dictate alterations in the methods presented.

INTERVIEWS

Interviews were structured with questions such as the following:

- What records or logs are used to record patient appointments?
- Are separate statistics collected for different characteristics of patient appointments, e.g., number of walk-ins, number of priority changes, etc. ?

- What time frame is employed to record these transactions ? Hourly ? Shift ? Daily ? Weekly ? Monthly ? Yearly ?

- How does your work area access these records ?

- Are manual logs kept to back up computer failures ?

- What is the average workload for the clinic ?

- What interactions exist between the clinic and the Pharmacy? Clinic and the Laboratory? Clinic and Records ?

- What information requests are received from other areas, i.e., resource management ? How many and from what areas ?

- How is area data recorded, i.e., by number of patients, type of affliction or by active duty/ dependent?

- What are the clinics peak seasons, time of day, days of week, etc. ?

- What data management problems are encountered by the clinics as a whole ?

The answers to these and other questions, as determined by type of functional area, enabled identification of functional boundaries as well as relationships that existed between the functional boundaries and within the boundaries. This enabled the start of a model to depict the information flow.

INFORMATION FLOW DIAGRAM

Having developed the genre of questions necessary for discovering the data elements and their information uses, it was necessary to build a general model that depicted in a graphic form the functional connections of the hospital.

This was done prior to any in depth interviews. The reasoning for this approach was that a guiding model graphic could aid the interviewer as well as the interviewees in constructing concise descriptions of how their specific areas functioned within the MTF. Figure II-1 is the model that was finally used in the interviews. The diagram was developed from information provided by the "Process Condition - Action Diagram Flowcharts" of Walter Reed Army Medical Center Study published in 1976. Thus what follows are the condensed accounts of what was revealed by interviews concerning function and information flow within and between Patient Affairs, Plant Management, Resource Management, Administrative Office, Directorate of Hospital Services and Department of Nursing.

A. Patient Affairs

The Patient Affairs office is primarily concerned with matters that deal with monitoring patient use of medical facilities. The areas addressed in this study were: Air Evac, Champus and Administrative Support.

1. The Air Evac system involves identifying patients that need to be transported from one MTF to another due to the non-availability of medical specialties at their base of origin. This process is not a simple one. Further questions revealed that there were restrictions on who could use this system. The potential user had to be on active duty or retired from one of the

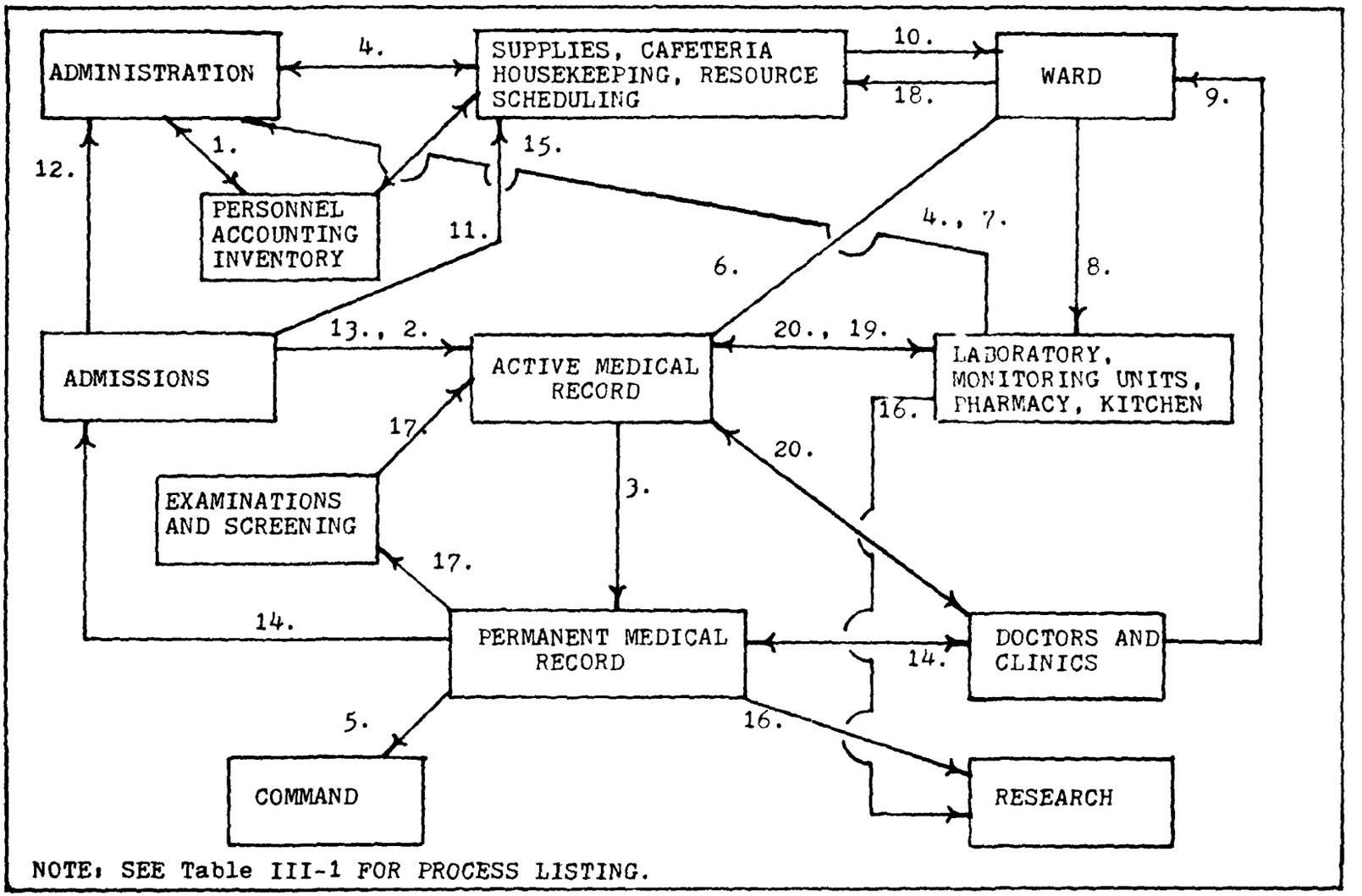


Figure II-1. Information Flow Diagram

branches of the service, a dependent or in very special cases a member of the civilian community (e.g. severe burn case from a civilian air crash would be moved via military air evac if civilian transport was not available). Once the potential user is identified as qualified for an air evac he/she must be admitted into the hospital and scheduled for movement. This causes demands on staff, equipment and facilities.

To give the reader a clearer understanding of how the Air Evac system impacts other areas of the hospital the following example is provided.

> An enlisted Air Force person stationed at WPAFB-MC, Oh., is diagnosed as having disease X. It is well known that proper treatment for such an illness can be best supported at Wilford Hall, Lackland AFB, Texas. The procedure for moving this patient via airplane is chosen due to the severity of the disease. So, the patient is admitted to the local military hospital. This required admission forms and assignment of a bed in a specific ward. This in turn affects personnel scheduling (e.g. physicians, nurses, technicians, etc.) and consumption of hospital supplies (drugs, dietary, linens, etc.)

2. CIVILIAN HEALTH and MENTAL PROGRAM of the UNIFORMED SERVICES (CHAMPUS)

The CHAMPUS office within WPAFB-MC advises patients and staff in matters involving CHAMPUS. The office assists sponsors in applying for benefits administered under CHAMPUS, as well as advising sponsors of available services within the MTF. An additional function is providing supplemental authorizations for medical care in the local

community due to non-availability at the military institution. An example of this would be special diagnostic tests or consultant examinations. The rest of the functions involve agencies and data that are external to the hospital information flow, therefor, they are not included in this discussion. An example of how this process is employed follows.

> Colonel Myers, neurosurgeon, has noted symptoms of bradicardia in a six month old female. The symtoms suggest pressure is occurring in the posterior fossa region of the scull. However, the CAT scanner at WPAFB-MC can not give clear resolution of that region of the brain. Therefor he has requested that an EMI scanner be used to confirm diagnosis of cerebral fluid pressure before attempting surgery. In addition he is requesting a consult from a civilian neurosurgeon who is familiar with these special test procedures. To accomplish these requests the CHAMPUS office must coordinate supplemental funding.

3. ADMINISTRATIVE SUPPORT

This area supervises the administrative functions of admission, disposition and transfer of patients. This in turn involves the administrative control of patients and beds. It assigns patients to inpatient units, arranges for receiving and safeguarding patient valuables (baggage and clothing), and initiates preparation of individual inpatient and related administrative records.

The Administrative Support Area compiles data and prepares recurring and special reports pertinent to admission, classification and disposition of patients. It en-

sures that vital statistic data are properly documented. It receives and monitors recurring statistical reports of hospital services. It also ensures that the data compiled is made known to the administrative and professional staffs.

Advising the appropriate Civilian Base Personnel Office (CBPO), in as prompt a fashion as possible, is the Administrative Support Areas responsibility when a patient member is expected to be hospitalized in excess of ninty (90) days. If third party liability notification is necessary this office is responsible.

This area provides administrative support for Medical Evaluation Boards (MEB), Physical Evaluation Boards (PEB) and examination of members on the temporary retired list (TDRL).

The Administrative Support Area reviews and processes health records. If records are not complete they are identified and referred to the responsible provider, or department supervisor for correction. It compiles clinical record statistical data and prepares reports based thereon. It also maintains inpatient record files. Lastly, it provides required information to the health record committee and the medical care evaluation committee.

B. PLANT MANAGEMENT

The principle purpose of plant management is to provide a clean, safe and adequate environment for patient care

within the hospital. This is accomplished through a comprehensive interior and exterior facility maintenance program, fire and ground safety programs, ground maintenance, security, housekeeping, work order control and programming activity, hospital space utilization program and emergency planning for disasters. From the functional descriptions presented it was concluded that the majority of data used or shared with this functional area would be relatively static and should be included in relations that were not accessed for updates on a continuing basis. An example of this concept follows.

> John Doe is about to be admitted to the hospital and the following information is needed:
>
> Is there a phone in the room?
> Has the room been cleaned?
> Is there a bed in the room?
> Can the room be secured?
> Are linens available for the bed?
>
> Is the necessary support equipment available and in good working condition for this patient?

The answers to these questions plus others not mentioned all stem from the plant management area of control. The data tends to become part of the background noise of any hospital but is essential to the proper care and well being of the patient both mentally and physically.

C. RESOURCE MANAGEMENT

The tasks this functional area performs involve controlling the budget, manpower, and management improvement functions of the base medical service. The major elements

of these activities are: financial management (budget, accounting, fiscal analysis), manpower programs, management analysis, and medical service accounts.

1. Financial management interacts in the information flow by establishing monetary controls on the consumption of hospital services and goods. The values established for the goods and services are used to compile fiscal values which can be analysed for future long and short term bugetary needs.
2. Manpower Programs serve as the monitor that compares the reported workload factors with the authorized manning standards to determine, in coordination with supervisors, if adequate manpower resources are available for each work area. There are several other functional areas this work area performs but they are beyond the scope of this paper.
3. Management Analysis interacts with the information flow of the functional areas by developing metrics which measure work output, e.g., patient to bed ratio, patient to provider ratio, bed days to average bed days, etc. The measures are then translated into manhours, material, space, and the like to produce a measure of work. These data are then collected periodically into various management summary reports. The reports' generic classifications

are: workloads, costs, budget status, staffings, etc.

The following example is provided to demonstrate a more vivid picture of how this agency translates data elements into workable information within the MTF.

> SGT Garcia has been in the hospital for one week. He had been air evaced due to the nature and severity of the burns he sustained in an aircraft accident. Because his condition was non disease in origin he was classified as a casualty admit. During his stay he had to have a heart/respiratory monitor, which was rented from a local civilian hospital. Because he could not take fluids orally they were administered intravenously. His condition was so quarded that additional staff (2 nurses) were needed because there was not adequate space to accomodate his case in intensive care.

The biometrics that SGT Garcia's stay generated are: patient and casualty census count for week, month, quarter, year; expense equipment account reduced for rental machinery; and medical supplies (Expense Equipment are all items of medical and nonmedical equipment having a unit prices of less than $3,000). Also additional nurses were transfered from another department thus generating an AF Form 896 - Personnel Loaned and Borrowed by Cost Center. The saturation in the intensive care unit prompted a need for a manning increase requirement since it was determined that it was not an isolated incident. A check of equipment also revealed that heart/respiratory equipment owned by the hospital was at one hundred per cent capacity, thus budgeting was noti-

fied to increase the next fiscal years budget to accommodate the purchase of addition life support equipment. These metrics were all incorporated into various reports that were used to adjust budgeted projects, re-evaluate manpower needs, and provide development of plans to anticipate the future needs of the hospital.

D. ADMINISTRATIVE OFFICE

This office's basic function is to support all other areas of the hospital in an administrative capacity. The responsibilities include maintaining the regulations library, and reviewing local drafted regulations and distributing personnel rosters. Also they control public affairs, tours, travel orders preparation, and special commander's briefings. These types of functions do not contribute data into the information flow of the MTF but can capitalize from reports that are compiled from the information flow. Therefor no direct contributions could be determined from this area as it relates to the development of a hospital data base.

E. DIRECTORATE OF HOSPITAL SERVICES

The information that flows through this area of the MTF involves staff activities and those functions that pertain to patient care and the documentation thereof. A listing of the areas that may be involved are: credentialing, medical audits, antibiotic usage, utilization review, surgical case review, medical records review, pharmacy and therapeutics,

blood utilization review, morbidity-mortality review, etc. Since the scope of this area was too large for this project emphasis was given to scheduling rosters for the Medical Officer of the Day (MOD), physician retention, and special skills manning of the hospital. An example of this information flow is provided.

> Dr. Mengle has had to be MOD for the last three weekends. He is quite upset with the way his free time is not being considered. Since he has only a few months left on his service commitment date he has decided to look in the civilian community at what opportunities are available for his specialty - neurosurgery. In addition his license needs to be renewed in less than a month.

F. DEPARTMENT OF NURSING

This department is responsible for the managment of nursing services. This is no small task when one realizes that this service supports all areas involved in the care and treatment of patients. Because of time constraints and the change over of personnel the only areas discussed dealt with manning problems, special training requirements, and scheduling of technical nursing personnel to nursing activities based on skill asessment. A representative sample of how these activities work follows:

> Two months ago Captain X had his/her refresher training in cardial-pulmonary resusitation and gained his/her certification as a scrub nurse. He/she presently has an outdated job skill identifier and thus is working in the pediatric clinic.

WHY INTERVIEW

The major strength discovered about the interview process was the speed with which one could collect and reduce required data. However, the benefit of speed was offset by some inaccuracy due to the inexperience of the interviewer and the interviewing techniques employed. In fact it was discovered late in the collection process that a very simple DBMS example enhanced the quality of the data gleaned from interviews. Another hinderance encountered that must be planned for in interviews is the tight schedules which all too often conflict with data collection efforts.

To demonstrate how one recognizes a relationship and the data elements that it may contain, the following excerpt from an interview with a representative of Plant Management is presented:

> One of the problems I face in plant management is lost (keys) and the cost of changing (locks) for the :rooms: in the hospital :wards:. You see all the keys are numbered and correspond to a -lock which is numbered-. We -sign out the keys to :supervisors:- and due to the constant change of personnel some of the keys get lost or damaged and it becomes a laborious record-keeping task.

An inspection of the above response reveals not only the possible relations and data elements but also the graphic technique used during the interview to facilitate organization of the elements revealed.

From the excerpt two possible relations can be identi-

fied - WARD and SUPERVISOR . The reason they are initially identified as relations is that they are terms which "common sense" says are composed of many elements or discriptors. In contrast to the relations are the data elements - lock number, key number and room. They are atomic terms which either lend description to or lend some type of pertinent quality to a relation.

As mentioned previously graphic symbols were used to identify relations, attributes and functions. The symbols and their meaning are:

1) ( ) used for atomic elements.
2) : : used for relations.
3) - - used for function.

These symbols speeded up the interview process since they allowed for quick recognition of terms. This facilitated the restructuring of the interview to specific pieces of data that the functional area would profit in using as information.

RECORDS

Since the interview process may induce some inaccuracies in the information model, it was supplemented by a record analysis method. The records pertinent to the study proved to be readily available and little training or special skills were required by the data collector. It was found that the existing reports used within the hospital had distinct data elements that could be easily identified and

incorporated into the relations that emerged from interviews. However, it is necessary to point out that this process proved to be the most time consuming.

METHOD OF DOCUMENTATION

The key to making sure that the relations are worth using in a DBMS is the data audit trail. It must be simple and accurate. It must clearly define which functional areas share data. The following format is thought to have all the qualities, previously mentioned, necessary to document for a DBMS:

FUNCTIONAL AREA	RELATION	DATA ELEMENT	DEFINITION OR FUNCTION	SHARED BY
PLANT MGMNT	ROOMS	KEY#	SEE DATA DICTIONARY	SUPER-VISOR

Figure II-2. Documentation Record

The result of this process was twenty-five relations with over one hundred and fifty data elements. It must be stressed that throughout the evolution of the DBMS interviews and record audits must be and were confirmed by the users involved to ensure validity of the final product.

III. DISTILLING THE DATA

OVERVIEW

This chapter deals with the procedures used to organize and implement the information presented in Chapter 2 into a logical design. The procedures employed are not new, but are an adaptation of the Business Systems Planning (BSP) method.

BSP APPROACH

The BSP method originated with IBM for their own internal use, but due to customer demand was released as a general methodology. "The primal purpose of BSP is to identify the information necessary to run the organization. It is suggested the master development plan include resource requirements, but the principles and quidelines of the methodology are directed at information requirements." (Ref 5, p 157)

BSP is basically a two phase approach. The first phase develops a broad understanding and it identifies what information currently supports the organization. This in turn is decomposed into a network of information systems required to support the organization. Once the network is defined its subsystems are prioritized to facilitate implementation. The primary means used to reveal the data is the interview. Throughout this phase emphasis is given to the functional processes without regard for the organizational structure.

This approach tends to prevent a narrow view of the data.

> Because people are inclined to measure performance in terms of past experience, they tend to collect data that are meaningful in these terms. As a result their data becomes personalized, lose meaning to others and lead to a narrow view of the enterprise. (Ref 14, p 2-3)

Chapter 2 portrays this process.

The objective of the second phase is to develop a design that implements the network of information systems. From this approach modules can be constructed which will eventually evolve into a total information system for the organization. This is accomplished by assessing the deficiencies of current systems, identifying processes and users that share data along with functional access privileges. (Ref 5, p 157)

PROCESSES

In the previous chapter twenty (20) processes were exhibited in Figure II-1. Their purpose at that point in the development cycle was to produce a model of the information flow of the hospital. But this is not the only use they have. By associating them with the six (6) functional areas studied one can begin to get at the relations that will support a relatonal data base management system. To accomplish this linkage a matrix is used. In fact this is the first of several matrices that will be used throughout the relation development process. The reason why matrices are used is because they provide a convenient method to

analyze associations.

Before any matrix can be utilized for specified characteristics it will be necessary to give the process being examined as complete a description as possible. (This process will need to be periodically reviewed throughout the entire project to ensure the validity of the nomenclature.) The processes being considered along with their decriptions are listed in Table III-1 located on the next page.

The information to be gained from a functional area/process matrix analysis is a reduction of the processes and a prioritization of the pertinent processes. In addition it is anticipated that a grouping of processes would emerge that could be networked into an information system that would support the functional areas analyzed in this paper. Figure III-1 is this matrix.

Analysis of the matrix reveals that two (2) of the functional areas Plant Management and Administrative Office would not be major contributors to the information. This is apparent from the lack of entries in the matrix for these two areas. It is speculated that as much as fifty-one per cent of the data necessary to WPAFB-MC's information system can be identified. This figure is a ratio of filled squares verses total number in the matrix. Unfortunately confirmation of this assertion will only come when the total system is built. This matrix also reveals commonality of involvement and some idea of the extent of involvement. However the

1. ADMINISTRATIVE INFORMATION: information that is generated by the internal management structure to monitor the effectiveness of the hospital in meeting its defined goals. Some of the data collected is forwarded to higher headquarters.

2. ADMISSION DETAIL: register, initiate or locate medical records, assign assession number, transfer to ward or clinic

3. CURRENT ADMISSION DETAIL: specifics that relate to current circumstances of admission, that is, type of illness

4. EXPENDITURE: goods, services or funds consumed in the operation of the hospital as it provides care to patients

5. HIGHER HQTRS STATISTICS: data directed to be compiled for comparison purposes

6. INFORMATION: any inquiry concerning the status of a patient

7. OPERATIONAL REPORT OF DEPTARTMENT: rates of consumption of supplies or utilization of personnel

8. ORDER FOR SERVICE: medications, special diets, therapy, patient education, etc.

9. ORDER FOR SPECIAL TREATMENT/SERVICE: priority requests for medical tests and procedures

10. OCCUPANCY: physically in place in the hospital and utilizing personnel and equipment

11. PATIENT ACCOMODATON RATE: a set of predetermined fees to be assessed according to number of days in hospital and type of patient category

12. PATIENT ACCOUNT: a means for tracking cost of hospital care

13. PATIENT IDENTIFICATION: a unique way to identify patient, patient records, tests, procedures and accounts. Normally is a social security number + dependent code.

Table III-1(a). Process Listing

14. PATIENT MEDICAL HISTORY: information relating to patient's health status, usually obtained by medical personnel. It will also include observations, physical examinations, consults, and etc.

15. PERSONNEL ACCOUNTING INFORMATION: processing and maintaining individual personnel records related to professional skills and payment of employees

16. RESEARCH INFORMATION: investigations or experimentation aimed at validation or interpretation with reference to the nature, diagnosis, treatment and course of diseases

17. RESULT OF MEDICAL EXAMINATION: feed back from tests and interpretations of subjective physical examinations

18. SPECIAL SERVICES REQUESTED: prioritization given to patients that does not relate to medical need

19. SUMMARY OF SERVICES: a total of all hospital processes that relate to patient. Some may be considered standard, while others are modified for specific diagnostic or therapeutic purposes.

20. UPDATE OF PATIENT INFORMATION: results of a variety of hospital services that provide information relevent to the status of the patient

21. MEDICAL TRANSFER: any movement of an inpatient to another medical facility and the related paper work

22. CASUALTY: the processes related to admission for non microbial reasons

23. MEDICAL BOARDS: a special non treatment review conducted to determine status of patient

24. AIR EVAC: the movement of patients by military aircraft that has an attending physician

Table III-1(b). Process Listing

FUNC-TIONS	PROCESSES 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
A	/	X	X			X	/	/		/			/	/				/	/	X	X	X	/	X
B		/					/	/		X											/	/		/
C	/	/		X	X		X	/		/	X	X	/		/			/	X		/	/	/	/
D						/	/								/							/	/	/
E	X				/		X		/						X	X	/	/	/			/	X	
F		/	/				/	X	X	/			X	X	X	/	X	/		X	X	X	X	X

LEGEND

A) PATIENT B) PLANT MANGEMENT C) RESOURCE MANAGEMENT D) ADMIN. OFF.
E) DIRECTORATE OF HOSPITAL SERVICES
F) DEPARTMENT OF NURSING

THE "X" SYMBOL IS USED TO REPRESENT "MAJOR INVOLVEMENT IN PROCESS.
THE "/" SYMBOL IS USED TO REPRESENT "SOME INVOLVEMENT IN PROCESS.
A BLANK INDICATES NOT INVOLVED IN PROCESS BUT DOES NOT EXCLUDE SOME FUTURE INVOLVEMENT.
(NOTE: THERE ARE MORE THAN THE ORIGINAL TWENTY PROCESSES. THE ADDITIONAL PROCESSES RESULTED FROM INTERVIEWS SUBSEQUENT TO INITIAL INTERVIEWS COVERED IN PREVIOUS CHAPTER.)

Figure III-1. Function/Process Matrix

developer should not accept these findings as gospel until they are reviewed with the users for confirmation. Their confirmation or refute is essential to the building process of the logical design. Since several of the users did not feel the processes analyzed were applicable to their specific area they were (the users) requested to produce sketches that depicted how they thought their area affected information flow. (The reader is reminded that this step occured after the primary interviews were completed.) To facilitate this process it was recommended that they reference specific documents that flow through their area by origin, any manipulation and where the document went to next. As an additional input it was requested that the resources of materials, money, facilities and personnel serve as the backdrop they develop their sketches from. This approach was expected to yield additional processes that had not been identified previously. It did satisfy this goal. The additional processes identified were: medical transfer (21), casualty (22), medical boards (23) and air evac (24). To give the reader an idea of the simplicity of the sketches Figure III-2 is provided.

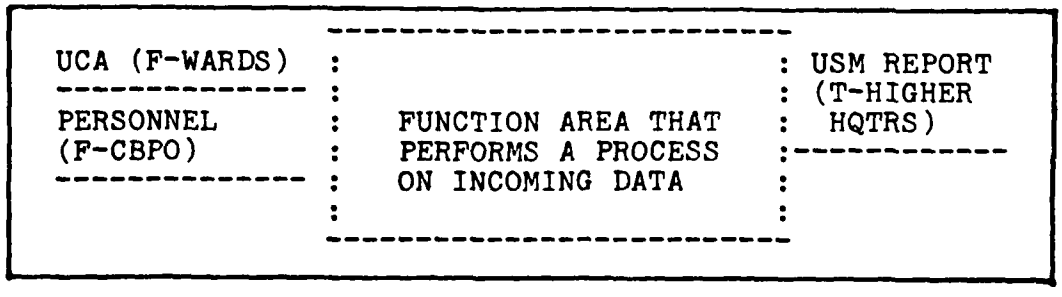


Figure III-2. Sample of Process Sketches

Since additional processes were uncovered it was necessary to repeat the functional area/process matrix along with a review by the users. It is stressed that this procedure should be repeated until the users are confortable with the associations depicted. This establishment of process identity and connectivity provides constraints necessary in developing a logical design.

DATA ANALYSIS

The next step in building this data base system is identifying the data created, controlled and used by the processes made known in the previous section. The majority of data elements have already been identified. This was accomplished using techniques presented in the previous chapter. Since the volume of data elements is too big to manipulate in a matrix, it was necessary to reduce the data into specific types. Once the unwieldiness of the data was overcome it was possible to relate the data types to the process in a matrix.

The categories used in this paper are: personal data, time related data, identifier data, statistical data, non personal data and logic control data. The meanings attached to these data types are:

PERSONAL DATA - data that describes and/or gives value to humans. (e.g., street, city, zip, state, sex, etc.)

TIME RELATED DATA - data that reflects a means of tracking time. (e.g., date, st:time, stp:time, etc.)

IDENTIFIER DATA - data that possesses a possible unique quality. (e.g., ssan, key#, id#, room#, etc.)

STATISTICAl DATA - data that reflects a history or a summary. (e.g., prev:bed:dys, prev:qtr:dys, #air:in, etc.)

NON-PERSONAL DATA - data that relates to facilities and machinery. (e.g., #beds, #rm, civ:mtf, phone, etc.)

LOGICAL CONTROL DATA - data that is tracked by a yes no or on off response. (e.g., avail:bed, blck:bed, xray:req, rec:req, etc.)

It must be stressed to the reader that the meanings attached to these categories as well as the categories are not the only ones possible. They are presented to demonstrate how this data base was developed and to give the reader a method for analyzing data. But no matter what categories and meanings are chosen it is recommended that the categories be restricted to seven (7) or less for ease of control.

Once the categories are identified and the data elements grouped another matrix can be constructed. This is a category/process matrix (Figure III-3). The information gained from this matrix is the identification of data that is shared by the processes, hat is unique to a process and that could have future uses in an information process. As an added mode to gain a better understanding of the data categories and processes, entries in the matrix should be in the letters 'C' and 'U' to indicate which processes create the data and which use it. The results of this method are:

CATE-GORY	PROCESSES 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
A		C	C						U					C		C	C	C	U	C		C	U	
B	C	C		U				C	C	U	C	U			U		C	C	U	C	U		U	
C	C		C			U				U		U	C		U			C	U		U			C
D				C	U						U			C					U	C			U	
E	C						C								U				U					C
F		U			U				U	U									U		U			C

LEGEND

A) PERSONAL DATA B) TIME RELATED DATA C) IDENTIFIER DATA D) STAT. DATA
E) NON PERSONAL DATA F) LOGICAL DATA

THE SYMBOL "C" IS USED TO REPRESENT THAT THE DATA IS CREATED BY THE PROCESS AND THE SYMBOL "U" IS USED TO REPRESENT THAT THE DATA IS USED BY THE PROCESS.

(NOTE: THERE ARE MORE THAN THE ORIGINAL TWENTY PROCESSES. THE ADDITIONAL PROCESSES RESULTED FROM INTERVIEWS SUBSEQUENT TO INITIAL INTERVIEWS COVERED IN PREVIOUS CHAPTER.)

Figure III-3. Category/Process Matrix

identification of duplicated data, potential access procedures, and data groupings for relations. To confirm interpretations found in the category/process matrix another matrix was constructed. This matrix was a functional area/category matrix (Figure III-4). The intent behind this process is to lend credence to the shared data findings; it does not confirm them. The findings were as expected since a confirmation would emerge only when the total system is implemented and users become familiar with the DBMS and its potential uses. (Ref 14, p 154)

However, the information gained from the previous process is too much to begin developing relations. To overcome this problem it was necessary to segment the data. The operation used to break the data up involved rearranging and grouping the twenty-four processes into subsystem types. The types used in this paper are: subsystems that create data without using other subsystems, subsystems that create data using other subsystems and subsystems that are user only. The catalyst used was an association between the processes and the following resources: materials, facilities, personnel and money. When the matrix (Figure III-5) for this regrouping is constructed the various subsystems emerge. How easily these groupings are recognized is dependent on how thorough an understanding you have of the hospital processes and the data required to support them.

What was found was the following: ADMINISTRATIVE INFOR-

FUNCTIONS	CATEGORY: PERSONAL DATA	TIME REL. DATA	IDENT. DATA	STAT. DATA	NON PER. DATA	LOGICAL DATA
A	C	C	U	C	U	U
B			C		C	
C		U	C	C	U	U
D	U			U		
E	U	U	C	U		
F		C	U		U	C

LEGEND

A) PATIENT AFFAIRS B) PLANT MANAGEMENT C) RESOURCE MANAGEMENT D) ADMIN. OFF.
E) DIRECTORATE OF HOSP. SRVC.
F) DEPARTMENT OF NURSING

THE SYMBOL "C" IS USED TO REPRESENT THAT THE DATA IS CREATED BY THE PROCESS AND THE SYMBOL "U" IS USED TO REPRESENT THAT THE DATA IS USED BY THE PROCESS.

Figure III-4. Functional/Category Matrix

CATEGORY	PROCESSES																							
	3	20	2	17	14	23	1	21	6	9	18	19	8	10	4	7	15	12	11	13	24	16	22	5
A	C	C	C	C	C	U				U	C	U	C									C	C	
B	C	C	C	C		U	C	U		C	C	U		U	U		U	U	C					
C							C	U	U		C	U		U			U	U		C	C			
D		C			C	U						U			C									U
E							C					U				C								
F			U									U												U

LEGEND

A) TIME RELATED DATA B) STATISTICAL DATA C) LOGICAL DATA D) NON PER. DATA
E) IDENTIFIER DATA F) PERSONAL DATA

THE SYMBOL "C" IS USED TO REPRESENT THAT THE DATA IS CREATED BY THE PROCESS AND THE SYMBOL "U" IS USED TO REPRESENT THAT THE DATA IS USED BY THE PROCESS.

(NOTE: THERE ARE MORE THAN THE ORIGINAL TWENTY PROCESSES. THE ADDITIONAL PROCESSES RESULTED FROM INTERVIEWS SUBSEQUENT TO INITIAL INTERVIEWS COVERED IN PREVIOUS CHAPTER.)

Figure III-5. Subsystem Matrix

MATION, EXPENDITURE, CASUALTY and AIR EVAC were independent data subsystems, the areas blocked by rectangles are dependent data subsystems and no user data subsystems were found. Thus by starting with the independent systems and then the dependent the relation development was easier.

Since the preceeding matrices resolved the questions of redundancy and of which areas to begin examining for relations, the data elements were put into a data dictionary. These data dictionary entries were made as complete as possible to reduce confusion if modifications to the system became necessary.

KEYS

The next step in the development process of a logical design for WPAFB-MC involves identification of key data elements that uniquely identify a particular and distinct grouping of data elements.

> Keys are data elements used throughout the organization to identify objects, create other data, or reference other data. There are two types of keys:
>
> > Unique keys are data elements that identify a particular and distinct thing or object (e.g., social security number, order number, customer number, etc.)
> >
> > Nonunique keys (composite key) are collections of data elements, unique in their use, that receive their identity through two or more unique keys (e.g., an inventory that is identified through the unique keys, item number, and warehouse location.) (Ref 3, p 274)

These keys usually exist in the content data elements. The term "content data elements" is used in the following context: data elements that are commonly identified with a process. This determination process of key data elements has been expedited by the category procedure employed in reducing the data elements. The category "Identifier Data" lists the primary choices. Capitalizing on this listing coupled with a little 'common sense' key data elements are found existing within most of the content data groupings. However, in some cases, it is difficult or inconvenient to use available attributes as the entity identifier. What is done is to create an artificial attribute which can positively identify the content data. Examples are "SSAN", "ROOM#", "BED#" and "WARD#".

The results of all the preceding procedures is a successful division of the data into logical groupings. These groupings allow for simultaneous use of certain content data items which have the same key in the established operational scheme. Thus a reduction in the number of information items manipulated is realized by considering only groups of fields. This is a considerable savings when the manipulation that is involved in a hospital information system could involve several thousand data fields. (Ref 19, p141)

An example of a logical grouping is:

PROVIDERS: SSAN,PROV#, SPEC-CODE, CLINIC#

THIRD NORMAL FORM

Even though the data has successfully been divided there are still problems in its composition. These problems can be grouped into three general types: insertion, deletion, and update. To overcome these problems the process of converting the data to "third normal form" (3NF) is employed.

"Before defining third normal form (3NF), we need a preliminary definition for a 'prime attribute'. An attribute A in relation scheme R is a prime attribute if A is a member of any key for R (there may be many keys). If A is not a member of any key, then a is nonprime." (Ref 21, p 235)

A formal definition of 3NF is: "A relation scheme R is in 3NF form if and only if there does not exist a key X for R, a set of attributes Y $\subseteq$ R, and a nonprime attribute A of R not in X or Y, such that

1. X-to-Y holds in R,
2. Y-to-A holds in R, but
3. Y-to-X does not hold in R.

If Y is a subset of X, and therefore by (3), Y is a proper subset of X, then R is said to have a partial dependency. If Y is not a subset of X, then R has a transitive dependency. If R satisfies the above condition whenever Y $\subseteq$ X, but not necessarily otherwise, then R is said to be in second normal form." (Ref 21, p 187)

To show how the logical examples are transformed to 3NF the following specimens are provided:

PROVIDER: (SSAN, PROV#, SPEC-CODE, CLINIC#)

becomes

1. PROVIDERS: (SSAN, PROV#)
2. PROVIDERS-SPECIALTY: (PROV#, SPEC-CODE)
3. PROVIDER-CLINIC: (PROV#, CLINIC#)

The final product develped after putting into 3NF is in the appendix. A graphic representation of the logical design is also provided in Figure III-6.

SAMPLES OF DATABASE USE

To demonstrate how information is extracted from the relational model developed in this paper three examples are provided. This degree of inquiry ranges from the simple one relation query to a multiple relation query. (Note: In the following queries pseudo code is used to represent how information is extracted from the data base.)

Example One:

The Inspector General Team (IG) representative is conducting a spot check of rooms. He wants to know when the last inspection was done on rooms 10, 30, 100. To accomplish this task one could refer to a log book for the information or the DBMS could be queried in the following way:

```
Use the relation "Rooms"
Select records with room numbers of:
"10", "30", "100".
```

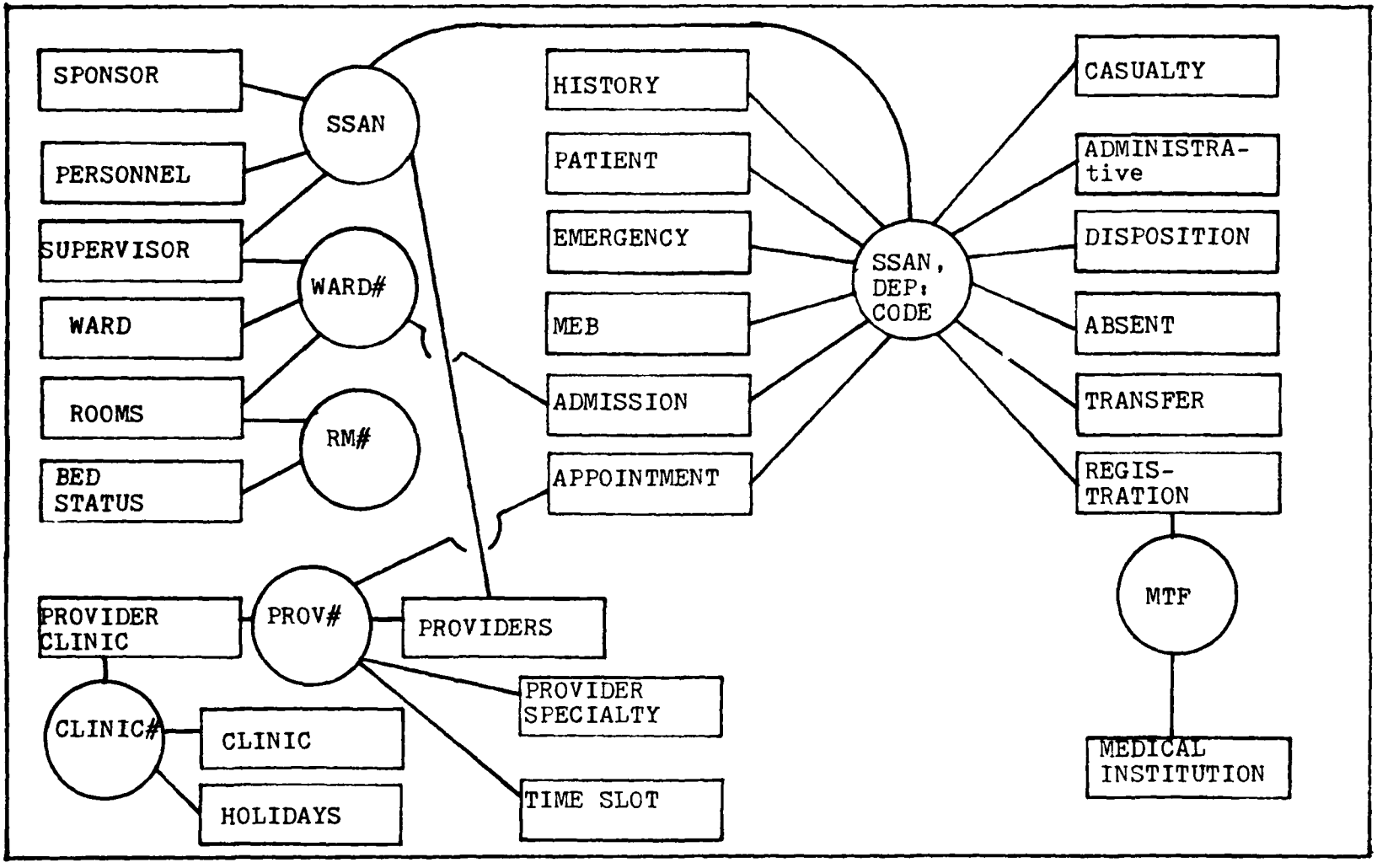


Figure III-6. Most Frequent Access Paths

Project out "insp:date".

The results would be the dates of inspection.

Example Two:

Suppose the same inspector now asks for the number of beds on Ward "3" , a Burn Center, that are available right now. His reason is a simulation of an aircraft accident in which six crew members have severe burns which need immediate care. The reason for the urgency is that the aircraft transporting the victims has damaged landing gear and can make only one landing and WPAFB-MC is the closest hospital. This type of query can be answered by conventional systems but not as quickly as a DBMS could. The DBMS could be queried in the following way:

```
Use relations "Rooms" and "Bed Status".
Select from "Rooms" where ward# = '3'.
Join the result with "Bed Status".
Select where avail:bed = "yes".
```

Example Three:

Doctor X calls in sick. He is not sure what his schedule was for this day. He provides his social security number since that will help locate information on how to deal with his absence.

```
Select from "Providers" where ssan = Dr. X's.
This gives his provider#.
Select from "Providers-Specialty" where prov#
= Dr. X's.
This gives his spec:code.
Select from "Provider-Clinic" where prov#
= Dr. X's.
This yields a list of clinics to notify that
Dr. X will not be in.
```

Select from "Appointment" where prov# and date = Dr. X's and today's date.
Select from "Provider-Specialty" where spec:code = Dr. X's.
If any doctor is on staff that has Dr. X's specialty the appointments can be reworked.
If no alternates are found then the following is necessary:
Join the list of appointments and "Patient" where ssan + dep:code match.
This will give the phone numbers to call for a reschedule.

Select from "Administrative" where prov#(attn:phy) = Dr. X's.
This will give a list of ssan-dep:code and ward#s that Dr. X is the attending physcian.
Join list of ward#s with "Ward".
This gives the supervisor:ssan for that ward.
Join list of supervisors' ssans with "Personnel".
This gives the duty phone of the supervisors to notify that Dr. X will not be in.

Summary of Process

This chapter has presented a method for organizing data into a relational information system that will support WPAFB-MC. All the processes presented involved using associations that exist when data is grouped by resources and specified processes. Matrices were employed to make the associations easier to identify. As each process is completed the system developer obtains a clearer idea of how to begin organizing data into logical groupings which are in at least 3NF.

IV. IMPLEMENTATION PLAN

OVERVIEW

The entire process for developing a DBMS is useless unless some type of overall plan is made available for implementation. Such a plan has been developed as a result of callaboration with Mr Raymond E. Girard, Chief, Medical Computer Systems Office, WPAFB-MC. This plan outlines the time process/sequence for implementation. What follows is the Purpose, Scope, Coordination and Documentation, and Responsibility descriptions of the plan.

PURPOSE

As stated before, the purpose of this plan is to provide general guidance and information for those Medical Treatment Facilities (MTF) that choose to implement the WPAFB-MC DBMS. This plan sets forth the procedures to be used in the conversion, implementation and evaluation of the DBMS. This plan also outlines procedures to determine the adequacy of hardware and software resources, functional procedures and documentation of the system.

SCOPE

This plan's guidance will pertain to the actions to be accomplished by the MTF. However, its scope is applicable to liason organizations such as Civil Engineering, the Base Data Processing Installation (DPI), Procurement, Communications, Major Command Headquarters, and the TRIMIS Program

Management Office. This document will outline the criteria and procedures associated with the successful implementation of the functional system. There is no intent to task other agencies, only the implementing MTF. The responsibilities involving other agencies should be derived by mutual agreement of representatives of those agencies.

COORDINATION AND DOCUMENTATION

Mr Girard's experience in computer systems has shown that the implementation of a DBMS within any MTF constitutes a significant amount of work. Many of the tasks associated with this implementation are frequently understated or grossly underestimated due to the MFTs' inexperience with implementing automated systems. The implementation of an information system requires precise management planning because of its impact throughout the MTF. Besides the physical and technical problems associated with a systems implementation there are many people problems (e.g., combatting resistance to change) that must be solved. There can not be too much emphasis placed on human factors and precise workflow and methods engineering. Paralleling the human factors problem is the need to work with other organizations. It will be necessary to gain and maintain technical assistance from various local organizations such as the local DPI and Civil Engineering as well as to assure support from higher commands and the responsible vendor.

Although certain time guidelines are provided within

this plan, it will be necessary to use personal experience to alter lead times as appropriate. It is essential that memoranda and documentation of all actions taken during the implementation are kept. This will serve to improve understanding among the individual organizations and units of responsibility.

It must be kept in mind that this plan should be supplemented by portions of regulations within each service that apply to data automation implementation. An example of this is Annex 7 and 9 from AFM 300-6 which provides management and implementation checklists.

RESPONSIBILITY

To ensure the success of this undertaking it is necessary that the commander of the MTF have overall responsibility for local implementation of this plan through his/her appointed project officer. The commander should take appropriate action to assure the efficient accomplishment of the implementation plan by his subordinate staff.

A. MTF DBMS Project Officer will:

(1) Serve as the primary DBMS project office and coordinator of all activities relating to the implementation of DBMS.

(2) Provide to the Equipment Control Office (ECO), of the DPI, sufficient documentation to accept or reject the DBMS hardware and software.

B. Directorate Hospital Services (SGH): As primary user of the DBMS capability, provides personnel and management resources required to accomplish the day to day operation of the DBMS.

C. Data Processing Department:

(1) Provide to the Equipment Control Officer, certification of acceptability/non-acceptability of DBMS software and supporting documentation.

(2) Provide guidance to the appropriate command on all facets pertinent to implementation.

(3) Evaluate acceptance data and accept or reject hardware and software.

(4) Act as primary contact with the vendor representatives for contractual matters as specified by AFM 300-6.

D. Command Data Automation:

(1) Advise and assist in determination of the suitability of contractor provided data processing equipment (DPE) configuration management.

(2) Assist MTF and computer operations personnel in interpreting and conforming with the provisions of appropriate regulations.

E. All above named organizations will: provide representation at the daily acceptance test meetings.

The actual plan is provided in Annexes A-F. (Note: '+'

symbol is used to delineate days after actual implementation of the DBMS and '-' symbol is used to delineate days prior to completion of the DBMS.)

V. DBMS CAUSES A NEW STRUCTURE

OVERVIEW

This chapter presents evidence to the reader of the necessity to have the WPAFB-MC's Data Processing Department (DP) more prominent in the command structure. The reality of this change is brought about by the emergence of a data base management system coupled with the predictable economic maturation an enterprise (civilian or military) will experience in a computer environment. Areas covered which depict the structure, growth and management change are: The DBA - Its Structure & Purpose, Technique To Determine Growth And Its Link To Management, and finally a Prudential Approach By Management.

THE DBA - ITS STRUCTURE AND PURPOSE

Inherent to any attempt to convince anyone of the need for change is the requirement to establish a common starting point. This point became quite obvious in discussions with the TRIMIS office's representatives as well as with non-computer-literate managers within the administrative sections of WPAFB-MC. There seemed to be a lack of understanding of what a data base management system did and why it would need a Data Base Administrator (DBA). In fact the two questions most uttered were: "What is a data base management system?" and "What is a Data Base Administrator?" The first of these two questions was covered and demon-

strated in chapters two and three. The latter will be covered in this chapter.

A DBA is not necessarily a single person, (as the name seems to imply) but a function which is created, organized, and staffed to manage the data 'resource'. (Ref 14, p 121) In the case of WPAFB-MC a DBA function would have to be sustained by several specialized support areas. These areas would involve a Software Expert, Application and Systems Specialist and a Data Base Technical Specialist. What each of these positions does is dependent on the different stages of the data base development process. Atre has distinquished these development stages into six levels. These areas are:

1. Design Phase
2. Physical creation of the data base.
3. Conversion of the existing data sets and applications to match the newly created data base.
4. Integration of the converted applications and of the new applications into the data base.
5. Operational phase.
6. Growth, change and maintenance phase.

(Ref 2, p 53)

Responsibilities of Sections

A. Software Expert. The Software Expert is responsible for insuring that documentation and develpment of programs is done. This person in this position must be able to determine what impacts programming styles will have on memory use as well as retrieval times. In addition he/she must evaluate the credibility of backup, recovery, security,

and privacy procedures.

B. Applications and Systems Specialist. This is the functional expert who can translate and develop the logical structures of individual departments in an organization into a physical structure within the computer's data base. In addition this position serves as support to the software expert in performance characteristics of the DBMS. Such support would be: checking for security, privacy and access control violations.

C. Data Base Technical Specialist. This area would encompass the communication mechanisms. That is maintaining a data dictionary/directory system, maintaining ancillary records, as well as coordinating all meetings involving the different functions in the data base environment.

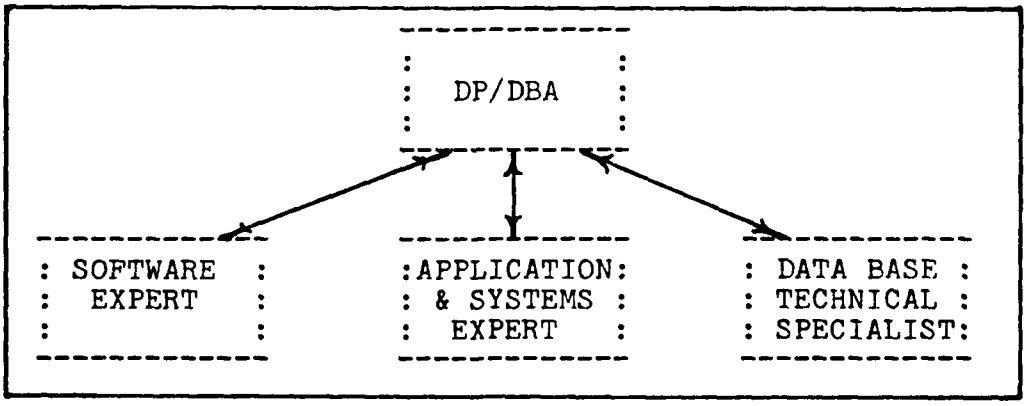


Figure V-1. Schematic of DBA Sections

The aforementioned three areas' responsibilities would be in part and/or entirety throughout all levels of the DBMS development.

To coordinate and manage these functional areas it is

necessary to incorporate them under the DP/DBA. This will ensure that standards will be set for accomplishing successful and efficient use of the data and its supportive function to the hospital.

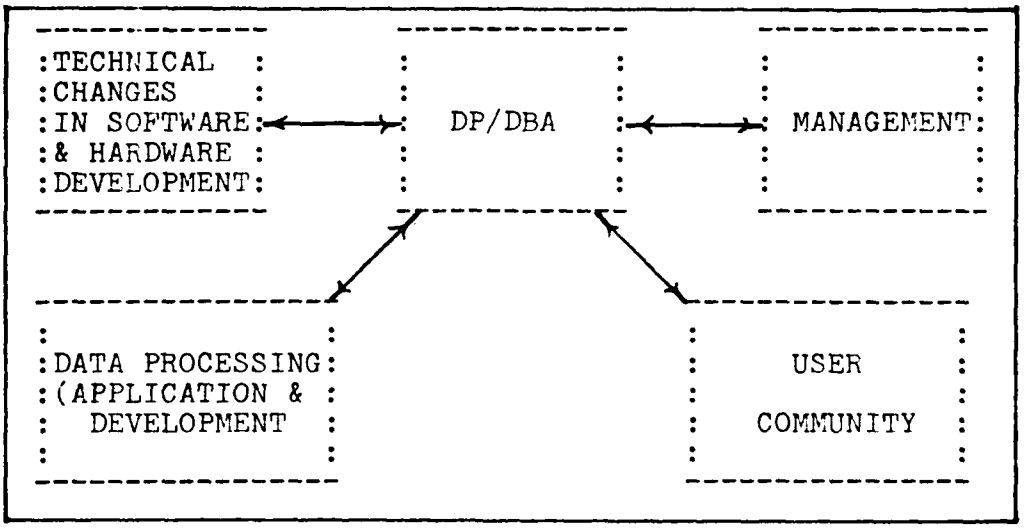


Figure V-2. Linking of DP/DBA to Management

MODEL WHICH LINKS MATURATION PROCESS OF DP TO MANAGEMENT

As the data base grows it will establish links with all functions of the hospital. This in turn means that the DP center will become a significant part of the hospital's operations. Because of this evident trend there is a need to predict when the DP department reaches a point where the data resource moves to a front-and-center position. It would become recognized as an essential asset to the hospital, and thus critical to fulfilling the directed goal of the best quality medical care possible. (Ref 11, p 19)

Gibson and Nolan did extensive research in this area of DP growth as it relates to management. Their investigations

revealed that DP budgets could be used to predict maturation of the DP environment as it relates to management.

> Although the cost of hardware on a per-unit basis is declining, total data processing costs continue to increase dramatically. From 1970 - 1978, aggregate United States data processing budgets rose almost two and one-half times from a total of $17 billion 1970 to $42 billion 1978. This trend is expected to continue in the 1980's. Aggregate spending for data processing is expected to top $78 billion in 1983 - almost double the amount spent in 1978 (International Data Corporation, 1980). This means that, as more and more corporate applications are put on the computer, the DP is managing a larger budget and the data center is becoming a very visible part of corporate operatons. (Ref 11, p 24)

This approach is most fortuitous when discussing with management the level of support that the DP needs to effectively perform its job, because it provides a common ground for both sides.

It is this common ground which prevents the all too often occurence of the following stereotypic views.

> From the viewpoint of the executive vice president:
> "The DP manager always waffles around when he has to explain his area."
> From the view point of the DP manager:
> "The excutive vice president never seems to understand what the department can do." (Ref 16, p 76)

Nolan's research revealed that there are six stages of growth from inception of the DP center to maturity. These stages are:

1. INITIATION
2. CONTAGION
3. CONTROL
4. INTEGRATION
5. DATA ADMINISTRATION
6. MATURITY (Ref 16, p 117)

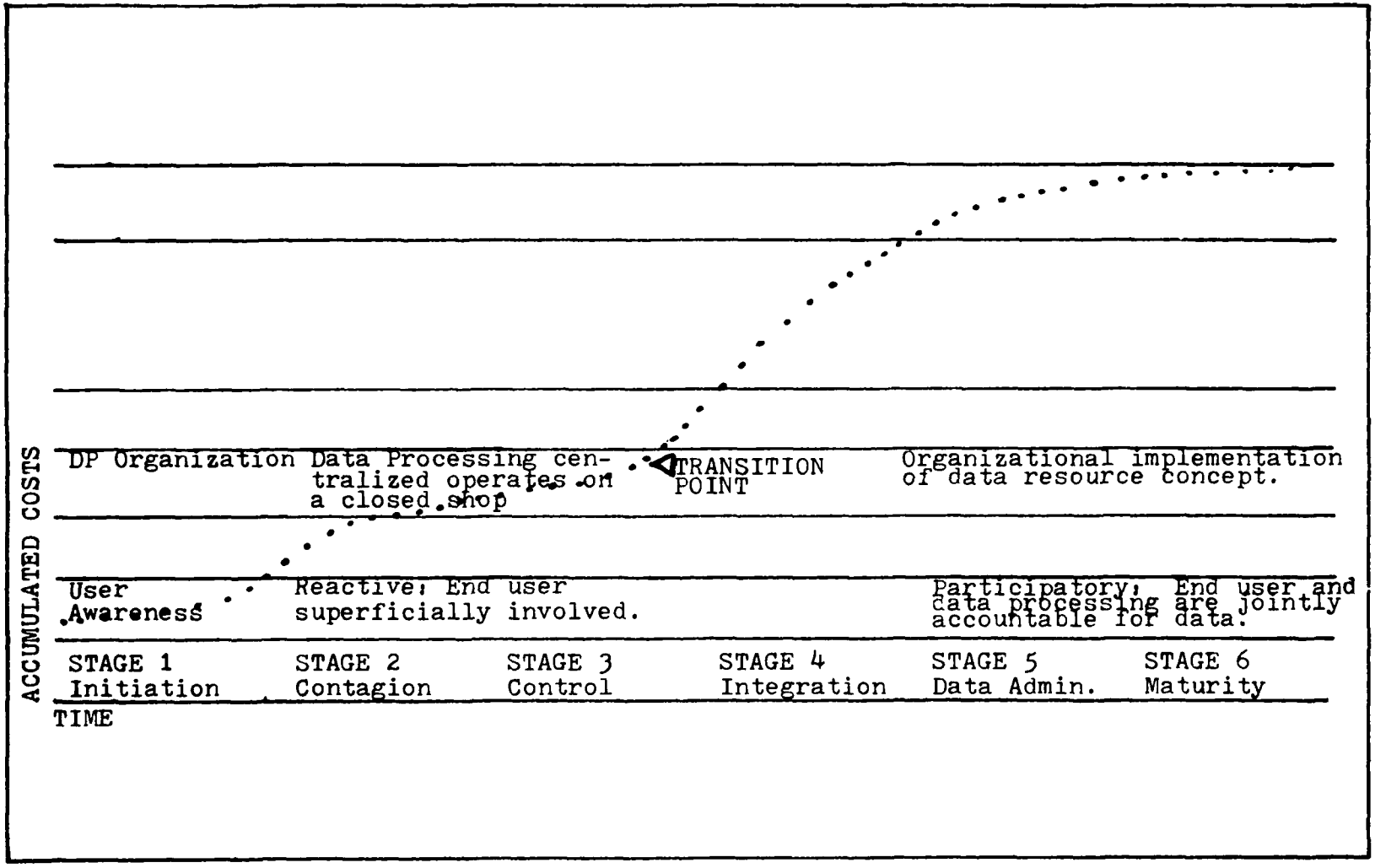
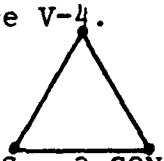


Figure V-3. Growth Stages of a DP Center
(Ref 16)

These stages are depicted graphically in Figure V-3 reproduced from Nolan's article in Harvard Business Review, Apr-May '79.

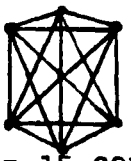
Nolan's view is that the basis for these stages of organizational fit can be determined from a graph using DP budget versus time from initial investment to mature operation. "The graph produced forms an 'S' shaped curve (refer to Figure V-3). The turnings of the curve correspond to the main events -often crisis- in the life of the DP function that signal important shifts in the way the computer resource is used and managed." (Ref 11, p 78)

Before using the findings and predictions this graph provides as it relates to WPAFB-MC, it is necessary to examine how a DP center grows. The types of growth usually are in the form of new equipment, specialization of personnel, management techniques and organizations, and software applications. This is important for management to note especially when one considers that as you add to a system its complexity increases. A graphic demonstration of this concept is provided in Figure V-4.



3 NODES = 3 CONNECTORS

4 NODES = 6 CONNECTORS



6 NODES = 15 CONNECTORS

Figure V-4. Graphic Demonstration of Growth

From the point provided by the figure coupled with an examination of prevailing conditions in WPAFB-MC's DP department one can easily perceive that a transition between stage two and three is transpiring. This is a critical point in the evolution of the DP function within the hospitals information support structure. The gravity of the situation is best characterized by the following:

> Stage 2 is a period of contagious and unplanned growth, characterized by growing responsibilities for the DP director, loose (usually decentralized) organization of the DP facility, and few explicit means of setting project priorities or crystallizing plans. (Ref 11, p 81)

The next stage of development is considered by many as a transition stage. The DP center no longer is dealing with cost-reduction of applicatons of specialized use. The emphasis turns toward integrating the functions into DBMS and development of projects aimed at improving operations and the quality of unprogrammed and strategic decisions. The influence of the computer will be felt throughout the organization at all levels. (Ref 11, p 85)

A PRUDENTIAL APPROACH BY HOSPITAL MANAGEMENT

As presented in the previous section the DP center is predicted to be on the verge of a dramatic change in its function and character. In fact one would expect the DP centers in all military hospitals to experience the same growing pains that WPAFB-MC is beginning to have. But, what is this new function and character that will begin emerging

at WPAFB-MC? It is the transition from computer management to that of data resource management.

> With the introduction of data base transition in stage 3, an important shift in emphasis goes from managing the computer to managing the company's data resources. Obviously, this transistion does not occur all at once. It appears first in the analysis of the late stage 2 applications portions and as a result of the requirements to restructure so all of the applications can be tied together efficiently.
>
> The transition also becomes apparent during the implementation of controls. Difficulties with charge-out systems that are computer-oriented start management searches for alternative ways to achieve user accountability. This often leads to the conclusion that the user can be accountable for the functional support, but data processing must be accountable for management of shared data.
>
> The key idea is to recognize the importance the shift in management emphasis from the computer to data and then to develop application and planning and control systems to facilitate the transition. Applications should be structured to share the data; new planning and control should be data-oriented. (Ref 16, p 124)

It is on this last part of the above quote that the key to meeting WPAFB-MC's mission is identified, and that is the need to shift managements emphasis to the data and more authority to the DP manager. This additional authority would increase the DP's participation in hospital planning. It would give added perspective to other managers of the importance data processing has to the hospital in meeting its defined needs now and in the future. (Ref 23, p 204)

The type of support being suggested should come from the position within the hospital which has the most to gain from effective and efficient use of the data. This position is that of the hospital commander.

According to AFR 168-4 the commander of the hospital has direct responsibility for the following areas: Directorate Aerospace Medicine, Directorate Physiological Training, Directorate Hospital Services, Directorate Veterinary Services, Directorate Dental Services, and Directorate Medical Education. Because these areas are becoming more dependent on computer support to maintain their quality of care, involvement by the DP director will be necessary. Therefore the DP center can no longer be considered a support function. It should be thought more in terms of a planning function.

> The recognition of the DP as a line (planning) function is also a realization by users and management that the DP and staff and the computer are indispensable to the company's/hospital's operation and that the computer manager should rightly be included in the planning for the company/hospital. (Ref 14, p 39)

With this new channel of support the DP manager will be able to "understand how current actions will affect both the solution of current problems and the accomplishment of goals for the future." (Ref 14, p 21) This is especially true when the proposed data base becomes a reality.

> ... a power whereby its applications can affect the strategy and structure of

> the company as a whole. In a company where a working data base can be used to back up the corporate planning process, for example, corporate planning assumes a somewhat different shape from what it does in a company that has no such data base available. This is clearly a point at which a person at the vice-presidential level (or even the presidential level) must accept responsiblity for dirrecting the evolution of the resource. (Ref 11, p 85)

This channel of authority is also necessary to overcome the natural political issues that will surface. Political issues in this case are: users losing personal control over their data, trade-offs as to what data elements need to be in the data base, and the fear of managers losing some authority by acquiescing to the data base for decision basing ability.

> For, from a behavioral perspective, political issues dominate at this time as never before. Managers throughout the company now see that the applications coming through the pipeline may affect their own roles directly. In the past it was their subordinates who were most affected, and it was largely their own decisions to approve or not approve a project, but now a given application may be supported from above and may impinge on their established patterns of work, their decision making, and even their ideas about what it is they do for a living.
>
> Because of the nature of his dilemma, he is bound to come under fire from the users-either for allowing parts of his department to obsolesce, in the name of stability or for introducing change, in the name of progress and the state of the art. His relationship and communications with the top must be sound enough to allow him to weather the inevitable storms given, of course, that the balance

> he strikes between stability and change is indeed reasonable in broad outline.
>
> With long-term support from the top founded in such a basis, the MIS manager is in a position to legislate policies internally that will exploit the computer as fully as possible.
> (Ref 11, pp 85 & 87)

From the evidence it is easy to see that the DP center is about to under-go a metamorphosis that will enhance managements decision capablities. But this is only possible if management heeds the premises presented and gives way to the idea of incorporating the DP center into a directorate reporting to the hospital commander.

> "Science is nothing but trained and organized common sense, differing from the latter only as a veteran may differ from a raw recruit: and its methods differ from those of common sense only as far as the guardsman's cut and thrust differ from the manner in which a savage wields his club."
>
> Thomas Henry Huxley, 1825-1895
> Collected Essays

VI. CONCLUSIONS AND RECOMMENDATIONS

OVERVIEW

The previous chapters have demonstrated that a portion of WPAFB-MC's information needs can be supported by a relational data base. In addition a method for accomplishing such a structure was illustrated. Because of these factors it would be possible, in the future, to employ this approach to create a total hospital information system. WPAFB-MC could exhibit its desire to meet future mission needs along with demonstrating leadership among MTFs by continuing the process until the total system is developed.

Conclusions

It is felt that the relational data base would benefit the hospital because it would reduce needless duplication of data. It is also believed that such a system would improve reliability of information, decrease the need for additional manpower slots and allow for better control of personnel, equipment and budgets.

If follow on theses are pursued via a module approach large expenditures for independent contractors could be reduced and thus lessen a portion of TRIMIS' yearly budget. A final point is that a relational hospital information system could support TRIMIS requirements and have the added feature of being tailored to the unique work characteristics

of the MTF through the addition of supplemental attributes. (Ref 25)

Recommendations

It is recommended that the TRIMIS office support WPAFB-MC and AFIT by sponsoring a follow on team (2) thesis that would develop a Laboratory - Pharmacy Module and an Accounting - Logistics Module. It is suggested that at least one team member have DBA experience and both members have course work in EE 646 - Computer Database Systems and MA 746 - Advanced Database Management Systems. In addition, as each module is built it should be implemented and run parallel with existing TRIMIS programs. This will allow for evaluation of the effectiveness of a relational data base.

Since the TRIMIS office was unable to provide inputs as to the type of DBMS they would prefer (this is due to confidentiality rules governing ongoing contract negotiations) and the lack of commonality of hardware, no recommendations are made as to type of existing DBMS to use. However, it is strongly suggested that a currently existing commercial system be used rather than in house development.

Final recommendations are: that AFIT and TRIMIS establish closer ties. TRIMIS should upgrade some of their 51XX slots to masters' level, and task the Military Personnel Center (MPC) for AFIT inputs. This approach would provide the expertise in computers that is essential to TRIMIS effectively meeting its goals.

Summary

The intent of this thesis was to develop a detailed method for specifying, implementing and demonstrating a conceptual model of the administrative portion of WPAFB-MC. It has accomplished that end. The schema's design has been developed in a style that can be generalized to other areas of the hospital so as to cultivate a total hospital information system. The challenge that remains is to complete the process.

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Appendix A

MANAGEMENT/ADMINISTRATION

1. Analyze existing information systems (-485).
2. Appoint DBMS project officer (-485).
3. Develop general mission guidelines (-455).
4. Appoint hospital data base manager (-425).
5. Begin hospital data base conversion (-330).
6. Establish liaison with local DPI management (-300).
7. Collect cost benefit analysis baseline data (pre-implementation) (-180).
8. Develop acceptance test plan (-150).
9. Develop cost benefit analysis measurement criteria (-150).
10. Determine if acquired documentaton is adequate (-120).
11. Develop parallel operation/fallback posture (-120).
12. Prepare disaster/emergency/fire/safety plans (-90).
13. Develop data security/privacy/medical ethics policy (-90).
14. Prepare operations schedule and product control/distribution plan (-90).
15. Prepare initial operating instructions (-60).
16. Review of acceptance test plan with vendor (-60).
17. Perform hospital DBMS verification in simulated mode (-60).
18. Develop recovery storage procedure (-45).
19. Develop discipline for receipt of software changes (-45).
20. Arrange Principal Period of Maintenance/Preventive Maintenance/Remedial Maintenance Schedules and specify problem reporting channels (-45).

21. Arrange fire/safety inspection (-30).

22. Establish master contacts roster (-30).

23. Specify acceptance test meeting schedule and format (-30).

24. Hardware installation (-30).

25. Hardware integration (-10). *

26. Software integration (-10).

27. Begin acceptance test (D-Day).

28. Functional validation (+10).

29. Hardware certification (+30). *

30. Software certification (+30).

31. Collect baseline data (post-implementation) (+120).

32. Cost benefit analysis (begin Phase I) (+180).

*(The references to hardware need only apply if new equipment is necessary to implement DBMS or if none exists.)

IMPLEMENTATION SCHEDULE
of
MANAGEMENT/ADMINISTRATION

A.1. Analyze existing data base information system.

Analyze existing hospital procedures to determine their inter and intra information requests. Establish objectives to be achieved by a DBMS at the facility.

A.2. Appoint DBMS project officer.

The commander of the Medical Treatment Facility (MTF) should appoint a project officer who will be responsible for implementing the DBMS. This project officer should be drawn from the command/administrative section or more ideally from a Medical Computer Systems Office if one exists within the MTF. He/She shall serve as the single point of contact to initiate actions and resolve problems associated with the implementation. The project officer must have full commitment from both the command section and hospital sections management to make timely system development schema changes.

A.3. Develop general mission guidelines.

Determine whether there will be any mission changes of offices associated with the DBMS in its development. Develop implementation plan. Develop a specific implementation plan for your MTF using this document as a guideline.

A.4. Appoint DBMS manager.

Appoint a person in the computer center who will be responsible for creating and maintaining the hospital DBMS. The skills of the person selected should be primarily administrative/clinical with a working knowledge of DBMS systems. Plan to involve all users inoperational training as early as possible.

A.5. Begin hospital data base identification.

Gather information concerning tests, workload, reports, and etc., so that all appropriate views of data can be developed for the new system. This information must be put into at least 3NF.

A.6. Establish liaison with local DPI management.

Establish a good working relationship with local Data Processing Installations (DPI). Their experience and background may save costly planning errors in your local schema design.

A.7. Collect cost benefit analysis baseline data (pre-implementation).

This normally done by either a consulting firm or the local Management Engineering Team. The purpose of this study is to provide an effective picture of the existing hospital operations prior to DBMS implementation.

A.8. Develop acceptance test plan.

Develop a plan to "accept" the DBMS. An acceptance test verifies that the hardware and software are acceptable to the MTF. The military services have specific requirements for conducting an acceptance test. Your DPI liaison should be able to assist in preparing this plan. Particular emphasis should be placed on devising the record format for tracking of acceptance test time elements as well as clearly defining those time elements from logical, regulatory and contractual guidelines. A key question for determining downtime will be, "Is the Government's normal schedule of useful work impaired by software or hardware downtime?". Objective should be clarity and completeness of definitions and rules during acceptance test phase.

A.9. Develop cost benefit analysis measurement criteria.

Based upon the objectives established in event A.1., determine how the achieving of these objectives (e.g., faster turnaround of test information) can be measured. It is important to remember that varying or inconsistent management policies during system implementation can cause erroneous interpretations of measurements or unwittingly change parameters.

A.10. Determine if acquired documentation is adequate.

Evaluate documentation needs (e.g., software, system and operations manuals) to assure supply on hand meets functional requirements.

A.11. Develop parallel operation/fallback posture.

As part of the acceptance test, parallel operations should be undertaken until a sufficient level of con-

fidence is achieved. Also, a fallback posture must be developed in case of a catastrophic failure during implementation.

A.12. Prepare disaster/emergency/fire/safety plans.

Prepare plans required by regulation in conjunction with appropriate offices. The plan should include provisions for training of affected personnel.

A.13. Develop data security/privacy/medical ethics policy.

After reviewing appropriate regulations develop a written policy on these matters. Consider distribution, disposition and destruction of records.

A.14. Prepare operations schedule and product control/distribution plan.

In conjunction with the functional departments prepare an operations schedule consistent with processing and report needs. Prepare product distribution plan considering breakdown and mailing conventions. Utilize self pick up where possible to reduce manpower needs but avoid unofficial access to reports.

A.15. Prepare initial operating instructions.

Prepare operating instructions that support all detailed aspects of the DBMS implementation.

A.16. Review of acceptance test plan with vendor.

Review plan developed in event A.8 with vendor so that he knows what type of test and the "ground rules" of the test that will be conducted.

A.17. Perform DBMS verification in simulated mode.

"Desk check" the DBMS to insure the quality of the information and reduce error correction once the acceptance test begins.

A.18. Develop redundant storage procedure.

Develop procedure and places for storing "copies" of the data base. These should be outside the computer room in a controlled environment offsite, that is, in another building storage should also be allocated. A good place for off-site storage would be the base DPI. Another redundancy consideration is archival search to secure individual patient histories or epidemiological data.

A.19. Develop discipline for receipt of software changes.

A method should be developed for reporting problems and receiving software changes from the vendor. This procedure will allow the MTF to monitor changes and vendor responsiveness to software problems. This plan must have vendor coordination. Modifications should consist of the following entities:

a. System change number.

b. Type of change.

c. Purpose and description of change.

d. Narrative of problems resolved (specifying dump numbers if appropriate).

e. Method of implementation and instruction.

f. Identity of programs, files, inputs or outputs affected and how.

g. Discussion of operational, functional and management procedures affected.

h. Copies of new and/or amended documentation.

i. List of attachments.

j. Additional information comments.

A.20. Arrange Principal Period of Maintenance/Preventive Maintenance/Remedial Maintenance Schedules and specify problem reporting channels.

The range of hours will be set during contract negotiations. The MTF will select the specific hours for each maintenance category with thelocal vendor representative. For detailed explanation of these terms refer to your specific contract.

A.21. Arrange fire/safety inspection.

The computer room site must be inspected by the fire and safety officials prior to acceptance test.

A.22. Establish master contacts roster.

Establish a list of all MTF, vendor, and DPI personnel who should be contacted if a problem occurs. Also determine the correct procedure for use of this roster (i.e., who should call whom on the problem).

A.23. Specify acceptance test meeting schedule and format.

The acceptance test procedure is a formal methodology for the Air Force to accept a system. The acceptance test meetingis part of the procedure, therefore all system problems should be documented in the minutes of these meetings. Assure full representation by responsible entities as the meeting will frequently provide the medium for assigning tasks to resolve problems.

A.24. Hardware installation.

Equipment should be installed by the vendor.

A.25. Hardware integration.

Is the system installed and working properly. Closely monitor vendor diagnostic activity and use of main peripheral devices.

A.26. Software integration.

Vendor wil load and integrate software after the hardware is operational. Again monitor vendor diagnostic activity.

A.27. Begin acceptance test.

Implement acceptance test plan.

A.28. Functional validation.

Taking each department or functional query, separately validate data entered and reported to insure validity. Functional validation will insure that the DBMS meets the requirements set forth in the Department of Defense documentation.

A.29. Hardware certification.

Hardware malfunctions and repair will accrue downtime which will enter into the effectiveness level computation maintained by the DPI. Hardware downtime will be substantiated on the approptiate form. Hardware downtime records must be maintained on a component as well as system basis. The hardware will be certified once the contractual effectiveness level is reached.

A.30. Software certification.

The performance of the systems functional tests will be reviewed. If the performance standards set forth

for acceptance testing are met, the software will be certified as acceptable. The certification with supporting documentation will be provided to the Equipment Control Officer of the DPI by the project director.

A.31. Collect baseline data (postimplementation).

The local Management Engineering Team collects this information.

A.32. Cost benefit Analysis (begin Phase I).

The local Management Engineering Team should perform this function.

Appendix B

FUNDING/BUDGET

1. Submit budget request for construction, supplies, equipment, utilities, rental and purchase of ADPE, as appropriate (365).

2. Assure budget requirements have been met (270).

FUNDING/BUDGET

B.1. Submit budget request for construction, supplies, equipment, utilities and rental/purchase of ADPE, as appropriate.

Computer systems in the Department of Defense are covered by specific regulations. The MTF will have to be familiar with these regulations and how to submit budget requests, in order to submit the proper paperwork. Be sure to consider budgetary projections for the various desks, tables, chairs, and cabinetry associated with any new functional activity.

B.2. Assure budget requirements have been met.

Since computer system in a hospital will not follow "normal" established procedures, the project officer must follow-up on all budget requests to insure adequate explanation of all paperwork is provided. Further he/she should monitor approval channels to obtain reasonable assurance that funds will be available when required.

Appendix C

SUPPLIES/EQUIPMENT

1. Appoint supply monitor (-395).
2. Identify supply needs (-365).
3. Establish availability and source for needed supplies (-330).
4. Order supplies (-270).
5. Order needed desks, tables, shelves, chairs, racks, etc., as required for central and remote site locations (-270).
6. Assure adequate supplies and equipment are on hand (-90).
7. Establish supply levels and reorder points (+90).

SUPPLIES/EQUIPMENT

C.1. Appoint supply monitor.

Self-explanatory. The supply monitor ideally should be the person normally associated with providing supplies to the MTF.

C.2. Identify supply needs.

Vendor, other DBMS users, and DPI personnel should be able to assist the supply monitor in establishing his supply needs.

C.3. Establish availability and source for needed supplies.

Some of the supplies (e.g., stock paper) can be ordered from base supply channels; other (e.g., test request cards) will have to be ordered from special sources. Identify these sources and necessary lead times for ordering.

C.4. Order supplies.

Self-explanatory.

C.5. Order needed desks, tables, shelves, chairs, racks, etc., for central site and remote locations.

The project officer should determine what office equipment is required for the computer room. This applies if a redesign of existing facilities is needed. Each potential remote location (outside computer room) should also be examined to insure that the equipment ordered for that location can be placed in an easily accessible area.

C.6. Assure adequate supplies and equipment are on hand.

Adequate follow-up procedures must be established to assure timely delivery of supplies and equipment.

C.7. Establish supply levels and reorder points.

After sufficient supply history has been maintained, establish reorder points for all items.

Appendix D

EDUCATION

1. Provide executive level briefings at 30 day intervals (-455)

2. Refresher training for DP personnel in data base design for conversion work (-365).

3. Determine availability of vendor or Department of Defense training support (-180).

4. Establish training requirements (-150).

5. Provide middle management briefings (-120).

6. Provide executive level briefing on acceptance test (-120).

7. Prepare operator/technician training plans (-90).

8. Begin operator/technician training (-30).

9. Begin product user training (-30).

10. Provide acceptance test briefing to middle management and technicians (-15).

11. Provide post-acceptance test briefing to middle management and technicians (+60).

EDUCATION

D.1. Provide executive level briefings at 30 day intervals.

Top management support is a requirement to successfully implement the DBMS. These meetings should be used to keep top management informed and solicit their support. A sincere and well managed investment in orientation, acclimation and training of the staff (OATS) will yield a significant return in terms of system efficiency and staff acceptance.

D.2. Train DP personnel in data base implementation techniques.

This training will be accomplished by either the vendor, TPO or other hospital sites.

D.3. Determine availability of vendor or Department of Defense training support.

This training will be specified by the contract in the case of the vendor. The TRIMIS Program Office will have a training plan for each hospital site. For repetitive training modules such as those for technicians, investigate the possibility of using computer-assisted instruction (CAI) capabilities.

D.4. Establish training requirements.

Identify all personnel who are to be trained and the type of training required.

D.5. Provide middle management briefings.

In order to gather support for system implementation, provide periodic briefings to middle management on what DBMS is and what benefits the system will provide. Hospital personnel must be continually kept up-to-date by required attendance briefings and by assistance visits. A user's guide for the health care provider should be prepared as soon as an operating protocol is developed.

D.6. Provide executive level briefing on acceptance test.

Provide top management with an overview of the acceptance process along with the expected objectives to be accomplished during the test.

D.7. Prepare operator/technician training plans.

Prepare detailed plans to accomplish both computer

vendor training, although a beginning, often lacks the essential references and examples that hospital personnel need to orient the presentation to the actual task at hand.

D.8. Begin operator/technician training.

Self-explanatory.

D.9. Begin product user training.

Self-explanatory.

D.10. Provide acceptance test briefing to middle management technicians.

Prepare management and technicians for acceptance test by using briefing developed in event D.6.

D.11. Provide post-acceptance test briefing to middle management and technicians.

Provide information regarding status of system and lessons learned during acceptance test. Emphasize how cooperative efforts have led to current stage of progress.

AD-A138 231 ANALYSIS OF ADMINISTRATIVE INFORMATION FLOW IN A MILITARY MEDICAL CENTER..(U) AIR FORCE INST OF TECH WRIGHT-PATTERSON AFB OH SCHOOL OF ENGI.. S G HULL

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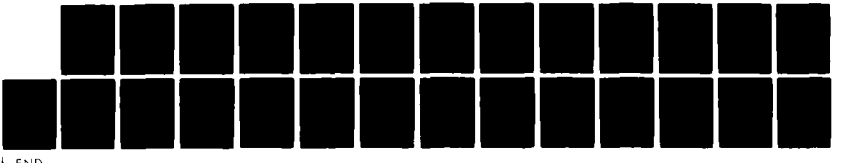

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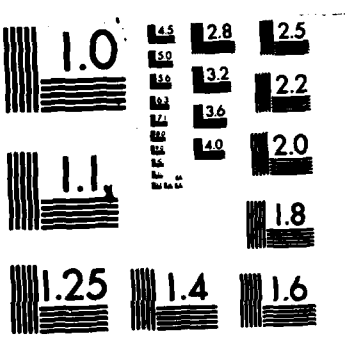

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Appendix E

PERSONNEL/MANPOWER

1. Ascertain manpower needs and type (i.e., civilian or military) (-425).

2. Submit manpower requests (-365).

3. Obtain confirmation of manpower allocation (-180).

4. Prepare position descriptions for new civilian job requirements (-180).

5. New personnel to report (-45).

PERSONNEL/MANPOWER

E.1. Ascertain manpower needs and types (i.e., civilian or military).

Determine what the manpower requirements are for DBMS. Other DBMS users will be a good source of information on this topic. Also determine the mix of the required personnel (refer to Chapter 5).

E.2. Submit manpower requests.

Self-explanatory.

E.3. Obtain confirmation of manpower allocation.

Monitor manpower requests.

E.4. Prepare position descriptions for new civilian job requirements.

Self-explanatory.

E.5. New personnel to report.

Self-explanatory.

Appendix F

FACILITIES/COMMUNICATIONS

1. Establish management plan for system layout (-425).
2. Obtain site specifications if any from computer vendor (-395).
3. Consider emergency backup power and air conditioning installation (-395).
4. Submit request for site design to CE (-365).
5. Begin Civil Engineering design (-330).
6. Solicit site preparation bids (-270).
7. Establish necessary work and storage areas (-270).
8. Award site preparation contract (-180).
9. Review design layout for efficiency, accessibility and human engineering (-180).
10. Submit requests for communicatons lines (-150).
11. Secure calibrated hydro-thermagraphs for measurement of critical environments (-90).
12. Review equipment movement plan considering door size, hallways, turns, elevators, ramps, docks and floor supports (-90).
13. Make final inspection of site environment(-45).

FACILITIES/COMMUNICATIONS

F.1. Establish management plan for system layout.

Develop plan for system (e.g., communication networks) layout. Determine where the system will be located and what impact the location will have on the existing work and information flow. Where peripheral devices are located is important for ease of access, protection of equipment and optimum utilization.

F.2. Obtain site specifications from computer vendor.

These specifications will detail the power requirements and access space around the computer equipment. This information will be needed by Civil Engineering to design any special remote sites. Other environmental considerations will include such things as temperature and humidity ranges for operation, susceptibility to power fluctuations, physical size and weight of devices, heat generation, noise generation, safety factors.

F.3. Consider emergency backup power and air conditioning installation.

If at all possible the computer room should be provided with a backup power source in case of a power failure and backup air conditioning in case of air conditioning failure. This will allow for continuous operaton.

F.4. Submit request for site design to Civil Engineering.

While the Base CE will design areas, they will be looking to the MTF to provide quidelines so that the work flow will proceed smoothly. Event F.1. should provide guidelines.

F.5. Begin Civil Engineering design.

Self-explanatory.

F.6. Solicit site preparation bids.

This will be done by Base Procurement.

F.7. Establish necessary work and storage areas.

The site design should include a small storage area in the computer room and a larger area in the immediate vicinity of the room for storage of tapes, disks and

supplies. Also areas must be allocated for records and redundant storage. A system analyst work area should preferably be proximal to the computer area and data base management area. An operator's break area near the computer room will accommodate operators on break or at lunch and will usually satisfy union demands.

F.8. Award site preparation contract.

Base Procurement will do this function.

F.9. Review design layout for efficiency, accessibility and human engineering.

This is the final chance to review the design prior to construction. Remember that human engineering includes the objective of making tasks as pleasant and convenient as possible.

F.10. Submit request for communication lines.

This request is for phone lines that will connect the computer and the terminals in the remote areas. This base Communication Group will need the information that is supplied by the vendor on type of service the system requires. Do not forget to consider any additional human to human communication needs.

F.11. Secure calibrated hydro-thermagraphs for measurement of computer room environment.

These instruments can be obtained through the GSA catalogue. One is required in all computer rooms. Vendors are historically hypercitical of operating environments. Maintain spare devices in case the primary hydro-thermagraph(s) are suspected to be inaccurate.

F.12. Review equipment movement plan considering door size, hallways, turn, elevators, ramps, docks and floor support.

Self-explanatory.

F.13. Make final inspection of site environment.

Self-explanatory.

Appendix G

DATA DICTIONARY

SYMBOL	DESCRIPTION	SIZE	VIEWS
ABSENT:STAT	INPATIENT ABSENT STATUS WHICH IS DETERMINED BY ADMISSION TYPE OF CARE BEING RENDERED OUTSIDE MILITARY MEDICAL FACILITY	2	ABSENT
ADDR	HOUSE NUMBER, STREET NAME & APT NO.	30	EMERGENCY MEDICAL INSTITUTION PATIENT REGISTRATION SPONSOR
ADMIT:DATE	DATE ADMITTED TO ORIGINAL MTF (DDMMYY)	6	TRANSFER
ADMIT:DIAG	CODED INITIAL DIAGNOSIS FOR DISORDER THAT NECESSITATED ADMISSION TO MTF	7	ADMISSION
ADMIT:PHY	PHYSICIAN WHO AUTHORIZES ADMISSION (USE PROV#)	9	ADMISSION
ADMIT:STAT	STATUS OF ADMISSION: CANCEL OR NEW DENOTED BY: C/N	1	ADMINISTRATIVE DISPOSITION
ADMIT:STATUS	ADMISSION STATUS	4	ADMINISTRATIVE
ADSCD	ACTIVE DUTY SERVICE COMMITMENT DATE (DDMMYY)	7	PERSONNEL
AERO:RTNG	AERONAUTICAL RATING (Y/N)	1	REGISTRATION
ARVL:TM	ARRIVAL TIME THAT PATIENT ANNOUNCES PRESENCE IN CLINIC RECORD IN MILITARY FORMAT (EX: 13:08)	5	APPOINTMENT
ATND:PHY	ATTENDING PHYSICIAN ASSIGNED TO CASE (USE PROV#)	9	ADMINISTRATIVE
AVAIL:BED	TOTAL NUMBER OF UNASSIGNED BEDS AVAILABLE ON THE WARD	3	BED STATUS

BED:DYS	CUMULATIVE TOTAL OF BED DAYS OCCUPIED BY PATIENTS (RESET TO ZERO MONTHLY)	4	WARD
BED#	UNIQUE NUMBER ASSIGNED TO A BED	4	BED STATUS
BENE:TYPE	BENEFICIARY TYPE SUCH AS ARMY, NAVY, AIR FORCE	2	PATIENT
BLCK:BED	TOTAL NUMBER OF BEDS EITHER IN USE OR TEMPORARILY MARKED UNAVAILABLE	3	BED STATUS
CASUALTY#	ANY NON VIRAL OR BACTERIAL ILLNESS DENOTED BY A NUMERIC IDENTIFIER	3	ADMISSION
CITY	NAME OF CITY IN WHICH PATIENT LIVES (PATIENT'S, PRIMARY CONTACT IN EMERGENCY, SPONSOR, ETC.	20	EMERGENCY MEDICAL INSTITUTION REGISTRATION SPONSOR
CIV:MTF	CIVILIAN HOSPITAL THAT INPATIENT IS LOCATED IN	27	ABSENT
CLERK	THE CLERK'S INITIALS	3	ADMISSION *DISPOSITION*
CLINIC#	UNIQUE CLINIC IDENTIFICATION NUMBER	2	APPOINTMENT CLINIC HOLIDAYS PROVIDER-CLINIC
CLINIC:SVC	MNEMONIC FOR CLINIC SPECIALTIES AVAILABLE (EX: bbGYN)	5	ADMINISTRATIVE
COMND: INTRST	PARENT COMMAND OF PATIENT OR SPONSOR (MAC,SAC,TAC, ETC.)	3	SPONSOR
CPR:TRNG: CODE	CODE REPRESENTING CURRENT CPR SKILL LEVEL (TABLE NOT MADE YET)	3	PERSONNEL
CPR:DATE	DATE CPR TRAINING COMPLETED (DDMMYY)	6	PERSONNEL
CUR:AIR:IN	TOTAL AIR EVAC PATIENTS *IN THAT DAY*	3	WARD

CUR:AIR:OUT	TOTAL AIR EVAC PATIENTS OUT THAT DAY	3	WARD
CUR:AIR	TOTAL NUMBER OF AIR EVAC PATIENTS CURRENTLY ON THE WARD	3	WARD
CUR:REGIST:NO	CURRENT INPATIENT REGISTER NUMBER ASSIGNED BASED ON DATE AND TIME OF ADMISSION TO MTF	6	HISTORY
DAFSC	DUTY AIR FORCE SPECIALTY CODE	5	PERSONNEL
DAS	DATE OF ACTIVE SERVICE (DDMMMYY)	7	PERSONNEL
DATE	CURRENT DATE	6	ADMISSION APPOINTMENT CASUALTY HISTORY
DATE: ASIGN	DATE PHYSICIAN ASSIGNED TO CASE (DDMMYY)	6	ADMINISTRATIVE
DATE:CHG	DATE CHANGE IN STATUS OF PATIENT CARE, DIAGNOSIS, ETC. (DDMMYY)	6	CASUALTY
DATE:CLSD	DATES THE WORK AREA IS CLOSED (DDMMYY)	6	HOLIDAYS
DATE:CNX	DATE OF ACTUAL CANCELLATION OF ADMISSION (DDMMYY)	6	ADMISSION
DATE:CONFMD	DATE THE INDIVIDUAL BECAME A CONFIRMED MEB CANDIDATE (DDMMYY)	6	MED BOARD
DATE:DISPO	DATE OF DISCHARGE (DDMMYY)	6	DISPOSITION
DATE:IDENT	DATE THE INDIVIDUAL WAS IDENTIFIED AS A POTENTIAL MEB CANDIDATE (DDMMYY)	6	MED BOARD
DATE:INACT: STATUS	ACTIVE OR INACTIVE STATUS DATE CHANGE (DDMMYY)	6	HISTORY
DATE:KIN:NTFY	DATE NEXT OF KIN NOTIFIED (DDMMYY)	6	CASUALTY

DATE:RESOLV	DATE THAT THE MEB RESOLVED THE INDIVIDUAL'S CASE (DDMMYY)	6	MED BOARD
DATE:RTRN:TIME	RETURN TIME AND DATE (DDMMYYb13:08)	12	ABSENT
DATE:RMVD	DATE REMOVED FROM CASUALTY ROSTER (DDMMYY)	6	CASUALTY
DATE:SVC	DATE SERVICE ASSIGNED (DDMMYY)	6	ADMINISTRATIVE
DAY:PH	PATIENT'S BUSINESS PHONE (XXXYYYZZZZ)	10	REGISTRATION
DEP:CODE	CODE ID FOR RELATIONSHIP TO SPONSOR (TABLE NOT AVAILABLE YET)	2	ABSENT ADMISSION APPOINTMENT CASUALTY DISPOSITION EMERGENCY HISTORY MED BOARD PATIENT REGISTRATION TRANSFER
DIAGNOSIS	FREE TEXT DIAGNOSIS	25	CASUALTY
DISPO#	REASON FOR AND TYPE OF DISPOSITION (TABLE NOT AVAILABLE)	4	DISPOSITION
DOB	DATE OF BIRTH (DDMMYY)	6	PATIENT PERSONNEL
DOR	DATE OF RANK (DDMMYY)	7	PERSONNEL
DTY:TITLE	DUTY TITLE	10	PERSONNEL
DTY:PH	OFFICE PHONE (XXXYYYZZZZ)	10	PERSONNEL
EFF:DATE:TIME	DATE/TIME THAT INPATIENT ABSENT STATUS EFFECTIVE (DDMMYYb13:08)	12	ABSENT
EXPIR:TRM:SVC	DATE A SERVICE MEMBER DUE TO BE RELEASED FROM ACTIVE DUTY (DDMMYY)	6	REGISTRATION
FLY:SVC:CODE	PATIENT'S ENTITLMENT STATUS (EX: 1 = PILOT)	2	REGISTRATION

FLY:STATUS	FLIGHT STATUS CURRENTLY ON FLIGHT ORDERS (Y/N)	1	PATIENT
GAIN:DATE	DATE PROJECTED GAIN TO MTF STAFF (DDMMYY)	6	PERSONNEL
HM:PH	HOME TELEPHONE NUMBER (XXXYYYZZZZ)	10	PATIENT PERSONNEL REGISTRATION
ID:CD:EXP	THE DATE ID CARD EXPIRES (DDMMYY)	6	REGISTRATION
INIT:ADMIT	ORIGINAL DATE ADMITTED TO MTF (DDMMYY)	6	TRANSFER
INSP:DATE	DATE ROOM WAS INSPECTED (DDMMYY)	6	ROOMS
KEY#	NUMBER ASSIGNED TO KEY	4	ROOMS SUPERVISOR
LEGAL:NXT:KIN	NAME OF PERSON WHO SHOULD BE NOTIFIED FIRST IF PATIENT SHOULD DIE	30	EMERGENCY
LNGTH:SVC	TOTAL AMOUNT OF TIME ACCRUED IN MILITARY	3	REGISTRATION
LOSS:DATE	DATE PROJECTED FOR PCS OUT (DDMMMYY)	7	PERSONNEL
LV	ON/OFF LEAVE (Y/N) 1 SUPERVISOR	1	SUPERVISOR
LST:INPAT: DISPO	DATE PATIENT WAS LAST DISCHARED FROM THE MTF (DDMMYY)	6	HISTORY
LST:INPAT: STATUS	DATE PATIENT WAS LAST ADMITTED TO THE MTF (DDMMYY)	6	HISTORY
LST:OUTPAT: CLINIC	DATE PATIENT WAS LAST SEEN BY APPOINTMENT AT AN OUTPATIENT CLINIC (DDMMYY)	6	HISTORY
LOCK#	NUMBER ASSIGNED TO A SPECIFIC LOCK	4	ROOMS
MARITAL: STATUS	PATIENT'S MARITAL STATUS (M/S/D)	1	REGISTRATION

MAX:APNT	MAXIMUM APPOINTMENTS FOR A WORK AREA IN 24 HR PERIOD	3	CLINIC
MEAL:CD	MEAL CARD AUTHORIZED (Y/N)	1	ADMISSION
MEB:STATUS	INPATIENT'S MEDICAL EVALUATION BOARD STATUS (TABLE NOT READY)	1	MED BOARD REGISTRATION
MED:HLD	IN HOSPITAL ATTACHMENT UNIT AND NOT OCCUPYING A BED WITHIN MTF (Y/N)	1	ADMISSION
MTF	NAME OF MEDICAL FACILITY CIVILIAN OR MILITARY	30	MEDICAL - INSTITUTION
NAME	NAME OF: PATIENT, DOCTOR, ETC.	30	PATIENT PERSONNEL SPONSOR
NEW:MOD	A NEW CLINICAL SERVICE ASSIGNMENT OR MODIFICATION OF ERROR CONCERNING AN INPATIENT (N/M)	1	ADMINISTRATIVE
NOTIFY:NAME	NAME OF PERSON TO CONTACT *IN CASE OF AN EMERGENCY* DOES NOT HAVE TO BE A NEXT OF KIN	10	EMERGENCY
OFC:SYMB	OFFICE SYMBOL	6	PERSONNEL
OCCUPY:BED	TOTAL NUMBER OF BEDS CURRENTLY OCCUPIED BY INPATIENTS	3	BED STATUS
OCCUPATION: CIV	NON-MILITARY OCCUPATION	25	REGISTRATION
OCCUPATION: MILITARY	INDIVIDUAL'S MILITARY SPECIALTY CODE	5	REGISTRATION
ORG:AUTH:ADM	PERSON OR ORGANIZATION AUTHORIZING ADMISSION TO MTF NORMALLY A PHYSICIAN	30	ADMISSION
OTHER	TOTAL NUMBER OF BEDS THAT ARE UNAVAILABLE FOR REASONS NOT LISTED	3	BED STATUS
PAFC	PRIMARY AIR FORCE SERVICE CODE	6	PERSONNEL

PATIENT:CAT	PATIENT'S CATEGORY (EX: TESTS, X-RAY, ETC.)	6	REGISTRATION
PERM:ACTIVE	PERMANENT ACTIVE DUTY	1	REGISTRATION
PHONE	PHONE NUMBER OF EMERGENCY CONTACT, LEGAL NEXT OF KIN, PHYSICIAN, ROOM, ETC. (XXX-YYY-ZZZZ)	14	ABSENT EMERGENCY MEDICAL INSTITUTION ROOMS
POS#	POSITION NUMBER-AUTHORIZED PERSONNEL SLOTS	7	PERSONNEL
PHY	NAME OF PHYSICIAN	30	ABSENT
PHY:AUTH	PHYSICIAN WHO AUTHENTICATES DISCHARGE OF PATIENT (USE PROV#)	6	DISPOSITION
PHY:DISCHG	PHYSICIAN ORDERING DISCHARGE	9	DISPOSITION
PREADMITS	TOTAL NUMBER OF BEDS BEING HELD FOR PREADMITTED PATIENTS	3	BED STATUS
PREV:BED:DY	NUMBER OF BEDS OCCUPIED AS OF 2400-HOURS ON THE DAY PREVIOUS TO THE CURRENT DATE	4	WARD
PREV:BED:DYS	TOTAL NUMBER OF BED DAYS PRIOR TO TRANSFER TO PRESENT MTF	3	TRANSFER
PREV:CONV:DYS	TOTAL NUMBER OF CONVALESCENT LEAVE DAYS PRIOR TO TRANSFER TO PRESENT MTF	3	TRANSFER
PREV:COOP:DYS	TOTAL NUMBER OF DAYS ACCRUED IN COOPERATIVE CARE PRIOR TO A TRANSFER TO PRESENT MTF	3	TRANSFER
PREV:QTR:DYS	TOTAL NUMBER OF DAYS ON QUARTERS STATUS PRIOR TO TRANSFER TO PRESENT MTF	3	TRANSFER
PREV:OTHR:DYS	TOTAL NUMBER OF DAYS NOT OTHER-WISE DEFINED	3	TRANSFER

PREV:REGIST:NO	REGISTER NUMBER OF PATIENT'S MOST RECENT INPATIENT EPISODE	6	HISTORY
PREV:SICK:DYS	TOTAL NUMBER OF ABSENT SICK DAYS PRIOR TO TRANSFER TO PRESENT MTF	3	TRANSFER
PREV:SUP:DYS	TOTAL NUMBER OF SUPPLEMENTAL CARE DAYS ACCRUED PRIOR TO TRANSFER TO PRESENT MTF	3	TRANSFER
PRIM:CARE: PROVIDER	PHYSICIAN WHO IS RESPONSIBLE FOR PRIMARY CARE (USE PROV#)	6	REGISTRATION
MTF	PRIMARY MEDICAL FACILITY THAT CARES FOR PATIENT	6	REGISTRATION
PRIOR:CODE	PRIORITY CODE ASSIGNED TO MOVE PATIENT AHEAD OF OTHERS DUE TO MEDICAL NECESSITY OR MISSION NECESSITY	1	APPOINTMENT
PROB	PROBLEM CLASSIFICATION OF MEDICAL ATTENTION NEEDED	3	APPOINTMENT
PROB:RECVR	ESTIMATED RECOVERY POSSIBILITY OF PATIENT	3	CASUALTY
PROJ:DISPO	ANTICIPATED DATE OF DISCHARGE FROM INPATIENT (DDMMYY)	6	ADMINISTRATIVE
PROV#	PROVIDER NUMBER REFERS TO PHYSICIAN UNIQUE IDENTIFICATION NUMBER (bbbnnnnnn)	9	APPOINTMENT PROVIDERS PROVIDER - CLINIC PROVIDER - SPECIALTY
RACE	GENERAL CLASSIFICATION OF HUMAN TYPES (EX: 'C' - CAUCASIAN)	1	REGISTRATION
RANK	THREE CHARACTER CODE SIGNIFYING RANK (EX: 2LT)	3	PERSONNEL SPONSOR
REC:RQS	RECORDS REQUESTED TO BE PULLED AND AT CLINIC FOR APPOINTMENT TIME (Y/N)	1	APPOINTMENT

REGISTER:NO	INPATIENT REGISTER NO. THAT IDENTIFIES PATIENT RECORD	7	REGISTRATION
RELATION	RELATIONSHIP TO PATIENT (LEGAL NEXT OF KIN, EMERGENCY CONTACT, ETC.)	12	EMERGENCY
RELIGION	RELIGIOUS PREFERENCE (EX: '1'-HEATHEN)	1	REGISTRATION
RM#	UNIQUE NUMBER ASSIGNED TO ROOM	4	ROOMS
SCHED:DATE	DATE APPOINTMENT MADE FOR (DDMMYY)	6	TIME SLOT
SERVICE	SPECIFIC BRANCH OF SERVICE	3	SPONSOR
SERV:ASGNMT	DATE CLINICAL SERVICE ASSIGNED	7	ADMINISTRATIVE
SEX	GENDER CLASSIFICATION (M/F)	1	PATIENT PERSONNEL REGISTRATION
SOURCE:ADM	DESCRIPTION OF ORIGIN OF ADMISSION (EX: ANOTHER MTF, EMERGENCY, AIR EVAC, ETC.)	10	ADMISSION
SPEC:CODE	SPECIALTY CODE IS THE DECLARED EXPERT AREA (EX: NEUROSURGERY)	3	PROVIDERS
SPONSOR: NAME	SPONSOR-NAME OF MILITARY MEMBER (LAST, FIRST, MI)	30	PATIENT
SSAN	SOCIAL SECURITY NUMBER-A UNIQUE IDENTIFIER	9	ABSENT ADMISSION APPOINTMENT CASUALTY DISPOSITION EMERGENCY HISTORY MED BOARD PATIENT PERSONNEL PROVIDERS REGISTRATION SPONSOR SUPERVISOR TRANSFER

SRVC	TYPE OF MEDICAL INSTITUTION (EX: CIV, MIL)	3	MEDICAL - INSTITUTION
STATE	ABBREVIATION OF STATE (PATIENT'S, PRIMARY CONTACT IN EMERGENCY, SPONSOR, ETC.)	2	EMERGENCY REGISTRATION SPONSOR
ST:TIME	START TIME FOR SCHEDULED APPOINTMENT (EX: 13:08)	4	APPOINTMENT TIME SLOT
STATUS:CASUALTY	CASUALTY STATUS (Y/N)	1	REGISTRATION
STP:TIME	STOP TIME FOR SCHEDULED APPOINTMENT (EX: 13:09)	4	APPOINTMENT
SUPERVISOR: SSAN	SUPERVISOR'S SOCIAL SECURITY NUMBER	9	PERSONNEL WARD
TIME	TIME OF ACTUAL EVENT IN MILITARY FORMAT (EX: 13:08)	5	ADMISSION DISPOSITION
TITLE	TITLE OF MEDICAL UNIT 20 CLINIC	20	CLINIC
TRANSFR:MTF: DATE	DATE PATIENT TRANSFERRED TO ANOTHER MTF (DDMMYY)	6	DISPOSITION
TAFDSD	TOTAL ACTIVE DUTY SERVICE DATE (DDMMMYY)	7	PERSONNEL
TAFMSD	TOTAL ACTIVE MEDICAL SERVICE DATE (DDMMMYY)	7	PERSONNEL
TTL:REF:DATE	TOTAL AIR EVACS IN, OUT, TRANSIENT BED DAYS REFERENCED DATE (DDMMYY)	6	WARD
TTL:IN:EVACS	CUMULATIVE TOTAL OF AIR EVAC PATIENTS WHO HAVE ENTERED THE WARD SINCE TTL:DATE	3	WARD
TTL:OUT:EVACS	CUMULATIVE TOTAL OF AIR EVAC PATIENTS WHO HAVE LEFT THE WARD SINCE TTL:DATE	2	APPOINTMENT
TYP	TYPE OF APPOINTMENT: DIRECT, TRANSFER, PRE-ADMISSION, ETC.	5	ADMISSION

TYP:CASE	ACTIVITY THAT RESULTED IN THE ACCIDENT (EX: 00001 - FLY ACCIDENT)	50	PATIENT
UNIT:ADDR	MAILING ADDRESS OF ASSIGNED DUTY SECTION (OFFICE SYMBOL, COMMAND, BASE, STATE, ZIP)	6	HISTORY
UPDATE:REGISTER	DATE REGISTRATION RECORD WAS CHANGED OR VERIFIED (DDMMYY)	3	ADMINISTRATIVE
WARD	WARD ASSIGNMENT	3	ADMINISTRATIVE
WARD#	WARD ID NUMBER	3	ADMISSION ROOMS SUPERVISOR WARD
WORK:AREA	ASSIGNED WORK LOCATION (CLINIC, WARD, EMERGENCY, ETC.)	3	PERSONNEL
X-RAY:RQS	X-RAY REQUESTED TO BE SENT TO CLINIC PRIOR TO SCHEDULED APPOINTMENT (Y/N)	1	APPOINTMENT
ZIP	ZIP CODE OF: PATIENT, PRIMARY CONTACT IN EMERGENCY, SPONSOR, ETC.)	5	EMERGENCY MEDICAL INSTITUTION REGISTRATION SPONSOR
#AIR:IN	NUMBER OF NEW AIR EVAC PATIENTS WHO HAVE ENTERED THE WARD SINCE LAST UPDATE	3	WARD
#AIR:OUT	NUMBER OF NEW AIR EVAC PATIENTS WHO HAVE LEFT WARD SINCE LAST UPDATE	3	WARD
#AUTH:NURSES	OFFICIAL NUMBER OF ALLOCATED NURSING SLOTS	3	WARD
#BEDS	NUMBER OF BEDS ASSIGNED TO A WARD	3	ROOM
#EMP	NUMBER OF ASSIGNED PERSONNEL	3	SUPERVISOR

#NURSES	ACTUAL NUMBER OF NURSES PRESENT FOR A SHIFT	3	WARD
#RM	NUMBER OF ROOMS	4	WARD
2AFSC	SECONDARY AIR FORCE SPECIALTY CODE	5	PERSONNEL
3AFSC	TERTIARY AIR FORCE SPECIALTY CODE	5	PERSONNEL

Appendix H

FUNCTIONAL DESCRIPTIONS OF EACH RELATION

1. PATIENT

This relation contains a list of identifying information of a patient for clinic use. Each patient is uniquely identified by social security number and dependent code. A centralized appointment center is responsible for alterations to the data.

2. APPOINTMENT

This relation contains information pertaining to when an appointment for a specific clinic is scheduled. The relation used social security number and dependent code to link it to other relations in the data base. A centralized appointment center is responsible for alterations to the data.

3. TIME_SLOT

This relation contains schedule data each doctor has for a specific clinic. The relation is linked to other relations through PROV#. Each department specialty is responsible for maintaining the data.

4. CLINIC

This relation contains information that shows the title of the specific clinic and the number of appointments it is capable of handling in a 24 hour period. The relation is accessed by the unique clinic number. Each clinic is responsible for any alterations to this relation.

5. PROVIDERS

This relation contains the social security number for each physician along with his medical identification number. The Directorate of Hospital Services (SGH) would be responsible for maintenance of the data.

6. PROVIDER_SPECIALTY

This relation contains data which identifies the specialty of each physician is qualified to perform. The relation is linked to other relations through the PROV#. SGH would be the office responsible for maintenance of the data.

7. PROVIDER_CLINIC

This relation contains data which identifies the clinic each physician is assigned. Each specialty department would be responsible for maintenance of the data.

8. HOLIDAYS

The relation contains the scheduled dates the clinic is closed. The clinic's identification number links it to other relations. Each clinic is responsible for the maintenance of the data.

9. REGISTRATION

This relation contains demographic data of each inpatient. Social security number and dependent code link it to other relations. The admissions department would be responsible for maintenance of the data.

10. SPONSOR

This relation contains demographic information about an inpatient. Social security number links it to other relations. The admissions department would be responsible for maintenance of the data.

11. HISTORY

This relation contains historical and demographic data about an inpatient. Social security number links it to other relations. The ward the patient is housed on would be responsible for maintenance of the data.

12. ADMISSION

This relation contains the most current data about an inpatient and his/her medical condition. In addition it provides an audit trail for cost, physician activity and patient load on the hospital. Social security number links it to other relations. Admission clerk is responsible for maintenance of the data.

13. ADMINISTRATIVE

This relation contains data that is used to guage usage of personnel and facilities along with monitoring location of inpatient. The ward the patient is physically on is responsible for maintenance of the data.

14. MEB

This relation contains data on Medical Evaluation Boards. Social security number and dependent code link it to other relations. Patient Affairs (SGR) would be responsible for maintenance of the data.

15. TRANSFER

This relation contains data on inpatients that are transported to other medical facilities or into WPAFB-MC. The primary purpose is to maintain sorted record of days hospitalized. The ward the patient is assigned to would be responsible for maintenance of the data.

16. EMERGENCY

This relation contains data on who to notify if a patient experiences serious medical complications. The ward the patient is assigned would be responsible for maintenance of the data.

17. ABSENT

This relation contains data on patients that are not physically in the hospital. They may be on pass or located in a local hospital. The ward the patient is assigned would be responsible for maintenance of the data.

18. CASUALTY

This relation contains data on inpatient admissions for problems not related to viral or bacterial pathogens. Social security number and dependent code link it to other relations. Admissions office would be responsible for maintenance of the data.

19. DISPOSITION

This relation contains information on inpatient discharges. Social security number and dependent code link it to other relations. The ward the patient was assigned would be responsible for maintenance of the data.

20. WARD

This relation contains data on personnel and patients assigned to a specific ward. It also contains data on equipment located in the ward. Each ward would be responsible for maintenance of the data.

21. BED_STATUS

This relation contains data on availability of beds. Each ward would be responsible for maintenance of the data.

22. ROOMS

This relation contains data on the equipment each room has along with the location of the room. Plant Management would be responsible for maintenance of the data.

23. SUPERVISOR

This relation contains data used to track supervisory personnel. SGH would be responsible for maintenance of the data.

24. PERSONNEL

This relation contains demographic and credential data of each person assigned to the hospital. Administrative Office would be responsible for maintenance of the data.

25. MEDICAL_INSTITUTION

This relation contains location data of medical facilities that WPAFB-MC has patients transferred to or in from.

Appendix I

RELATIONS
(KEYS FOR EACH RELATION ARE DENOTED BY "*"s)

1. PATIENT

*SSAN, *DEP:CODE, NAME, BENE:TYP, SEX, HM:PH, DTY:PH, DOB, FL: STAT, ADDR, SPON, UNIT-ADDR

2. APPOINTMENT

*SSAN, *DEP:CODE, CLINIC#, TYP, PROV#, DATE, ST-TM, STP-TM, PROB, REC-REQ, XRAY-REQ, ARVL- TIME, PRIOR

3. TIME SLOT

*DATE, *ST-TIM, *PROV#

4. CLINIC

*CLINIC#, MAX-APT, TITLE

5. PROVIDERS

*SSAN, *PROV#

6. PROVIDERS SPECIALTY

*PROV#, SPEC-CODE

7. PROVIDER CLINIC

*PROV#, *CLINIC#

8. HOLIDAYS

*DATE-CLSD, *CLINIC#

9. REGISTRATION

*SSAN, *DEP:CODE, NAME, ADDR, CITY, STATE, ZIP, HM:PH, DAY:PH, PATIENT:CAT, SEX, MARITAL:STATUS, RACE, RELIGION, PRIM:CARE:PROVIDER, PRIME:MTF, ID:CD:EXP, FLY:SVC:CODE, EXPIR:TRM:SRVC, LNGTH:SVC, REGISTER:NO, AERO:RTNG, MEB:STATUS

10. SPONSOR

*SSAN, NAME, RANK, SERVICE, COMND:INTRST, ADDR, CITY, STATE, ZIP

11. HISTORY

*SSAN, *DEP:CODE, LST:INPAT:STATUS, CUR:REGIST:NO, UP-DATE:REGIST, LST:INPAT: DISPO, PREV:REGIST:NO, LST:OUT-PAT:CLINIC, DATE, DATE:INACT:STATUS

12. ADMISSION

*SSAN, *DEP:CODE, DATE, TIME, SOURCE:ADM, ADMIT:PHY, CLERK, TYP:CASE, ADMIT: DIAG, MED:HLD, MEAL:CD, ORG:AUTH:ADM, LNGTH:SVC, MEB:STATUS, CASUALTY, ABSENT: STAT, DATE:CNX

13. ADMINISTRATIVE

*SSAN, *DEP:CODE, ADMIT:STAT, WARD, PROJ:DISPO, ATND:PHY, DATE:ASIGN, NEW:MOD, CLINIC:SVC, DATE:SVC

14. MEB

*SSAN, *DEP:CODE, MEB:STATUS, DATE:CONFMD, DATE:IDENT, DATE:RESOLV

15. TRANSFER

*SSAN, *DEP:CODE, INIT:ADMIT, PREV:BED:DYS, PREV:QTR:DYS, PREV:COOP:DYS, ADMIT:DATE, PREV:SICK:DYS, PREV:CONV:DYS, PREV:OTHR:DYS, PREV:SUP:DYS

16. EMERGENCY

*SSAN, *DEP:CODE, NOTIFY:NAME, RELATION, ADDR, CITY, STATE, ZIP, PHONE, LEGAL:NXT:KIN, RELATION, ADDR, CITY, STATE, ZIP, PHONE

17. ABSENT

*SSAN, *DEP:CODE, EFF:DATE:TIME, ABSENT:STAT, DATE:RTRN:TIME, CIV:MTF, PHY, PHONE

18. CASUALTY

*SSAN, *DEP:CODE, DIAGNOSIS, DATE:KIN:NTFY, DATE, PROB:RECVR, DATE:CHG, DATE:RMVD

19. DISPOSITION

*SSAN, *DEP:CODE, DATE:DISPO, TIME, ADMIT:STAT, CLERK, TRANSFR:MTF,DISPO#, PHY: DISCHG, PHY:AUTH

20. WARD

*WARD#, #AIR:IN, #AIR:OUT, CUR:AIRIN, CUR:AIROUT, TTL:REF:DATE, TTL:IN:EVACS, TTL:OUT:EVACS, AIR:EVACS, BED:DYS, #BEDS, #RM, SUPERVISOR, #AUTH:NURSES, #NURSES

21. BED STATUS

*BED#, AVAIL:BED, RM#, BLCK:BED, OCCUPY:BED, PREADMITS

22. ROOMS

*RM#, LOCK#, KEY#, #BEDS, PHONE, INSP:DATE, WARD#

23. SUPERVISOR

*SSAN, LV, KEY#, WARD#, #EMP

24. PERSONNEL

*SSAN, NAME, RANK, DOR, TAFSCD, TAFMSD, DOB, DAS, ADSCD, PAFC, DAFSC, 2AFSC, 3AFSC, OFC:SYMB, DTY:PH, DTY:TITLE, HM:PH, GAIN:DATE, LOSS:DATE, POS#, SUPERVISOR:SSAN, CPR:TRNG:CODE, CPR:DATE, SEX, WORK:AREA

25. MEDICAL INSTITUTION

*MTF, ADDR, CITY, STATE, ZIP, PHONE, SERVC

Appendix J

Glossary

Relation: given a collection of sets D-1, D-2 ... D-n; R is a relation of these sets if it is the N tuple such that tuple element d-1 comes from D-1, d-2 comes from D-2 ... d-n from D-n.

Domain: in the data base context is the defined set of characteristics from which an attribute of a relation may be drawn.

Attribute: a single tuple element drawn from a designated domain; column in a relation.

Tuple: a collection of attributes; rows in a relation.

Primary Key: an attribute or combination of attributes which yeild a unique identification property to a tuple.

3NF: transitive dependencies are eliminated

VITA

Stephen G. Hull was born on 31 December 1949 in Daytona Beach, Florida. He graduated from high school in Daytona Beach, Florida in 1967 and attended University of South Florida from which he received the degree of Bachelor of Mathmatics in May 1972. In 1975 he received a commission in the USAF through OTS program. He completed navigator training and received his wings in November 1975. He attended the University of Southern California, California from which he received the degree of Master of Science in Systems Management in September 1980. He served as a C-141 navigator in the 63 MAW, Norton AFB, California until entering the school of Engineering, Air Force Institute of Technology, in October 1982.

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11. ANALYSIS OF ADMINISTRATIVE INFORMATION FLOW IN A MILITARY MEDICAL CENTER PURSUANT TO DESIGN OF A DATA BASE MANAGEMENT SYSTEM THAT WILL ULTIMATELY SUPPORT A HOSPITAL INFORMATION SYSTEM

19. A partial centralized relational data base in third normal form was designed for use by the staff of the United States Medical Center Wright-Patterson. Information requirements were gathered by means of an in-depth data/information analysis at the directorate and division level, and used as the basis of the design. Provided with the design is a detailed data dictionary and an implementation plan.

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