3

Overview of Information Systems Development in Health Services

Most information systems in health services organizations have evolved in a piecemeal fashion rather than resulting from a carefully controlled planning process. Specific requirements for capturing, storing, and retrieving data when needed have developed on an ad hoc basis as new services are added. The result often has been a series of problems and inefficiencies in information processes. The same data are captured repetitively; files are duplicated needlessly; information is not always available when needed, often resulting in patient inconvenience; and numerous other gaps and inefficiencies are commonplace.

As organizations grow more complex and as data processing technology becomes increasingly sophisticated, the need for careful planning in the development of information systems is paramount. Institutions can no longer afford the luxury of a laissez-faire, evolutionary approach to the use of information. Administrators must take responsibility for a careful, orderly process of planning to insure that information requirements are satisfied.

This chapter presents an overview of the process of information systems development in hospitals and other health services organizations as a prelude to more detailed material that follows in subsequent chapters.* Topics covered include master planning, systems integration, and alternative approaches to information system development. The master plan provides a framework for the detailed steps that follow in planning, designing, installing, and operating information systems. The chapter ends with a discussion of administrator and governing board responsibilities for overseeing the entire process.

*Some technical terminology is introduced in this chapter. For definitions the reader is referred to the "Glossary of Technical Terms."

Master Plan for Information Systems Development

This section presents for purposes of illustration the master planning process as it might occur in a single hospital.[1] The same general principles apply to other types of health services organizations. Further discussion of the special requirements of multi-institutional systems and vertically integrated organizations is included later in the chapter.

The development of information systems in a modern hospital is a complex task involving major capital expenditures and significant work force commitments if the systems are to function properly. The development of an overall hospital master plan for information systems development is an essential first step in the process. To exclude this essential planning activity would be analogous to beginning a major hospital construction project without functional specifications for the new building. And yet, many hospitals have moved directly into the development of computer systems without any kind of master plan.

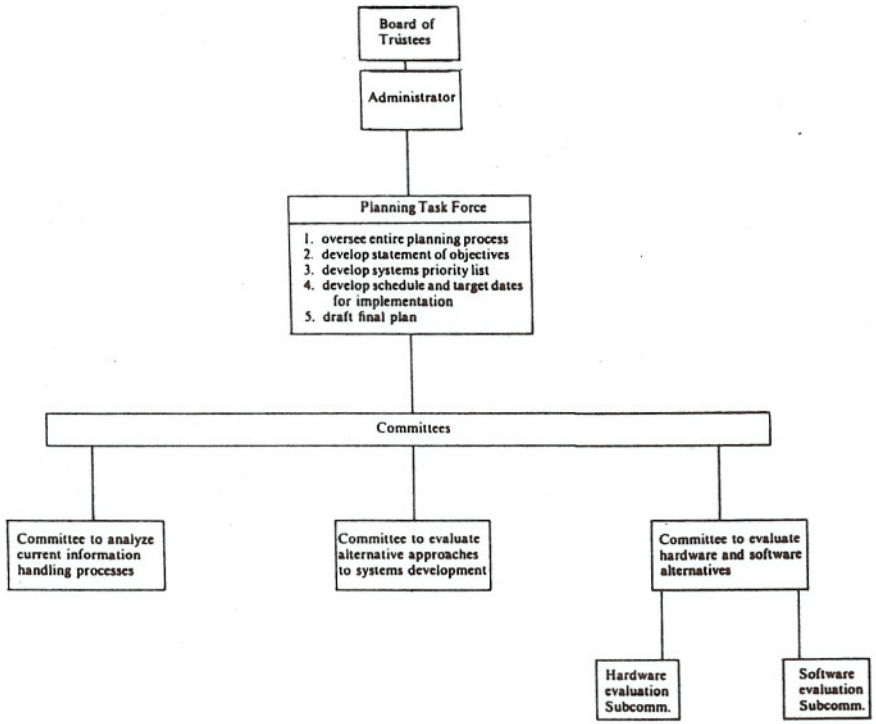
The hospital administrator should take direct responsibility for organizing the planning effort. A planning task force should be formed with representation from major organizational units, including the medical staff, nursing service, controller's office, personnel office, physical plant, ancillary service departments, and hospital administration. The task force should be directed by a knowledgeable member of the administrative staff or by a senior systems analyst or industrial engineer, if the hospital employs such a person.

A suggested organizational chart for the planning effort is shown in Figure 3-1. Task force members should serve as chairs for the committees; additional hospital personnel or technical consultants can serve as members of the specific committees and subcommittees.

Consideration also should be given to use of an outside consultant if additional technical expertise is needed, as it is in many hospitals. However, consultants should be chosen carefully. They should possess technical knowledge of systems analysis and computer systems and should be well informed about hospitals and their functioning. It is essential that consultants be independent practitioners not associated with any equipment manufacturer or firm that sells predesigned systems to hospitals. They must be familiar with the latest technological developments but must resist the temptation to push for applications that are too close to the leading edge.

The administrator also should insure that hospital staff members participating on the task force are provided sufficient released time from their normal duties so that they can participate fully in the planning efforts. Released time estimates should be drawn up in advance, and formal written notification of this

Figure 3-1
Organizing the Planning Effort



should be provided to all involved. The hospital administration and board of trustees should be prepared to spend a significant amount of the institution's work force resources on carrying out this important task. Although it is not possible to specify the time required to develop this master plan, a range of 6 to 12 months of intensive effort would not be at all unusual.

Figure 3-2 summarizes the major elements that should be included in the master plan, and Figure 3-3 is a flowchart showing the major steps in the planning process. The first step in the process is to carry out a general study of the hospital's current information-handling activities and practices. This is sometimes referred to as a preliminary systems analysis. Before the staff can make intelligent decisions about improving information systems, it must first document the present status of the hospital. The study should document current processing steps as well as the costs of generating and using information throughout the hospital for (1) direct patient care functions, (2) supporting services, (3) administrative and financial control, and (4) quality assessment and assurance. The techniques for carrying out the study involve principles of systems analysis,

Figure 3-2
Master Plan for Information System Development

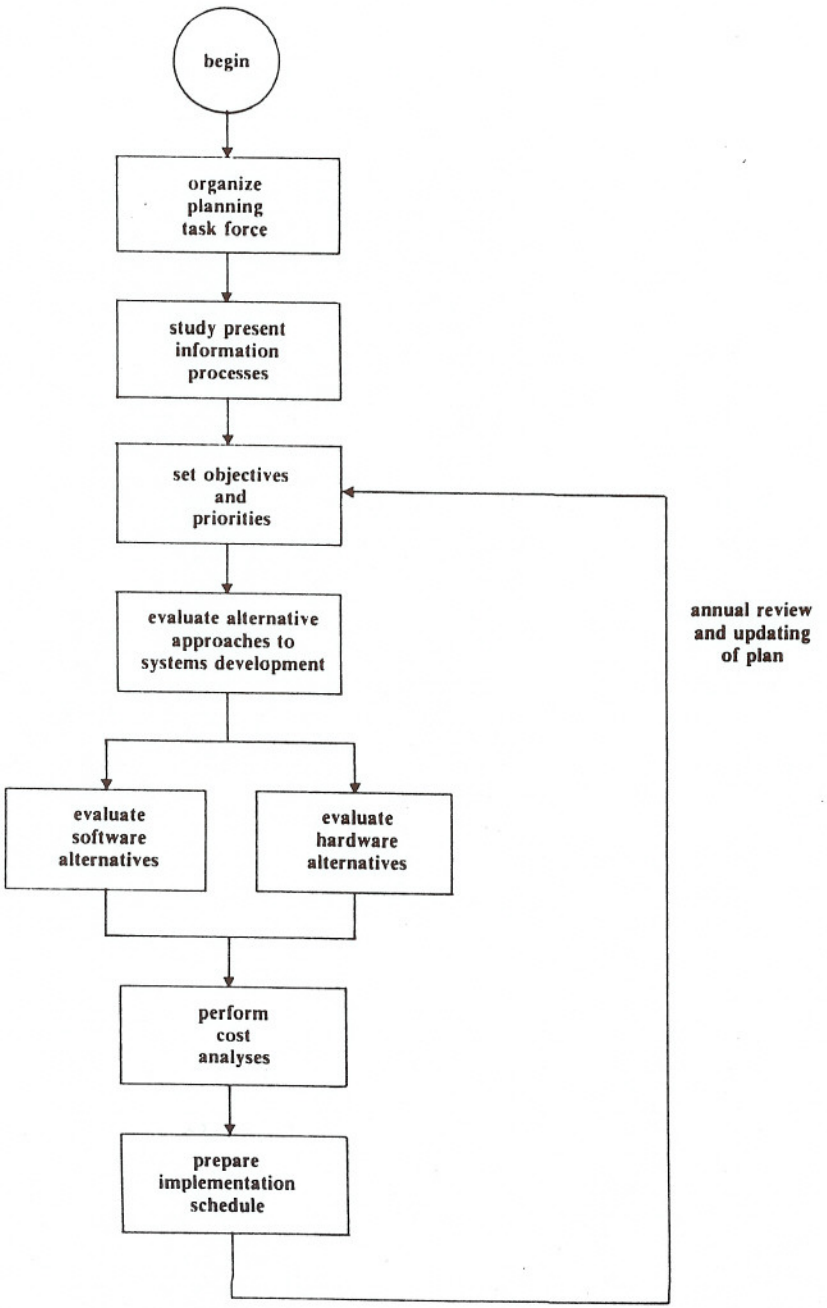
1. General documentation of current information handling processes and practices, including costs, gaps, and deficiencies
2. Statement of institutional objectives for information systems and establishment of a sequential priority list for implementation of systems in various areas
3. Evaluation of alternative approaches to systems development
   a. Individual systems—no attempt at integration
   b. Modular approach—interchange among systems
   c. Total systems approach—complete integration
   d. Distributed processing approach—network of mini- and microcomputers
   e. Central data base linked to decentralized computers (modified distributed processing approach)
4. Evaluation of alternative approaches to systems analysis, design, and computer programming
   a. In-house—hire and train analysts and programmers
   b. Contract services
   c. Predesigned or packaged systems
   d. Combinations of the above
5. Evaluation of alternatives concerning equipment
   a. Acquisition of in-house equipment
   b. Use of service bureau
   c. Sharing services with other hospitals
   d. Combinations of the above
6. Analyze costs of recommended alternatives
7. Establish a schedule and target dates for implementation of the system

which are discussed in detail in Chapter 7. Although a trained systems analyst is needed to carry out much of the work, there should also be heavy involvement of hospital operating personnel who are familiar with the functions being reviewed.

Given these baseline data on current hospital information processes, the next step for the task force is to develop a clear statement of objectives for the hospital to follow in initiating an information systems development program. These objectives should be as specific as possible and should flow from the deficiencies and gaps identified in the preliminary study just completed. Avoid general statements of objectives such as, "Information systems in Community Hospital should be designed to improve the quality of care and increase the efficiency of hospital operations." Such statements are self-evident and nonfunctional as far as planning is concerned. Rather, a detailed list of objectives should be established that will provide specific targets against which future progress can be measured and systems evaluated. Examples of specific objectives might include:

1. Information systems should be designed such that 75 percent of all necessary admitting information is obtained in advance from patients with elective admissions.

Figure 3-3
Flowchart—Master Planning Process



2. Information systems should be designed such that all diagnostic test results are available at the nursing unit within two hours after the tests have been completed.
3. Information systems should be designed such that all bills (patient pay and third parties) are in the mail within 72 hours of discharge.

The statement of objectives will aid the task force in completing the second part of step 2, development of a priority list for information systems development. The list should include all major functional areas of the hospital and should be rank-ordered in the recommended sequence for systems development. For example, the task force might determine that financial control is the most pressing problem within the hospital and direct that development of a financial information system take top priority.

After the first two steps have been completed, the task force should report preliminary results back to the administrator and board of trustees. The statement of objectives and priority lists should be carefully reviewed and modified, as necessary, before the next planning steps are undertaken. Given a comprehensive analysis of current information processes, a specific statement of objectives, and a priority list for systems development, the task force now needs to begin to examine various alternatives, indicated by steps 3, 4, and 5 in Figure 3-2.

The first (and perhaps most important) set of alternatives to consider relates to various approaches to systems design in the hospital. Although many choices are available, they cluster into five groupings. First, the hospital may choose to develop individual, "stand-alone" applications and not attempt to integrate them or transfer information from one application to another. Second, it might prefer to follow the most common approach—modular design, in which the system is implemented in functional units, or modules, with specifications for information interchange across modules. Third, the hospital might choose the fully integrated, or "total systems," approach, which involves one or more large central data bases with communications equipment employed throughout the hospital for entry and retrieval of information. Fourth, the hospital might choose to follow a distributed processing approach with multiple minicomputers or microcomputers, or both, initiated in a network of decentralized locations throughout the institution. Finally, a combination of steps 3 and 4 might be followed utilizing a central data base in communication with a network of decentralized microcomputers throughout the hospital.

The committee that is established to examine these alternatives should be staffed primarily by technical personnel—hospital information systems analysts or consultants—working with a representative of the hospital administration. This committee should review the experience in information system development of other hospitals of similar size and with similar functions. Costs are obviously an important factor. The total systems approach will require a major immediate commitment of capital funds, whereas the more cautious modular approach will

require incremental allocations of capital. Therefore, costs and benefits should be examined for a long-range period (five to ten years).

Once an approach to systems development has been selected, consideration must next be given to the human resources required to carry out the detailed work of systems analysis, design, and computer programming. It is important that this step be carefully planned, since major staffing commitments are required to carry out a comprehensive systems program in the hospital. Several alternatives are available. The first would be to recruit and train an in-house staff of systems analysts and programmers. A second approach would be to contract for services with firms that specialize in systems development and programming. A third would be to use predesigned or packaged programs to carry out the various functions included in the priority list. And, of course, various combinations of these approaches are possible. The hospital, for example, might choose to use contract services for development of clinical systems, to buy packaged systems for payroll and patient accounting, and to develop its own staff for systems maintenance and development of additional applications. Although the staffing decision does not have to be unalterable, initial planning of human resource requirements is an essential part of the master plan.

The final set of alternatives relates to computer and data processing equipment choices. Once again, the hospital has several options available. It may choose to acquire and install its own equipment, either purchasing or leasing. Or it could choose to utilize outside services from organizations that sell computer time and other data processing services. Hospitals in one community or part of a larger organization might join together in sharing the costs and services of a central computer installation. Of course, various combinations of these choices are possible. Some hospitals might choose to employ the "turnkey" approach, in which one vendor supplies all equipment, computer programs, and personnel for operations and maintenance on a contract basis.

Intelligent choice among all the alternatives described above obviously requires a combination of technical knowledge and knowledge of the detailed objectives of the hospital. Hence, the planning task force must be sure that both kinds of skills are available in developing its recommendations.

Once a set of alternatives has been selected, it must be subjected to a thorough cost analysis. Costs should be presented in three major categories: (1) costs of system design and implementation, (2) costs of operation, and (3) costs of system maintenance. The final element of the master plan is an overall schedule and set of target dates for implementation. Although cost estimates and target dates will be preliminary at this point, they will aid hospital administration and board members in evaluating the magnitude of institutional commitment required to implement the recommended set of alternatives.

As with any plan, the master plan for information systems development must be a dynamic instrument which is reviewed periodically and updated. At least once a year progress should be reviewed against the original criteria set forth in the plan, and the plan should be changed as necessary. Hospitals that already have some computerized systems in place, but have not developed a master plan, should begin the planning process with a review of existing systems before proceeding to the setting of objectives and priorities (see Figure 3-3).

Alternative Approaches to Systems Development and Implementation

Several alternatives are available to health services organizations for the design and installation of information systems, including in-house development, use of shared services, use of packaged systems, and employment of contractual services. Whatever approach is followed, decisions should be made in reference to the master plan for information systems development, as discussed earlier in this chapter. If outside services are to be employed, particular attention must be paid to ensuring that the resulting systems can be integrated with others in the organization.

There are several advantages to an in-house design effort. System requirements can be tailored to specific organizational needs if the institution develops its own system. Control over system integration will be easier to achieve, and operational maintenance will be facilitated by having an in-house staff that is completely familiar with the system and how it functions. Disadvantages of the in-house design approach include the possibility of reinventing a system that has already been developed and tested elsewhere, as well as the relatively high costs associated with a comprehensive design and implementation effort.

Many health services organizations are now employing predesigned, or packaged, systems available from software vendors rather than entering into in-house design projects. If packaged systems can be used extensively, then fewer technical design and programming personnel will be needed, with savings accruing to the operating budget. With software packages, the developmental costs involved are shared by the multiple users of the packages.

Care must be exercised, however, in the use of packaged systems. Many predesigned packages may not meet specific institutional requirements and many modifications may be required. The cost of making these modifications could exceed the savings realized by using the package. System maintenance also can be a problem when packaged systems are used. The software firm may hold copyright privileges and might charge high fees for modifying the package to meet changing needs of an individual organization. If the institution is permitted to make its own changes, then the documentation provided by the vendor must be accurate and sufficiently detailed for use by maintenance programmers.

The following factors should be considered in the evaluation of packaged systems:

1. Does the package meet the specific needs of the institution? If not, is the organization willing and able to adjust to the general system specifications?
2. Who else has used the package? Careful reference checking is essential.
3. Can the packaged system be implemented on the existing computer configuration? If not, what will be the costs of hardware modifications?
4. How will the system be maintained? How good is the documentation? How difficult will it be to make changes?
5. What will be the costs to: (a) purchase the package; (b) implement it on the organization's existing hardware; and (c) maintain it after it is operational?

A third alternative to in-house design or purchase of packaged systems is the use of contractual services for design and implementation of systems. Such services can be purchased from several vendors specializing in systems analysis and programming. Contracts can range from purchase of services on an hourly basis to fixed price contracts for a total turnkey effort, in which the entire project is handled on a contractual basis. The following factors should be considered in evaluating responses to a request for proposals (RFP) for contract services:

1. Carefully review the prior experience of the contractor. Talk to several previous clients.
2. Review the credentials (experience and training) of the specific personnel to be assigned to the project. Insist that the contractors identify the specific individuals to be assigned to the project.
3. Check the proposal to be sure it employs well-established principles of systems analysis and design in its methodology.
4. Carefully examine the cost estimates. Be sure they are thoroughly prepared, complete, and comprehensive.
5. If necessary, use a neutral, disinterested party (independent consultant) to assist in the technical evaluation of proposals. Further discussion of contract specifications and evaluation of proposals is included in more detail in Chapter 6.

A fourth alternative available to some hospitals and health organizations is the sharing of services with other institutions. Shared hospital information services are available in a variety of forms, including (1) services offered by corporate headquarters to members of hospital systems or chains; (2) voluntary affiliations of hospitals that organize to share services; and (3) contracts with service bureau organizations that sell shared services to hospitals.[2]

A 1980 report indicated that 73 nonprofit and commercial shared service organizations were providing computer services to 2,219 community hospitals in

the area of financial applications.[3] Forty-four of the organizations were affiliated through formal ownership or contractual management with the hospitals they served, 18 serviced both affiliated and unaffiliated hospitals, and 29 provided services on a purely contractual basis.

Combinations of approaches are also possible. Whatever the approach or combination of approaches to be followed, the principles of master planning, system integration, and use of well-accepted practices of systems analysis and design must be followed. Management must be sufficiently involved in project oversight to ensure that such is the case.

Integration of Information in the Age of Microcomputers

Information systems, to be effective, must be integrated; that is, individual systems must be able to communicate with one another and share information. For example, a computer system in the clinical laboratory designed to keep track of laboratory tests ordered must not only produce reports of test results for the patient's chart, but this system must also be able to communicate electronically with the hospital's automated patient accounting and billing system.

There are five basic approaches to integration of systems, depicted in Figures 3-4, 3-5, 3-6, 3-7, and 3-8. The health service organization may choose to develop individual and independent systems for each major application area with no attempt to build relationships across the several information systems to be developed (see Figure 3-4). Note that in this alternative, each system stands alone and there is no data communication across systems. Most hospitals started into the data processing business following this approach. Although the task of systems design and programming is less complicated, the lack of integration and information transfer across systems constitutes a major disadvantage and inefficiency which often causes problems later. Almost all hospital functions, clinical and administrative, are closely interrelated, and hospitals are well advised to think seriously about the consequences of following a completely independent, nonintegrated approach to systems development.

The second approach, modular design, is the one used most frequently in hospitals and other health services organizations. A graphic description of this approach is included in Figure 3-5. The basic concept is to design systems in functional units, or modules, and to plan for information interchange across modules through planned data transfer techniques. Note that in Figure 3-5, Module A operates independently of Module B except in the sharing of information common to both systems. For example, a system might be designed for processing laboratory orders and test results (Module A), and this system could be so planned as to provide data directly to another system for processing patient charges (Module B).

The third option is the total, or fully integrated, systems approach (see Figure 3-6). In this case, one large system is designed centering around one or

Figure 3-4
Alternative Approaches to Systems Development: Individual Applications Approach

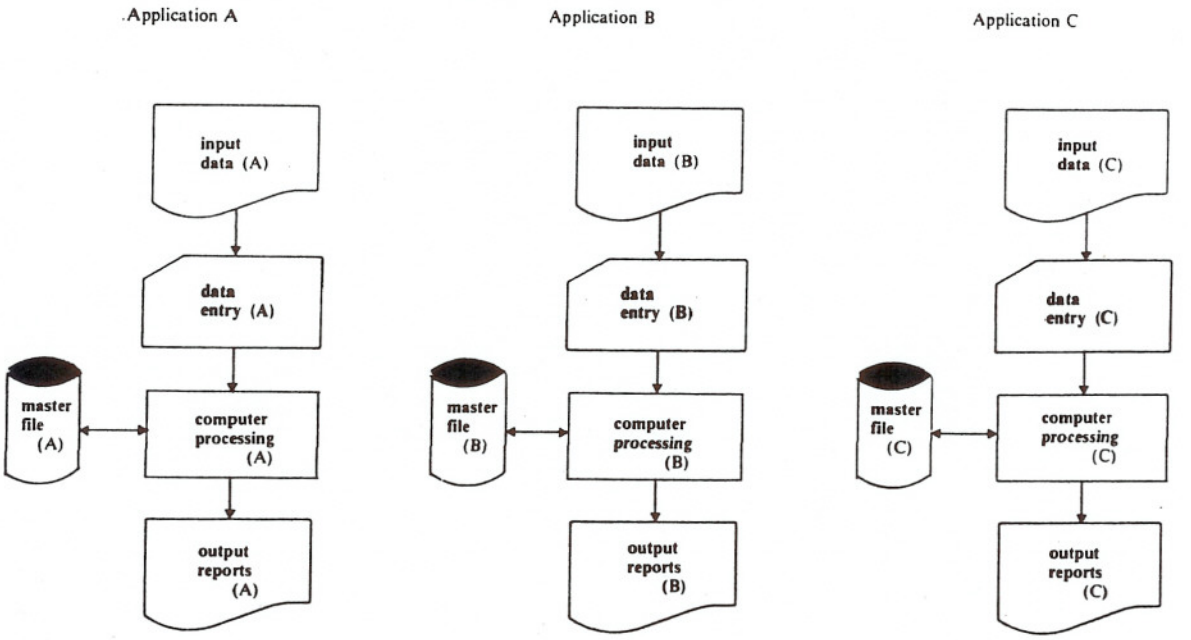
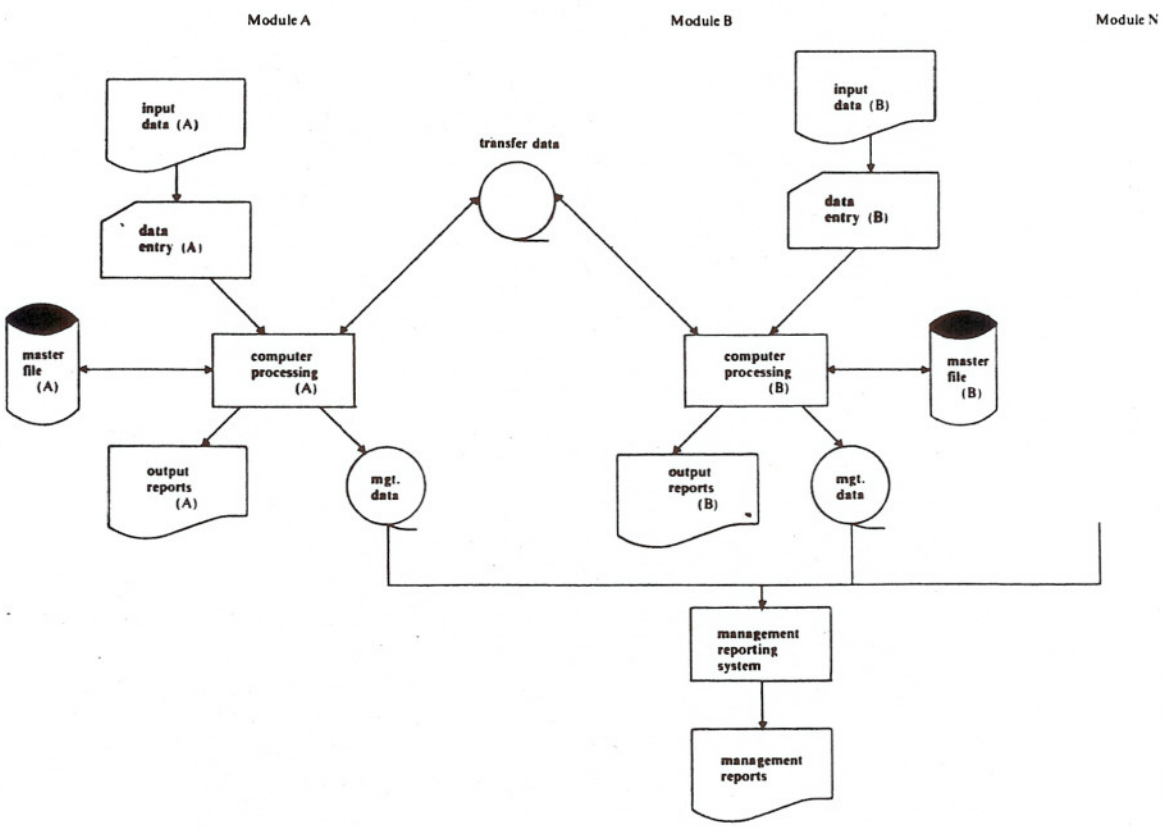


Figure 3-5
Alternative Approaches to Systems Development: Modular Design Approach



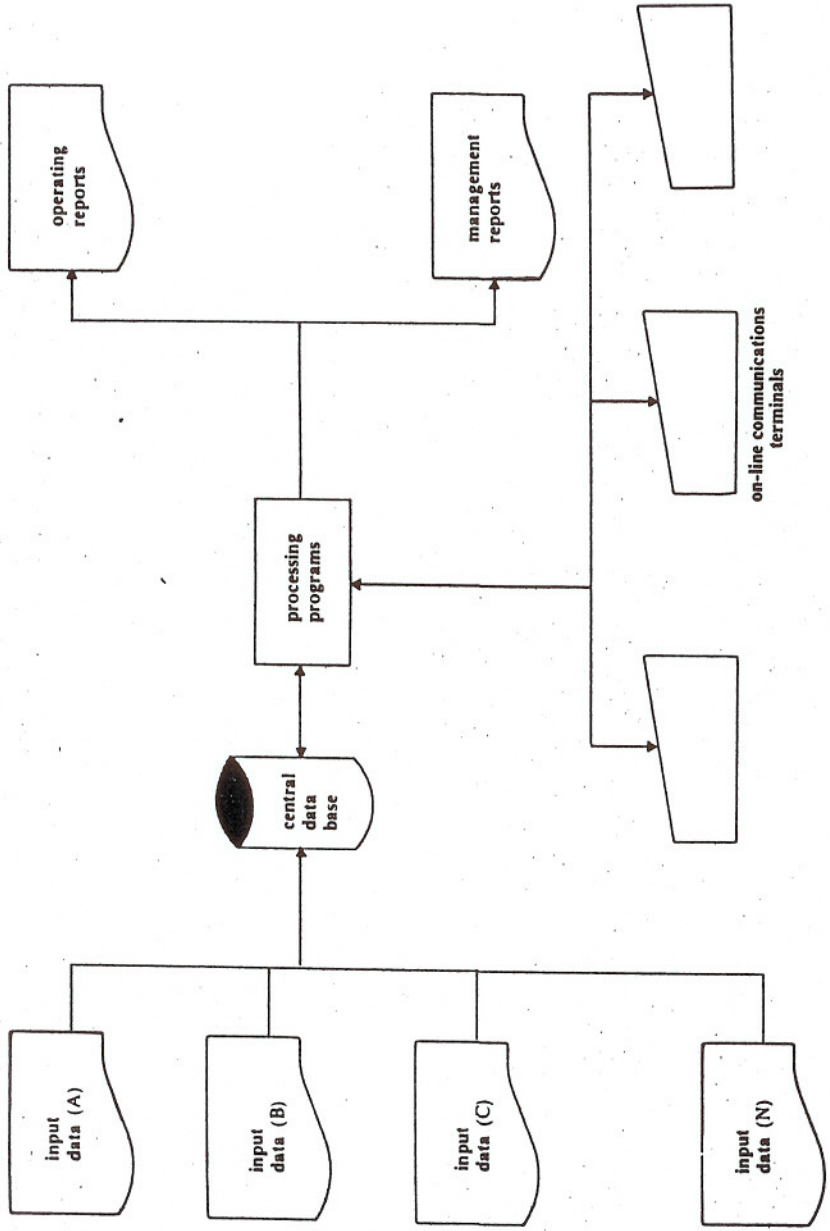
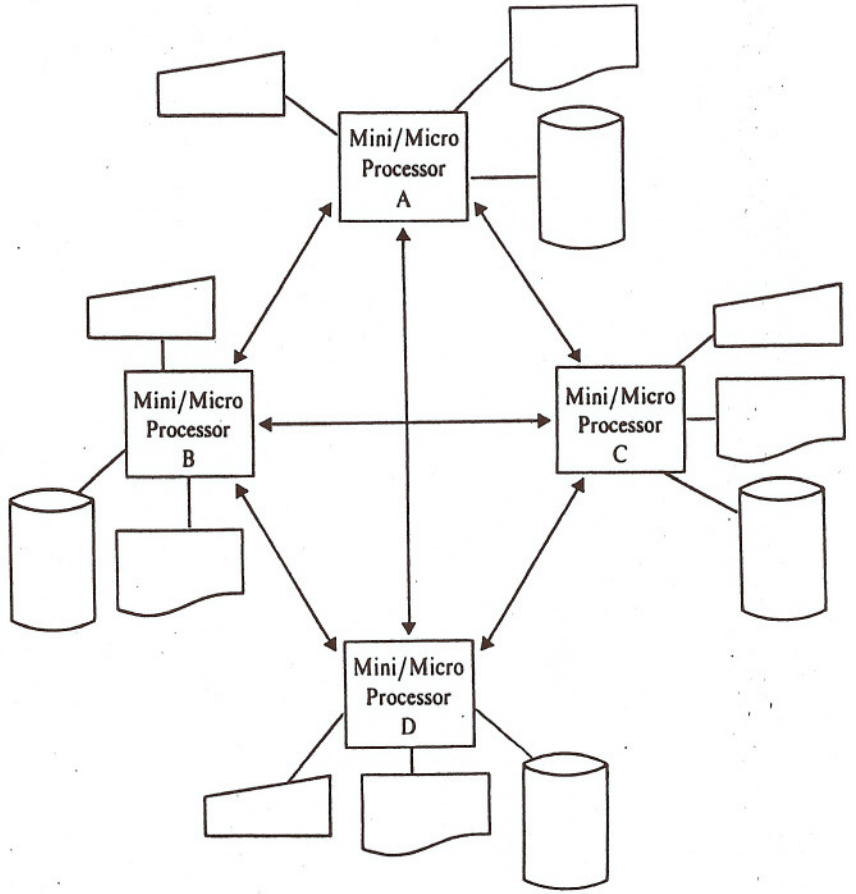


Figure 3-6
Alternative Approaches to Systems Development: Total Systems Approach

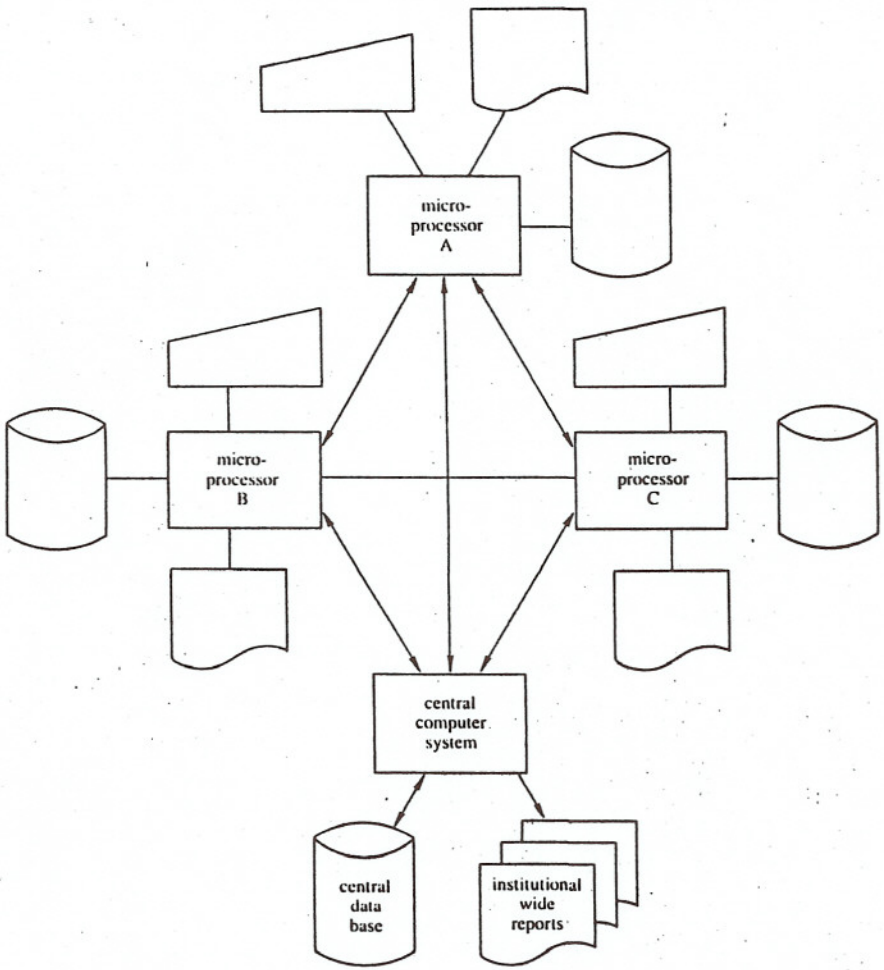
Figure 3-7
Alternative Approaches to Systems Development:
Distributed Processing Approach



more central data files (referred to as a central data base) which provide information to a variety of areas in the organization.

Several prototype systems have been developed around a central file of patient information available for retrieval and automatic communication of information throughout the health services organization for both clinical and administrative uses. Examples of such systems are included in Part IV. Although this alternative is an attractive one conceptually, the costs and complexity are on an order of magnitude greater than the other two approaches. The organization would need to consider this route very carefully and be sure that there is a

Figure 3-8
Alternative Approaches to Systems Development:
Modified Distributed Processing Approach



complete commitment to carry it out, including making sufficient capital resources available. The importance of complete integration increases with the size of the health services organization, since communication breakdowns often occur in very large, complex settings. Also, the resource base of a large hospital is more likely to be able to carry the expense of installing a total system, so this alternative seems to be one for serious study by larger hospitals (300 beds plus).

The fourth approach, and one of growing interest in hospitals, is the distributed processing approach (see Figure 3-7). The costs of small, but powerful, mini- and microcomputers have come down substantially in recent years. Some health services organizations have chosen to decentralize their information processing and install several small computers at different departmental locations. Thus, the admitting department might have its own computer and do its own processing, as would the laboratory, pharmacy, outpatient department, patient accounting department, etc.

If this approach is followed, careful central planning and control must be maintained. Each system must be planned so that it can share information and communicate with the other systems in order for integration to be achieved. If individual departments are allowed to go their own separate ways, then there is little probability that systems can be integrated, with organizational chaos the likely result.

A variation of the distributed processing approach is shown in Figure 3-8. Decentralized microcomputers at departmental locations are linked directly to the organization's central computer (mainframe) for access to the central data base and for input of data needed to prepare institution-wide reports. This approach is becoming more common in larger hospitals and medical organizations.

A Generalized Approach to Information Systems Development

Guided by the principles embodied in the master plan, there are well-established procedures to follow in the design and implementation of individual information systems, regardless of whether the work is being done by in-house systems personnel or through contractual services. It is the responsibility of the administrator to oversee the process and to be sure that sound procedures are not bypassed or cut short in an effort to get a system implemented quickly. The five basic steps required in the complete cycle of information systems development are:

- Systems analysis
- Selection of design approach
- Systems design
- Implementation
- System maintenance

Each of these steps is examined in detail in Part III. The discussion which follows presents an overview of the entire process.

Systems analysis, the essential first step in any information systems project, is the process by which current information practices are reviewed and new or modified system requirements are established. Simply defined, *systems analysis is the process of collecting, organizing, and evaluating facts about information system requirements and the environment in which the system will operate.*

To use the analogy of a construction project, systems analysis is comparable to the first stage of a construction program in which management, working with the architect, develops functional specifications for the building. In a systems project, management should work with the head systems analyst to delineate the information requirements the system must meet.

The second major step in the process is selection of a design approach. Guided by the master plan, which specifies the overall approach being followed (e.g., development of compatible modules rather than the total system approach), the specific approach to design of each particular system must be delineated in advance. Choices range from minor improvements upon the existing method of obtaining the information (no automation) to complete design of an automated information system with no present constraint being placed on the new system. This point in a system project is an important transitional period in which a decision to proceed or not to proceed can and should be made. Unfortunately, too many organizations have been unwilling to make a decision *not* to proceed, either because of inadequate systems analysis or unwillingness to accept an analysis that indicates that the present manual system is working well.

Once a design approach has been selected, and assuming that a decision has been reached to proceed with the development of a new information system, the process of system design begins. System design is the architectural phase of the project. The results of the design effort should be a detailed set of written system specifications covering all elements of the new information system: inputs, outputs, master files, computer programs required, operating procedures, cost estimates of the new system, and other items to be discussed more fully later. In addition, plans should be included for a manual backup system to be used when the main system is down for any reason.

The system specifications should be subjected to a formal review procedure involving written sign-off by management and all operating departments involved in the new system. This represents another critical decision point at which the "go" or "no go" decision should be reviewed. The development of detailed system specifications could provide additional data showing that the new system will be too expensive or will not meet operating requirements. If such is the case, management and systems personnel must make the difficult decision not to proceed with the project.

Given a completed set of detailed system specifications approved by management, implementation of the system can proceed. Implementation involves more than just writing computer programs. It also entails ordering equipment, preparing space for the equipment, training personnel to use the system, and, above all, careful testing prior to operational use of the system. The importance of careful system testing cannot be overemphasized, and many catastrophes could have been avoided if adequate testing had been carried out in advance.

Systems maintenance is the final step in the cycle and one that is often ignored, with disastrous results. Many people, including some administrators, believe that an automated information system, once operational, does not require further attention. Nothing could be further from the truth. No matter how good the system testing, operational systems are subject to occasional breakdowns, and trained personnel must be available to make quick corrections. Health services organizations are dynamic, and the requirements placed upon an information system are subject to constant changes. Hence, maintenance personnel are needed to make these required changes. Finally, all information systems should be periodically evaluated, and changes should then be made to improve the effectiveness and efficiency of each system.

Differences in Approach Based on Organizational Size and Complexity

As with most management decisions in hospitals and other health services organizations, decisions about the most appropriate approach to information systems development will be situational, based upon current and projected needs and the present state of development at each institution. However, certain general statements can be made about differences in approach as influenced by organizational size and complexity.

Information systems in smaller hospitals will, in general, be smaller and less complex. Potential deficiencies in system integration may possibly be overcome through direct communication among hospital personnel. Alternatives for the smaller hospital will be more limited since the budget base for capitalization of a major design and development effort will be limited.[4] Minicomputers and microprocessors, particularly small business computers, are now within the price range of most small hospitals. The key to their feasibility is the availability of accompanying software packages to support hospital applications. Shared computing arrangements will continue to be attractive to smaller hospitals, particularly when predesigned software systems are included in the sharing agreement.

Information systems in larger organizations are, of course, more complex and more difficult to design and implement. Integration of systems becomes particularly important in order for systems to function effectively in support of operations. Predesigned packaged systems are less likely to meet the particular needs of large hospitals which tend to develop their own particular way of doing business suited to their situational environments. The budget base of the larger organization, however, makes more alternatives potentially feasible, including the relatively expensive capital costs of in-house system development. Distributed data processing has become an attractive alternative to the cost and complexity of the total system or central data base approach for large, complex facilities. However, as mentioned previously, unless careful controls are exercised by management, lack of system integration and inability of systems to communicate with one another could result from the decentralized approach.

Special Considerations for Multi-institutional Organizations

Multi-institutional systems must consider the need for integration of information systems across institutions as well as within individual organizational units. Such integration is particularly critical in vertically integrated organizations where patients may progress and seek treatment at various organizational components, including clinics, surgicenters, acute care hospitals, substance abuse centers, and skilled nursing home facilities. Information systems must be patient-centered in order to aggregate data from the various medical care units and track patients throughout the system.

Information systems for multis must also be able to provide comparative financial data in order for management to efficiently allocate resources to individual units. Such a capability is especially critical when health care costs are paid on a capitation basis. Corporate management will need to carefully monitor how patient care dollars are being spent across system units for actuarial risk analysis.

Multis also have special information needs in market research and analysis of competitor services. Physician performance in various components of the system must be monitored as well.

At the technical level, information systems for multis require standardization of coding and data definition for all organizational units—for example, a common chart of accounts for financial reporting. In order to serve both corporate management information needs and the operational support requirements of each medical care unit, multis need to "strike an appropriate balance between central control of data management and local control of data processing."[5]

Sandrick summarizes the special needs of multis as follows:

> Industry experts predict that in coming years, multi's will need to aggregate data by patient, track patients throughout the multihealth care system, follow competitors' movements in the marketplace, develop new measures of performance and quality health care, and strike a balance between central control of data management and local control of data processing.[6]

Behavioral Aspects of Systems Development

The major problems encountered in system development projects are human problems. Computer technology has advanced rapidly, and well ahead of our ability to employ it effectively. Consequently, attention to behavioral factors in the design of systems is essential. An understanding of these factors by management personnel will facilitate effective project oversight. Administrators need to understand some of the characteristics of technical personnel involved in systems analysis and programming and must also consider how personnel from user departments may respond to a new approach to doing business.

Consider first some of the concerns user personnel often have about a systems project.[7] Fear of change is a common problem faced in many system development efforts with resultant employee anxiety and tension. Employees will have concerns about possible effects of the new system on their own jobs and possible changes in the work environment that may be required. Managers may have concerns about changes that could result in the redistribution of power, greater centralization of authority, or increased accountability as by-products of the new system. Some may have concerns that the information system will result in more rigid and less flexible patterns of operations, with resultant lack of discretion in carrying out a task. Often, these concerns are unfounded and based upon misunderstanding of the technology involved.

Whisler describes another common concern—that automated systems somehow will inhibit creativity on the part of the innovator, the entrepreneur, the organizational maverick. On the contrary, when properly designed, automated systems should open up new opportunities for creativity because of expanded information available to the innovator and decision maker.[8]

Technical personnel (programmers and analysts) also have their idiosyncracies. Characteristics of such personnel are discussed in more detail in Chapter 10. However, at the risk of overgeneralization, they tend to be technocratic, absorbed in the mechanical details of their systems, and may not be people-oriented in their approach to problem solving. And yet, analysts and programmers must work closely with personnel from the user departments in the development of system specifications. On occasion, technical staff may lack understanding of the politics of an organization and become so fascinated with the technology that they ignore the realities of the organizational setting in which the system must function.

There are several ways to deal with the human problems. Open communications are essential. Whenever possible, avoid being secretive during a systems development project. Provide a comprehensive program of staff orientation and training prior to initiating a design effort. User involvement at all stages of a project is essential. Structure the project in such a way that users will be part of the design of the system and "buy in" from the very beginning. Make top-level management support explicit and visible, and reinforce that support periodically.[9] Develop appropriate institutional rewards that encourage creativity and risk-taking, and develop procedures for resolving conflict when that becomes necessary. Above all, managers must work at understanding the needs and motivations of all the people who will be involved in the system in order to develop an effective work plan and mode of operation for the development project.

Ramsgard summarizes the need for a new kind of systems management quite well:

> When the systems analyst becomes a member of the user group and functions truly as a doctor of business, a diagnostician of business ills, the caste system will break

down and we can anticipate changes in traditional roles. Administrators will begin to replace technicians as the directors of computer operations. . . . Long ago it was found that the best surgeon did not make the best hospital administrator, nor did a good engineer always make a good engineering manager. Now it is data processing's turn to become professionally administered.[10]

Governing Board and Management Responsibilities

What, then, is the health administrator's role in developing an information system? In general, the administrator's responsibilities are to oversee the entire process and to be sure that systems development in the organization is properly managed. It is very important that the administrator participates actively in these developmental efforts and ensures that other key personnel do the same. The need for careful management is self-evident given the magnitude of capital expenditures required for the development of computer systems in the institution.

An important responsibility of the administrator is to organize project teams for systems analysis, design, and implementation. Each major information systems development project should be so organized. A senior systems analyst, knowledgeable about the health organization and its idiosyncracies, should serve as team leader. At least one key person from each operating department to be included in the system should be assigned to the team, and there should be one administration representative as well. After the team has been organized and has completed a preliminary assessment of the task to be accomplished, a written schedule and time commitment for each member of the team should be drawn up and approved by the administrator. This is an important step, since the pressure of day-to-day operations and the crises that inevitably occur can stand in the way of effective participation if not formalized and agreed to in advance.

The administrator should insist upon receiving periodic progress reports and updated schedules from the project team. He or she should meet with the team regularly for an oral report and sharing of information. In reviewing progress, the administrator should be certain that the five-step procedure described previously is being followed. Specifically, he or she should insist that careful systems analysis precede any implementation decisions. The recommended design approach should be checked for compatibility with the organization's master plan, and system specifications should be carefully prepared and formally reviewed before implementation begins.

During the implementation phase of the project, the administrator should check to see that adequate training of personnel who will be involved in the new system is conducted and that good documentation and procedures manuals are prepared. Of paramount importance, the administrator should check plans for complete system testing prior to final conversion to operational status. Proper provisions should also be made for systems maintenance after the new system goes into production.

Summary

Information systems development in the health services organization should begin with development of a master plan. The plan should include study of existing information processes, statement of objectives and priorities, examination of alternative system designs, examination of staffing approaches, analysis of equipment alternatives, cost analysis, and schedule and target dates.

Systems analysis, design selection, systems design, implementation, and maintenance are five steps essential to the development of good information systems, and none of these should be cut short in a rush to make a system operational. Decisions can and should be reached at various points in this cycle to drop the system when data show that costs may be prohibitive or that the system will not provide the anticipated benefits.

System integration, that is, the ability of information systems to communicate with one another and share information, is essential. Integration can be achieved through the modular design approach, a total systems approach employing a central data base, or a carefully planned network of distributed processing centers located throughout the health services organization.

Several alternatives are available for the design and installation of information systems, including in-house development, purchase of packaged systems, employment of contractual services, use of shared services, and various combinations of these alternatives. Organizational size and complexity will influence the alternatives chosen, with in-house development more practical for larger institutions and use of packaged systems on microcomputers becoming attractive to smaller medical care units.

Since information systems are designed, operated, and used by people, knowledge of behavioral factors and how they can affect a system is essential. Computer technology is well ahead of our human ability to employ it effectively in organizations.

It is the responsibility of administration to ensure that good management practices are followed in the planning and design of information systems. Management must take the lead in the development of a master plan and must carefully monitor specific systems development efforts that spring from the plan to be sure that good design practice is followed.

Part III of this book is a more detailed and somewhat more technical explanation of the principles and processes introduced in this chapter, and Part II presents technical information on computers. The reader who does not desire more detail on computer hardware and software, systems analysis, design, and implementation may turn to Part IV for a discussion of specific information system applications in health services delivery.