DECISION SUPPORT SYSTEMS AND THE ARMY CHAPARRAL/VULCAN AIR DEFENSE BATTALION

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Decision support systems offer tremendous opportunities for improving organizational decision-making and resource management. One area for potential use of such computer aids is at the Army battalion level. In an attempt to create interest in the possible uses and benefits of such decision support system applications, this report analyzes the organization and operation of the Chaparral/Vulcan Air Defense Battalion.

Three examples of administrative applications of decision support systems

DECISION SUPPORT SYSTEMS AND THE ARMY

CHAPARRAL/VULCAN AIR DEFENSE BATTALION

APPROVED:

Charles C. Holt

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This paper is dedicated to my wife, Barbara,

for her love, patience, and understanding

during the course of my studies.

DECISION SUPPORT SYSTEMS AND THE ARMY CHAPARRAL/VULCAN AIR DEFENSE BATTALION

by

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ABSTRACT

Decision support systems offer tremendous opportunities for improving organizational decision-making and resource management. One area for potential use of such computer aids is at the Army battalion level. In an attempt to create interest in the possible uses and benefits of such decision support system applications, this report analyzes the organization and operation of the Chaparral/Vulcan Air Defense Battalion.

The fact that officers are responsible for hundreds of personnel, millions of dollars worth of equipment and supplies, and countless files of paperwork demonstrates the need for computer assistance. A review of organizational decision-making and the history of decision support systems lays the foundation for the study of this unit.

The internal structure of the battalion and its setting within the division provide opportunities and pose problems for designing and implementing decision support systems. Further examination of the personalities and roles of individual officers helps to identify any difficulties. Communication networks, power relationships, and job responsibilities are among the considerations for successfully implementing this concept. Based on these factors possible solutions for each battalion staff section can be recommended.

It is then the responsibility of those individuals designated by the design process to further investigate and create the most suitable decision aid.

Three examples of administrative applications of decision support systems illustrate the benefits of using simple computer aids. A model using an SAS program provides assistance to administrative and security personnel. This tool enables the user to quiz a database, create tables and charts, and generate reports. An Interactive Financial Planning System model can be used in formulating proposed unit budgets. An added feature is the ability to create scenarios based on changing data variables. A Lotus spreadsheet model can be important in operational and logistical planning. This resource allocation model provides the officer with easy access to complex calculations, changing scenarios, and graphics capability.

Decision support systems have great potential in improving battalion-level management within the Army. Computer assistance can be invaluable in cutting costs, saving time, and conserving fuel. Such results stem from making people more effective in their jobs and improving decision-making within the organization through the use of computer technology.

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CHAPTER I

INTRODUCTION

Today's military establishment can be viewed as an extremely large bureaucratic organization that must compete with other federal agencies for increasingly scarce resources. In attempting to accomplish their missions of peace, the units of the United States Army must make better uses of personnel and economic resources. Huge government deficits, increasing taxpayer scrutiny, and Congressional pressure make it essential for everyone in the Army to cut costs, save time, and conserve fuel.

The Army battalion-level organization, in particular the Chaparral/Vulcan Air Defense Battalion, can improve its resource utilization through the use of decision support systems (DSS). The expanded use of computer technologies, the nature of the decision-making, and the changing character of the organization are examined to improve decision-making, costs savings, and mission accomplishment.

The Chaparral/Vulcan Air Defense Battalion provides an example, although all Army battalions have many of the same basic staff sections performing similar functions. This analysis will demonstrate the need for computer aids through the use of past experiences in various units. The nature of decision-making and the purpose and history of decision support systems lay the foundation for the study of this particular battalion.

The internal structure of the organization and its setting within the division provide opportunities and pose special problems for implementing and designing any computer system. The individuals and their roles impact on any proposed design features. The personalities, job responsibilities, communication networks, and power relationships are potential problems that need to be addressed. Possible solutions are then discussed in terms of these difficulties. The design process to be used must be specified with assigned responsibilities.

Three example applications of decision support systems emphasize the possible uses of such models in the administrative, security, operations, and logistical staff sections of the battalion. This analysis will illustrate the potential of decision support systems to further mission accomplishment in the most efficient, cost-effective method.

CHAPTER II

NEED FOR COMPUTER AIDS

Prior to launching an in-depth study of the Chaparral/Vulcan Air Defense Battalion and the potential use of decision support systems, a few examples of the need for computer aids at this level of military organization may be in order. One only needs to question past participants and investigate past incidents to find times when some form of decision support system would have aided the decision-makers at the battalion level. A few examples emphasize this need.

One battalion was experiencing difficulty maintaining its equipment and supplies while remaining within the budget allocated by the division headquarters. As the end of the fiscal year approached it appeared that the unit would require more money to support its activities. The battalion commander requested that his logistics officer submit a request with justification for additional funds. With no exact measure of past or anticipated expenses, a request was submitted for an additional $100,000. As the fiscal year ended, the battalion was forced to return over $80,000 to the division unused. The return of surplus funds reflected negatively on the unit and its responsible personnel. The credibility of the logistics officer and the battalion commander was threatened. Later requests were viewed skeptically.

Another battalion faced the prospect of deploying the entire unit to a training area several hundred miles distant. While the battalion commander and the operations officer planned demanding schedules for training, the logistics officer repeatedly emphasized his inability to support this previously unscheduled exercise without additional fuel and financial resources from the division. Without any means of accurately tracing past resource usage or forecasting future needs, the logistics officer was forced to present ineffective justifications. The intervention of the division staff finally resulted in additional resources leading to a successful deployment. Without the additional fuel and funds the exercise would have been canceled or curtailed causing the training to be limited and ineffective.

A third example is that of a battalion that was required to plan for the permanent relocation of the unit from one military post to another. When faced with the decision on utilizing truck, train, or convoy transportation to relocate, the operations and logistics officers were unable to accurately predict fuel usage, spare parts needed, or financial considerations. The detailed calculations combined with the different contingencies were beyond the personnel and time available. The manual extraction of the needed data was too cumbersome and incomplete to be of help in planning the unit movement.

After relocating, that same unit was faced with reconstituting the unit rosters since many soldiers had been reassigned to other units. Making personnel assignments which were consistent with rank, job training, and security classifications were time consuming and difficult. Computer aids would have been a great help in matching personnel to jobs.

The critical need for some form of decision support system in the Chaparral/Vulcan Air Defense Battalion, and for that matter in all Army battalions, can be traced to the fact that most of the staff positions that control the personnel, security, operations, and logistical aspects of the unit are occupied by young lieutenants and captains who are trained in air defense tactics. Little or no staff training is provided to these individuals who must make significant decisions affecting the resources entrusted to them.

Most training is on-the-job training, often with little time to consult the previous occupier of the job. These young officers are required to manage hundreds of personnel and their training, millions of dollars worth of equipment, thousands of gallons of fuel, and the expenditure of hundreds of thousands of dollars all with little help. Currently only paper records, a word processor, a duplicating machine, and calculators are available to aid these people in handling the personnel and economic resources entrusted to their management.

Decision support systems can aid the decision-making and administration of these young officers by: (1) providing information and data in a relevant and convenient form; (2) facilitating information processing in making and executing operational and logistical plans; (3) supplying decision-making tools; and (4) supplying information and instruction about data and information, their processing, and methods for making decisions. For these reasons decision support systems should be examined to determine the feasibility of their use at this critical level of military organization.

CHAPTER III

FRAMEWORK FOR STUDY

The first step in establishing a framework for the study of this issue is to review the current literature and then decide on the manner of examining the organizations, the personnel, and the systems. Both a level of analysis and a perspective or model must be determined prior to actually examining the organization. Two levels of analysis are available for study: (1) individuals, coalitions, or subunits; and (2) the total organization.[1]

The organizational perspective supplied by Lynne Markus is the one used in this paper when designing and implementing a computer system. It consists of the following three steps: (1) defining the organizational context; (2) constraining the design features of the solution; and (3) specifying the design process and the roles of the participants. In order to define the organizational context one must identify, describe, and understand the proposed setting of the system. As Markus says:

> . . . The major reasons for defining the context of a proposed system is to determine if a system, any system, has the potential to effect the desired outcomes . . . Therefore, if the objectives for a system require design features that are incompatible with the context, the system is not likely to succeed

> in achieving its objectives, not at least without concurrent changes in contextual features. . .[2]

The design features must be constrained in order to eliminate any designs that are impractical due to technical, political, or cultural reasons. In constraining the design feature, the following steps must be taken: (1) identifying the participants, their interests and objectives, and their potential resistance or acceptance of change; (2) examining any problems in the context, such as improper communication flows or responsibility with no authority or resources; (3) creating a list of possible solutions (to include changes in strategy, structure, human resource management, and manual systems); (4) eliminating any solutions that are beyond control or that are not feasible; and (5) describing the contextual features and eliminating those solutions that do not fit those features.[3] The final step in system design and implementation is used to establish a procedure for the development of the solution and to assign responsibilities to the important personnel.[4]

Jeffrey Pfeffer provides additional perspectives for studying organizations. One perspective of action is that it is "prospective, intendedly rational, created action" that has behavior being chosen based on set preferences prior to the action with the intent of achieving some goal. Another perspective is that of the "external constraint or situational control perspective" in which all action results from external constraints, effects, or stimuli on the organization. The final perspective is that organizations have people, problems, and answers that cause results which were determined by the processes and effects or constraints on those processes. This is the "almost random, emergent process view of action".[5]

Additionally, George Huber classifies the models of the organizational decision-making found in the published literature in four types as follows: (1) the Rational Model; (2) the Political/Competitive Model; (3) the Garbage Can Model; and (4) the Program Model. Huber believes that:

> . . . these four models can serve us in three ways. First, they can provide a framework for interpreting the decision-making that goes on in the organizations in which we work. Second, in that DSS are generally more useful if they are custom designed for the decision-maker's environment, the models can help us interpret and articulate the organizational aspects of that environment. Finally, . . . the models can suggest the nature of the information and decision aids that might be useful in specific types of organizational environments, and thus might be helpful in the design of specific DSS.[6]

The Rational Model shows decisions to be the result of the organization using information rationally by stating the alternatives, the future conditions, the means of evaluating the alternatives, the probabilities of future events, the importance of the criteria, the payoffs or costs, and the constraints.[7] The Political/Competitive Model states that decisions are the results of the strategies and tactics used to direct the decision-making in manners that benefit those particular units. This model requires information on the participants in decision-making, the influence of those personnel, the alternatives favored by those parties, the types of influence that can be used, and the strategies that may be chosen.[8] The Garbage Can Model, originally developed to describe university systems, does not apply to goal-directed military units. Finally, the Program Model utilizes two factors, programs (such as standard operating procedures and budgets) and earlier "programming" (such as training and reinforcement).[9]

With an understanding of the models by which past researchers have examined organizations, a particular framework for studying Chaparral/Vulcan Air Defense Battalions and the potential use of decision support systems can be developed. This study will focus on the individuals, coalitions, and subunits within the battalion as the level of analysis. Markus' organizational perspective for designing and implementing a system will provide the basis for this analysis while utilizing Pfeffer's rational action, external constraint, and emergent process views of organizational behavior and the Rational Model, the Political/Competitive Model, and the Program Model to aid in explaining the actions of the organizations and those in them. This analysis combines these perspectives and models while following Markus' procedure in examining this organization.

CHAPTER IV

PRESENT AND FUTURE STATE OF DSS

History and Purpose of DSS

Prior to turning to an analysis of this military unit, the purpose, history, present uses, and potential uses of decision support systems should be examined to fully understand the nature of the systems that are being proposed for this particular level of military organization. According to Bonczek, Holsapple, and Whinston, a decision support system is an ". . . information-processing system that is embedded within a decision-making system . . . may be a human information processor, a mechanical information processor, or a human-machine information processing system . . ." that combines both data base management and artificial intelligence techniques.[10] In a more technical sense Bonczek views a decision support system as consisting of three major parts: (1) a language system; (2) a knowledge system; and (3) a problem-processing system. The language system allows the user to utilize commands or expressions to obtain information and can be a retrieval language or a computational language or a combination of both. The knowledge system consists of data files or data bases organized in a systematic manner pertaining to the problem area. The problem-processing system is the "interfacing mechanism" between the knowledge system and the language system. It provides the information to allow the decision-maker to choose (see Figure 1).[11] Decision support systems support decision-making, often pertain to poorly structured problems, can be utilized without the aid of a computer expert, and are " . . . highly interactive and operate in real time . . . " according to Huber.[12]

The unstructured nature of many problems in today's organizations provide decision support systems with their greatest challenge. Such systems attempt to structure the problem (see Figure 2). Charles Holt defines structuring as:

> . . . the degree to which the decision-maker can formulate the decision problem clearly and accurately in terms of environment, objectives, constraints, relationships, data requirements, and applicable decision methods.[13]

Ill-structured problems are caused by: (1) the "ambiguity and incompleteness" of the information; (2) the amount and nature of problem redefining by managers; (3) the lack of knowledge of desired results; (4) the presence of numerous personnel influences; and (5) the amount of time available in which a decision can be made (see Figure 3).[14] In an effort to handle such problems, use can be made of analogies, the collection of more information to redefine or better define the problem, developing a new strategy based on present strategies, or using intuition.[15] By aiding the decision-maker in structuring a poorly defined problem, the decision support system helps guide thinking toward a reasonably good solution to that particular problem.

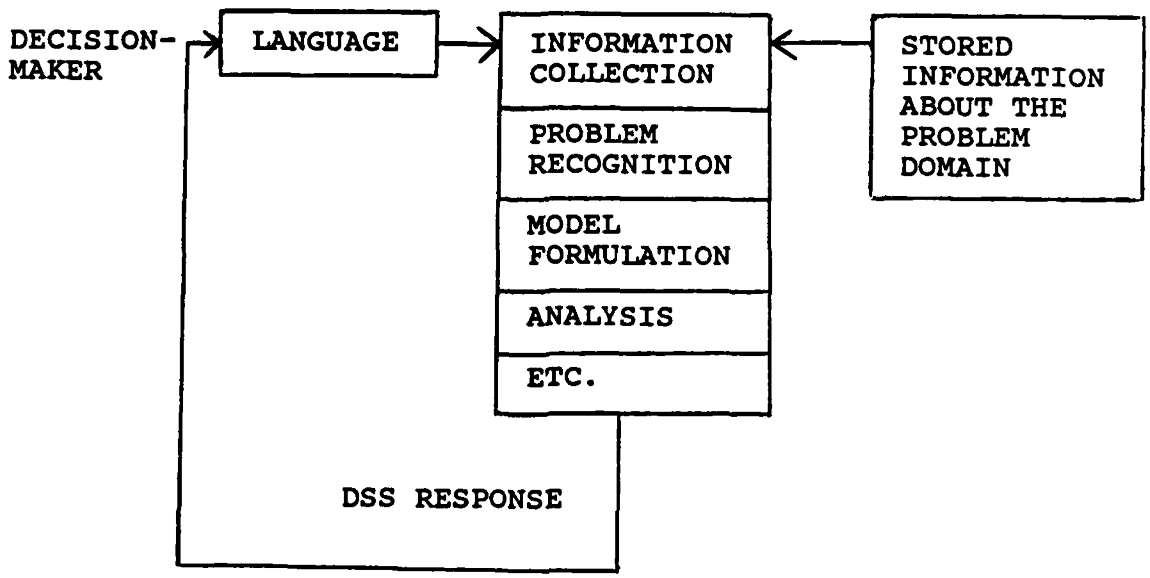


FIGURE 1. Computer-Based Decision Aid

Source: Robert H. Bonczek, Clyde W. Holsapple, and Andrew B. Whinston, Foundations of Decision Support Systems (New York: Academic Press, Inc., 1981) p.39.

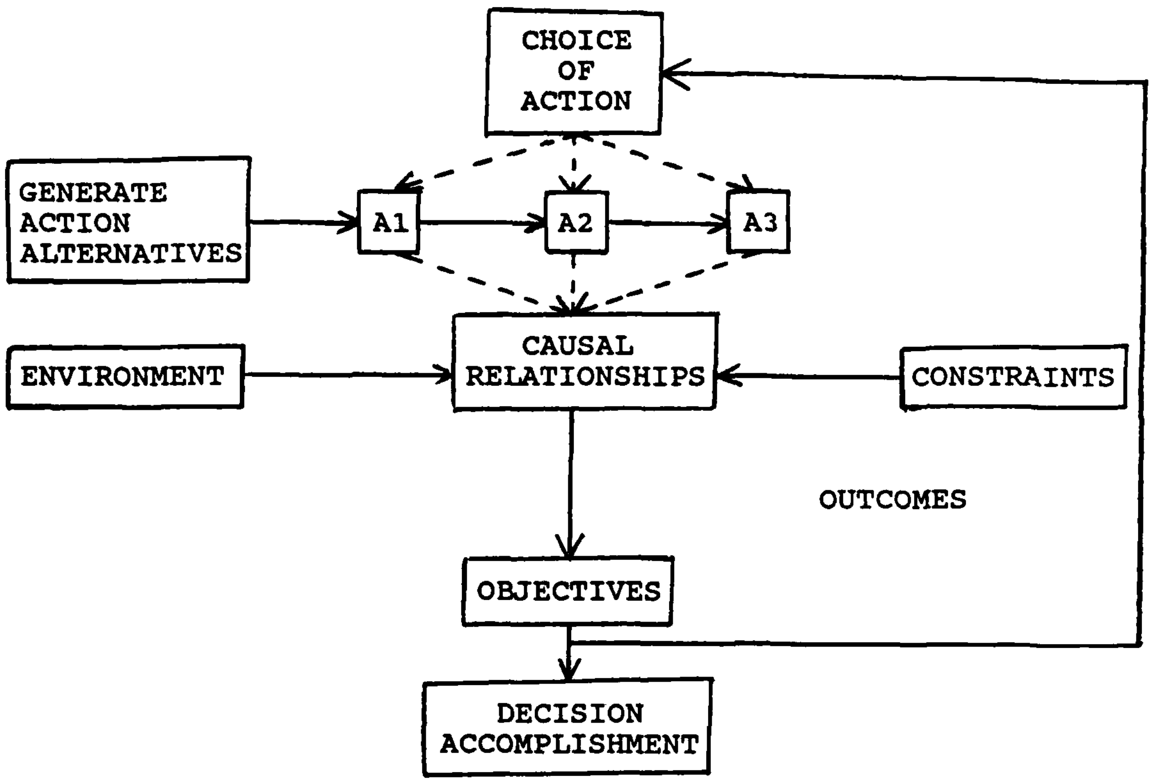


FIGURE 2. Action Decisions With Method Given

Source: Charles C. Holt, "How Can Computers Help in Formulating Decision Problems?" working paper at the Graduate School of Business, The University of Texas at Austin, Austin, Texas, p.1.

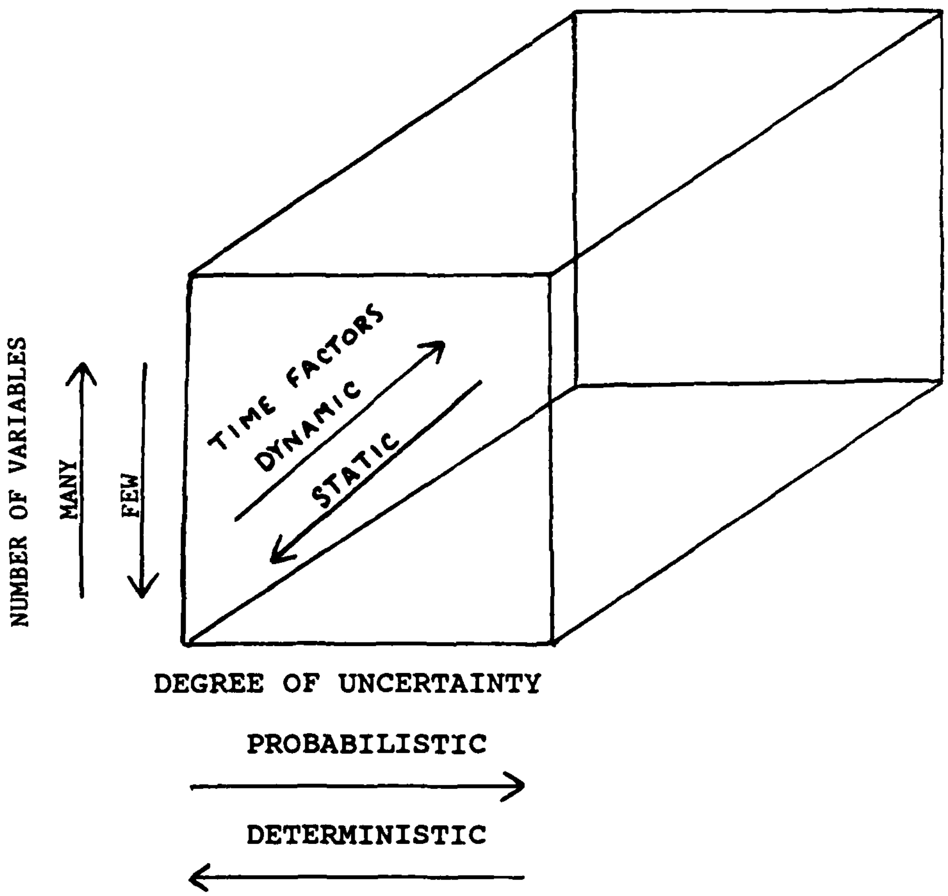


FIGURE 3. Problem Space

Source: Ronald A. Howard, "The Science of Decision-Making:, paper from the Department of Engineering-Economic Systems, Stanford University, Stanford, California, p. 162.

Over the last few years several categorization systems for decision support systems have evolved. One such detailed categorization of decision support systems has been developed to understand the different types of uses for such systems. Steven Alter categorized decision support systems by the type of operation that is performed. In this manner seven different types of systems can be identified as follows: (1) file drawer systems, which provide access to stored data; (2) data analysis systems, which enable data to be manipulated using certain methods designed for a particular task or for general tasks; (3) analysis information systems, which allow access to numerous data bases and limited models; (4) accounting models, which calculate the results of future actions based on accounting methods; (5) representational models, which attempt to determine the results of actions that are based on "partially non-definitional" models; (6) optimization models, which calculate optimal solutions for an action consistent with the known constraints; and (7) suggestion models, which perform "mechanical work" by suggesting a decision for a somewhat structured task.[16] All of these systems can be described as either data-oriented or model-oriented systems (See Figure 4).

Current and Potential Uses of DSS

After understanding the purpose and categories of decision support systems, a brief look at some present and future systems will help in appreciating the present and

FILE DRAWER SYSTEMS
DATA ANALYSIS SYSTEMS
ANALYSIS INFORMATION SYS.
DATA RETRIEVAL
DATA ANALYSIS
DATA-ORIENTED

ACCOUNTING MODELS
REPRESENTATIONAL MODELS
OPTIMIZATION MODELS
SUGGESTION MODELS
SIMULATION
SUGGESTION
MODEL-ORIENTED

FIGURE 4. Decision Support System Types

Source: Steven Alter, "A Taxonomy of Decision Support Systems", Sloan Management Review (Fall, 1977), p.42.

future state of the art. One of the simplest decision support systems currently in use is the Lotus spreadsheet in which a model can be designed to be used in calculating the results of planned actions. Computer support of project management involves a data base management system and a project management model PERT (Project Evaluation and Review Technique). The software packages utilized in the PERT system are of three types: (1) resource scheduling and forecasting; (2) resource and cost control; and (3) analysis of scheduling and cost information. The Statistical Package for the Social Sciences (SPSS) can be used to perform statistical or economic analyses in many different functional areas.[17]

The Business Definition Language (BDL) system is being developed to allow businesses to state a problem and method to be used to solve that problem. Such a system is supposed to enable business people to more easily write programs for solving problems. Another system is PLANNER, which is a theorem-proving system developed by MIT, while the General Problem Solver (GPS) approach developed by Simon uses states (such as information), operators (models to move from one state to another), and goals (output). MYCIN is a system designed to help doctors diagnose and design treatments for certain diseases. By inputting symptoms and patient information the doctor is asked for additional information or tests which builds a patient data base. The Generalized Planning System (GPLAN), which was developed at Purdue Univeristy, allows non-computer expert users to quiz a flexible knowledge system to obtain data to be used in a variety of analyses.[18] A system being currently tested at the University of Texas at Austin is DSS-DU, in which FRAMEWORK is utilized with the system to help the decision-maker structure the problem by looking at the objectives, the environment, the relations, the constraints, and the alternatives.[19] Finally, one can look at Group Decision Support Systems (GDSS) which are composed of components and methods used to support a group involved in a decision-related activity. As George Huber stated:

> . . . the purpose of group decision support systems is to increase the effectiveness of decision groups by facilitating the interactive sharing and use of information among group members and also between the group and the computer . . .[20]

As can be seen by the few examples given, decision support systems vary widely in their complexity and design as well as in their application. Numerous systems have been and many more will be designed as emphasis continues to mount for effective decision-making in today's world of scarce resources and improving technology.

CHAPTER V

DEFINING THE ORGANIZATIONAL CONTEXT

The first step in analyzing an organization to design and implement a particular system is to define the setting of the organization. This is extremely important because the smaller the difference between a system and the setting the less likely it will meet user resistance.[21] The Chaparral/Vulcan Air Defense Battalion is organized in a manner that is basically similar to all Army battalions with some differences based on particular missions and compositions. For this reason much of what is discussed here is applicable in other battalions with slight modifications.

Fit Into the Larger Organization

First, the organizational context itself must be understood by placing this battalion within its larger organization. The Chaparral/Vulcan Battalion is the only unit of its kind in the Army division. Although it is usually one of sixteen battalions in the division, it reports directly to the Assistant Division Commander (Maneuver) while many of its logistical and legal requirements are routed through brigade-level units, such as the Division Artillery.

Staff and Line Organization

The typical battalion of this type is composed of approximately 500-600 personnel divided among five batteries (see Figure 5). Headquarters and Headquarters Battery is a unit devoted to supporting the remaining four firing batteries (two composed of Chaparral missile systems and two composed of Vulcan gun systems). It is Headquarters and Headquarters Battery that is the focus of this analysis since it has the greatest potential use of decision support systems.

Headquarters and Headquarters Battery is the support unit whose decisions impact the most on personnel and economic resources. Six major staff sections are found in this unit. The S-1 section manages all of the personnel, legal, and administrative actions within the battalion. The S-2 Section monitors and controls the intelligence and security aspects of all operations. The S-3 Section plans, coordinates, and monitors all training and operational actions of the battalion and its subordinate units. All logistical, financial, and property accountability actions are handled through the S-4 Section. The BMO Section (Battalion Maintenance Office) coordinates and manages all maintenance activities of the battalion while the Medical Section is responsible for all first-line medical care (see Figure 6). Since they control the administrative functions of the unit, these major staff sections can benefit the most from the use of some form of decision support system.

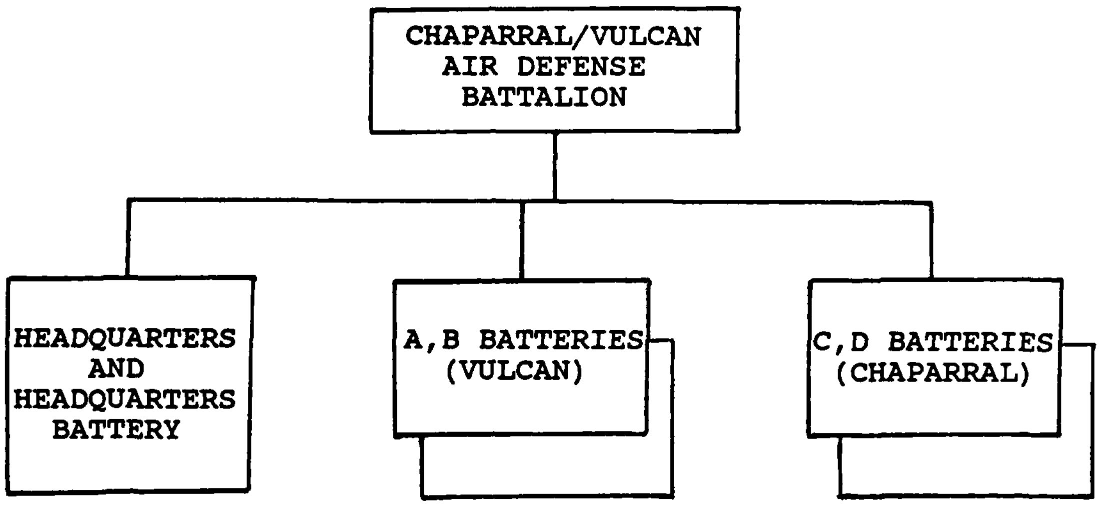


FIGURE 5. Chaparral/Vulcan Battalion Organization

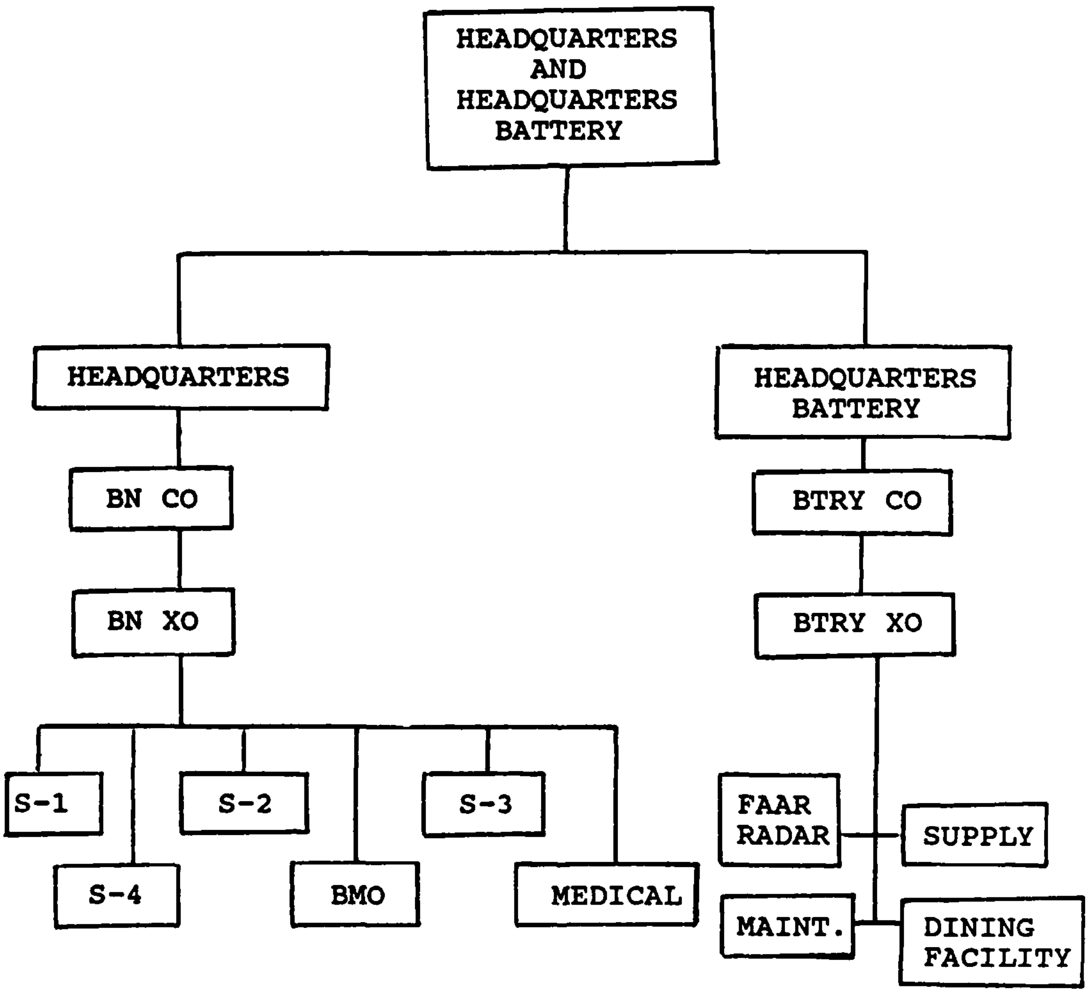


FIGURE 6. Headquarters and Headquarters Battery

CHAPTER VI

CONSTRAINING THE DESIGN FEATURES

Participants and Roles

Once the overall setting is understood, the second step in the organizational perspective can be examined. In constraining the design features, all of the participants and their roles must be analyzed. As Markus stated, the impacts of a system are caused by the characteristics of the designers, the characteristics of the users, the technology, the organizational structure, the organizational culture, and the politics.[22] Although this study is being initiated by a member of the Air Defense Branch of the Army with two tours in this type of unit, many of the actual designers of systems to be used will be civilian contractors, government civil service employees, and military data processing specialists. Such people will have a wide variety of experiences which may not be applicable to a particular unit.

There are many participants on the proposed user side of the system. The battalion commander is an air defense lieutenant colonel whose objectives, while varying in priorities and emphasis, are to improve the combat capability of his unit and to provide the best leadership and living conditions for his soldiers. The battalion executive officer, an air defense major, will be directly affected since he is the officer responsible for the successful functioning of all six battalion staff sections. His objectives should be to improve and maintain the proper efficient operation of the support functions of the battalion staff.

In the S-1 Section the administrative officer or S-1, usually an air defense lieutenant or captain, assisted by a senior non-commissioned officer is responsible for the overall management. These individuals conduct all of the personnel, legal, and administrative functions of the battalion, hopefully in an orderly, efficient manner with a minimum of paperwork.

The S-2 Section is supervised by two officers, supposedly a captain of the intelligence branch and an air defense lieutenant, assisted by a senior non-commissioned officer. Their jobs are to insure the security of all military information and property while also keeping abreast of all applicable intelligence matters. In this section the proper completion, filing, and security of certain forms is imperative.

The S-3 Section is headed by an air defense major (who is third in the hierarchy of command behind the battalion executive officer and the battalion commander) assisted by two captains, three lieutenants, and several noncommissioned officers. Their function is to insure the combat capability of the battalion and the subordinate batteries through planning, coordinating, and monitoring all unit and individual training. This section has numerous diverse responsibilities entailing detailed planning and large amounts of paperwork in the form of operations orders, standard operating procedures, and operations plans as well as record-keeping of all training activities.

The logistics or S-4 Section is headed by an air defense captain assisted by a senior noncommissioned officer. This staff unit is also extremely important in that it handles all supply, financial, and property accountability responsibilities within the battalion. This section probably most closely resembles a business operation due to its requirements to order and reorder supplies while maintaining proper inventories, to prepare and distribute budget allocations while remaining within the constraints set by higher authorities, and to maintain and account for all property from fifty-cent parts to million dollar missile systems. The diverse responsibilities and the amount of paperwork is tremendously large.

The Maintenance Section is really subordinate to the S-4 Section but is separated in this study due to the tendency for unit commanders to relieve the logistics officer of the responsibilities and to emphasize maintenance within the unit. This section is usually headed by a systems or motor warrant officer often aided by any air defense officer deemed available for the job. The objectives of this subunit are to insure the proper maintenance and combat capability of all vehicles and systems. In accomplishing this mission decisions must be made on proper maintenance efforts and the applications of resources to insure the highest maintenance status possible.

Finally, the Medical Section is actually responsible to the S-1 officer, but it usually reports to the executive officer due to the particular expertise involved. This section is usually headed by a medical warrant officer assisted by a senior noncommissioned officer. Their interests lie in insuring the best state of medical care for the battalion's soldiers while maintaining the very important medical records.

All of these participants may vary in their willingness to accept or reject a decision support system for use in their particular areas. The individual's education, motivation, past experience with computers, willingness to learn, need for assistance, and superior and subordinate enthusiasm will all impact on how the individual participants will accept any new system that will change many of the current manual methods of work. To properly analyze the organization each individual would need to be studied prior to trying to implement a system.

Potential Problems For DSS

There are several important problems that must be identified prior to proceeding in this analysis. The proposed use of decision support systems will, in this case, probably not affect the size or composition of the sections but will affect the job design, work flow, culture, structure, and politics of the organization and its people. Job content and satisfaction as well as new opportunities for job improvement may result. Job tasks may increase in importance and variety and the organizational structure may need to be changed.[23] In considering the setting this battalion is one of a kind in the division and cannot rely too heavily on experience or information from the other battalions. Additionally, the chain of command runs straight to the division commander level which causes numerous political problems with other commanders often giving the air defense battalion tremendous influence. Having legal and some logistical functions processed through other chains often causes friction since these chains of responsibility are not the same as that of the chain of command. Power relationships are extremely important in that the locations and uses of power must be known when designing and implementing a system. Individual and coalition power relationships must be recognized and not threatened if the system is to accomplish its goal.[24] The battalion organization often lends itself to competition and political power struggles as the batteries and the staff sections compete for power, resources, additional responsibilities, or the battalion commander's favor. The staff-line organization also fosters problems as subunits have competing objectives and ways of obtaining them (for example the S-4 wants to constrain the budget within limits while a line unit may feel the need to spend extra funds to improve its maintenance posture). The use of decision support systems may lead to more consistent decisions and affect job designs, work flows, culture, structure, and politics.[25] The power of the staff sections over the line units may be increased since the use of computers in decision-making may lend them more credibility (especially if perceived by the commander). Communication flows may not be strictly in accordance with the organizational structure due to personalities, rank, past education (ROTC versus Military Academy), or position (staff versus line or Chaparral versus Vulcan). Finally, the stage at which the organization is located in terms of Information System (IS) development must be considered prior to designing and implementing the proposed systems as suggested by Cash, McFarlan, and McKenny.[26]

Images and symbols are portrayed to the different participants and cause them to act in different ways. Individuals have different perceptions of the organizational structure, especially when considering work flow, communication flow, and authority.[27] It must also be noted that the decision-making in a military organization is the result of numerous factors. Most military decisions are thought to be the result of rationally considered alternatives, possible results, and the chances of those results occurring (Pfeffer's rational action or Huber's

Rational Model). Other decisions result from the pressures of the external environment (Pfeffer's external constraint or Huber's Political/Competitive Model). Some of the external environmental constraints consists of technical advances, legal requirements, political, social, economic, cultural, educational, and resource factors.[28] Others decisions within the organization are often made as a result of the military's many standard operating procedures or programs or as a result of the training, socialization, and reinforcement found in the military society (Huber's Program Model). It is essential to study such programs as standard operating procedures and rules of thumb in order to understand the organization.[29] These are only a few of the problems that may be present in the organization and must be identified in order to minimize their impact on the system design and implementation.

Solutions Available For DSS

The next step is to consider the solutions that are available for use as decision support systems. This study proposes several solutions to be considered as aids in the form of decision support systems to be used in the staff sections. It is not the purpose of this paper to actually design the systems but to propose the area for study of potential system use.

In the S-1 Section there are numerous possible uses for decision support systems. In the personnel management area officer and senior noncommissioned officer assignments within the battalion could possibly be improved through the use of a system that structures the nebulous problem of taking into account the individual and his qualifications, the environment of the proposed assignment, the constraints on the individual and the job, and the objectives desired by the commander. A similar system might also potentially be used to handle some of the legal requirements such as assisting the commander in determining punishments in Article 15 nonjudicial hearings by allowing input on a soldier's financial and personal circumstances, past record, the recommendations of the soldier's superiors, and the possible punishments based on the soldier's rank and status. It must be noted that such a use for legal hearings would probably meet great resistance. Other administrative duties might utilize decision support systems. Data processing might be more appropriate to assist the clerks who now use only a word processor and a copy machine.

The S-2 Section would probably have fewer applications for systems. Some potential uses would be in the area of processing security applications. A system could ask basic questions to help the decision-maker determine the need for a security classification based on an individual's past record, future jobs, present job, need to know, and leader recommendations prior to requesting the security clearance from higher authorities.

The S-3 Section probably has the most difficult job in addressing unstructured problems. The responsibility of maintaining a unit's combat capability through training is extremely difficult due to the problems of deciding on what training events will be most beneficial given the limited resources. A decision support system, such as DSS-DU, that structures these problems by presenting the training alternatives available (whether individual Skills Qualification Testing, field exercises, classroom studies, or small unit training), the constraints present in the form of limited resources (whether time, space, ammunition, personnel, funds, or supplies), the environment (such as the commander's expressed interest or emphasis, the type unit, the type terrain available for training), the causal relationships between particular types of training and combat effectiveness (as measured by evaluations), and the objectives desired by the commanders at all levels of the organization would be extremely useful.

In the logistical area of the S-4, other forms of decision support systems could be utilized. Simple systems that may only be models created on Lotus spreadsheets could be utilized to determine resource consumption for particular exercises. For example, fuel consumption for certain exercises could be determined based on the type and number of vehicles involved, the length of time of the exercise, and the expected distance to be covered. Such a model would be valuable to the S-3 in planning unit exercises based on resources available and to the S-4 in allocating those resources. The battalion budget could also benefit from such systems by enabling the S-4 to allocate funds and to test certain scenarios of activity and their influence on funds use in much the same method as that mentioned earlier. More complicated systems, such as DSS-DU, could be utilized to structure the problem of budget formulation and requests since such a financial process depends on the environment, the financial constraints, the objectives, and the methods used to obtain those objectives.

The maintenance personnel, on the other hand, could use simple decision support systems to allocate maintenance resources, such as personnel, parts, and equipment, to help insure the highest maintenance readiness possible for the battalion overall and for the individual subunits. The Medical Sections's use of decision support systems would be limited due to their limited medical capability.

As can be seen from the previous discussions there are numerous possible uses within the battalion staff of simple decision support systems. It has been the intention of this study to focus on only a brief illustration of the potential uses within the staff sections without actually trying to design the system or look at the use of such systems at the battery level. There may be some improper solutions suggested to these problems although all of these suggested systems could work. The actual acceptance or rejection of such systems would be determined more by each individual battalion's composition, personnel attitudes, leader support, and division/post-level support from IS personnel.

CHAPTER VII

SPECIFYING THE DESIGN PROCESS

Since this paper has only proposed areas for future in-depth design and implementation studies of decision support systems at the battalion level, a design process must be mentioned in order to establish a method for designing the specific solutions and for assigning responsibilities. Each air defense battalion does not need its own specifically designed system. General decision support systems using flexible models can be designed for all units of this type using hardware and software currently available on the market. A truly in-depth analysis of all the functions of the staff sections must be conducted by experienced personnel to establish all of the requirements that can be met by using a decision support system. Once the functions are specified and the models created or adapted to the current situation, then the systems can be implemented in the organization.

The manner of the implementation will be critical to the successful use of the systems. The support of post-level IS personnel and the battalion commanders and executive officers, the education of the user, the applicability to current real-life problems, the ease of access, and the continued up-grading as methods and equipment change are only a few of the essential ingredients to successful implementation and use. Finally, and possibly most importantly, both IS personnel and air defense users must be involved in analyzing the organization, designing the models, and implementing the systems.

CHAPTER VIII

EXAMPLE OF DSS APPLICATIONS

Three examples of models created using simple decision support systems can illustrate the application of computer aids to administrative functions at the battalion level. These three decision support systems are provided only as examples of the potential for such systems. A more complete discussion with computer printouts of results can be found in Appendices A, B, and C.

The first sample decision support system is a model created for use by the S-1 Section (Administration) and the S-2 Section (Security) utilizing an SAS program developed by the SAS Institute (See Appendix A). The user creates a data file of names, ranks, social security numbers, security clearances, military occupation specialty (MOS) test scores, and ages. As required, the user can then quiz the system using some of the commands as shown in Appendix A. As can be seen from this illustration, a decision support system using SAS can be used to select information, print the data, and create tables and charts. Such information is valuable in determining an individual's suitability for a job based on rank, MOS test scores, or security clearance. Additionally, the status of the unit in the rank structure or security clearance numbers can be determined which would aid in requisitioning personnel of the proper ranks and clearances. The unit commander may also be able to determine the unit's training status by rank or age which would help him focus his training to achieve the greatest effect.

The second example of a decision support system consists of a model for the S-4 Section (Logistics). It uses the Interactive Financial Planning System (IFPS) program developed by Execucom Systems, Inc. (see Appendix B). In this budget model the user inputs data for the required years 1986 - 1990. The data consists of the 1986 funds and fuel allocations, the 1986 estimated expenses, and the 1987 - 1990 expected allowances for inflation. Total revenue, total expenses, remaining funds, and funds utilization can then be determined. Additionally, "What If" scenarios can be used to change certain variables to determine the effect on the unit's proposed budget. The program can also generate formal reports. Such a system would be beneficial in creating a unit budget by demonstrating the effect of certain variables and scenarios.

The third application of a decision support system is a simple model for the S-3 Section (Operations) and the S-4 Section (Logistics) using the Lotus spreadsheet package (see Appendix C). This example of a fuel resource allocation model can be used to allocate fuel to meet scheduled training requirements as well as to determine the most efficient use of the fuel resources available. The input data consists of the fuel available, the unit exercise requirements, vehicle fuel usage rates, and certain miscellaneous data. The model is then used to calculate exercise fuel usage and predicted fuel usage for the year. Fuel can then be appropriately allocated or readjusted as necessary to meet operational requirements. The input data can be varied to determine the effects that changes in the data variables will have on the fuel usage and allocations. Lotus' graphics capability can then be used to illustrate the results of the calculations. Such a simple model would be extremely beneficial by effectively allocating fuel resources among the units of the battalion. It will also aid in promoting communication between the S-3 Section, the S-4 Section, and the subordinate units.

These three simple examples of decision support system models are included here to illustrate the various applications that are available. They are intended to show the kinds of things that can be done, not necessarily to recommend these particular approaches.

Systems can be more detailed than these examples if needed, since additional variables can readily be added. These models demonstrate the tremendous potential that decision support systems can have in aiding these young officers to properly plan and use the resources effectively.

CHAPTER IX

CONCLUSIONS AND RECOMMENDATIONS

In today's world of scarce resources and increasing responsibilities, new and more efficient methods of management are essential to survival. This study has suggested that the battalion-level military organization, in particular the Army's Chaparral/Vulcan Air Defense Battalion, is one organization that can take advantage of today's rapid advances in technology to improve decision-making.

The recommendation of this analysis is that there are potential uses of *decision support systems* within the Chaparral/Vulcan Air Defense Battalion that should be examined in much more detail by information systems and air defense personnel. Particular emphasis should be placed on personnel assignments, legal requirements, security clearances, training, resource consumption, resource allocation, budgeting, and maintenance. Further studies may produce additional areas of use for such systems. By utilizing advanced technology and better decision-making the military can better compete for the necessary resources and can accomplish its mission more effectively.

APPENDIX A

S-1 AND S-2 USAGE

OF DSS WITH SAS

Appendix A is an example of a simple decision support system model for the S-1 Section (Administration) and the S-2 Section (Security). This model uses an SAS program developed by the SAS Institute. In creating this decision support system the user inputs data consisting of the names, ranks, social security numbers, security clearances, military occupation specialty (MOS) test scores, and ages into a file called ADAINFO. This data can then be downloaded from a central source. A number of commands as listed can then be given to the computer:

COMMAND	RESULT
PROC PRINT;	Lists selected data with column headings
PROC FREQ; TABLE SECURITY;	Produces a table giving the security classifications, frequency, and percent
PROC MEANS; VAR MOS AGE;	Gives the average score and age as well as the standard deviation, minimum value, and maximum value
PROC CHART; VBAR RANK;	Produces a frequency bar chart for the number of individuals of each rank in the unit
PROC PLOT; PLOT RANK * MOS;	Plots the individual's rank with his test score
PROC CORR; AGE;	Produces a table with the correlation information between a soldier's age and his test score
PROC CHART;	Produces a frequency bar chart

This simple decision support system can be expanded to include other variables as well as more data entries. The flexibility of the system commands enable the user to obtain information, print the data, create tables, and produce charts. Such output is important in enabling the leadership to improve its decision-making.

FILE: WORKFILE SAS A1 ACADEMIC 3081 HPO 3.4 (318)

```
  CMS FILEDEF JUNK DISK ADAINFO DATA;
DATA MILDATA;
  INFILE JUNK;
  INPUT NAME $ 1-10 RANK $ 12-14 SSN 16-24 SECURITY $ 26-27 MOS 29-31
    AGE 33-34;

PROC PRINT;


PROC FREQ;
  TABLE SECURITY;


PROC MEANS;
  VAR MOS AGE;


PROC CHART;
  VBAR RANK;


PROC PLOT;
  PLOT RANK*MCS;


PROC SORT;
  BY AGE;


PROC CORR;
  VAR MOS AGE;


PROC CHART;
  VBAR SECURITY;
```

FILE: ADAINFO DATA A1 ACADEMIC 3081 HPJ 3.4 (318)

ADAMS	SGT	892425211	S	100	25
ALLAN	PVT	756401232	C	99	19
AYERS	PVT	732102421	C	91	19
BINGHAM	SSG	869203451	S	100	27
BUTTERFELL	SSG	435401239	TS	98	28
CLEMENTS	PVT	211711452	C	71	21
DAY	SGT	322512666	C	85	25
DELLOMS	SGT	428321241	C	89	22
ELRIDGE	PVT	671113459	C	71	18
FARMER	SGT	999222453	C	91	23
GUTHRIE	PVT	874514691	C	89	19
HARRIS	PVT	543231466	C	88	27
HILLARY	SSG	866326271	S	95	29
JONES	CPL	724534671	C	96	24
MASON	PVT	649215289	C	83	20
MILLER	PVT	639232383	C	61	19
PETERS	SGT	212127891	C	75	21
ROSENBERG	SSG	222233299	TS	95	23
SIMON	CPL	522528591	C	86	21
STEVENS	SGT	721161592	C	75	19
STELBY	SSG	543229399	S	90	22
TILBY	PVT	323271991	C	71	18
TREADWELLS	PVT	621931993	C	69	18
VICTOR	PVT	235422777	C	51	21
VILMON	SGT	431191161	C	59	23

SAS

DATA FILE

OBS	NAME	RANK	SSN	SECURITY	MOS	AGE
1	ADAMS	SGT	892425211	S	100	25
2	ALLAN	PVT	756401232	C	99	19
3	AYERS	PVT	732102421	C	91	19
4	BINGHAM	SSG	869203451	S	100	27
5	BUTTERFELL	SSG	435401239	TS	98	28
6	CLEMENTS	PVT	211711452	C	71	21
7	DAY	SGT	322512666	C	85	25
8	DELLOMS	SGT	428821241	C	69	22
9	ELRIDGE	PVT	671113459	C	71	18
10	FARMER	SGT	999222453	C	91	23
11	GUTHRIE	PVT	874514691	C	89	19
12	HARRIS	PVT	543231466	C	68	27
13	HILLARY	SSG	866826271	S	95	29
14	JONES	CPL	724534671	C	96	24
15	MASON	PVT	649215289	C	38	20
16	MILLER	PVT	639232885	C	61	19
17	PETERS	SGT	212127891	C	75	21
18	ROSENBERG	SSG	222233299	TS	95	23
19	SIMON	CPL	622528591	C	86	21
20	STEVENS	SGT	721161592	C	75	19
21	STELBY	SSG	543229399	S	90	22
22	TILBY	PVT	323271991	C	71	18
23	TREADWELLS	PVT	621981998	C	69	18
24	VICTOR	PVT	235422777	C	51	21
25	VILMON	SGT	431191161	C	59	23

SAS

FREQUENCY OF SECURITY CLASSIFICATION

SECURITY	FREQUENCY	CUM FREQ	PERCENT	CUM PERCENT
C	19	19	76.000	76.000
S	4	23	16.000	92.000
TS	2	25	8.000	100.000

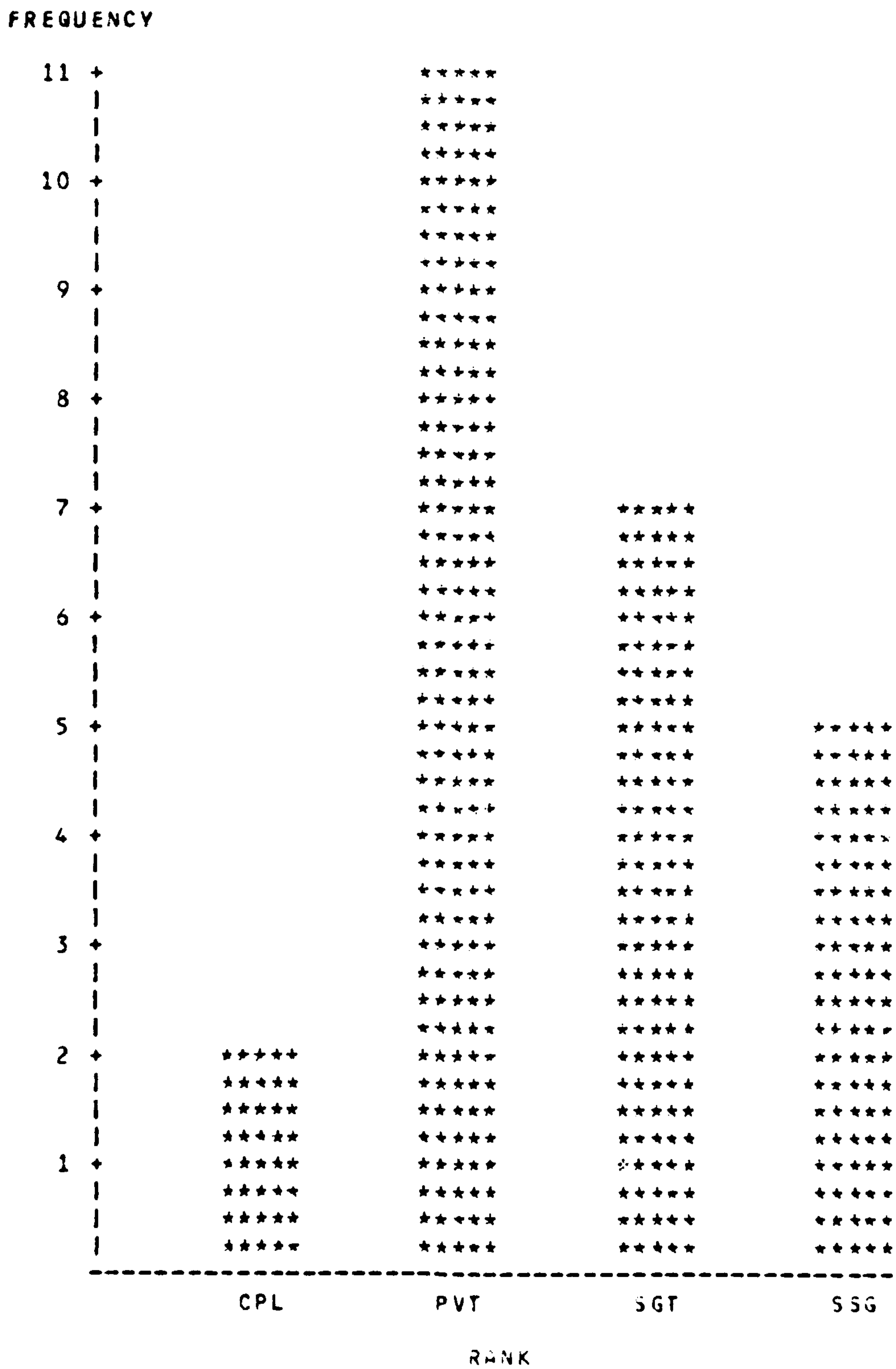
SAS

MEANS OF MOS AND AGE

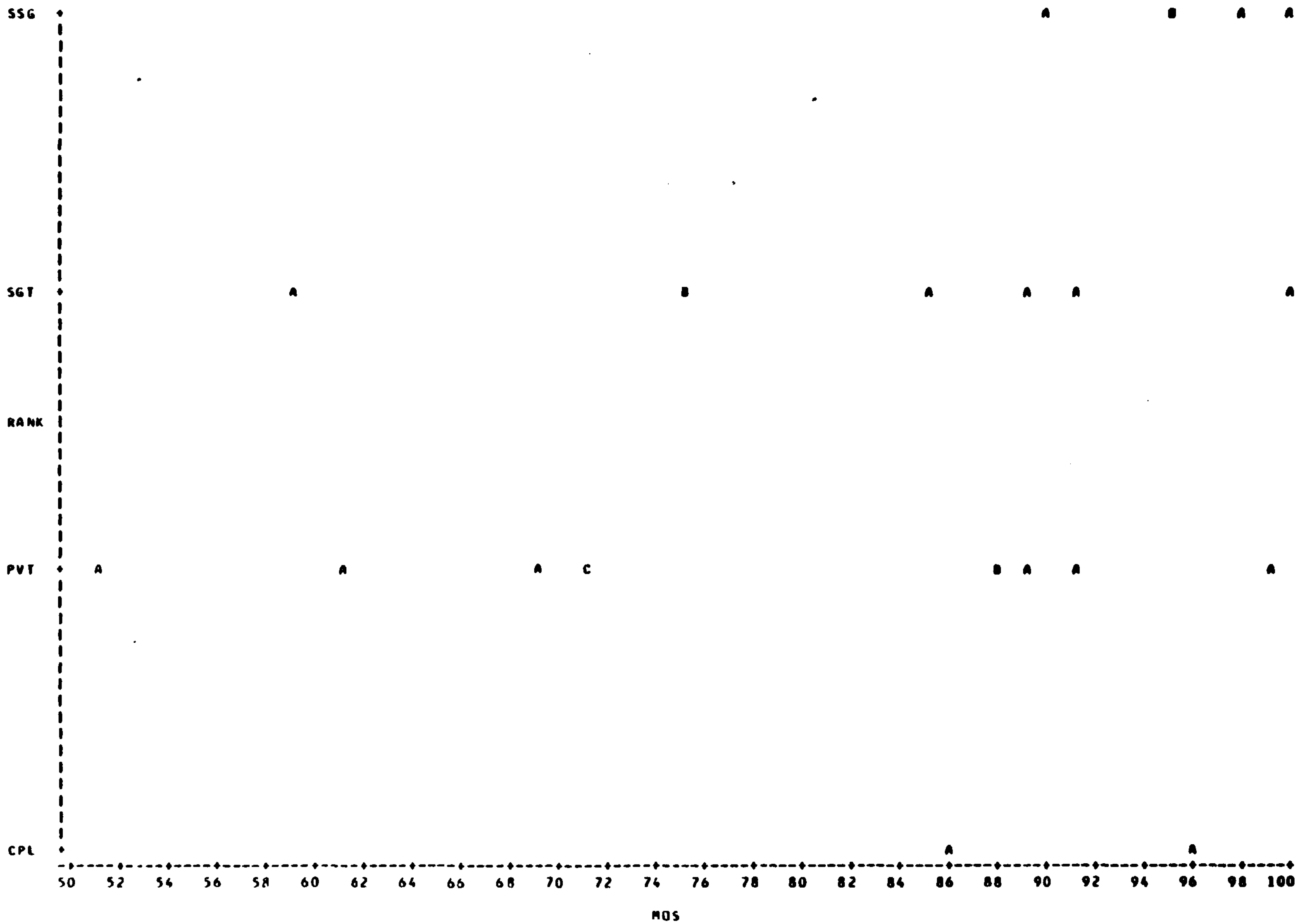
VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE
MOS	25	83.32000000	13.94250097	51.00000000
AGE	25	22.04000000	3.29747378	18.00000000

MAXIMUM VALUE	STD ERROR OF MEAN	SUM	VARIANCE
100.00000000	2.78850019	2083.0000000	194.39333333
29.00000000	0.65949476	551.0000000	10.87333333

FREQUENCY BAR CHART --- RANK



PLOT OF RANK*POS   LEGEND: A = 1 OBS, B = 2 OBS, ETC.



SAS

CORRELATION OF MOS AND AGE

VARIABLE	N	MEAN	STD DEV	SUM	MINIMUM	MAXIMUM
MOS	25	83.32000	13.94250	2083.000	51.0000	100.0000
AGE	25	22.04000	3.29747	551.000	18.0000	29.0000

CORRELATION COEFFICIENTS / PROB > |R| UNDER HO:RHO=0 / N = 25

	MOS	AGE
MOS	1.00000 0.0000	0.50179 0.0106
AGE	0.50179 0.0106	1.00000 0.0000

SAS

FREQUENCY BAR CHART --- SECURITY CLEARANCES

```
FREQUENCY

19 +         *****
   |         *****
18 +         *****
   |         *****
17 +         *****
   |         *****
16 +         *****
   |         *****
15 +         *****
   |         *****
14 +         *****
   |         *****
13 +         *****
   |         *****
12 +         *****
   |         *****
11 +         *****
   |         *****
10 +         *****
   |         *****
 9 +         *****
   |         *****
 8 +         *****
   |         *****
 7 +         *****
   |         *****
 6 +         *****
   |         *****
 5 +         *****
   |         *****
 4 +         *****     *****
   |         *****     *****
 3 +         *****     *****
   |         *****     *****
 2 +         *****     *****     *****
   |         *****     *****     *****
 1 +         *****     *****     *****
   |         *****     *****     *****
   --------------------------------------
               C         S        TS

                     SECURITY
```

APPENDIX B

S-4 USAGE OF DSS WITH IFPS

Appendix B shows a simple decision support system model for the S-4 Section (Logistics). This model uses the Interactive Financial Planning System (IFPS) program developed by Execucom System, Inc. In creating this decision support system model the user input data for the years 1986-1990. The data includes the 1986 amount of funds and fuel allocated as well as the estimated 1986 expenses for supplies, maintenance, ammunition, fuel, temporary duty (TDY) assignments, training, and miscellaneous. Allowances for inflation are built into the model for the allocations and the expenses in the years 1987-1990. Total revenue, total expenses, remaining funds, and funds utilization can then be calculated using the model created. The original data can be printed in a working copy followed by a formatted report of the same material using the GENREPORT QUICK option.

"What If" scenarios are then run changing some of the input data. In the first scenario change the supply expense is increased to see its effect on the unit's proposed budget for the five years. The five percent increase in supplies results in a deficit in all five years. A formal report format of these findings can then be generated. The second scenario change increases the funds allocated while also increasing the supply expenses percentage as well as the inflation rate of the fuel expenses. The resulting effect on the proposed unit's budget is easily calculated and a report generated.

This decision support system model allows the logistics officer to estimate his budget over the years while also determining the effect of particular changes in estimates. In this manner the logistics officer can better predict the financial future of the unit.

```
R; T=0.01/0.01 17:22:52
IFPS
NOW FORMATTING DISK...
DISK ACCESSED AND READY
DMSFOR603R FORMAT WILL ERASE ALL FILES ON DISK 'C(19F)'. DO YC
DMSFOR605R ENTER DISK LABEL:
DMSFOR733I FORMATTING DISK 'C'.
DMSFOR732I '2' CYLINDERS FORMATTED ON 'C(19F)'.
IFPSLOD: Begin run from DSS IFPSDSS:.
INTERACTIVE FINANCIAL PLANNING SYSTEM - 10.0
ENTER NAME OF FILE CONTAINING MODELS AND REPORTS
SHERILYN
FILE SHERILYN PROCESSED
READY FOR EXECUTIVE COMMAND
MODEL INCOME
READY FOR EDIT, LAST LINE IS 23
SOLVE
MODEL INCOME  VERSION OF  03/11/86  14:42 -- 5 COLUMNS 13 VARI
ENTER SOLVE OPTIONS
LIST

MODEL INCOME  VERSION OF  03/11/86  14:42
1 COLUMNS 1986-1990
2 * REVENUES
3 *
4     FUNDS ALLOCATION = 550000, PREVIOUS * 1.05
5     FUEL ALLOCATION = 100000, PREVIOUS * 1.05
6 *
7 TOTAL REVENUE = L4 + L5
8 *
9 * EXPENSES
10 *
11      SUPPLIES = FUNDS ALLOCATION * .20, PREVIOUS * 1.05
12      MAINTENANCE = 200000, PREVIOUS * 1.05
13      AMMUNITION = 40000, PREVIOUS * 1.05
14      FUEL = 90000, PREVIOUS * 1.02
15      TDY = 10000, PREVIOUS * 1.05
16      TRAINING = FUNDS ALLOCATION * .33, PREVIOUS * 1.03
17      OTHER = 5000, PREVIOUS * 1.05
18 *
19 TOTAL EXPENSES = L11 + L12 + L13 + L14 + L15 + L16 + L17
20 *
21 REMAINING FUNDS = TOTAL REVENUE - TOTAL EXPENSES
22 *
23 FUNDS UTILIZATION = TOTAL EXPENSES/TOTAL REVENUE
END OF MODEL
QUIT
DASD 19F DETACHED
R; T=0.18/0.53 17:23:55
SPOOL CONSOLE STOP CLOSE
```

```
SHERILYN
FILE SHERILYN PROCESSED
READY FOR EXECUTIVE COMMAND
MODEL INCOME
READY FOR EDIT, LAST LINE IS 23
SOLVE
MODEL INCOME  VERSION OF  03/11/86  14:42 -- 5 COLUMNS 13 VARIABLES
ENTER SOLVE OPTIONS
COMMAS
ALL
```

	1986	1987	1988	1989	1990
REVENUES					
FUNDS ALLOCATION	550,000	577,500	606,375	636,694	668,528
FUEL ALLOCATION	100,000	105,000	110,250	115,763	121,551
TOTAL REVENUE	650,000	682,500	716,625	752,456	790,079
EXPENSES					
SUPPLIES	110,000	115,500	121,275	127,339	133,706
MAINTENANCE	200,000	210,000	220,500	231,525	243,101
AMMUNITION	40,000	42,000	44,100	46,305	48,620
FUEL	90,000	91,300	93,636	95,509	97,419
TDY	10,000	10,500	11,025	11,576	12,155
TRAINING	181,500	196,020	211,702	228,638	246,929
OTHER	5,000	5,250	5,513	5,788	6,078
TOTAL EXPENSES	636,500	671,070	707,750	746,680	788,007
REMAINING FUNDS	13,500	11,430	8,875	5,777	2,072
FUNDS UTILIZATION	.9792	.9833	.9876	.9923	.9974

```
ENTER SOLVE OPTIONS
QUIT
```

MODEL INCOME VERSION OF 03/11/86 14:42 -- 5 COLUMNS 13 VARIABLES
ENTER SOLVE OPTIONS
GENREPORT QUICK

PROJECTED UNIT BUDGET

	1986	1987	1988	1989	1990
REVENUE					
FUNDS ALLOCATION	$550,000.00	$577,500.00	$606,375.00	$636,693.75	$668,528.44
FUEL ALLOCATION	$100,000.00	$105,000.00	$110,250.00	$115,762.50	$121,550.63
TOTAL REVENUE	$650,000.00	$682,500.00	$716,625.00	$752,456.25	$790,079.06
EXPENSES					
SUPPLIES	$110,000.00	$115,500.00	$121,275.00	$127,338.75	$133,705.69
MAINTENANCE	$200,000.00	$210,000.00	$220,500.00	$231,525.00	$243,101.25
AMMUNITION	$ 40,000.00	$ 42,000.00	$ 44,100.00	$ 46,305.00	$ 48,620.25
FUEL	$ 90,000.00	$ 91,800.00	$ 93,636.00	$ 95,508.72	$ 97,418.89
TDY	$ 10,000.00	$ 10,500.00	$ 11,025.00	$ 11,576.25	$ 12,155.06
TRAINING	$181,500.00	$196,020.00	$211,701.60	$228,637.73	$246,928.75
OTHER	$ 5,000.00	$ 5,250.00	$ 5,512.50	$ 5,788.13	$ 6,077.53
TOTAL EXPENSES	$636,500.00	$671,070.00	$707,750.10	$746,679.57	$788,007.42
REMAINING FUNDS	$ 13,500.00	$ 11,430.00	$ 8,874.90	$ 5,776.68	$ 2,071.64
FUNDS UTILIZATION	.98 %	.98 %	.99 %	.99 %	1.00 %

```
WHAT IF
MODEL INCOME  VERSION OF  03/11/86  14:42 -- 5 COLUMNS 13 VARIABLES
WHAT IF CASE 1
ENTER STATEMENTS
SUPPLIES = FUNDS ALLOCATION * .25, PREVIOUS * 1.05
SOLVE
ENTER SOLVE OPTIONS
COMMAS
ALL
```

```
***** WHAT IF CASE 1 *****
1 WHAT IF STATEMENT PROCESSED
```

	1986	1987	1988	1989	1990
REVENUES					
FUNDS ALLOCATION	550,000	577,500	606,375	636,694	668,528
FUEL ALLOCATION	100,000	105,000	110,250	115,763	121,551
TOTAL REVENUE	650,000	682,500	716,625	752,456	790,079
EXPENSES					
SUPPLIES	137,500	144,375	151,594	159,173	167,132
MAINTENANCE	200,000	210,000	220,500	231,525	243,101
AMMUNITION	40,000	42,000	44,100	46,305	48,620
FUEL	90,000	91,800	93,636	95,509	97,419
TDY	10,000	10,500	11,025	11,576	12,155
TRAINING	181,500	196,020	211,702	228,638	246,929
OTHER	5,000	5,250	5,513	5,788	6,078
TOTAL EXPENSES	664,000	699,945	738,069	778,514	821,434
REMAINING FUNDS	-14,000	-17,445	-21,444	-26,058	-31,355
FUNDS UTILIZATION	1.022	1.026	1.030	1.035	1.040

***** WHAT IF CASE 1 *****
1 WHAT IF STATEMENT PROCESSED

PROJECTED UNIT BUDGET

	1986	1987	1988	1989	1990
REVENUE					
FUNDS ALLOCATION	$550,000.00	$577,500.00	$606,375.00	$636,693.75	$668,528.44
FUEL ALLOCATION	$100,000.00	$105,000.00	$110,250.00	$115,762.50	$121,550.63
TOTAL REVENUE	$650,000.00	$682,500.00	$716,625.00	$752,456.25	$790,079.06
EXPENSES					
SUPPLIES	$137,500.00	$144,375.00	$151,593.75	$159,173.44	$167,132.11
MAINTENANCE	$200,000.00	$210,000.00	$220,500.00	$231,525.00	$243,101.25
AMMUNITION	$ 40,000.00	$ 42,000.00	$ 44,100.00	$ 46,305.00	$ 48,620.25
FUEL	$ 90,000.00	$ 91,800.00	$ 93,636.00	$ 95,508.72	$ 97,418.89
TDY	$ 10,000.00	$ 10,500.00	$ 11,025.00	$ 11,576.25	$ 12,155.06
TRAINING	$181,500.00	$196,020.00	$211,701.60	$228,637.73	$246,928.75
OTHER	$ 5,000.00	$ 5,250.00	$ 5,512.50	$ 5,788.13	$ 6,077.53
TOTAL EXPENSES	$664,000.00	$699,945.00	$738,068.85	$778,514.26	$821,433.84
REMAINING FUNDS	$(14,000.00)	$(17,445.00)	$(21,443.85)	$(26,058.01)	$(31,354.78)
FUNDS UTILIZATION	1.02 %	1.03 %	1.03 %	1.03 %	1.04 %

```
WHAT IF
MODEL INCOME  VERSION OF  03/11/86  14:42 -- 5 COLUMNS 13 VARIABLES
WHAT IF CASE 1
ENTER STATEMENTS
FUNDS ALLOCATION = 600000, PREVIOUS * 1.05
SUPPLIES = FUNDS ALLOCATION * .25, PREVIOUS * 1.05
FUEL = 90000, PREVIOUS * 1.05
SOLVE
ENTER SOLVE OPTIONS
COMMAS
ALL


***** WHAT IF CASE 1 *****
3 WHAT IF STATEMENTS PROCESSED
```

	1986	1987	1988	1989	1990
REVENUES					
FUNDS ALLOCATION	600,000	630,000	661,500	694,575	729,304
FUEL ALLOCATION	100,000	105,000	110,250	115,763	121,551
TOTAL REVENUE	700,000	735,000	771,750	810,338	850,854
EXPENSES					
SUPPLIES	150,000	157,500	165,375	173,644	182,326
MAINTENANCE	200,000	210,000	220,500	231,525	243,101
AMMUNITION	40,000	42,000	44,100	46,305	48,620
FUEL	90,000	94,500	99,225	104,186	109,396
TDY	10,000	10,500	11,025	11,576	12,155
TRAINING	198,000	213,840	230,947	249,423	269,377
OTHER	5,000	5,250	5,513	5,788	6,078
TOTAL EXPENSES	693,000	733,590	776,635	822,447	871,052
REMAINING FUNDS	7,000	1,410	-4,935	-12,110	-20,198

***** WHAT IF CASE 1 *****
3 WHAT IF STATEMENTS PROCESSED

PROJECTED UNIT BUDGET

	1986	1987	1988	1989	1990
REVENUE					
FUNDS ALLOCATION	$600,000.00	$630,000.00	$661,500.00	$694,575.00	$729,303.75
FUEL ALLOCATION	$100,000.00	$105,000.00	$110,250.00	$115,762.50	$121,550.63
TOTAL REVENUE	$700,000.00	$735,000.00	$771,750.00	$810,337.50	$850,854.38
EXPENSES					
SUPPLIES	$150,000.00	$157,500.00	$165,375.00	$173,643.75	$182,325.94
MAINTENANCE	$200,000.00	$210,000.00	$220,500.00	$231,525.00	$243,101.25
AMMUNITION	$ 40,000.00	$ 42,000.00	$ 44,100.00	$ 46,305.00	$ 48,620.25
FUEL	$ 90,000.00	$ 94,500.00	$ 99,225.00	$104,186.25	$109,395.56
TDY	$ 10,000.00	$ 10,500.00	$ 11,025.00	$ 11,576.25	$ 12,155.06
TRAINING	$198,000.00	$213,840.00	$230,947.20	$249,422.98	$269,376.81
OTHER	$ 5,000.00	$ 5,250.00	$ 5,512.50	$ 5,788.13	$ 6,077.53
TOTAL EXPENSES	$693,000.00	$733,590.00	$776,684.70	$822,447.35	$871,052.41
REMAINING FUNDS	$ 7,000.00	$ 1,410.00	$ (4,934.70)	$(12,109.85)	$(20,198.03)
FUNDS UTILIZATION	.99 %	1.00 %	1.01 %	1.01 %	1.02 %

APPENDIX C

S-3 AND S-4 USAGE

OF DSS WITH LOTUS

Appendix C illustrates the use of an extremely simple DSS model for fuel resource allocation using the Lotus spreadsheet package. The S-3 Section (Operations) and the S-4 Section (Logistics) would find such a model beneficial. In creating this fuel resource allocation model the user first inputs data on the fuel resources available, the unit exercise requirements, miscellaneous data, and vehicle fuel usage rates (as given in FM 101-10-1 Staff Officers Field Manual of Organizational, Technical, Logistical Data). The fuel usage per training exercise for each subordinate unit and for the complete battalion are then calculated for the different categories of usage. The yearly fuel usage for exercise requirements can be calculated for each unit and compared to the amount allocated by the logistics officer to determine the amount of fuel remaining in each unit and the percentage of fuel utilization. Using Lotus' graphics capability the user can prepare graphs illustrating the yearly fuel usage and the percentage of each fuel allocated to each unit under this plan. Then the model can be changed in the subsequent printouts to determine the effect of increasing the exercise requirements (for all units or participating units), the distance to the training area, or the length of the exercise.

By utilizing such a model the S-3 and S-4 can properly allocate fuel among the units to support the established training requirements. The training plans can then be manipulated (distance, length, number) to stay within the constraints established by higher headquarters while achieving the greatest training benefit. Additionally such a system may increase the cooperation and communication between the operations and logistics staff sections which will truly benefit the unit.

FUEL RESOURCE ALLOCATION MODEL
AIR DEFENSE ARTILLERY BATTALION (CHAPARRAL/VULCAN, SELF-PROPELLED)

ENVIRONMENTAL CONSTRAINTS

Resources Available

Gasoline (MOGAS)(gals):	45000
Diesel Fuel (DF)(gals):	35000
Vehicles:	As Per TOE 44-325H

Exercise Requirements (FTX)(per year)

Battalion Field Training Exercises:	4
HHB Field Training Exercises:	4
A Battery Field Training Exercises:	4
B Battery Field Training Exercises:	4
C Battery Field Training Exercises:	4
D Battery Field Training Exercises:	4

DATA

Distance To/From Training Area (km):	100.0	(round trip)
Length of Exercise (days)	3.0	(bivouac only)
Supply Trip Usage Rate (% total consump):	0.1	(movement only)
Service Usage Rate (per day):	16.0	
Wastage Rate (% total consumption):	0.1	
Stationary Equipment Usage (hrs/day):	20.0	

USAGE RATES

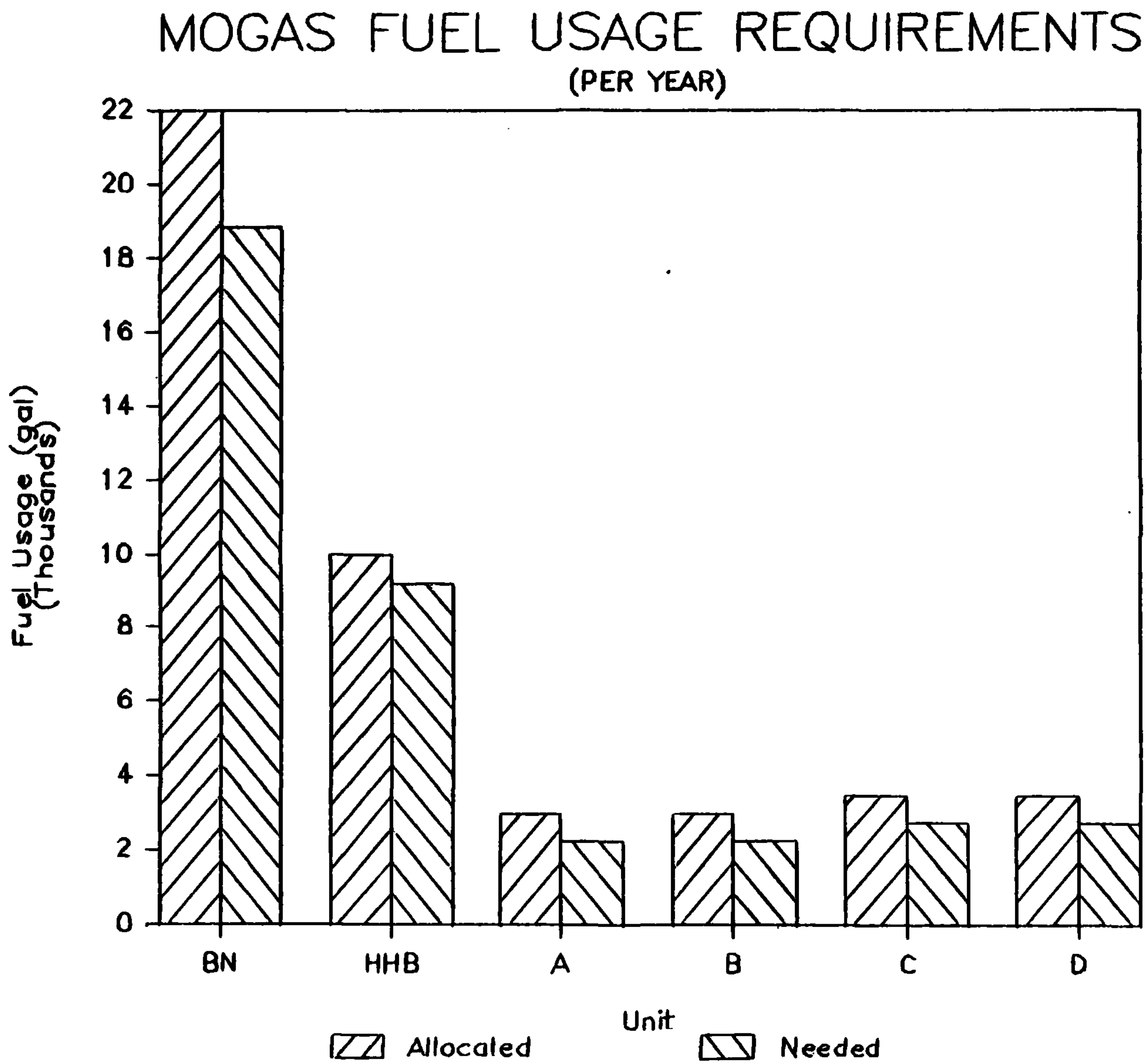
	GENERATORS (gal/hr)		HEATING (gal/hr)		STAT. EQUIP. (gal/hr)		STAT. EQUIP. (VEH) (gal/hr)		TRACKED VEHICLE (gal/km)		WHEELED VEHICLE (gal/km)	
	MOGAS	DF	MOGAS	DF	MOGAS	DF	MOGAS	DF	MOGAS	DF	MOGAS	DF
Battalion	46.0	0.0	12.0	20.0	5.0	0.0	5.0	0.0	0.0	8.3	1.6	6.9
HHB Battery	27.0	0.0	4.0	4.0	1.0	0.0	1.0	0.0	0.0	0.0	0.9	1.4
A,B Batteries	4.0	0.0	2.0	4.0	1.0	0.0	1.0	0.0	0.0	3.2	0.2	1.5
C,D Batteries	6.0	0.0	2.0	4.0	1.0	0.0	1.0	0.0	0.0	1.0	0.2	1.3

FUEL USAGE MODEL
(PER FTX)

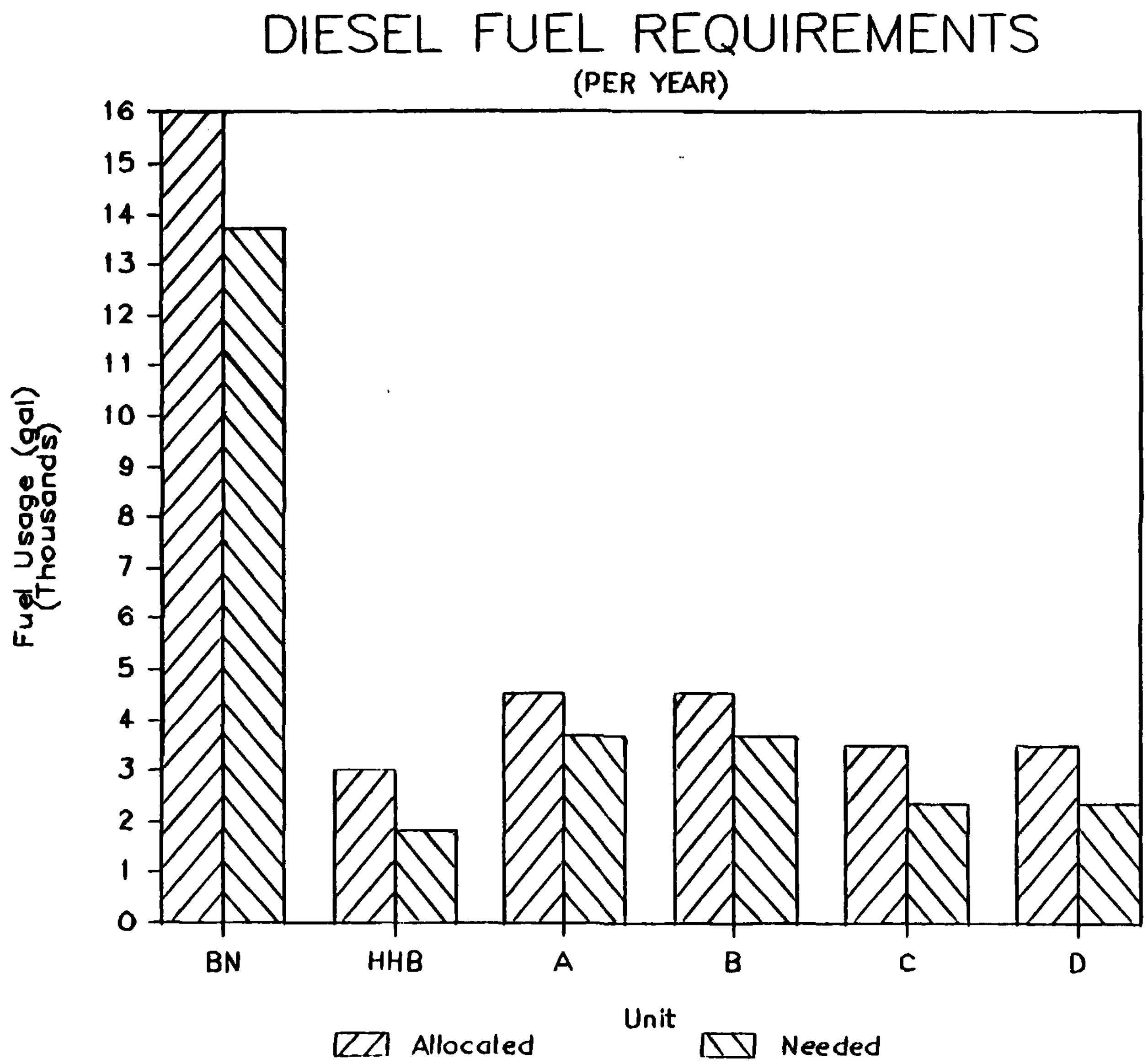
	MOVEMENT (gal)		SUPPLY (gal)		SERVICE (gal)		WASTAGE (gal)		STAT. EQUIP. (gal)		TOTAL (gal)	
	MOGAS	DF	MOGAS	DF	MOGAS	DF	MOGAS	DF	MOGAS	DF	MOGAS	DF
Battalion	160.0	1520.0	16.0	152.0	25.6	243.2	428.2	311.5	4080.0	1200.0	4709.8	3426.7
HHB Battery	90.0	140.0	9.0	14.0	14.4	22.4	209.3	41.6	1980.0	240.0	2302.7	458.0
A Battery	20.0	470.0	2.0	47.0	3.2	75.2	50.5	83.2	480.0	240.0	555.7	915.4
B Battery	20.0	470.0	2.0	47.0	3.2	75.2	50.5	83.2	480.0	240.0	555.7	915.4
C Battery	20.0	230.0	2.0	23.0	3.2	36.8	62.5	53.0	600.0	240.0	687.7	582.8
D Battery	20.0	230.0	2.0	23.0	3.2	36.8	62.5	53.0	600.0	240.0	687.7	582.8

FUEL USAGE REQUIREMENTS
(PER YEAR)

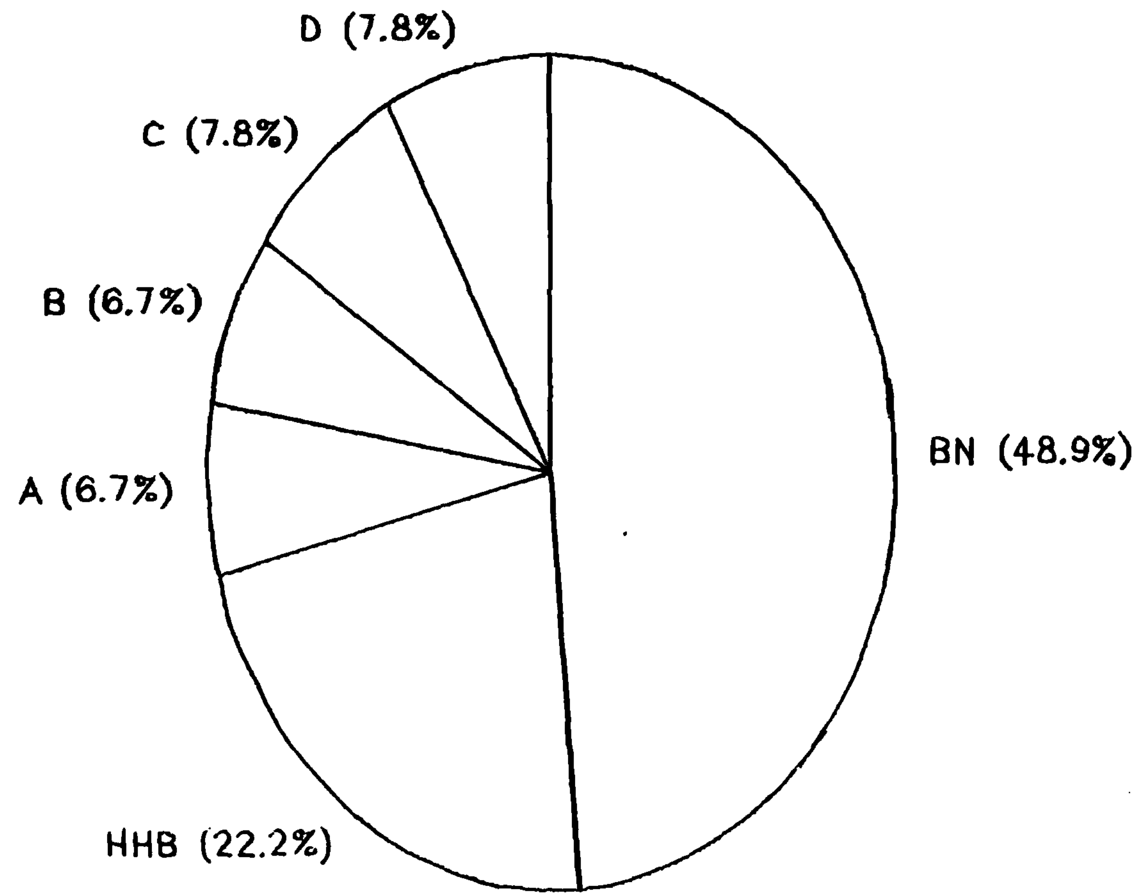
	ALLOCATED (gal)		NEEDED (gal)		REMAINING (gal)		UTILIZATION (%)	
	MOGAS	DF	MOGAS	DF	MOGAS	DF	MOGAS	DF
Battalion	22000.0	16000.0	18839.0	13706.9	3161.0	2293.1	85.63	85.67
IHB Battery	10000.0	3000.0	9211.0	1832.2	789.0	1167.8	92.11	61.07
A Battery	3000.0	4500.0	2222.9	3661.7	777.1	838.3	74.10	81.37
B Battery	3000.0	4500.0	2222.9	3661.7	777.1	838.3	74.10	81.37
C Battery	3500.0	3500.0	2750.9	2331.1	749.1	1168.9	78.60	66.60
D Battery	3500.0	3500.0	2750.9	2331.1	749.1	1168.9	78.60	66.60
Total	45000.0	35000.0	37997.5	27524.6	7002.5	7475.4	84.44	78.64



MOGAS FUEL USAGE REQUIREMENTS
(PER YEAR)
Fuel Usage (gal)
(Thousands)
22
20
18
16
14
12
10
8
6
4
2
0
BN
HHB
A
B
C
D
Unit
Allocated
Needed

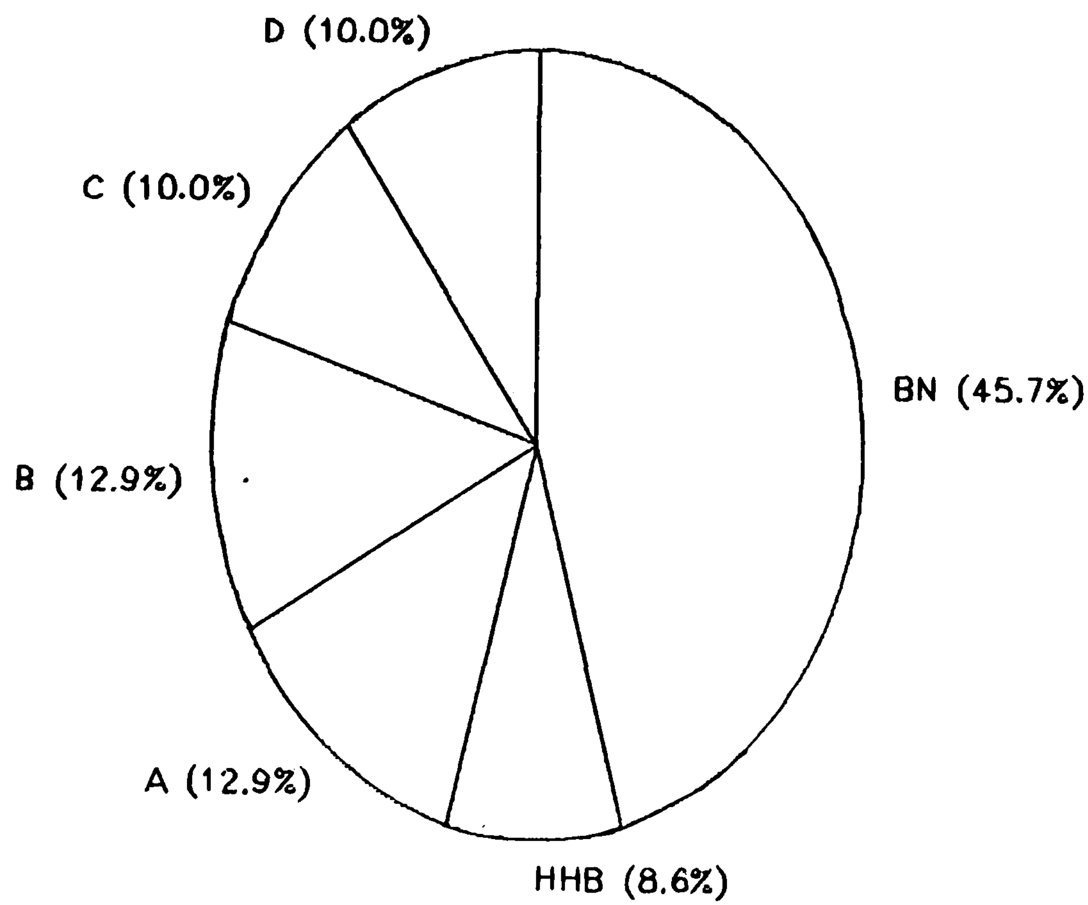

DIESEL FUEL REQUIREMENTS
(PER YEAR)
Fuel Usage (gal)
(Thousands)
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
BN
HHB
A
B
C
D
Unit
Allocated
Needed

MOGAS ALLOCATION
(PER YEAR)



DIESEL FUEL ALLOCATION

(PER YEAR)



FUEL RESOURCE ALLOCATION MODEL
AIR DEFENSE ARTILLERY BATTALION (CHAPARRAL/VULCAN, SELF-PROPELLED)

ENVIRONMENTAL CONSTRAINTS

Resources Available

Gasoline (MOGAS)(gals):	45000
Diesel Fuel (DF)(gals):	35000
Vehicles:	As Per TOE 44-325H

Exercise Requirements (FTX)(per year)

Battalion Field Training Exercises:	5
HHB Field Training Exercises:	5
A Battery Field Training Exercises:	5
B Battery Field Training Exercises:	5
C Battery Field Training Exercises:	5
D Battery Field Training Exercises:	5

DATA

Distance To/From Training Area (km):	100.0	(round trip)
Length of Exercise (days)	3.0	(bivouac only)
Supply Trip Usage Rate (% total consump):	0.1	(movement only)
Service Usage Rate (per day):	16.0	
Wastage Rate (% total consumption):	0.1	
Stationary Equipment Usage (hrs/day):	20.0	

USAGE RATES

	GENERATORS (gal/hr)		HEATING (gal/hr)		STAT. EQUIP. (gal/hr)		STAT. EQUIP. (VEH) (gal/hr)		TRACKED VEHICLE (gal/km)		WHEELED VEHICLE (gal/km)	
	MOGAS	DF	MOGAS	DF	MOGAS	DF	MOGAS	DF	MOGAS	DF	MOGAS	DF
Battalion	46.0	0.0	12.0	20.0	5.0	0.0	5.0	0.0	0.0	8.3	1.6	6.9
HHB Battery	27.0	0.0	4.0	4.0	1.0	0.0	1.0	0.0	0.0	0.0	0.9	1.4
A,B Batteries	4.0	0.0	2.0	4.0	1.0	0.0	1.0	0.0	0.0	3.2	0.2	1.5
C,D Batteries	6.0	0.0	2.0	4.0	1.0	0.0	1.0	0.0	0.0	1.0	0.2	1.3

FUEL USAGE MODEL
(PER FTX)

	MOVEMENT (gal)		SUPPLY (gal)		SERVICE (gal)		WASTAGE (gal)		STAT. EQUIP. (gal)		TOTAL (gal)	
	MOGAS	DF	MOGAS	DF	MOGAS	DF	MOGAS	DF	MOGAS	DF	MOGAS	DF
Battalion	160.0	1520.0	16.0	152.0	25.6	243.2	428.2	311.5	4080.0	1200.0	4709.8	3426.7
HHB Battery	90.0	140.0	9.0	14.0	14.4	22.4	209.3	41.6	1980.0	240.0	2302.7	458.0
A Battery	20.0	470.0	2.0	47.0	3.2	75.2	50.5	83.2	480.0	240.0	555.7	915.4
B Battery	20.0	470.0	2.0	47.0	3.2	75.2	50.5	83.2	480.0	240.0	555.7	915.4
C Battery	20.0	230.0	2.0	23.0	3.2	36.8	62.5	53.0	600.0	240.0	687.7	582.8
D Battery	20.0	230.0	2.0	23.0	3.2	36.8	62.5	53.0	600.0	240.0	687.7	582.8

FUEL USAGE REQUIREMENTS
(PER YEAR)

	ALLOCATED (gal)		NEEDED (gal)		REMAINING (gal)		UTILIZATION (%)	
	MOGAS	DF	MOGAS	DF	MOGAS	DF	MOGAS	DF
Battalion	22000.0	16000.0	23548.8	17133.6	-1548.8	-1133.6	107.04	107.09
HHB Battery	10000.0	3000.0	11513.7	2290.2	-1513.7	709.8	115.14	76.34
A Battery	3000.0	4500.0	2778.6	4577.1	221.4	-77.1	92.62	101.71
B Battery	3000.0	4500.0	2778.6	4577.1	221.4	-77.1	92.62	101.71
C Battery	3500.0	3500.0	3438.6	2913.9	61.4	586.1	98.25	83.25
D Battery	3500.0	3500.0	3438.6	2913.9	61.4	586.1	98.25	83.25
Total	45000.0	35000.0	47496.9	34405.8	-2496.9	594.2	105.55	98.30

FUEL RESOURCE ALLOCATION MODEL
AIR DEFENSE ARTILLERY BATTALION (CHAPARRAL/VULCAN, SELF-PROPELLED)

ENVIRONMENTAL CONSTRAINTS

Resources Available

Gasoline (MOGAS)(gals):	45000
Diesel Fuel (DF)(gals):	35000
Vehicles:	As Per TOE 44-325H

Exercise Requirements (FTX)(per year)

Battalion Field Training Exercises:	4
HHB Field Training Exercises:	4
A Battery Field Training Exercises:	5
B Battery Field Training Exercises:	5
C Battery Field Training Exercises:	5
D Battery Field Training Exercises:	5

DATA

Distance To/From Training Area (km):	100.0	(round trip)
Length of Exercise (days)	3.0	(bivouac only)
Supply Trip Usage Rate (% total consump):	0.1	(movement only)
Service Usage Rate (per day):	16.0	
Wastage Rate (% total consumption):	0.1	
Stationary Equipment Usage (hrs/day):	20.0	

USAGE RATES

	GENERATORS (gal/hr)		HEATING (gal/hr)		STAT. EQUIP. (gal/hr)		STAT. EQUIP. (VEH) (gal/hr)		TRACKED VEHICLE (gal/km)		WHEELED VEHICLE (gal/km)	
	MOGAS	DF	MOGAS	DF	MOGAS	DF	MOGAS	DF	MOGAS	DF	MOGAS	DF
Battalion	46.0	0.0	12.0	20.0	5.0	0.0	5.0	0.0	0.0	8.3	1.6	6.9
HHB Battery	27.0	0.0	4.0	4.0	1.0	0.0	1.0	0.0	0.0	0.0	0.9	1.4
A,B Batteries	4.0	0.0	2.0	4.0	1.0	0.0	1.0	0.0	0.0	3.2	0.2	1.5
C,D Batteries	6.0	0.0	2.0	4.0	1.0	0.0	1.0	0.0	0.0	1.0	0.2	1.3

FUEL USAGE MODEL
(PER FTX)

	MOVEMENT (gal)		SUPPLY (gal)		SERVICE (gal)		WASTAGE (gal)		STAT. EQUIP. (gal)		TOTAL (gal)	
	MOGAS	DF	MOGAS	DF	MOGAS	DF	MOGAS	DF	MOGAS	DF	MOGAS	DF
Battalion	160.0	1520.0	16.0	152.0	25.6	243.2	428.2	311.5	4080.0	1200.0	4709.8	3426.7
HHB Battery	90.0	140.0	9.0	14.0	14.4	22.4	209.3	41.6	1980.0	240.0	2302.7	458.0
A Battery	20.0	470.0	2.0	47.0	3.2	75.2	50.5	83.2	480.0	240.0	555.7	915.4
B Battery	20.0	470.0	2.0	47.0	3.2	75.2	50.5	83.2	480.0	240.0	555.7	915.4
C Battery	20.0	230.0	2.0	23.0	3.2	36.8	62.5	53.0	600.0	240.0	687.7	582.8
D Battery	20.0	230.0	2.0	23.0	3.2	36.8	62.5	53.0	600.0	240.0	687.7	582.8

FUEL USAGE REQUIREMENTS
(PER YEAR)

	ALLOCATED (gal)		NEEDED (gal)		REMAINING (gal)		UTILIZATION (%)	
	MOGAS	DF	MOGAS	DF	MOGAS	DF	MOGAS	DF
Battalion	22000.0	16000.0	18839.0	13706.9	3161.0	2293.1	85.63	85.67
HHB Battery	10000.0	3000.0	9211.0	1832.2	789.0	1167.8	92.11	61.07
A Battery	3000.0	4500.0	2778.6	4577.1	221.4	-77.1	92.62	101.71
B Battery	3000.0	4500.0	2778.6	4577.1	221.4	-77.1	92.62	101.71
C Battery	3500.0	3500.0	3438.6	2913.9	61.4	586.1	98.25	83.25
D Battery	3500.0	3500.0	3438.6	2913.9	61.4	586.1	98.25	83.25
Total	45000.0	35000.0	40484.4	30521.0	4515.6	4479.0	89.97	87.20

FUEL RESOURCE ALLOCATION MODEL
AIR DEFENSE ARTILLERY BATTALION (CHAPARRAL/VULCAN, SELF-PROPELLED)

ENVIRONMENTAL CONSTRAINTS

Resources Available

Gasoline (MOGAS)(gals):	45000
Diesel Fuel (DF)(gals):	35000
Vehicles:	As Per TOE 44-325H

Exercise Requirements (FTX)(per year)

Battalion Field Training Exercises:	5
HHB Field Training Exercises:	5
A Battery Field Training Exercises:	5
B Battery Field Training Exercises:	5
C Battery Field Training Exercises:	5
D Battery Field Training Exercises:	5

DATA

Distance To/From Training Area (km):	60.0	(round trip)
Length of Exercise (days)	3.0	(bivouac only)
Supply Trip Usage Rate (% total consump):	0.1	(movement only)
Service Usage Rate (per day):	16.0	
Wastage Rate (% total consumption):	0.1	
Stationary Equipment Usage (hrs/day):	20.0	

USAGE RATES

	GENERATORS (gal/hr)		HEATING (gal/hr)		STAT. EQUIP. (gal/hr)		STAT. EQUIP. (VEH) (gal/hr)		TRACKED VEHICLE (gal/km)		WHEELED VEHICLE (gal/km)	
	MOGAS	DF	MOGAS	DF	MOGAS	DF	MOGAS	DF	MOGAS	DF	MOGAS	DF
Battalion	46.0	0.0	12.0	20.0	5.0	0.0	5.0	0.0	0.0	8.3	1.6	6.9
HHB Battery	27.0	0.0	4.0	4.0	1.0	0.0	1.0	0.0	0.0	0.0	0.9	1.4
A,B Batteries	4.0	0.0	2.0	4.0	1.0	0.0	1.0	0.0	0.0	3.2	0.2	1.5
C,D Batteries	6.0	0.0	2.0	4.0	1.0	0.0	1.0	0.0	0.0	1.0	0.2	1.3

FUEL USAGE MODEL
(PER FTX)

	MOVEMENT (gal)		SUPPLY (gal)		SERVICE (gal)		WASTAGE (gal)		STAT. EQUIP. (gal)		TOTAL (gal)	
	MOGAS	DF	MOGAS	DF	MOGAS	DF	MOGAS	DF	MOGAS	DF	MOGAS	DF
Battalion	96.0	912.0	9.6	91.2	25.6	243.2	421.1	244.6	4080.0	1200.0	4632.3	2691.0
HHB Battery	54.0	84.0	5.4	8.4	14.4	22.4	205.4	35.5	1980.0	240.0	2259.2	390.3
A Battery	12.0	282.0	1.2	28.2	3.2	75.2	49.6	62.5	480.0	240.0	546.0	687.9
B Battery	12.0	282.0	1.2	28.2	3.2	75.2	49.6	62.5	480.0	240.0	546.0	687.9
C Battery	12.0	138.0	1.2	13.8	3.2	36.8	61.6	42.9	600.0	240.0	678.0	471.5
D Battery	12.0	138.0	1.2	13.8	3.2	36.8	61.6	42.9	600.0	240.0	678.0	471.5

FUEL USAGE REQUIREMENTS
(PER YEAR)

	ALLOCATED (gal)		NEEDED (gal)		REMAINING (gal)		UTILIZATION (%)	
	MOGAS	DF	MOGAS	DF	MOGAS	DF	MOGAS	DF
Battalion	22000.0	16000.0	23161.6	13455.2	-1161.6	2544.8	105.28	84.10
HHB Battery	10000.0	3000.0	11295.9	1951.4	-1295.9	1048.6	112.96	65.05
A Battery	3000.0	4500.0	2730.2	3439.7	269.8	1060.3	91.01	76.44
B Battery	3000.0	4500.0	2730.2	3439.7	269.8	1060.3	91.01	76.44
C Battery	3500.0	3500.0	3390.2	2357.3	109.8	1142.7	96.86	67.35
D Battery	3500.0	3500.0	3390.2	2357.3	109.8	1142.7	96.86	67.35
Total	45000.0	35000.0	46698.3	27000.6	-1698.3	7999.4	103.77	77.14

FUEL RESOURCE ALLOCATION MODEL
AIR DEFENSE ARTILLERY BATTALION (CHAPARRAL/VULCAN, SELF-PROPELLED)

ENVIRONMENTAL CONSTRAINTS

Resources Available

Gasoline (MOGAS)(gals):	45000
Diesel Fuel (DF)(gals):	35000
Vehicles:	As Per TOE 44-325H

Exercise Requirements (FTX)(per year)

Battalion Field Training Exercises:	5
HHB Field Training Exercises:	5
A Battery Field Training Exercises:	5
B Battery Field Training Exercises:	5
C Battery Field Training Exercises:	5
D Battery Field Training Exercises:	5

DATA

Distance To/From Training Area (km):	100.0	(round trip)
Length of Exercise (days)	2.0	(bivouac only)
Supply Trip Usage Rate (% total consump):	0.1	(movement only)
Service Usage Rate (per day):	16.0	
Wastage Rate (% total consumption):	0.1	
Stationary Equipment Usage (hrs/day):	20.0	

USAGE RATES

	GENERATORS (gal/hr)		HEATING (gal/hr)		STAT. EQUIP. (gal/hr)		STAT. EQUIP. (VEH) (gal/hr)		TRACKED VEHICLE (gal/km)		WHEELED VEHICLE (gal/km)	
	MOGAS	DF	MOGAS	DF	MOGAS	DF	MOGAS	DF	MOGAS	DF	MOGAS	DF
Battalion	46.0	0.0	12.0	20.0	5.0	0.0	5.0	0.0	0.0	8.3	1.6	6.9
HHB Battery	27.0	0.0	4.0	4.0	1.0	0.0	1.0	0.0	0.0	0.0	0.9	1.4
A,B Batteries	4.0	0.0	2.0	4.0	1.0	0.0	1.0	0.0	0.0	3.2	0.2	1.5
C,D Batteries	6.0	0.0	2.0	4.0	1.0	0.0	1.0	0.0	0.0	1.0	0.2	1.3

FUEL USAGE MODEL
(PER FTX)

	MOVEMENT (gal)		SUPPLY (gal)		SERVICE (gal)		WASTAGE (gal)		STAT. EQUIP. (gal)		TOTAL (gal)	
	MOGAS	DF	MOGAS	DF	MOGAS	DF	MOGAS	DF	MOGAS	DF	MOGAS	DF
Battalion	160.0	1520.0	16.0	152.0	25.6	243.2	292.2	271.5	2720.0	800.0	3213.8	2986.7
HHB Battery	90.0	140.0	9.0	14.0	14.4	22.4	143.3	33.6	1320.0	160.0	1576.7	370.0
A Battery	20.0	470.0	2.0	47.0	3.2	75.2	34.5	75.2	320.0	160.0	379.7	827.4
B Battery	20.0	470.0	2.0	47.0	3.2	75.2	34.5	75.2	320.0	160.0	379.7	827.4
C Battery	20.0	230.0	2.0	23.0	3.2	36.8	42.5	45.0	400.0	160.0	467.7	494.8
D Battery	20.0	230.0	2.0	23.0	3.2	36.8	42.5	45.0	400.0	160.0	467.7	494.8

FUEL USAGE REQUIREMENTS
(PER YEAR)

	ALLOCATED (gal)		NEEDED (gal)		REMAINING (gal)		UTILIZATION (%)	
	MOGAS	DF	MOGAS	DF	MOGAS	DF	MOGAS	DF
Battalion	22000.0	16000.0	16068.8	14933.6	5931.2	1066.4	73.04	93.34
HHB Battery	10000.0	3000.0	7883.7	1850.2	2116.3	1149.8	78.84	61.67
A Battery	3000.0	4500.0	1898.6	4137.1	1101.4	362.9	63.29	91.94
B Battery	3000.0	4500.0	1898.6	4137.1	1101.4	362.9	63.29	91.94
C Battery	3500.0	3500.0	2338.6	2473.9	1161.4	1026.1	66.82	70.68
D Battery	3500.0	3500.0	2338.6	2473.9	1161.4	1026.1	66.82	70.68
Total	45000.0	35000.0	32426.9	30005.8	12573.1	4994.2	72.06	85.73

ENDNOTES

ENDNOTES

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[7]Huber, "The Nature of Organizational Decision-Making and the Design of Decision Support Systems," pp. 3,5.

[8]Huber, "The Nature of Organizational Decision-Making and the Design of Decision Support Systems," pp. 3,6.

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[12]George P. Huber, "Effects of Decision Support Systems on Governmental Organization and Policy Making," paper presented to the International Council for Automatic Data Processing in Governmental Administration, Copenhagen, Denmark, 13-15 September 1983, p. 3.

[13]Charles C. Holt, "How Can Computers Help in Formulating Decision Problems?" working paper at the Graduate School of Business, The University of Texas at Austin, Austin, Texas, p. 3.

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[18]Bonczek, pp. 74-75, 77-79, 80, 82.

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[21]Markus, p. 11.

[22]Markus, pp. 8-9.

[23]Markus, pp. 16, 37-44.

[24]Pfeffer, pp. 65, 67.

[25]Markus, p. 16.

[26]James I. Cash, Jr., F. Warren McFarlan, and James L. McKenny, Corporate Information Systems Management: Text and Cases (Homewood, Illinois: Richard D. Irwin, Inc., 1983), pp. 29-30.

[27]Pfeffer, pp. 215-217.

[28]Blake Ives, Scott Hamilton, and Gordon B. Davis, "A Framework for Research in Computer-Based Management Information Systems," Management Science (September 1980, Vol. 26, No. 9), p. 916.

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VITA

PII Redacted

George Richard Bruce [redacted] the son of Joan Batson Bruce and Robert Cleveland Bruce, Sr. After completing his work at Gulfport East High School, Gulfport, Mississippi in 1973, he entered The United States Military Academy at West Point, New York. He received the degree of Bachelor of Science from The United States Military Academy in June 1977. Since that time he has served as a platoon leader, battery executive officer, battalion logistics officer, battalion assistant operations officer, and battery commander in two Army Chaparral/Vulcan Air Defense Battalions located in Hawaii, Texas, and Louisiana. In September 1984, he entered the Graduate School of Business at The University of Texas at Austin.

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