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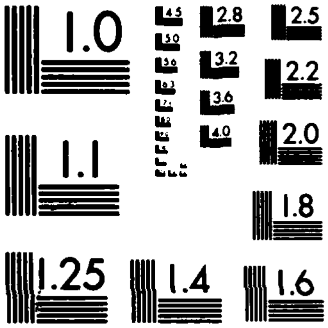

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BASE CIVIL ENGINEER ORGANIZATION: STANDARDIZED VERSUS FLEXIBLE

Edwin S. Taylor, Captain, USAF

LSSR 67-83

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The structure of Air Force Civil Engineering is standardized by Air Force Regulation 85-10. However, organizational theorists maintain that in order to be effective, an organization's structure should be contingent on the environment in which it operates. This research is an exploratory study of two Civil Engineering squadrons operating in different environments. Using the IDEF system modeling technique, functional models of the two Civil Engineering organizations were developed. A comparative analysis was then performed on the models. The study revealed evidence of differences between the structures of the two organizations due to operating in different mission environments. However, not all differences were predicted by organizational theory.

Integrated Computer aided manufacturing Definition

LSSR 67-83

BASE CIVIL ENGINEER ORGANIZATION:
STANDARDIZED VERSUS FLEXIBLE

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 Requirement for the
Degree of Master of Science in Engineering Management

By

Edwin S. Taylor, BS
Captain, USAF

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Benjamin L. Dilla
COMMITTEE CHAIRMAN

READER

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CHAPTER I

INTRODUCTION

Background

The primary mission of Air Force Base Civil Engineering activities is to acquire, construct, maintain, and operate real property facilities, and provide related management, engineering and other support work and services (AFR 85-10, 1975). According to AFR 85-10, Base Civil Engineering activities were organized specifically to:

(1) maintain in the most economical manner all active property to a standard that prevents deterioration beyond normal wear and tear;

(2) conserve natural resources through efficient land and forestry management and environment pollution control and abatement;

(3) provide fire prevention and protection engineering services;

(4) furnish refuse collection and disposal, custodial, and insect control services;

(5) furnish utility services required to accomplish assigned missions efficiently;

(6) formulate and maintain a maintenance program that accurately reflect the backlog of essential maintenance and repair;

(7) use contract services to effectively support or satisfy mission requirements;

(8) accomplish alteration and minor new construction necessary to provide essential facilities needed in support of mission change;

(9) provide management and professional engineering services to ensure effective operation of all activities;

(10) support civil and airbase disasters and emergencies, using the personnel and material resources of civil engineering as necessary to save lives and mitigate suffering; and

(11) provide forces to recover airbases damaged by natural disasters or enemy attack.

To perform its assigned mission, Base Civil Engineering is typically a highly centralized organization, organized along functional lines. That is, the organization is structured into functional groups by areas of specialization (See Fig 1.1). The Base Civil Engineer (BCE) is responsible for planning, supervising, and coordinating all civil engineer activities in the overall accomplishment of the organization's assigned mission. The chiefs of each functional area or branch supervise and coordinate all activities in their areas, and report to the BCE (AFR 85-10, 1975). As shown

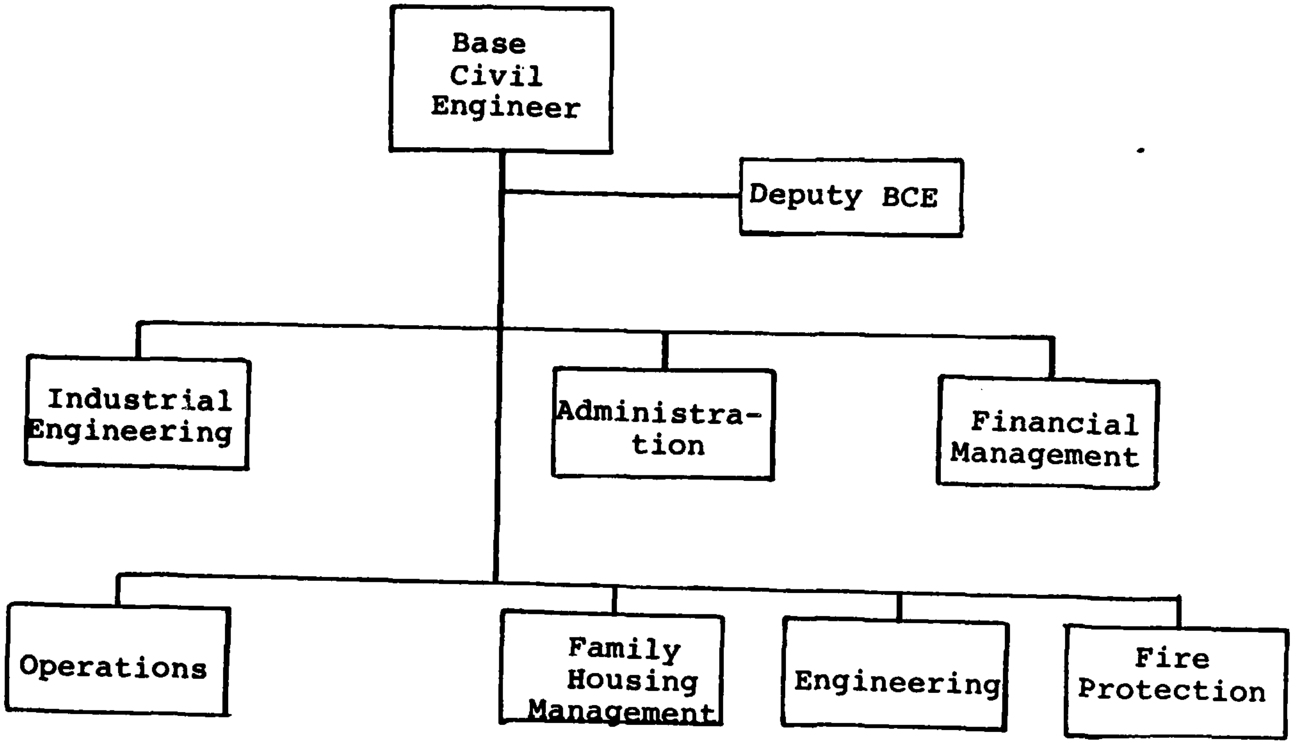


Fig 1.1. Base Civil Engineer Organization

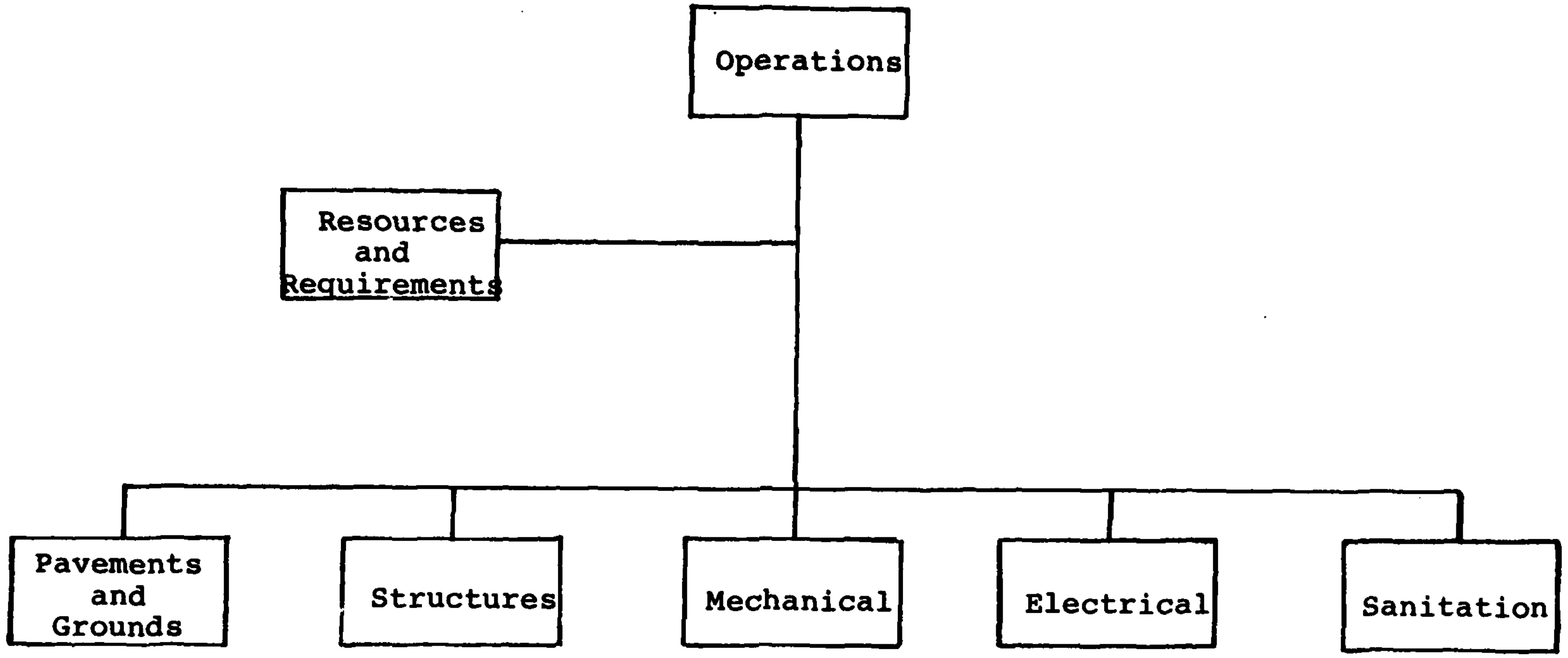


Fig 1.1a. Operations Branch

in the Figure 1.1, the typical Civil Engineering squadron is composed of six branches. These are: (1) Industrial Engineering (2) Administration (3) Operations (4) Engineering, Environmental and Contract Planning (5) Family Housing Management, and (6) Fire Protection.

The Industrial Engineering Branch is responsible for evaluating the quality of work performed by all Civil Engineering personnel. Industrial Engineering (IE) evaluates the effectiveness and adequacy of the squadron work force, facilities, equipment, programs and procedures. The IE branch identifies and documents deficiencies; recommends corrective action to achieve maximum effectiveness. The IE branch implements and monitors the data automation of BCE records, systems, and procedures, and provides technical support within its professional competence to all other organizational elements (AFR 85-10, 1975).

The Administration Branch includes the Squadron Section. Its duties includes preparing administrative work of the BCE organization, providing liaison with appropriate base organizations concerning BCE manpower and personnel matters, and developing and directing the internal Civil Engineering security program (AFR 85-10, 1975).

The Operations Branch is one of the two productive branches within Civil Engineering. As shown in Figure 1.1a, the Operations Branch includes the construction shops of Civil Engineering as well as the Resources and Requirements

Section. In general, the Operations Branch is responsible for accomplishing all in-service work by Civil Engineering. Within the Operations Branch, each of the individual shops is responsible for performing installation, maintenance, repair and construction work within its area of competence, as may be required. The work of the Operations Branch is controlled and coordinated by the Resources and Requirements Section. This section is composed of the Chief, Resources and Requirements, the Production Control Center, the Planning unit, the Material Control unit and the Readiness and Logistics unit. All incoming requests for in-service work are received, coordinated and approved by the Resources and Requirements Section. Once approved, the work requests are planned by the Planning unit, materials are obtained by the Material Control unit, and the job is programmed, scheduled and controlled by the Production Control Center. The Resources and Requirements Section also serves as the primary interface between Civil Engineering and the public (AFR 85-10, 1975).

The Engineering, Environmental and Contract Planning (EECP) Branch is responsible for controlling and coordinating all contract projects accomplished by civil engineering. The EECP Branch is the second productive branch in civil engineering. The EECP Branch is composed of the Engineering Section, the Environmental and Contract Planning Section and the Construction Management Section. The Engineering Section provides the architectural and engineering professional services for civil engineering. The Environmental and Contract Planning Section programs and schedules all contract projects, as well as serving as environmental coordinator and advisor for squadron units. The Construction Management Section is responsible for providing technical inspections of all maintenance, repair, construction and service work by contract to assure quality performance and contractural compliance (AFR 85-10, 1975).

Family Housing Management directs and supervises management of military family housing functions. Family Housing provides consultant services to the BCE and Base Commander on all aspects of military family housing.

The Fire Protection Branch administers and performs the duties and responsibilities of the BCE Fire Protection activities as outlined in AFR 92-1.

Together these six branches along with the Financial Manager provide the expertise, material and personnel resources the BCE uses to accomplish the assigned mission. This structure, illustrated in Figure 1.1 is highly centralized and is the standard Air Force BCE organization as set forth in AFM 26-2 and supplemented by AFR 85-10.

Terms Explained

In the remaining sections of Chapter 1 and throughout Chapter 2, extensive use is made of the term environment. Since this research is a study of the relationship between an organization's structure and the environment in which it operates, it is important that we define the term environment as it is used in the context of this research.

Dr. Jay Lorsch, a researcher whose early work on the relationship between structure and environment laid the groundwork for much of today's work in the field of organizational design, defines environment as "...the forces and institutions outside the firm with which its members must deal to achieve the organization's purposes..." (Lorsch, 1977). Lorsch includes in these forces any financial constraints, customer requirements and technological knowledge required by the organization. The point of commonality between these forces is that all provide information used by the affected organization to make decisions inside the organization (Lorsch, 1977). For the purposes of this research, the term environment refers to the forces and institutions representing the local constraints and requirements imposed on the civil engineering organizations at Luke Air Force Base, and Misawa Air Base, due to their respective missions.

The primary mission at Luke AFB is to train tactical fighter pilots. As such, the operation of the services and facilities deemed essential to that training program form the highest priority for use of civil engineering resources. This means the civil engineering activity at Luke AFB is constrained financially by the requirements generated by the operation of the flight training program. These requirements come in the form of maintenance for the two runways and runway systems, power requirements, and other mission essential activities. While the operation of the flight training program places the greatest constraints on the resources of civil engineering, other elements of the mission environment include support of base support facilities, as outlined in the background section.

The primary mission of Misawa Air Base, on the other hand, is to support an Electronic Security Command (ESC) activity. However, because of its highly classified nature, the ESC activity maintains its own small civil engineering activity. This in turn limits the amount of support civil engineering must provide the ESC activity. Due to this setup, the mission environment faced by the civil engineering activity is composed of the requirements generated by the base's support elements, rather than a mission essential element. These requirements and their accompanying constraints are general facility maintenance and base services as outlined in the background section.

Problem Statement

As stated in the Background, Air Force BCE organizations are standardized by AFM 26-2 and AFR 85-10. Two main reasons are given for this policy: (1) to minimize retraining for people moving from one organization to another, and (2) to maintain standard manpower authorizations for BCE organizations. However, Chapter 2 presents numerous studies indicating that there is no one best way to structure an effective organization. Instead, researchers tend to endorse a contingency approach to organizational structure; that is, an organization's structure should fit the environment in which it operates if that organization is to be effective. In light of this, it is not surprising that several USAF organizations are questioning whether a standard BCE organization is still appropriate. This research will analyze the organizational structure of two BCE organizations operating in different environments.

Justification

The assigned missions of the Civil Engineering organization have been set forth. Civil Engineering activities are far ranging and diverse. Since each BCE organization operates in a unique and dynamic environment, any particular BCE organization is at best an approximation of the established standard. Due to this fact, Civil Engineering managers must continually change the informal (local) BCE organization to fit the needs of today's assigned missions. Acknowledging the reduced capabilities and resources available today, it becomes imperative that the BCE organization operates as effectively as possible. Determining the proper type of organizational structure (standardized for all bases versus flexible according to mission requirements) is one means available to achieve that end.

Scope and Limitations

This research will analyze the structure of the Base Civil Engineer organization from an organizational theory perspective. The focus is on the development of a valid framework to be used to determine the most effective type of structure of the Air Force base level Civil Engineer organization. This research is limited to the study of the BCE organizations at Luke Air Force Base, Arizona and Misawa Air Base, Japan. These organizations were selected because of the author's familiarity with these organizations, and because these organizations are similar in size and technology. Their main difference is in the missions that they support. It is not the intent of this research to make definitive statements about Air Force BCE organizations in general, only to discover if there is cause to initiate further research into the issue of the appropriate BCE organization structure. As such, this research is an exploratory study.

Research Objectives

The objectives of this research are to:

(1) Develop functional models of the BCE organizations at Luke AFB, Arizona and Misawa AB, Japan.

(2) Compare the models of the two organizations and analyze the differences between the two from a structure-environment perspective.

Research Questions

The objectives above will answer this question:

(1) Are there significant differences between the structure of the two BCE organizations which operate in two distinct mission environments?

CHAPTER II

REVIEW OF LITERATURE

Overview

A review of the literature reveals extensive, often conflicting research concerning the design of effective organiaztional structures. This chapter seeks to answer the question of what constitutes an effective organizational structure; are there one or several effective structures, and if there are more than one, under what circumstances are they more likely to be adopted? The chapter begins with a brief background discussion of the structural contingency model, before moving to a brief description of the technological and size correlates of the model. In each case, evidence is presented both for and against that model correlate. Next a discussion of the contingency model for environment is presented. This section includes six empirical studies in support of the model, with each study focusing on a different dimension of structure and its relationship to environment.

Structural Contingency

Organizational researchers currently researching the question of what is the best way to design an effective organization conclude there is no one best way to structure an effective organization (Ford and Slocum, 1977). Instead, researchers are searching for a framework that allows for consistent and valid predictions about the relationship between structure and effectiveness.

The structural-contingency model is currently advocated as the framework for which theorists have been searching. In fact, many researchers claim that contingency theory is widely accepted, and thus no longer controversial (Schoonhoven, 1981). The structural-contingency model suggests that an organization's effectiveness *depends on the fit* between its structure, technology, size and the environment in which it operates. (Azma and Mansfield, 1981). Though the structural-contingency model has its detractors, considerable evidence exists to support the idea that an effective organizational structure depends on the environment, size and technology.

Structural-contingency: Structure and Technology

The early work of Woodward found some evidence for the technological correlate. Woodward studied 100 varied English organizations and concluded that success depended on the appropriatedness of an organization's structure for a particular operations technology (Woodward, 1965). However, in subsequent studies by Hickson, Pugh, Child, and Mansfield, no relationship between technology, structure and effectiveness was found (Ford and Slocum, 1977; Stansfield, 1976; Donaldson, 1976). Further, Tushman (1979), measuring environment as "task uncertainty" in his study of sub-unit characteristics found that for technical service projects greater uncertainty led to greater not less centralization in high performing units. Randolph (1981) found technology useful only at the unit level, especially for large organizations. In view of this body of evidence, technology's influence on structure and effectiveness is not altogether known. Furthermore, since the technology used by the two organizations studied is essentially the same, this research will not focus on the contingency model for technology, structure and effectiveness.

Structural-Contingency: Structure and Size

In addition to research into the relationship between structure and technology, considerable research has been done examining the relationship between size and structure, expecially complexity and administrative intensity. The assumption is that increases in the size of the organization lead to increases in control and coordination requirements (Ford and Slocum, 1977). Armandi and Mills (1982) found some support for the relationship between size and complexity in a study of 128 savings and loan associations. Their study, an extension of the Blau-Hage model, found evidence that large size does promote greater complexity.

The relationship between size and administrative intensity is less clear. While there is evidence that supports this contention, there is much evidence that disputes this theory (Ford and Slocum, 1977). However, in the present research size, measured in terms of number of employees, is controlled, since both organizations are of approximately the same size. With this in mind, this research will concentrate on the relationship between structure, environment and effectiveness.

Structural-Contingency: Structure and Environment

The early study of the environmental correlates of complex organizations began with Woodward (1965) and Burns and Stalker (1961). However, it wasn't until Lawrence and Lorsch (1967) that contingency theory crystallized. Lawrence and Lorsch showed that an organization's market and technological environments have a major impact on organizational design. Environment is defined here as the forces and institutions outside the firm with which its members must deal to achieve the organization's purposes (Lorsch, 1977). The result of contingency theory was the finding that a centralized authority is more appropriate for relatively stable environments (Lawrence and Lorsch, 1967). Pennings (1975) went one step further citing the inherent assumption of contingency theory, that an organization's effectiveness is a function of the fit between environment and structure.

Dimensions of Structure

Researchers have used a variety of measures to define organizational structure. Khandwalla (1973) used integration and differentiation as variables of structure. Smith and Nichol (1981) used standardization as their measure of structure, while Tushman (1979) sought to measure structure using information processing networks. However, while researchers have used a variety of measures to define or measure an organization's structure, most researchers agree that there are three main elements or dimensions of structure. These are the degree of centralization or decentralization, the degree of integration, and the degree of complexity within the organization. So before proceeding further, these dimensions of structure must be defined, and their relationship to the measures used in the following empirical studies described.

Centralization is a condition where the upper levels of an organization's hierarchy retain the authority to make most decisions. Its opposite, decentralization, refers to the condition where the authority to make specified decisions is passed down to units and people at lower levels in the organization's hierarchy (Child, 1977).

Integration is essentially the degree of information processing done within and between internal departments of an organization. Integration is generally achieved via three methods: (1) coordination through setting of programs of work and establishing procedures (2) coordination through feedback from individuals, and (3) coordination through scheduled and unscheduled meetings as a mechanism for mutual adjustment (Child, 1977). Formalization and standardization, mechanisms of integration, refer to the degree to which an organization relies on written policies, procedures, rules and standing orders. These variables have as their opposite informality, which is the lack of formal rules and procedures.

Finally, complexity refers to the level of differentiation within a system (Ford and Slocum, 1977). Differentiation can be both vertical and horizontal. Vertical differentiation refers to the number of levels between upper management and the operating levels (Albanese, 1981). Horizontal differentiation refers to the segmentation across the organization chart (Albanese, 1981). Some aspects of differentiation used by researchers are functional divisions within an organization, and staff distribution.

The Studies

Controversy still surrounds the structural-contingency model, due to the vagueness and lack of clarity with which the model is often stated (Schoonhoven, 1981; Pennings, 1975; Azma and Mansfield, 1981). However, empirical evidence in support of the model does exist.

A study of 79 manufacturing firms in various industries, varying widely in profitability, revealed that the more profitable firms did indeed pattern their structures differently from the less profitable firms (Khandwalla, 1973). Khandwalla surveyed by questionnaire the presidents of each of these firms to measure structural indicators such as staff support, vertical integration, controls and participative management. Khandwalla measured effectiveness in terms of profitability of the firms. Dividing his sample roughly in half between the more profitable and less profitable firms, Khandwalla found that for three structural variables (uncertainty reduction, differentiation, and integration) the profitable firms tended to pattern these variables either all high or all low, or all moderate in accordance with the level of uncertainty in their operating environment. The least profitable firms tended to mix these variables (Khandwalla, 1973). Khandwalla asserts that for a firm to be effectively designed, it may have to be designed so as to be high, medium or low on all three sets of variables, and the particular design would depend on, "how uncertain its external environment is". Though Khandwalla's study supports contingency theory, he really did not attempt to measure environmental uncertainty directly.

A study of 20 Mexican and 20 Italian firms sought to measure environmental uncertainty and test the contingency model (Simonetti and Boseman, 1975). Simonetti and Boseman measured environmental uncertainty (the independent variable) in terms of market uncertainty or market competition. Market competition was typified as "high" or "low". Highly competitive markets were characterized by: (a) severe price competition among manufacturers (b) limitation on the amount of alternatives available to consumers (c) speed of delivery to consumers. Low competitive market conditions reflected: (a) little price competition (b) less than five alternative products available to the consumer, and (c) long delays in deliveries.

Effectiveness was measured in terms of profitability, however Simonetti and Boseman added a behavioral effectiveness construct, defined as the use of human resources. Decentralization of decision-making was considered a mediating variable and was evaluated using factors such as:

(1) layers of hierarchy
(2) locus of decision-making with respect to major policies
(3) locus of decision-making with respect to sales policies and product mix
(4) degree of participation in long range planning (Simonetti and Boseman, 1975).

A decentralization index was developed consisting of a three point rating scale for each factor considered. Using a non-parametric statistical test, the researchers found that under highly competitive market conditions a relatively decentralized structure was significantly correlated with effectiveness.

Under opposite conditions the centralized firms were more correlated with effectiveness (Simonetti and Boseman, 1975). Their findings were clearly consistent with the contingency model for structure, environment and effectiveness. Futhermore, it formed the basis for future research.

Smith and Nichol (1981), performed a study of a firm in the retail motor trade and found even more support for the contingency model. The firm consisted of six company units, each handling a different vehicle model. Three of the company units were geographically removed from the firm's headquarters. The researchers were looking to measure the effects of implementing a standardization program on the company.

As orginally conceived, the program was supposed to bring about standardization within and between companies in the firm. This was to be achieved in sequence beginning with the service departments, moving to the sales department, and finishing with the parts departments. As it turned out, the service departments were the only departments to achieve the greater standardization. As mentioned earlier, the purpose of the research was to measure the effects of the program on the firm's performance or effectiveness.

Performance was the measure of company effectiveness, and was measured by three variables: profitability, customer retention and productive time (Smith and Nichol, 1981). Changes in these variables were measured using customer surveys, profit and production data. The researchers found an increase in the levels of formalization and centralization due to the standardization program. The changes in performance were mixed, with little overall improvement occuring in the service departments. In fact, performance was reduced in some of the service departments (Smith and Nichol, 1981).

In an effort to explain the lack of improvement, the researchers referred to contingency theory of structure and environment. The differences in environment were measured as a function of market type and volatility. Market type referred to those service departments that serviced either specialist franchises or volume franchises. Market volatility was assesed by comparing variations in sales turnover. Though the results were somewhat mixed, the researchers suggest that "the standardization program was inappropriate from the outset to the situation facing the group as a whole" (Smith and Nichol, 1981).

In a test of the contingency model down at the subunit level, a study was performed to see if subunits with different information processing requirements had different communication structures (Tushman, 1979). Studying the oral communications within and between work teams at a research and development laboratory of a large corporation, researchers found support for the model (Tushman, 1979).

To develop a measure of project communication structure, data were gathered on the overall amount of communication within projects. Each professional was asked to report his work related, oral communication on a number of selected days. These communication data were collected once each week for 15 weeks, with an equal number for each day of the week (Tushman, 1979).

The amount and direction of intra-project communication was determined for each individual. The ratio of vertical (supervisor-subordinate) to horizontal (peer) communication was used to develop a centralization measure such that the more vertical bonds or the fewer horizontal bonds, the more centralized the communication structure of the project unit (Tushman, 1979).

Tushman found that units with a rapidly changing environment developed a more decentralized communication structure to meet that requirement. Tushman also reports that for the highest performing units, this reaction to environment was accentuated.

DuBick (1978) performed a study of 72 major metropolitan newspapers, seeking to measure the relationship between their structure and the environment in which they operate. DuBick related the level of structural differentiation to their metropolitan environment, using the distribution of staff and the functional divisions within the staff as his measure of structure. Environment was measured as the degree of competition within the metropolitan community, the varying sources of the news and the level of fiscal support.

DuBick used two measures of differentiation in his study. The first was an index which reflects the division of labor in terms of how evenly employees are distributed among the occupations in a work organization. The second was a measurement of the number of departments staffed in a newspaper (DuBick, 1978). As a result of his study DuBick found that: (1) the functional divisions within the newspaper increased as the level of uncertainty increased in their environment, and (2) the staff distribution measure depends primarily on the complexity of news channels leading into a newspaper (DuBick, 1978). Thus "complex environments require complex newspapers" (DuBick, 1978).

More evidence for contingency theory was found in a study of the formal organizational structure of regulatory agencies and their task environments (Thompson, Vertinsky, Kira, Scharpf, 1982). The purpose of the study was to determine if the relationship of environment to structure affected the effectiveness of regulatory policy. The study by Thompson et al. (1982) conceptualized the internal structure of the organization along three dimensions:

(1) the formal structure of vertical authority relationships among organizational sub-units;

(2) the formal structure of horizontal dependency relationships among sub-units; and

(3) the formal and informal structure of the communications network among organizational sub-units.

The environment in this study is made up of clients who are affected with problems of varying frequency and intensity. The study itself was a simulation study using a model based on the West German Federal Ministry of Transport. The basic structure of the model assumes external clients who impose demands upon the organization. The results of the simulation experiments concur with contingency theory in that it found that

> "...the "fit" on congruence between the network policy and the formal structure of the organization is an important factor which affects performance" (Thompson et al., 1982).

The evidence in favor of contingency theory, while not overwhelming, is nevertheless impressive. In fact, it appears evident that in choosing the proper organizational structure one must first identify the environment in which the organization operates. At this point organization theory becomes less clear. Theorists refer to structure in terms of the degree of centralization, integration, and complexity, however, from an organization's perspective the choice of structure may be simply functional or decentralized (Duncan, 1979). When the organization's environment is relatively simple, that is, there are not many factors to consider in decisionmaking, then a functional type organization is most appropriate (Duncan, 1979). In more dynamic environments, organizational structure is most appropriately decentralized (Duncan, 1979). The dilemma is deciding when to use which structure, or what degree of which to use.

Pennings (1975) in a study of 40 branch offices of a brokerage firm found that decentralization and autonomy were most related to organizational effectiveness. Azma and Mansfield (1981) found similar results in a study of 52 firms in South Wales. These studies seemingly contradict contingency theory, since neither study found environment very important. However, as Child (1977) observes,

> "...most researchers have so far failed to adopt a multivariate analysis of contingent...variables in relation to structural design and performance."

Instead, researchers have concluded that organizational design should be decided in reference to environment, size or technology. However, this ignores the possibility that an organization may face a configuration of many contingencies simultaneously (Child, 1977). This in turn could distort the findings of a particular study, and could explain the problem of a weak environmental relationship to structure and performance.

Conclusion

This chapter discussed the design of organizational structures, focusing on the question of "What is the best way to structure an effective organization?" This research examined the structural contingency model, primarily for environment, as an answer to that question. The review presented six empirical studies of the structure-environment relationship, each occurring under different circumstances, and each attempting to measure an organization's structure as a function of one particular dimension of structure. We found that Khandwalla's early work provided the first empirical evidence for the model. However, his study of 79 manufacturing firms did not attempt to measure environment directly. Later studies by Simonetti and Boseman, Tushman and DuBick, all attempted to measure the environmental variables. Their research also provided strong evidence for the model. The review also looked at a study by Smith and Nichol that sought to measure the result of the implementation of a standardization program on a retail motor firm. They found that such a program, when implemented without regard to an organization's environment, is not likely to produce the results desired. Finally, we reviewed a simulation study of a government agency that also supported the contingency model.

In conclusion, one would have to say that the contingency model for environment is valid. The model has been supported by several studies, using varying structural variables and measurement criteria. With this in mind, one would have to conclude that there is no one best way to structure an organization. Instead, the designers of any particular organization must first identify the environment in which the organization must function, and then design the proper organizational structure for that environment.

CHAPTER III

METHODOLOGY

Overview

The purpose of this chapter is to outline the methods used to achieve the two research objectives listed in Chapter I. As you recall, these objectives were to develop models of the two BCE organizations at Luke AFB, Arizona and Misawa AB, Japan, and to compare and analyze the differences between the two organizations. This chapter will present a discussion of the modeling technique used to develop the organization models, and will then present the criteria by which the qualitative analysis of the models can be performed.

Modeling Approach

Research objective one requires that functional models of the BCE organizations at Luke AFB and Misawa AB be developed. The models must be able to show what the organization is rather than what it is supposed to be. The modeling technique must show the basic relationships within the organization, the points of commonality and the internal and external interfaces of the organizations.

The Materials Laboratory of the Air Force Wright Aeronautical Laboratories, in association with SofTech Incorporated, developed just such a model. Based on SofTech's Structured Analysis and Design Technique developed for the United States Air Force's Integrated Computer Aided Manufacturing (ICAM) program, the model ICAM Definition ($IDEF_0$), was developed to increase manufacturing productivity through the systematic application of computer technology (Ross et al., 1981). Structured analysis is a graphic language for describing any system. By system, the authors mean both what something is and what it does. A structured analysis system model describes that tangible or functional reality (Ross et al., 1981). This modeling approach is a systems design architecture which provides a blueprint defining "the fundemental relationships, the functional interfaces, the identification of common, shared and discrete information, and the dynamic interaction of resources" (Ross et al., 1981).

$IDEF_0$ Concepts

$IDEF_0$ is used to produce a functional model which is a structural representation of the functions of an organization's system or environment, and of the information and objects which interrelate with those functions (Ross et al., 1981). However, this technology can be used to model any system composed of hardware, software and people (Ross et al., 1981). For existing systems, $IDEF_0$ can be used to analyze the purposes the application serves and the function it performs, and in addition, record the mechanisms by which these are done. The basic concepts are:

(1) Understand a system by creating a model that graphically shows things and activities;

(2) Distinguish what functions a system must perform from how the system is built to accomplish those functions;

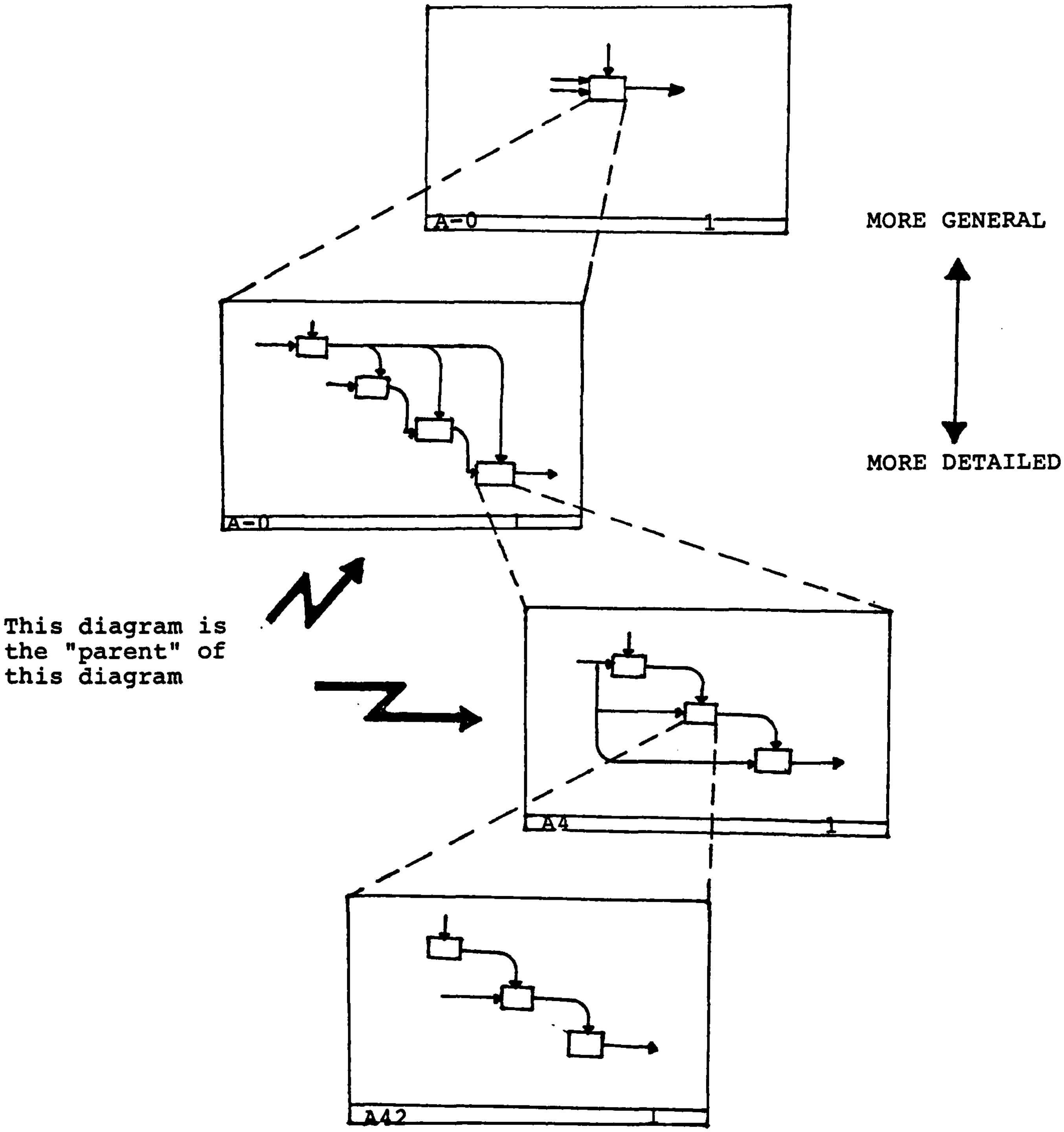
(3) Structure a model as hierarchy with major functions at the top and successive levels revealing well-bounded details (Ross et al., 1981).

The result of applying IDEF$_0$ is a model, consisting of diagrams, texts, and glossary that breaks the system into its component parts and underlying functional relationships.

IDEF$_0$ Diagrams and Procedures

The model is a series of diagrams that break a complex subject into its component parts. The initial diagram is the most general desscription of the system. On each diagram the major component at that structural level is shown as a box. These boxes can be broken down into more diagrams until the system is described to any level of detail.

> "Each detailed diagram is the decomposition of a box on a more abstract diagram. At each step, the abstract diagram is said to be the "parent" of the detailed diagram. A detailed diagram is best thought of as fitting "inside" a parent box" (Ross et al., 1981) (See Figure 3.1).



This diagram is
the "parent" of
this diagram

Fig. 3.1. Decomposition of Diagrams
(Ross et al., 1981)

Each box represents a functional activity which occurs over time and transforms input into output. Boxes are connected by arrows representing data constraints. The arrows provide definition for the boxes; they do not provide a flow between functions or a sequence of functions (Ross et al., 1981).

The arrows affect boxes in different ways. The side of the box at which an arrow enters or leaves shows the arrow's role as an input, a control, or an output (See Figure 3.2). An input arrow represents data that is transformed by the function specified in the box. An output is data which either results from or is created by the functional box. A control differs from an input in that it determines the function or tells why the transformation is taking place. Finally, the bottom of the box is reserved to indicate a mechanism. A mechanism defines how a function is performed. Arrows are labeled to identify what they represent. In activity diagrams, arrows may branch or they may join. It is usually the case that more than one kind of data is needed to do an activity, and that more than one kind of data is produced by an activity. The branches may represent the same thing, or different things of the same general type.

> "On any given diagram, data may be represented by an internal arrow (both ends connected to boxes shown on the diagram) or a boundary arrow (one end unconnected, implying production by or use by a function outside the scope of the diagram)" (Ross et al., 1981).

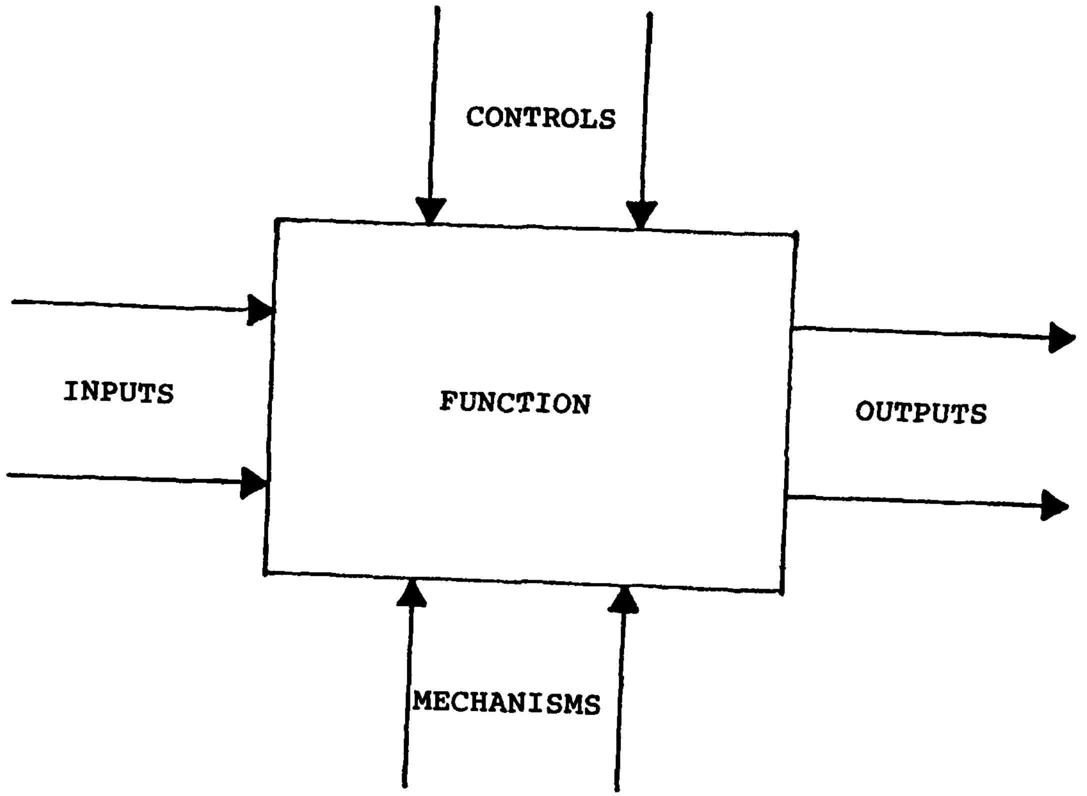


Fig 3.2 IDEF$_0$ Function Box and Interfaced Arrows (Ross et al., 1981)

A boundary arrow's source or destination is found by referring to the parent diagram. It is important to realize that the function inside the box cannot be performed until all required data shown by the incoming arrows have been provided.

Each IDEF$_0$ diagram is supported by written text and a glossary to aid in defining the system. They are intended to emphasize significance or clarify the intent of the diagram, not duplicate its detail. Additionally, a node index is provided for convenience in accessing any desired level of detail.

An important feature of the IDEF$_0$ modeling technique is that it slowly introduces greater level of detail as each function is decomposed into its subfunctions. The procedure starts by representing the modeled system as a single box with arrow interfaces to functions outside the system. At this level both the descriptive name of the box and its arrows are general. This general function is then broken down into its major subfunctions with their arrow interfaces. Each subfunction can be further decomposed in order to reveal even more detail. Every subfunction can contain only those elements within the parent model's scope, and it cannot omit any elements of the parent model. The decomposition of the system stops when the desired level of detail has been reached.

The final form of the diagrams is a hierarchical format. This format is achieved by breaking down each functional box into its more detailed functions. Such a hierarchical structure is known as a node tree.

> "All node numbers of $IDEF_0$ diagrams begin with the letter A, which identifies them as "Activity" or function diagrams. A one-box diagram is provided as the "context" or parent of the whole model. By convention, the diagram has the node number 'A-0'" (Ross et al., 1981).

The arrows associated with this diagram are called external arrows because they represent the system's environment, while the box establishes the context of the modeled system.

Boundary arrows for all lower level diagrams must be labeled with an ICOM code.

> "The letter I,C,O or M is written near the unconnected end of each boundary arrow on the detail diagram. This identifies that the arrow is shown as an Input, Control, Output, or Mechanism on the parent box. This letter is followed by a number giving the position at which the arrow is shown entering or leaving the parent box, number left to right and top to bottom" (Ross et al., 1981).

Arrows shown as inputs or controls on a parent diagram are not limited to the same role throughout the decomposition (Ross et al., 1981).

Research Objectives

The research objectives required that functional models of the two BCE organizations be developed, compared and analyzed from a structure-environment perspective. The analysis of the models was a qualitative analysis, using the three main dimensions of structure outlined in chapter two. As you recall, the three dimensions of structure were the degree of centralization, the degree of integration and the degree of complexity within the organization. The analysis presented in the next chapter will use these dimensions of structure to make the comparisons of the functional models.

Conclusion

This chapter presented an argument for applying the $IDEF_0$ methodology to this research effort. It defined the $IDEF_0$ methodology, outlining the concepts and procedures of the methodology, that were used to make the qualitative analysis presented in the next chapter.

CHAPTER IV

ANALYSIS

Overview

Applying the $IDEF_0$ methodology results in a series of diagrams that seek to break a complex subject into its component parts. In this case, the complex subject is the operation of Civil Engineering squadrons seeking to use available resources to attain their unit objectives in support of the airbase's mission. The $IDEF_0$ models presented here are diagrams that chart the activities of the two squadrons as they seek to accomplish established mission objectives. The squadrons develop various plans and programs to provide the framework for allocating those resources to accomplish the requirements as directed by unit mission objectives. These plans are then implemented. The implementation phase is followed by inspection and evaluation of the work and procedures. This chapter begins with a discussion of the $IDEF_0$ models' node indices indicating major activity functions within the Civil Engineering squadrons studied. Following this is an example illustrating how the comparative analysis of the models was done. Next is a descriptive analysis of the differences between the models, focusing on the three main dimensions of structure defined in chapter two. The detailed functional models referred to in the following discussion are presented in the appendices. The functional model for Luke AFB, Arizona is presented in Appendix A, followed by the functional model for Misawa AB, Japan in Appendix B.

Node Indices

An overview of each model is shown in its *node index*. The node index gives the reader a quick reference to a specific location by placing related diagrams together as in an ordinary table of contents. The reader should use the index to locate specific diagrams in the functional models presented in the appendices.

Example of Comparative Analysis

The purpose of this section is to provide the reader with a sample comparative analysis of the IDEF$_0$ models presented in the appendices. Throughout this discussion, the reader should refer to Figures 4-1 through 4-4.

As outlined in chapter three, applying the IDEF$_0$ methodology results in a series of diagrams that break a complex subject into its component parts. The component parts are illustrated in the accompanying figures, and are the subject of the analysis. Figures 4-1 and 4-2 are from Luke AFB and depict the activities involved in deciding whether to approve a submitted work request. Figures 4-3 and 4-4 are the contrasting figures from Misawa AB. The comparison centers on

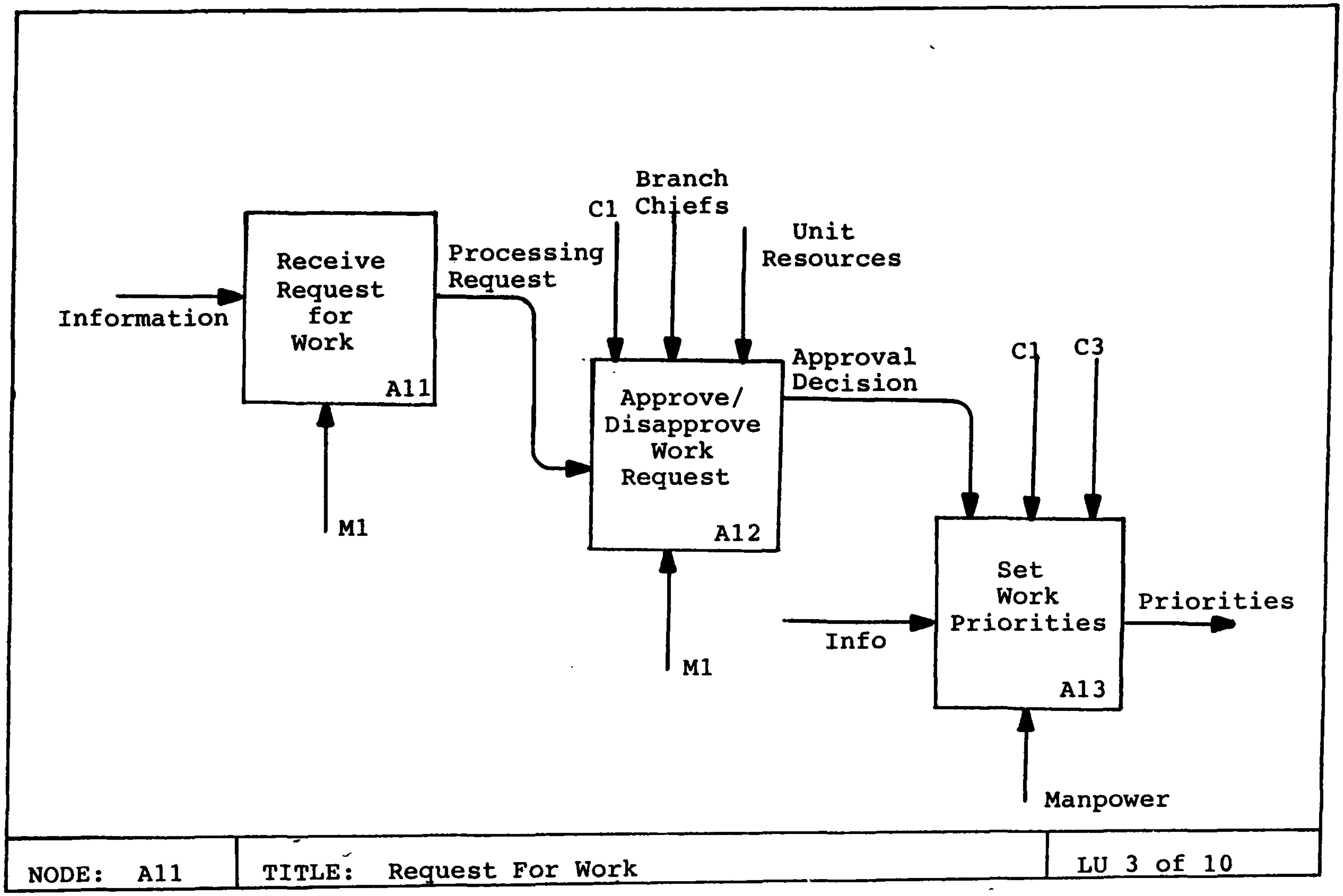


Fig 4.1. NODE: A11 Receive Request for Work (Luke)

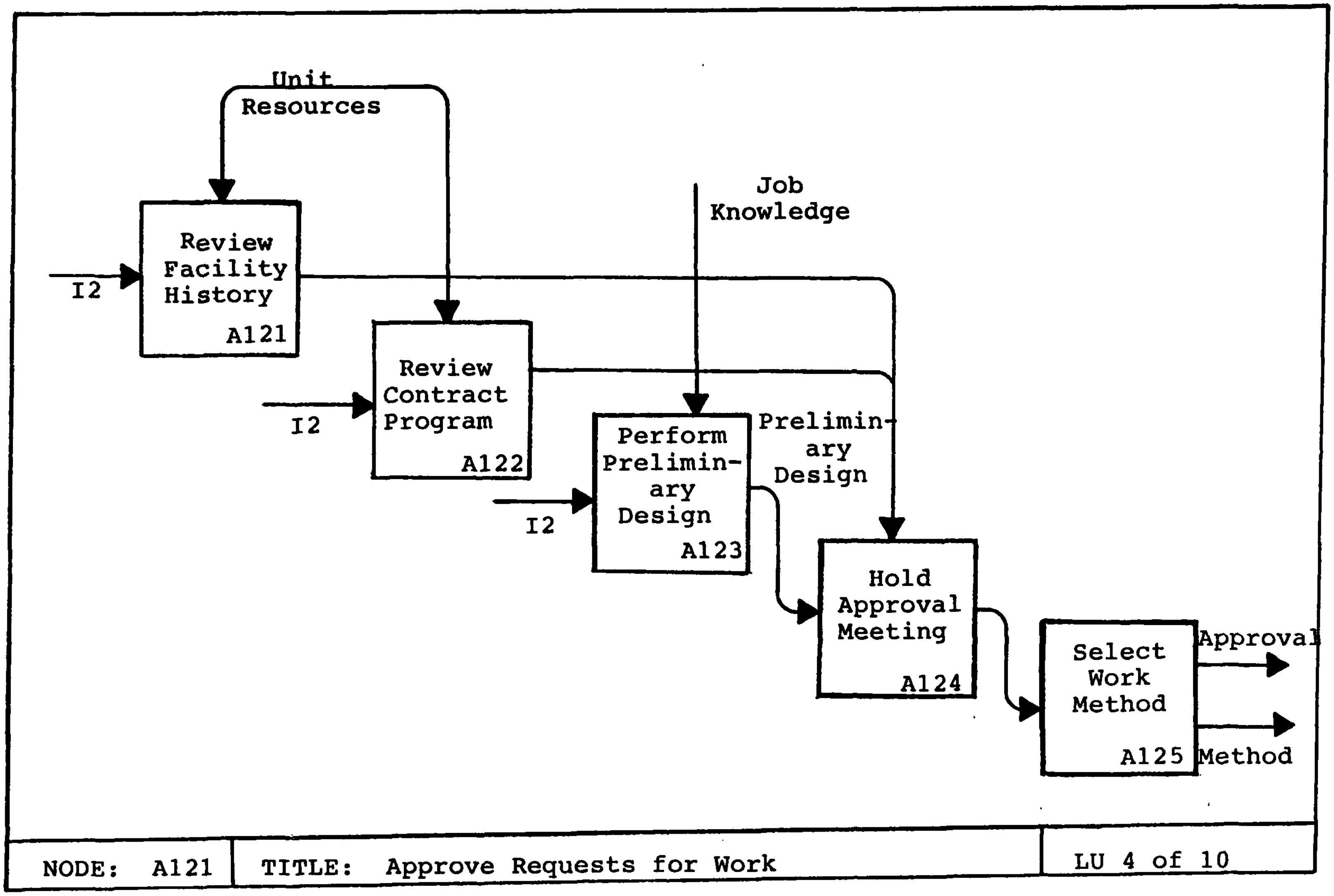


Fig 4.2. NODE: A121 Approve Request for Work (Luke)

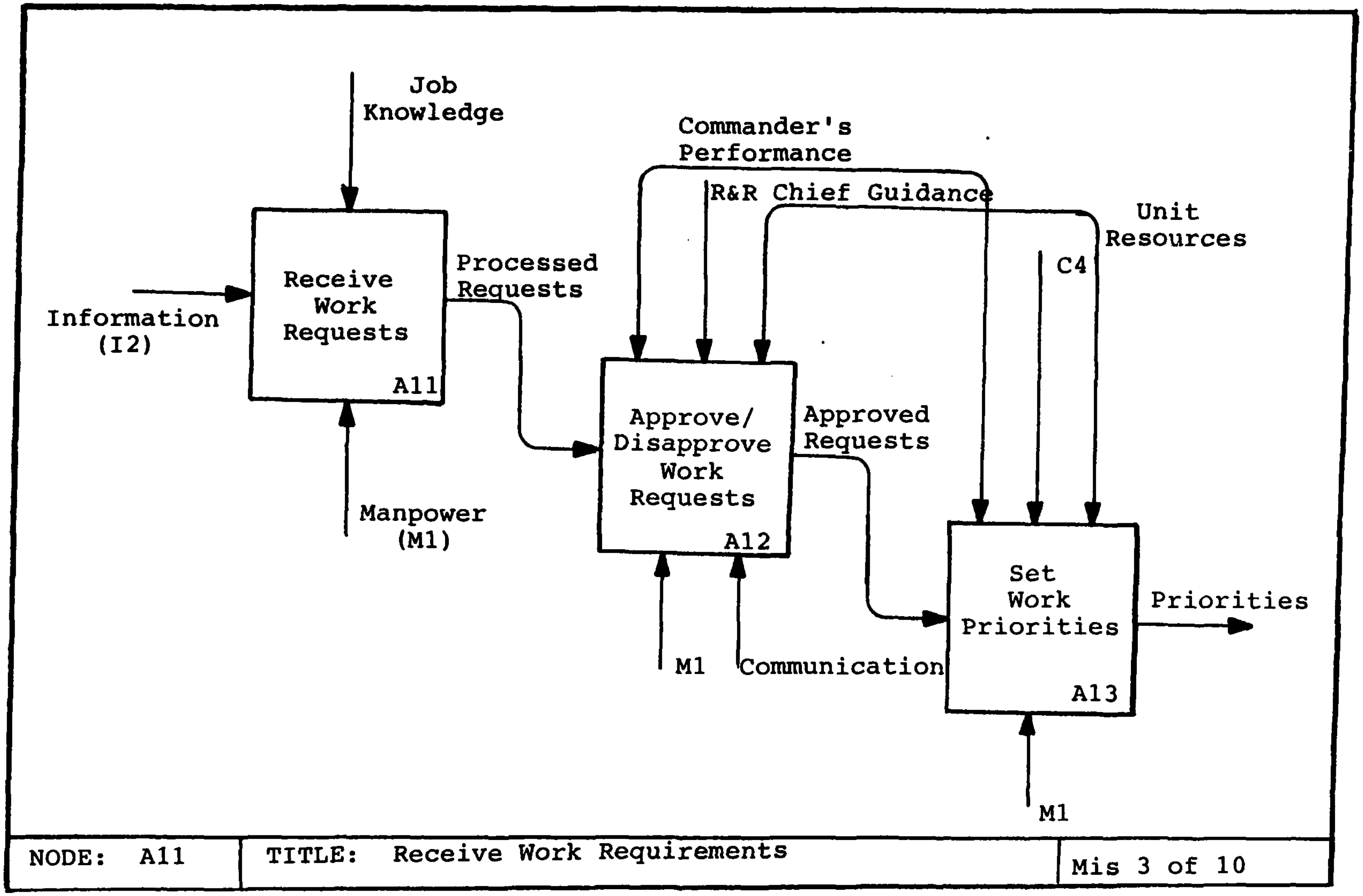


Fig 4.3. NODE: A11 Receive Request for Work (Misawa)

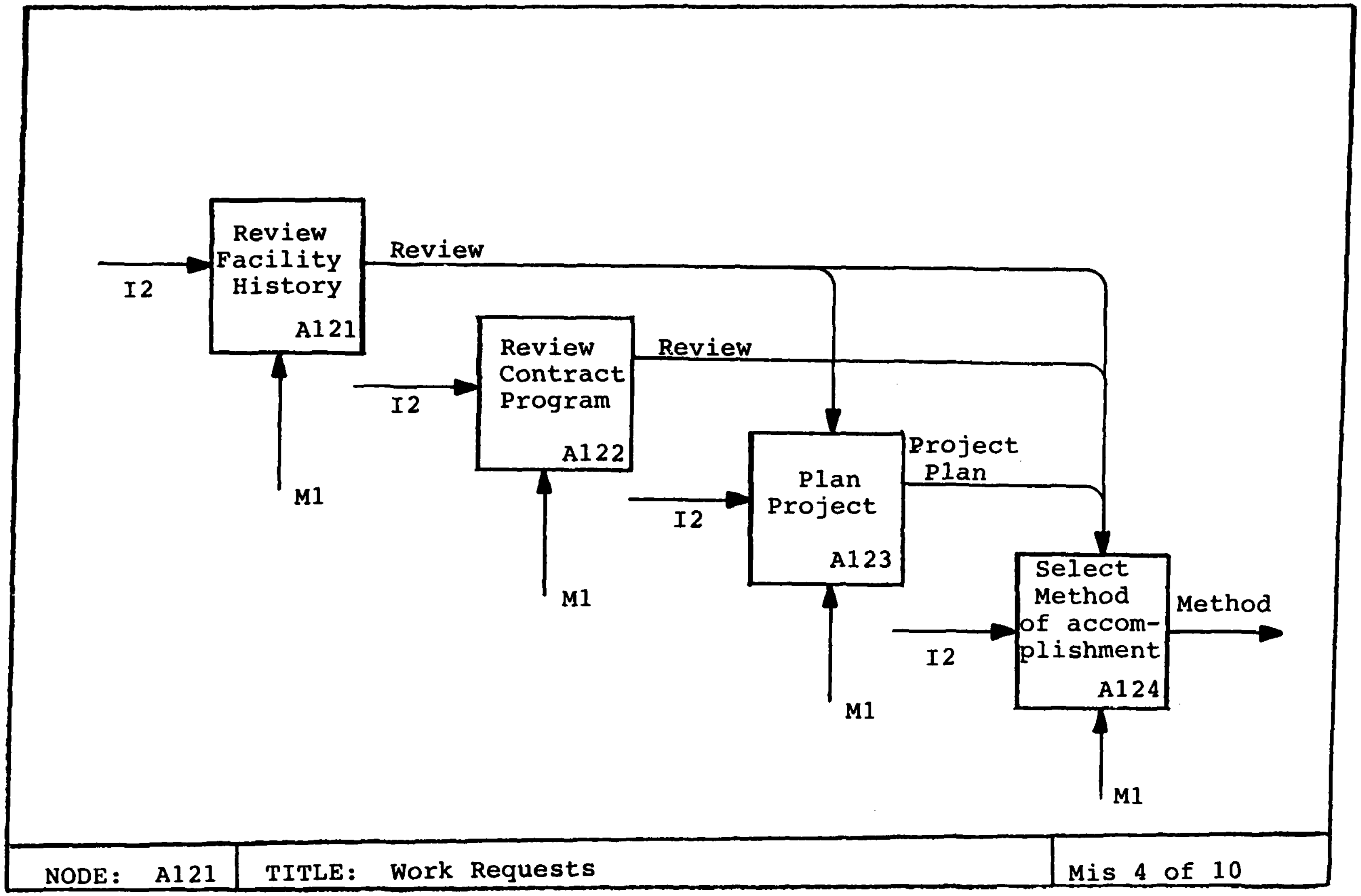


Fig 4.4. NODE: A121 Approve Request for Work (Misawa)

the differences in activities required to make the decision and the differences in the input and controls that affect the activity. For example, if this comparison was to determine the differences in degree of centralization, then the activities and their controls are the important aspects of the analysis. The activity of approving and disapproving work requests at Luke AFB show more controls and input from the upper levels of management than the same activities at Misawa AB, as shown in block A12 of Figures 4.1 and 4.3. Therefore, one could conclude that for this particular activity, there is a greater concentration of control in the hands of upper management. Likewise, the entire series of diagrams are compared in this fashion to determine the extent of the differences, and the importance of those differences. It must be noted that a narrative accompanies each diagram and should be consulted when making comparisons.

Descriptive Analysis

The purpose of this section is to present the analysis of the functional models of the two BCE organizations. As you recall from chapter one, Research Objective Two required the functional models to be compared and the differences analyzed from a structure-environment perspective. In this analysis, the models are analyzed using the three main dimensions of structure discussed in chapter two. The dimensions were the degree of centralization, the degree of integration, and the degree of complexity within the organizations.

Centralization

Centralization is defined as a condition where the upper levels of an organization's hierarchy retains the authority to make most decisions. By this definition, Air Force Civil Engineering squadrons are typically centralized organizations. The squadrons studied are no different. However, the comparison of the functional models of the BCE organizations at Luke AFB and Misawa AB reveal a few important differences in the degree of this dimension of structure.

According to the contingency model for organizational structure, one would expect that the organization that exists in the most dynamic environment would have the least centralized structure. However, the $IDEF_0$ models gives a different picture. Of the many decisions made each day in Civil Engineering, there are three that are most important, and most basic to the operation of the squadron. These are: what work will be done, how will work be done, and when will the work be done. When the models are compared, one finds that the squadron hierarchy at Luke AFB retains much more of this decision making in its upper levels than the organization at Misawa AB.

Within the organization at Luke AFB, deciding what work will be done translates to which work requests will be approved or disapproved. Referring to Figures A-3 and A-4 and their accompanying narratives, the model reveals that the decision to approve work requests, though delegated down to the Chief, Resources and Requirements Section (Chief, R&R), is actually controlled by the squadron commander and his staff. That is, any decision made by the Chief, R&R must be coordinated with the squadron commander and is subject to his approval. Further, the bi-monthly staff meeting initiated by the commander, to approve non-routine or complex requests is another feature of the greater centralization in this organization (see Figures A-3 and A-4). Finally, though the approval decision is delegated somewhat, the decision to disapprove work requests can only be made by the squadron commander. Beyond the decision of what work will be done are the decisions of how the work will be done and when. Referring to Figures A-3, A-4 and A-7, and their accompanying narratives, the model reveals that again there is a pattern of controlling guidance from the commander and his staff.

In contrast, the functional model for Misawa AB indicates a lesser degree of command control and greater delegation of decision making. The diagrams shown in Figures B-3, B-4 and their accompanying narratives indicate that the decision of what work requests to approve is delegated down to the Chief, R&R. Also, the decision to disapprove work requests is delegated down to lower levels. Both these decisions are made with minimal guidance from the squadron commander. Further, the decisions of how work will be done and when it will be done are made with only minimal guidance from the squadron commander and his staff. This decision is delegated down to the programming section personnel within the Misawa AB squadron (see Figure B-7).

Integration

Integration is defined as the degree of information processing done within and between internal departments of an organization. Both BCE organizations have very formal procedures and policies with which to operate, because of the regulations that govern much of the operation of Air Force Civil Engineering. Organizational theory states that the organization in the most dyanmic environment will usually have the most integrating mechanisms to meet that environment, so it is not surprising that the BCE organization at Luke AFB has developed a more extensive information processing network.

Due to the fact that Civil Engineering maintains a two-track programming function, one for contract programming and one for in-service programming, there are two decision areas where the flow of information between departments or branches is very important. The first is the decision to approve work requests, and the second is the decision of where to place work projects in the upcoming program. As expected, the IDEF$_0$ models reveal differences in both these areas. Figure A-4 and its narrative, details the work request approval process. The model indicates that information required to approve work requests comes from the Operations Branch, the Engineering Branch, and the squadron commander's staff. At Luke AFB, to insure that this decision is made with the most up-to-date information, the squadron commander has formalized a bi-monthly meeting of his staff to make the decision (see Figure A-4). The second indication of the greater integrating mechanisms at Luke AFB is the engineer's meeting held weekly (shown on Figure A-7). The purpose of this meeting is to disseminate information concerning the status of the contract program to the other branches in the squadron. This meeting helps prevent the separate programming sections from programming the same work twice, or having the in-service work forces undo or redo what is done by contract.

By contrast, the model of the Misawa AB squadron did not reveal this type of integrating mechanisms to process information used by more than one branch (see Figures B-4 and B-7). Instead, the squadron depended on the squadron commander to disseminate the information at the weekly staff meetings.

Complexity

The third dimension of structure examined is complexity. Complexity is defined as the degree of differentiation within a system or organization. Organizational theory states that the organization operating in a complex environment will become more complex to meet that environment. Therefore, one would expect that the organization at Luke AFB will be more complex due to its mission environment. However, by virtue of the fact that Civil Engineering squadrons are standardized structurally, it appears that both squadrons are relatively equal in complexity. An analysis of the $IDEF_0$ models do not provide much relevant information to make a comparison or to arrive at a conclusion concerning the complexity of the organizations in relationship to environment.

Conclusion

This chapter presented the results of applying the $IDEF_0$ methodology to the BCE organizations at Luke AFB and Misawa AB. The chapter began with a brief discussion of the node indices that accompany the models. Next, an example of how the models were compared was presented to aid the reader in visualizing important elements of the analysis. Then a descriptive analysis of the differences between the diagrams was presented. The author found differences in the degree of centralization and integration between the two organizations. However, while the differences in the degree of integration were as expected, the differences in the degree of centralization ran counter to contingency theory. Luke AFB, operating in the more dynamic environment should have tended toward less centralization. Instead, the Luke AFB squadron was more centralized than the Misawa AB squadron. The author also found that the functional modeling technique was much less helpful in analyzing the level of organizational complexity. In fact it provided little relevant information that would allow a conclusion to be drawn concerning complexity.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

This research effort started with a general discussion of the mission and functions of Air Force Civil Engineering. It described the activities and functions of the various branches within the typical Civil Engineering Squadron, and described that squadron as a highly centralized and functionally differentiated organization. From this general view, the author moved to a discussion of the issue of organizational structure of Civil Engineering, specifically, the question of whether the Air Force's policy of standardizing the structure of Civil Engineering squadrons is still valid in light of today's varied missions, changing requirements, and limited resources.

This question is a valid one, since an extensive review of literature reveals that organizational theorists currently accept the structural-contingency model as the framework for studying organizational design. The model suggests that an organization's effectiveness depends on the fit between its structure, technology, size and the environment in which it operates. This research chose to focus on environmental contingency since the general issue concerned changing mission environments.

In keeping with contingency theory, one would expect that organizations operating in different mission environments would change their informal structure to fit that environment in order to remain effective. With this in mind, the general issue was reduced to the following research question: "Are there significant differences between the structure of two BCE organizations which operate in two distinct mission environments?" To answer this question, two BCE organizations were selected for study, the organization at Luke AFB and the organization at Misawa AB. In order to analyze their respective structures, a relatively new modeling technique was selected. The modeling approach was the $IDEF_0$ methodology. The methodology produces a functional model of an organization, and in doing so, shows the relationships between the processes involved, and the information and objects which interrelate those functions. The functional models consist of boxes representing activities and arrows representing the controls, outputs and mechanism affecting the activity. Once the functional models are constructed, the next step was to descriptively analyze the models in terms of their structural aspects.

Conclusions

In response to the research question, there are significant differences between the two BCE organizations that can be attributed to their operating in two distinct mission environments. The results of this analysis indicates that in respect to the dimensions of structure, there are differences between the two organizations. In the area of centralization, the author found that the squadron at Luke AFB chose an increased level of centralization such that few decisions were made without the commander's input or direct guidance. Misawa on the other hand, chose to decentralize many important decisions such as work request approval, work method selection and programming decisions. It was noted that this was contrary to contingency theory in that the organization in the most dynamic environment chose a higher level of centralization than the squadron in the less dynamic environment. Since the degree of integration in both organizations conformed to contingency theory, it can not be said that the leadership of the Luke AFB squadron misread its environment. One might conclude that the higher degree of centralization was due to management's belief that only the upper levels of the organization were completely aware of the rapidly changing environment, therefore it was in their best interest to retain as much decision-making authority as possible. On the other hand, the environment at Misawa AB, although less dynamic than Luke AFB, might still have been dynamic enough to allow a reduction in the degree of centralization in the organization to fit that envrionment. Although the methodology did not provide enough relevant information to make conclusions concerning the relative levels of complexity, enough differences were found overall between the two organizations to conclude that different mission environments can affect the structure of organizations. Therefore, this research does question the validity of a standardization policy for Civil Engineering squadrons. It would appear from this study that local managers are already adapting the "informal organization" in response to the changing mission environments they face.

Limitations of Research

As indicated in chapter one, this study was intended as an exploratory one, and did not attempt to make a definitive statement about the validity of the current policy to standardize Air Force Civil Engineering. Even more, the author realizes that this research studied only two organizations, and that no attempt was made to define or measure the effectiveness of the organizations. Instead, the organizations were considered effective since both were operating satisfactorily. Finally, the author realizes that more organizations need to be studied, and the differences between them quantified. Therefore, these are areas of future research that the author recommends.

Recommendations

This study was intended as an exploratory study, and as such was not intended to be the final work on this issue. Therefore the author recommends the following:

(1) A study should be done that examines the structural differences between Civil Engineering squadrons operating in different mission environments. The research could use questionnaire surveys to study a representative sample of BCE organizations from each Major Command to determine if there are structural differences between organizations within the same Major Command, or if the differences are due mainly to operating in different Commands.

(2) Once the study above is complete, the researchers should investigate several organizational designs as alternatives to the present standardized BCE organizational structure. The purpose of this research should be to determine which organizational design is most appropriate for the various mission environments in which Civil Engineering organizations operate.

APPENDICES

APPENDIX A

IDEF$_0$ FUNCTIONAL MODEL: LUKE AFB, ARIZONA

NODE INDEX: LUKE AFB, ARIZONA

- A0 Support Base Mission
  - A1 Establish Priorities
    - A11 Receive Requests for Work
    - A12 Approve/disapprove Requests
      - A121 Review Facility History
      - A122 Review Contract Program
      - A123 Perform Preliminary Project Design
      - A124 Hold Approval Meeting
      - A125 Select Method of Accomplishment
    - A13 Set Work Priorities
  - A2 Program Requirements
    - A21 Develop In-Service Work Plan
      - A211 Determine Manpower Requirement
      - A212 Budget O&M Funds
      - A213 Budget Manpower Skills
    - A22 Develop Contract Program
      - A221 Collect Contract Requirements
      - A222 Design Projects
      - A223 Hold Engineer's Meeting
      - A224 Build Installation Contract Program
      - A225 Submit Program to Higher Headquarters
    - A23 Program Recurring Work/Services
  - A3 Schedule Work
    - A31 Verify Materials Complete
    - A32 Verify Skills Available
    - A33 Build Tentative Weekly Schedule
  - A4 Provide Services
    - A41 Perform Job Order
    - A42 Perform Work Order
    - A43 Perform Contract Work
  - A5 Inspect and Evaluate Work
    - A51 Inspect Contract Work
    - A52 Inspect In-Service Work
    - A53 Evaluate Procedures

A0 Text. Mission requirements and support capability form the basis for the mission support generated by Civil Engineering. The squadron commander insures that his staff work closely together to develop plans, programs and schedules which best support squadron mission objectives. It is important to remember that the mission of Luke AFB is that of Tactical Fighter Training, and such the BCE squadron's mission objectives are derived from the missions of the airbase. Realizing this, the installation commander provides input into the support process as required. Resources, such as men, materials, equipment and funding determine the squadron's ability to meet its requirements, and support the mission of the airbase.

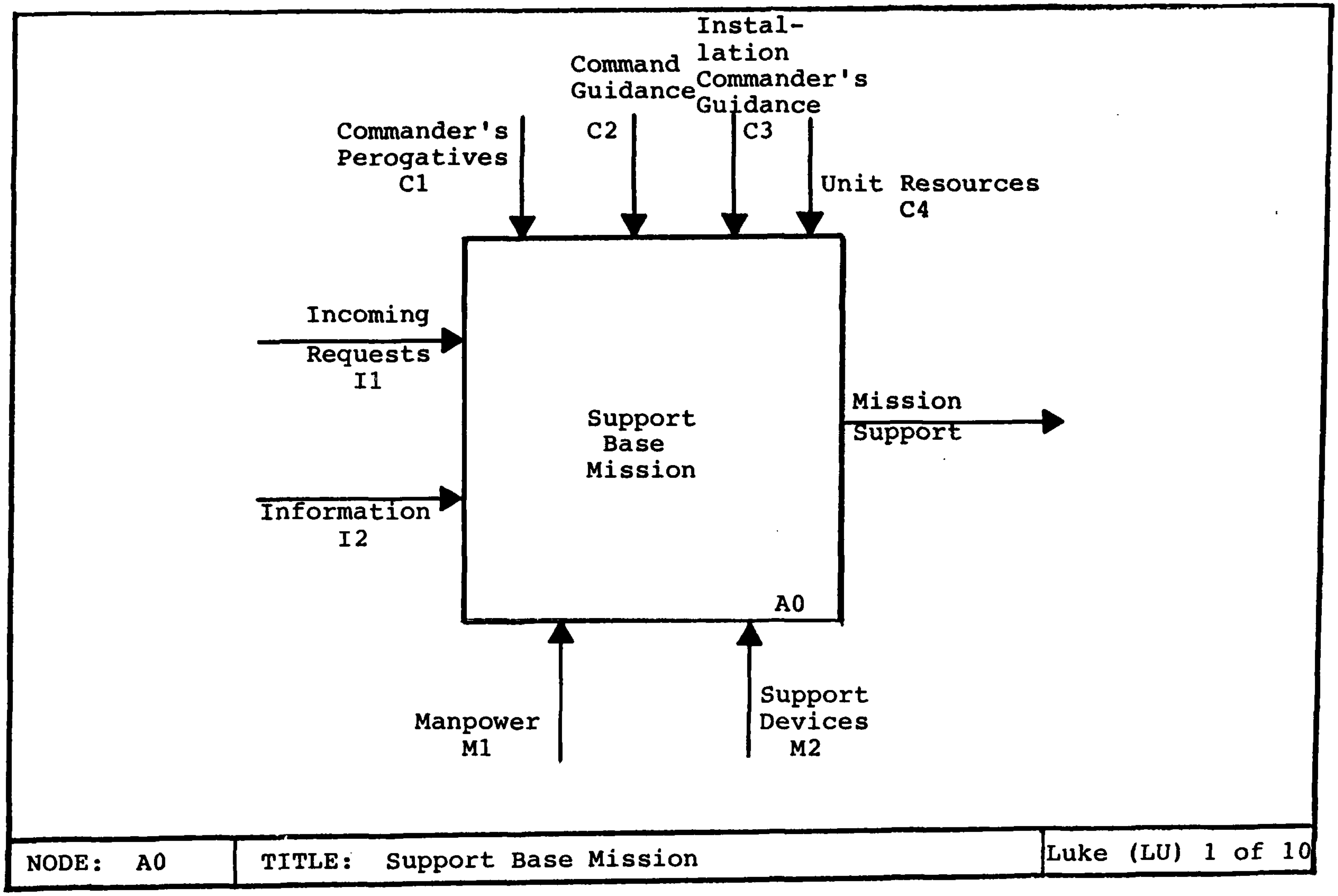


Fig A-1. NODE: A0

A1 Text. The phases involved in supporting the airbase's mission reflect the general approach Civil Engineering takes to decide which work requests will be done, how it will be done, and when. First, the squadron leadership must decide how it is to function. Guidance from the installation commander, as well as, higher headquarters places constraints on what is done and how. As requests are received by the squadron, they must be ranked in order of their priority to the airbase's mission. Next, the work is programmed and scheduled. During this step, the airbase's contract requirements are brought into line with the contract requirements of higher headquarters, and funding is obtained for those projects. The work is done as scheduled, and the work is inspected and evaluated. Part of the evaluation phase is to insure that the work is being done in the most efficient manner possible.

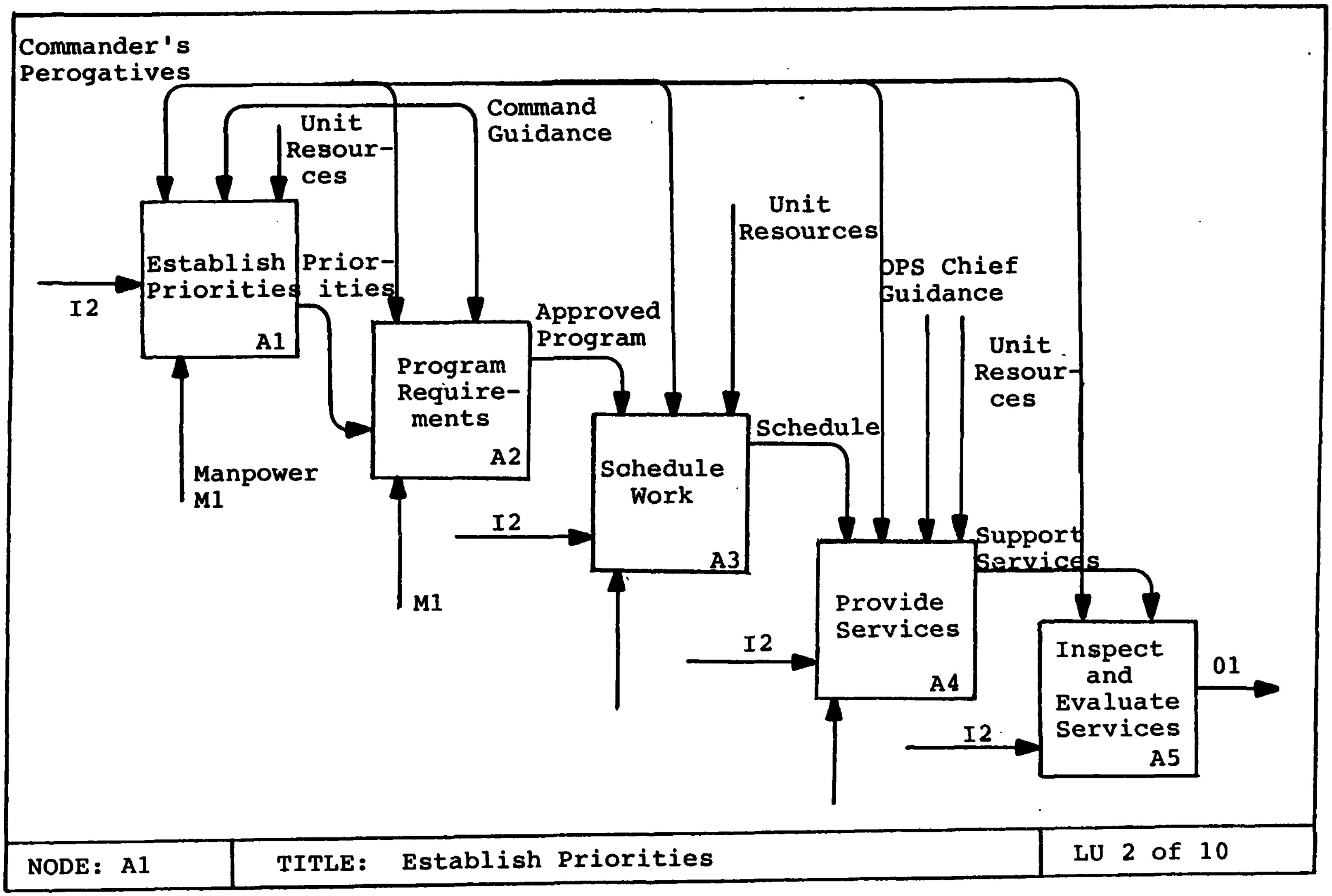


Fig A-2. NODE: A1

All Text. For the most part, Civil Engineering receives its requests for work from base personnel via the Air Force Form 332 or the Service Call Section. Other work is identified by squadron personnel on the AF Form 1135, or is recurring requirements. Once the work request is processed by the Customer Service Unit, the decision to approve the work request is made. This decision is generally made by the Chief, Resources and Requirements using specific guidance from the squadron commander, with inputs from the squadron commander's staff. The inputs from the commander's staff are made during a bi-monthly meeting initiated for the purpose of providing the commander with the information necessary to make an informed decision. Also, the bi-monthly meeting is reserved for determining which request will be disapproved. The disapproval decision is reserved for the squadron commander. Two major constraints on the approval decision is how much time and money is required to do the work. If the work is approved, and the method of accomplishment is to be contract, the project must be approved by the installation's Facility Use Board (FUB). The FUB is attended by the installation's unit commanders. At the FUB, the commanders are briefed on the scope of the contract projects, and are able to make their inputs into those projects before the project is approved. With these inputs into the process, the squadron work priorities are set.

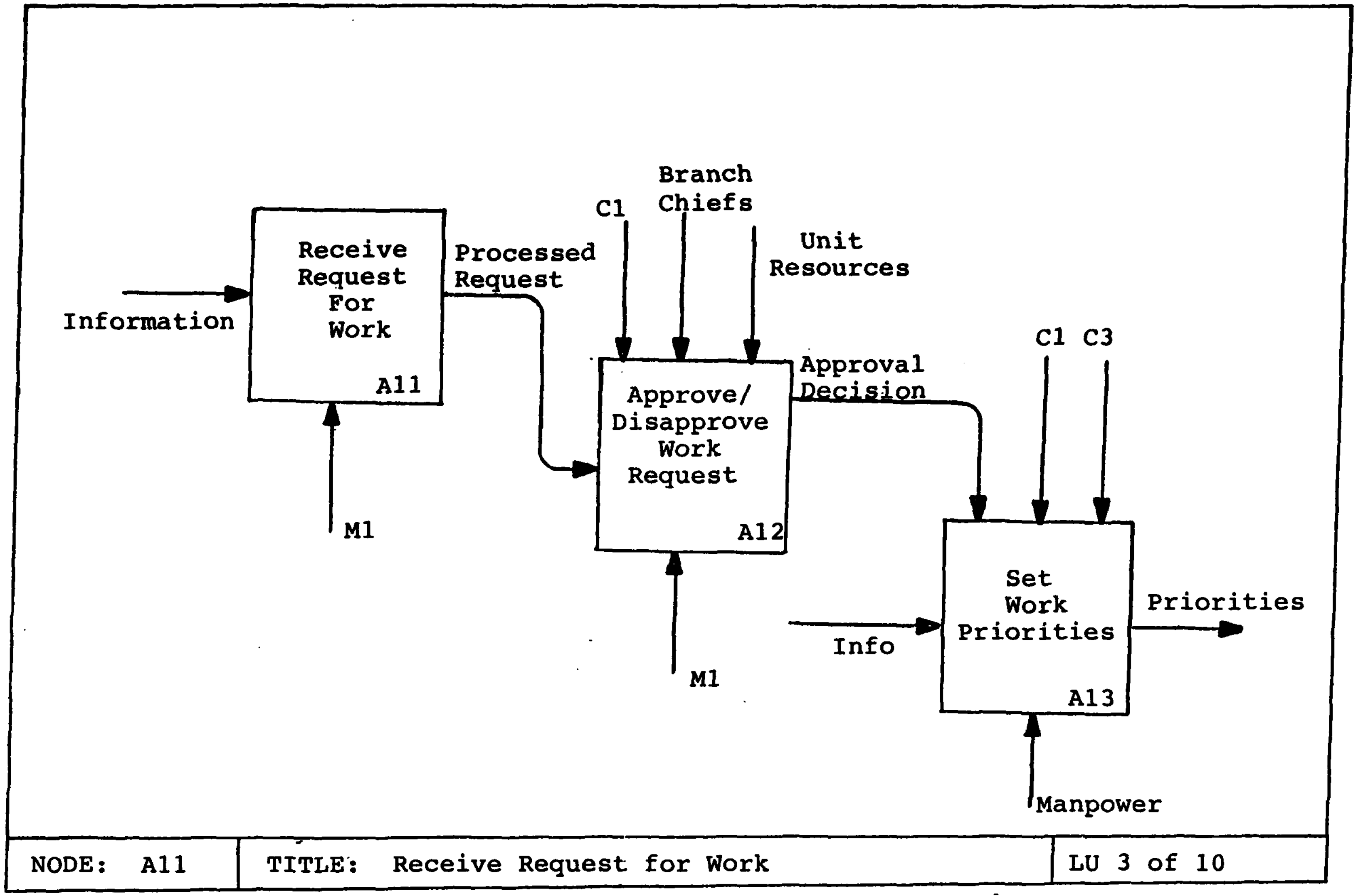


Fig A-3. NODE: A11

A121 Text. The decision to approve a request for work requires three bits of information. The decision maker, in this case the Chief of Resources and Requirements, needs a brief history of the facility, a review of the contract program, and a preliminary design of the project. This information gives the decision maker an idea of the scope of the project, status of the facility, and information concerning future contract projects slated for the facility. This information comes to the decision maker from several sources. The project design usually is done by the Planning unit, and details the scope and cost of the project. The contract program is developed by the Contract Programming Section in the Engineering Branch, and is generally reviewed during the bi-monthly staff meeting used to approve/disapprove work requests. The information regarding the status of the facility is maintained by Resources and Requirements Section personnel. All this information together is used to determine if the work request seeking approval is a legitimate Civil Engineering requirement, or within the scope of Civil Engineering's abilities. If it is determined that a work request should be disapproved, the Chief Resources and Requirements may only recommend disapproval to the squadron commander. Only the squadron commander may disapprove work requests. During the approval phase, a decision is also made as to how the work will be accomplished.

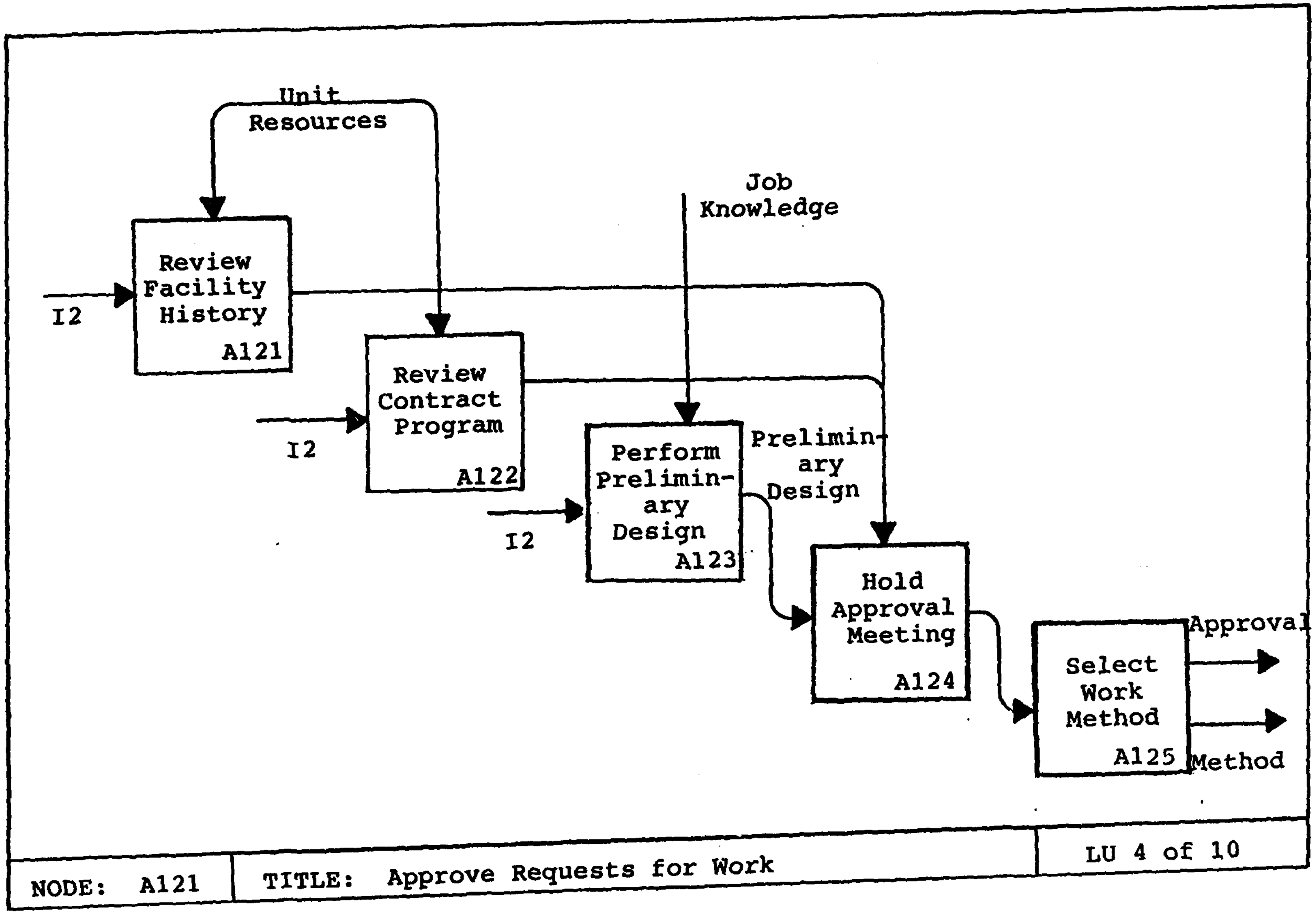


Fig A-4. NODE: A121

A21 Text. Developing the work program for Civil Engineering is a two-track process. In Civil Engineering, work is done by in-service personnel or by contract. The work done in-service is either work requirements identified by base personnel, or is work of a recurring nature that is done as a routine part of the Civil Engineering function, such as utility services or fire protection services. The development of the In-service Work Plan (IWP) and the contract program is a process that is constrained by time, money, and knowledge of the process. Other controls on the process are inputs from higher headquarters and the Installation Commander. This is especially true of the contract program development. Also, the squadron commander maintains an awareness of the operation of the recurring services program, and makes regular inputs into the process.

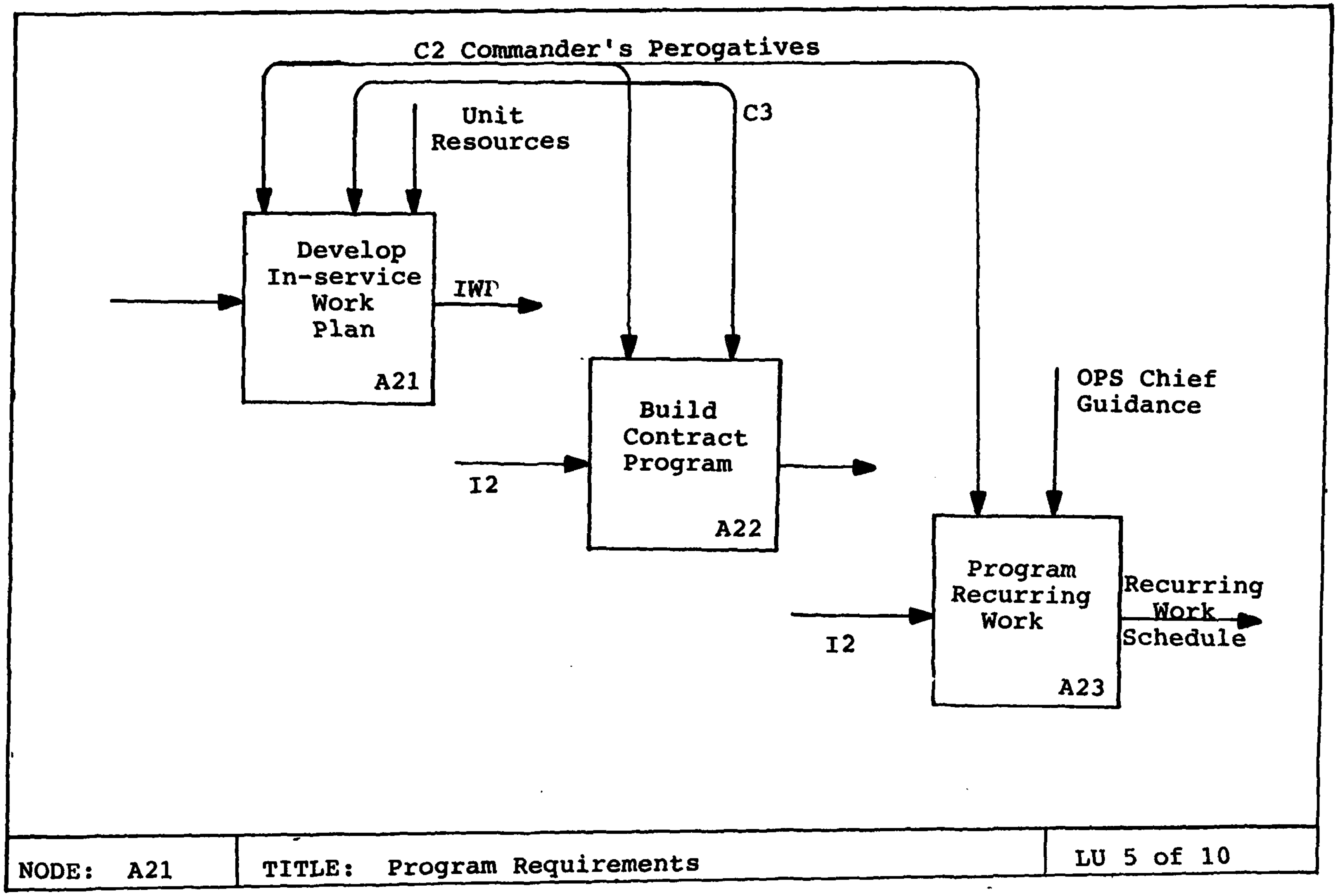


Fig A-5. NODE: A21

A211 Text. The IWP is developed in the Resources and Requirements Section. The main constraint on the process is the level of experience of the personnel developing the plan. The IWP is an optimization process, essentially balancing available funds and manpower with stated requirements. Developing the IWP involves considerable input from the squadron commander and a lesser amount from the installation commander. The IWP is a plan of the next three months in-service work activity, and any inputs made into the plan are simply added into the plan at the most convenient location or as directed. Updating the plan is a continuing process.

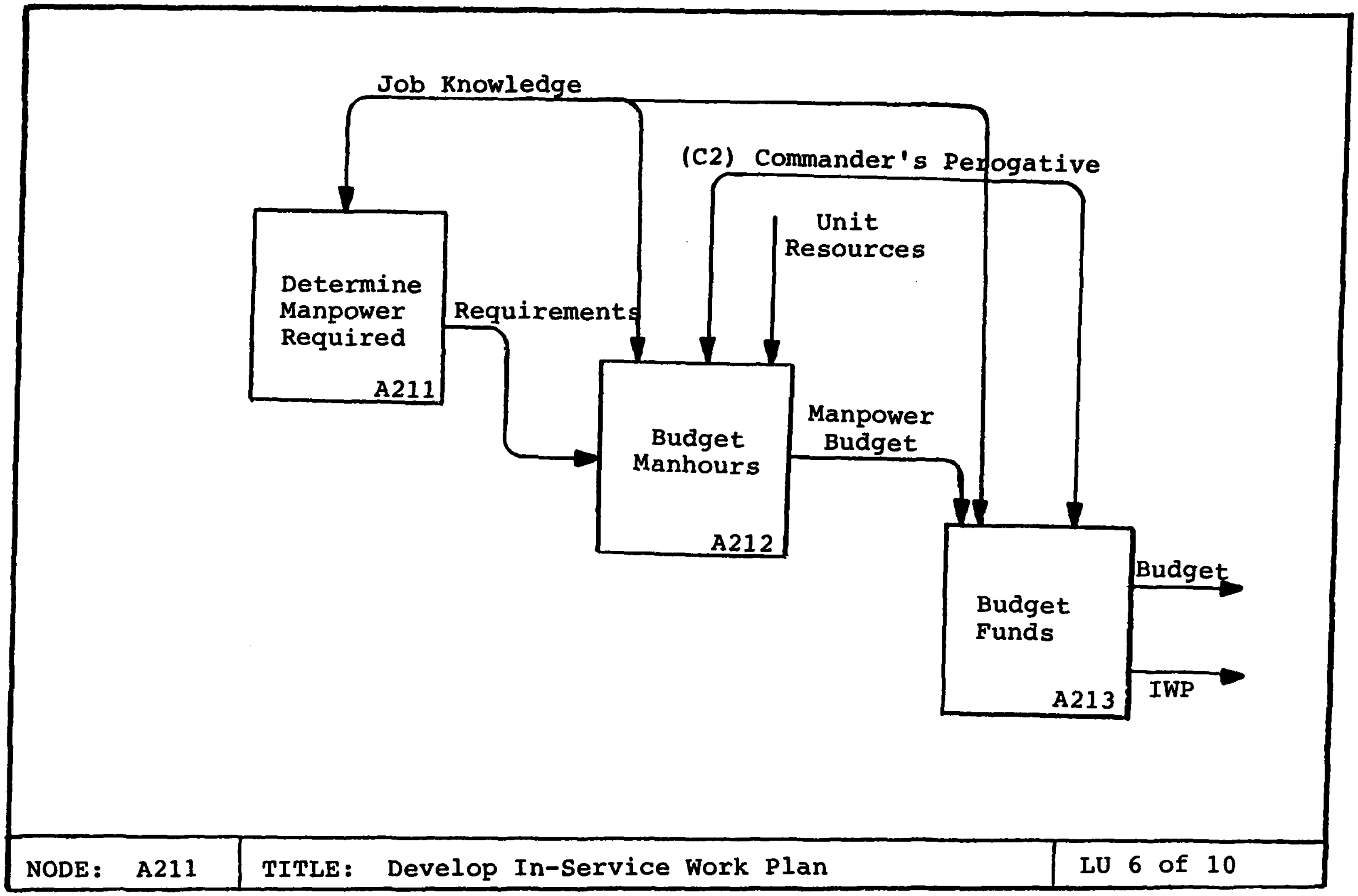


Fig A-6. NODE: A211

A221 Text. The Contract Program is developed in the Engineering Branch, in the Contract Programming Section. There are four main steps in the process. These are: collect requirements, design the projects, build the program in accordance with base priorities, and submit program to higher headquarters for inputs and approval. Building the program is an iterative process, as guidance from local commanders and higher headquarters often forces changes in the program. Changes in the program are disseminated at a weekly meeting held in the Engineering Branch. This meeting is attended by personnel from the Engineering and Operations Branches, the squadron commander, and his deputy. At the end of the process, the Major Command approves the program, and funds either all or a portion of the program. When funding is received, contracts are let.

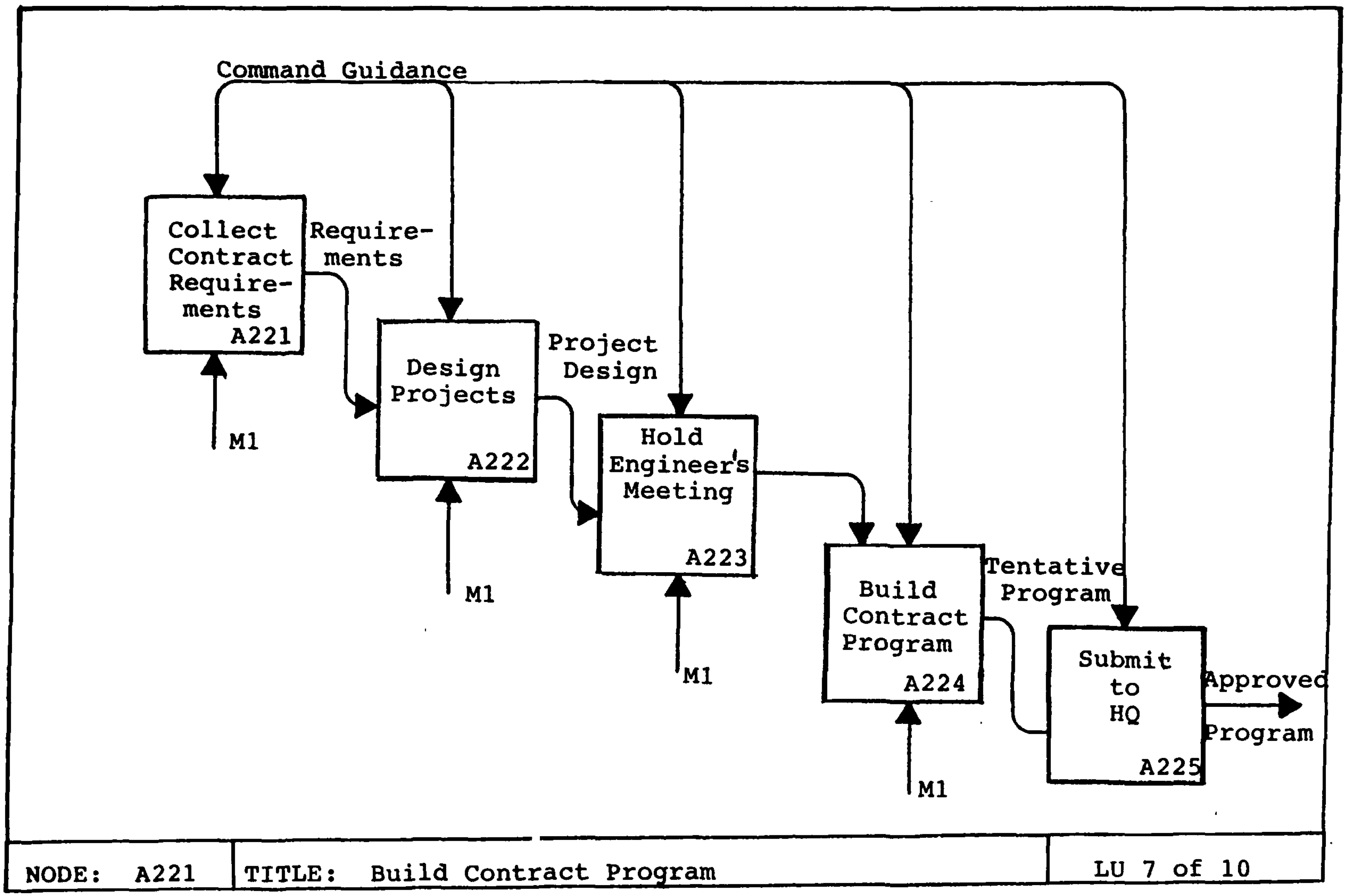


Fig A-7. NODE: A221

A31 Text. The scheduling process is a function of the in-service work program. The schedule is a plan of action enabling the squadron's in-service forces to accomplish the squadron's objectives in support of the airbase's mission. The work schedule for in-service work forces is developed weekly. Materials ordered for a project are verified as available, and a review of available manpower is made. Next, a tentative weekly schedule is made. This schedule is then used to hold a weekly scheduling meeting to finalize the schedule. The meeting is held in the Operations Branch, and is attended by the branch chief, Resources and Requirements personnel, superintendents and shop foremen. Together, any problems in the schedule for the upcoming week or the past week are discussed and solved. The scheduling function is an ongoing process for the Operations Branch.

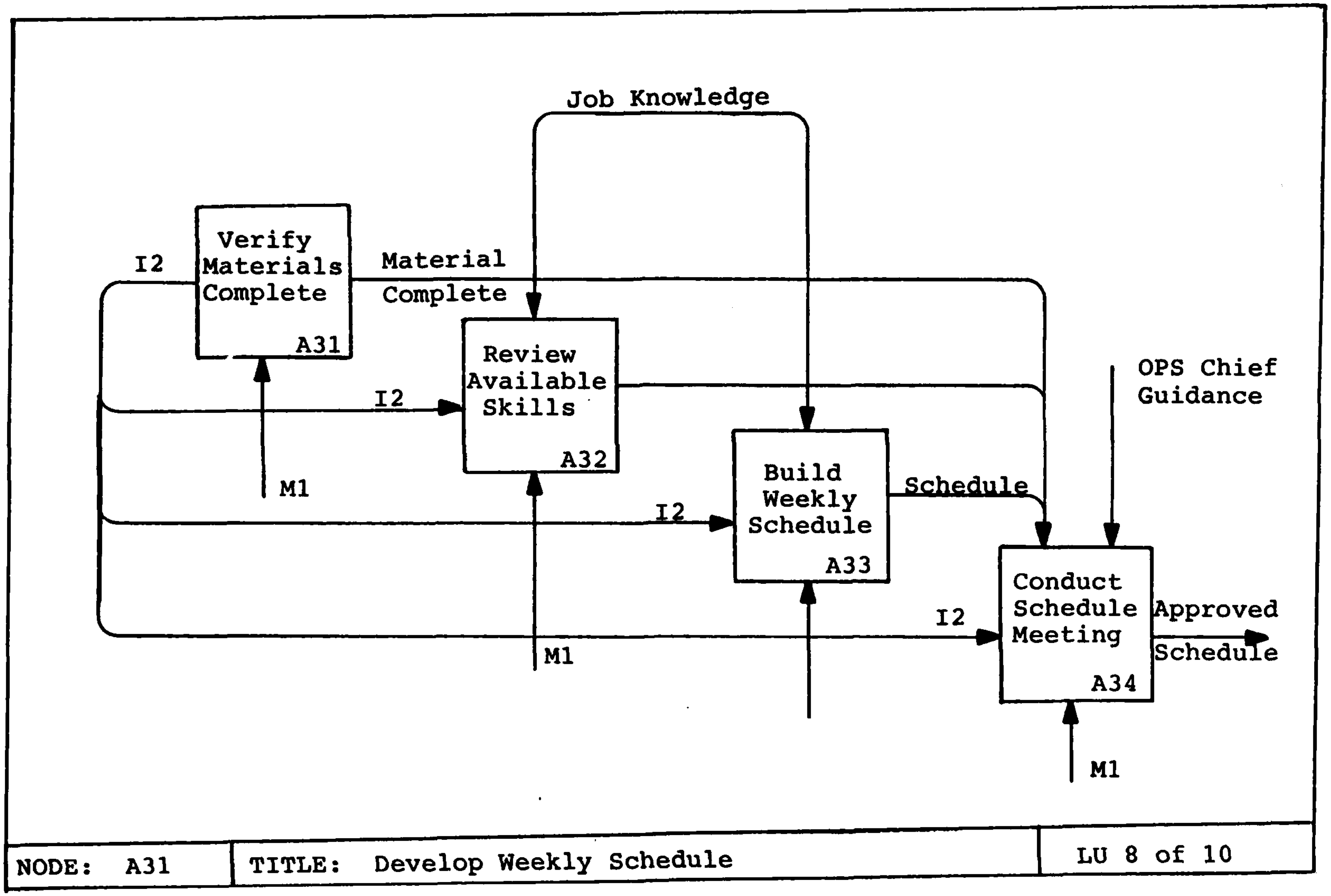


Fig A-8. NODE: A31

A41 Text. Civil Engineering has basically three methods of accomplishing its work. These are job order, work order, or contract. Job orders are used for jobs that do not require extensive planning. Usually, requests coming into the Service Call Unit are handled by job order. Work orders are used for all other in-service work. One time requests are handled on normal work orders, while recurring work is usually done on collection work order. The other productive work is done by contract. The Operations Branch handles in-service work, while the Engineering Branch handles contract projects. Both branches operate with guidance from the squadron commander, and at times, the Installation Commander.

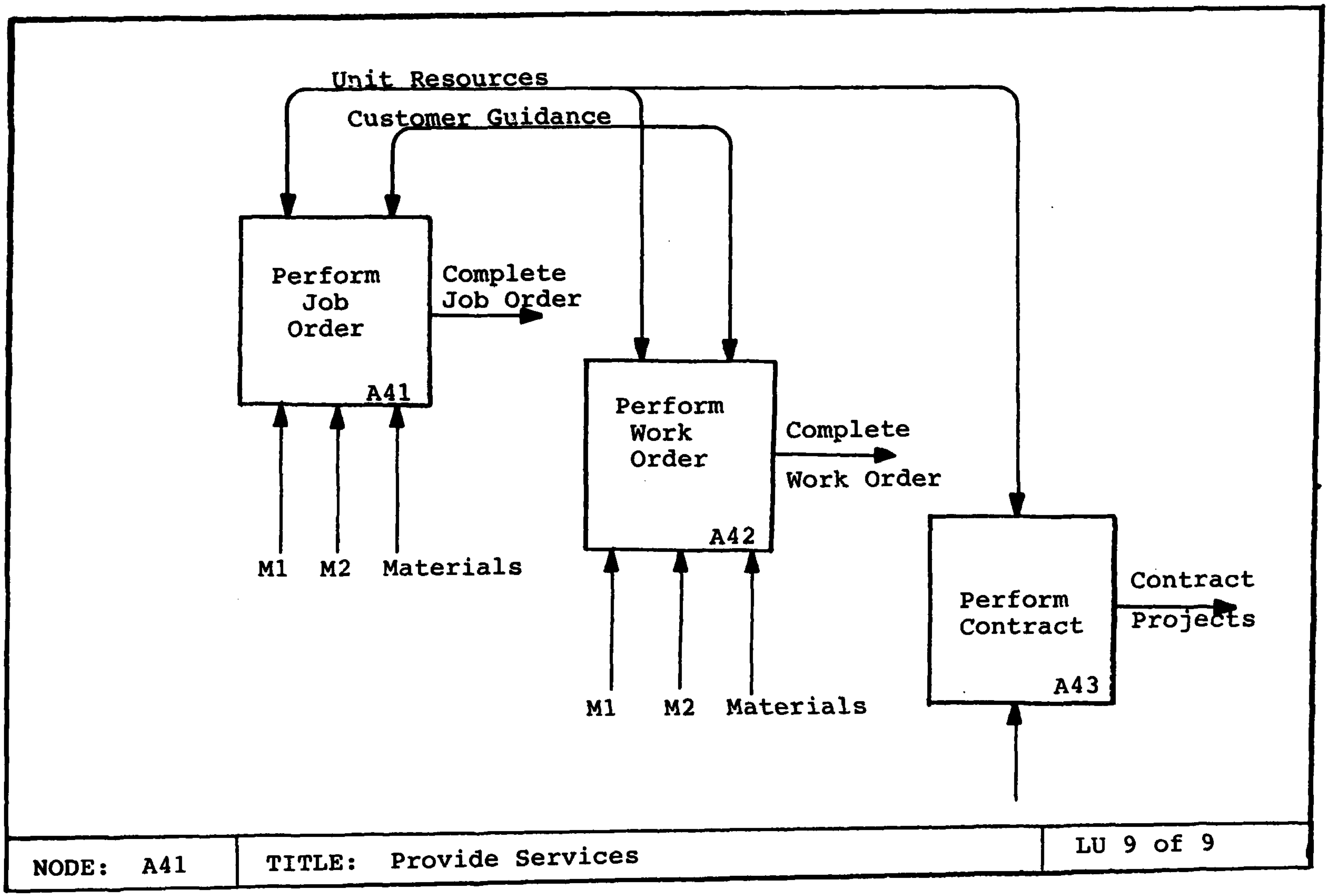


Fig A-9. NODE: A41

A51 Text. After Civil Engineering personnel accomplishes a project it is inspected. The inspections are handled two ways. Contract work is inspected by the Contract Management Section of the Engineering Branch. This section monitors contractor's progress when performing contract work. For in-service work shop foremen are responsible for inspecting any work performed by their personnel. Finally, periodically analysts from the Industrial Engineering Branch will review procedures and policies of squadron units to insure that work is being done as efficiently as possible.

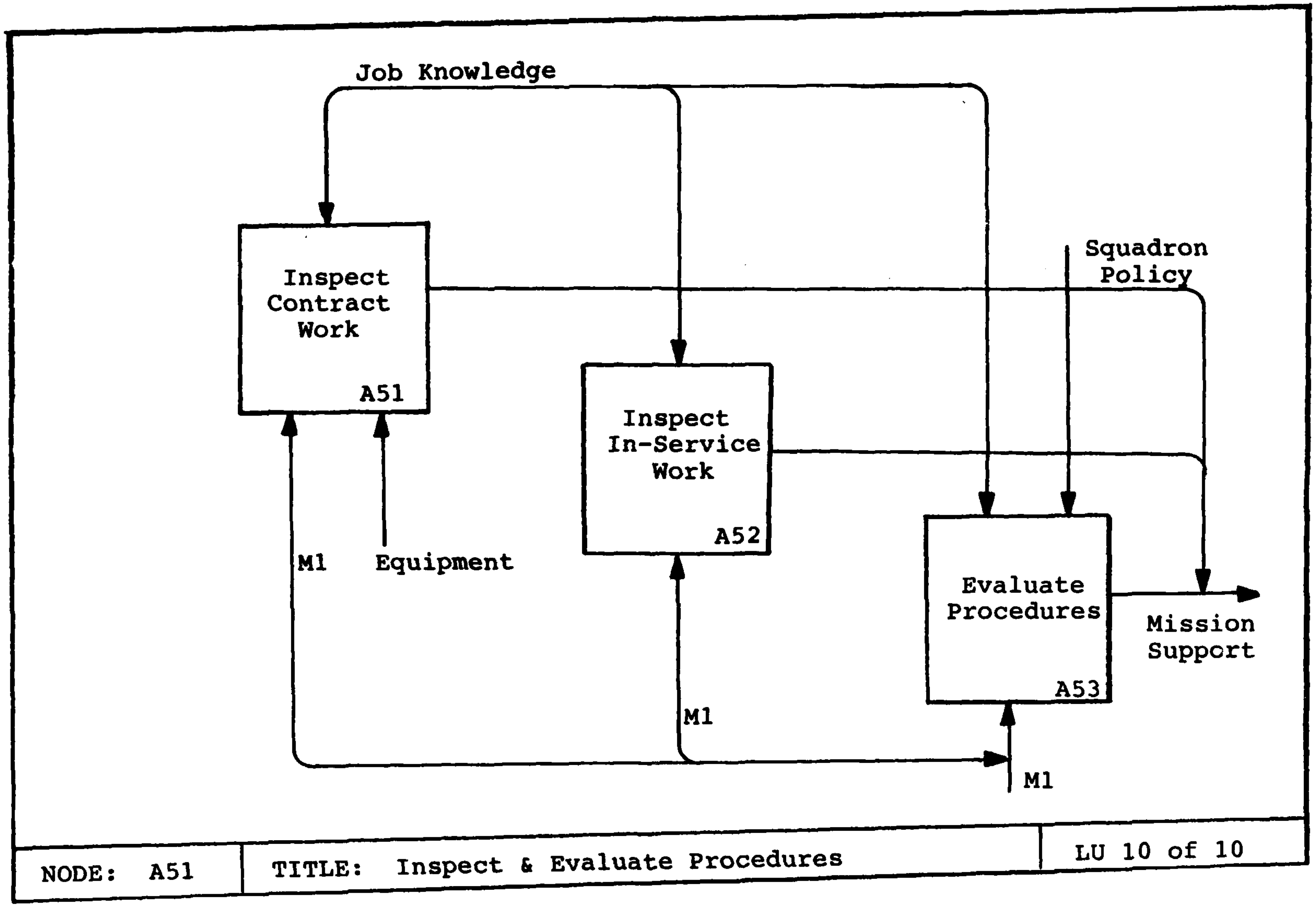


Fig A-10. NODE: A51

APPENDIX B

IDEF$_0$ MODEL: MISAWA AB, JAPAN

NODE INDEX: MISAWA AB, JAPAN

- AO Support Base Mission
  - A1 Establish Priorities
    - A11 Receive Requests for Work
    - A12 Approve/disapprove Requests
      - A121 Review Facility History
      - A122 Review Contract Program
      - A123 Perform Preliminary Project Design
      - A124 Select Method of Accomplishment
    - A13 Set Work Priorities
  - A2 Program Requirements
    - A21 Develop In-Service Work Plan
      - A211 Determine Manpower Requirement
      - A212 Budget O&M Funds
      - A213 Budget Manpower/Skills
    - A22 Develop Contract Program
      - A221 Collect Contract Requirements
      - A222 Design Projects
      - A223 Build Installation Contract Program
      - A224 Submit Program to Higher Headquarters
    - A23 Program Recurring Work/Services
  - A3 Schedule Work
    - A31 Verify Materials Complete
    - A32 Verify Skills Available
    - A33 Build Tentative Weekly Schedule
  - A4 Provide Services
    - A41 Perform Job Order
    - A42 Perform Work Order
    - A43 Perform Contract Work
  - A5 Inspect and Evaluate Work
    - A51 Inspect Contract Work
    - A52 Inspect In-Service Work
    - A53 Evaluate Procedures

A0 Text. Mission requirements and support capability form the basis for the mission support provided by Civil Engineering. The Base Civil Engineer is responsible for insuring that his staff work closely together to develop the plans and programs to best support the squadron objectives. The Installation Commander, and the Major Command provide input into this process as required. Resources, such as men, materials, equipment and funding determine the squadron's ability to function properly, and support the mission of the airbase.

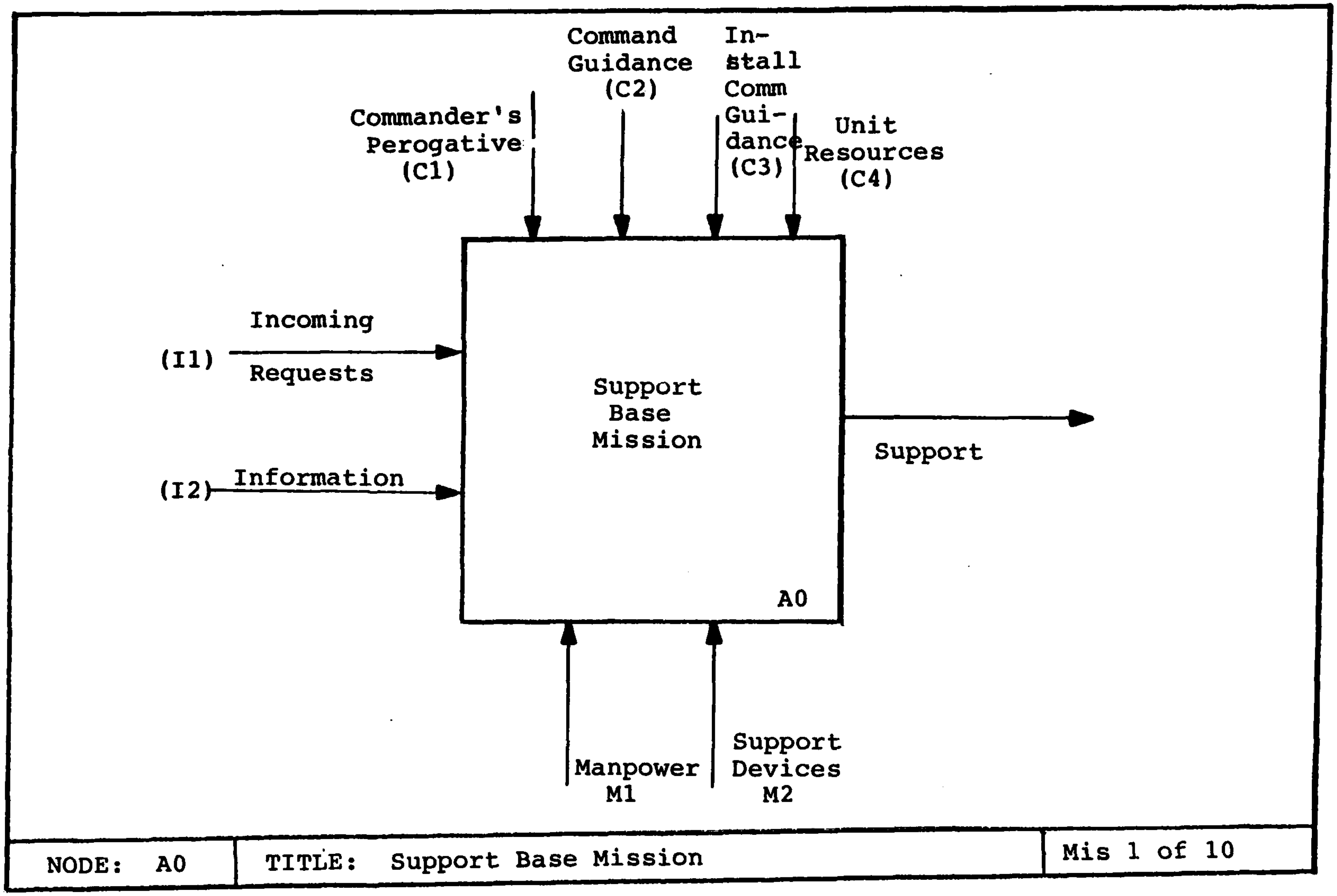


Fig B-1. NODE: A0

A1 Text. There are five phases involved in supporting the mission of the airbase. These phases reflect the general approach to management. First, the squadron leadership must decide on its priorities. Here, guidance from the Installation Commander and his staff is important. Also, the Major Command makes some inputs into the decision of what will be done, and how it will be done. Next, the work must be programmed. It is during this step that the requirements of the airbase are brought into line with those of higher headquarters, and funding is obtained for those projects that will be accomplished. Scheduling is the next step. After the schedule is complete, the work is done and inspected. Finally, an evaluation of squadron procedures and policies is done periodically to insure that the work is being done in the most efficient manner.

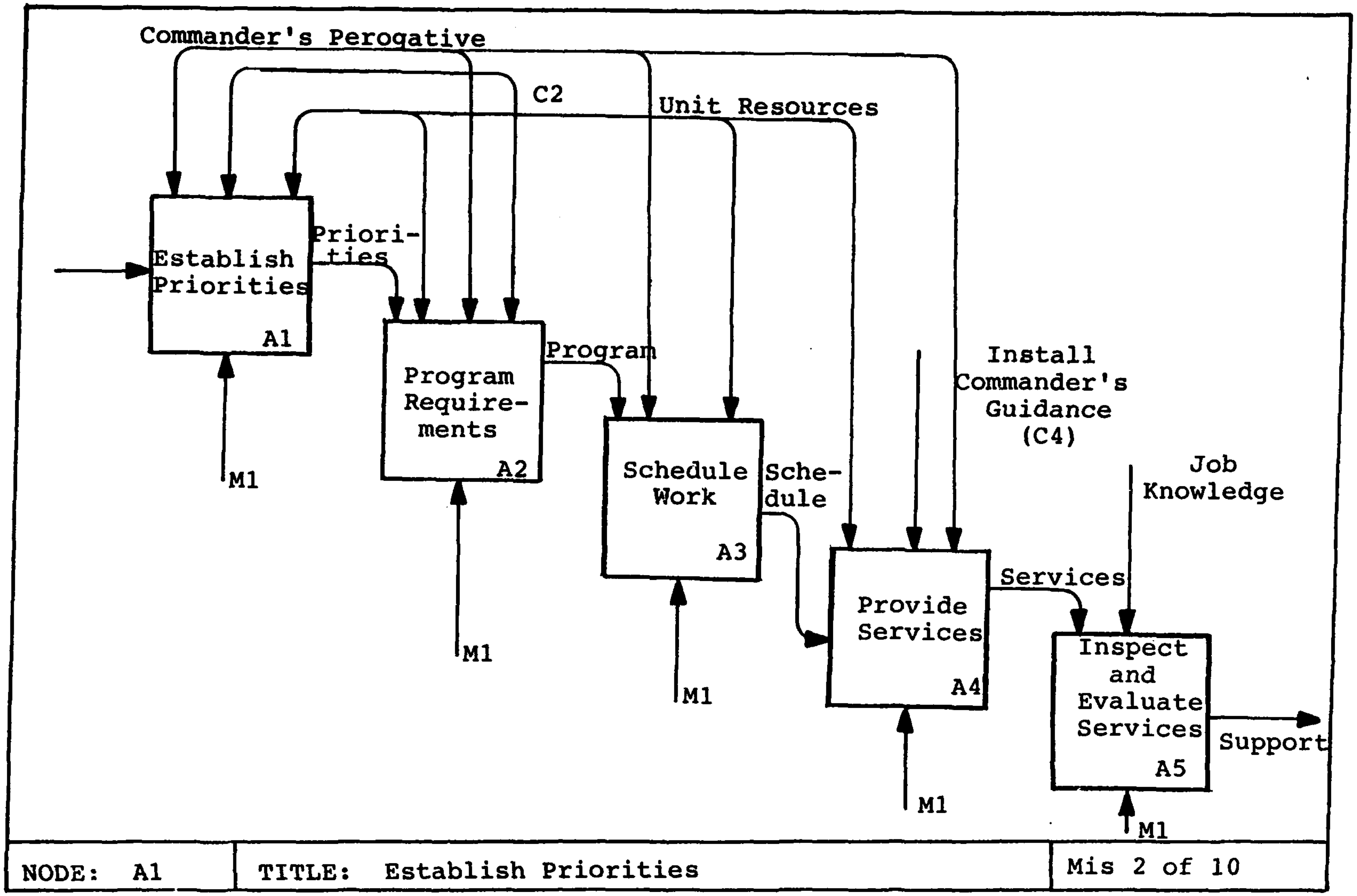


Fig B-2. NODE: A1

AD-A135 004 BASE CIVIL ENGINEER ORGANIZATION: STANDARDIZED VERSUS FLEXIBLE(U) AIR FORCE INST OF TECH WRIGHT-PATTERSON AFB OH SCHOOL OF SYSTEMS AND LOGISTICS E S TAYLOR SEP 83

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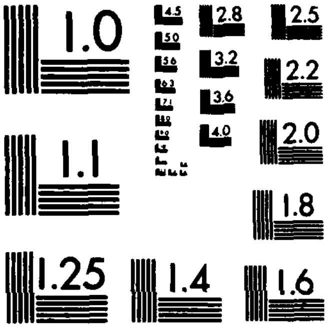

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

All Text. The process of setting priorities begins with the identification of airbase requirements. These requirements are usually submitted to Civil Engineering on the AF Form 332 or are inputted through the Service Call Section in the Operations Branch. Other requirements are identified by squadron personnel on the AF Form 1135, or are recurring requirements. The requirements, or work requests, are processed in the Customer Service Unit and a decision to approve or disapprove the request is made. The approved requests are then ranked in order of their importance to the airbase's mission. The approval decision and the ranking of the requests is done with the overall interests of the base in mind, while remaining sensitive to the personalities and other intangibles involved.

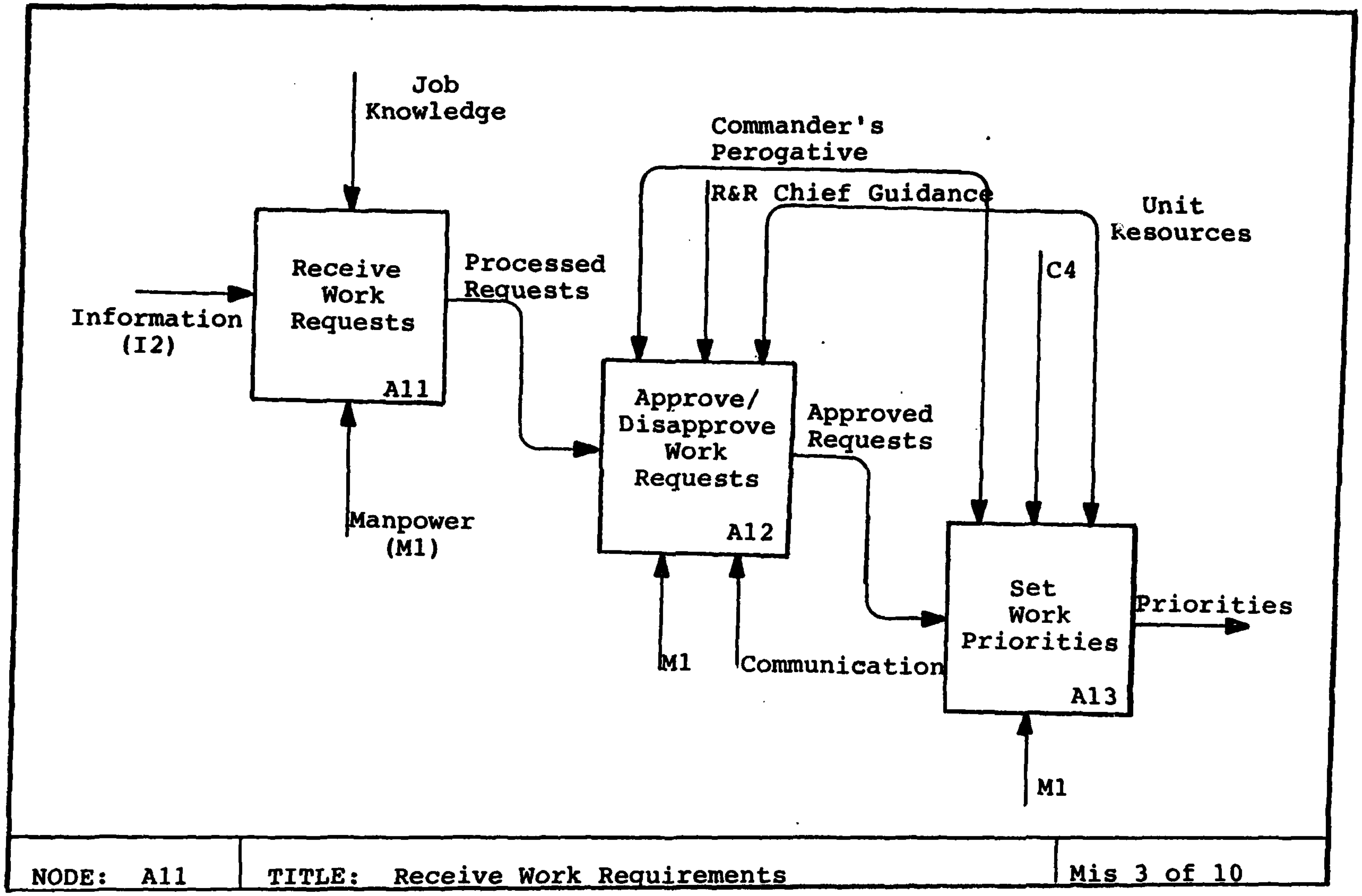

Fig B-3. NODE: A11

A121 Text. The decision to approve or disapprove a work request is made by the Chief, Resources and Requirements Section, with guidance from the squadron commander when necessary. In order to make the decision, three steps must be performed. First, the history or past uses of the involved facility must be reviewed. This gives the decision maker an idea of the status of the facility, and the type of work or users the facility has had in the past. Next, the decision maker must review the contract program to insure that no conflicting work is planned for the facility. The contract program is maintained in the Engineering Branch. Finally, the Chief Resources and Requirements must have a preliminary design of the work project. The design provides some insight into the scope of the project, and an estimated cost and manhour projection. With this information the Chief, Resources and Requirements can determine if the request is a Civil Engineering responsibility, whether it is within the scope of Civil Engineering, and how the work can be accomplished. It is during this last step that a decision is made to do the work by job order, work order, or by contract.

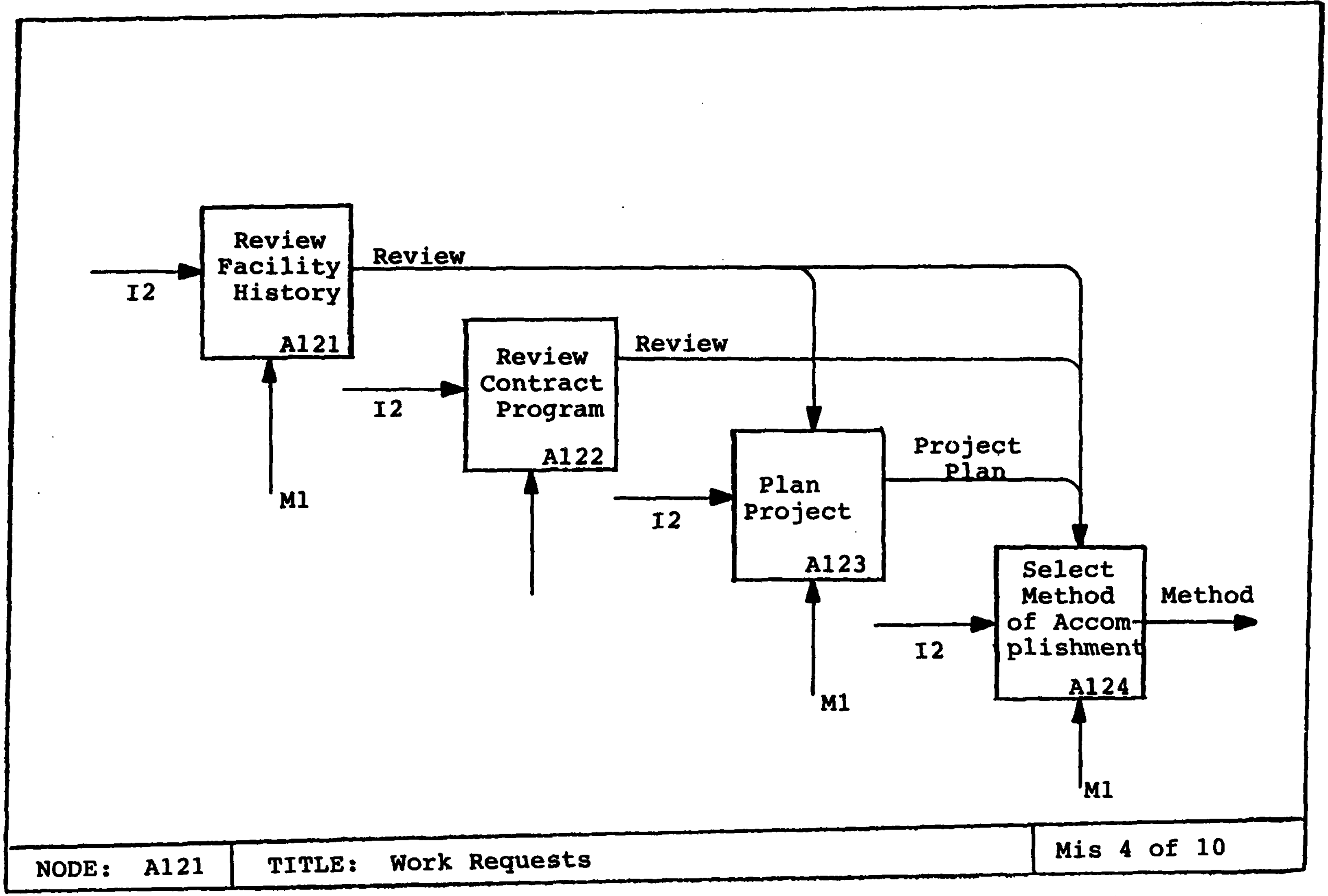

Fig B-4. NODE: A121

A21 Text. Developing the work program for Civil Engineering is a two-tract process. Work is either done as a contract project, or by in-service personnel. Work done in-service is either work requirements identified by base personnel, or are recurring requirements such as utility services and fire protection services. Those non-recurring requirements are programmed via the In-service Work Plan (IWP). The IWP is a plan of the next three future months work projects to be performed by Civil Engineering work forces. The IWP is developed in the Operations Branch, by Production Control Center personnel. The contract program is developed in the Engineering Branch, and is composed of those requirements identified by the Major Command and local commanders as being of the most importance to the airbase.

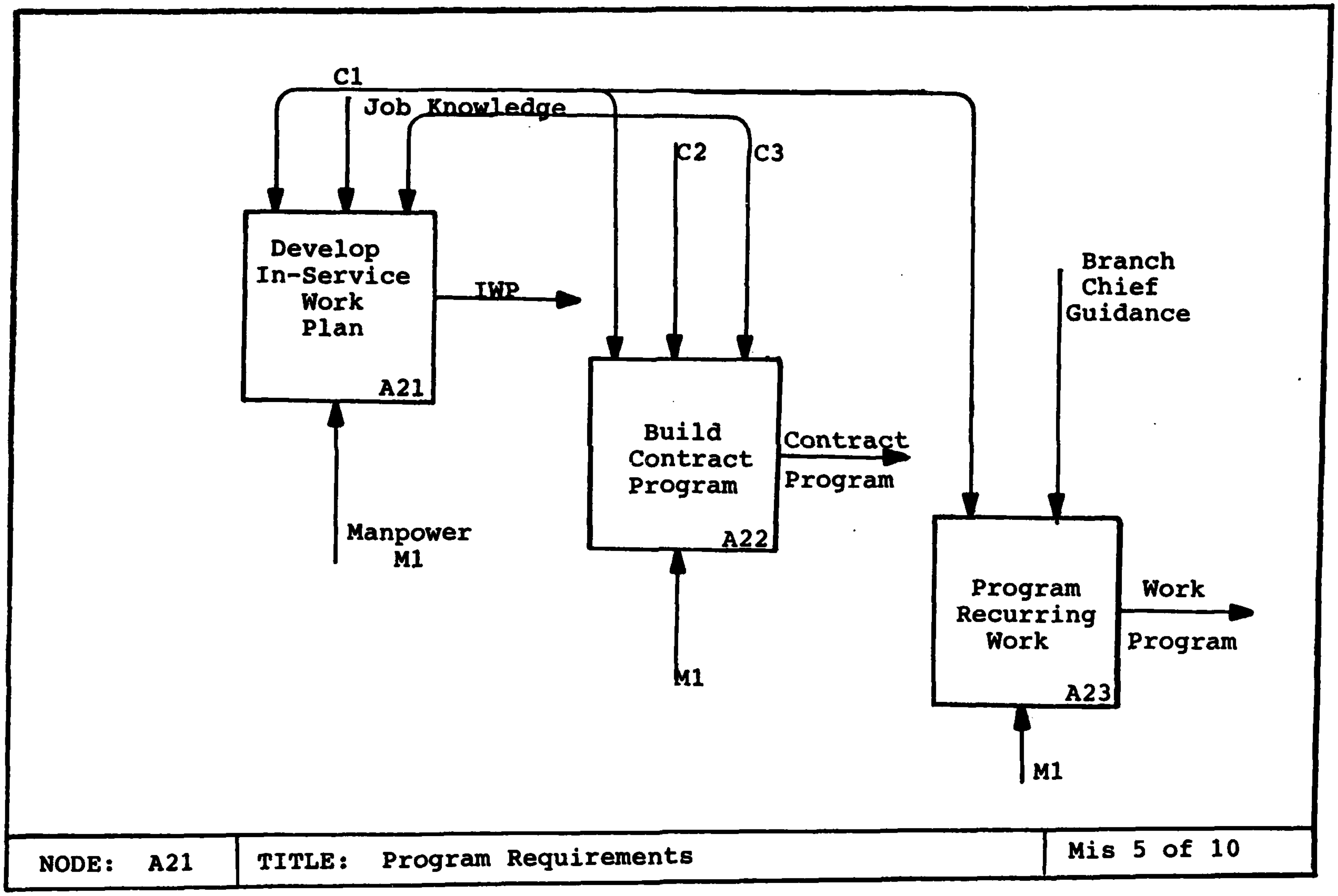

Fig B-5. NODE: A21

A211 Text. Developing the In-service Work Plan (IWP), is constrained mainly by the knowledge and experience of the personnel developing it. The IWP is developed by Resources and Requirements personnel. Though the squadron commander has the option to make inputs into the process, the IWP is developed with only minimal guidance from the squadron commander, and is developed in accordance with the priorities established by the squadron hierarchy. The process resembles an optimization process that seeks to balance available manpower and funds in order to accomplish those requirements identified as most important. A further constraint on the process is the degree of supply support the squadron receives. This is because a requirement is not included in the plan until all material necessary to complete the job are on hand.

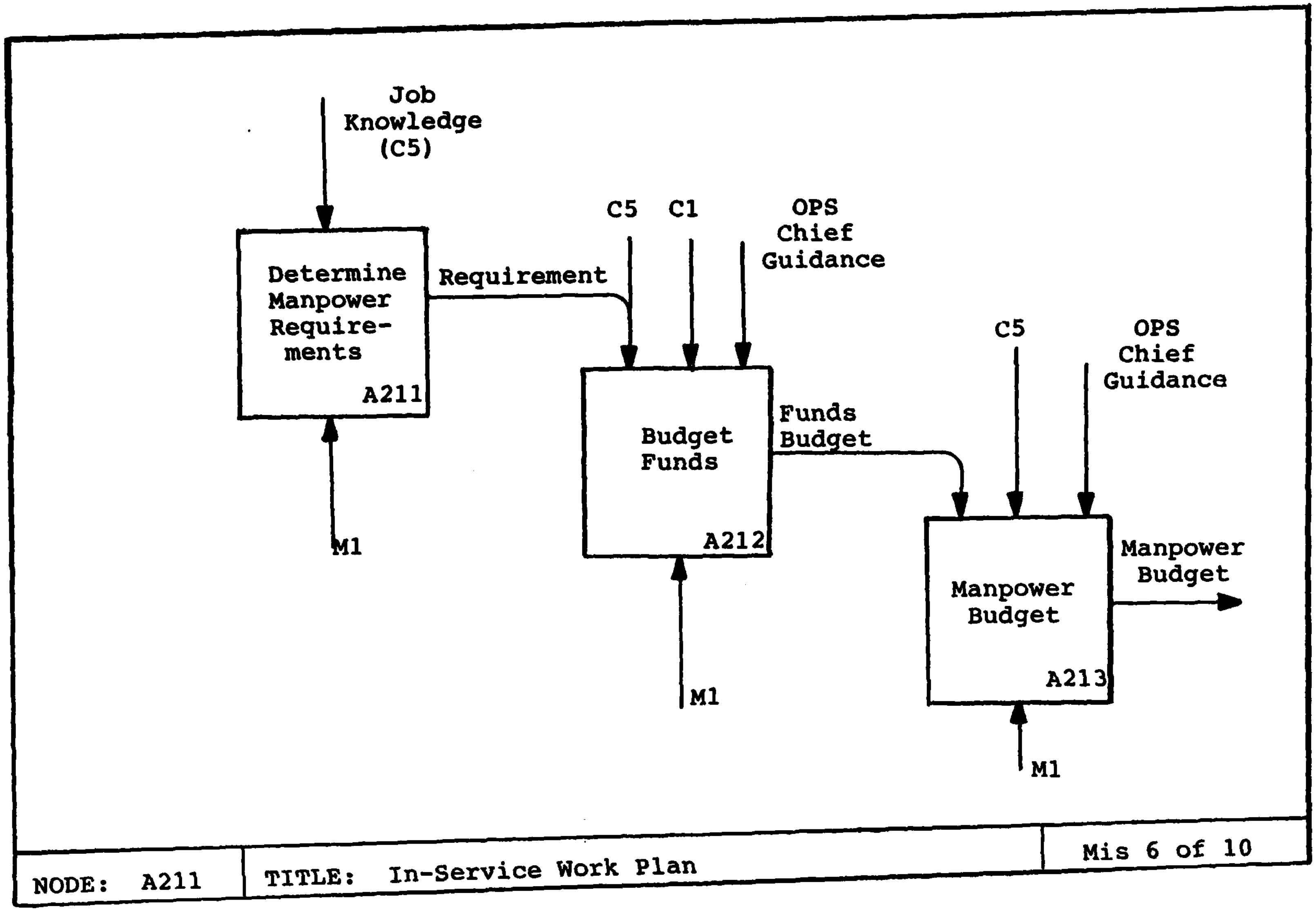

Fig B-6. NODE: A211

A221 Text. Building a contract program is an iterative process performed by personnel in the Contract Programming Section of the Engineering Branch. Essentially, contract requirements are collected, priorities established, and preliminary designs are done so as to define the scope and cost of the project. At this point, a tentative program of contract projects is developed according to guidance from higher headquarters and local commanders. The tentative program is then submitted to the Facility Use Board (FUB) for local approval. Finally, the contract program is submitted to the Major Command for approval. The Major Command will make any changes in the contract program is deems necessary, and will then approve and fund the program. The funding levels may or may not be enough to complete the entire program. As the contract program is funded, contracts are let to complete the work.

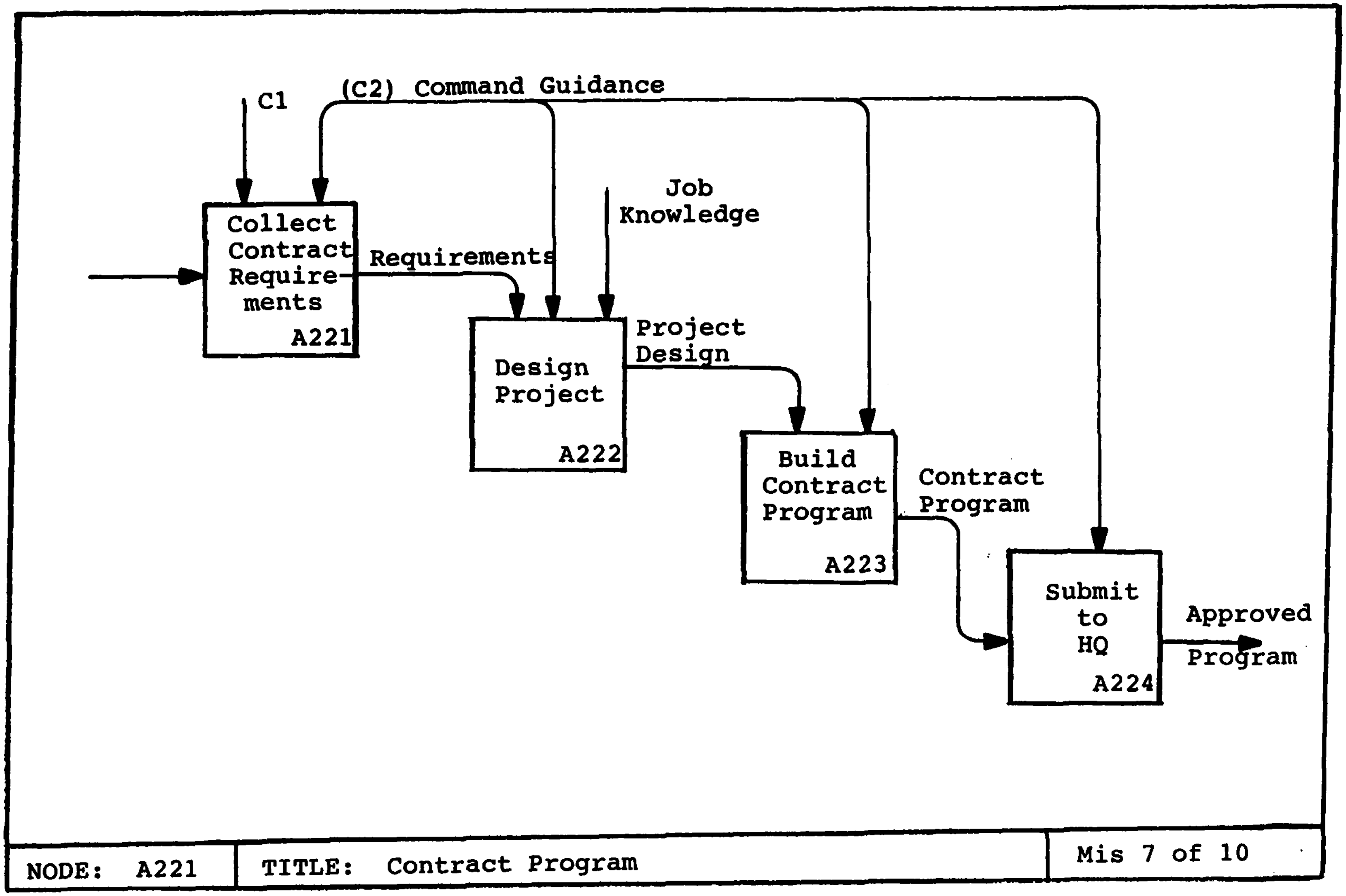

Fig B-7. NODE: A221

A31 Text. The scheduling process is basically a function of the in-service work program. The schedule is a weekly plan of action for the squadron as it attempts to provide support to the airbase's mission. The scheduler must verify that the materials are available to do the work, and then will review available manpower to insure that requisite skills are available. A tentative schedule is then developed, and this schedule is used to hold a scheduling meeting to build a final work schedule. This scheduling process is done entirely in the Operations Branch. The scheduling meeting includes the Operations Chief, Resources and Requirements Section personnel, superintendents, and shop foremen.

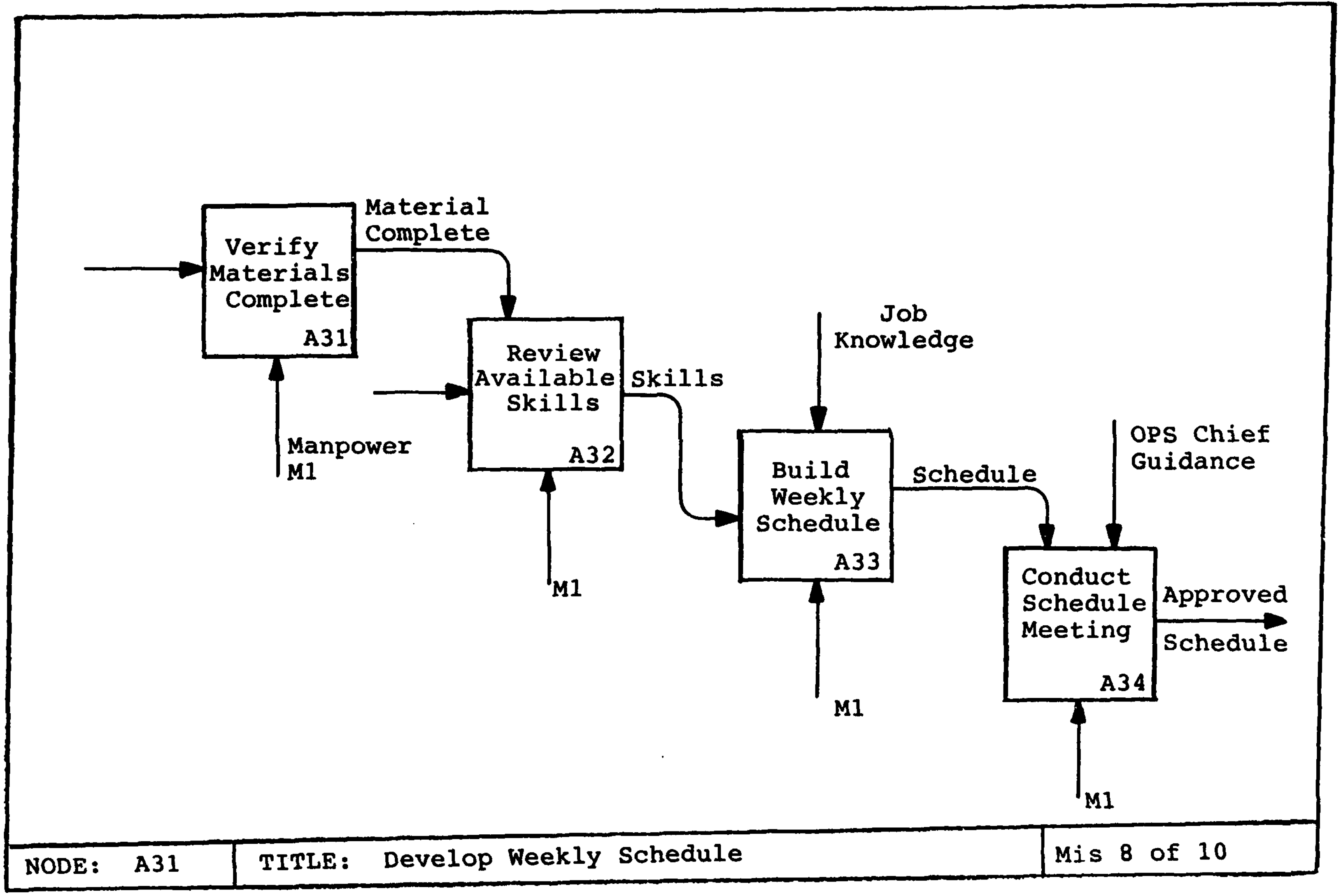

Fig B-8. NODE: A31

A41 Text. Civil Engineering has basically three ways to accomplish its work. These are job order, work order, and contract. Generally, job orders are used for small jobs that do not require extensive planning. Usually, requests coming into the Service Call Section are handled this way. Work orders are used for all other in-service work. One time requests are handled on normal work orders, while recurring work is handled on collection work orders. The other productive work is done by contract. The in-service work comes under the guidance of the Chief, Operations Branch, while the contract work comes under the guidance of Chief, Engineering Branch.

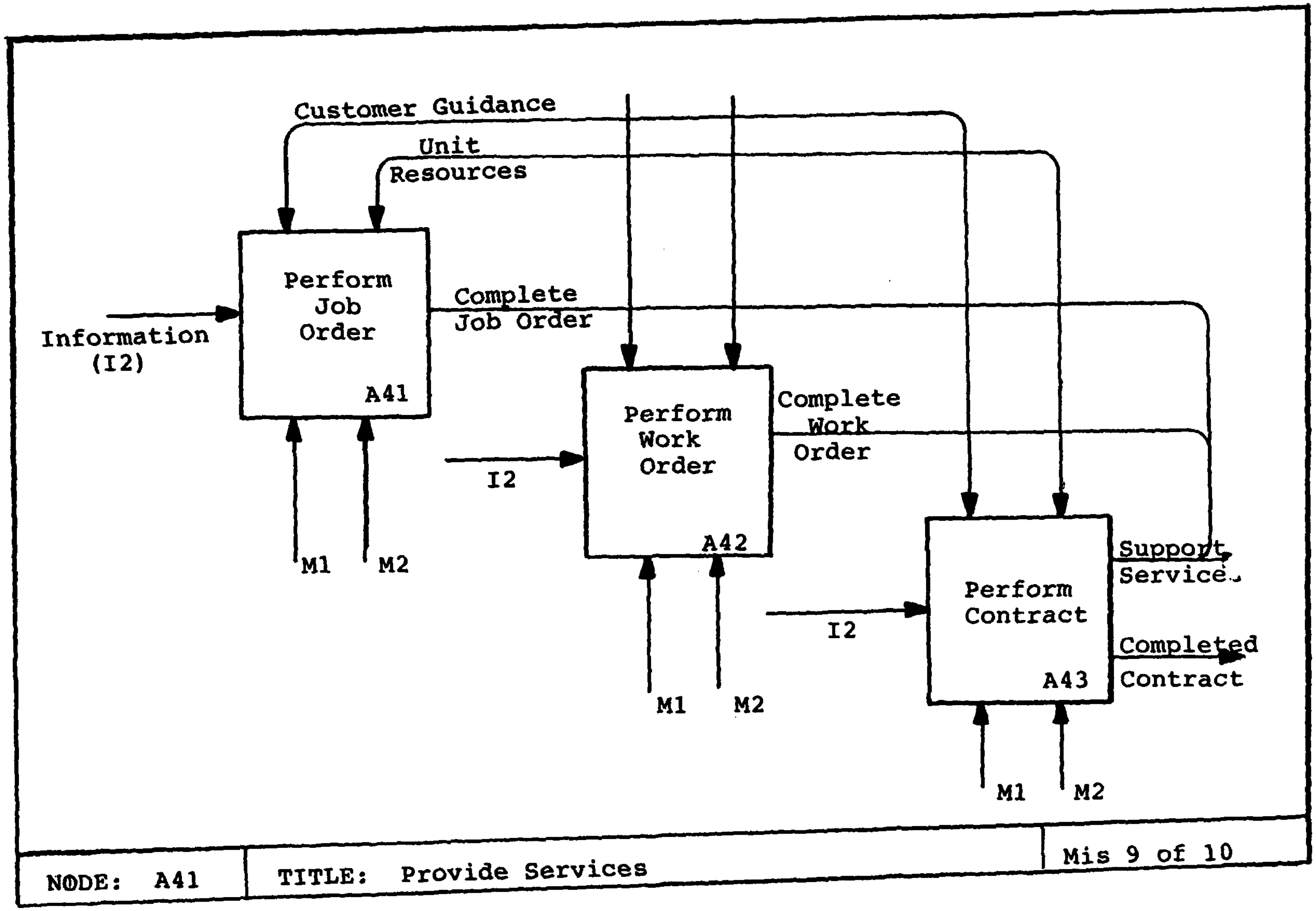

Fig B-9. NODE: A41

A51 Text. After Civil Engineering personnel accomplishes a project it is inspected. The inspections are handled two ways. Contract work is inspected by the Contract Management Section of the Engineering Branch. This branch monitors contractors' progress when performing contract work. For in-service work the shop foreman is responsible for inspecting any work performed by Civil Engineering personnel. Finally, periodically, analysis from the Industrial Engineering Branch will review procedures and policies of squadron units to insure that the procedures are the most efficient alternatives.

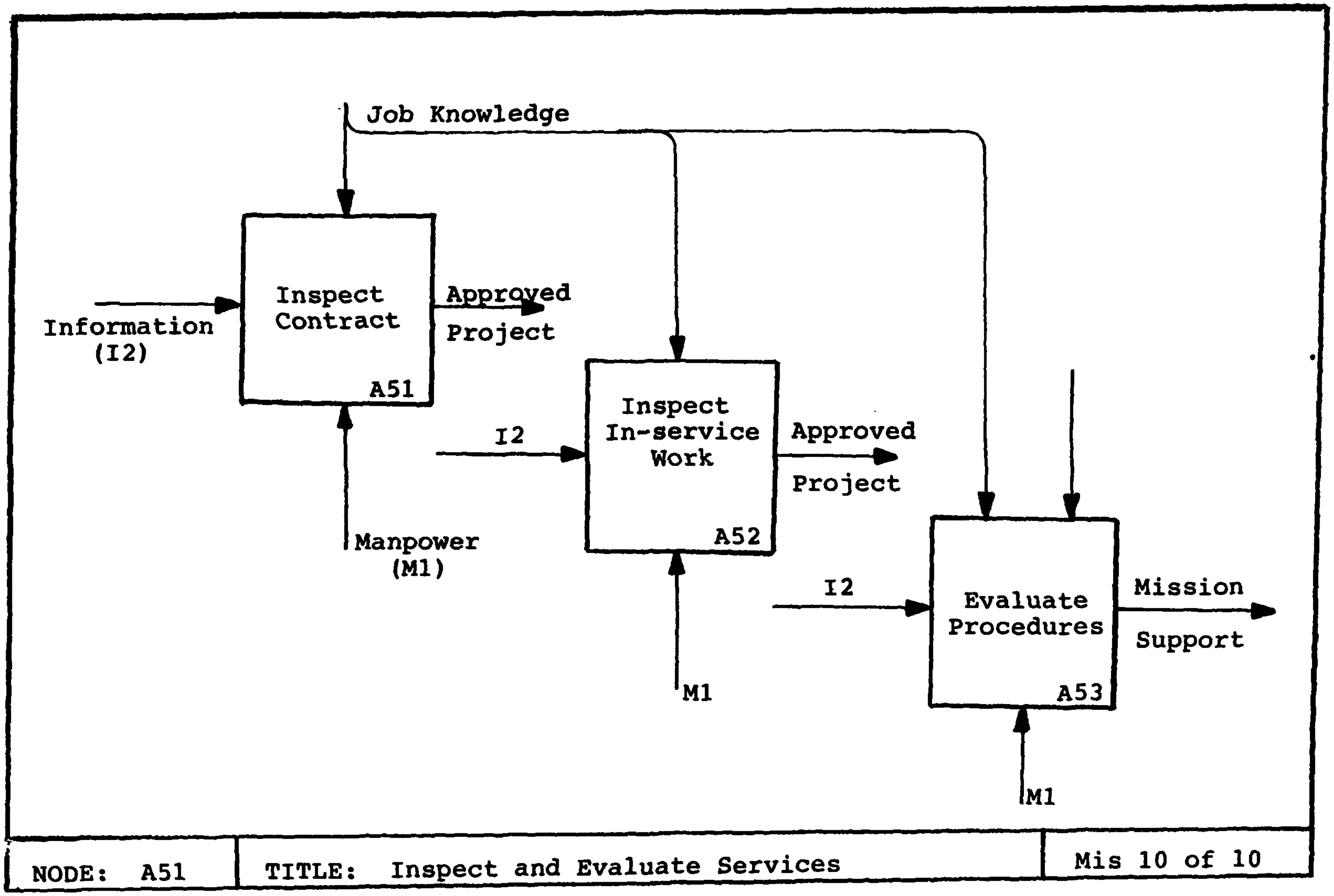

Fig B-10. NODE: A51

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