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## Design and Development Methods for Project MIS

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DESIGN AND DEVELOPMENT METHODS  
FOR PROJECT MIS

BY

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B.S.I.E., University of Florida, Gainesville 1968

RESEARCH REPORT

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## INTRODUCTION

A Management Information System (MIS) is an information network of operations, practices, and procedures designed to meet the goals and objectives of management. The purpose of MIS is to convert information into management action.

Management Information Systems are found in all areas of the firm. They are becoming increasingly more mechanized, more complex and often involve multiple functional organizations. The scopes of today's systems are encompassing not just clerical functions but major portions of the operational control functions, management decision making and in some cases, strategic planning for the firm. These advances have been made possible by the technology explosion in the computer industry. MIS has evolved into sophisticated, interactive systems with integrated data bases, real-time processing and on-line input and output devices.

Management Information Systems are frequently criticized for not meeting management's objectives, as well as for being too costly and non-responsive to management's information needs. The adage that the operation was a success but the patient died is often true of MIS projects.

This paper addresses this problem by researching the methods used to design and develop Management Information Systems. Section I presents the MIS project approach. It discusses the project phases,

their objectives, the methods used and the project documentation. Section II is an analysis of the MIS project, pointing out the weaknesses and the reasons why the project itself is a success but often the end product quickly becomes unmanageable. Section III presents the changes that are required in the project objectives, the methods used, the personnel assigned and the documentation. These changes will reduce the management risk of failure of the MIS project and increase the probability of the end product, the information system, meeting managements needs.

## I. THE MIS PROJECT APPROACH

The study method employed for the development of business systems, particularly mechanized business systems, is the project approach. The total effort is considered as a project and is divided into a series of phases<sup>1</sup> as shown in Figure 1. Each phase is distinct. However, occasionally it may be practical to combine two or more phases; e.g. in the case of small projects the Requirements Definition and System Specification may be combined. This is generally limited to the first three phases of a project. It is normally not practical to start programming until the technical design is complete.

Projects to design and develop new business systems are given birth when the firm's management determines that there is a need for change. This need may arise for various reasons. For example, the firm may be expanding and more accurate and complete controls may be required to aid management in the decision making process, or it might be that a present control system is either non-responsive or too costly and may need a redesign to meet management's needs. In response to such a need, management will initiate a feasibility study to determine in which direction change should take place.

### Feasibility Study

The Feasibility Study is an investigative and analysis process into the problem areas creating the management need.<sup>2</sup> Through

<sup>1</sup>Martin Marietta Data Systems, Systems Development Methodology (Orlando; Martin Marietta Corp., 1974), I, p. 13.

<sup>2</sup>Ibid., II, p. 75.



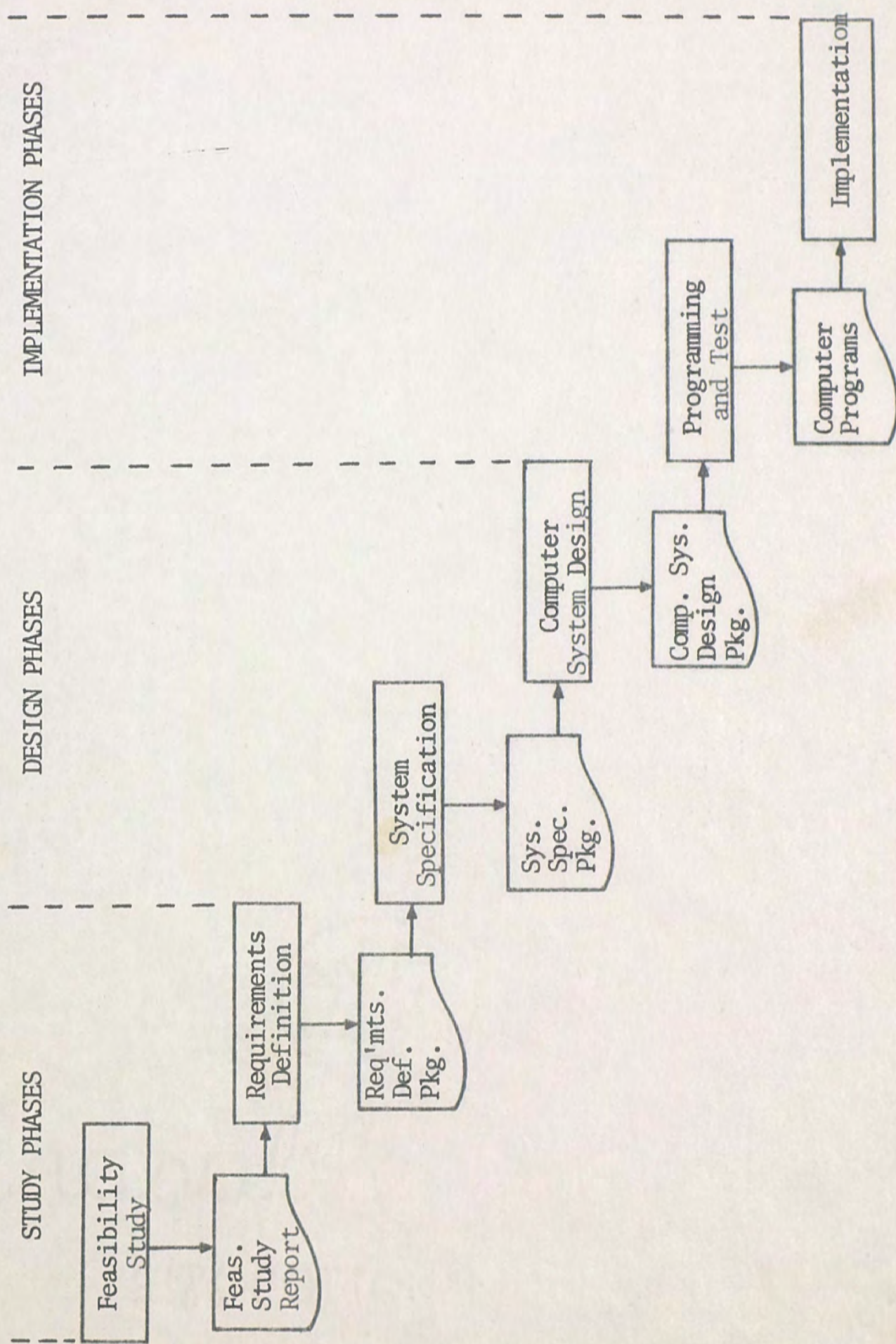


Fig. 1. MIS project phases

this analysis various alternative solutions are identified. The types of solutions will vary widely depending on the particular need or problem being addressed. For example, they could range from changes in operating practices and procedures, to departmental reorganizations, to the redesign of existing mechanized systems, to proposed new mechanized business systems or a combination of these. For each alternative, the benefits, risks, development costs and operating costs are determined. Each alternative is then evaluated in terms of its ability to meet the need, its cost effectiveness and its soundness of approach. And when weighed against management's objectives, the most attractive solution is selected and a plan is developed, including budget and schedule, to implement the proposed solution.

Management then reviews the results of the Feasibility Study. This is the first of many project reviews which occur between each of the project phases. A decision is made as to whether the proposed project is in fact a viable solution to management's needs or that further investigation and analysis is required. The elements of the Feasibility Study phase are depicted in Figure 2. The type of project considered in this paper is the design and development of a new mechanized business system.

#### Requirements Definition

The next project phase is the Requirements Definition. As the name implies, this phase is the process of identifying the detailed requirements that the new business system must meet.<sup>1</sup> The scope of this phase will vary with the scope of proposed system under study.

<sup>1</sup>Ibid., II, p. 231.

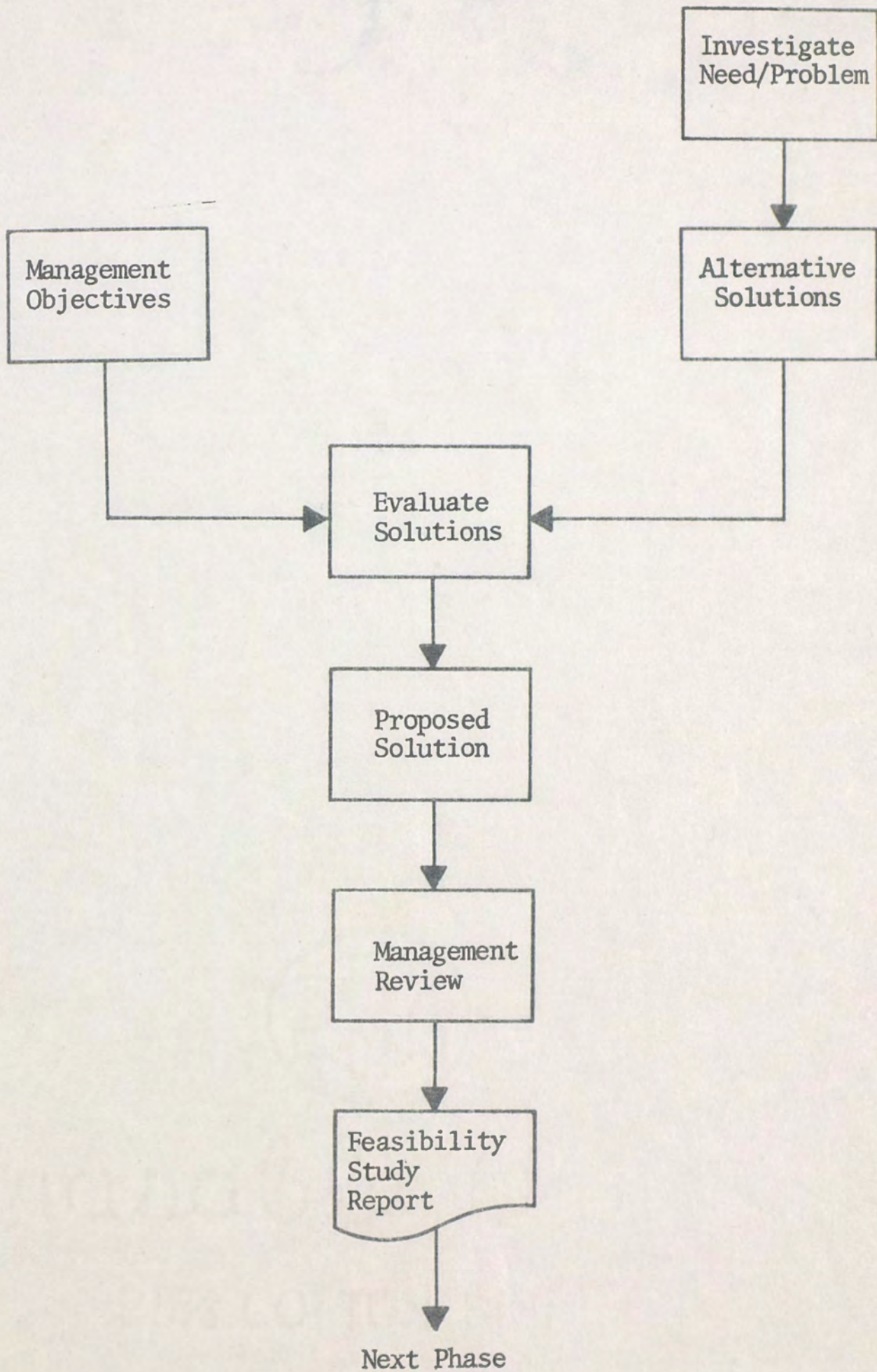


Fig. 2. Elements of feasibility study phase

In the case of large systems, this phase requires an in-depth analysis of all aspects of the firm's operations pertinent to the new system. For relatively small systems, this investigation is much less extensive. It is even sometimes desirable to combine this phase with the System Specification.

The elements of this phase are shown in Figure 3. The present business and operating environment is first evaluated to determine the functional practices and procedures that are both within the scope and, just as importantly, outside the scope of the proposed system. The areas and characteristics of change are determined by evaluating the information network for its strengths, weaknesses, information flow, response times and audit control.<sup>1</sup> When these characteristics are evaluated together with management's objectives, the system's requirements are defined. The initial design concept is formulated and documented in the Requirements Definition Package.

The final step of this phase is a project review. The functional requirements and initial design concept for the proposed system are reviewed by both the user management and project management. User managements' evaluation centers on the total impact of the proposed changes to the functional organization, the cost effectiveness of the approach and if, in fact, the proposed changes meet the need or solves the problem being addressed. Project management evaluates the soundness of the design concept, as well as, the viability of the remaining effort in terms of project cost and

<sup>1</sup>Sherman C. Blumenthal, Management Information Systems: A Framework for Planning and Control (Englewood Cliffs: Prentice Hall, Inc., 1969), pp. 94-95.

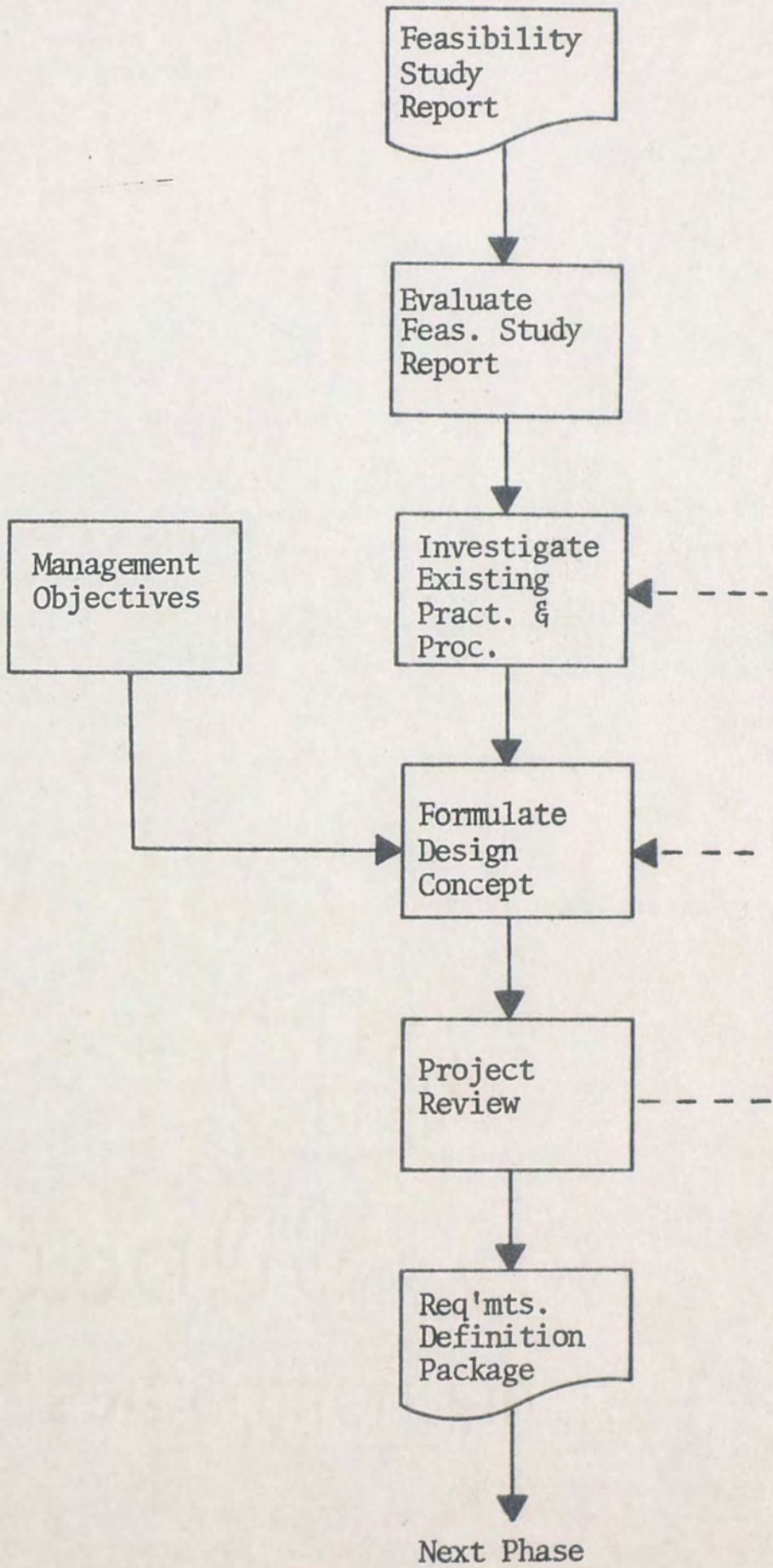


Fig. 3. Elements of the requirements definition phase

schedule.

### System Specification

In the System Specification phase the project moves from the definition stage to the design stage. The purpose of the System Specification phase is to define the proposed business system to the level necessary for user agreement and approval of the systems design and to obtain user authorization for the expenditure of funds to complete the project. This phase also has its purpose to design the system to the level necessary for input to the next phase, the Computer System Design. The new systems design is documented in the System Specification package and when approved, becomes the baseline definition of the proposed system and the scope of the remainder of the project.<sup>1</sup>

The elements which make up the System Specification Phase are shown in Figure 4.

The systems analyst is involved in many activities, all of which can be directly related to the System Specification package. The contents of a typical System Specification package are shown in Figure 5. The analyst would begin by reviewing the functional requirements and identifying the outputs that are required. Each output is then defined in terms of its content, format, sequence, frequency and use. The mode of output is determined, (e.g. Should the output be an off-line report or display on an on-line termination?). With the definition of the required outputs, the system processing requirements and inputs start to come into focus. Here the analyst

<sup>1</sup>International Business Machines Corp., IBM Study Organization Plan: The Method Phase III (White Plains, N.Y.: IBM Corp., 1963), pp. 1-2.

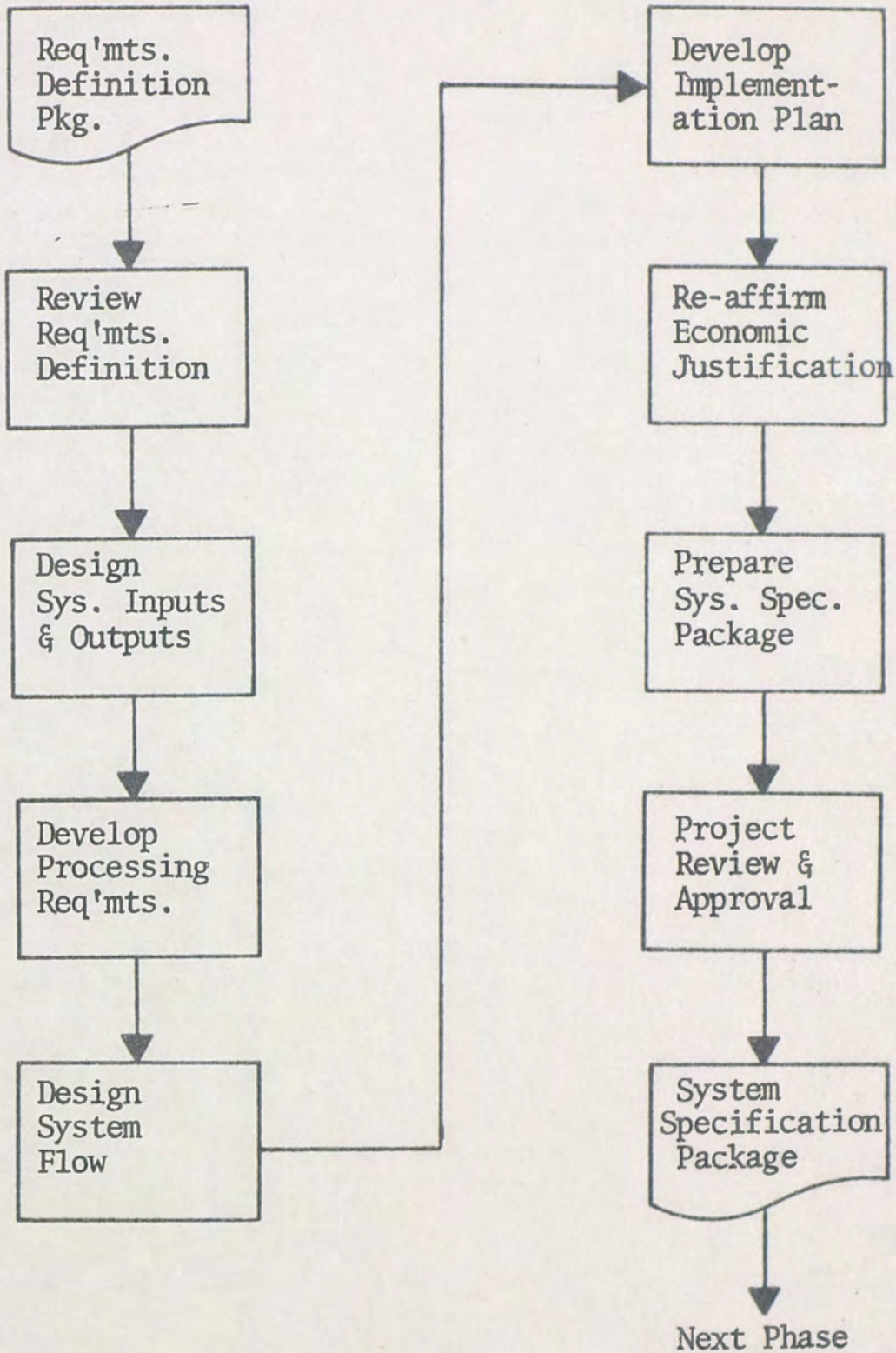


Fig. 4. Elements of the system specification phase

- I. Management Summary
  - A. Introduction
  - B. System Overview
- II. System Specification
  - A. System Flow
  - B. Data Base Requirements
  - C. Inputs
  - D. Processing
  - E. Outputs
  - F. System Performance, Maintenance and Control
- III. Implementation and Acceptance
  - A. Master Schedule
  - B. Installation Requirements
  - C. File Creation and Conversion
  - D. Acceptance Criteria
- IV. Economics
  - A. Cost Evaluation
  - B. Benefits
  - C. Risks

Fig. 5 Contents of system specification package



is concerned with transaction flow, data transformation, data base structure and organization. Inputs are defined, as were the outputs, in terms of content, format, sequence, frequency and use. At this point the inputs, processing, data base, and outputs are integrated into a system flow. The system flow is what the name implies - a schematic representation of the system design. Examples of typical system flows are shown in Figures 6 and 7. With the definition of the system performance, maintenance and control requirements, the system specification section is complete.

To complete the system design process and the Specification package, the analyst must develop an implementation plan. In the case of large systems, it must be determined whether the system will be implemented as a whole, or split into modules to be implemented at separate times. The implementation plan is then established together with the schedule and resources required for the remainder of the project. This includes the Computer System Design phase, data base creation and conversion, training and acceptance testing.

Economic justification of the project must be re-affirmed. Development and operating costs are re-evaluated in light of the new system design concept. Benefits and risks are reviewed and justification for proceeding to completion is re-confirmed.

Throughout the System Specification phase, the analyst attempts to define the most cost effective systems design concept that meets management's requirements and objectives identified the Requirements Definition phase.

The last event of the phase is again a Project Review. User

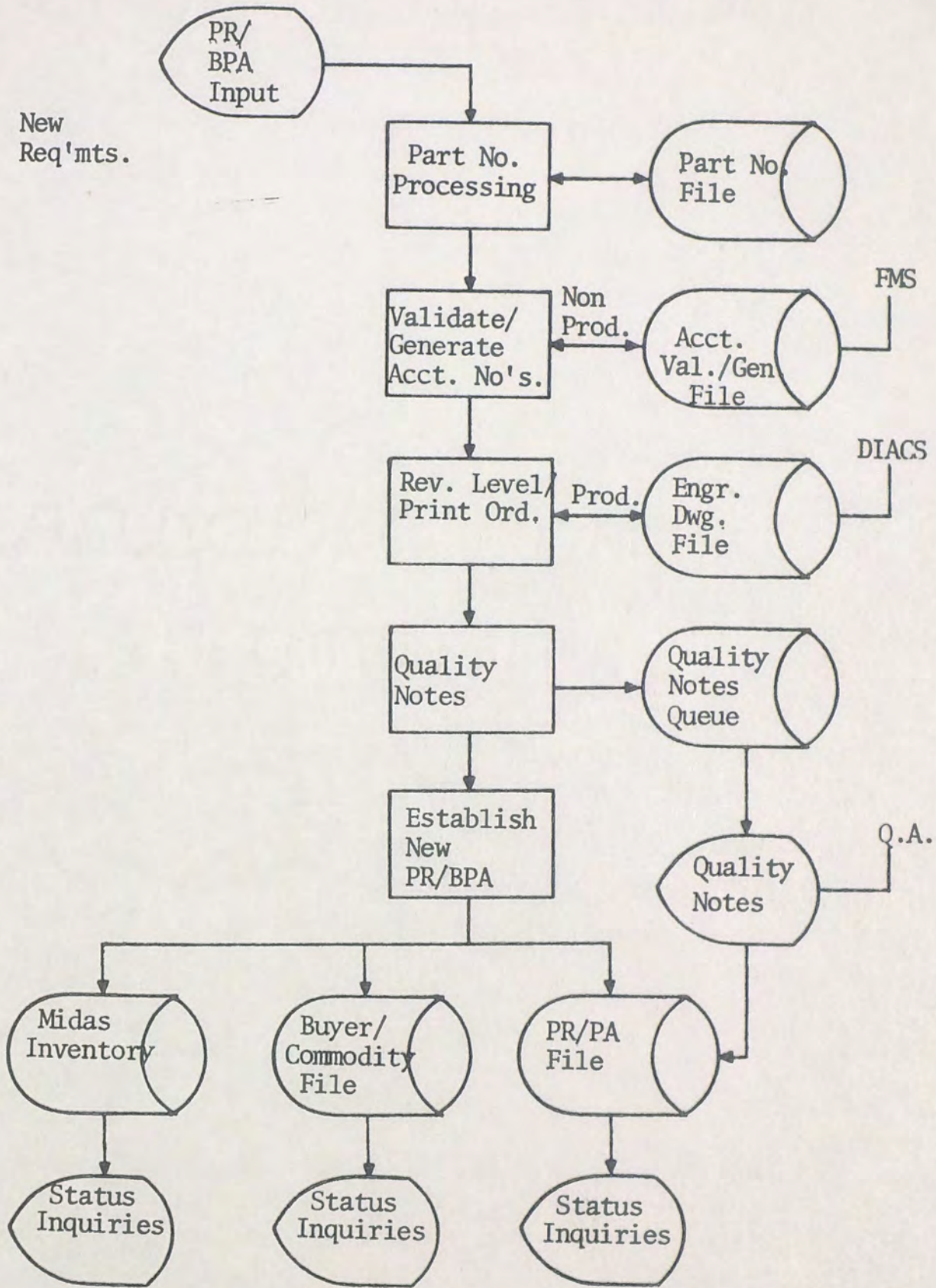


Fig. 6. Example of system flow utilizing on-line processing<sup>1</sup>

<sup>1</sup>Martin Marietta Data Systems, Order Management System (Orlando: Martin Marietta Corp., 1975), p. 46.

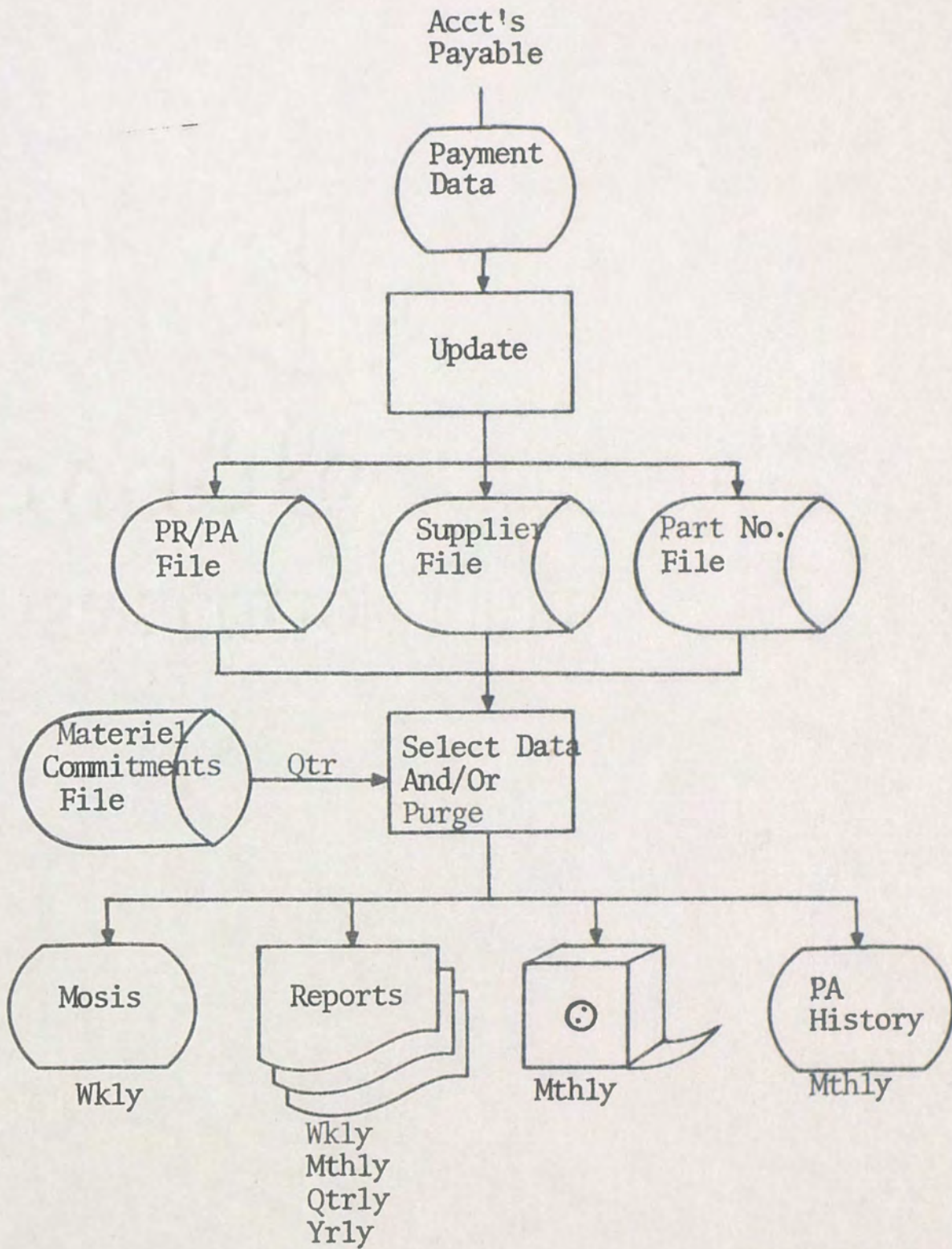


Fig. 7. Example of system flow utilizing batch processing<sup>1</sup>

<sup>1</sup>Ibid., p. 54.

Management reviews the system specification to determine if the objectives, as defined in the Requirements Definition, have been satisfied and to approve the expenditure of funds to complete the project. Project Management draws on the expertise within the organization to evaluate the technical design and determine if the remaining project commitment can be met within the constraints of the project budget and schedule. With the approval of both user and project management, the project moves to the next phase.

### Computer System Design

The next project phase is the Computer System Design (CSD). The elements of this phase are shown in Figure 8. The objectives are to translate the System Specification package into a specification of computer programs, file structures and access methods which allows the programming team to flowchart, code, check-out and test the system. The CSD also provides a firm machine and manpower budget and schedule for the Programming Phase and defines a schedule and plan for the system test. The results of these efforts are documented in the Computer System Design package.<sup>1</sup>

The CSD package consists of additions to and an expansion of the System Specification document, as shown in Figure 9. The System Specification then contains all the information to allow Programming to create a network of computer programs which meets the requirements of the system.

The processing section is expanded to the program level. A

<sup>1</sup>Martin Marietta Data Systems, Systems Development Methodology (Orlando: Martin Marietta Corp., 1974), III, p. 79.

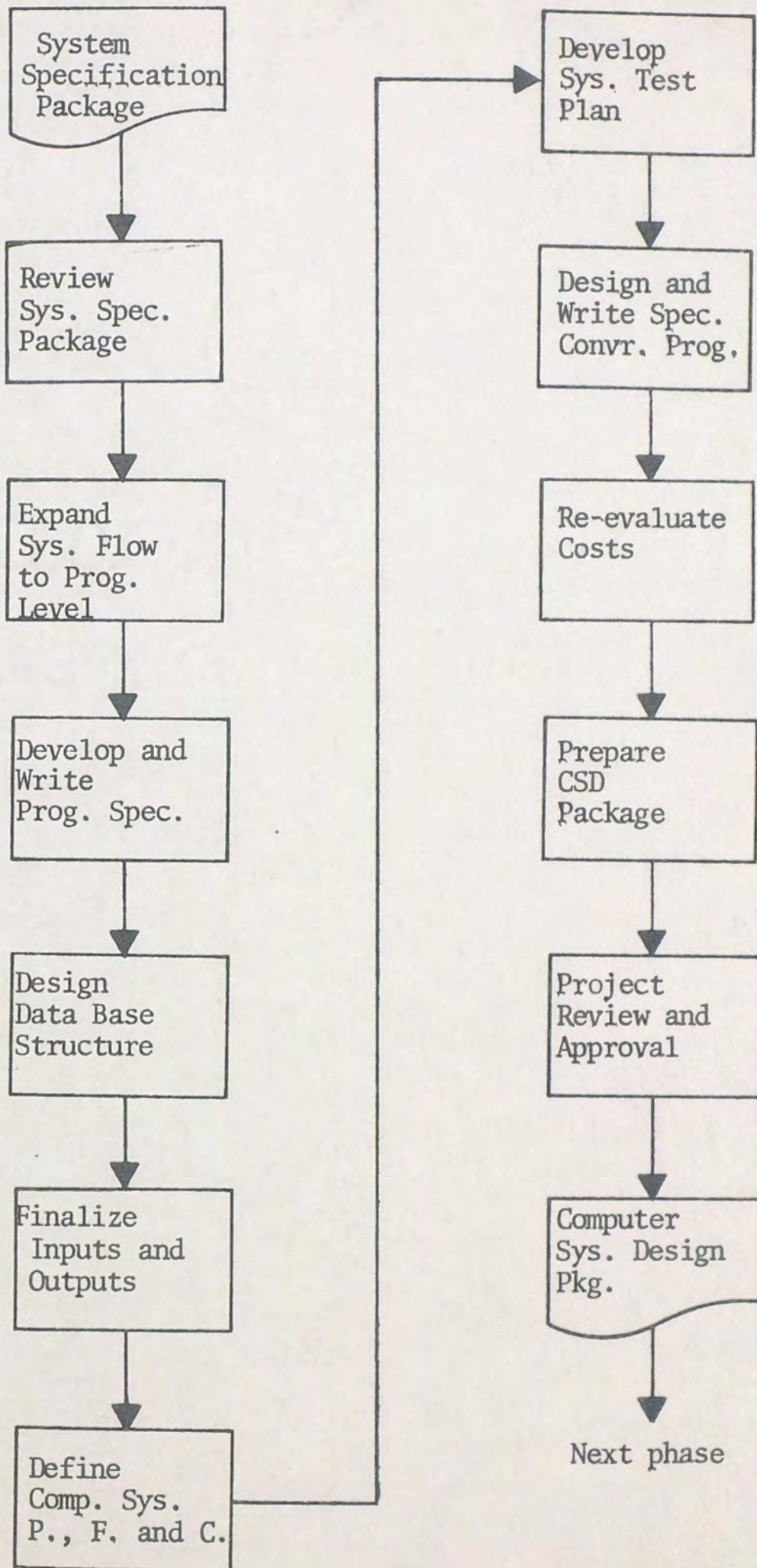


Fig. 8. Elements of computer system design (CSD) phase

detailed program level flow is developed and for each program identified, a narrative description of the processing requirements is written. These narrative program specifications describe requirements such as transaction validation, error processing, file updating, intermediate file creation and output generation.

The system data base requirements and structure are finalized with each file being described by its content and layout.

Each input and output is reviewed and laid out in its final format and any special forms that may be required are designed.

The System Performance, Maintenance and Control requirements are expanded to include specifications for the computer system, such as restart and recovery procedures, file retention criteria and scheduling requirements.

A detailed schedule is made for the Programming and Implementation phases. This schedule shows the start and end dates as well as the manpower requirements for programming each computer program, user training, acceptance testing, data base creation and conversion, user acceptance and cut-over to the new system. This is inserted to support the Master Schedule as shown in Figure 9.

A system test plan is written specifying the system test requirements, responsibilities, test organization and detail schedule. In the case of large systems, it may be necessary to define the machine resources required to support the system test.

A narrative program specification is written to define any special programs required to support file creation and conversion. Programs of this type are required to convert files from existing

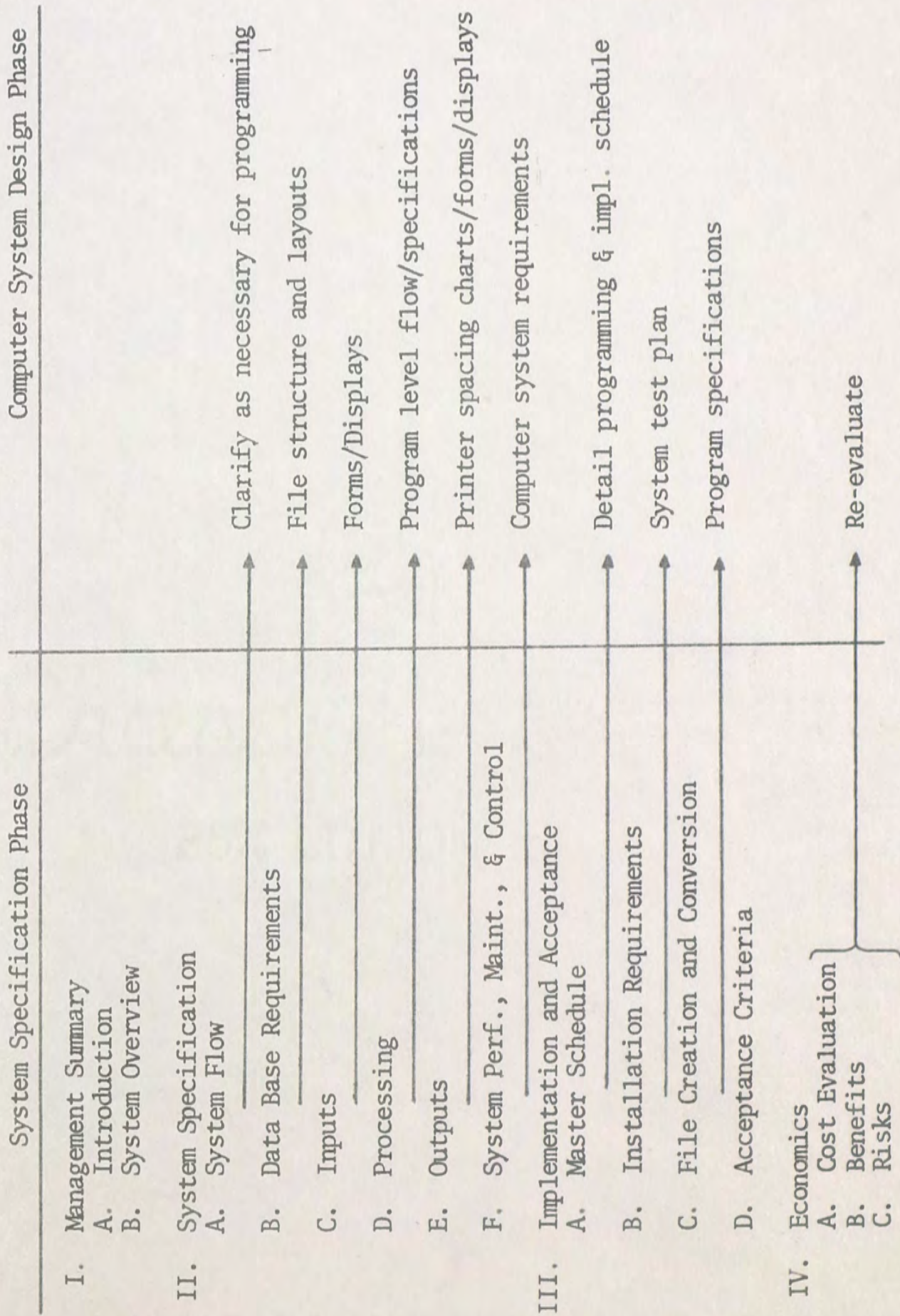


Fig. 9. Completed system specification package

systems or manual files to the new system format.

Finally the development and operating costs are re-evaluated. Now that the mechanized system has been designed in detail, a more accurate estimate can be made and the cost figures adjusted accordingly. The System Specification now contains all the detail specifications to begin the programming effort.

The project review at the end of the CSD phase is a technical design review by project management, with user management not usually participating. The project manager appoints lead analysts, programmers and a representative from computer operations to form a project review team. The review team critiques the design approach, the programming philosophy and techniques to be used, the written program narratives and the data base design. Also reviewed are the man hour estimates and detailed programming and test schedule to assure project management that the Programming Phase is in keeping with the constraints of the project budget and schedule. Upon approval of the Computer System Design Package by the review team and the project manager, the CSD phase is complete.

### Programming

With the Programming Phase the project again changes its characteristics, moving from the design to the implementation stage. The Programming Phase converts the System Specification into tested and documented programs. The purpose is to create a network of programs which meets the objectives and constraints of the System



Specification.<sup>1</sup> On the surface this may appear as simply coding and testing each computer program as defined in the Computer System Design Documentation. As shown in Figure 10, this phase must first be planned by reviewing the CSD portion of the System Specification to determine the various types of programming talent that are required. The selection of the proper personnel is vital to the success of any programming effort. Consideration must also be given to familiarizing the programming team with the system, assigning specific tasks to team members, establishing a common programming and test strategy and assembling programming documentation such as program flow charts, program listings and control cards. All the various tasks and activities of the Programming Phase require monitoring and control to assure the end product is reliable, efficient, maintainable and operational sound. The Programming Phase ends only when the system is in full production.

When programming and testing is complete, the project review team reviews the programming documentation and test results to assure that the requirements of the CSD have been met and that each program has been sufficiently tested for the project to proceed to the Implementation Phase.

### Implementation

The Implementation Phase has as its purpose a smooth, controlled transition from the old to the new system. To be successful, the new system must be installed with a minimum of

<sup>1</sup>James Martin, Design of Real-Time Computer Systems (Englewood Coiffs: Prentice Hall, Inc., 1972), pp. 559-569.

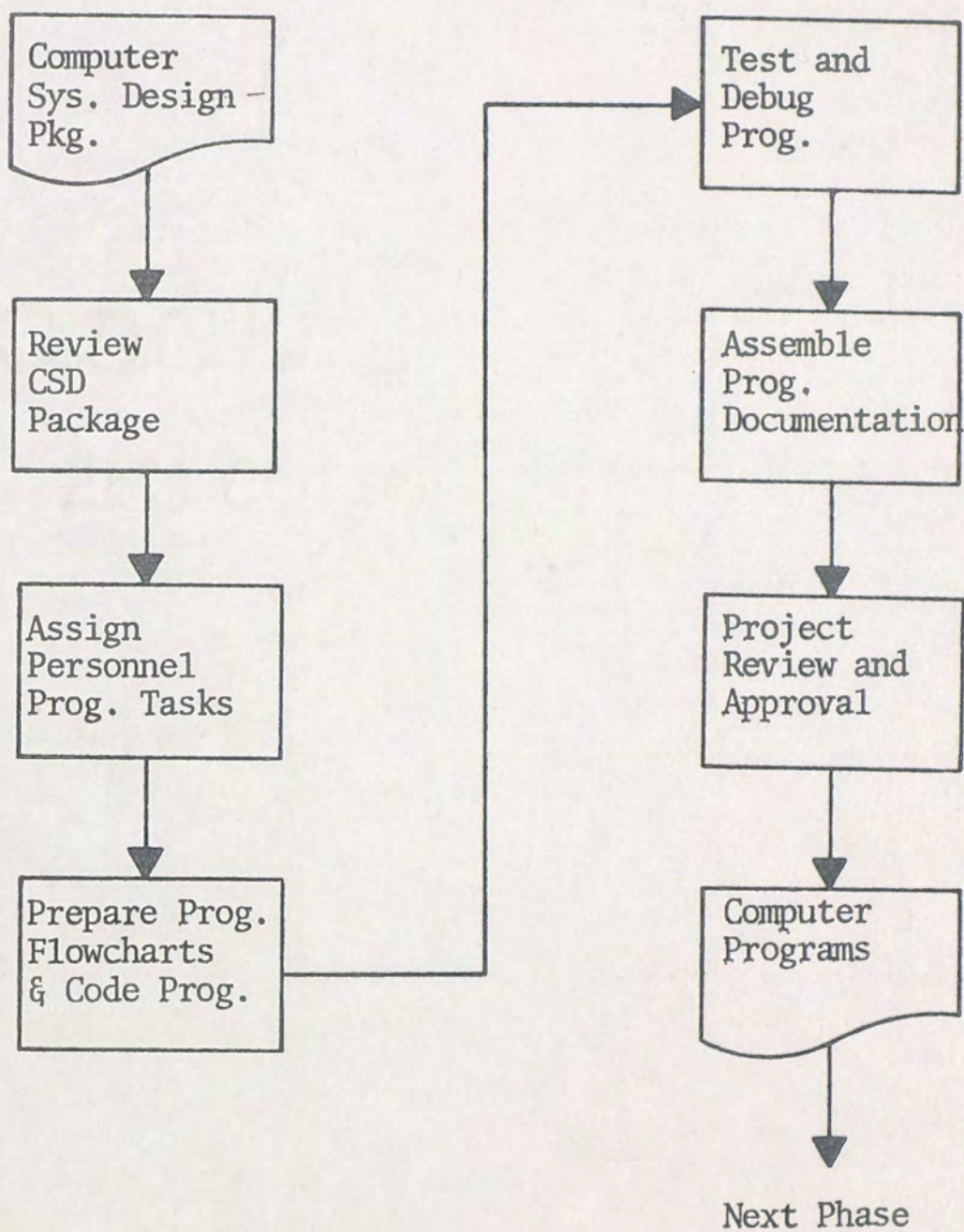


Fig. 10. Elements of programming phase

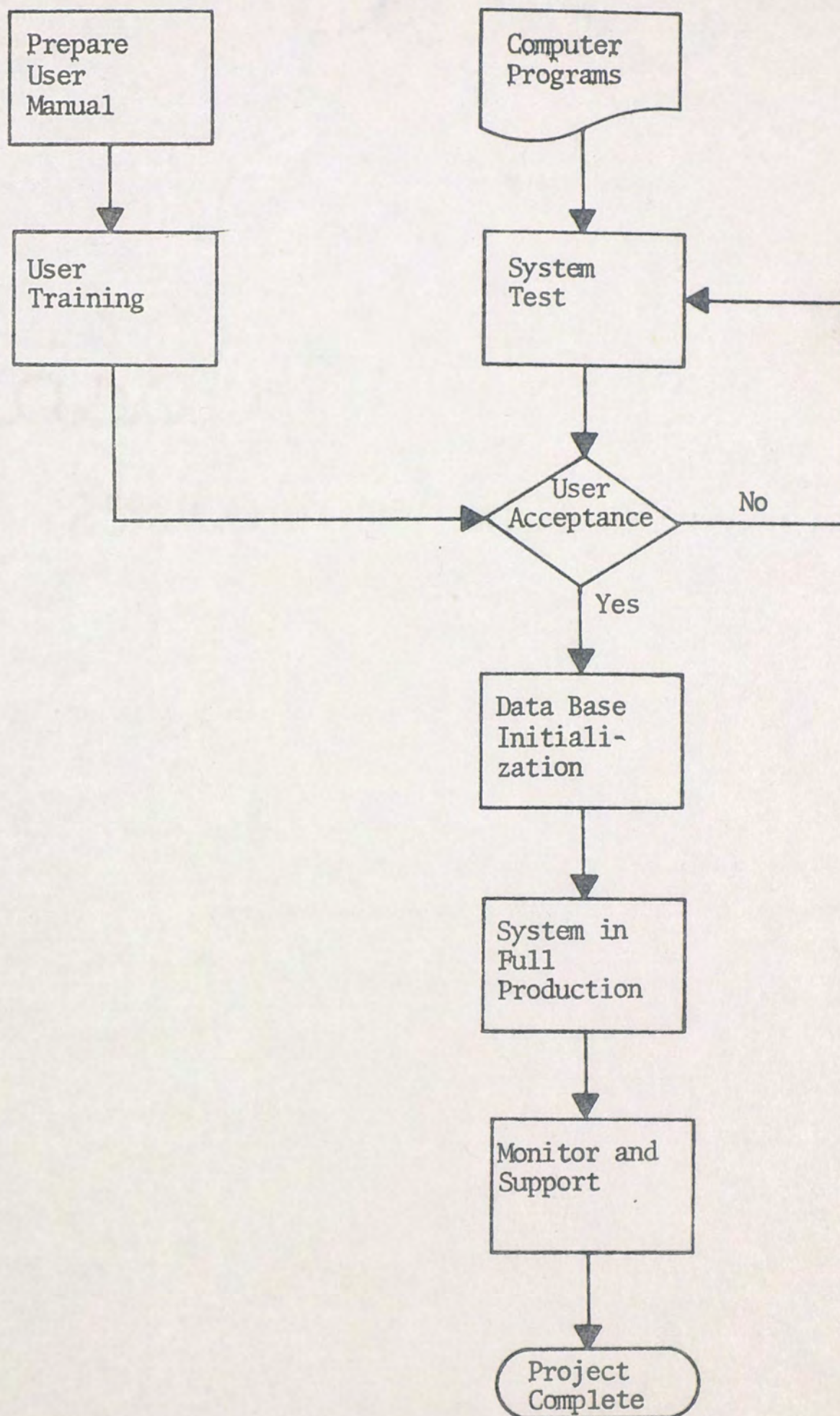


Fig. 11. Elements of implementation phase

disruption to the user's normal business routine.

Figure 11 shows the elements which make up the final phase of the project. User operating procedures require rewriting to reflect the changes to present practices and clearly define new procedures resulting from the new system. This is especially important when a reorganization of user departments will accompany the installation of the new system. A User Manual is written to document the direct interface of the user and the computer system. The User Manual contains a general system description, defines source data, preparation instructions, and samples of system inputs. It also defines the contents, use and samples of system outputs and any data processing terms or abbreviations that may not be in everyday use by user personnel.

Another key ingredient to a successful system is user education and training. A good training program is required to educate user management at all levels and familiarize them with the functional aspects of the system and its impact on their organization. Training of operating personnel is normally conducted by key user personnel with support from user management where appropriate. Data sources, system input preparation and use of outputs are stressed using examples with live data and actual system inputs and outputs. A good training program will assure an effective user-computer system interface.<sup>1</sup>

The system test is the next step in the Implementation Phase. Each computer program is individually tested during the Programming

<sup>1</sup>Ibid., pp. 685-688.

Phase. The system test proves the integration of the programs into the network that is the computer system. Transaction response times, information flow, interfaces with other systems and outputs are verified to assure system reliability.<sup>1</sup> Key user personnel participate in the system test to verify that all the requirements agreed upon in the System Specification have been met, that the system is operationally sound and ready for installation.

With user acceptance, the final steps of the Implementation Phase and the project are performed. The file creation and conversion programs are processed to establish the system data base and after a thorough analysis to assure the conversion process was successful, all user functions are transferred to the new system. The system is considered implemented and the project is complete.

Although the project phases are all completed successfully and the system is operating in a production environment, there is normally a monitoring period immediately following implementation to assure the system remains operationally sound and no major problems develop.

<sup>1</sup>Ibid., pp. 570-579.

## II. ANALYSIS OF EXISTING MIS PROJECT METHODS AND THEIR WEAKNESS

The project method of developing new business systems, particularly mechanized business systems, is a widely used method. The project is normally a joint effort between the user department for whom the system is being developed and the Data Processing (D.P.) department. In most firms, the resources required to conduct a development project of this type reside primarily in the D.P. department. The major departments of the firm, such as the Manufacturing, Finance or Engineering departments, normally do not staff personnel with background and experience in systems development and data processing. Management of the project, including planning, control and documentation, becomes the responsibility of the D.P. department with the user department in a support and approval role. This sets the theme of the project.

If the project method of developing business systems, with its planned and controlled phases and documentation, is such an effective method, why then are business systems so often criticized for being inflexible, over-burdening and unresponsive to management's needs? The system that was designed to reduce costs by eliminating manual record keeping and reporting can over-burden operating personnel with input requirements to the point that the total information flow within the department is slowed. Likewise when a particular function becomes mechanized, data and reports are available that previously may

have been too time consuming and costly. The department can be flooded with reports that are also over-burdening, requiring untold manhours of analysis. The system becomes counter productive and from the user's point of view inefficient. But the project was considered a success by the project and user management. The mechanized system meets all the requirements agreed upon in the System Specification. It was implemented on schedule and at the estimated costs. The system is operationally sound, processing the required data and producing the necessary output on schedule. However, often after a short period of time in operation, the user finds that the system does not integrate well with the other functions within the department. The flow of information is hampered. In the case of large systems, communications between departments may even be hampered, adversely impacting the objectives and goals of the firm. Examples of this would be an Inventory System, a Manufacturing Requirements Planning System or an Engineering Documentation Control System. The user department finds itself in the situation in which the mechanized system is operationally sound, but when integrated with the other practices and procedures of the operation, the resulting Management System is ineffective and inefficient.

It would be easy to fault the project management approach of systems development as the problem. However, the problem is not the project approach per se but the application of the project approach, the personnel assigned, the documentation produced and the objectives

of the project management.<sup>1</sup> These are the ingredients that control the make-up of the project and the end product.

### Development Methods Lagging

Systems development methods have not kept pace with rapid evolution of mechanized systems.<sup>2</sup> Over the short period of the last fifteen (15) to twenty (20) years computerized business systems have evolved from simple punched card payroll systems to sophisticated interactive systems with integrated data bases, real-time processing and on-line input and output devices. These systems are no longer restricted to the Finance Department as they were those few short years ago. They are now in wide use in all areas of the firm and encompass major portions of the operational control functions, significant portions of intermediate management decision, and are making gains at the strategic planning levels of top management. These systems can no longer be considered as simple mechanized business systems. Their impact on the individual departments and the firm are far too great. What has to be addressed is the total Management System. The Management System encompasses the mechanized system as well as its operating environment within the user department as shown in Figure 12.

The study methods being used to design and develop these complex systems have lagged. When the typical project approach is closely analyzed, it can be seen that the primary emphasis is on the computer system with very little, if any, attention paid to the

<sup>1</sup>Sherman C. Blumenthal, Management Information Systems: A Framework for Planning and Control (Englewood Cliffs: Prentice Hall, Inc., 1969), pp. 91-93.

<sup>2</sup>Ibid., pp. 1-9.



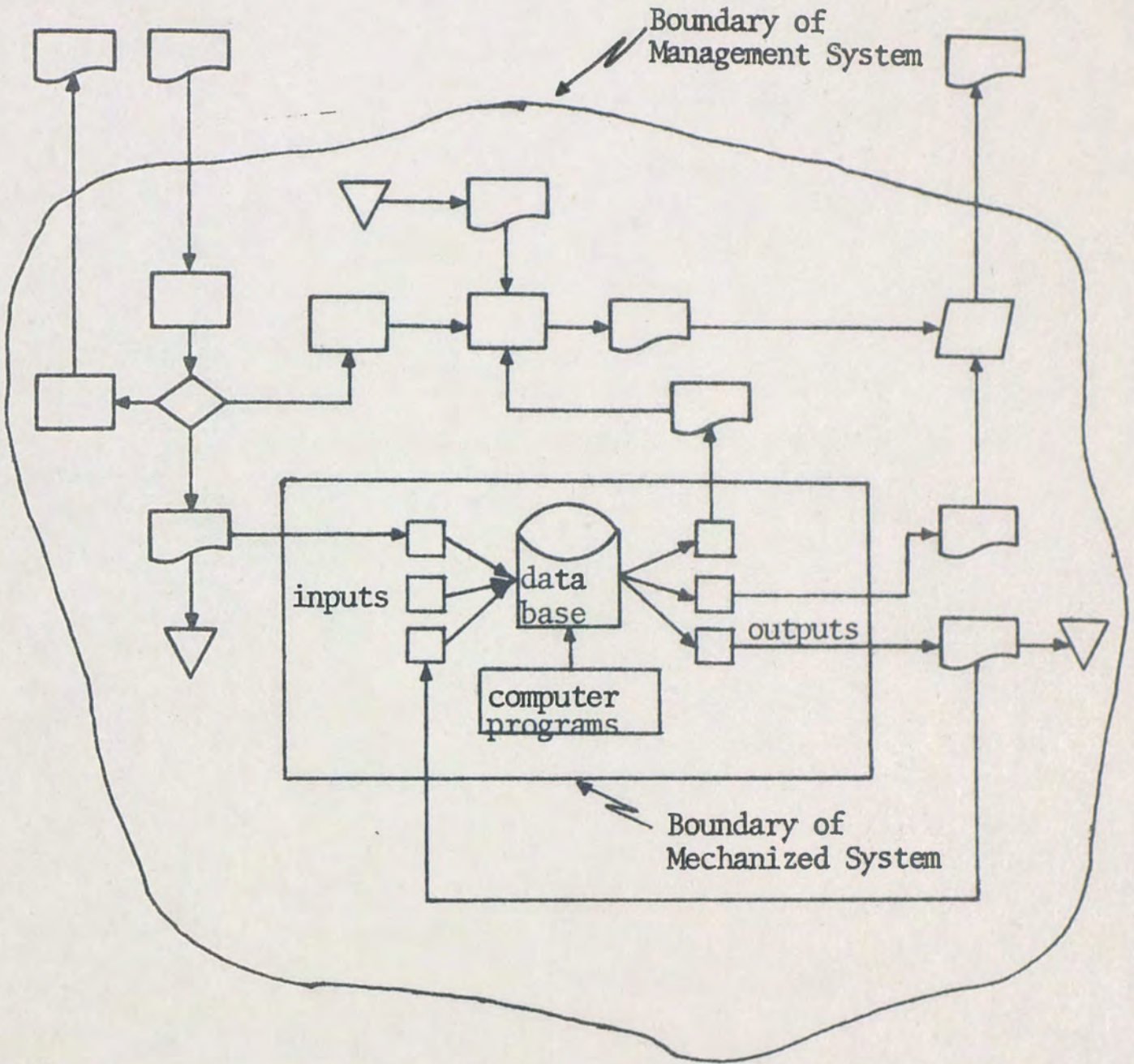


Fig. 12. Illustrates difference between scope of mechanized system and the management system

Management System. What frequently results is a highly effective system that integrates rather poorly with the other practices and procedures of the user environment.

Further analysis of the application of the project approach, the study methods used, the personnel assigned and the project documentation can be used to identify some of the problem areas.

#### Weaknesses of the Requirements Definition

In the Requirements Definition phase the detailed requirements of the new business system are identified. If the proposal is for a large system, this will require an in-depth analysis of the user department operations by a study team. User management, not having a systems analyst on its staff, will assign the supervisor or the person considered most knowledgeable of this area of the departments operation to the study team. The Data Processing manager, who is responsible for the total project, will assign the top programmer/analyst with experience in developing computer systems in this particular area of application to head-up the study team.<sup>1</sup>

Since the Requirements Definition is a data gathering function, the study teams activities involve interviewing user management and supervisory personnel to obtain the goals and objectives of the proposed system. The study team must analyze in detail the user procedures and practices relating to the new system and through this analysis identify the functional requirements such as required inputs,

<sup>1</sup>Dick H. Brandon & Max Gray, Project Control Standards (Philadelphia: Auerbach, 1970), pp. 101-105.

outputs and response times. The result of these activities, when documented, is a statement of functional requirements to provide a firm basis for the design of the new system.

Two factors have greatly influenced this study phase into the direction of the mechanized (computer) system. First is the background and experience of the team leader, the programmer/analyst. His forte is data processing, with experience in designing and programming computer systems of the type being proposed. The programmer/analyst's primary concern is to identify the functional requirements of the mechanized system, as it should be. Second is the definition of functional requirements themselves. Inputs, outputs and processing requirements primarily address the mechanized system. The Management System is, in fact, considered, but only on the surface. The focal point is the identification of the functional requirements for the mechanized system. This is illustrated in Figure 13.

#### Weaknesses of the System Specification

The same study team that performed the Requirement Definition phase is assigned to the System Specification phase. However, depending on the size and complexity of the system, additional team members may be added.

Reviewing the activities of the study team and the results of their efforts which are documented in the System Specification Package (ref. Fig.'s 4, 5, 6 and 7) clearly points out that the System Specification phase is the process of designing a new computer system. The System Specification Package is actually a preliminary computer system design. The project continues to concentrate on the

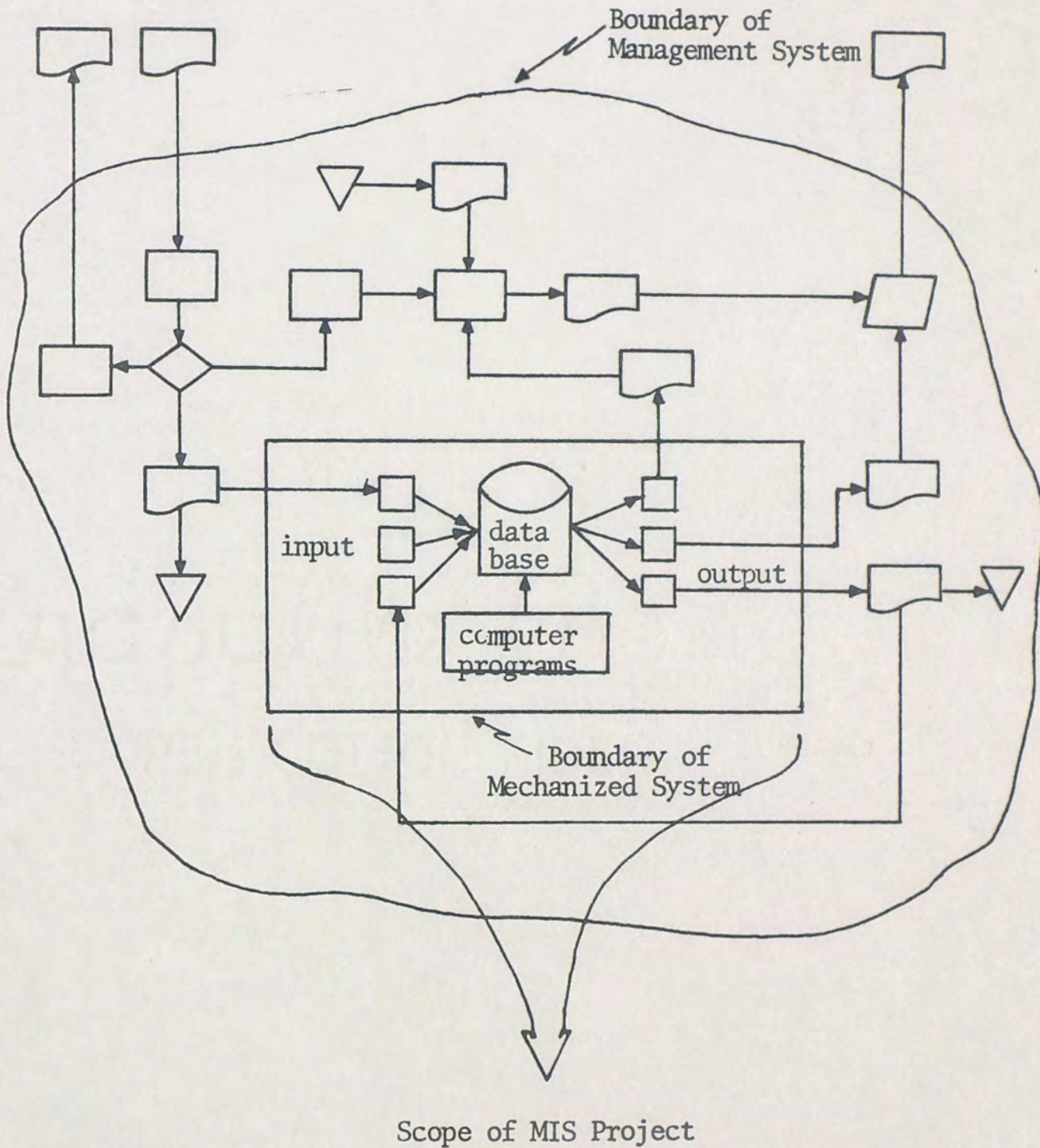


Fig. 13. Illustrates the scope of MIS project centering on the mechanized system

mechanized system. There are two major reasons why this phase of the project concentrates so heavily on the computer system.

### System Specification Package

The development project is a joint effort between the user and Data Processing departments. In most firms the Data Processing department is chartered with the responsibility of managing and conducting projects of this nature. It is not uncommon for two or three major development projects to be in-process concurrently. The Data Processing department will establish standard practices and procedures to be followed during each phase to allow for effective project management and control.<sup>1</sup> These procedures define the study methods to be used and the documentation requirements for the project. It is not surprising then that the procedures and documentation requirements are designed primarily to meet the objects and goals of the Data Processing department which are to design, develop and implement computer systems. The best example of this is the System Specification Package. This package is intended to be a preliminary design specification of the mechanized system. Since its contents are established as the standard procedure, it dictates the type of activities performed in the System Specification phase and focuses the study team efforts primarily on the computer system from the start of the project. Since each project phase builds the accomplishments of the previous phase, the Requirements Definition phase is also influenced to the point where it must concentrate primarily on the mechanized portion of the total system.

<sup>1</sup>Dick H. Brandon & Max Gray, Project Control Standards (Philadelphia: Auerbach, 1970), pp. 27-28.

### Study Team

The other influencing factor is again the background and experience of the study team leader, the programmer/analyst. As was the case in the Requirements Definition phase, the programmer/analyst has very little experience designing Management Systems. It is only natural for his attention to turn to that which he has knowledge of, the design of the computer system.

### Changes During Computer System Design

The Computer System Design phase is the point at which the project team should focus its attention on the design of the computer system. During this detail design process it is not uncommon, especially for complex on-line systems, for the preliminary system design contained in the System Specification to be significantly redesigned due to technical and programming constraints.<sup>1</sup> The user department computer system interface is not affected. However, the technical design of the system is often changed.

This can cause a serious dilemma. The System Specification approved by both the user and data processing management as the baseline for developing the new system is now incorrect. Updating the System Specification may require rewriting the sections on processing, data base requirements and the system flow. The project budget and schedule does not allow for rewriting major portions of the System Specification. This is one of the major causes of schedule slippages

<sup>1</sup>James Martin, Design of Real-Time Computer Systems (Englewood Cliffs: Prentice Hall, Inc., 1972), pp. 565-566.

and cost overruns. Projects involving large, complex, on-line systems are particularly sensitive to this problem. There is an unnecessary and costly overlap between the activities and documentation of the System Specification and Computer System Design phases.

The question posed at the beginning of this section was why do mechanized business systems so often fall short of user management's expectations, failing to meet their needs, unable to integrate with the total operation and shortly after being installed become overburdening and ineffective? The answer is that the typical development project primarily addresses the design and development of the computerized portion of the system, with less than adequate emphasis on the total Management System. This is illustrated in Figure 14.

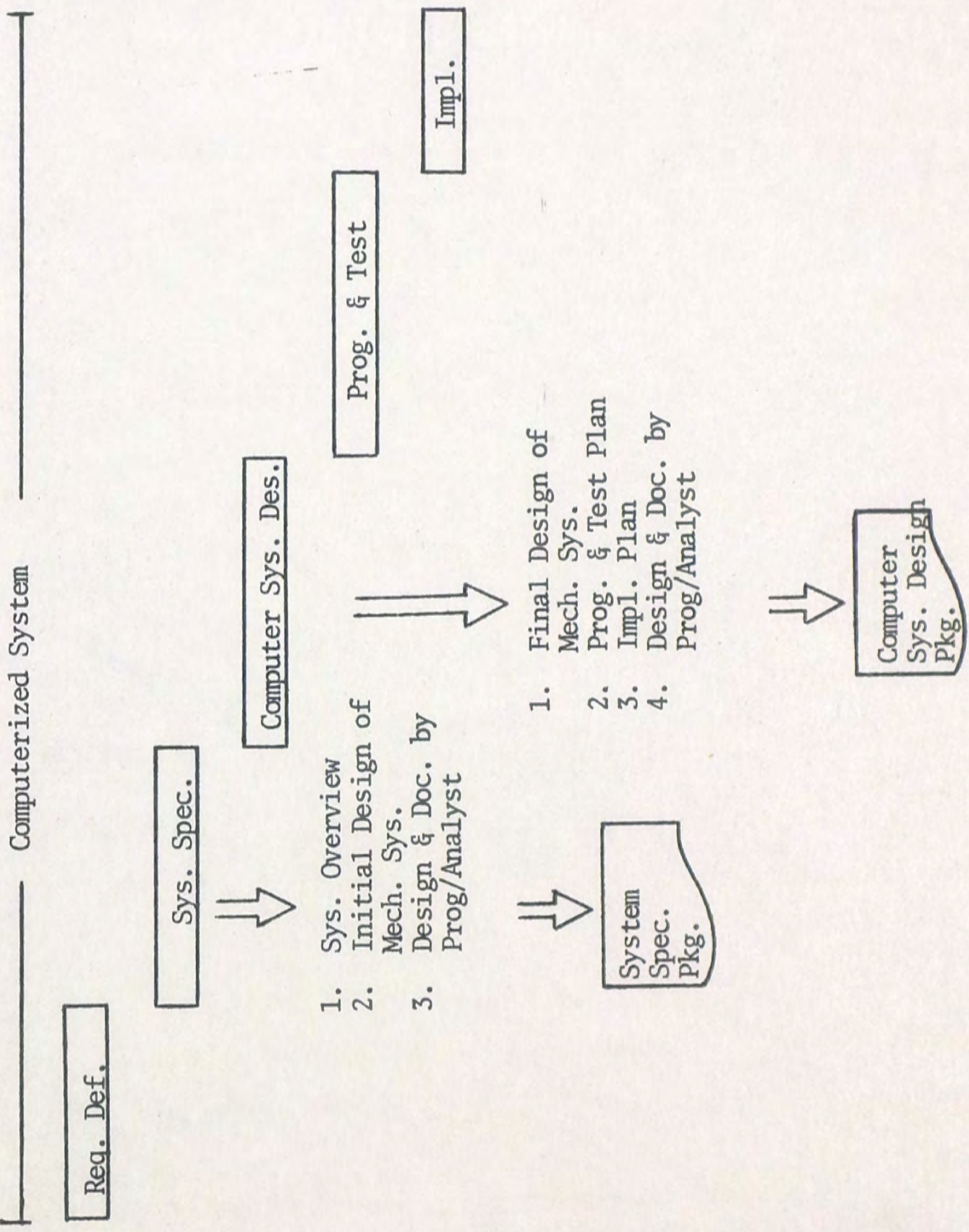


Fig. 14. Project phases showing emphasis on computerized system vs. management system



### III. A MANAGEMENT SYSTEMS APPROACH TO STRENGTHEN MIS PROJECT

The methods used to design and develop mechanized business systems are lagging far behind the explosive pace of the technology of the computer industry.<sup>1</sup> Mechanized systems are in use today in virtually all areas of the firm. They are becoming increasingly more complex, often involving multiple functional organizations. The scopes of today's systems are encompassing not just clerical functions but major positions of the operational control functions, management decision making and in some cases, strategic planning for the firm. These advances have been made possible by the technology explosion in the computer industry. Mechanized systems have evolved into sophisticated, interactive systems with integrated data bases, real-time processing and on-line input and output devices.

#### Single Function MIS Projects

In contrast, system development methods have changed very little from the time when computerized business systems were, by comparison, much less sophisticated. Systems were limited to a single functional requirement (e.g. Payroll), involved only one functional user, maintained a single file, were limited to punched card input, printed output and processed on a periodic basis, such as weekly.

<sup>1</sup>Dick H. Brandon & Max Gray, Project Control Standards (Philadelphia: Auerbach, 1970), pp. 3-6.

This is the environment in which system design and development methods were first used. The objective of a project in this case would be to computerize or mechanize Payroll. As can be seen in Figure 15, Payroll is but a small section of the total Finance function or Department.<sup>1</sup>

The scope of this system is limited to a single function and easily defined, so the restricted approach to system's development described earlier in this paper are adequate. After the project feasibility is established, the system requirements are identified. Certain outputs have to be printed such as paychecks and reports, most of which are presently available and being prepared manually. It might be determined that the output is needed weekly and certain inputs, such as time cards, have to be processed to update the payroll records.

At this point, the D.P. department would assign a lead programmer/analyst to design the new system and write a System Specification Package. The programmer/analyst would design and layout the output reports, the input forms and the files to be maintained. These system requirements would be documented in the System Specification Package along with a preliminary computer system flow and the system processing requirements.

After approval of the System Specification Package by user and D.P. management, the programmer/analyst will write the Computer System Design Package. This is the process of defining the file

<sup>1</sup>Sherman C. Blumenthal, Management Information Systems: A Framework for Planning and Control (Englewood Cliffs: Prentice Hall, Inc., 1969), p. 5.

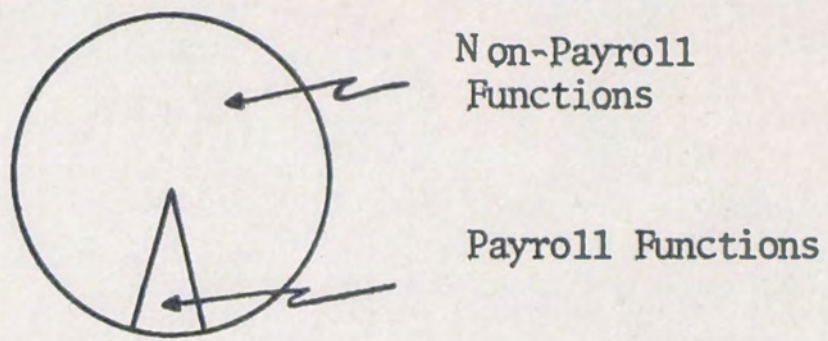


Fig. 15a. Illustrates scope of payroll function vs. scope of total finance department

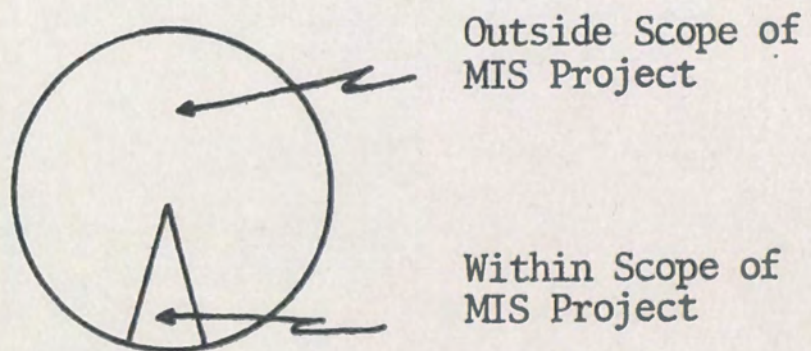


Fig. 15b. Illustrates limited scope of early MIS projects

structure and breaking the system down into a set of programs. For each program, a detailed specification is written to define the program logic, input, output and test requirements.

With this completed, the next step would be program coding and testing. After successful testing and user approval, the manual files are converted and the new Payroll System is implemented.

A project of this size and scope has a very high probability of success. The system is designed to meet only one functional requirement, in this case Payroll, involves but one functional user and has very little, if any, interface requirements with the other functions of the Finance Department. As a result when implemented, it integrates rather well with its environment, meets the users Payroll needs and is functionally efficient and productive.

#### Multiple Function MIS Projects

It is often argued that the systems being developed today are really no different than those in the past. They're just bigger than Payroll. Systems are still made up of inputs, files, processing and outputs. The only change has been in computer technology. The input and output methods are more advanced and the speed of processing has greatly increased but the basic ingredients are still the same.

This is true to some extent. However, there is a major difference of some significance. The failure to recognize this difference is the reason that single function methods are still being used to develop systems. This failure is also the reason today's systems fall short of their goals, fail to adequately meet users needs and become functionally ineffective.

The major difference is that in the past the goals and objectives of the project and system were the actual output reports produced and the necessary system inputs. The only requirement was for these inputs and outputs to be timely and accurate for the system to be functionally effective. It would meet the single functional requirement. Today's systems are not designed to meet a single functional objective. The inputs and outputs are no longer the goals and objectives of the project or the system, but are merely the means to the end. Today's systems are intended to meet the needs of multiple functions and often a large portion of the functions of an entire department. They must effectively integrate with the remaining non-mechanized functions and provide for a free flow of information to and from the department. Today's systems are chartered with the responsibility of carrying out management policy concerning major areas of the firm. The goal then of the project is to design and develop an integrated Management System that can meet and carry out management policy on a broad scale.<sup>1</sup>

Carrying the Payroll example a little further will illustrate the types of Management Systems being developed today. The Finance Department of most firms is made up of many functions such as Accounts Payable, Accounts Receivable and Central Accounting to name a few. After the great success of mechanized Payroll, further projects are undertaken over the years to computerize some of these other financial

<sup>1</sup>Jay W. Forrester, Industrial Dynamics (Cambridge: MIT Press, 1972), pp. 210-212.

functions. These projects are very similar to the Payroll project and are mostly successful. As time passes, however, these systems become victims of the information explosion. Changes are made, more reports are added and to keep up with the ever increasing demand for data, are processed more and more frequently, often daily. These systems soon become over-burdening and too costly. A study is then undertaken to determine if some of the newer developments in computer technology can be taken advantage of to solve some of the problems. It is discovered that quite a few of these systems contain duplicate data in their files and have redundant processing, often one system feeding duplicate data to another. It is determined that a combined data base of all this financial data can eliminate most of the duplication and greatly reduce the cost of data storage.<sup>1</sup> If all these systems have access to this data bank, the duplicate processing can be eliminated for further savings. The cost of handling and processing large files and volumes of data daily can be reduced by processing on-line in a real-time environment, handling one transaction at a time as it occurs. So the feasibility is reestablished and a project is undertaken to design and develop a new system.

This is not just a larger system with inputs, files, processing and outputs. It is sophisticated, inter-active system that will handle most of the firms financial transactions. This system would become the companies totally integrated Financial Management System and if current restricted methods are used for its design and development,

<sup>1</sup>James Martin, Design of Real-Time Computer Systems (Englewood Cliffs: Prentice Hall, Inc. 1972), pp. 314-316.

probability of its eventual success after implementation is less than desirable. Figure 16 further illustrates the scope of a project of this type.

### Management Education

What specifically can be done to strengthen the MIS project? The first recommendation is to appraise both user and data processing management, and more importantly assure their understanding, that today's systems are not just bigger computer systems but total Management systems.<sup>1</sup> A Management System is a network of operations, processes, procedures and information flow designed to meet a pre-determined set of goals and objectives.<sup>2</sup> The scopes of today's systems are so extensive that the redesign of most of the user organizations practices, procedures, and information flow is required for their implementation. These changes must not be limited to within the system but must also encompass any interfacing activities that either supply information to or rely on information from the new system. These interfacing activities, especially manual activities, are often overlooked and are a major cause of systems being non-responsive to the users needs. Management must assure that these redesign efforts are in keeping with the organizational objectives and meet management's goals.

<sup>1</sup>Sherman C. Blumenthal, Management Information Systems: A Framework for Planning and Control (Englewood Cliffs: Prentice Hall, Inc., 1969), pp. 196-202.

<sup>2</sup>Jay W. Forrester, Industrial Dynamics (Cambridge: MIT Press, 1972), pp. 14-16.

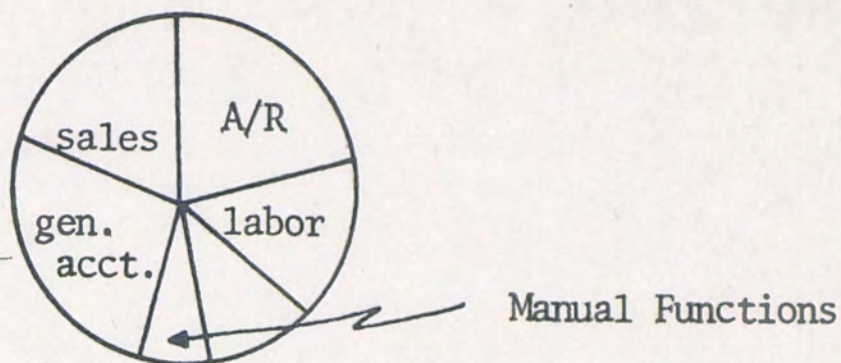


Fig. 16a. Illustrates the mechanized vs. manual functions of the finance department

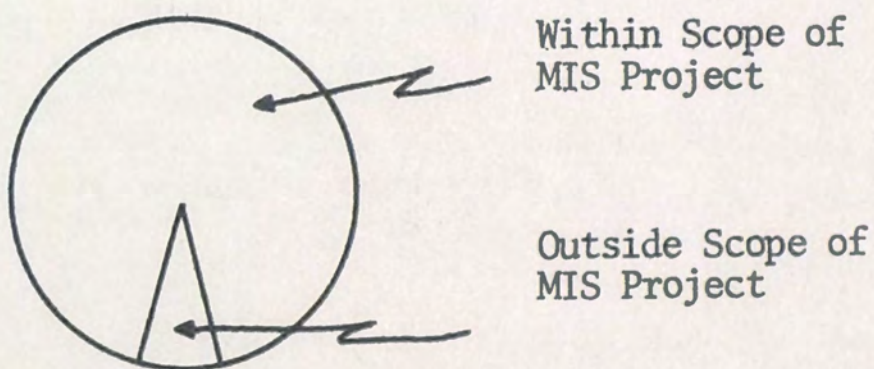


Fig. 16b. Illustrates scope of management system that present-day MIS projects encompass



### MIS Project Objectives -- Management System

The second recommendation is to realign the objectives of the first three phases of the development project as illustrated in Figure 17. As discussed earlier, projects tend to prematurely focus their attention on the mechanized system. The efforts of the first three phases of the project must be aimed at the design of a total Management System that both meets the needs of the user organization and the goals of management. In doing this, adequate attention will be given to not only the mechanized system but also its operating environment. The ultimate success or failure of a new mechanized system is determined at this time. By concentrating on the Management System as shown in Figure 18, the mechanized systems usability, effectiveness and ability to smoothly integrate with its environment is consciously designed into the system and not left to chance after implementation.

The first three phases of the project now become the definition for the feasibility, requirements and system specification of a totally integrated Management System.<sup>1</sup> With a sound design concept for the total Management System, the project is now, and only now, ready to narrow its effort to the development of the mechanized system.

The realignment of the first three phases of the project does not require changing the individual activities performed by the study team. It requires expanding the scope of these phases beyond the computer system to include the total environment in which the computer

<sup>1</sup>International Business Machines Corp., IBM Study Organization Plan: The Method Phase III (White Plains, N.Y.: IBM Corp., 1963), pp. 4-6.

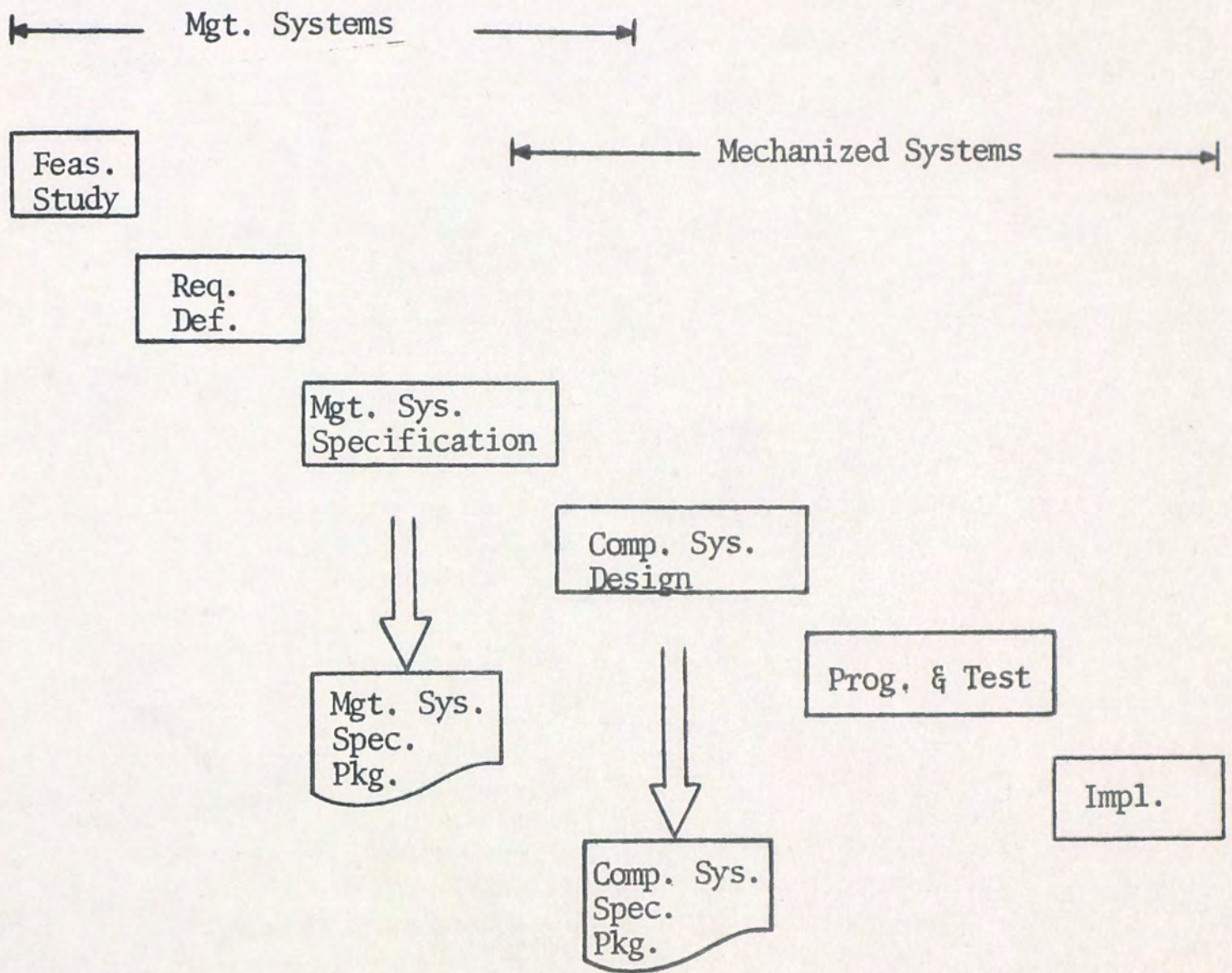


Fig. 17. Project phases showing emphasis on total mgt. system vs. mechanized system

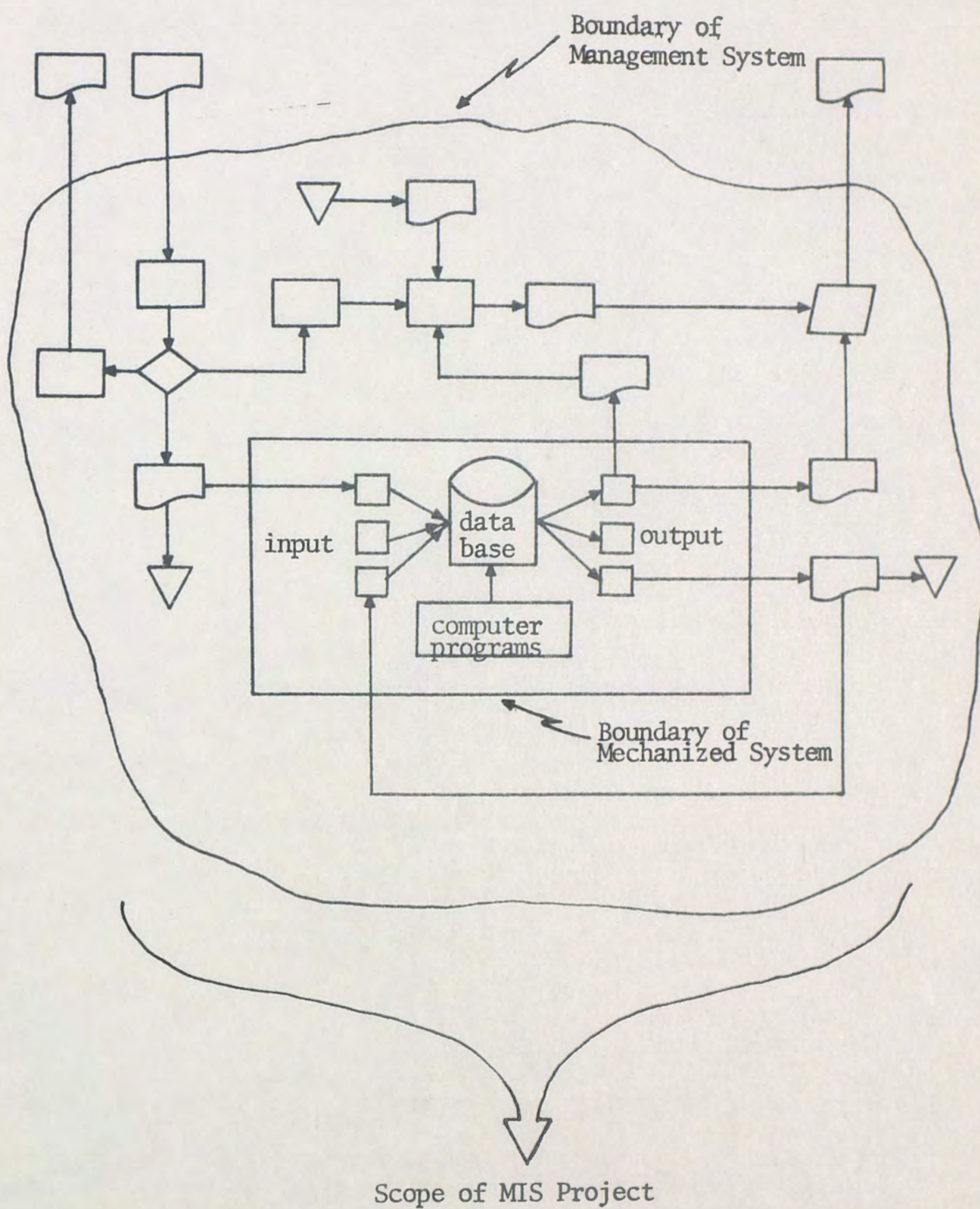


Fig. 18. Illustrates re-alignment of scope of MIS project to address the management system

system must function. When taken together, the computer system and its operating environment are the Management System.

The scope of the first two phases of the project, the Feasibility Study and the Requirements Definition are actually determined by the third phase, the System Specification. The System Specification Package is the first formal documentation produced by the project. As such, this Package represents the end product of the combined efforts of the first three phases. Most firms define the contents and format of the System Specification Package as a standard procedure. If the scope of this package is defined as a specification for a computer system, the scope of the activities required to produce this package will be, by necessity, limited to the computer system. It follows therefore, that if the scope of the System Specification Package were expanded to the Management System, the scope of the activities required to produce the package would, by necessity, be expanded to the Management System.

#### Management System Specification Package

The typical System Specification Package was discussed thoroughly in section I with an example of its contents shown in Figure 5. To expand the scope of this document requires eliminating some of the premature detail which concentrates solely on the design of the computer system and adding the specification for the total functional operating environment.<sup>1</sup> The document now becomes a

<sup>1</sup>Sherman C. Blumenthal, Management Information Systems: A Framework for Planning and Control (Englewood Cliffs: Prentice Hall, Inc., 1969), pp. 94-100.

specification for a total Management System. An example of the contents of a Management System Specification Package is shown in Figure 19.

At first glance it can be seen that the contents of the two packages (Figure 19 and Figure 5) have similarities. This bears out the point that the activities presently being performed by the study team are not necessarily incorrect but the scope and objectives the study team are striving for are incorrect.

An analysis of each section of the two packages, highlighting the differences, will bring this point into sharper focus.

The Management Summary presents the total system design concept in capsule form. It summarizes the detail of the other three sections of the package into a system overview. Any changes to scope of the body of the Specification Package would be directly reflected in the Management Summary. If the package is a specification for a mechanized system, the Management Summary is an overview of the mechanized system. If the package contains a specification of a total Management System, the Management Summary is an overview of the Management System.

The most significant changes to the package are in section II which now becomes the Management System Specification. This section is the specification of the design concept for a new business system. To expand the scope of this section to become a Management System Specification requires two changes. The first is to include, along with the specification for the mechanized system, the total functional operating environment surrounding the computer system which together make up the Management System. The second is to tone down some of the

- I. Management Summary
  - A. Introduction
  - B. Management System Overview
- II. Management System Specification
  - A. Management System Flow
  - B. Information Flow Requirements
  - C. Management System Inputs and Outputs
  - D. Management System Performance, Maintenance and Control
- III. Implementation and Acceptance
  - A. Master Schedule
  - B. Installation Requirements
  - C. Acceptance Criteria
- IV. Economics
  - A. Cost Analysis
  - B. Benefits
  - C. Risks

Fig. 19 Contents of a management system specification package

detail description of the mechanized system. This is not to say to water down the description of the mechanized system to the point of being useless. This detail design is still necessary, but as will be seen later, to support the Computer System Design.

The system flow is the key ingredient of the system specification. The system flow is a pictorial representation of the total design concept. If asked to evaluate a new system, the first step any good systems analyst will take is to review the system flow to determine the scope, the information flow, methods of processing, inputs and outputs. The scope of any business system being developed, and therefore the scope of the project, can be determined by the system flow. The system flow found in a typical System Specification Package was shown in Figures 6 and 7. This is clearly the flow for a computer system. This is not surprising since the scope of the project and the design efforts are typically limited to the computer system. The system flow must be expanded to the level of the Management System. An example of a Management System flow is shown in Figure 20.

Using the Procurement function as an example, a sharp contrast can now be drawn between the scope of the mechanized (computer) system and the Management System. Referring to Figure 20, the scope of the Management System includes the mechanized system as well as its total operating environment. The requirements of the total Procurement function are included in the design concept. The flow of information is designed for the mechanized system and each functional group within the department. The design includes not only the user departments interface with the mechanized system but also with the other depart-

ments of the firm.

Referring back to Figure 19, this idea of an expansion is carried right through section II of the specification and the entire package. The Information Flow or Processing Requirements is a detail discussion that supports the system flow. As such, the topics covered in this discussion are, by necessity, expanded to the Management System level. Likewise the Inputs and Outputs section is no longer limited to the mechanized system. The input and output requirements of the total environment must be determined. System performance criteria such as information flow times, response times, etc. are expanded to include the total Management System. Specifications for maintaining and controlling the system at an effective operating level, such as periodic audits, must also include the non-mechanized portions of the Management System.

Sections III and IV of the specification package also have some significant changes. The Implementation Requirements not only cover the requirements to install the new computer system, such as conversion of the existing computer system, but also specify any changes necessary in the user area as well. Implementing the new Management System may require extensive rewriting of user operating procedures or possibly a reorganization of the user department. The Acceptance Criteria likewise must cover acceptance testing of all aspects of the new Management System not just the new computer system.

The economic analysis must also be expanded to include all costs, savings, benefits and risks associated with the total Management System. The costs and savings realized by the computer system



alone are not an accurate indicator of the financial impact of implementing a new Management System.

### Management System Analysis -- An Example

An example of a system design problem and how it is solved will illustrate the differences between the analysis and design processes of present methods and the Management System approach.<sup>1</sup> Suppose the task team, using present methods, is designing a new mechanized system and one phase of the new system is to process Purchase Requisitions. The problem given the task team is a severe backlog of Purchase Requisitions and how to relieve it. Through the analysis of the existing computer system, the task team determines that the backlog is a result of the current computer system being batch processed twice weekly. If the response time of the system were increased, the backlog can be eliminated. Therefore, this phase of the new system is designed for on-line input of Purchase Requisitions from a terminal and by utilizing real-time processing techniques, the system response time can be reduced to seconds. The solution requires a more costly computer system; however, the savings realized by eliminating the backlog will offset the increased computer cost. What typically occurs is that after installation the backlog is eliminated. However, after several months, the backlog suddenly reappears. The savings are not realized. The computer costs have increased. The total department operating costs are increased, with no corresponding increase in productivity.

<sup>1</sup>Jay W. Forrester, Industrial Dynamics (Cambridge: MIT Press, 1972), pp. 21-23.

Using a Management System approach the analysis is quite different. The analysis would follow the guidelines of Figure 20. The task team would analyze the total information flow involving the Purchase Requisition. Their efforts would not merely center on how to relieve the backlog, but what is actually causing the backlog. This involves analyzing the source of Purchase Requisition, how and why they are generated, which is actually outside the department. The flow of Purchase Requisition would be followed through each step and operation prior to being received by the Material Analyst making the input to the system. The analyst's activities prior to system input would be evaluated. The form itself examined for possible cause of delays. Finally the computer system input and processing response times are evaluated for causes of delay.

The analysis of the total Management System surrounding the Purchase Requisition could result in three types of solutions versus the one typical solution using present methods. The first is that causes of the backlog may be determined to be delays in the flow prior to input to the computer system. By changing and improving the flow or possibly the form, the backlog can be eliminated without costly changes to the computer system. The expense of changing the computer system is avoided and a true cost reduction can be realized. The second type of solution would be a combination of improvements in the PR flow and computer system response time. This solution could still result in a total cost reduction. However, part of the savings would be applied to the computer system improvements. The third solution would be similar to the solution proposed using present study

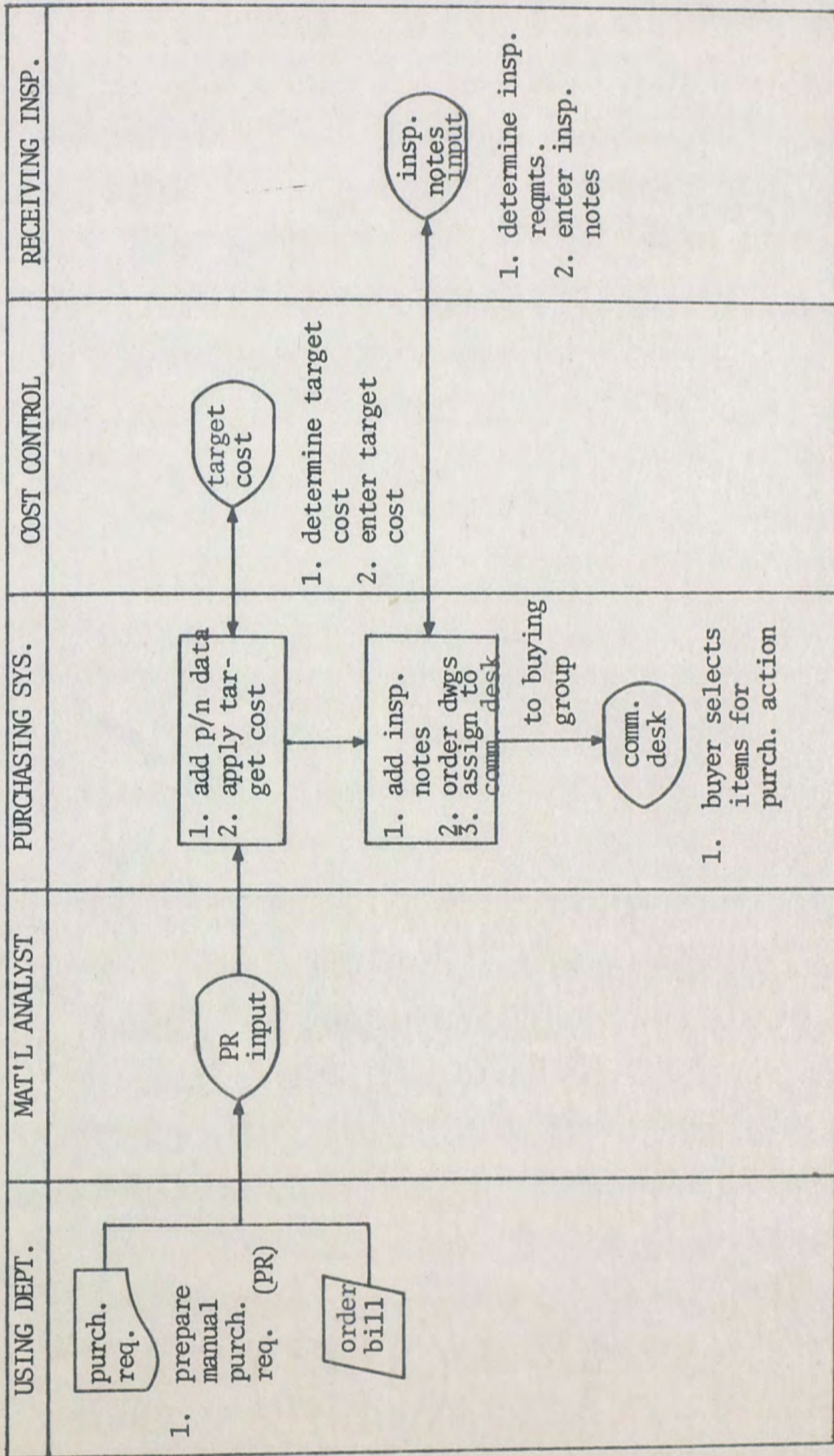


Fig. 20. Example of system flow expanded to the management system level

methods. Improve the computer system input and response times to eliminate the backlog. There is a significant difference however. Management is assured that the total problem was sufficiently analyzed that the solution attacks and solves the cause and not the symptom of the problem.

#### Systems Engineer

Reorienting the study phases of the project and the resulting documentation to the Management System concept will require changes in the personnel assigned to the project. In the discussion of the typical development project, it was pointed out that a study team is formed to perform both the Requirements Definition and System Specification phases and to write the System Specification Package. It was also pointed out that the team leader is typically a senior programmer/analyst with experience in designing and programming computer systems of the type being proposed. In the discussion of the problem areas of the typical development project (Section II), it was determined that the background and experience of the team leader greatly influences the activities of the study phases in the direction of the mechanized system.

To perform and direct the activities in the analysis and design of the Management System requires the expertise of a systems engineer.<sup>1</sup> The study and design phases should be performed by a systems analyst with Industrial Engineering background, with education and experience in management systems as well as data processing. The

<sup>1</sup>Ibid., pp. 5-6.

systems engineer must have the ability to identify and define the scope of the Management System and the total information flow that is the Management System. This is the single most important task of the entire project. The systems engineer must have the perception and experience to clearly and concisely define the objective of the design and development project. Vague and incomplete objectives are the primary causes of systems being ineffective and not meeting the needs of the user organization after implementation.

The systems engineer must then plan and organize the first three phases of the project within the scope of the Management System. This requires breaking the Management System down into its components and determining the analysis and design activities for each. For larger systems, these activities are assigned to the various team members. The systems engineer must monitor the results to assure the analysis is complete, that alternative solutions were considered and that the total design concept meets the objectives of the Management System.

#### Programmer/Analyst -- Computer System Design

This is not to say that the programmer/analyst is not needed at this time. As shown in Figure 17, there should be a definite overlap between the Management System Specification and the Computer System Design phases. Since a significant portion of the system will be mechanized, a preliminary design of the computer system will be necessary to adequately complete the specification for the Management System. By coordinating and to some extent overlapping the activities of these two phases will assure a smooth transition to the Computer

System Design phase and that the design concept for the mechanized system meets the requirements and objectives of the Management System.

The degree of detail required for the preliminary design of the computer system will vary from project to project. As stressed earlier in the discussion of the Management System Specification Package, the detail should be passed on and become a part of the Computer System Design Package with only the conceptual design of the computer system documented in the Management System Specification Package.

With the completion of the Management System Specification, the project moves to the Computer System Design Phase. At this point the scope narrows to the design and development of the mechanized system. As discussed earlier, with the proper objectives and constraints identified in the Management System Design concept, the activities of the remaining phases of the project are more than adequate to develop an effective computer system.

## CONCLUSION

This paper has researched the design and development methods of Management Information Systems to answer the question why systems so often become unmanageable, shortly after being developed. It was determined that MIS project methods have not kept pace with the rapid changes in MIS applications, brought on primarily by the technology explosion in the computer industry. Significant changes are required in the MIS project objectives, the methods used, the personnel assigned and the documentation to realign the project to the Management System. Current MIS projects concentrate their efforts on the computer system. More emphasis needs to be placed on the functional environment within which the computer system must operate. When taken together, the functional environment and the computer system make up the Management System.

The pace of MIS applications and the technology of the computer industry is accelerating. The rate of change with which management must contend is increasing. Each passing decade -- or so it is said -- witnesses more change than all the years combined. Since Management Information Systems reach into all the areas subject to this explosive rate of change -- functional, organizational and technological -- they too must change. The challenge is to industrial management and institutions of higher learning to provide aggressive and innovative methods of managing and controlling this change to ensure healthy

growth. The lag must not widen.



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