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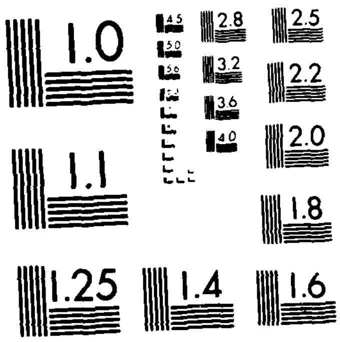

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Wright-Patterson Air Force Base, Ohio

INFORMATION NEEDS AND SYSTEM
SPECIFICATIONS FOR THE B-1B
EXECUTIVE INFORMATION SYSTEM

David E. Morgan, Captain, USAF
George H. Stilwell, Major, USAF

LSSR 36-83

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This thesis provides the B-1B Program Office with assistance in development of their executive information system. To achieve this purpose, two research objectives were identified. The first objective was to identify the information needs of the B-1B executive management team not currently satisfied by the existing computer-based information system. The second objective was to determine and document the system specifications to support these needs. To achieve these research objectives, a structured systems approach, $IDEF_0$, was used to develop a functional model of the management activities within the B-1B Program Office. The specific information needs were identified and documented. Also, system specifications were identified and documented. System specifications identified by the executive managers as most important to them concern security, ease of system operation, trend analysis and forecasting, and interface with contractor information systems. Recommendations to the program office address data base management, centralization/decentralization of software development, system documentation, and operational control of system hardware and software. The results of this study should be applicable to efforts to automate information systems in major weapon system program offices.

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INFORMATION NEEDS AND SYSTEM SPECIFICATIONS FOR THE B-1B EXECUTIVE INFORMATION SYSTEM

A Thesis

Presented to the Faculty of the School of Systems and Logistics

of the Air Force Institute of Technology

Air University

In Partial Fulfillment of the Requirements for the

Degree of Master of Science in System Management

By

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September 1983

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distribution unlimited

This thesis, written by

Captain David E. Morgan

and

Major George H. Stilwell

has been accepted by the undersigned on behalf of the faculty of the School of Systems and Logistics in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE IN SYSTEMS MANAGEMENT

DATE: 28 September 1983

Ronald H. Rasch

COMMITTEE CHAIRMAN

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We wish to express our appreciation also to each other. Some nights were long, sometimes we disagreed, but never did we lose our respect for the other.

PREFACE

This thesis identifies information needs and system specifications for the executive information system in the B-1B Program Office. The authors recognize there are several categories of people who may read this thesis, and wish to provide a general guide to the thesis for the various audiences.

The reader interested only in the results of the thesis research should read Chapter One, Chapter Five, and Chapter Six. The reader interested in the application of $IDEF_0$ should read Chapter Three, Chapter Four, and Appendix C. Chapter Two provides a discussion of information system design concepts and should be read by individuals not familiar with these concepts. The final report submitted to the B-1B Program Office is provided for the interested reader in Appendix B.

The authors hope this guide saves the reader time in gaining the degree of understanding desired.

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CHAPTER 1

INTRODUCTION

The mission of Air Force Systems Command (AFSC) is to develop and acquire weapon systems to support the mission of the Air Force. A program office is the organizational unit within AFSC which has responsibility for developing and acquiring these weapon systems. The B-1B Program Office is the organizational unit tasked with the development and acquisition of the new strategic manned bomber, the B-1B, which is needed to replace the aging B-52 bomber. The complexities of the development and acquisition of a major weapon system such as the B-1B accentuates the importance of information for effective program management.

Definitions

To insure a common basis for the discussions which follow, a clear understanding of certain terms is essential. These terms are data, information, management information system (MIS), and information needs.

Data are unstructured facts that have been acquired from direct observation, experimentation, or historical review.

A management information system can best be defined by addressing its components: management, information, and system. Management is defined as the planning, organizing, coordinating, directing, and controlling of human resources and materials to accomplish an objective. Information is data that has been processed into a form that is meaningful to the recipient and is of real or perceived value in current or prospective decisions. In the most general view, a system is a collection of elements which functions to accomplish an objective. The inputs and outputs of a system establish its relationship to its external environment.

Kennevan developed a definition of MIS which ties these concepts together.

> a management information system is an organized method of providing past, present, and projected information relating to internal operations and external intelligence. It supports the planning, control, and operational function of an organization by furnishing uniform information in the proper time-frame to assist the decision making process [21:100].

In sum, MIS represents a tool which enables managers to use corporate information resources when performing management functions.

Discussion in the literature focuses on two aspects of information needs: content of information and characteristics of information. Content is discussed across a spectrum ranging from general classification (i.e. inventory status) to specific facts (i.e. specific inventory level for each item). Characteristics relate to qualities required to structure and differentiate meaningful and valuable information. Both aspects of information needs are functionally dependent upon the user (16:209-213). In this research project, the definition of information needs incorporates both the content, which was focused toward general classifications, and the characteristics of information. These characteristics correspond to the attributes of information as defined by Burch, et. al. (11:17).

Background

The rapid development of computer technology and computer applications has made significant amounts of information available for management use in decision making (40:1). Information is an essential managerial resource to be used in business planning, organizing, and controlling processes.

> Current writers are generally consistent in emphasizing that data--and the information derived from data--constitute a corporate resource and should be managed as such [38:6].

Murdick and Ross state:

> Men, money, material, and machines and facilities have always been considered the basic resources of production and the basic factors with which management is concerned. Each of these has a body of knowledge surrounding it and a set of principles devoted to its management. A fifth resource, now recognized as equally important, is information. The effective use of information has become as important as the effective use of any resource in the company [29:159].

Management no longer speaks in terms of data processing but in terms of information resources management. Lucas notes that in the coming decade an organization's success will be dependent, in large part, on successfully managing its information resources (24:47).

A measure of the emphasis managers are placing on information resources can be found in the budgets devoted toward developing this corporate resource. Some experts estimate that between 1981 and 1983 U.S. organizations will have spent 78 billion dollars for developing and operating data processing and computer based information systems (13:170).

The federal government has a substantial investment in information resources and computer based information systems, with a base of over 15,000 computers, 100,000 computer specialists, and a $5 billion plus annual budget for computer work (19:4). Air Force Systems Command (AFSC) has recognized the growing importance and large expense of information systems in its operations. As a result, AFSC initiated the Command Management Information System (CMIS) project in December 1978. The stated purpose for this project was to reduce duplication of MIS efforts in the command, increase productivity and data sharing, and improve operations through effective coordination (5:4). In March 1981, the CMIS project was incorporated into the Information Resources Management (IRM) project. The IRM project was initiated in response to the Paperwork Reduction Act of 1980 (39). The concepts of the IRM project were the same as those in the CMIS project. The project's scope was expanded to include not only management information systems, but all data processing, office automation, and telecommunication activities within AFSC. Each of AFSC's subordinate agencies are charged with developing their own programs under the IRM project framework (39).

Aeronautical Systems Division's (ASD) major effort has been the development of the Automated Management System (AMS). The AMS concept is to "... provide a consistent, common, simple, and reliable interface between the users and the AMS Network [2:p.6-2]." In general terms, AMS is a hardware/software development and acquisition project. The primary emphasis of the project is to provide an ASD-wide network to process data on common equipment. The prime objective is to provide automated support for all ASD program offices, staff, and corporate elements (2:p.10-1).

Statement of the Problem

The recent development of IRM and AMS means that the major benefits these projects seek to achieve will not be available for some time. The complexities of the development and acquisition process for a major weapon system accentuate the importance of information to the program manager in any of ASD's program offices. For example, Archibald identified 17 activities a MIS should support in a project management type organization (7:6). The Program Manager in the B-1B Program Office is concerned about the use of information resources available to the program office. As a result of this concern, a Management Information System Plan for the B-1B Program Office was developed. The purpose of the plan is to provide a coordinated approach to improve information resource use in the organization (8). The plan's three major areas of concern were office automation, word processing, and development of an executive information system. Of particular interest to the Program Director was the executive information system. In March of 1982, an initial study was performed to provide direction for executive information system development (34). However, the information needs for an executive information system have not been completely identified. These information needs, and the system specifications to support those needs, must be identified before an information system for executive level use can be fully developed.

Justification

Program management is a dynamic, complex process. DoD Regulation 5000.1 identifies the four major phases of the acquisition life cycle as concept exploration, demonstration and validation, full scale development, and production and deployment (17:4). The specific program objectives and the management strategies required to accomplish these objectives change as the program matures from concept to operational deployment. Additionally, each program office has unique characteristics and operating environments (i.e. political controversy, technological sophistication of the system, environmental and social impact) which compound the internal complexities.

The B-1 program has been subject to a considerable amount of political controversy throughout its history. The program was cancelled by President Carter in 1977 just prior to production. In 1981, President Reagan restarted the program. The four year delay in the acquisition process resulted in a requirement for concurrent full scale development and production of the system to meet defense needs. Currently, the extensive debate over the 1984 defense budgets has produced uncertainty over program stability and increased the visibility of the program to Congress and the general public.

A basic tenet of MIS design is that a management information system must be tailored specifically to the organization it serves, reflecting the size, organizational structure, and management style (31). Although several studies have attempted to identify general information needs for a program office, only one has addressed the unique information needs for the B-1B program office. By identifying the information needs within the B-1B office and the system specifications to satisfy those needs, this study will provide a necessary step in the development of an executive information system.

Scope and Limitations

The information needs identified in the March 1982 study in the B-1B Program Office will not be duplicated. The focus of this research effort was directed toward information needs not currently fulfilled by the existing executive information system. The information needs identified will be appropriate for the current phase of the B-1B program. An update of these information needs will be required as the program progresses through its life-cycle.

This study effort was limited to the executive level managers in the B-1B program office. Executive level managers are defined to be the Program Director and his deputy directors (26). These positions are identified in the organizational chart displayed in Figure 1-1. A brief description of the responsibilities of each directorate is included in Appendix A.

Because of differences in program size, cost, and system complexity, each program office has unique features and problems. Therefore, any generalizations of the results of this study to other program offices should be approached with caution.

Research Objectives

The overall purpose for this effort was to provide the B-1B Program Office assistance with development of their executive information system. To achieve this purpose, two research objectives were identified.

The first objective of this study was to identify

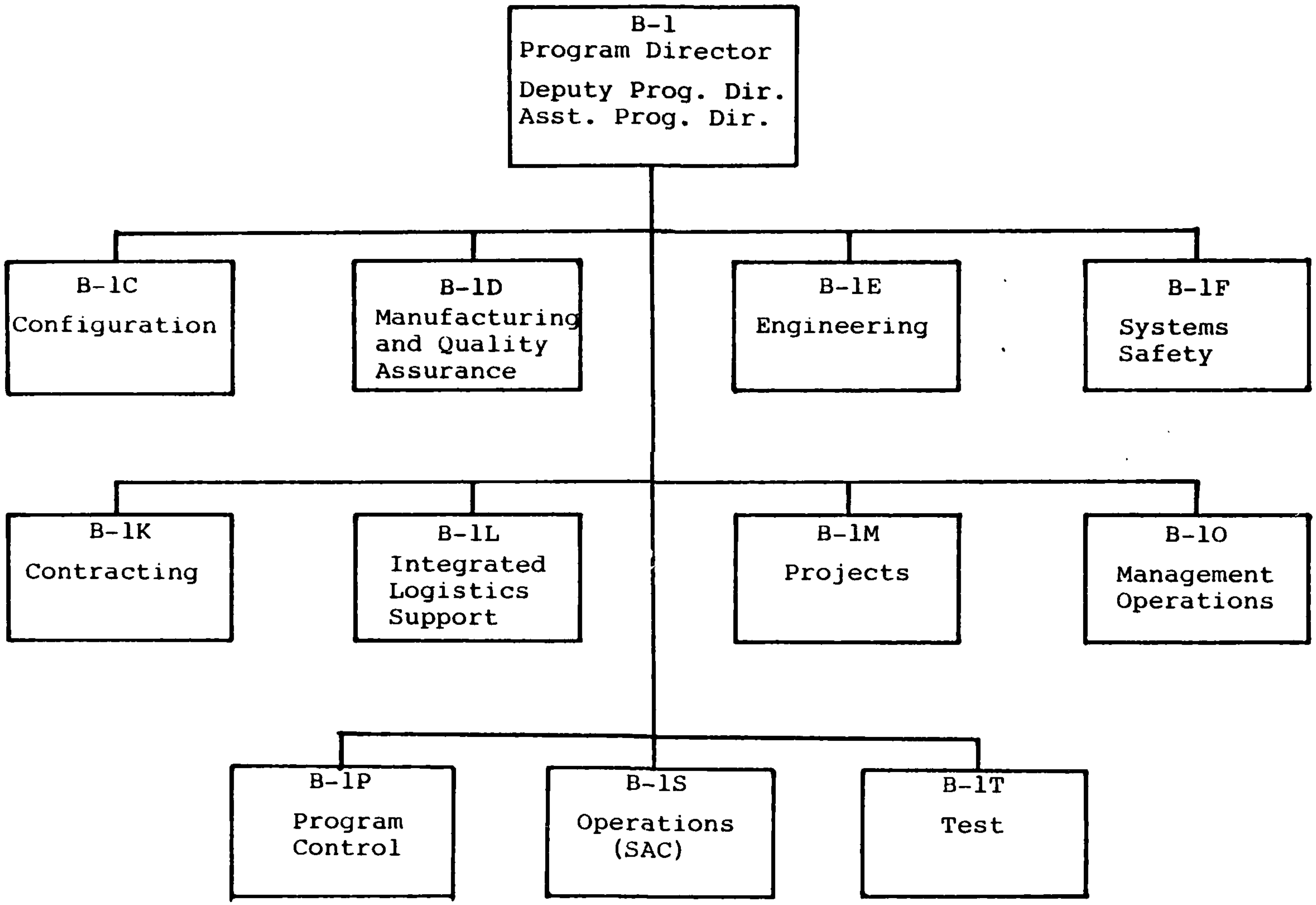

Fig. 1-1 B-1B Organizational Chart

and document the information needs not currently fulfilled by the existing executive information system. The second objective was to determine and document the system specifications necessary to support these information needs. These specifications address the second aspect of information needs: the characteristics or attributes of the information. If the information system is to become a valuable tool for management use, these specifications must be incorporated into the executive information system.

To identify the information needs and determine the system specifications to support those needs, it was essential that the design team understand the functional relationships within the system (1;10;11;12;14;25;37). Functional relationships are defined as the formal interactions and interdependencies of the personnel within the system.

Overview of the Thesis

There are five chapters remaining in this thesis report. Chapter Two contains a discussion of information system design concepts. Two factors were identified as important to information system design: information needs determination and user involvement. Chapter Three discusses the structured system design process. The $IDEF_0$ functional modeling technique is described and explained. The method of data collection and use of the functional model is presented. Chapter Four contains the final model and instructions about how to read the model. Based on the authors' analysis, primary information interfaces in the program office are identified and listed. Chapter Five contains the findings of the thesis research. Specific information needs and system specifications are presented. Chapter Six contains a brief summary of the thesis research, recommendations made to the B-1B Program Office, the authors' recommendations for future study and conclusion. Appendix A contains a brief description of the organizational directorates. Appendix B contains the final project report submitted to the B-1B Program Office. Appendix C contains observations concerning the $IDEF_0$ methodology.

Chapter One has presented key definitions, background leading to the problem statement, justification, and the scope and limitations for this thesis effort. Two specific research objectives were stated and an overview of the material presented in the remaining chapters was presented. Chapter Two discusses information system design concepts.

CHAPTER 2

INFORMATION SYSTEMS DESIGN CONCEPTS

Introduction

The major information systems design concepts discussed in the literature are focused toward development of a management information system. The common thread throughout the literature is the importance of matching the design of an information system to the organization in which it will operate. Current literature deals with two important factors related to the principle of matching the information system to the organization it serves. These factors are determination of the information needs and user involvement in the design process. Retzer reviewed 50 references that identified 150 important factors relating to successful implementation of information systems. Information/systems needs were identified by 16 authors and user/management involvement by 26 (33:15).

Information Needs

A key factor in identifying the information needs for a system is the type of decisions the system must support (15:275). Anthony developed a frequently used framework to identify the type of decisions made in an organization (12:4). He divides decision making into three levels; strategic planning, management control, and operational control.

> Strategic planning is the process of deciding on objectives of the organization, on changes in these objectives, and on the policies that are to govern the acquisition, use, and disposition of these resources [6:17].
>
> Management control is the process by which managers assure that resources are obtained and used effectively and efficiently in the accomplishment of the organization's objectives [6:17].
>
> Operational control is the process of assuring that specific tasks are carried out effectively and efficiently [6:18].

The decisions of the program director and his staff correspond to the management control level of Anthony's framework (32).

Gorry and Scott-Morton combined Simon's concepts of programmed and unprogrammed decisions with Anthony's levels of management decisions (12:5). This expanded model, depicted in Figure 2-1, has programmed and unprogrammed decisions within each level of management decision. The model implies that different types of information are required for each management level and decision structure. Beiler expanded Anthony's classification scheme to include his view that "... at the strategic planning level, there is a much greater need for external information - or information from the environment [9:10]." This construct is represented in Figure 2-2.

Beiler studied the information requirements and information flows in a program management office. He noted

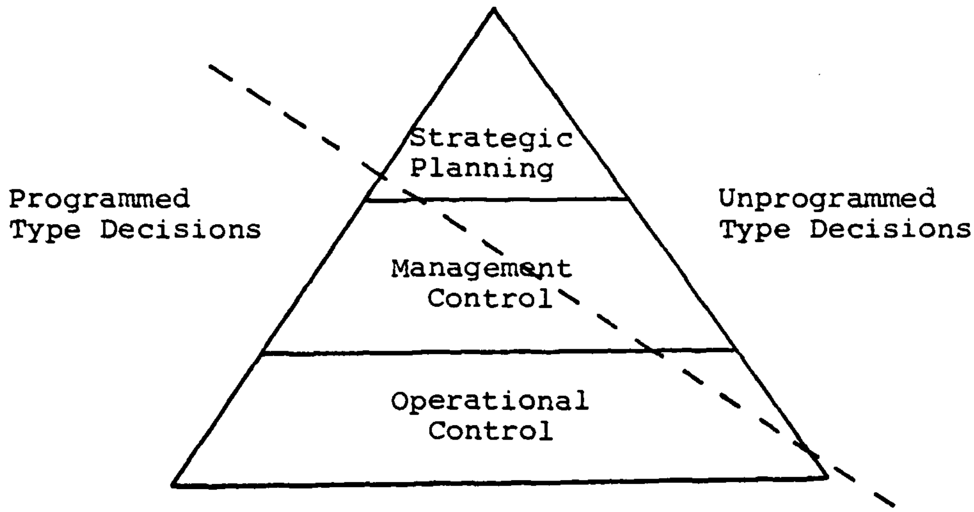

Fig. 2-1 Gorry and Scott-Morton Model (12:5)

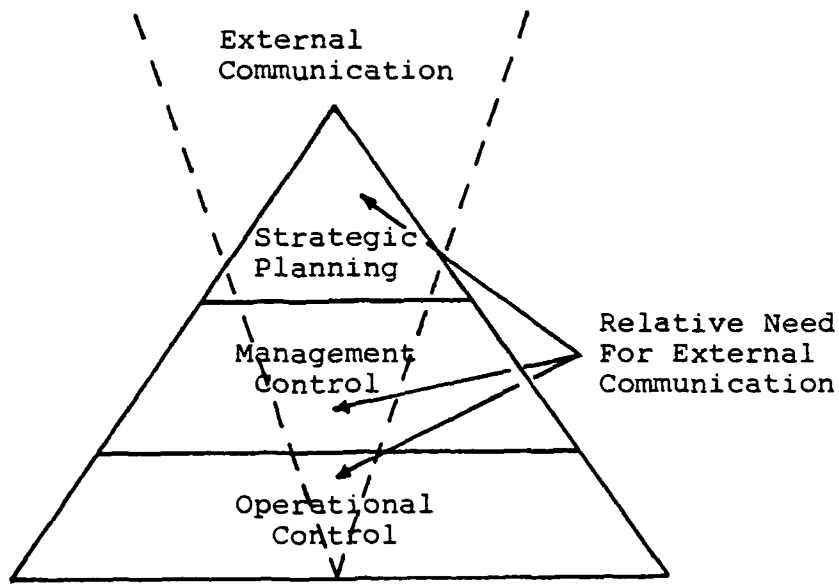

Fig. 2-2 Beiler Model (9:10)

that determining information needs is an iterative process. Information needs change as the program moves through its life cycle (9:18). Beiler concluded accurate identification of user information needs is an important prerequisite for building a useful information system (9:41).

Smith concluded that determining the information needs of the information system user is very important to the successful development of a MIS (38:36). Lucas observed that a noticeable trend in systems design was to spend more time in analysis and design prior to the programming, testing, and implementing phases. In his view, this trend holds great promise to improve the accurate identification of managements' information requirements (24:294). Increasingly, MIS developers are urged to involve the user in all development phases (35:73).

McClain and Doucette examined the essential information requirements for a procurement organization and concluded that the designers of a MIS must first define user information needs. After this has been done, development of an MIS could be started (27:57).

Kruppenbecher concluded that unless an orderly approach to MIS development is conducted, the MIS effort is likely to fail (22:2). He identified six key problems with AFSC program office MIS development.

1. MIS personnel utilized were not always qualified in computer systems design and program management,

2. System requirements are not properly defined,

3. Management does not participate in definition of system objectives and information requirements,

4. There is resistance to system acceptance by organizations and personnel,

5. Organizational conflict arises when the data base cuts across functional lines, and

6. "Company" guidance is not available for MIS development in terms of regulation, education and training, and information on related developments and resources [22:12-13].

The two stated problems which are of particular interest for this study are a lack of properly defined system requirements and a lack of management participation in development of the requirements.

User Involvement

There are two major issues surrounding user involvement in information system development. The first issue concerns the organizational impact of the information system. The impact is manifested in user acceptance or non-acceptance of the new information system.

Robey and Farrow state that

> Increasingly, system developers are urged to involve ultimate users in various stages of MIS development. Recognizing the generally-accepted value of participation in facilitating change, as documented in the behavioral sciences, management scientists have pressed for greater user involvement [35:73].

Among the expected benefits of user participation in the design process are greater user acceptance, user support, and improved user understanding (35:73).

The second issue concerns accurate determination of information needs the system must satisfy. In a study for the Office of Naval Research, Alpha Omega Group, Inc., reviewed 14 different methodologies which were developed for or applied to determination of information needs. Each of these methodologies depended to some degree on user participation in the requirements determination process (3:24-43). Retzer conducted a survey of 750 Air Force personnel involved in computer applications and found user involvement in MIS development was a critical factor (33:95).

The underlying reason user involvement in the design process appears so important is perhaps best summed up by Carter and Silverman. Their view is that

> High start-up costs for system design, equipment purchase, software development, data collection and storage, and personnel training make it important to carefully determine the firm's needs and objectives before deciding what kind of information system to develop [13:17].

Several authors (3;4;9;11;12;18;24) express the importance of user involvement more in line with the principle of matching the information system to the organization. These authors recognize the differences which exist between the functions of the system designer and the user. For example, Lucas's justification for his Creative Design approach is that

Creative design lets the user and analyst exploit their comparative advantages: the user is most knowledgeable about a specific information processing problem, and the analyst is most familiar with computer and information systems technology [23:43].

Alter's empirical study of fifty-six systems identified user involvement as an important factor in MIS development.

Intended users neither initiated nor played an active role in implementing 11 of the 15 systems that suffered significant implementation problems. Conversely, there were relatively few such problems in 27 of the 31 systems in which users had a hand in initiating and/or played an active role in implementing [4:103].

The amount of user involvement in the development of an information system will vary depending on the situation. Lucas notes that a system used for operational control may not require active user participation. However, he states that as an information system design moves toward managerial and strategic planning applications, user participation becomes very important (24:234).

In summary, a primary objective for the system designer is to match the information system to the management system it supports. To accomplish this objective, the designer must determine the information needs of the management system. The user of the information system should play an integral part in this process. Not only does he establish the information requirements, but his participation contributes to his support and understanding of the information system. Chapter Three will discuss the use of a structured methodology used in this thesis research.

CHAPTER 3

METHODOLOGY

Introduction

The methodologies developed to determine the information needs generally incorporate some form of structured, top-down analysis conducted in an iterative design process. Structured analysis is a concept borrowed from the realm of computer programming. It consists of a set of specific rules which attempt to reduce inaccuracies that result from the designer's interpretation of reality.

A top-down approach is one in which the analyst first takes a broad view of the overall function, identifying all inputs, outputs, and constraints for the total system. Next, the sub-functions or sub-activities which make up this broad view are identified along with their inputs, outputs, and constraints. This decomposition of the system is continued until the required level of detail is reached (12:7). One advantage of this approach is its usefulness in matching the users' information needs to the design of the information system. Zani points out:

> If management sees to it that this framework (top-down design approach) is used when an information system is being designed, then the resulting system will be smartly tailored to the company from the top down, and not merely patched together from the bottom up in a crazy quilt of residues from automated clerical procedures [41:222].

Another advantage of this approach is that it avoids interface problems which can result from a bottom-up approach (18:217). For example, during development of a large inventory control system for the US Navy, the design of the Global Logical Data Base was initially attempted using simultaneous top-down and bottom-up approaches. The design team discovered the bottom-up approach rapidly generated too much complexity and detail, so it was abandoned (20:25).

Incorporating an iterative methodology is a strategy used to improve understanding of complex requirements and/or improve communication between the designer and user. An iterative approach results in a stepwise increase in the specificity of system requirements and a corresponding advance in the state of the system (28:6). Lucas, in describing his Evolutionary Design approach, identifies the major advantage of this strategy as the capability it provides the analyst to provide feedback to the user. This in turn allows the user to redefine his requirements (23:51). He further states:

> This approach is best where the goals and objectives of the system are unclear. Systems most amenable to evolutionary design are probably those in the management control and strategic planning cells of the Gorry and Scott Morton framework [23:51].

Functional Modeling Methodology

Based on the information in the literature, it is desirable to select a methodology which incorporates a structured, top-down, iterative approach to systems design. A promising methodology with these attributes has been developed for the Integrated Computer Aided Manufacturing (ICAM) program. The ICAM program is "... directed toward increasing manufacturing productivity through a systematic application of computer technology [37:3]." The methodology to aid accomplishment of the ICAM objective was developed for the Materials Laboratory of Air Force Wright Aeronautical Laboratories with the assistance of SofTech, Inc. This methodology, termed ICAM Definition ($IDEF_0$), is a systems methodology which provides a blueprint defining the fundamental functional relationships of the system.

> $IDEF_0$ is used to produce a function model which is a structured representation of the functions of a manufacturing system or environment, and of the information and objects which interrelate those functions [37:3].

Although specifically developed as a tool to analyze manufacturing systems, the concepts and procedures are applicable to any system analysis which is concerned with functional relationships (30). The following sections provide an overview of the $IDEF_0$ concepts, diagrams and procedures.

$IDEF_0$ Concepts

The $IDEF_0$ concepts incorporate a top-down systems approach. The modeling process begins by representing the whole system as a simple, single unit--depicted as a box. Arrows into the box represent the interfaces to the outside environment. This single unit, or module, is decomposed into its subfunctions on another diagram using a box to represent each subfunction. The boxes on the new diagram are connected with interface arrows.

> This decomposition reveals a complete set of submodules, each represented as a box whose boundaries are defined by the interface arrows. Each of these submodule boxes may be similarly decomposed to expose more detail [37:14].

Figure 3-1 shows how the complete set of diagrams represents a hierarchical graphic representation of the system under analysis.

$IDEF_0$ Diagrams

The rules used to construct the $IDEF_0$ diagrams provide structure to the methodology. The diagrams are arranged in a hierarchical format and systematically break a complex activity into its component parts. On a subsequent diagram, a box can be broken down into a more detailed structure by using additional submodules. $IDEF_0$ has rules which guide development of further detail during the decomposition process. A decomposition of a diagram is limited to no more than six, but no fewer than three submodules.

> The upper limit of six forces the use of a hierarchy to describe complex subjects. The lower limit of three insures that enough detail is introduced to make the decomposition of interest [37:14].

This process of decomposition continues until the system is

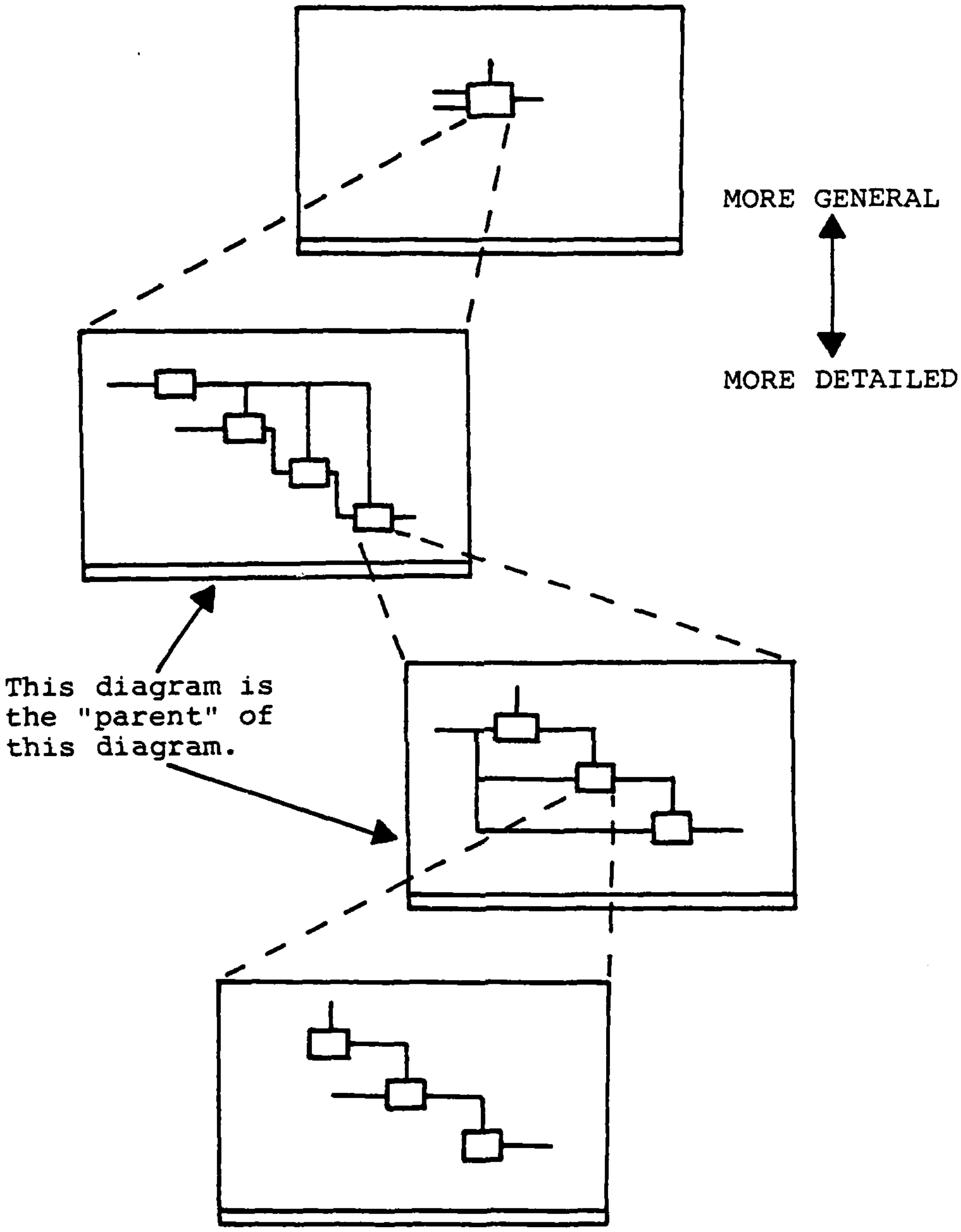

Fig. 3-1 Model Structure (37:13)

described to the desired level of detail.

The submodules, or boxes, represent system functions. The functions must be described by an active verb phrase written inside the box. The arrows that connect submodules represent either objects or information which are needed or produced by the function. Arrows must be labeled with a noun phrase. The exact relationships among the diagrams are indicated by interconnecting arrows. These requirements provide additional structure to the methodology.

$IDEF_0$ Procedures

The $IDEF_0$ procedures support the iterative process of the design effort. "The $IDEF_0$ methodology includes procedures for developing and critiquing models by a large group of people ... [37:15]." The system designer(s) or system analyst(s) construct the initial model diagrams from information supplied by experts--personnel who function within the system. The diagrams are distributed to the experts for review and critique. The diagrams are then returned to the designer(s) for correction. "This cycle continues until the diagrams, and eventually, the entire model are officially accepted [37:15]." This official acceptance insures the model accurately reflects functional relationships in the system.

Data Collection

Interviews with the deputy program directors, defined as experts for this study, provided the most important source of information (37:138). The information transmitted during these interviews was used to construct the diagrams. Figure 3-2 contains the list of organizational positions which constitute the entire population of experts for this study. The anticipated number of interviews required to determine the functional relationships and important management tasks were specified for each position. The number of interviews planned represented an initial estimate of the complexity of the position within the current program office operations.

Four types of interviews which could have been used in the course of the systems analysis are identified in the IDEF methodology. These are:

1. Fact finding for understanding current operations. This type of interview is used to establish the content of a Current Operations Model, or to help understand the existing environment.

2. Problem Identification to assist in the establishment of future requirements. This type of interview is used to validate the Current Operations Model and to provide the foundation for a Future Operations Model.

3. Solution Discussion regarding future system capabilities. This type of interview is used to establish the content of a Future Operations Model.

4. IDEF Author/Commenter Talk Session. This type of interview is used to resolve problems which

	Planned Number of Interviews	Actual No. of Interviews
Program Director	3	1
Deputy Program Director	3	1
Assistant Program Director	3	1
Director of Contracting	3	2
Director of Program Control	3	2
Director of Configuration	3	3
Director of Management Operations	3	2
Director of Projects	3	2
Director of Systems Safety	1	2
Director of Operations (SAC)	1	2
Director of Manufacturing and Quality Assurance	3	2
Director of Test	3	2
Director of Logistics Support	3	3
Director of Engineering	3	2

Fig. 3-2 Interview List

have surfaced during the construction of an IDEF model [37:138].

Practical experience with the methodology indicates that some features of each type of interview would be present in the actual interviews. As the detail in the model develops, the type of interview evolves toward an IDEF Author/Commenter Talk Session (30). The appropriate organization for these interview types uses a semi-structured format (30).

The outline for the initial interviews is depicted in Figure 3-3. The interview began with presentation of an example of a basic $IDEF_0$ model to help the "expert" focus on the objectives of the interview. Interviews were conducted using a team approach. One team member directed the interview, the other team member recorded the experts comments. The interview was also tape recorded. The recordings were used to provide clarification of comments made during the interview. These recordings helped reduce misinterpretations resulting from the time lag between the interview and actual model construction.

The information needs and system specifications for the program director and the deputy directors were determined from analysis of the functional model, analysis of the information contained in the interview records, and analysis of secondary sources of information in the B-1B Program Office.

The model has several purposes. First, the development of the model provides a documented representation of the

INTRODUCTION

group introductions
project overview - outline methodology of analysis
    interview
    develop function model
    verify previous interview
    amplify and expand the model
    cycle as required to explain functions and requirements
purpose - aid in developing MIS for executive level decision making
team functions in interview
tape recorder

INTERVIEW QUESTIONS

NOTE: use IDEF model as starting point

1. What task's do you perform to fulfill your responsibilities?
2. What decisions do you need to make?
3. What information do you use to make decisions?
4. What additional information would be useful that you don't have now?
5. Do you know if it is available? If so where?
6. What are your current sources of information?

SUMMARY

Summarize data gathered during the interview
Make the appointment for next meeting

Fig. 3-3 Interview Outline

functional relationships among the program director and the deputy directors. As such, the model was a tool used during the analysis to enhance understanding of the organizational interrelationships within the B-1B Program Office. Second, the model can be extended to lower levels for detailed task definition and analysis. Third, as the program requirements change over time, the model can be revised and used to update information system requirements. Updating these system requirements is necessary to support changing management needs in the dynamic environment of weapon system acquisition.

The secondary sources of information were used to provide supplemental information to the interview records. Secondary sources of information included operating instructions, functional job descriptions, the program management plan, and existing management reports and control documents.

Chapter Three has presented the methodology used in this thesis effort. Chapter Four contains the functional model developed as a result of the interviews with the B-1B personnel. Primary information interfaces are documented at the end of the chapter.

CHAPTER 4

THE FUNCTIONAL MODEL

Introduction

This chapter contains the functional model developed from interviews with the B-1B directors. The chapter begins with a review of some basic concepts which must be understood to read and interpret an $IDEF_0$ model. The model, which represents the authors' conceptualization of the management processes and their interrelationships within the program office, is then presented. The presentation of the model begins with figure 4-1 which depicts the model's hierarchial structure. This is followed by the individual model diagrams which are contained in figures 4-2 through 4-11. Accompanying each diagram is a brief definition of the arrows and boxes depicted on that diagram. Next, the organizational structure of the current B-1B Program Office is presented in figure 4-12. This structure will be used to identify the organizational interfaces that exist within a task identified in the model. The last section of this chapter presents the primary information interfaces identified during the analysis of the model and the interviews.

Reading Instructions

The diagrams are used to describe functions and information at various levels of detail. The functions identified within the hierarchial structure of the model do not, nor were they intended to, correspond to any specific organizational structure in the program office. In the diagrams, boxes represent system functions and activities, arrows represent objects or information. A box on an upper diagram is detailed by the boxes and arrows of the lower diagram. Arrows entering and leaving the upper level box are exactly those arrows entering and leaving the entire lower diagram. Both the upper level box and the lower diagram represent the same part of the system.

Because a box can be detailed with a diagram, a system can be modeled with a set of diagrams. The first diagram of a model represents the system by a single box. The box is detailed with a first-level diagram. Boxes on the first-level diagram can be detailed with second-level diagrams. Continuing this way, a set of diagrams that describe the system to any desired level of detail can be produced.

Key Diagram Features

The model is a static (snapshot in time) representation of the management activity in the program office.

The format of the diagrams (arrangement of boxes from the upper left to the lower right corners) should not be interpreted as a time dependent sequence.

The node number (lower left corner of diagram) indicates a diagram's place in a model. A lower diagram's node number is constructed from the node number of the upper diagram by appending the number of the upper level box. For example, the A12 diagram is a further detailed representation of block 2 in the A1 diagram.

Input arrows enter a box on the left. Output arrows leave a box on the right. Control arrows enter a box on the top. The upward pointing arrows entering the bottom of the box indicate the doer or mechanism of the activity. To help keep the diagram simple and readable the mechanism arrows were not depicted on lower level diagram. This is a generally accepted practice in the $IDEF_0$ methodology (30).

The model was developed from the viewpoint of the executive level managers in the B-1B program office. The functions identified in the model are tasks accomplished to achieve the primary objective: development and acquisition of the B-1B weapon system. In some cases, the functions depicted are performed in part or in total by the prime contractor, subcontractor, or agencies outside the program office. When this occurs, the program office is concerned with monitoring and evaluating task accomplishment. For example, the Test Function (A32) is actually performed by the contractor or the Combined Test Force. The Test and Development Directorate is responsible for planning, controlling, coordinating, evaluating, and reporting these test activities.

In the discipline of the modeling structure, consistent level of detail is demanded. Since the viewpoint is bounded at the executive level, task decomposition does not detail the specific organizational elements. For example, in the Modify the Baseline diagram (A31), support from the Engineering Directorate is required to accomplish each of the tasks identified. However, the level of detail is insufficient to identify the specific support required. This situation must be kept in mind as the model is reviewed.

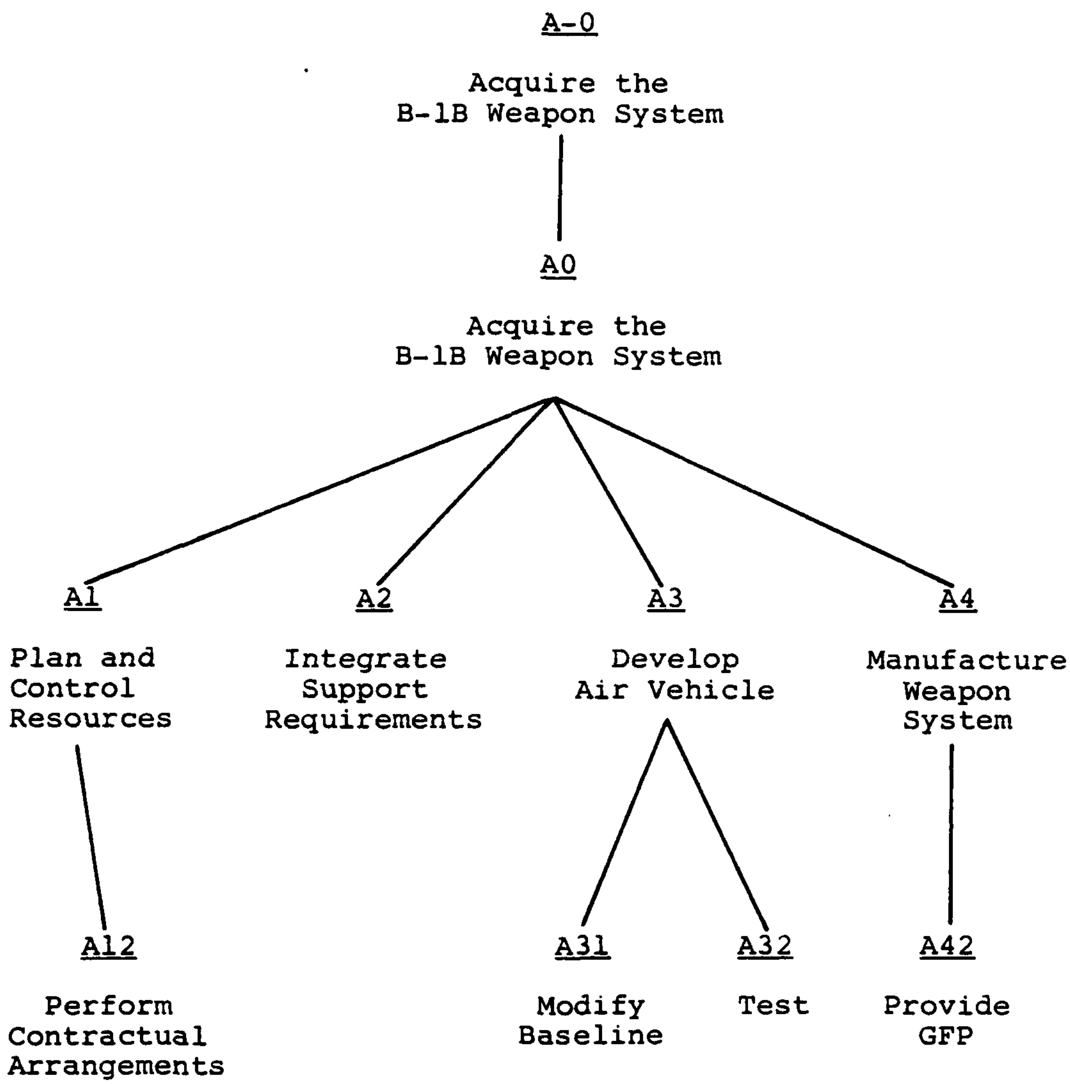

Fig. 4-1 B-1B Hierarchial Weapon System Acquisition Representation

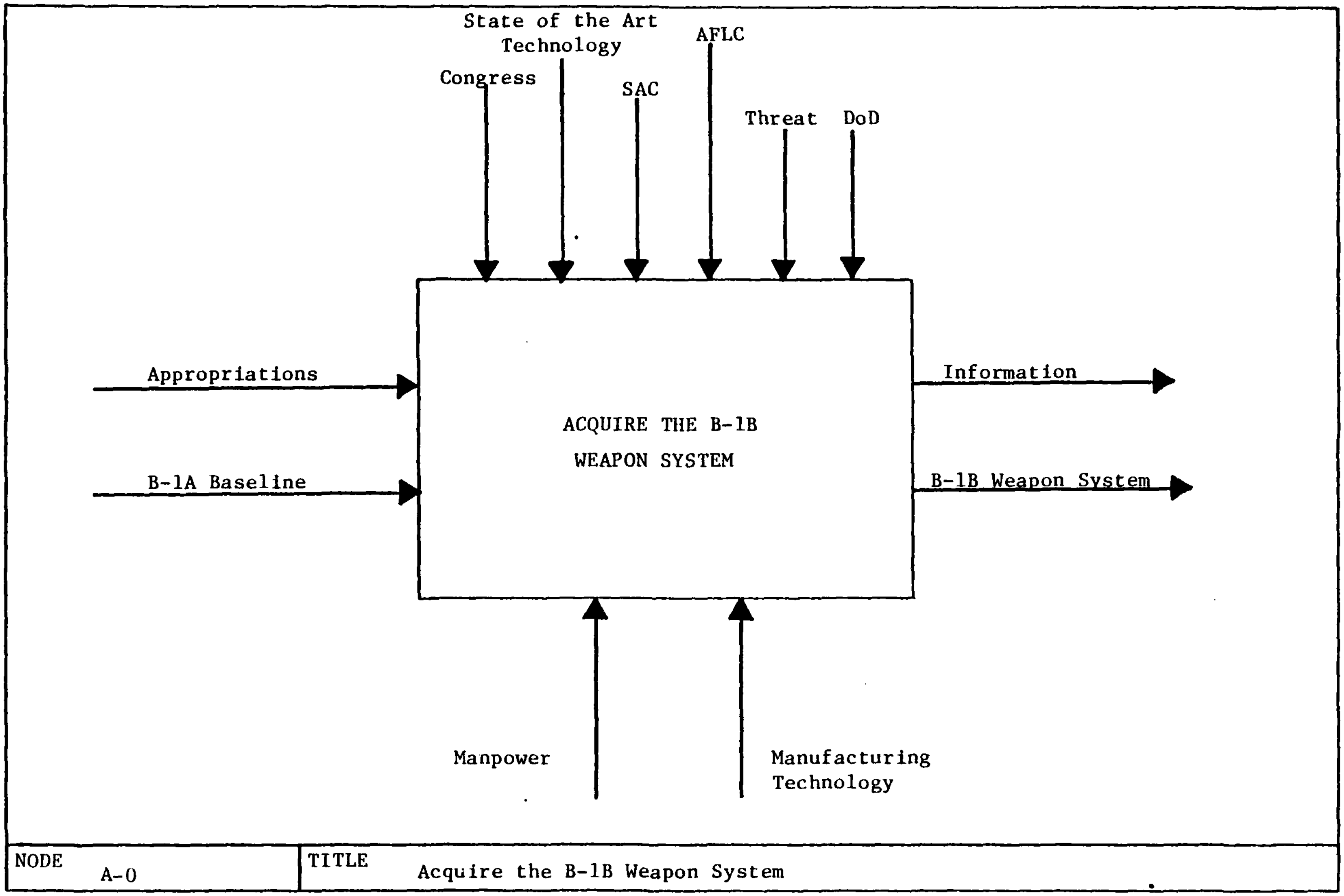

Fig. 4-2 A-0 Diagram

A-0 Diagram

The A-0 diagram defines the purpose of the B-1B Program Office and the interfaces between the program office and the external environment. The viewpoint is that of the Program Manager and the directors.

Congress represents the authorization/appropriation process. They also exercise legislative review over acquisition of the B-1B weapon system.

State of the Art Technology represents the policy decision to apply existing technology rather than develop totally new technology.

SAC is the using command and places operational requirements as a control which influences the final product.

AFLC is the major command responsible for supporting the weapon system when it is deployed.

The Threat represents the military capabilities of potential adversaries which could prevent the weapon system from achieving its assigned objectives.

DoD represents the hierarchical chain of command between the Secretary of Defense and the program office. All of the applicable regulations, directives, and policy statements that affect the B-1B program are transmitted through this control channel. In addition, this channel provides for the input of requirements for changes and modifications in the weapon system's capabilities. The mission for the weapon system is defined and revised via the DoD command structure.

B-1A Baseline represents the technology used to develop the original B-1 aircraft plus all the technological advances incorporated in the design up to the restart of the program.

Appropriations are the actual amounts of money which the program office is authorized to spend.

Information is the collection of all facts, figures, projections, reports, and responses to specific inquiries that are sent to the external environment.

B-1B Weapon System represents the complete aircraft, including all support equipment, spares, and any other associated items.

Manpower represents all of the military and government civilian personnel necessary to acquire the B-1B weapon system.

Manufacturing Technology represents the productive capabilities of the contractor and includes technology modernization which represents a partnership between the contractor and the Air Force directed at systematically bringing new and existing technologies, and the capital investments needed to implement them, onto the production floor.

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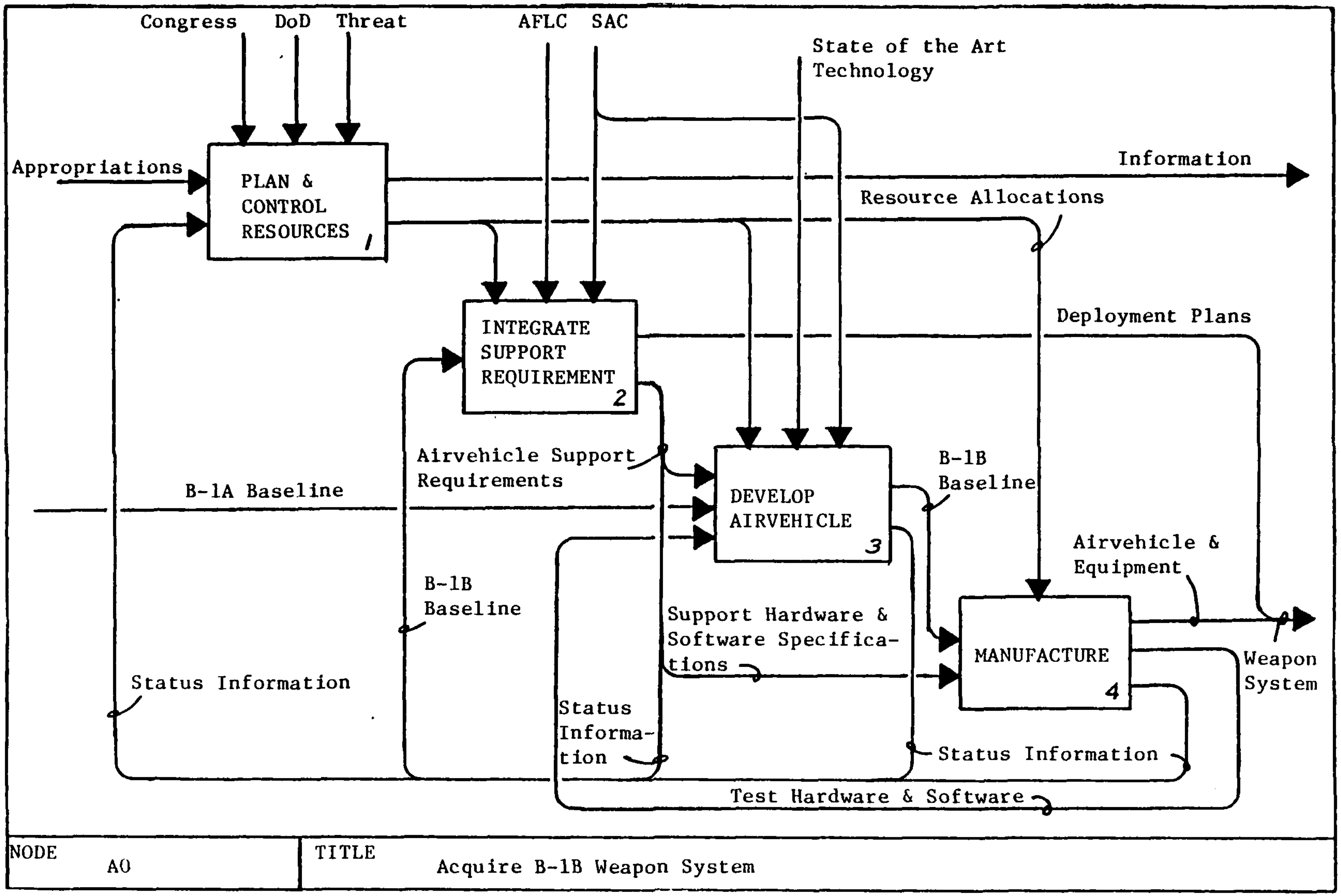

Fig. 4-3 A0 Diagram

A0 Diagram

The A0 diagram depicts the major tasks performed to accomplish the acquisition of the weapon system.

Plan and Control Resources (Box 1) represents the top management planning and policy formulation. This function provides the overall management control and resource allocations for the other functions. Resource allocations at this level are general in nature and represent implementation of program policy and objectives. This function provides the formal communication link with the external environment.

Deployment Plans (output of Box 2, Integrate Support Requirements) include all maintenance plans such as interim contractor support and depot level maintenance, in addition to initial deployment plans. When combined with the aircraft (output of Box 4, Manufacture) the weapon system is complete and ready for operational deployment. Air Vehicle Support Requirements (output of Box 2) encompass requirements which impact design of the aircraft and its subsystems. Support Hardware/Software Specifications include the definition of specialized maintenance and test equipment and associated software required to provide continued operational capability. Some of the requirements can be satisfied by existing equipment, some by modifying existing equipment, and some will require manufacture.

The B-1B baseline (output of Box 3, Develop Air Vehicle) includes all aircraft, subsystem, and software specifications, both technical and physical.

Productivity changes represent improvements in the manufacturing process which result in a net cost savings in the acquisition of the weapon system. These changes may or may not affect the design of the weapon system.

Each of the functions depicted in Box 2, 3, and 4 produces status and control information. The general nature of this information is provided in the diagrams where the information originates. The interdependence of the functions is reflected in the feedback channels to the other functions.

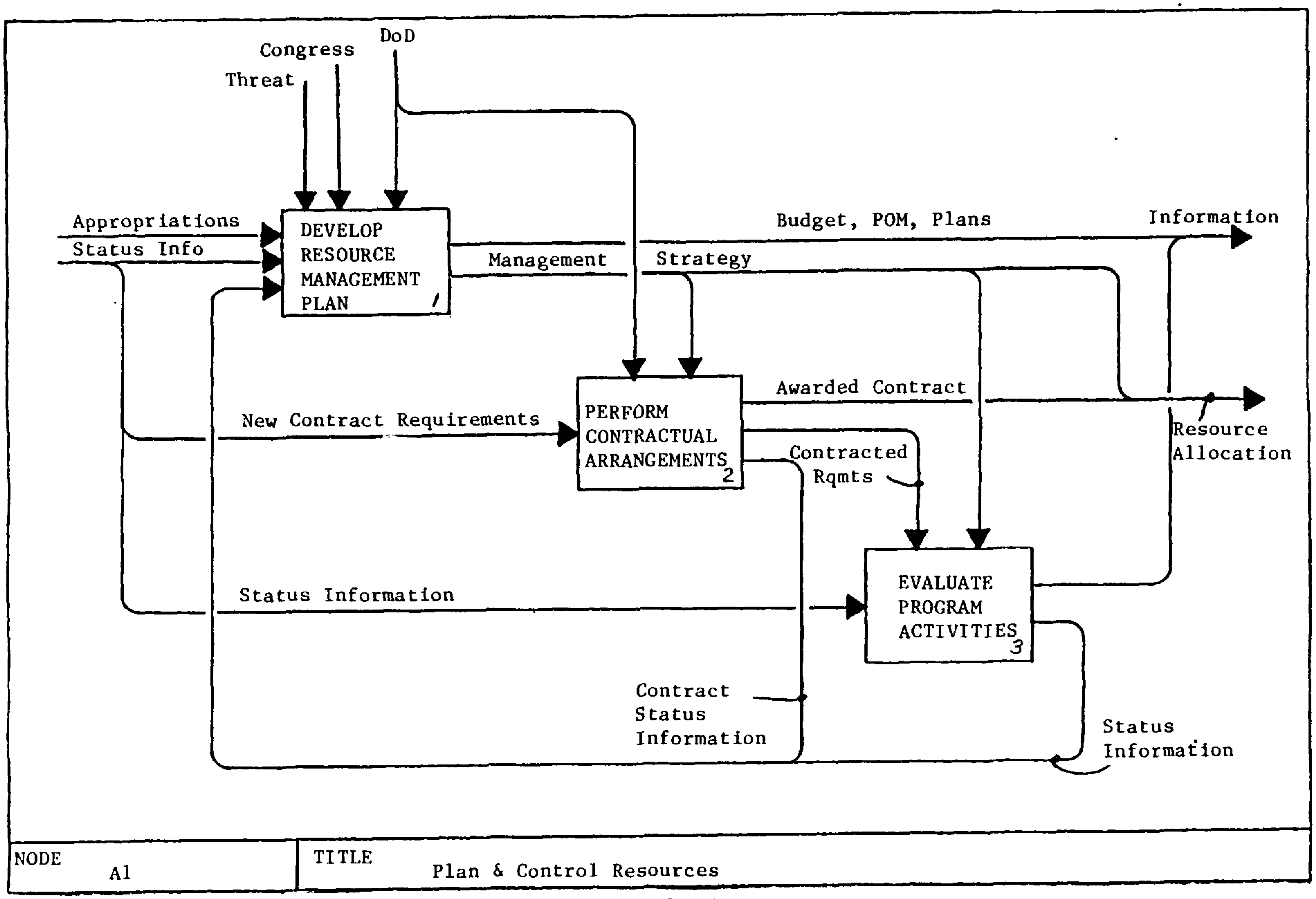

Fig. 4-4 A1 Diagram

A1 Diagram

The A1 diagram identifies the three major tasks in planning and controlling resources.

Develop Resource Management Plan (Box 1) represents the formulation of management strategy used to provide daily guidance for program office activities. The status information input represents the summation of all feedback mechanisms from the development and manufacturing of the weapon system. Management strategy represents the directives and specific objectives for sub-program elements.

Perform Contractual Arrangements (Box 2) concerns the legal functions and the negotiation process which are performed by the program office. New contract requirements represent the ECPs and CCPs resulting from the development and manufacture of the weapon system.

Negotiated contracts, when combined with the management strategy generated from Box 1, form resource allocations.

Evaluate Program Activities (Box 3) includes monitoring of contractor performance and tracking of internal program office activities. Status information contains information about Production Readiness Reviews, Physical Configuration Audits, Functional Configuration Audits, Internal Program Reviews, External Program Reviews, and milestones accomplished.

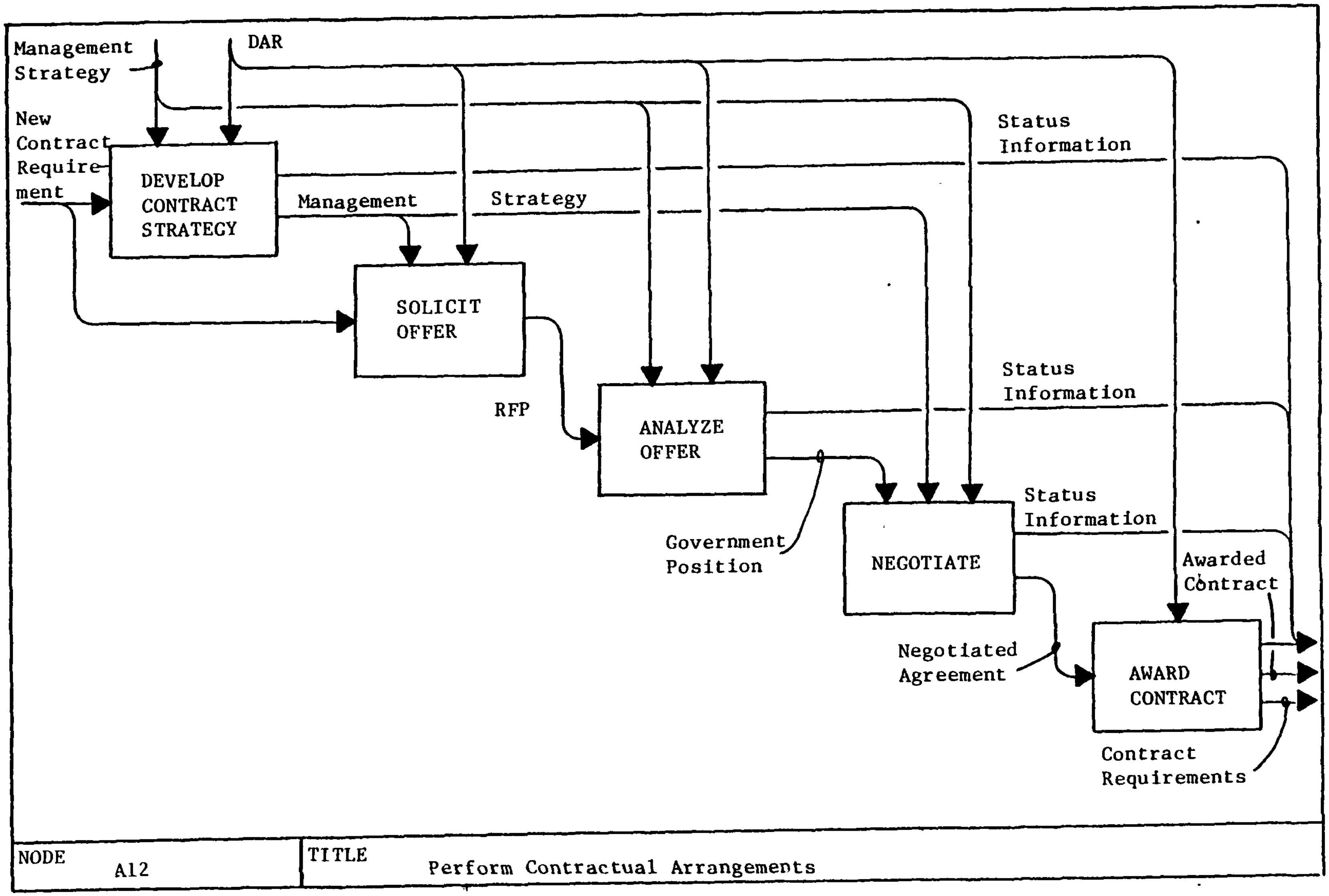

Fig. 4-5 A12 Diagram

A12 Diagram

<u>Develop Contract Strategy</u> (Box 1) concerns the selection of strategy (Firm Fixed Price, Fixed Price Incentive, Cost plus Ince. Included in Management Strategy (output of Develop Resource Management Plan) is the decision to pursue Multiyear Procurement for future contracts. Status information contains information concerning contract type, cost estimates, and identification of potential contractors.

<u>Solicit Offer</u> (Box 2) concerns all activities associated with generation of Request for Proposals to satisfy new contract requirements. Status information contains information concerning cost, schedule, and performance specifications submitted by the contractor in response to the Request for Proposal (RFP). Also contained in this channel are the results of the technical and cost evaluation conducted by program office personnel.

<u>Analyze Offer</u> (Box 3) concerns the examination of the proposal made by the contractor to determine its acceptability. Status information contains information concerning the negotiation positions of the contractors and the Program Office.

<u>Negotiate</u> (Box 4) concerns the resolution of any differences in costs, performance, or schedule. The result of this function is an agreement with the contractor.

<u>Award Contract</u> (Box 5) is the final step in performing contractual arrangements and represents the formal decision to enter into a legally binding agreement with the contractor. This agreement can be in the form of a modification to the existing contract or a new contract.

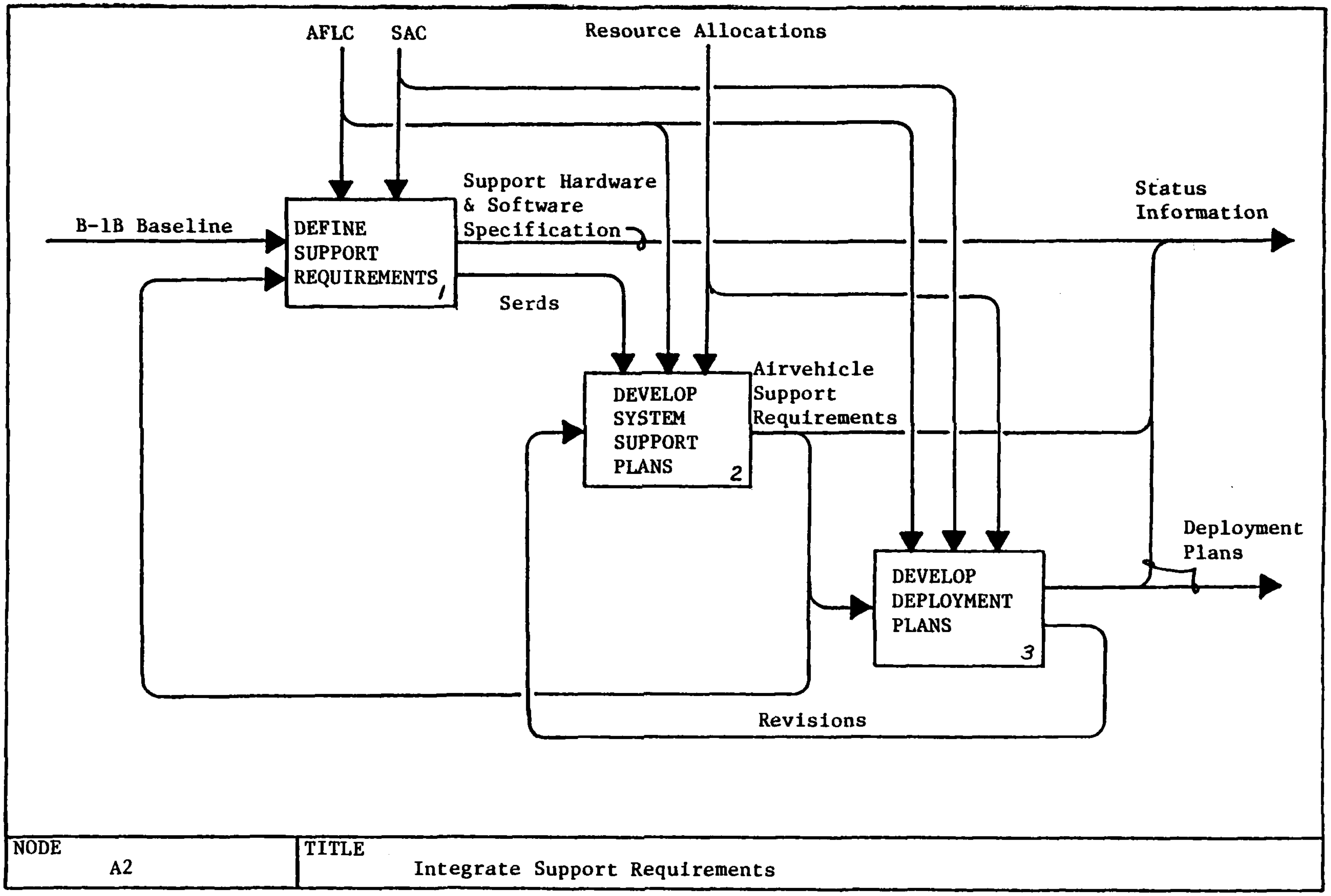

Fig. 4-6 A2 Diagram

A2 Diagram

This diagram depicts the functions associated with providing the necessary equipment, programs, and plans to effectively support the B-1B aircraft.

Define Support Requirements (Box 1) represents the efforts of the program office and contractors to identify and document support requirements. The output of this task is the Support Equipment Requirements Definition (SERDs), which is supplied by the contractor.

Develop System Support Plans (Box 2) produces plans based on the defined requirements, the resource allocations, and guidance from AFLC directives. The output of this function, Air Vehicle Support Requirements, represents the summation of the Integrated Logistics Support effort and becomes an input into developing the air vehicle.

Develop Deployment Plan (Box 3) concerns formulating plans and procedures necessary to prepare a base for deployment of the weapon system. Part of the output of this activity is a feedback mechanism which provides a means of revising system support plans to facilitate deployment. The other output represents the overall plan for site activation.

The diagram status information output includes the summation of information about support hardware/software specifications, support requirements, and deployment plans.

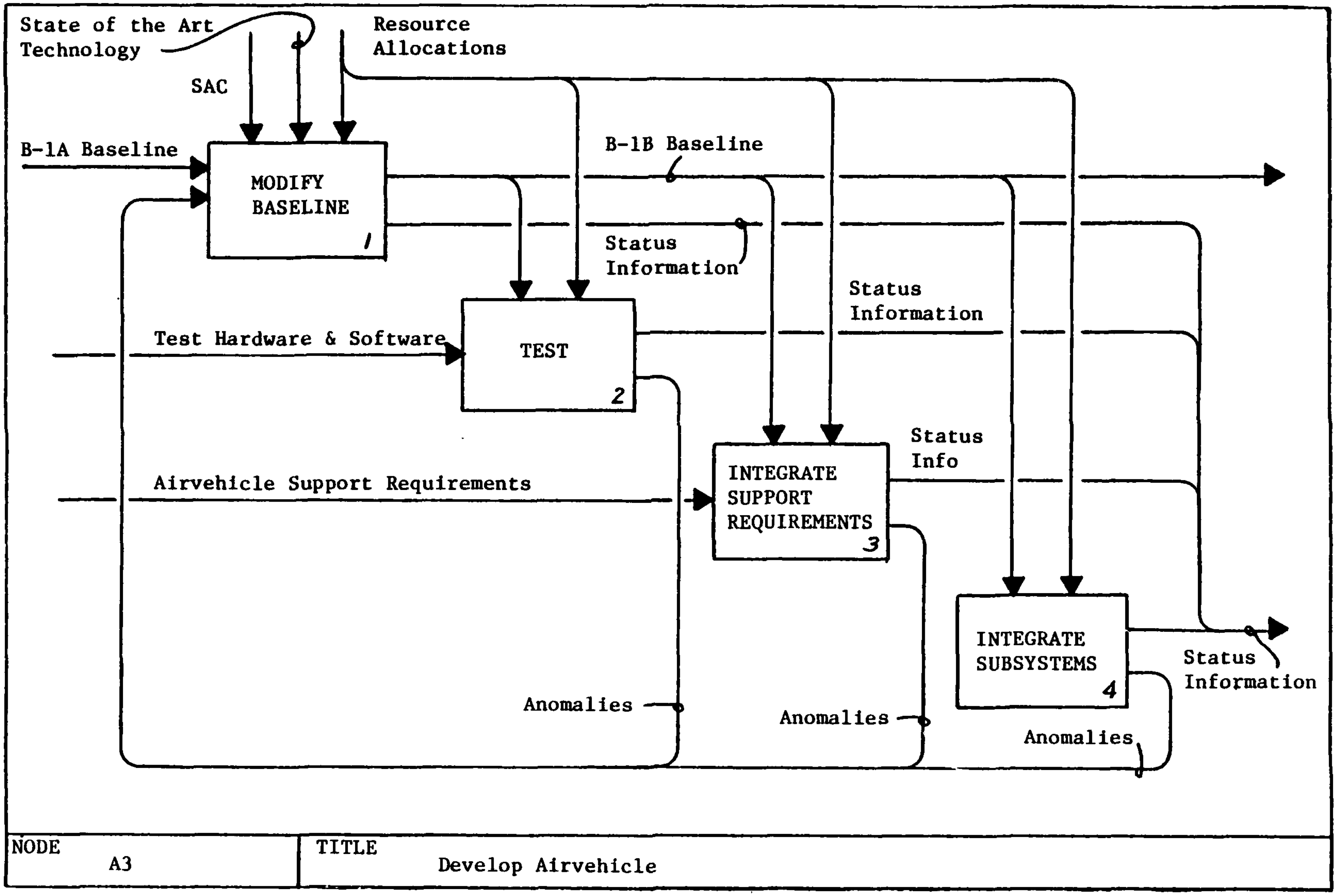

Fig. 4-7 A3 Diagram

A3 Diagram

The A3 diagram depicts the subfunctions associated with development of the actual aircraft. This development effort includes the subsystems and software.

Modify Baseline (Box 1) encompasses the change process. Changes can result from outside or from within the organization. Changes in mission objectives are transmitted from the external environment to this function through the resource allocations. These allocations come from the A1 diagram of the model. Anomalies identified in other development activities within the organization also trigger this process. The results generate the current baseline which provides the standard for the other functions.

Test (Box 2) operates on the hardware and software produced in the manufacturing process and compares the results with the baseline specifications. Anomalies identified may result in a change in the baseline or a modification of the support requirement.

Integrate Support Requirements (Box 3) is the process in which the baseline is compared with air vehicle support requirements.

Integrate Subsystems (Box 4) represents the activities required to insure that subsystem interfaces have been accurately identified and integrated into the aircraft design.

Each of the activities generates status information necessary to A1 and A2 levels of the model. Status information from Box 1 and Box 2 is identified in greater detail on lower level diagrams. The status information from Box 3 and Box 4 contains information about progress toward milestones measured against program standards and baselines.

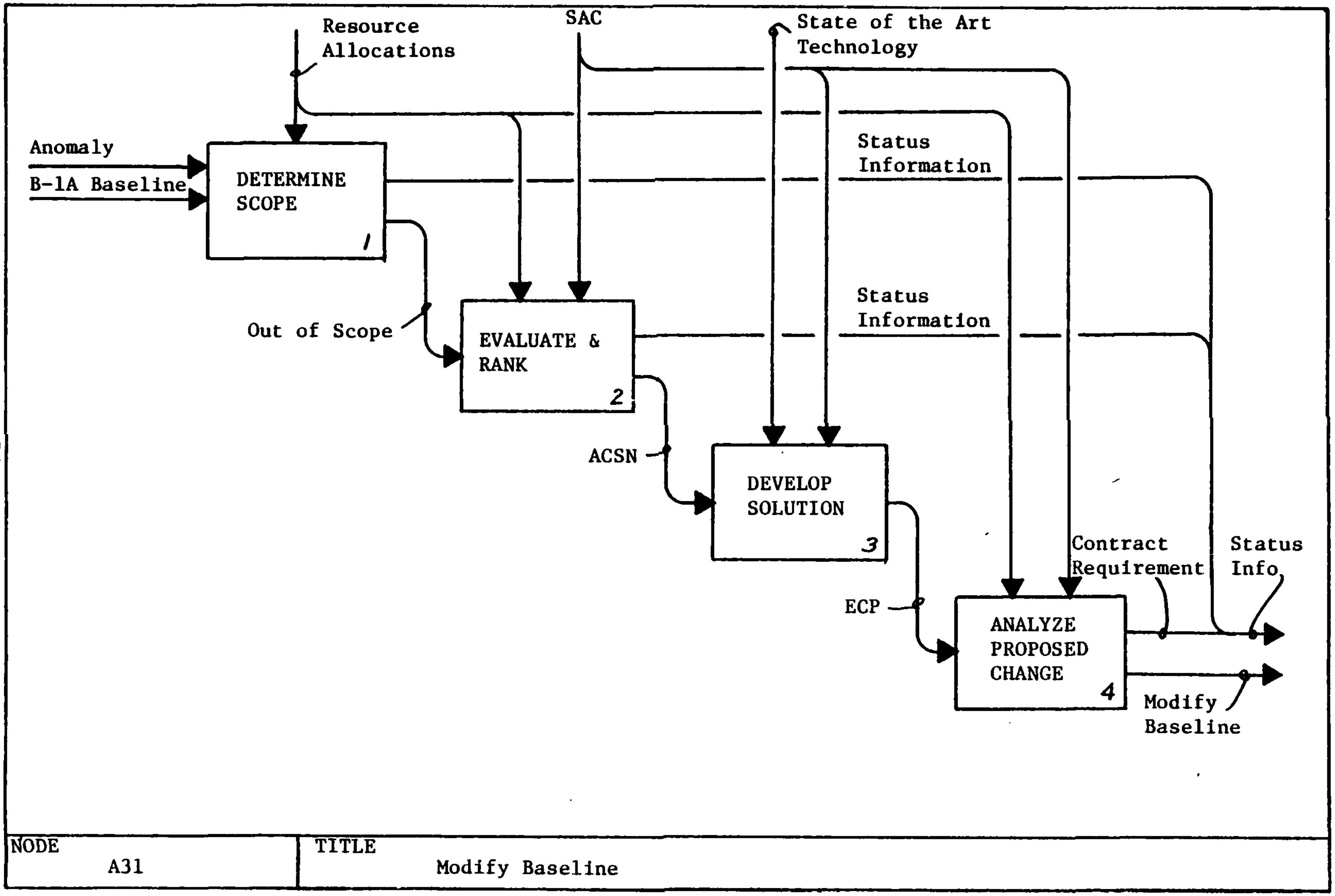

Fig. 4-8 A31 Diagram

A31 Diagram

This diagram depicts the routine change process. Urgent and Emergency Changes follow the same general procedure, but the time required is significantly reduced.

Determine Scope (Box 1) represents the decision process which identifies whether the anomaly is a failure of the system to satisfy contracted requirements and specifications (in-scope), or a failure not covered by existing contract requirements (out-of-scope). Out-of-scope determination requires additional actions. Status information output from this function includes the outcome of the scoping process and is provided for executive level coordination.

Evaluate and Rank (Box 2) is the next action taken on proposed changes determined to be out-of-scope in Box 1. In this box, priorities are established among the various proposed changes for funds allocated to make system changes (the margin account). Status information includes information that concerns cost estimations of the proposed changes and the proposed change's priority for margin account funds.

Develop Solution (Box 3) is generally a contractor response to the Advanced Change Study Notice (ACSN). This function includes initial evaluation and interchange of technical information provided by the contractor. When combined with cost estimates for the proposal, an Engineering Change Proposal (ECP) is submitted for evaluation.

Analyze Proposed Change (Box 4) concerns the activities associated with fact finding and cost analysis. This function incorporates the final Configuration Control Board (CCB) process. Status information includes summary information about the cost, schedule and technical assessment of the proposed change. Also, the final approval/disapproval decision is transmitted through this channel.

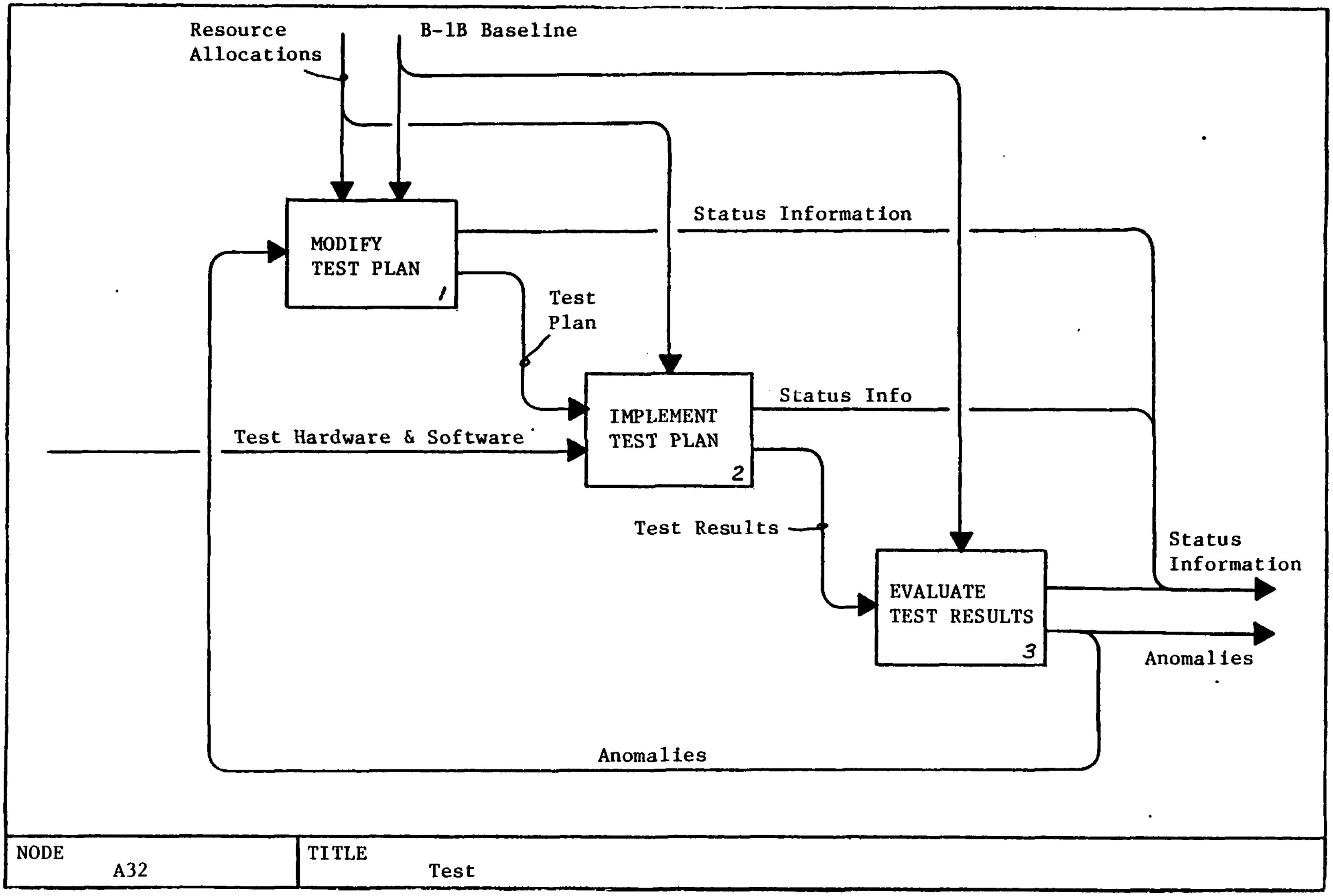

Fig. 4-9 A32 Diagram

A32 Diagram

The A32 diagram depicts the three basic tasks required to complete the test function.

Modify Test Plan (Box 1) involves incorporating external factors (weather, range availability, production delays, etc.) and some of the output of Evaluate Test Results (Box 3) to make the changes necessary to accomplish the test objectives. Status information includes the revised test schedule milestone.

Implement Test Plan (Box 2) represents the actual test process. The results become the input to the evaluation process (Box 3). Status information includes the actual events achieved and not achieved during the test program.

Evaluate Test Results (Box 3) includes two major tasks. The first task is to determine sufficiency of the data collected. The second task is the actual analysis of the test data. The output of this function is status information and anomalies. Anomalies include the information on insufficient data or unsatisfactory performance input into Box 1 in addition to information which triggers the change process. Status information includes information concerning progress of the analysis effort and its content.

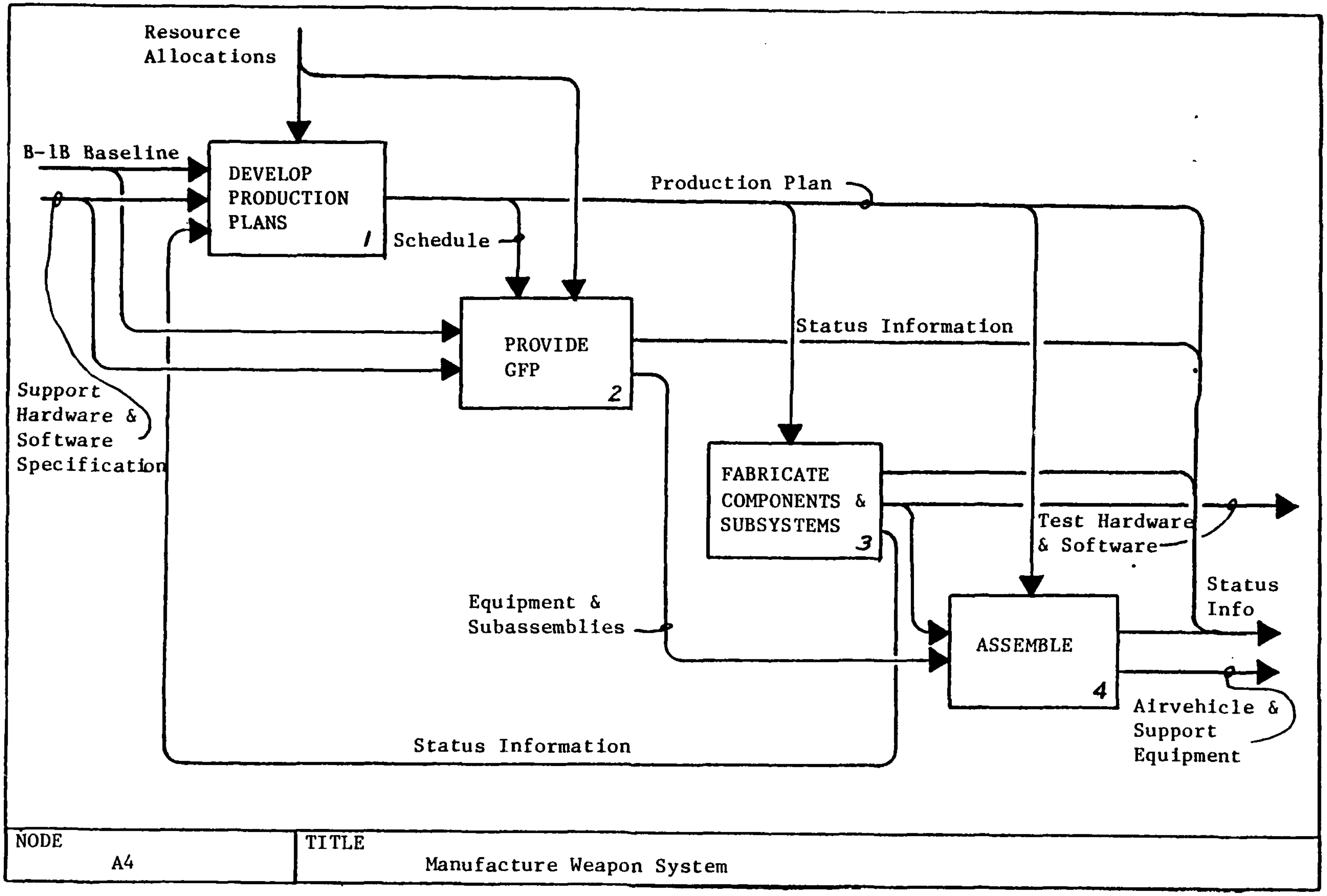

Fig. 4-10 A4 Diagram

A4 Diagram

The A4 diagram depicts the four major tasks associated with manufacture of the weapon system. The diagram depicts the manufacturing process for the air vehicle. Further, certain support equipment follows the same process.

Develop Production Plans (Box 1) is accomplished in partnership with the contractor. This task incorporates quality assurance planning and TECHMOD. The output of this function is the Production Plan. The plan includes schedule, material requirements, design specifications, recommended productivity changes, etc.

Provide GFP (Box 2) includes identifying, acquiring, integrating and tracking equipment and subsystems supplied to the contractor by the government. Some equipment and subassemblies are delivered directly to associate contractors.

Fabricate Components and Subsystems (Box 3) is the actual manufacturing process accomplished by the contractors. A portion of the physical products fabricated become test hardware and software. The remainder are input to the assembly process. Status information includes information concerning work-in-process, scrap and rework rates, and production schedule milestones.

Assemble (Box 4), like (Box 3) represents contractor activity required to construct the aircraft. The output of the box is the B-1B air vehicle and support equipment.

The diagram status information output includes the summation of the production plan, the status information output from Box 2 and Box 3, and schedule milestones accomplished from Box 4.

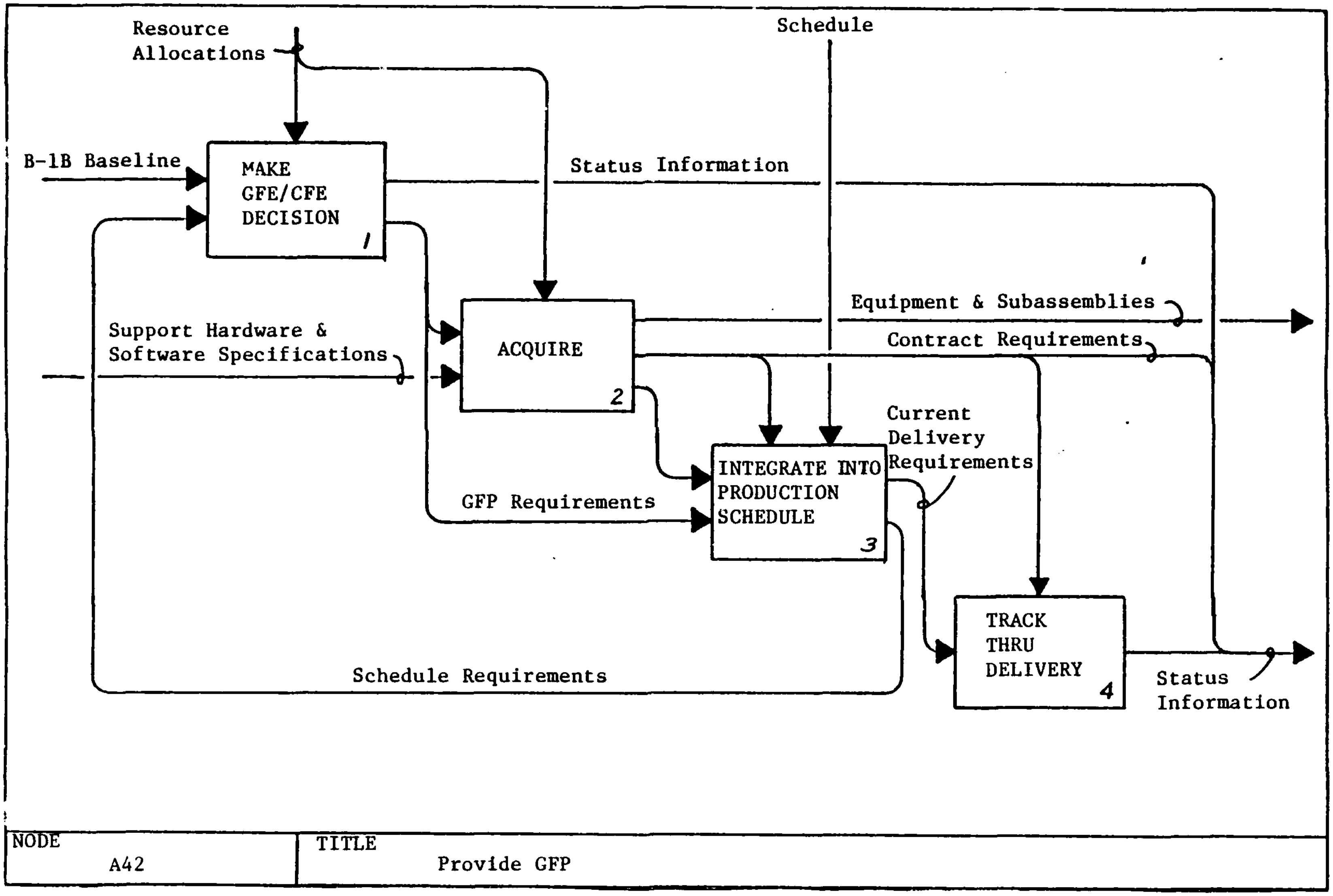

Fig. 4-11 A42 Diagram

A42 Diagram

The A42 diagram, Provide GFE, captures the major program office activities required to accomplish this task.

Make GFE/CFE Decision (Box 1) includes the component breakout function. The decision to proceed with a GFE approach triggers an acquisition process (Box 2) which parallels the acquisition of the weapon system.

Integrate into Production Schedule (Box 3) and Track thru Delivery (Box 4) are management responsibilities required to insure delivery of the weapon system on schedule.

The diagram status information output includes the results of the GFE/CFE decision, acquisition requirements, delivery schedule requirements and the progress toward completing schedule milestones.

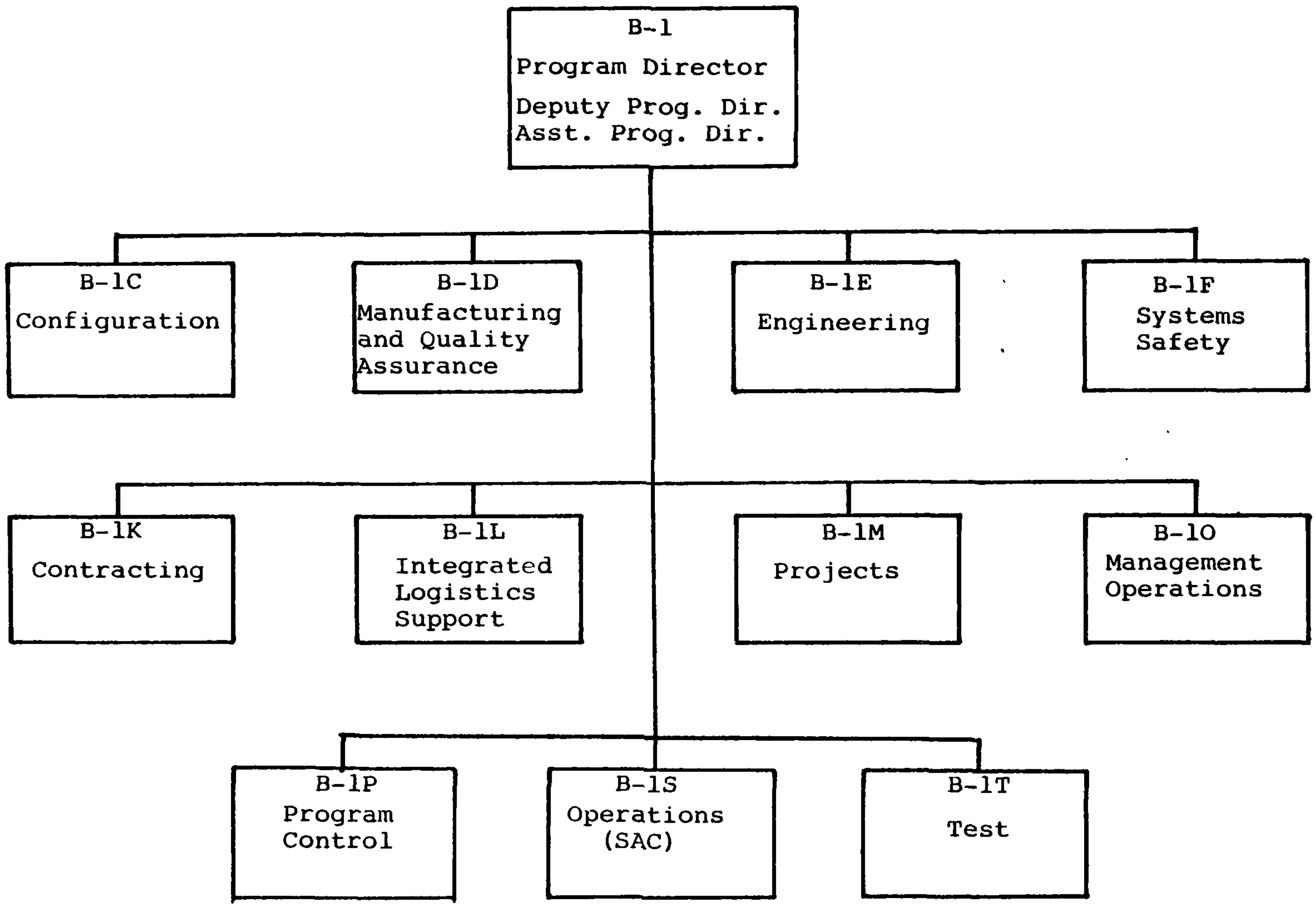

Fig. 4-12 B-1B Organizational Chart

Primary Information Interfaces

This section identifies the major management functions performed in the B-1B Program Office identified from the model. Detailed explanation of the content of these functional areas was provided in the text accompanying each diagram. The functions are subdivisions of four general areas of management concern: planning and controlling resources, integrating support requirements, developing the air vehicle, and manufacturing the weapon system.

Based on our analysis, Table 4-1 summarizes the flows of information among the directorates and relates the organizational structure to the major management functions. To assist the reader in identifying these relationships, the B-1B Organizational Chart is provided in Figure 4-12. The Program Director, the Deputy Program Director, and the Assistant Program Director are included as primary users for all functions.

Chapter Four has presented the functional model of the B-1B Program Office and its description. Based on the authors' analysis, primary information interfaces were identified and documented. Chapter Five contains the specific information needs and system specifications which were identified during the thesis research.

Table 4-1 Primary Information Interfaces

Function	Model Reference	Primary Information Source	Primary Information Users
Develop Resource Management Plan	A11	All Directors	All Directors
Perform Contractual Arrangements	A12	B-1K, B-1E	B-1C, B-1D B-1L, B-1P
Evaluate Program Activities	A13	All Directors	All Directors
Define Support Requirements	A21	B-1L, B-1E	B-1D, B-1K B-1T, B-1P
Develop System Support Plan	A22	B-1L, B-1E B-1M	B-1K, B-1D B-1P
Develop Deployment Plan	A23	B-1L, B-1S B-1T	B-1P
Modify the Baseline	A31	All Directors	All Directors
Test	A32	B-1T, B-1E	B-1D, B-1F B-1C, B-1L B-1S
Integrate Support	A33	B-1L	B-1C, B-1D B-1E, B-1P B-1S, B-1T
Integrate Subsystems	A34	B-1D, B-1E B-1F	B-1C, B-1L B-1P, B-1T
Develop Production	A41	B-1D, B-1E	B-1L, B-1P B-1T
Provide GFP	A42	B-1D, B-1L	B-1C, B-1K B-1P
Fabricate	A43	B-1D, B-1F	B-1C, B-1L B-1T
Assemble	A44	B-1D, B-1F	B-1C, B-1L B-1T

CHAPTER 5

RESEARCH FINDINGS

Introduction

This chapter contains the findings of the research effort. The findings are presented in two sections: Specific Information Needs and System Specifications. The content of this chapter formed the basis of the final project report (Appendix B) which was submitted to the B-1B Program Office. The individuals interviewed within the B-1B Program Office are listed in Table 5-1.

Study Findings

Specific Information Needs

The development effort in the Program Office during the past year has been impressive. Significant progress has been made in developing high priority applications. Currently 23 application projects are completed or under development which will enhance the information system's value as a management tool. During the course of this study, several additional applications were identified which will increase in importance as the program progresses into full production. These applications are:

Table 5-1 List of B-1B Personnel Interviewed

Major General Thurman	Program Director
Col Miller	Dep. Program Director
Mr. Peot	Asst. Program Director
Mr. Suttles	B-1C
Lt Col Rinker	B-1C
Col Prine	B-1D
Mr. Harstad	B-1D
Col Kurzenberger	B-1E
Major Lindemann	B-1F
Col Krahenbuhl	B-1K
Mr. Croucher	B-1K
Col Sheets	B-1L
Lt Col Curtis	B-1L
Col Fritz	B-1M
Major Zimmerman	B-1O
Mr. Conley	B-1P
Lt Col McCauley	B-1P
Lt Col Nelson	B-1S
Col Baran	B-1T
Capt Walsh	B-1T

a. Manufacturing:

(1) Schedule information (actual vs projected) for all major items--airframe, avionics, major subassemblies to the Line Replacable Unit (LRU) level of detail.

(2) Critical path, capacity assessment, and lead time information for all contractors.

(3) Quality performance data which includes nonconformance, scrap and rework, and adverse trend data.

b. Configuration:

(1) Contract definitization date and amendment/ modification identification number on supplemental agreements.

(2) Retrofit status information.

c. Contracts:

(1) Status of contract actions and priorities of their disposition during government processing outside the program office.

(2) Engineering Change Proposal (ECP) workload forecast for 30, 60, and 90 days.

d. Engineering:

(1) Status of contractor design test results.

e. Test:

(1) Service Report status and tracking.

f. Management Operations:

(1) Personnel database to include information about manpower projections, Officer Evaluation Reports (OER), Airman Proficiency Reports (APR), Civilian Performance Appraisals (CPA), and awards and decorations.

(2) Office administration data to include suspense control, training documentation, office inventory of consumable and nonconsumable items.

g. Integrated Logistics Support:

(1) Maintenance training equipment status and tracking.

(2) Facilities development status at Main Operating Bases (MOBs).

(3) Status of Site Activation Task Force to include manning.

(4) Status of Interim Contractor Support (ICS) development.

(5) Status tracking of Intermediate Automatic Test Equipment (IATE) to include Modular Automatic Test Equipment (MATE) and Test Package Sets (TPS).

System Specifications

System specifications represent the basic requirements which should be satisfied by the executive level management information system. Based on our observations, the systems development effort has attempted to incorporate these requirements. However, ASD's recent transition to the All-in-1 operating system was a major setback to system development. This setback has had a negative impact on system usefulness and user confidence.

The All-in-1 system is a menu driven software package commercially developed by Digital Equipment Corporation. The package was developed for office management applications. The highest level menu permits selection of the type of application program desired (i.e. electronic mail, work processing, financial analysis, etc.). Subsequent progressions through menu hierarchies presents the user with the specific application desired. The All-in-1 package was selected for the Automated Management System (AMS) program to provide a universal framework for ASD's information system development.

To provide directors with meaningful information, the system must focus both on forecasting future outcomes and reporting historical results. The information system should provide the directors with 30, 60, and 90 day look-ahead capability. In conjunction with this information, impact analysis of program changes, such as schedule changes, would provide directors with a basis for conducting "what if" decision analysis.

Emphasis for system development should not be placed on providing software programs which provide infrequent or one time information. There will be instances where it is more efficient to manually supply unique information requirements than develop to computerized application programs.

Any director should have the capability to enter the information system at the level he considers appropriate. After log-in, the All-in-1 system currently in use presents all users with system status information. The user must progress through three menu levels to gain access to B-1B specific application programs. The user must still progress through additional menu levels to gain access to desired information. This sequence produces unacceptable delays for the directors. In most cases, the director will be concerned with specific application programs for his area of responsibility. He should be provided entry to this level of the system after log-in.

Directors should be provided positive visual indications that the system is operating on their request/instruction, particularly when processing delays longer than 3-5 seconds are encountered.

The data used to generate reports/responses must be consistent and accurate. To a large extent, the data is supplied by the contractors. It is essential that the contractors and the program office operate with the same data. As data bases are developed to support unique applications within the program office, common data elements in the data bases must be identical.

The requirements for timely updating of the data in the system are dependent upon the specific application. Data used to generate historical trend analysis should be updated monthly/quarterly. Scheduling, cost, and contracting data should be updated weekly. Mission test results were identified as time critical information. Directors require "quick look" reports within 24 hours of mission completion.

The information system must have the capability to interface directly with all associate contractors, Air Logistics Centers, the Combined Test Force, and the Site Activation Team. In addition, some benefit would result from interface with other DoD systems such as AMIS and DATACEN. AMIS is an Air Force Systems Command system which provides status of all contracts after they have been awarded. DATACEN is an ASD system which provides status of ASD contract actions. Ability to interface with these systems reduces the work load required to supply data to separate systems.

Within the program office, the information system must provide a clear audit trail for all management actions. Data base structure should permit cross referencing by Work Breakdown Structure (WBS), Advanced Change Study Notice (ACSN), Engineering Change Proposal (ECP), and Contract Change Notice (CCN) numbers.

Information presented to the director should be in summary form. To provide useful information, meaningful measures of merit should be identified for all tasks and functions of each director. Identification of these measures provides the basis for developing exception reports. Maximum use of exception reporting for program status information should be incorporated. Additionally, there is a requirement to allow director inquiry capability to lower levels of detail. Output formats should make maximum use of graphic representations of information for both hardcopy and CRT.

The issue of security concerns protection of both contractor data and program office data from unauthorized access and use. Since the program has four associate contractors, precautions must be taken to protect the rights of each associate regarding data shared between the Program Office and all other contractors. In most cases, the data input by the program office relates to resource allocation decisions. Information about resource allocations, particularly management reserve (margin), is sensitive and access must be controlled.

Because of the frequent use of graphic displays for briefings to higher headquarters and contractor reviews, the information system should have graphics capability. The graphics output should be available in hardcopy or viewgraph form and be capable of electronic transfer to other users. The graphics package must contain an editor function which is simple to operate and has full interactive capability. These features provide the ability to rapidly make changes with a minimum of effort. The graphics output must be integrated with on-line teleconferencing capability.

Chapter Five documented the specific information needs which are not satisfied by the existing information system. System specifications for the information system were also documented. Chapter Six summarizes the thesis research, presents the recommendations made to the B-1B Program Office, the conclusion, and recommendations for future study.

CHAPTER 6

SUMMARY, RECOMMENDATIONS, AND CONCLUSION

Summary

The overall purpose of the thesis research was to provide the B-1B program office assistance with development of their executive level management information system. To achieve this purpose, two research objectives were identified. The first objective was to identify the information needs of the B-1B executive management team not currently satisfied by the existing information system. The second objective was to determine and document the system specifications to support these needs.

To achieve these research objectives, a structured systems approach, $IDEF_0$, was used to develop a functional model. The model provided the researchers with a tool to analyze the B-1B program office functions.

Analysis of the model identified the functional relationships within the B-1B Program Office. The specific information needs and the system specifications were then identified and documented in Chapter Five. The following recommendations were provided to the B-1B Program Office.

RECOMMENDATION 1: As the system development effort continues, management of the data base structures should receive greater attention. The potential exists for unnecessary duplication of data elements within the data bases developed to support the various organizational elements.

RECOMMENDATION 2: Centralization of application program development in one office may ultimately create a backlog of user requests due to limited manpower within the office. Alternative manpower sources should be explored. These include ASD, Reserve Assistance, AFIT, local colleges and universities, and contracts for specific software/database development.

RECOMMENDATION 3: Centralized documentation is needed to ensure accurate understanding of what is currently available on the system. Also, this documentation will assist in determining organizational interface relationships. This type of information is essential to system designers and programmers charged with the responsibility to maintain system integrity and reliability.

RECOMMENDATION 4: The B-1B Program Office should have complete operational control over information system hardware and software. The Program Office has made significant progress in development of software applications and system performance capability over the course of this study. However, the recent transition to the All-in-1 system was a major setback to system development. This setback has had its most dramatic impact on system usefulness and user confidence. The All-in-1 system has made access to desired information extremely difficult, and in some cases caused directors to stop using the system entirely.

RECOMMENDATION 5: The B-1B Program Office should be provided the capability to produce the highest quality outputs possible for correspondence and briefings to external parties. Because of its size, importance, and political sensitivity, the Program Office must present professional products to the external environment. B-1B personnel possess highly professional capabilities and the personnel need to have their capabilities supported by the management information system. This will require quality printers and high resolution color graphics.

Recommendations for Future Study

Several areas were identified during the course of the interviews and construction of the model which have significant implications for information system development. These areas are identified in the following recommendations for future research efforts.

1. Conduct a survey of perceived effectiveness of Executive Information Systems in program offices. The results of such a survey could provide important guidance to system development efforts.

2. Conduct an evaluation of MIS used by DoD contractors to manage and control a specific DoD acquisition program. This evaluation would provide a useful framework and

valuable lessons learned for information system development in a program office.

3. Examine the potential use of commercial software packages in program offices. The results of this examination would indicate if significant reductions in the amount of time and cost required to complete system design could be realized through acquisition of commercial software packages.

4. Develop an algorithm for controlling the Management Reserve Fund allocation process. One of the major activities in any weapon system acquisition program is management of the change process. In most cases, more changes are proposed than can be funded with the resources available. A decision support tool could offer significant advantages in optimizing this resource allocation decision.

5. Develop a cost estimator for line replaceable units (LRU) and their impact on the program office's budget. A major decision process in a program office is evaluating alternatives. A valid cost estimating tool would improve the quality of the information used in the evaluation process.

Conclusion

In conclusion, this thesis research provided the B-1B Program Office with valuable assistance in developing the executive information system. The final report to the B-1B Program Office (Appendix B) provided the identification and documentation of the information needs and system specifications for their executive information system. The information needs of the executive managers in the B-1B Program Office are detailed in Chapter Five. These needs can be categorized using the model in one of three major areas: resource allocations, baseline, or status of program activities. The system specifications are also detailed in Chapter Five. They concern system security, ease of operation, trend analysis and forecasting, and interface with contractor information systems. Finally, recommendations for future research have been made. These recommendations will assist the Air Force in developing information systems for use in program offices.

APPENDIX A

B-1B ORGANIZATIONAL STATEMENTS

1. B1

Manages (plans, organizes, and directs) the collective actions of participating organizations in planning and executing the B-1B program; proposes and/or prepares modifications of or changes to the program within the limits of guidance received. Functional support in the areas of program control, engineering, contracting and manufacturing/quality assurance and system safety provided by collocated personnel from AC/EN/PM/SE. Liaison with the using command is provided through SAC personnel located in Bldg. 52.

2. B1E Engineering

Provides system engineering technical direction to the Deputy. Insures that Program Directors are provided with engineering visibility, technical alternatives, risks, and technical guidance to making required decisions. Establishes weapon system performance, design, and test requirements. Provides technical guidance in the areas of air vehicle design, propulsion, avionics, support equipment, armament and specialty engineering. Assures inclusion of current applicable technology into systems through continuous interfacing with Air Force laboratories, other government agencies and industry. Incorporates current technology into new systems with emphasis on performance, standardization, cost effectiveness and low risk. Collocated to ASD/B1 from ASD/EN "Home" office in accordance with ASDR 30-2.

3. B1P Program Control

Responsible for the budget formulation and execution of all development and acquisition of the B-1B aircraft. Develops, presents, and justifies budget estimates and financial plans. Assures compatibility between all programming documents and directives in response to current program requirements. Allocates financial resources and issues program authorizations (PAS) for funds within control of the deputate to all functional agencies participating in the program. Maintains current status and records of program funding, initiations, commitments, obligations and expenditures. This is a matrixed organization. Collocated to ASD/B1 from ASD/AC "Home" office in accordance with ASDR 30-2.

4. B1K Contracting

Accomplishes or directs accomplishment of all required policy, support and guidance to the SPO in all phases of contracting. This includes but is not limited to acquisition planning, contract file preparation and contract award. Encompasses preparation and approval (within delegated limits) of determinations and findings, acquisition plans, RFPs/IFBs, source selections, negotiation, review and award of all designated program office contractual actions. This is a matrixed organization collocated to ASD/B1 from ASD/PMW "Home" office in accordance with ASDR 30-2.

5. B1D Manufacturing

Manages all manufacturing, quality assurance and GFE support activities required to support production of the B-1B weapon system. Establishes manufacturing/quality assurance plans and policy. Assures that direct manufacturing cost and capital investments to improve productivity are consistent with program objectives; that unsatisfactory manufacturing/ quality conditions are defined and corrected; and timely delivery of quality hardware. Provides technical assistance to other B-1B directorates. Coordinates with contract administration offices. This is a matrixed organization collocated to ASD/B1 from ASD/PMDP "Home" office in accordance with ASDR 30-2.

6. B1F System Safety

Manages a total, integrated System Safety Program in accordance with AFR 800-16. Provides guidance to the Deputy to assure that the safest B-1B weapon system is developed and procured; resulting in a mature system with minimal risk and accident potential. Establishes safety criteria and requirements that are within cost, schedule, and performance constraints and are consistent with program objectives. Advises Deputy on management and technical issues and problem area via the System Safety Group. Manages the nuclear safety and conventional safety certification efforts to insure a nuclear and conventional weapons capability for the B-1B weapon system. This is a matrixed organization collocated to ASD/B1 from ASD/SE "Home" office in accordance with ASDR 30-2.

7. B1M Projects

Manages all phases of development and acquisition of the B-1B airframe and avionics systems. Provides management for interface and integration of primary supporting sub-systems within the B-1B weapon system on compatible schedules and within established funding limitations. Assures adequate planning, budgeting, and implementation to meet engineering specifications and operational requirements for successful and timely incorporation of the system.

8. B1C Configuration Management

Integrates the technical and administrative actions of identifying the functional and physical characteristics of an item during its life cycle, controlling changes to those characteristics and providing information on the status of the change actions. Governs and controls the data acquired during the acquisition program. Provides visibility and traceability required to permit the system director to direct the program.

9. B1L Integrated Logistics Support

Manages the acquisition and integration of assigned logistics elements including support equipment/technical orders/facilities/spares/maintenance training/packaging/handling and transportation, contractor support, and computer resources. Manages logistics related funding requirements and cost center activities. Responsible for logistics support planning. Evaluates the supportability characteristics of the weapon system, develops alternatives and recommends changes. As Director of Integrated Logistics Support, represents AFLC on CCB.

10. B1O Management Operations

Provides centralized support and services to all elements of the deputate in planning, organizing, controlling, and utilizing resources to accommodate the assigned programs. Provides centralized administrative support in the following functional areas: Personnel administration, training and awards; correspondence, publications, and records management; manpower, and organization; security; communications and facilities requirements; supplies; and equipment.

11. B1T Test and Deployment

Plans, controls, evaluates and reports on the development test and evaluation (DT&E) ground and flight test programs. Integrates the AFTEC OT&E requirements into the flight test program. Prepares and implements test plans. Serves as OPR for negotiations and direction to government test facilities. Assures that government test facility support requested by the contractors is proper and available. Obtains cost estimates and expenditures from test facilities. Directs contractor development test efforts and negotiates changes to test contracts. Serves on Configuration Control Boards and Deficiency Report Boards. Integrates conflicting flight test requirements for the Joint Test Force. Responsible for planning aircrew training and overall deployment of the weapon system.

12. B1I Special Assistant for Public Affairs

Public Affairs Director for the B-1B program. Acts as central point of contact for all media as well as community groups. Provides regular program updates to Air Force internal media. Responsible for planning, preparing and distributing all releasable program information such as fact sheets, news releases, audio-visual material and briefings. Serves as program security review officer. Provides public affairs counsel to the Deputy for B-1B and his staff. Interfaces daily with DoD, USAF and aviation industry representatives in the development of related public affairs policy.

13. B1S SAC Liaison

Represents the Strategic Air Command within the B1 SPO. Interprets using command requirements for system engineers and program managers and provides access to and guidance in the use of information from SAC. Monitors program milestones and insures that operational requirements will not be compromised by program constraints or management decisions. Serves as a focal point for SAC inquiries and inputs to the B-1B program.

APPENDIX B

B-1B FINAL PROJECT REPORT

Appendix B contains the final project report submitted to the B-1B Program Office. The functional model, as presented in Chapter Four of this thesis, was included in the final project report as an attachment. To avoid unnecessary duplication, the model attachment was deleted from the final project report in this appendix. The reader interested in examining the functional model should refer to Chapter Four of this thesis.

DEPARTMENT OF THE AIR FORCE
AIR FORCE INSTITUTE OF TECHNOLOGY (ATC)
WRIGHT-PATTERSON AIR FORCE BASE, OH 45433

REPLY TO ATTN OF: AFIT/LSB (Maj Rasch)

SUBJECT: Final Project Report - B-1B Executive Level Management Information System

TO: ASD/B-1B (Maj Gen Thurman)

1. In January, we began an ambitious project to determine the information requirements for an executive level management information system in the B-1B Program Office. Three objectives were identified for this effort. They were: (1) to develop a model that describes the functional relationships of the executive level program directorates, (2) to identify essential information, and (3) to identify and document the flows of information used by the executive level management team.

2. Interviews with the deputy program directors were conducted between February and mid-July. The focus of the interviews was directed toward determining information requirements that the directors desired, yet were not satisfied by the existing information system. Application programs under development for future use were compared with the stated information requirements to determine their adequacy to satisfy these requirements. Additionally, any unfulfilled information requirements have been documented for your attention. The final report of this project is attached for your review.

3. I would like to take this opportunity to express my gratitude and that of the project team for the support and cooperation you and the deputy directors gave to this undertaking. As you are aware, the team members are graduate students in the Systems Management Program at AFIT. They will shortly begin tours in ASD as System Program Managers, Maj George Stilwell in the Tactical Program Office and Capt David Morgan in the B-1B Program Office. The experience they have gained by working directly with the executive managers in the B-1B Program Office will greatly contribute to their successes in future assignments. We sincerely hope the attached report provides useful information for you and your staff as you continue to develop your executive management information system.

Ronald H. Rasch

RONALD H. RASCH, Major, USAF
Associate Professor
School of Systems and Logistics
Air Force Institute of Technology

2 Atch
1. Final Project Report w/atch
2. Distribution List

INTRODUCTION

The B-1B program office has been actively involved in developing an information system. Results from this effort will help to effectively manage the B-1B weapon system acquisition process. Additionally, this effort will provide a basis for design of information systems in future program offices. The purpose of AFIT's consulting effort was to assist system developers in identifying existing and future executive level information requirements within the B-1B program office. Three objectives were identified for this effort. They were: (1) to develop a model that describes the functional relationships of the executive level program directorates (Atch 1), (2) to document essential information, and (3) to identify and document the flows of information used by the executive level management team. To achieve these objectives, personal interviews with the organizational directors were conducted between February and July of 1983. These interviews focused on identifying information used by the directors not currently available on the computer system. The individuals interviewed within the B-1B program office are listed below:

Major General Thurman	Program Director
Col Miller	Deputy Program Director
Mr. Peot	Asst. Program Director
Mr. Suttles	B-1C
Lt Col Rinker	B-1C
Col Prine	B-1D
Mr. Harstad	B-1D
Col Kurzenberger	B-1E
Maj Lindemann	B-1F
Col Krahenbuhl	B-1K
Mr. Croucher	B-1K
Col Sheets	B-1L
Lt Col Curtis	B-1L
Col Fritz	B-1M
Maj Zimmerman	B-1O
Mr. Conley	B-1P
Lt Col McCauley	B-1P
Lt Col Nelson	B-1S
Col Baran	B-1T
Capt Walsh	B-1T

STUDY FINDINGS

The functional model developed during this project is presented as Attachment 1 to this report. The model was used as an analytic tool to enhance the project team's understanding of the B-1B Program Office organization. The model can be used to identify the central tasks or functions performed to achieve the primary objective: develop and acquire the B-1B weapon system. It becomes a baseline for MIS development. It can be further refined to lower levels for detailed task definition and analysis. As the program requirements change over time, the model can be revised and used to update the information system requirements necessary to support changing management needs in the dynamic environment of weapon system acquisition.

The remainder of this report is divided into four sections. These are: System Specifications, Specific Information Needs, Primary Information Interfaces, and Recommendations.

System Specifications

General system specifications represent the basic requirements which should be satisfied by the executive level management information system. Based on our observations, the systems development effort has attempted to incorporate these requirements. However, the recent transition to the All-in-1 operating system was a major setback to system development. This setback has had a negative impact on system usefulness and user confidence.

a. To provide directors with meaningful information, the system must focus on both forecasting future outcomes and reporting historical results. The information system should provide the directors with a 30, 60, and 90 day look-ahead capability. In conjunction with this information, impact analysis of program changes, such as schedule changes, would provide directors with a basis for conducting "what if" decision analysis.

b. Emphasis for system development should not be placed on providing software programs which provide infrequent or one-time information. There will be instances where it is more efficient to manually supply unique information requirements than to develop computerized application programs.

c. Any director should have the capability to enter the information system at the level he considers appropriate. After log-in, the All-in-1 system currently in use presents all users with system status information. The user must progress through three menu levels to gain access to B-1B specific application programs. The user must still progress through additional menu levels to gain access to desired information. This sequence produces unacceptable delays for the directors. In most cases, the director will be concerned with specific application programs for his area of responsibility and should be provided entry to this level of the system after log-in.

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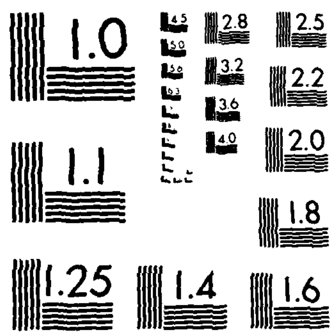

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

d. Directors should be provided positive visual indications that the system is operating on their request/instruction, particularly when processing delays longer than 3-5 seconds are encountered.

e. The data used to generate reports/responses must be consistent and accurate. To a large extent, the data is supplied by the contractors. It is essential that the contractors and the program office operate with the same data. As data bases are developed to support unique applications within the program office, common data elements in the data bases must be identical.

f. The requirements for timely updating of the data in the system is dependent upon the specific application. Data used to generate historical trend analysis should be updated monthly/quarterly. Scheduling, cost, and contracting data should be updated weekly. Mission test results were identified as time critical information. Directors require "quick look" reports within 24 hours of mission completion.

g. The information system must have the capability to interface directly with all associate contractors, Air Logistics Centers, the Combined Test Force, and the Site Activation Team. In addition, some benefit would result from interface with other DOD systems such as AMIS and DATACEN. Within the program office, the information system must provide a clear audit trail for all management actions. Data base structure should permit cross referencing by WBS, ACSN, ECP, and CCN numbers.

h. Information presented to the director should be in summary form. To provide useful information, meaningful measures of merit should be identified for all tasks and functions of each director. Identification of these measures provides the basis for developing exception reports. Maximum use of exception reporting for program status information should be incorporated. Additionally, there is a requirement to allow director inquiry capability to lower levels of detail. Output formats should make maximum use of graphic representations of information for both hardcopy and CRT.

i. The issue of security concerns protection of both contractor data and program office data from unauthorized access and use. Since the program has four associate contractors, precautions must be taken to protect the rights of each associate regarding data shared between the Program Office and all other contractors. In most cases, the data input by the program office relates to resource allocation decisions. Information about resource allocations, particularly management reserve (the margin), is sensitive and access must be controlled.

j. Because of the frequent use of graphic displays for briefings to higher headquarters and contractor reviews, the information system should have graphics capability. The graphics output should be available in hardcopy or viewgraph form and be capable of electronic transfer to other users. The graphics package must contain an editor function which is simple to operate and has full interactive capability. These features provide the ability to rapidly make changes with a minimum of effort. The graphics output must be integrated with on-line teleconferencing capability.

Specific Information Needs

The development effort in the B-1B Program Office during the past year has been impresive. Significant progress has been made in developing high priority applications. Currently 23 application projects are completed or under development which will enhance the information system's value as a management tool. During the course of this study, several additional applications were identified which will increase in importance as the program progresses into full production. These applications are:

a. Manufacturing:

(1) Schedule information (actual vs. projected) for all major items--airframe, avionics, major subassemblies to the LRU level of detail.

(2) Critical path, capacity assessment, and lead time for information for all contractors.

(3) Quality performance data which includes non-conformance, scrap and rework, and adverse trend data.

b. Configuration:

(1) Contract definitization date and PO number.

(2) Retrofit status information.

c. Contracts:

(1) Status of contract actions and priorities of their disposition during government processing outside the program office.

(2) ECP workload forecast for 30, 60, and 90 days.

d. Engineering:

Status of contractor design test results.

e. Test:

Service Report status and tracking.

f. Management Operations:

(1) Personnel database to include information about manpower projections, OERs, APRs, CPAs, and awards and decorations.

(2) Office administration data to include suspense control, training documentation, and office inventory of consumable and nonconsumable items.

g. Integrated Logistics Support:

(1) Maintenance training equipment status and tracking.

(2) Facilities development status at Main Operating Bases (MOBs).

(3) Status of Site Activation Task Force to include manning.

(4) Status of Interim Contractor Support (ICS) development.

(5) Status tracking of Intermediate Automatic Test Equipment (IATE) to include Modular Automatic Test Equipment (MATE) and Test Package Sets (TPS).

Primary Information Interfaces

This section of the report identifies the major management functions performed in the B-1B Program Office. Detailed explanation of the content of these functional areas is provided in the model attached to this report. The functions are subdivisions of four critical areas of management concern: planning and controlling resources, integrating support requirements, developing the air vehicle, and manufacturing the weapon system. The functions identified are not necessarily associated with a specific organizational element. For example, the functions performed in the section of the model labeled "Manufacture the Weapon System" are not solely or uniquely the responsibility of the Director of Manufacturing and Quality Assurance.

Based on our analysis, the table on page 6 summarizes the flows of information among the directorates and attempts to relate the organizational structure to the major management functions. The Program Director, the Deputy Program Director, and the Assistant Program Director are included as primary users for all functions.

Recommendations:

RECOMMENDATION: As the system development effort continues, management of the data base structures should receive greater attention. The potential exists for unnecessary duplication of data elements within the data bases developed to support the various organizational elements.

RECOMMENDATION: Centralization of application program development in one office may ultimately create a backlog of user requests. This results because of limited manpower within the office. Alternative manpower sources should be explored. These include ASD, Reserve Assistance, AFIT, local colleges and universities, and contracts for specific software/database development.

RECOMMENDATION: Centralized documentation is needed to ensure accurate understanding of what is currently available on the system. Also, this documentation will assist in determining organizational interface relationships. This type of information is essential to system designers and programmers charged with the responsibility to maintain system integrity and reliability.

RECOMMENDATION: The B-1B Program Office should have complete operational control over information system hardware and software. The Program Office has made significant progress in development of software applications and system performance capability over the course of this study. However, the recent transition to the All-in-1 system was a major setback to system development. This setback has had its most dramatic impact on system usefulness and user confidence. The All-in-1 system has made access to desired information extremely difficult, and in some cases caused directors to stop using the system entirely.

RECOMMENDATION: The B-1B Program Office should be provided the capability to produce the highest quality outputs possible for correspondence and briefings to external parties. Because of its size, importance, and political sensitivity, the Program Office must present professional products to the external environment. B-1B personnel possess highly professional capabilities and the personnel need to have their capabilities supported by the management information system. This will require letter-quality printers and high-resolution color graphics.

APPENDIX C

OBSERVATIONS CONCERNING THE $IDEF_0$ METHODOLOGY

During the course of the research project, two observations concerning use of the $IDEF_0$ methodology were made. The first observation concerns the training requirement for the modelers and the designated experts. The second observation concerns using the methodology on a management process.

A substantial amount of time was required to learn and understand the concepts and procedures of the $IDEF_0$ technique. We found that the greatest obstacle to using the modeling technique was adopting a functional perspective instead of a traditional time sequential perspective. The difficulty with this concept is most apparent when dealing with functional activities that appear at several different levels of system decomposition. We found that extensive practice with sample modeling exercises was required to overcome this obstacle prior to beginning the modeling effort in the program office. Two significant procedural obstacles were also rapidly identified. First, no clear guidance exists to differentiate between control and input classification. This lack of guidance causes a great deal of confusion in applying the $IDEF_0$ technique. Second, numerous rules and conventions for construction of the actual diagrams makes the methodology cumbersome to work.

Another important aspect of training concerns the training of the expert. Since the expert has an important role in the methodology, his understanding of the $IDEF_0$

process and procedures is essential for successful applications. For the research project, the experts were defined to be the Program Director and his deputy directors. Because of their conflicting schedules, these experts were not able to attend a general introductory orientation briefing. Instead, the methodology was introduced to each expert at the beginning of the first interview. Because of the limited training for the experts, a greater amount of the available time during the first interview was required to explain and clarify the modeling technique instead of developing the model and defining the functional relationships.

The second observation concerns the difficulty of using the methodology to model a management process in a project environment. There are two explanations why applying $IDEF_0$ to a management process was difficult. The first reason is that the methodology was specifically designed for a manufacturing process. The second reason concerns the technique's emphasis on functions and tasks.

As previously indicated, $IDEF_0$ was designed for use in a manufacturing environment. The differences between management and manufacturing processes account for some of the difficulties in applying $IDEF_0$ to a management environment. Manufacturing can be characterized as a well defined, stable, deterministic, and process oriented function. Efforts are directed toward the optimal production of an end product. On the other hand, management can be characterized as a nebulous, dynamic process, possessing a greater degree of uncertainty, and is decision oriented.

The model was developed to identify the key functions and functional interrelationships in the program office. There was no attempt to develop the functions in concert with the organizational structure. As a result, a given organization department could participate in several functions and a given function could have several organization departments participating in it.

As a result of these two factors, functions could not be uniquely distinguished. Further, it was difficult to pinpoint a decision to one location. For example, the decision to change the baseline can be considered a decision to Plan and Control Resources (A1) instead of a decision in Develop the Air Vehicle (A3). Therefore, the same decision would be depicted in the model in two separate locations and at two different levels of detail. Such a situation has the potential to be confusing to a user of the model.

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