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The U.S. Army Research Institute for the Behavioral and Social Sciences, with the assistance of the General Research Corporation, undertook a project to modernize and improve the way the Army determines an individual's Military Occupational Specialty (MOS) at time of enlistment. Researchers developed the Enlisted Personnel Allocation System (EPAS). This report is the final report for the EPAS project. It summarizes the key research issues and findings resulting from this effort. Keywords: Army personnel ... (RWJ)

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Enlisted Personnel Allocation System: Final Report

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July 1990

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FOR THE BEHAVIORAL AND SOCIAL SCIENCES

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of the Deputy Chief of Staff for Personnel

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FOREWORD

The U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) undertook a comprehensive research program to improve the selection, classification, and allocation of new Army applicants. A key part of this program is the Enlisted Personnel Allocation System (EPAS). EPAS significantly improves predicted performance and retention behavior through new application of techniques used in operations research, computer science, and mathematics. This report summarizes the results of the EPAS project.

The Memorandum of Agreement for this research was titled "Improvements to Current Enlisted Personnel Selection and Classification System." It was signed by Major General W. G. O'Leksy, Director of Military Personnel Management (DMPM), and COL V. D. Henderson, Commander of ARI in October 1985.

Product delivery briefs validating the research and planning for its implementation were provided to both the Enlisted Accession Division of DMPM and the Deputy Chief of Staff for Personnel in March 1990.

EDGAR M. JOHNSON
Technical Director

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ENLISTED PERSONNEL ALLOCATION SYSTEM: FINAL REPORT

EXECUTIVE SUMMARY

Requirement:

The Army's present person-job-match (PJM) system has substantial opportunities for improvement. These include assigning more enlistees to jobs that maximize their expected performance and minimize their attrition and holding open selected jobs that can attract high-quality applicants. Key requirements for realizing these improvements include the ability to look ahead at the supply of applicants and the job training requirements, to identify an optimal combination of projected supply and job requirements, and to transform the results of the optimization into a usable, sequential format compatible with the Army's current selection, classification, and allocation procedures.

Procedure:

The authors have developed a prototype decision support system (DSS) that incorporates advanced operations research techniques to improve the Army's person-job-match capabilities. Called the Enlisted Personnel Allocation System (EPAS), this system provides the proof of principle of the integration of techniques from a variety of disciplines to address the PJM requirement. Specific techniques included in the prototype are clustering techniques, forecasting, large-scale linear optimization, and heuristic simulation.

Because of the complexity of this effort, the authors first developed a reduced scale prototype on a Wicat minicomputer to evaluate the system concept. This prototype validated the approach to the problem, but proved impractical for larger scale efforts because of the solution times involved. The prototype system was transferred to the National Institute of Health (NIH) Computer Facility for more extensive testing. The NIH version of the system demonstrated the ability to process realistically sized problems in a practical time. The NIH prototype was then transferred to the Army Information System's Command computer at the Pentagon (ISC-P) for final testing. The ISC-P system was further enhanced to include features based on continuing research and analysis of the PJM process and to demonstrate the ability to process problems in an operational environment.

Findings:

The prototype system validated the EPAS design concept. The prototype demonstrated the feasibility of using this complex DSS to guide Army guidance counselors' classification decisions and to evaluate recruiting strategies.

Refinement and testing of EPAS further demonstrated EPAS'S capabilities and flexibility. The EPAS concept represents a significant improvement over current person-job-match systems.

Utilization of Findings:

The present work has provided a sound justification for continued development of the EPAS concept. Detailed analysis of the Army's functional requirements in the recruiting, allocation, and training areas should be conducted to clearly identify functionally based issues and requirements. This analysis should include both policy analysis and long-range planning requirements, as well as day-to-day allocation of applicants.

From these functional definitions, an operational system based on the EPAS research can be developed. Such a system would present the Army significant opportunities for cost savings and improved utilization of available recruit resources while functioning within the parameters of its policy guidelines and legal restrictions.

ENLISTED PERSONNEL ALLOCATION SYSTEM: FINAL REPORT

CONTENTS

Page

LIST OF FIGURES

Page

LIST OF TABLES

ENLISTED PERSONNEL ALLOCATION SYSTEM: FINAL REPORT

I. INTRODUCTION

The Army Research Institute for the Behavioral and Social Sciences (ARI-PERI) sponsored a major research effort to improve the "selection, classification, and utilization of Army enlisted personnel." The underlying approach associated with the required research was divided into two major projects:

Project A -- the development and validation of improved selection and classification instruments and standards.

Project B -- the identification of techniques for, and development of, a prototype computerized personnel allocation system.

The second of these projects, Project B, was awarded to the General Research Corporation (GRC) in September of 1982. The major objective of Project B, as defined in the original statement of work (SOW, page 2), was to:

> "...develop a prototype system to link personnel resources to Army requirements in ways which will optimize the total effectiveness of the Army. This research should yield a set of operation, computer-assisted, decision aids for military personnel actions. ... The research will build on the state-of-the-art in such areas as: differential classification of people/jobs, prediction of employee work behavior, optimization, algorithms, methods of combining multiple objectives, and estimation of utility or pay-off equations as used (or planned for) the Air Force preenlistment, person-job match system."

GRC developed the Enlisted Personnel Allocation System (EPAS) to meet the requirements of this contract.

STATEMENT OF PROBLEM

Each year, the Army routinely processes approximately 140,000 non-prior service (NPS) applicants for active duty. Army policy requires that the MOS in which each new recruit is to be trained be determined at the time of enlistment. The applicant/MOS classifications made at this time will have significant impact on numerous operational issues, including:

- Recruiting effectiveness
- Force readiness
- Soldier performance
- Retainability

In theory, each of these applicants could be eligible for approximately 6,000 Military Occupational Specialty (MOS)/training start dates, resulting in some 840 million possible combinations of applicants, MOS, and start dates. In this idealized association, all applicants have an equal ability and propensity to fill any position in the Army.

In reality, of course, this idealized situation does not occur. Applicants have a wide range of aptitudes, interests, and abilities. Each of these individual characteristics has a direct bearing on how well individuals will be able to perform particular jobs, how successful they will be in the requisite training, what their propensity will be to complete their initial term of enlistment, and what their inclination toward reenlistment will be.

In addition to differences within the applicant population, the skill set also exhibits a great deal of variability. Army policy will dictate such factors as priority, minimum qualifying factors (aptitude score, physical requirements, etc.), and desired policy objectives (e.g., quality goals). Finally, the availability of training varies over time as a function of such factors as Delayed Entry Program (DEP) policy, size and frequency of classes, etc.

The Army Accession Process

Making classification decisions effectively and efficiently requires an understanding of the relationship of an individual's characteristics to probable performance in the Army in some specific MOS. This, in turn, requires both the ability to quantify this relationship and the means to systematically apply this knowledge. These requirements are addressed by Projects A and B, respectively. That is, Project A addresses the quantification and validation of predicted performance as a function of individual characteristics. Project B deals with identification and verification of means by which these quantifications can be applied.

Eligibility Standards

The Army uses the Armed Services Vocational Aptitude Battery (ASVAB) to determine an applicant's basic qualification for entry into the Army. The ASVAB consists of ten specific subtests. The Army generates normalized ASVAB Composites of the subtests as depicted in Table 1. One of these composites, the Armed Forces Qualification Test (AFQT), defines basic entry eligibility. The other nine tests are used for qualification within job "families."

AFQT scores are further clustered into groups, called AFQT Categories, based on the percentile distributions. The AFQT Categories, with their corresponding AFQT percentile scores, are shown in Table 2. The Army particularly desires applicants who are high school graduates and whose AFQT scores place them in the top half of the general population (AFQT Categories I-IIIA). The Army has administratively restricted the number of applicants from AFQT Category IV who are high school graduates. In addition, Congress has prohibited the Army's accepting AFQT Category IV applicants without a high school diploma or applicants from the bottom ten percent (AFQT Category V).

Table 1. Army Aptitude Area Composites.

APT AREA	AR (Arithmetic Reasoning)	AS (Auto/Shop Information)	CS (Coding Speed)	EI (Electronics Information)	GS (General Science)	MC (Mechanical Comprehension)	MK (Mathematical Knowledge)	NO (Numerical Operations)	VE (Verbal)	
CL	x						x		x	Clerical/Administration
CO	x	x	x			x				Combat
EL	x			x	x		x			Electronics Repair
FA	x		x			x	x			Field Artillery
GM		x		x	x		x			General Maintenance
MM		x		x		x		x		Mechanical Maintenance
OF		x				x		x	x	Operator/Food
SC		x	x					x	x	Surveillance/Communication
ST	x	x					x		x	Skilled Technical
AFQT	x						x		x	Armed Forces Qualification Test

Applicant Screening and Processing

Figure 1 illustrates the steps an applicant goes through in the enlistment process. The applicant first takes the ASVAB to determine basic eligibility, then goes through a series of additional screening activities to determine physical and moral qualifications. Presuming the applicant meets all minimum qualifications, s/he is interviewed by an Army guidance counselor, at which time the applicant is offered a job assignment from a list of computer-generated options. The proffered job list identifies both specific job types (MOS) and training starting dates.

If the applicant finds one of the offerings acceptable, a contract is signed. Depending on the training start date, the applicant will either proceed directly to training or enter the Delayed Entry Program (DEP), deferring entry into the Army for up to twelve months.

Table 2. AFQT Category Definitions.

AFQT Category	Percentile Score
I	93-100
II	65-92
IIIA	50-64
IIIB	31-49
IV	10-30
V	< 10

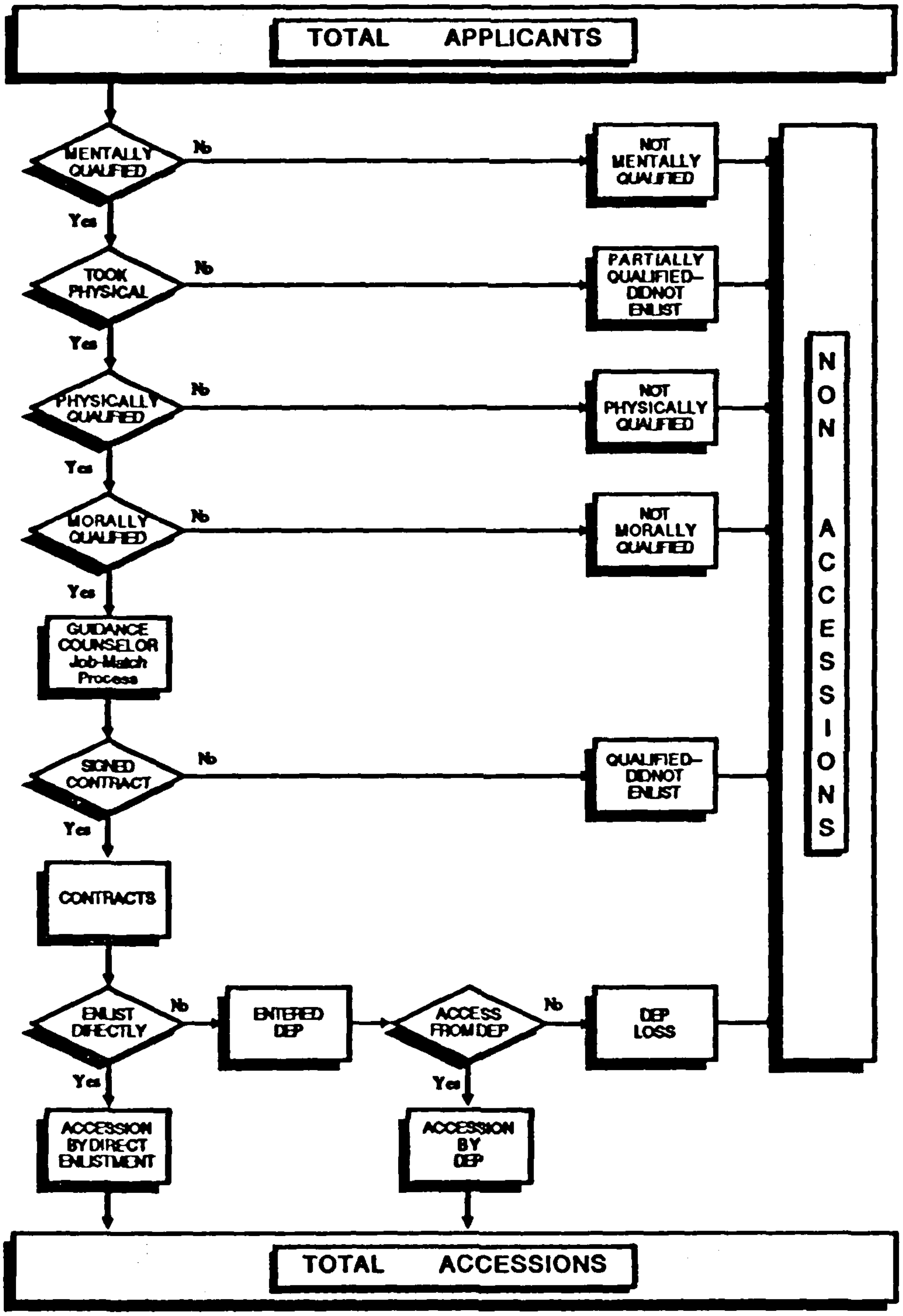

Figure 1. Army Enlistment Process.

The Job Classification Process

Current Army policy dictates that applicants agree to train for a specific job before they sign a contract. Therefore, considerable negotiation occurs between the guidance counselor and the applicant. The negotiation process has three significant components which affect the final decision:

1) The Guidance Counselor--the individual counselor's ability to sell jobs to potential recruits. The Army facilitates this component by providing the guidance counselor with a variety of enlistment options--cash bonuses, college fund, assignment of choice, etc.--with which the guidance counselor can influence the applicant's choice.

2) The Applicant's Preference--what type of duty, enlistment options, or, occasionally, spec: : MOS are of most interest to the applicant.

3) The Generated Job Option List--how well does the computer-generated list match the abilities and desires of the applicant with the goals and requirements of the Army.

It is important to note the sequential nature of this process. The Army must consider applicants in the order in which they present themselves for processing. It is unrealistic, within the parameters of an All-Volunteer Force (AVF), to assume a system which will control the actual arrival sequence of applicants.

As an inherently sequential one, the current process does not "look ahead" to consider future impacts or alternatives. As a result, numerous factors can not be addressed, such as:

- What is the effect of filling a training seat with a minimally-qualified volunteer?

- What is the impact of deliberately leaving a training seat empty in anticipation of a better-qualified applicant's later arrival?

- What is the likelihood that a person who is "better" qualified than the current applicant will become available to fill some specific training seat?

- What contribution will some specific person-job match make to the applicant's performance in the initial entry skill?

- What impact will some specific person-job match have on the probability of the applicant successfully completing his/her first term of enlistment?

OBJECTIVE OF RESEARCH

The primary objective of this research was identification of a methodology, and design and development of a prototype system, which could be used to make global, optimal recommendations for individual job lists. The guidance provided by such a system would represent a changing definition based on real-time assessments of training requirements and anticipated applicant arrivals. Use of an operation system based on principles demonstrated by this effort would place applicants where they can be expected to perform to their maximum potential, while still adhering to the policy restrictions and mission requirements of the Army.

ORGANIZATION OF REPORT

GRC conducted extensive research and analysis to determine the best technique for the development of a system concept which would provide the desired optimization capabilities. Based on this research, a prototype system was designed and developed to provide:

- Proof of principle, demonstrating that the identified methodology would provide the optimization capabilities, while still providing specific support to individual guidance counselors.

- A "test bed" which allows systematic evaluation of alternative performance predictors and classification techniques.

This report documents the results of GRC's research pursuant to this contract effort. It is divided into the following sections:

I A general introduction to the basic problem and the report.

II A discussion of the Army's current classification system.

III An overview of the research conducted by GRC and the resulting prototype system and its capabilities.

IV Recommendations for work, including additional research efforts and activities require to implement the research into an operational system.

TERMS AND ABBREVIATIONS

The terms and abbreviations used in this report are in Appendix A.

II. CURRENT SYSTEM

The Army's current allocation system, depicted in Figure 2, is imbedded within the Recruit Quota (REQUEST) System. The REQUEST System is a multi-faceted system designed to provide extensive support to personnel in the Army's recruiting community. Its subsystems include seat reservations, MOS requirements definitions, and report generation.

Of particular concern to this research effort, however, are its person-job match routines. REQUEST provides two modes for identifying class availability:

- <u>Look-up</u>. In this mode, the guidance counselor requests seat availability information for a specific MOS between two dates. REQUEST responds with open class dates within the specified date range.

- <u>Search</u>. In this mode, the guidance counselor provides an initial date of availability. REQUEST identifies MOS for which the applicant is eligible which have training seats available during a predefined time period following the date of availability.

Current Army policy dictates that the guidance counselor is to use the Search Mode for classifying applicants. It is within the REQUEST System, in general, and the Search Mode, in particular, that the EPAS methodology must be applied if practical use is to be made of the results of this research effort.

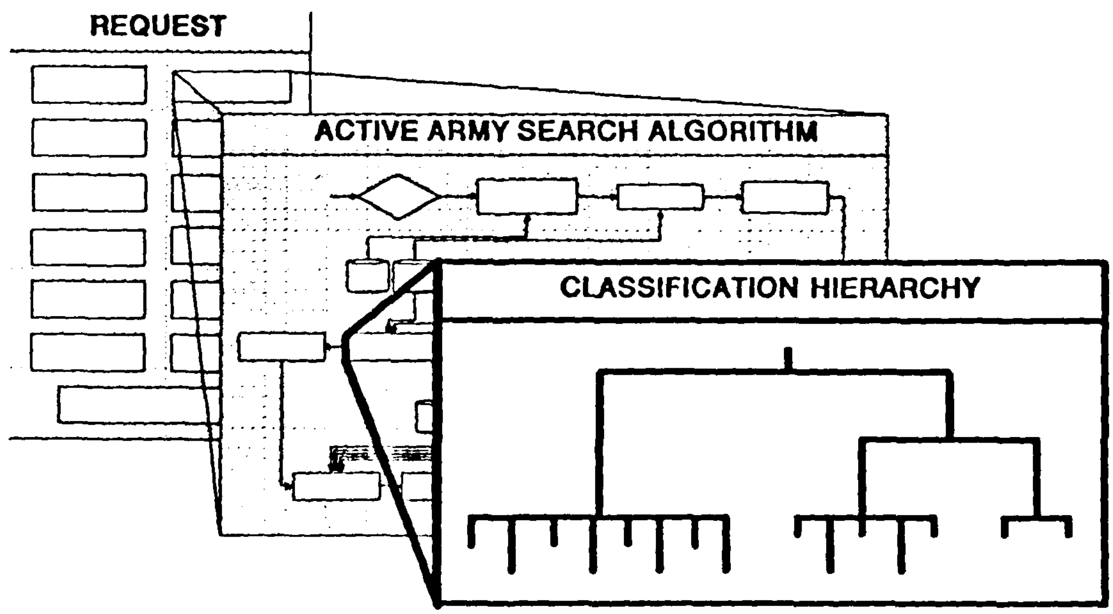

Figure 2. Current Allocation System.

THE ACTIVE ARMY SEARCH ROUTINES

Figure 3 depicts a graphical overview of the REQUEST System's allocation methodology, the Search Mode. As mentioned earlier, Search is but one of numerous modules within the REQUEST System. Search performs two primary functions: the identification of MOS for which the applicant qualifies and generation of an ordered list of preferred MOS. There are two key elements in the Search process, the search window and the classification hierarchy.

The Search Algorithm can be broken into three broad sections: verification of applicant quality, checking for availability of training, and application of any special incentive programs. The first section, quality, identifies MOS for which the applicant meets all minimum requirements and limits the number of MOS to be processed. This limiting process, using an adjustable Search Window, will be described below.

The second section of the algorithm determines the availability of training for the identified MOS, establishes the Army's requirements to fill the MOS, and determines the relative merit of allocating the applicant to individual MOS. The principle component of this section, the Classification Hierarchy, is also described below.

The third section, incentives, identifies applicable incentive options, eliminates redundant training options, and displays an Ordered List of recommended MOS. At present, 25 job options are displayed in five sets of five options each. If the applicant has requested an MOS which is not on the ordered list, it will be displayed as an extra option on the third panel.

The Search Window

When discussing the current, or any other, computerized, allocation support system, one must keep in mind that the system must function in a real-time environment. That is, a guidance counselor will use the system while the applicant is present; it is an essential part of the negotiation process. The system must respond quickly--within ten to fifteen seconds--with the result of the search.

As mentioned in the first section, there are literally thousands of possible combinations of MOS and training dates for which an applicant might qualify. To search for, evaluate, and report every possible combination would take a prohibitively long time. A critical first component of any search algorithm, therefore, must be some means of limiting the number of evaluations to be performed and, thus, drastically reducing the solution time.

REQUEST's Search Mode addresses this problem with its Search Window, depicted in Figure 4. The Search Window is defined as a fixed period of time, generally four or five weeks, from a guidance counselor-defined date

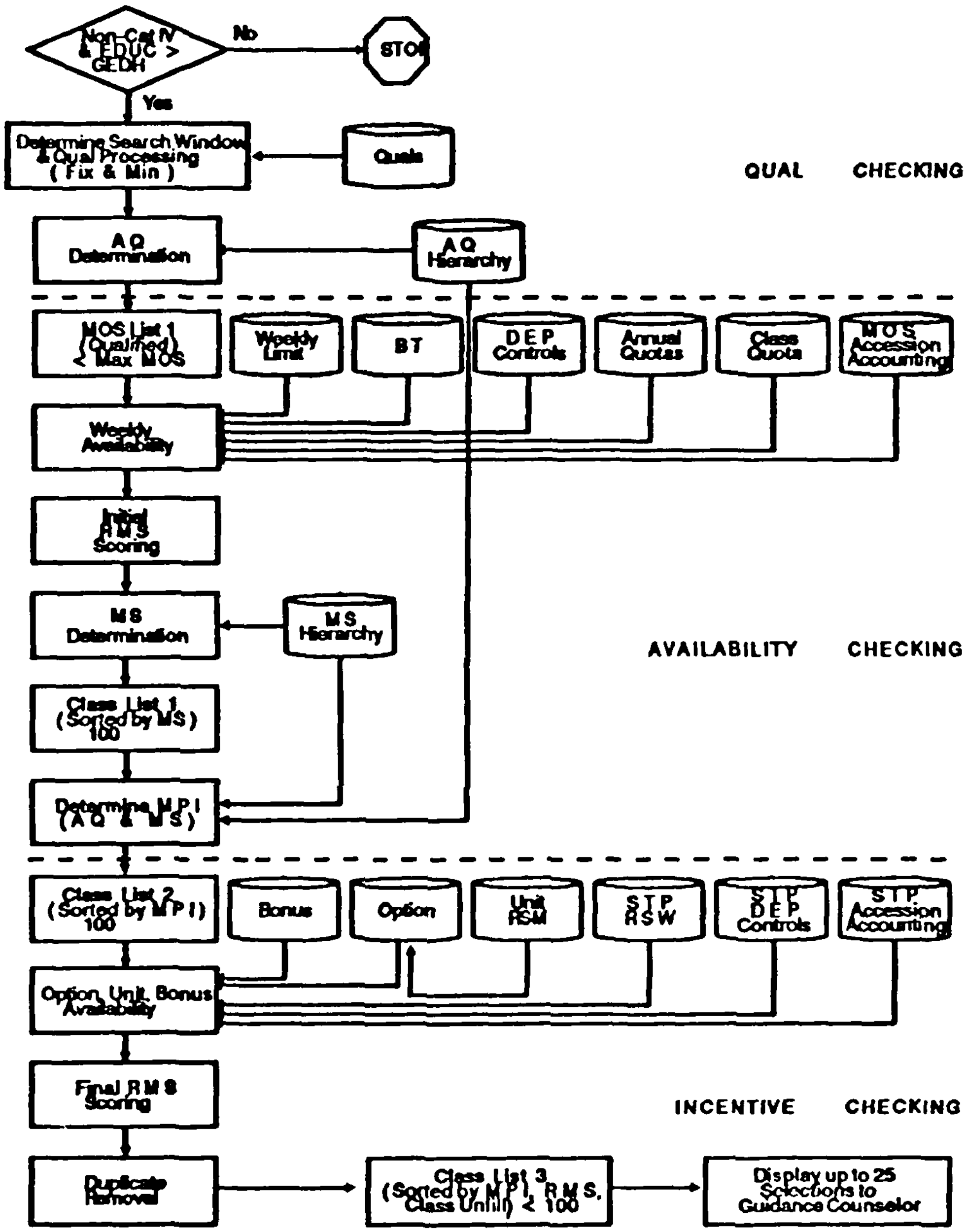

Figure 3. Active Army Search Routines.

of availability (DOA). A second window may be defined as one week from the current date. The search algorithm only examines MOS which have training beginning within the "window" and for which the applicant meets the minimum qualifications.

This methodology, while limiting the number of MOS/training dates, has the significant problem of overlooking potentially critical MOS. In the example depicted in Figure 4, for instance, "MOS #6" is shown as having a

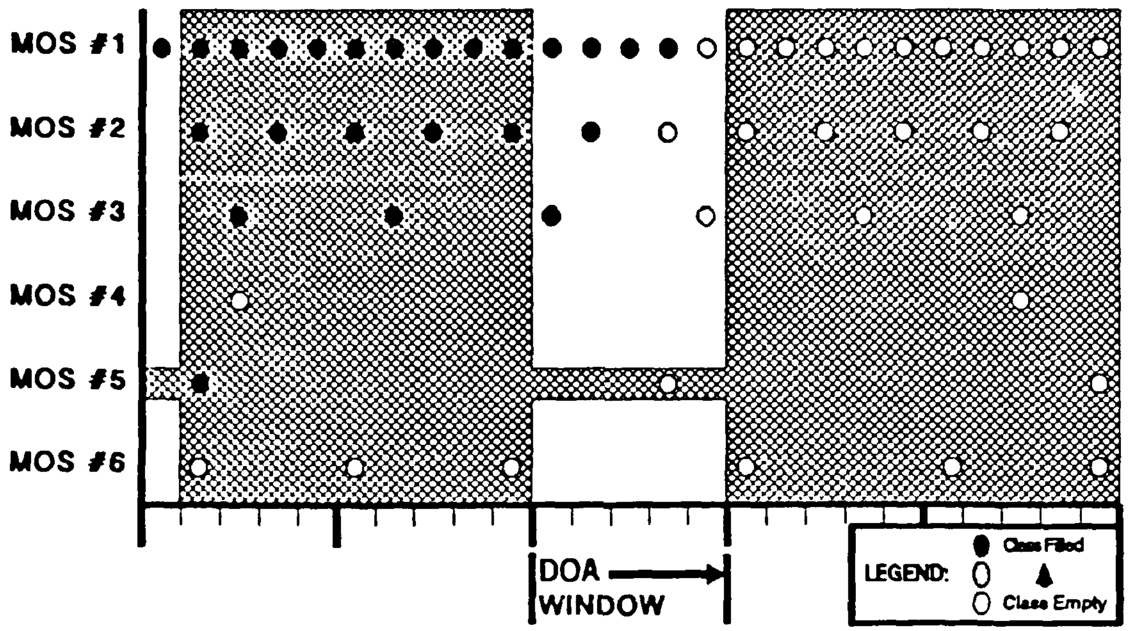

Figure 4. Search Window.

class requiring fill starting two weeks from the current date. The search window will not display this MOS/date combination as it does not fall within the specified window.

Observations of actual practices at the Military Entrance Processing Stations (MEPS) show that guidance counselors overcome this limitation by manually "gaming" the system. That is, they will run repeated iterations of the search algorithm changing the DOA. This has the effect of sliding the window back and forth, allowing the guidance counselors to identify MOS/date combinations which would otherwise not be depicted. The observations of GRC personnel at the MEPS sites showed that guidance counselors were quite skilled at identifying potential problem MOS/date combinations and then manipulating the system to ensure that these combinations would be displayed to appropriate applicants.

The Classification Hierarchy

The second essential component of the Search Mode is the Classification Hierarchy. This is the component of the system which computes a score, called the MOS Priority Index (MPI), for each MOS/date combination within the Search Window. The hierarchy utilizes a set of factors to determine the desirability of each Person-Job Match (PJM). Each factor has a Transformation Function, such as depicted in Figure 5, to convert the factor from its inherent metric to a 0-to-1000 utile.

The factors are grouped into two broad categories: MOS Status (MS) factors, which effectively define Army's need to fill the particular MOS;

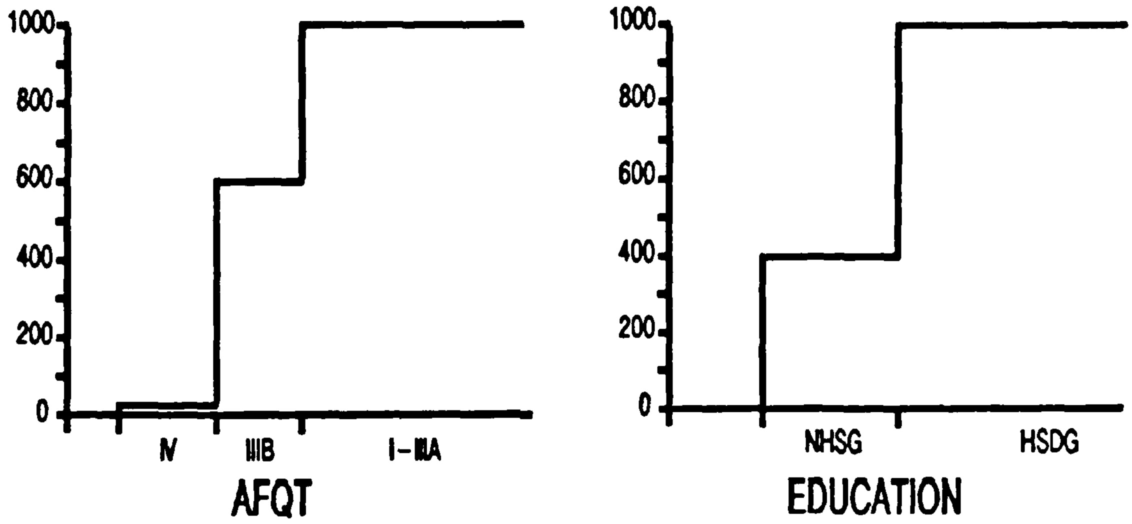

Figure 5. Hierarchy Transformation Functions.

and the Applicant Qualification (AQ), which define the degree to which the applicant is matched to the MOS. The AQ hierarchy is further subdivided into two additional categories: physical and intellectual qualifications. Each factor and each grouping of factors is assigned a Weighting Value which is used to combine the factor with other factors. Figure 6 graphically depicts the groupings of factors and their individual weights.

The classification hierarchy is used to compute a relative score for each MOS *within the Search Window* for which the applicant qualifies. The scores are sorted into descending order and adjusted so that the highest score is always 1000. The top scores are then displayed to the applicant.

In theory, each MOS can have a different transformation function and different weighting factor. Exercising this option, however, would require definition of hundreds of transformation functions and weights. What, in fact, happens is that virtually all MOS utilize the same transformation functions and weights; only a handful of selected, high priority MOS have different values defined. The transformations shown in Figure 5, for example, are both applicable to all MOS. Similarly, the weights assigned to each MOS are the same.

The result of this conformity is that the search algorithm, while distinguishing among applicants, fails to differentiate among MOS for a given applicant. Table 2 depicts this impact. In this table, the "Net Weight" column depicts the result of multiplying the defined weights for each of the factor groupings (see Figure 6). The "Range" column defines the differentiability associated with the factor among MOS for the given applicant.

As can be seen in Table 2, the effective result of the settings is that the applicant's qualifications have no impact on the final order of

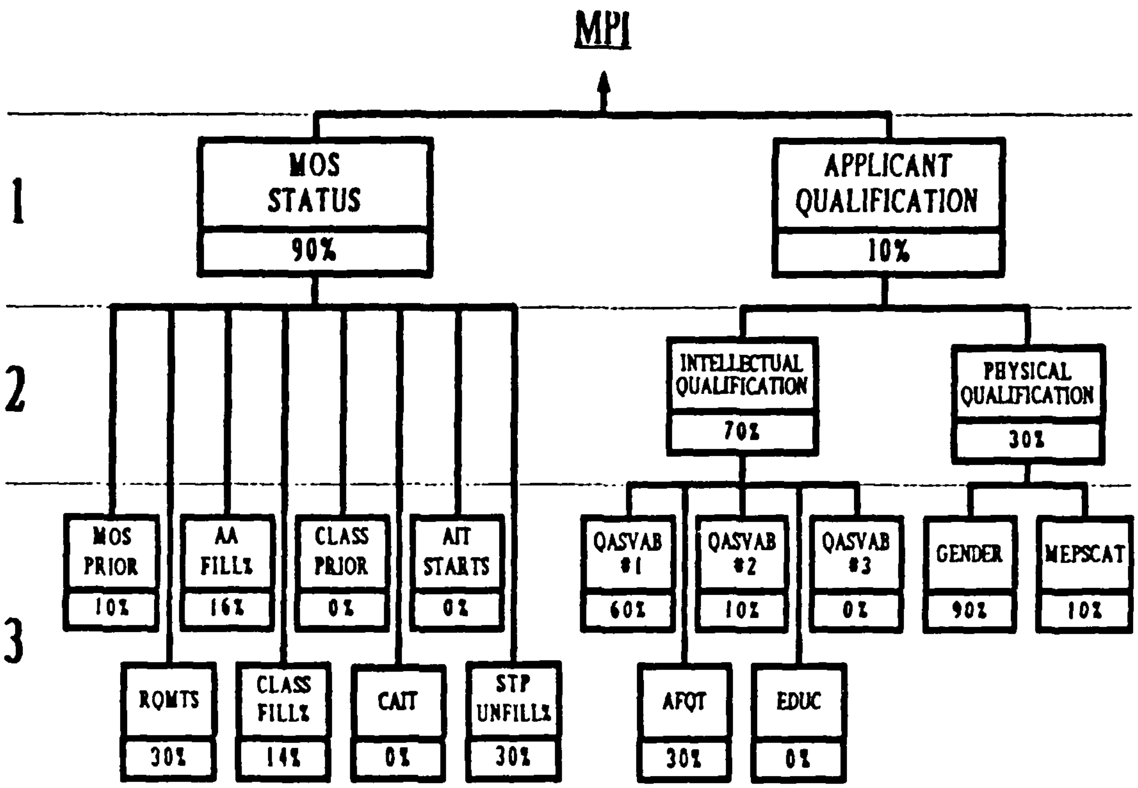

Figure 6. Hierarchy Weighting Values.

recommended jobs. It is important to note that this impact is the result of the current definitions of the transformation functions and weights within the hierarchy. It is not the result of the basic formulation of the algorithm itself.

Table 3. Effective Hierarch Weights.

Hierarchy Factor	Base Weight	Lvl1 Weight	Lvl2 Weight	Lvl3 Weight	Range	Effective Range	Effective Weight
MOS Priority	0.1	1.0	0.9	0.090	1000	90.000	0.151
Requirements	0.3	1.0	0.9	0.270	800	216.000	0.361
AA Fill %	0.16	1.0	0.9	0.144	980	141.120	0.236
Class Fill %	0.14	1.0	0.9	0.126	980	123.480	0.207
Class Priority	0.0	1.0	0.9	0.000	1000	0.000	0.000
CAIT	0.0	1.0	0.9	0.000	980	0.000	0.000
AIT Starts	0.0	1.0	0.9	0.000	800	0.000	0.000
STP Unfill %	0.3	1.0	0.9	0.270	100	27.000	0.045
Quality ASVAB 1	0.6	0.7	0.1	0.042	0	0.000	0.000
Quality ASVAB 2	0.1	0.7	0.1	0.007	0	0.000	0.000
Quality ASVAB 3	0.0	0.7	0.1	0.000	0	0.000	0.000
AFQT Category	0.3	0.7	0.1	0.021	0	0.000	0.000
Education	0.0	0.7	0.1	0.000	0	0.000	0.000
Gender	0.9	0.3	0.1	0.027	0	0.000	0.000
MEPSCAT	0.1	0.3	0.1	0.003	0	0.000	0.000
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LIMITATIONS OF CURRENT ARMY CLASSIFICATION SYSTEM

The current classification system does an excellent job in meeting the Army's immediate training requirements. This performance, however, is made at the expense of several shortcomings in the system's performance and capabilities. These shortcomings can be classified into two general categories: ones arising from the implementation of the system and ones inherent in the fundamental design of the system.

Implementation Issues

Implementation issues are those which could be overcome by different utilization of the existing design. Foremost among these issues is the settings of the transformation functions and weighting values.

As was previously depicted, the current settings result in virtually no differentiability among alternative MOS for a given applicant. Clearly, using different transformations functions and weights result in different classification recommendations. The current system, however, provides no means of assisting the system manager in defining factors which will result in increased differentiability while ensuring that the training goals will be met. The number of possible combinations of functions and weights makes it virtually impossible for managers to effectively manipulate them to achieve desired results. The consequences of this are that common values are established for all combinations; unique values are established only in special cases (e.g., 11X, cohort training); unique values tend to be implemented in extreme fashion (e.g., 11X priority weighting is 100% with a score of 1000--effectively ensuring that minimally qualified personnel will always be cast into 11X if a vacancy exists); and, once established, factors are rarely changed.

A second implementation issue is achieving policy goals. This issue is further exacerbated by the current definitions of factors, functions, and weights. An example of this is achieving quality goals. Army personnel policy establishes desired goals for quality (i.e., AFQT Category I-IIIA) applicants in each MOS. The current formulation does not include factors which target these goals. Army managers must, therefore, monitor skills manually and externally set controls (called Define Quality (DQ) switches) which open or close MOS to applicants based on the current fill status of the MOS.

Thus, highly qualified applicants may be denied MOS simply because they happened to be "closed" in the week the applicant was processed. Had the applicant come in a week earlier or later, the skill may have been available. Conversely, marginally qualified applicants may find themselves allocated to MOS for which the DQ switch was "open" and the need to fill existed.

System Design Issues

The second category of shortcoming are those which are inherent in the fundamental design of the current system. The principle shortcoming of this type is the system's inability to "look ahead" in any significant manner. Each applicant is processed entirely independently, as if s/he is the only, last, and best person. The current system does not, indeed can not, consider future impacts or alternatives to address questions such as:

- What is the effect of filling a training seat with a minimally-qualified applicant?
- What is the impact of deliberately leaving a training seat empty?
- What is the probability that a person who is "better" qualified than the current applicant will become available to fill some specific training seat?
- What contribution will some specific person-job match make to the applicant's performance in the initial entry skill?

An additional issue is the need for highly experienced guidance counselors to "game" the system to ensure that critical skills will be identified and filled. As previously discussed, the basic search window methodology will fail to identify skills not happening to fall within the arbitrarily defined window. If the guidance counselors do not effectively manipulate the system by varying input parameters, some training might easily go unfilled.

A final issue is the inability of the current system to simulate the impact of policy alternatives. Thus, while it provides some assistance to guidance counselors, it provides none to the managers who are determining the overall policy direction for the counselors.

III. OVERVIEW OF RESEARCH

The inherent shortcomings evident in the current allocation system presented avenues of potentially significant improvement in the utilization of Army personnel resources. ARI awarded contracts for Projects A and B to determine if capabilities existed which could be applied to these problems.

Project A's research, which is ongoing at the time of this report, is intended to develop new means of predicting applicant performance using existing measures (e.g., the ASVAB) and new tests being developed as part of the research. In the next Section, Results and Conclusions, it will be shown that the results of Project A will have a significant impact on a system's ability to improve overall performance. This research, however, is outside the scope of this report.

HISTORY OF RESEARCH

Table 4 presents a tabular summary of the work performed under this contract. For additional details on the activities performed, the reader is referred to the list of publications found in Appendix B.

Initial Research

The contract objective for Project B was to investigate techniques for, and create a prototype of, a system which could support real-time enlisted personnel classification as performed by the REQUEST System. The primary focus of the research was to identify and verify an automated technique which would redress the deficiencies of the current system. The secondary objective was to provide a test bed for evaluation of: new performance predictors being developed by Project A; new measures of behavior, such as ARI's research into attrition; and new techniques for sequential classification, such as those being employed by the Air Force in its allocations system, the Procurement Management Information System (PROMIS).

The first two years concentrated on general research to identify existing and potential applications.

Baseline Prototype

The proposed solution methodology, based on a linear optimization using a network, was selected during the second year. A preliminary, baseline prototype was developed using only ten MOS and a subset of the total recruit population. This baseline prototype demonstrated the basic feasibility of the technical approach.

Table 4. EPAS Key Events Summary.

YEAR	KEY EVENTS
1	• Literature and Data Survey • Analysis of current recruiting and allocation system; observations of actual practices • Survey of other allocation methodologies
2	• Initial definition of methodology • Development of baseline system • Additional Research: - goaling Army recruiters - "sales-tools" for counselors - utility theory applications
3	• Full development of initial prototype • Preliminary tests on USAREC, Sperry Univac • Additional Research: - clustering methodology - non-linear programming applications
4	• Conversion to NIH computer system • Additional Research: - reenlistment/reclassification applications
5	• Simulations and Evaluations on NIH • Benefit/Cost analysis • Additional Research: - expert system applications
6	• Simulation-based enhancements • Non-network constraints/LP formulation • Additional Research: - REQUEST emulation - refined clustering methodology
7	• ISC-P conversion • Field Test of prototype • Additional Research: - DBMS (DB2) applications - automatic screen generation (CSP)

Full-Scale Prototype

A key element of this procurement was verification that the identified methodology would continue to function when real-world constraints were applied. Accordingly, the baseline prototype was expanded to a full-scale prototype which included:

- Inclusion of all initial entry MOS.
- A random sampling of the entire recruit population.
- Addition of extensive policy constraints in the optimization formulation, including:
  - -- Delayed Entry Program (DEP)
  - -- Quality Goals
  - -- Skill restrictions, e.g., exclusion of females from combat skills

The full-scale prototype, like the baseline prototype, was developed on the Decision Laboratory Facility (DLF), a mini-computer based system specifically developed to support this effort. The DLF used a Wicat Model 160, a minicomputer built around the MC-68000 microchip. This system, while adequate for initial efforts and supporting analyses, was incapable of supporting test simulations of the full-scale prototype.

The prototype was, therefore, converted to the National Institute of Health (NIH) computer. Conversion efforts included a complete rewrite of the program code (from Pascal to PL/1) and a complete revision of the data access procedures (from Wicat's Keyed Sequential Access Method (KSAM) to IBM's Virtual System Access Method (VSAM)).

Numerous simulations were performed on the NIH prototype. These simulations tested the EPAS formulation, alternative prediction techniques (from ARI, Project A work, and Project B analysis). The results of the tests demonstrated conclusively the viability of the solution methodology and the potential savings to the Army. The reader is referred in particular to GRC Report Evaluating the Benefits and Costs of the Enlisted Personnel Allocation System, 1317-23-86-CR, June 1986, for details.

Operational Prototype

While the NIH full-scale prototype confirmed the methodology, two issues were raised: (1) the cost of running the system on the NIH computers and (2) the impact of running the system in an operational environment rather than a research-oriented environment. To address these issues, the system was once again converted; this time to the Army's Information System Command--Pentagon (ISC-P) computer facility.

Two new design issues were also addressed concurrent with the conversion to the ISC-P computer facility. These include: a new optimization formulation based on a Linear Programming (LP) formulation and redesign of the user interface routines.

Linear Program Formulation

The network formulation of the earlier prototypes forced several restrictions in the design of the problem to avoid non-network constraints. An LP formulation was developed to meet these design issues. The LP formulation is discussed below and described in detail in Appendix D.

User Interface Procedures

The EPAS prototype has been designed as a user-centered, menu-driven system to facilitate the data manipulation necessary for analyses. With the original prototypes (both on the Wicat and the NIH computer systems), the screens were "hard coded" using standard ASCII protocols. These protocols are unacceptable in the Army's operational environment.

IBM equipment, in particular the 327x-type terminals in the ISC-P and HQDADSS environments, do not support ASCII protocol, but instead utilize an IBM-specific message header protocol. On the NIH computer, GRC personnel bypassed this problem by generating a special program which intercepted and interpreted the ASCII control codes.

This approach would not be acceptable in an operational environment because of the time delays in processing the control codes and portability and maintainability problems. Accordingly, GRC rebuilt the principle user menus utilizing IBM's Cross System Product (CSP) facility.

EPAS OVERVIEW

The initial objective of the GRC effort was to investigate methodologies for, and develop a prototype of, a system supporting real-time enlisted personnel classification (as performed by the REQUEST system. Functional analysis conducted as part of the research showed that a planning capability was needed in addition to the real-time support. The planning capability would provide for the analysis of policy alternatives and determination of optimum strategies for the classification and allocation of recruits.

EPAS Functional Areas

Based on the results of the functional analysis, the EPAS prototype was developed to demonstrate capabilities in three modes:

1) Policy Analysis Mode
2) Simulation Mode
3) Operational Mode

Policy Analysis Mode. The policy analysis mode provides a rapid, long-range analysis potential. In this mode, the Army manager can define factors such as policy options, environment scenarios, and training restrictions. EPAS will then provide a rapid analysis of the basic feasibility of the combined factors.

Simulation Mode. This mode provides a detailed, long-range analysis capability, i.e., the ability to simulate the flow of applicants through the allocation process. Like the Planning Analysis Mode, the Army manager can define the desired "what if" scenario. EPAS can then provide a detailed simulation of individual applicants providing a detailed analysis of the resulting impacts. GRC anticipates that this capability, unique to EPAS, will provide the Army with a powerful management tool.

Operational Mode. This is the capability intended to provide support to the real-time classification process. Input to real-time classifications flows directly from the planning subsystem, i.e., the developed strategies could then be used to provide guidance to the REQUEST system.

The principal functional areas required to support the three operating modes were then identified. These areas, depicted in Figure 7, are discussed below. Note that each of the functional areas is further subdivided into two primary components.

1) Determine MOS Requirements -- identifying the future demand for accessions into individual skills.

   -- Identify Training Requirements -- determining the training requirements still to be filled and the capacity within the training base to meet the demand.

   -- Identify Classification Requirement -- determining the qualifications necessary for an applicant to enter a specific MOS.

2) Define Applicant Supply -- predicting the future supply of applicants in sufficient detail to allow the model to accurately predict performance in selected MOS.

   -- Project Applicant Arrivals -- forecasts of the quantity and times of applicant arrivals.

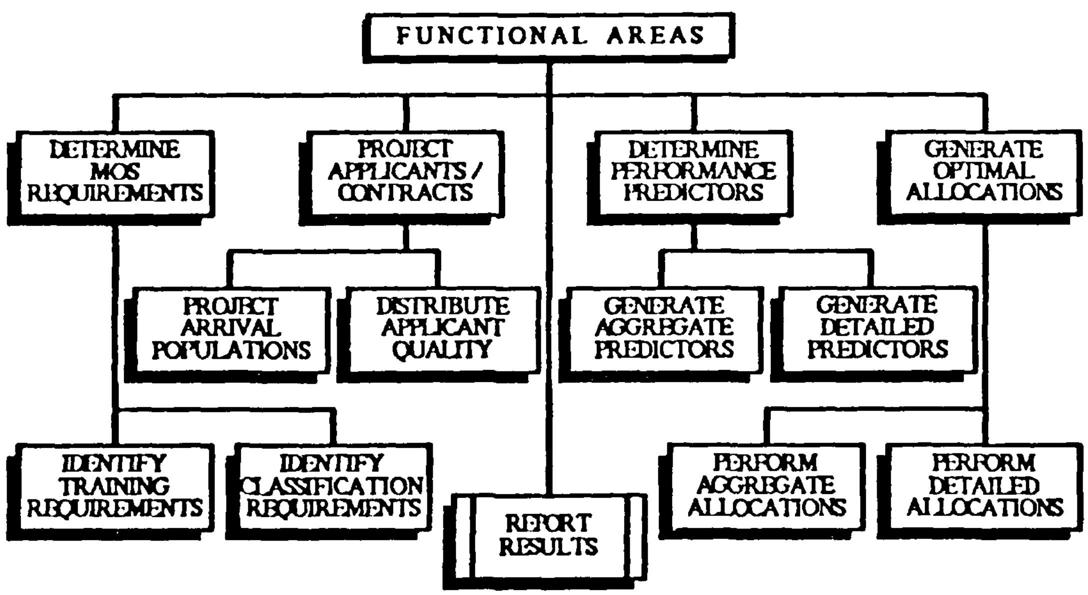

Figure 7. EPAS Functional Areas.

- -- Distribute Applicant Quality -- decompose the forecast applicant arrivals into sufficient information to accurately predict performance.

3) Determine Performance Predictors -- identify and quantify specific measures of predicting applicant performance by skill.

- -- Generate Detailed Predictors -- identify and utilize predictors which can be applied at the individual applicant and specific MOS level-of-detail.

- -- Generate Aggregate Predictors -- combine detailed predictors into aggregations which can be applied to groups of applicants and skills.

4) Generate Optimal Allocations -- perform actions necessary to match future supply to training demand in a manner which best fulfills all of the Army's requirements.

- -- Perform Aggregate Allocations -- generate "globally" optimal allocations, i.e., matches of groups of applicants to clusters of skills.

- -- Perform Detailed Allocations -- generate "locally" optimal allocations, i.e., the best PJM for a specific applicant.

EPAS System Overview

EPAS consists of four principal, or "core," modules designed to meet these functional requirements. These core modules, depicted in Figure 8, are presented in detail in Appendixes C and D and summarized below. In addition, an extensive set of ancillary routines were developed to facilitate testing and evaluation of Project A, Project B, and ARI analyses.

Quality Forecast Module

The Quality Forecast Module (QFM) defines future accessions. The principle functions associated with the QFM are depicted in Figure 9. It is important for the reader to note that EPAS is not a supply forecasting model. Instead, it accepts forecasts from other models and distributes the forecasts into the detail required by EPAS.

Combining Similar Applicants. In Section I, it was indicated that there exist approximately 840 million possible combinations of applicants to MOS classes during a given year--a number considerably larger than

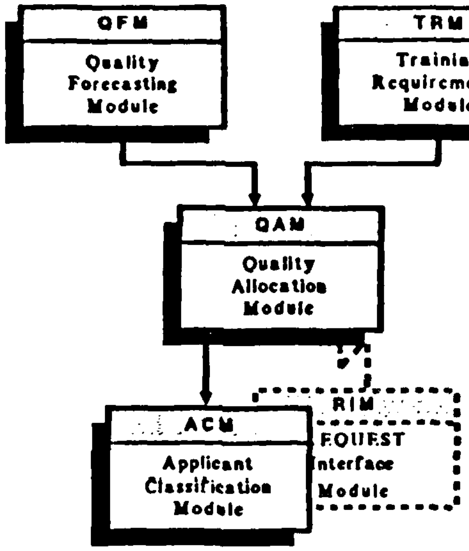

Figure 8. EPAS Core Modules.

Figure 9. QFM Functional Requirements.

available computer technology can support. Some means is required, therefore, for reducing the problem to a tractable size. This reduction was accomplished by performing research into means of combining, or clustering, both the applicants and the MOS in groups. (MOS clustering is described in the Define MOS Requirements section, below.)

When clustering applicants, two requirement have to be met:

(1) The system must maintain the ability to enforce Army policy restrictions and guidelines,

(2) The ability to predict an applicant's likely performance in a selected MOS must be maintained.

Key performance predictors were identified which enabled the development of combinations of applicants, called Supply Groups, which met both of these requirements. A two-step process is currently used to define EPAS' Supply Groups.

First the contract population is subdivided into distinct subpopulations based on demographic characteristics. The subpopulations allow EPAS to model Army policy, such as Quality Goals. The demographics used to subdivide the population are:

(1) Gender -- male and female.

(2) Education -- three classifications are used for education: High School Graduates, High School Seniors, and Non-Graduates.

(3) Armed Forces Qualifications Test (AFQT) Score -- categories I-IIIA, category IIIB, and category IV.

Next, each of the subpopulations were clustered based on ASVAB Aptitude Area Composite Scores. Project A analysis has demonstrated that the ASVAB test scores are valid predictors of performance (McLaughlin, 1984). A computerized technique, using Ward's Minimum Variance Method (Ward, 1963), was used to generate 81 distinct Supply Groups.

Forecasting Contractees. The Army's recruiting process is a sequential, first-come-first-serve process. Linear optimization techniques, on the other hand, distribute a predefined available supply of some product (in this case, NPS applicants) across an established demand for that product (training seats). A forecast of the number, quality and arrival times of contractees was required, therefore, to determine the population to assign to MOS and associated school seats.

A number of techniques are available for forecasting volunteer characteristics and arrival rates. GRC has provided a system which allows Army analysts to integrate existing methodologies into EPAS, thus providing the ability to evaluate policy alternatives using any of several forecasting techniques. Several different models, as described in Appendix C, were evaluated. In the current formulation, all forecasts are generated from USAREC (contract) Mission Goals.

Regardless of the forecasting technique employed, the projections of applicants must be presented in the form of EPAS Supply Groups to be consistent with the other modules within the system. Therefore, procedures were developed for each of the basic forecasting techniques to redefine the projections into Supply Groups.

Training Requirements Module

The Training Requirements Module (TRM) defines the future demand, i.e., the training requirements. Figure 10 depicts the primary functional areas for the TRM.

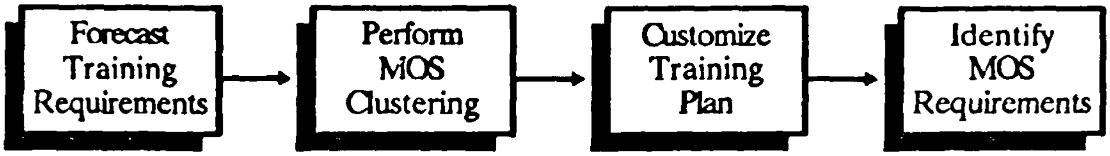

Figure 10. TRM Functional Requirements.

Forecasting Requirements. These data are defined externally. The TRM begins by reading the current status of schools from REQUEST files, that is, the number of seats yet to be filled to meet the annual requirements, the current fill of each class, and the capacities of the classes. These data are then manipulated to meet the requirements of EPAS, including:

- Distributing policy objectives (e.g., quality goals) over all of the classes.
- Aggregating individual classes into monthly totals by MOS.
- Aggregating MOS into EPAS-define clusters.

MOS Clustering. As with the Supply Groups discussed above, MOS must be aggregated into groups, called MOS Clusters, which maintain performance differentiability and the ability to enforce policy restrictions. Details of the methodology and current formulation are found in the Appendixes.

MOS Clustering was performed by first aggregating the MOS into distinct groups based on their characteristics. The basic criteria currently used to define the MOS Clusters, in the order of their priority, are:

(1) Female Exclusions -- some MOS, such as those classified as combat skills, are closed to female recruits. MOS were divided into two groups: male-only and open to all.

(2) Education -- some MOS require a high school education. The two gender-based groups were each divided into two subgroups: MOS requiring a high school education and others.

(3) Qualifying Aptitude Area ASVAB Composite Score -- the minimum ASVAB score which must be achieved to be eligible to serve in the MOS.

(4) DoD Occupational Areas -- each of the subgroups developed above were further subdivided into nine groupings based on the DoD Occupational Areas, shown in Table 5. This criterion, used by the Department of Defense to categorize skill types across all services, groups the skills based on a broad measure of their duties.

Table 5. DoD Occupational Areas.

CODE	DoD OCCUPATIONAL AREA
0	Infantry, Gun Crews, Seamanship
1	Electronic Equipment Repair
2	Communications and Intelligence
3	Medical and Dental
4	Other Technical
5	Functional Support and Administrative
6	Electrical/Mechanical Repair
7	Craftsmen
8	Service and Supply

This consecutive decomposition process resulted in too many clusters to be effectively used by the model. An expert panel was formed, therefore, to review the clusters and their component MOS and identify clusters which were similar and could be combined. A total of 58 clusters resulted; additional detail on the current clusters can be found in Appendix C.

Customized Training Plan. To effect policy analyses of changes in the training plan, Army analysts require the ability to create customized training plans. EPAS supports this by providing detailed editors which allow analysts to perform such activities as altering class sizes or start dates, or entering or deleting MOS.

Identify MOS Classification Requirements. Each MOS has certain eligibility requirements, such as minimum ASVAB scores and gender restrictions. EPAS must include these MOS requirements to prevent the generation of allocation plans which, while feasible in an overall sense, would violate policy guidelines and, therefore, not be practical. This functional requirement has been addressed by the inclusion of procedures to allow definition and management of these criteria. As with other components of EPAS, customized definitions can be developed to allow evaluation of alternatives (such as altering the minimum eligibility score for selected MOS).

Quality Allocation Module

The Quality Allocation Module (QAM) addresses the principal requirement of EPAS, the generation of an optimal allocation scheme. Figure 11 depicts

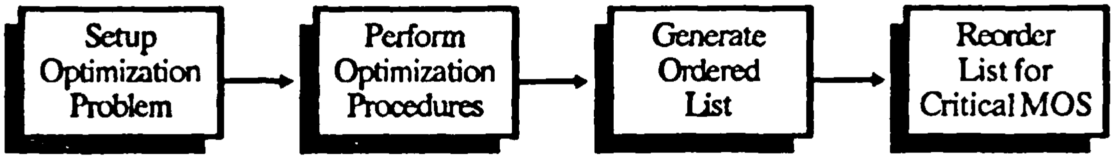

Figure 11. QAM Functional Requirements.

the primary functional areas of the QAM. The QAM presented a unique challenge to Project B, for optimization is not feasible for allocating individuals on a one-by-one basis, while sequential classification cannot take into account the overall goals and missions of the Army by "looking ahead" at future applicant supply and MOS requirements. Research was performed to identify and develop techniques by which optimal strategies could be applied to an inherently sequential process.

A two-stage approach was employed to allow EPAS to "...allocate individuals on a one-by-one basis while simultaneously taking into account the overall goals of the Army..." (SOW, pg. 4). Optimization is used to generate aggregate allocations, thus providing a classification strategy to address the overall goals and missions. The optimization develops a 12-month classification strategy that meets all training targets and constraints defined at the Supply Group and MOS Cluster level of detail.

This classification strategy is then input to a detailed, sequential classification procedure (described below) to process individuals. The resulting sequential process gains "look-ahead" intelligence of future recruiting conditions when making classification recommendations.

Setup Optimization Problem. Based on the analyses described in Appendix C, GRC analysts developed two methodologies to meet the EPAS challenge: a modified assignment network, using special structure techniques to incorporate various Army recruiting policies, and an LP, which expands the structure to provide additional detail.

For each formulation, the first step in the optimization process is the formulation of the problem to be solved. This process is similar for both techniques, involving the translation of the many Army policies, goals, objectives, and limitations into a mathematical model.

Perform Optimization Procedures. Both the network and the LP programs used by EPAS are "off-the-shelf" procedures: the network utilizes ARCNET; the LP, Whizard. Both of these programs are currently available on the ISC-P computer facility.

Network Formulation. Figure 12 depicts the basic formulation used by the EPAS network model. The network model works as follows:

(1) Forecasted supply for each Supply Group, by month, is input to the model. This supply may be used to fill training requirements, specified by MOS Cluster, for any month from the supply's arrival month to some previously specified number of months into the future. This future fill ability simulates the Army's Delayed Entry Program (DEP) and provides the model with its ability to balance the recruit allocations to optimally meet the Army's goals.

(2) Each MOS Cluster has its specific training parameters defined:

(a) The quality goal, i.e., what portion of the population should be filled by AFQT Category I-IIIA recruits. The model will assign each MOS at least this number of quality applicants, if this is feasible.

(b) The limit on AFQT Category IV personnel, i.e., the maximum number of such personnel which will be allowed into an MOS Cluster.

(c) The upper bound on the training capacity. The total training capacity of each MOS cluster, in general, exceeds the annual training demand for that cluster. The model utilizes this fact to provide additional flexibility in the distribution of its supply; each class will, however, not exceed its maximum capacity.

(d) The annual training requirement. This value provides the desired goal, i.e., the total number of personnel to be trained for an MOS Cluster during the year.

(3) The cost associated with each possible Supply Group/MOS Cluster combination is generated by an ancillary procedure called the Metric Generation Module (MGM). The network algorithm utilizes these costs to determine the optimal configuration, within the imposed limits. The term "cost" is an operations research term which does not necessarily refer to dollar cost. It is, instead, some measure of performance to be used by the model. Examples of performance costs available are:

LEGEND:

FS--Forecast Supply	AH--Category I-IIIA Training	B --Class Size Bound
SG--Supply Group	AL--Category IIIB Training	L --Category IV Limit
MT--Monthly Total	A4--Category IV Training	C_u--Quality Cost
AR--Annual Requirement	AT--Total Class Capacity	C_L--Cat IIIB Sub. Cost
	G --I-IIIA Quality Goal	C_4--Cat IV Sub. Cost

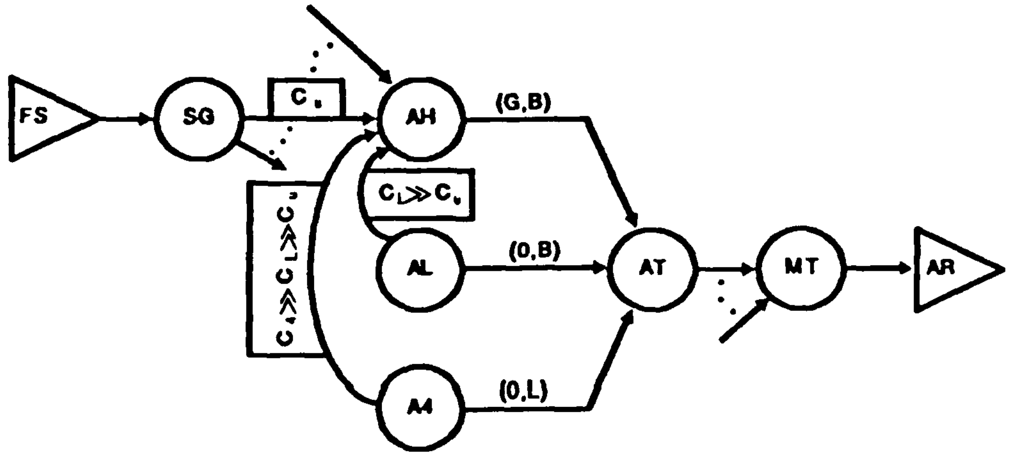

Figure 12. EPAS Network Formulation.

(a) First Term Attrition -- personnel are allocated to MOS so as to minimize their loss prior to completing the first term of enlistment.

(b) ASVAB Composite Score -- personnel are allocated to MOS so as to maximize the Army-wide average Aptitude Area scores for all initial entry skills.

(c) DEP/Attrition Cost -- personnel are allocated to MOS so as to minimize the dollar cost associated with a combination of time in the DEP and first term attrition.

(d) Project A Composites -- personnel are allocated to MOS so as to maximize the composite scores defined by the Project A research.[1] (Alternatively, a subset of the Project A composite scores can be used; e.g., using only the Technical Knowledge/Skill (TKS) score).

Linear Programming Formulation. The network formulation provides rapid, optimal, time-phased allocations incorporating annual MOS training

[1] Project A has defined a new set of tests which result in the generation of scores for five new categories, specifically: Technical Knowledge/Skills, General Soldiering Skills, Physical Fitness/Appearance, Maintaining Personal Discipline, and Effort/Leadership. For more information on these new predictors, the reader is referred to the relevant Project A documentation

requirements and quality goals. When this guidance is communicated to the detailed allocation procedure, it allows generation of ordered lists of recommended MOS assignments which will meet the immediate needs of the Army, address the long-range objectives of the Army, and incorporate the predicted performance of the individual applicant.

The network formulation is constrained, however, in the type of problems which can be solved. These constraints, called "non-network constraints," limit the detail which can be built into the model. An alternative,

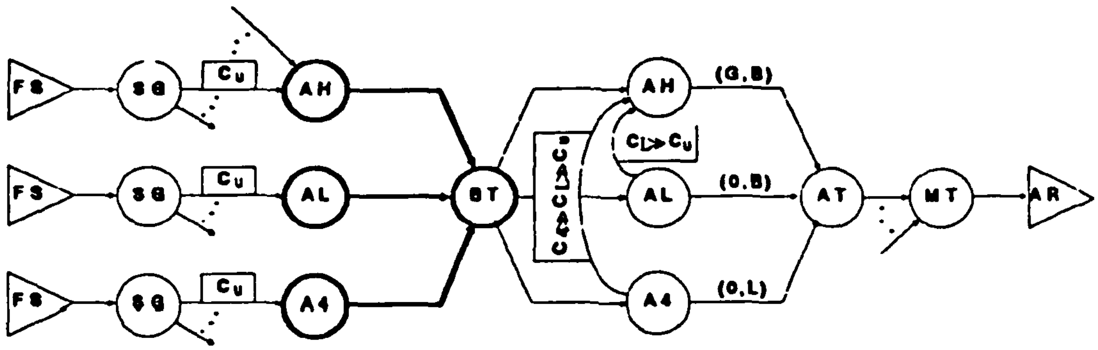

Figure 13. EPAS Linear Program Formulation.

Linear Programming (LP) formulation, depicted in Figure 13, was constructed to provide additional simulation detail in the optimization model.

In Figure 13, the non-network constraint is depicted in the collection of the supply into the basic training node (BT) and its subsequent expansion into the component supply groups.

<u>Model Formulation Summary</u>. The LP formulation, while providing additional accuracy, does so at the expense of execution time. EPAS utilizes both the network and LP formulations to provide speed for the Policy Analysis Mode and accuracy for the Simulation and Operational Modes. The three functional areas described thus far -- define applicant supply, define MOS requirements, formulation of the optimization model -- provide a stand-alone, analysis capability enabling the Army analyst to examine feasibility and impact of policy alternatives at an aggregate level.

<u>Generate Ordered Lists</u>. When the optimal solution has been generated, the resulting guidance is formulated so that it can be communicated to the detailed, sequential allocation procedures. This functional area performs two major tasks:

1) Definition of Non-Optimal Payoffs. The solution generated by the optimization procedures is not a practical one. Individual anomalies and preferences will result in applicants contracting for MOS other than those in the optimal solution. An ordered list must be generated to provide the relative desirability of alternate MOS/start date combinations.

2) Decomposition of the Aggregate Solution. Individuals are not assigned to MOS Clusters; therefore, the solutions generated by the optimization routines must be decomposed into the component MOS.

The QAM utilizes the reduced costs associated with the optimal solution to generate an ordered list of optimal and non-optimal MOS/start date combinations for each Supply Group.

Reorder List for Critical MOS. The final action performed by the QAM is an analysis of each MOS in the ordered list to identify potentially critical ones. In the construction of MOS Clusters, information about individual MOS will be lost. It is possible, therefore, for a small, or critical, MOS to be "masked" by larger MOS within the same cluster. The optimization procedure may assign a relatively low priority to the critical MOS because of the total capacity of the cluster.

The QAM identifies all such MOS and repositions them on the ordered list as a function of criteria such as the MOS's priority, its difficulty of fill, and the time left to fill the training requirement.

Applicant Classification Module

The optimization model leads to aggregate allocations which do not include all the detail necessary to make individual sequential MOS recommendations. The capability had to be developed, therefore, for dealing with the contract's requirement to allocate "individuals on a one-by-one basis." Personal choice, specific individual characteristics, and hour-by-hour MOS availability all contribute to a level of detail with which the optimization procedures cannot deal.

A detailed, sequential classification routine, called the Applicant Classification Module (ACM), was developed to simulate the classification

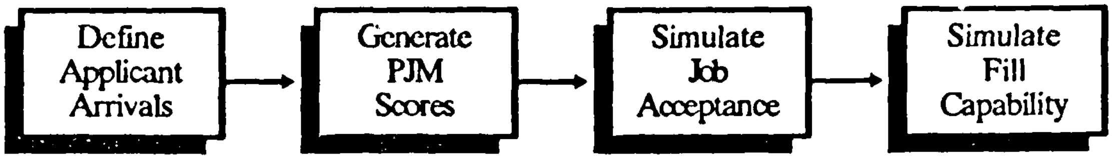

Figure 14. ACM Functional Requirements.

of individual recruits. Figure 14 depicts the functional requirements of the ACM. The ACM takes into account the individual characteristics and specific MOS requirements which may allow or prevent specific PJM assignments.

Define Applicant Arrivals. A simulated population of individual recruits must be available for the detailed analyses performed in the Simulation Mode. An ancillary routine, the Applicant Setup (APS) procedure, generates a statistically-defined file of actual recruit records. In the APS, the Army manager defines the size, distribution, and source of the desired simulation population. Actual records are then randomly selected to form the population. (The standard population is a 20%, proportional subset of the total population, i.e., the subset maintains the same demographic distributions as the full file.)

The ACM controls the selection of individual records from the user-defined subset, feeding them one at a time to subsequent ACM functions. Thus, the ACM simulation procedures are able to process applicants in an accurate simulation of a real-world environment,

Generate PJM Scores. The next step in the detailed allocation process is the generation of the PJM scores for the applicant being processed. The ACM's scoring routines were designed to be consistent with the Classification Hierarchy (page 10) of the Army's current system, i.e., it uses a linear, weighted combination of individual factors. This formulation allows Army managers and analysts direct control over the affects of the individual factors.

The research objectives of the ACM were twofold: to provide a detailed allocation simulation capability and to serve as a "test bed" for the evaluation of new scoring factors. To meet these objectives, the scoring routines were divided into three categories, as depicted in Figure 15, each of which is constructed in a highly modularized fashion. The three categories are:

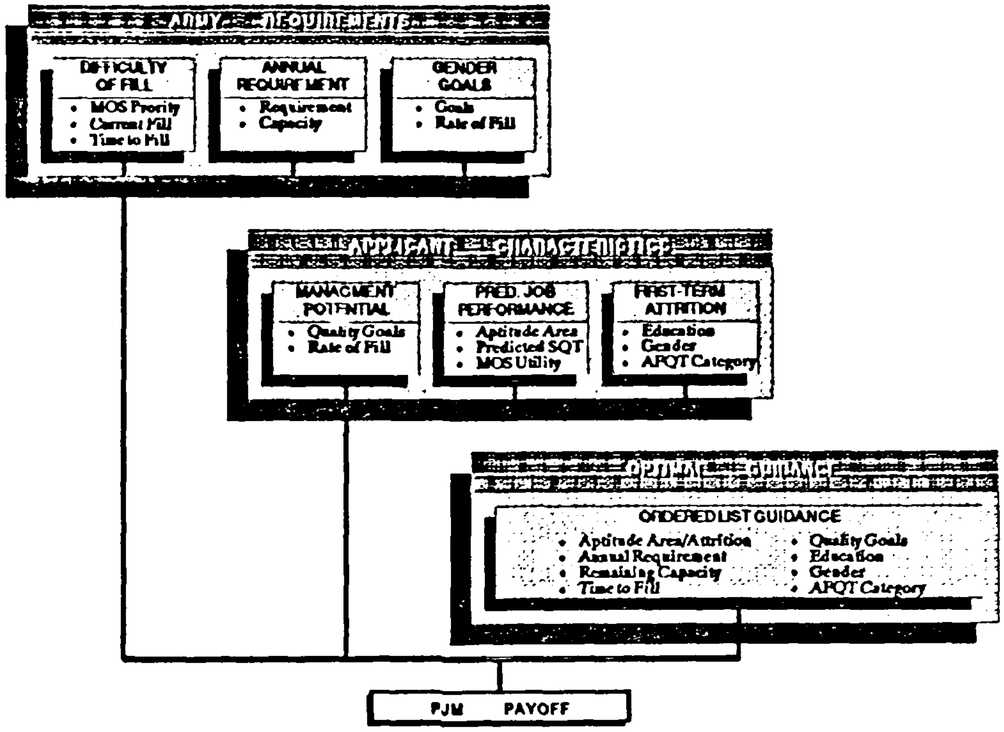

Figure 15. ACM Person-Job Match Categories.

(1) Army Requirements. The modules within this category reflect the need for the Army to meet its annual mission independent of the characteristics of the individual applicants. This allows Army managers to ensure that less desirable, hard-to-fill skills are given additional emphasis by the system so that their annual requirements are met. [This category is comparable to the MOS Status portion of the current Classification Hierarchy.]

(2) Applicant Characteristics. The modules within this category reflect the anticipated performance of the applicant, allowing the system to determine the MOS in which the applicant can perform best. This MOS is called the "local optimal" as it reflects the individual's best job match, without regard to the overall goals and missions of the Army. [This category is roughly comparable to the Applicant Qualification portion of the current Classification Hierarchy.]

(3) Optimization Ordered List. This category provides the ACM with the ability to identify the "global optimal," i.e., the best job match taking into account the overall goals and missions of the Army. The Optimization Ordered List is used both to identify the MOS/start dates to be scored and provide the relative merit of each combination. [There is no comparable capability within the current Classification Hierarchy].

The modules within each category measure some specific characteristic of the person-job match, e.g., the predicted first term attrition. Each of the disparate measures are scaled to a common, dimensionless unit measure and are then linearly weighted. The resulting composite measure provides a numeric payoff for each specific person-job match. The job match with the highest numerical value represents the "best" possible assignment, taking into consideration the individual's characteristics, the Army's requirements, and the long-range goals and missions.

By combining the optimization routine's aggregate guidance with the ACM's detailed allocations, EPAS can perform accurate simulations of the probable impacts of policy alternatives.

Simulate Job Acceptance. Once potential job matches have been identified, scored, and rank-ordered, acceptance of a specific option from the ordered list must be simulated. The ACM provides several options which may be used by the analyst to determine which job will be selected from the list of options.

Simulated Fill Capability. When the simulation capabilities of EPAS are being employed, the system will automatically update training fill to reflect the simulated assignments being generated by the system. Clearly, this process cannot be allowed to interfere with the actual training plan defined for REQUEST's day-to-day operations. Similarly, if repeated analyses are being conducted, the analyst should not be required to redefine the training plan for each alternative being examined. EPAS, therefore, has been developed to utilize a temporary definition of the selected training plan, thus allowing full simulations without altering the training plan on which the simulations are based.

REQUEST Interface Module

The ACM provides the detailed allocation capability for EPAS' Simulation Mode. In its Operational Mode, however, the detailed allocation will be performed by the Army's existing systems, in particular, REQUEST. This capability will require two developments:

1) A module, the REQUEST Interface Module (RIM) to communicate the EPAS optimal guidance (i.e., the ordered list) to REQUEST.

2) Modifications to REQUEST's Search routines to accept and process the optimal guidance.

Discussion of these issues will be found in Chapter IV, Results and Recommendations.

Ancillary Routines

To meet the needs of this research, EPAS had to be developed within a user-friendly, interactive, computerized system framework. This enables the evaluation of interdependent methodologies in a controlled environment and supports test scenarios.

A detailed discussion of the characteristics and key features of the EPAS system framework may be found in Appendix C. The basic features are summarized below.

System Framework. The system framework, called the Process Test System (PTS), provides several features to facilitate development, testing, and analytical support. The significant aspect of the PTS from the user's standpoint is its use of interactive menus to control all aspects of the system. Figure 16 presents an example of a typical menu as implemented in the EPAS user interface. These menus allow the EPAS user

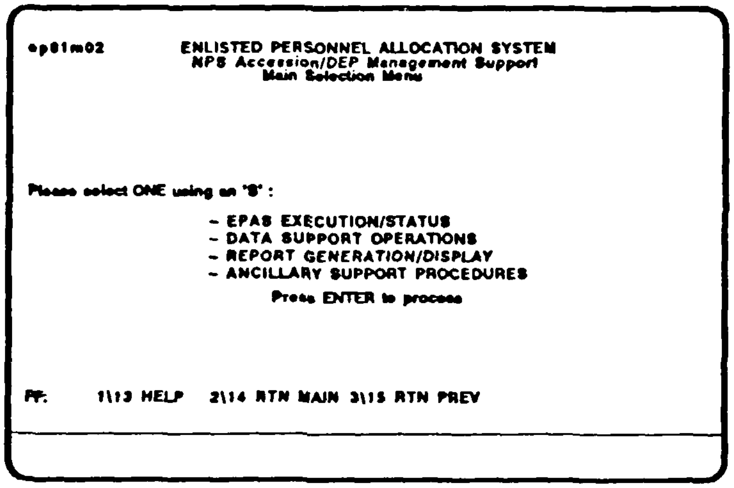

Figure 16. Sample EPAS Menu.

to easily set up alternate scenarios and control their execution and analysis.

Standardized Editors. All data within EPAS is accessible to the user through a series of interactive editors. Access to the full spectrum of data provides the ability to easily alter any data within the model for policy analysis and the ability to query the current or simulated values for any part of the system. The Army analyst can define alternate scenarios through the Standardized Editors, saving each as a different file within the EPAS data base. All editors have been standardized to provide identical capabilities.

Execution Control. The execution control procedures within the PTS perform all actions necessary to generate and execute the model in accordance with the user's specifications. The analyst identifies which of the saved scenario files are to be used for a given execution. The Execution Control procedures then automatically generate the necessary job control information and submit the job for execution.

Report Results. If the policy analysis capabilities of EPAS are to be utilized, the Army analyst must be able to generate clear, precise reports describing the results of the simulations. The user may select desired reports as an execution is being formulated. These reports will then be generated automatically.

The user may also request the generation of reports after the model execution has been completed. To facilitate this option, EPAS automatically computes summary statistics as the model executes. When after-the-fact reports are requested, these summary files are accessed to speed the report generation process. Full detail is also kept after each iteration, so detailed queries may also be generated if desired.

IV. RESULTS AND RECOMMENDATIONS

The long-range objective of this research is the development of a computerized decision support system which will apply Project A's new measures and Project B's new techniques to the actual selection and classification of recruits. This objective can only be realized if the results of Projects A and B demonstrate feasible and positive results. This section presents a quantitative summary of the results of Project A, requirements to implement the results of Project B as an operational system, and recommendations for future research.

RESULTS

Feasibility of Approach

The results of the research conducted under this contract demonstrate conclusively the feasibility of applying global optimization techniques to the recruit allocation problem. Techniques were developed which enable the global, optimal solution to be used by the sequential PJM process. Additionally, the policy analysis capability inherent in the EPAS formulation represents a significant enhancement to the Army's existing management and analysis capabilities.

Applying the EPAS methodology will result in a totally different list of recommended MOS. Table 6, for example, shows the list of recommended MOS generated by the two approaches for the same two applicants. Both the applicants in Table 6 were male, high school graduates. One was in AFQT Category II, with an AFQT score of 88; the other, AFQT Category IIIA, with an AFQT score of 60. Both applicants were processed through REQUEST; they were then processed using the EPAS-generated optimal guidance.

As one compares the MOS recommendations, it is clear that the EPAS-enhanced system generates a markedly different list than that generated by REQUEST for any given individual. None of the REQUEST-generated recommendations are on the EPAS recommendations for either of the two individuals depicted in Table 6.

In addition, the ordered list from REQUEST is virtually identical for the two applicants. The only distinction between the two lists is the result of the AFQT Category II individual meeting a qualifying score which the AFQT Category IIIA individual fails.

EPAS, on the other hand, produces a distinctly different list for the two applicants. Clearly, the difference in methodology between EPAS and REQUEST has a significant impact on the outcome.

Results of Methodology

Preliminary analysis performed by ARI prior to the award of contracts for Projects A and B indicated significant room for improvement in the

Table 6. Comparative MOS Recommendations.

Applicant One AFQT Category IIIA			Applicant Two AFQT Category II		
ORDER No.	REQUEST	EPAS	ORDER No.	REQUEST	EPAS
1	13B	26L	1	13B	13C
2	98C	27B	2	98C	13E
3	63T	27N	3	63T	13F
4	11X	32D	4	11X	19D
5	29F	32G	5	33T	27M
6	94B	32H	6	29F	36C
7	96R	34Y	7	94B	41C
8	31C	35L	8	96R	41J
9	63D	35M	9	31C	45B
10	93B	35R	10	63D	45K

utilization of available recruiting resources. Simulations using have show that the EPAS methodology has the potential to effect much of this improvement.

This improvement is depicted in Figure 17. Actual recruits from FY86 were randomly assigned to MOS for which they minimally qualified. The Aptitude

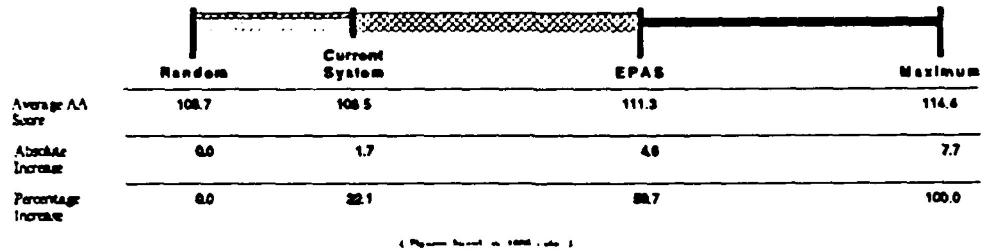

Figure 17. Potential for Improved Performance.

Area Composite scores associated with the resulting MOS were averaged. The resulting score, 106.7, represents the expected value if no systematic approach were used to allocate NPS recruits. Next, the highest aptitude area score for each recruit was averaged, without regard to the availability of training in the aptitude area. The resulting score, 114.4, represents an absolute, albeit unattainable, maximum value.

The average aptitude area score from the actual MOS to which the recruits were assigned was 108.5. This indicates that the current allocation system was able to effect an improvement of 22% of the potential range. Simulations using the EPAS methodology raised the expected average score to 111.3. This represents an improvement of nearly 60% of the potential range; almost triple that achieved by the current system.

Research has also shown that a synergistic relationship exists between Projects A and B. The results of either project may be used independently to provide performance improvements over the current system. Using both together, however, provides an anticipated improvement greater than the sum of the two used independently.

Figure 18 graphically depicts predicted performance increases in AFQT Category I-IIIA equivalents[2]. One of the early results from the Project A research was a recommendation to redefine the ASVAB subtests used to

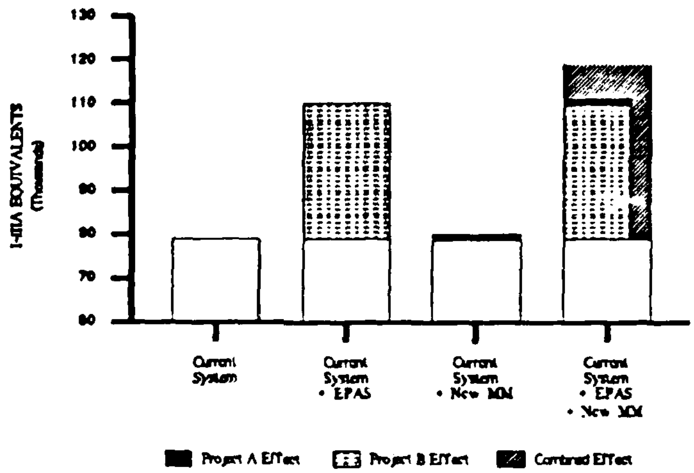

Figure 18. Project A and B Synergistic Effects.

compute the Mechanical Maintenance (MM) aptitude area composite score. As can shown in Figure 18, application of this independently resulted in a slight gain of performance, equivalent to about 1,000 additional AFQT Category I-IIIA personnel. Similarly, independent use of EPAS resulted in an increase of nearly 30,000 I-IIIA equivalents.

When the two are used together a substantial increase, equivalent to approximately 40,000 additional I-IIIA personnel, was experienced. This increase is significantly more than the simple sum of the two efforts taken independently.

2 AFQT Category I-IIIA equivalents refers to the number of additional quality (i.e., AFQT Category I-IIIA) personnel which would have to be recruited to achieve the same performance increase as was gained by redistributing the personnel actually recruited. The USAREC recruiting budget is directly affected by the number of quality recruits required. Thus, this measure depicts dollar savings as well as performance improvements.

IMPLEMENTATION RECOMMENDATIONS

The demonstrated feasibility of, and anticipated improvements from using, the EPAS methodology clearly warrant the development of a fully operational capability. GRC developed EPAS with the concept that much of the system, particularly the core modules, would be usable in an operational system. Some additions to, and modifications of, the existing system will be required, however, to develop a usable operational capability.

Data Support Requirements

Foremost among the necessary activities is full automation of the data environment. The EPAS data is currently based on information from a variety of sources, e.g., recruiting transactions from USAREC. These data are edited using a combination of special-purpose, ancillary routines and manual review. While adequate, and frequently necessary, in a research-oriented environment, this practice will not be practical in an operational environment.

GRC published a Data Requirements Document in March, 1989 (GRC Report 1317-33-89-TR) describing the type of data and probable data sources needed to support a fully operational EPAS. The first step in developing an operational capability must be verification of these data requirements and sources, establishing procedures to facilitate the routine transfer of data, and automation of procedures to edit and load the data.

Identification of Functional Requirements

The functional proponent for this contract was ARI; the associated functional requirements were research oriented. All contractual efforts have, obviously, oriented on the types of issues associated with the ongoing research being performed by ARI, Project A, and EPAS itself. Output reports, for example, provide extensive analytical information enabling analysts to perform detailed studies issue being investigated.

Implementation of a practical operational capability requires identification of the end-users of the system and a clear definition of the functional requirements which will be necessary to support their day-to-day needs.

Modification to EPAS

The EPAS routines, while designed to have practical applications, are not necessarily compatible with the needs of an operational environment.

Excessive Model Flexibility

The flexibility of EPAS, i.e., the ability of the system to change parameters, is inappropriate to an operational environment.

In many cases, EPAS was designed to facilitate an analysts need to test alternatives. An example of this is the generation of Aptitude Area Composite scores. EPAS currently utilizes the ASVAB subtest raw scores as input. Composite scores are computed within the model. This capability has been used to support various research issues, such as:

- Evaluation of alternative composite formulations, i.e., using different subtests to generate composites.

- Evaluation of alternative aptitude area definitions, e.g., the Project A recommendation to change from nine to five aptitude areas.

- Evaluation of alternative predictive measures, e.g., predicting Skill Qualification Test (SQT) scores based on the subtest scores.

Capabilities such as this provide an inappropriate degree of flexibility. While mandatory to support research associated with this contract, this flexibility complicates the model operationally. Further, many of the capabilities inherent in EPAS may result in completely unacceptable abilities.

Insufficient Model Flexibility

Conversely, in some instances, the model did not require the kind of flexibility that is required in an operational capability. An example of this is in the definition of the basic LP formulation. As depicted in Figure 13, page 28, a time lag may exist between the completion of basic training and the beginning of AIT. The duration of this time is defined by Army policy and may be changed.

From the standpoint of verification of the LP formulation, however, it was necessary only to demonstrate that the problem could be successfully defined and solved. The period between BT and AIT has been "hard coded" at two weeks in the current model. Operationally, this value needs to be defined as a parameter, with appropriate support procedures established to enable the Army manager to change its value.

Interface with REQUEST

EPAS, with its Policy Analysis and Simulation Modes, has the ability to function independently. To be used effectively, the Operational Mode must also be fully implemented. This will require interfacing EPAS with

REQUEST. This interface will require modifications to REQUEST and enhancements to EPAS.

Modification to REQUEST

Several major modifications are required if REQUEST is to be able to apply the lessons learned from Projects A and B:

(1) New factors will have to be added to, or existing factors replaced in, the current hierarchy to utilize the Project A measures of prediction.

(2) A means must be developed to utilize the planning guidance from the EPAS (Project B) optimization routine.

(3) Recognition of the EPAS Supply Groups.

Accept New Predictors. The focus of the Project A effort is to develop new performance predictors, enabling the Army to better utilize applicants. EPAS has been specifically designed to use these measures; REQUEST, on the other hand, would have to be modified to accept these new predictors.

In addition, the EPAS-enhanced sequential classification algorithms must have a factor which will enable them to accept the relative PJM score generated by the optimization procedures. This capability is required to differentiate among the relative merit of allocation combinations.

For example, if the relative [optimal] scores for two combinations were 1000 and 995, there is little substantial difference between the two. The final decision could, in effect, be based on other factors in the classification algorithm. If the scores were 1000 and 500, however, a significant preference of one over the other is being indicated and must be addressed.

Utilizing EPAS Guidance. Because of the large number of MOS/start date combinations available to applicants, both EPAS and the REQUEST search routine utilize logic to reduce the number of combinations to actually be considered for an applicant. Both systems first eliminate all MOS for which the applicant is not eligible, e.g., those for which the applicant fails to achieve the minimum qualifying ASVAB score.

REQUEST's search algorithm only examines those MOS with classes within a specified search window (page 8). This approach results in a myopic perspective, preventing the scoring algorithms from evaluating skills essential to the Army.

EPAS, on the other hand, eliminates MOS/date combinations based on the ordered list generated by the optimization routines. The ordered list has the effect of eliminating MOS which, while the applicant meets eligibility requirements, represent less desirable assignments while examining classes for the remaining MOS throughout the DEP horizon.

The impact of this difference is depicted in Figure 19. In this figure, MOS/start dates processed by REQUEST's Search Window methodology are only

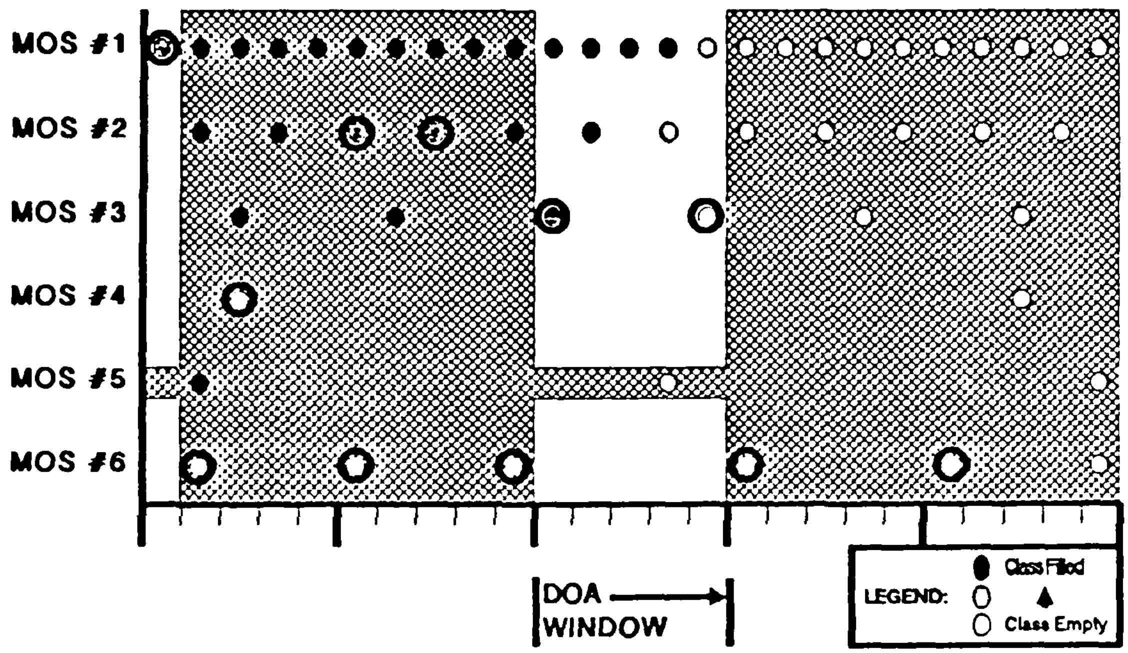

Figure 19. PJM Scoring: REQUEST vs EPAS

those depicted in the unshaded regions. Those processed by the EPAS methodology are circled. Clearly, there are substantial differences between the two.

Because of this difference, implementation of EPAS optimal guidance solely as a new factor in the classification hierarchy would be largely ineffective. With the current Search Window methodology, most of the guidance provided by EPAS would be lost. Highly recommended jobs from EPAS would never be seen by REQUEST, hence their factor score would be meaningless.

<u>Recognition of Supply Groups</u>. EPAS generates optimal guidance for Supply Group aggregations, not for individual applicants. REQUEST, therefore, will have to implement a procedure which will enable it to determine with which Supply Group a specific applicant is associated.

EPAS Enhancements

Implementation of the EPAS Operational Mode requires development of the REQUEST Interface Module (RIM). The RIM would provide two types of information to REQUEST:

(1) Ordered list guidance for each Supply Group.

(2) Statistical information for determining with which Supply Group individual applicants are to be associated.

Details on the data to be generated by the RIM may be found in Appendix D.

In addition, the weekly transaction information from REQUEST would have to be made available to EPAS. This data would be used to update the supply and demand projections, allowing weekly recommendations to be made based on current status.

RECOMMENDATIONS FOR FURTHER RESEARCH

In the course of the work performed in the development of EPAS, several areas were identified in which GRC personnel felt additional research would be warranted. These issues were identified as secondary issues, that is, ones not specifically need to validate the EPAS concept. Instead, they represent enhancements of capabilities to provide better PJM recommendations.

Dynamic Analysis of Supply Forecasts

The Supply Group forecasts used by EPAS are, of necessity, generated by applying historically-based statistical distributions to forecasts of future contracts, e.g., the USAREC Mission Blocks. The EPAS methodology applies its statistical distributions to the forecasts to generate its detailed (Supply Group by month) forecasts. Adjustments to the forecasts are made throughout the year as actual contracts are recorded.

These adjustments are made, however, with the underlying assumption that the forecasts of contracts are correct. If the forecasts are in fact erroneous, the detailed forecasts will continue to be in error. It would be highly desireable to be able to automatically distinguish between accurate forecasts with different detailed distributions and erroneous forecasts. Such a capability would also be of significant benefit to Army managers as well, enabling them to identify problems in achieving specified recruiting missions before these problems become critical.

The techniques used by EPAS to generate Supply Groups and to adjust forecasts based on actual occurrences would appear to offer an excellent means of automatically identifying potentially problematic situations.

Research in this area would focus on identification of statistical techniques to identify significant deviations from expected values and evaluating the feasibility of merging these techniques into EPAS' Supply Group definition and forecasting procedures.

Goal Programming

One of the principle activities performed in the aggregate optimization procedures (see page 25) is the decomposition of the MOS Clusters recommended for a Supply Group into their component MOS. This function is necessary to ensure that information about critical MOS (i.e., those which must have immediate action taken to ensure that their annual requirements are met) is not lost.

The current process employed by the QAM is a relatively simple heuristic. GRC personnel have observed that the decomposition problem might be an ideal Goal Programming application. In this concept, the EPAS LP would continue to be used to define the optimal solution as a list of MOS Clusters for each Supply Group. Each Supply Group would then be the basis for a secondary optimization problem. The secondary problems would solve for the optimal MOS list, while remaining constrained to the MOS Cluster solution of the global LP.

Research in this issue would involve basic feasibility assessment; problem formulation, in particular, definition of a suitable objective function; and benefit/cost evaluations.

Probability of Acceptance

A key issue in the Simulation Mode is the determination of which job offer would be accepted by an applicant. Numerous techniques have been included in the ACM to simulate this occurrence (see Appendix C). Each of these techniques, however, provide an *a priori* estimate, that is, the technique is defined before any recommendations are made and is, therefore, independent of the guidance provide by the model.

An alternative approach is to dynamically define the probability of an applicant accepting a job offer as a function of the applicant's characteristics and the MOS' requirements. This alternative would seem to offer a more accurate means of simulating outcome. It would also provide a new metric which might be directly applicable in both the aggregate and detailed allocation process.

Before such an approach could be implemented, extensive research will be required to identify the independent variables, i.e., the predictors, the functional relationship, and the statistical accuracy of such a technique.

Supply Group Formulation and Forecasting Techniques

Extensive research, as documented in Appendix C, has been conducted into the definition of Supply Groups. This research has focused almost entirely on defining the Supply Groups from the base of the USAREC Mission Goals. The accurate forecasting of contracts in terms of Supply Groups is essential to the success of the EPAS methodology.

GRC has continuously reviewed and revised the methodology used to generated Supply Groups to ensure the most accurate technique is always be used. This review process should be continued to accommodate changing populations and environments.

The second aspect of projecting supply is the forecasting methodology used. The USAREC Mission Goals, at present, continue to be the most accurate forecasts, particularly in the Operational Mode.

For the Policy Analysis and Simulation Modes, however, alternative forecasting models may better suit the needs of the Army's managers and analysts as the attempt to evaluate the affect of policy alternatives on future allocations. The generation and evaluation of forecasting models remains outside the purview of EPAS, but constant coordination is required to maintain the linkage between the forecasting model and the defintion of the EPAS Supply Groups.

The Horne model, for example, generates quarterly forecasts of Male, AFQT Category I-IIIA, High School Graduates. While suitable for certain types of policy analyses, extensive additional analysis must be performed to provide information on:

- The rest of the accession population: non-graduates, females, AFQT Categories IIIB and IV, etc.
- Monthly distributions
- Generation of EPAS Supply Groups from the adjusted forecasts.

Considerable research must be performed in close coordination with the research into the forecasting models before these models can be used in EPAS.

Automation of MOS Clustering

Current methodology groups individual MOS into MOS Clusters by successive partitioning of subpopulations. The process results in an excessive number of clusters. The number is reduced to a tractable number by manually reviewing and grouping selected clusters. The manual collection is based on information such as the clear-text description of the component skills' requirements.

Automation of this process would be highly desireable for a fully operational implementation of the EPAS methodology. Further research might yield means by which this could be accomplished. Keyword matching algorithms coupled with artificial intelligence, for example, might provide the desired automation capability.

APPENDIX A

TERMS AND ABBREVIATIONS

APPENDIX A
TERMS AND ABBREVIATIONS

The following terms and abbreviations are used in this report and its appendixes. A thorough understanding of these terms will significantly facilitate the reader's understanding of these reports.

Accession -- term applied to a recruit who reports for active duty and begins formal training.

ACM -- Applicant Classification Module -- one of the EPAS core modules. It performs the detailed allocation simulations for the model.

AFQT -- Armed Forces Qualification Test -- the basic test used to determine eligibility for entrance into the Armed Forces.

AFQT Category -- grouping of AFQT scores into categories based on the percentile of the AFQT score.

Ancillary Routines -- EPAS procedures which are supportive to, but not part of, the primary EPAS methodology.

Applicant -- term applied to an individual who begins any portion of the recruiting testing and evaluation process.

APS -- Applicant, Secondary File Generator -- the EPAS ancillary procedure which creates a simulated applicant population.

AQ -- Applicant Qualifications -- that portion of the REQUEST Classification Hierarchy which attempts to identify the applicant's suitability for an MOS.

ARCNET -- the networking algorithm used by EPAS; a proprietary product of Analysis, Research and Computation of Austin, TX.

ARI -- Army Research Institute -- the sponsoring and monitoring agency for the research performed under this contract.

ASVAB -- Armed Services Vocational Aptitude Battery -- a set of tests designed to determine an applicant's basic aptitudes in several areas pertinent to jobs within the Armed Forces.

ASVAB Composites -- linear combinations of the ASVAB subtests used by the Army to determine an applicant's capability in, and qualifications for, groups of MOS.

Classification Hierarchy -- the portion of the REQUEST system which computes a score to determine the desirability of a specific PJM.

Core Modules -- those procedures within EPAS which are directly concerned with the generation of an optimal, ordered list for future applicants.

CSP -- Cross-System Product -- a proprietary product of IBM used to define EPAS interactive panels for data entry.

DEP -- Delayed Entry Program -- an Army program through which applicants can sign contracts but delay actual entry into the Army for a negotiated length of time.

DLF -- Decision Laboratory Facility -- a mini-computer-based facility used to provide analytical support during the early stages of the contract.

DOA -- Date of Availability -- a user-input date utilized by REQUEST to determine which MOS/class data combinations are to be evaluated for an applicant.

DQ Switch -- Define Quality Switch -- an externally-defined parametric switch used by REQUEST to distribute quality among MOS over time.

EPAS -- Enlisted Personnel Allocation System -- the computer system developed under the auspices of this contract to evaluate the feasibility of the proposed methodology.

Evaluation Factor -- any measure used to determine the desireability of a potential person-job match.

GRC -- General Research Corporation -- the lead contractor for the work performed under this contract.

Guidance Counselor -- the Army's representative at a MEPS who negotiates the initial entry MOS with applicants.

ISC-P -- Information Services Command--Pentagon -- the computer facility on which the EPAS operational prototype was tested.

Look-up -- a mode of operating REQUEST in which the Guidance Counselor has the option of directly evaluating the suitability and availability of an MOS for an applicant.

LP -- Linear Program -- a linear optimization methodology utilized by EPAS. LPs sacrifice speed for detail.

MEPS -- Military Entrance Processing Station -- the location at which applicants are tested, evaluated, and contracted for military service.

MGM -- Metric Generation Module -- an EPAS ancillary procedure which generates the "cost" values to be used by the optimization procedures.

MOS -- Military Occupational Specialty -- the coding system by which the Army identifies its skill requirements.

MPI -- Military Priority Index -- the result of the REQUEST Classification Hierarchy scoring algorithm; this value indicates the desirability of allocating an applicant to an MOS.

MS -- MOS Status -- that portion of the REQUEST Classification Hierarchy which determines the Army's need to immediately fill an MOS.

Network -- a linear optimization methodology utilized by EPAS. Networks sacrifice detail for speed.

NIH -- National Institute of Health -- the computer facility on which the full-scale, EPAS prototype was developed and tested.

NPS -- Non-Prior Service -- applicants for military service with no previous military experience.

Operational Mode -- one of three waus of using EPAS; this mode is designed to provide day-to-day support for the NPS allocation process.

Ordered List -- a rank-ordered list of possible initial assignments for an applicant. The list is ordered so that the job best suited to the Army's requirements is first.

PJM -- Person-Job Match -- a potential matching of an applicant to an MOS.

Policy Analysis Mode -- one of ways of using EPAS; this mode is designed to provide relatively fast, aggregate long-range projections of the impact of alternative policies.

Project A -- the "sister" contract to Project B; Project A objectives were to identify and validate means of predicting performance.

Project B -- the contract under which EPAS was developed.

PTS -- Process Test System -- the basic, computer framework which links together the complete EPAS system.

QAM -- Quality Allocation Module -- one of the EPAS core modules; the QAM sets up, performs, and analyzes the optimal allocation of future applicants.

QFM -- Quality Forecasting Module -- one of the EPAS core modules; the QFM defines anticipated future applicants by type and date of arrival.

Quality Goals -- the desired percentage of an MOS' annual requirement to be filled with personnel in AFQT Categories I-IIIA.

REQUEST -- Recruit Quota System -- the system which currently supports the Army's recruiting process; includes routines for generating ordered lists of PJM recommendations.

RIM -- REQUEST Interface Module -- a hypothetical module required to interface EPAS' Operational Mode with REQUEST. This module will have to be developed if EPAS is made fully operational.

Search -- a mode of operating REQUEST in which the Guidance Counselor has the allows the system to generate a list of suitable and available MOS for an applicant.

Search Window -- a fixed length of time from the DOA; the means by which REQUEST reduces the number of MOS/start date possiblities to a manageable size.

Simulation Mode -- one of ways of using EPAS; this mode is designed to provide detailed long-range projections of the impact of alternative policies.

SQT -- Skill Qualification Test -- an MOS-specific test given to soldiers to determine their skill proficiency; predicting SQT is one of the means by which EPAS predicts job performance.

Transformation Function -- a mathematical function for translating an evaluation factor into a dimensionless, relative measure of desirability.

TRM -- Training Requirements Module -- one of the EPAS core modules; the TRM generates the future training demand for each MOS.

USAREC -- U.S. Army Recruiting Command -- the Army command with the responsibility of meeting annual recruiting requirements.

USAREC Mission Goals -- the objectives USAREC uses to ensure that its recruiters meet the annual recruiting demand.

Weighting Value -- a value used to express the relative importance of evaluation factors as they are combined to form the MPI.

Whizard -- the linear programming algorithm used by EPAS; a proprietary product of Ketron, Inc. of Arlington, VA.

Wicat -- a Motoralla 68000-based minicomputer used for the DLF; the initial research was performed on a Wicat Model 160.

APPENDIX B

EPAS PUBLICATION LIST

APPENDIX B
EPAS PUBLICATION LIST

GRC frequently published reports documenting the research being performed throughout the duration of the contract. This appendix lists the primary documents provides a brief synopsis of the contents of each document. Not all documents published as part of the contract are included here, for example, drafts of subsequent final reports are not included.

TITLE of REPORT	REPORT NUMBER	DATE of REPORT	CONTENTS of REPORT
Biographical List of Proposed Advisory Committee Members	1317-03-83-CR	January 1983	List of advisor panel members.
Completed Literature & Data Review	1317-04-83-CR	March 1983	Documentation of existing technologies, including Linear Programming, Adaptive Learning Networks, Utility Theory.
Completed Systems Analysis Report	1317-07-83-CR	September 1983	Description of systems and processes which support the Army's accessioning program.
Final Annual Report (1st Year)	1317-11-83-CR	December 1983	Documentation of all actions during first contract year.
Semi-Annual Progress Report October 1983--March 1984	1317-12-84-CR	April 1984	Documentation of research during first half of second contract year.
Final Annual Report (2nd Year)	1317-16-84-CR	December 1984	Documentation of actions during second contract year; includes initial discussion of EPAS formulation.
Semi-Annual Progress Report October 1984--March 1985	1317-17-85-CR	April 1985	Documentation of research and EPAS development during first half of third contract year.
Final Annual Report (3rd Year)	1317-21-85-CR	December 1985	Documentation of activities during third contract year.
Semi-Annual Progress Report October 1985--March 1986	1317-22-86-CR	April 1986	Documentation of progress and research during first half of fourth contract year.
Evaluating the Benefits and Costs of the Enlisted Personnel Allocation System	1317-23-86-CR	June 1986	Results of multiple EPAS simulations with anticipated dollar benefit to Army of EPAS implementation.

TITLE of REPORT	REPORT NUMBER	DATE of REPORT	CONTENTS of REPORT
Final Annual Report (4th Year)	1317-27-86-CR	December 1986	Documentation of EPAS simulations and additional research during fourth contract year.
Semi-Annual Progress Report October 1986-March 1987	1317-28-87-CR	April 1987	Documentation of activities during first half of fifth contract year.
Field Test Plan	1317-29-87-CR	September 1987	Descriptions of scenarios for final test with supporting data.
Final Annual Report (5th Year) (Two Volumes)	1317-31-87-CR	December 1987	Documentation of activities during fifth contract year; includes complete overview of EPAS development and design.
Semi-Annual Progress Report October 1987--March 1988	1317-32-87-CR	April 1988	Documentation of activities during first half of sixth contract year.
Data Requirements Document	1317-33-89-TR	March 1989	Description of requirements and probable sources for EPAS data.
Field Test Results	1317-34-89-CR	December 1989	Evaluation of the results of the EPAS Field Test

APPENDIX C

OVERVIEW OF EPAS ANALYSIS

APPENDIX C

OVERVIEW OF EPAS ANALYSIS

APPENDIX C
OVERVIEW OF EPAS ANALYSIS

The EPAS Operational Prototype is the product of a series of analyses conducted by personnel associated with the project. This analysis has been conducted primarily by GRC personnel; however, analyses performed by personnel of the Army Research Institute (ARI); the American Institute for Research (AIR, Project A); and various subcontractors was also used in the system's development.

The results of the analyses have been extensively documented in previous GRC reports (see Appendix B). A summary of the history of the research and decisions for each of the major functional areas of EPAS is included in this appendix to provide the reader with a comprehensive overview of the Project B research and the design and development of EPAS. References to earlier documentation are included in case the reader desires more detailed information on a specific research issue.

Areas covered in this Appendix are:

FORECAST APPLICANTS/CONTRACTEES
- Conduct a Literature and Data Review of Forecasting Techniques
- Review the Army's Recruit Mission Process
- Select Appropriate Forecasting Methodologies for EPAS
- Investigate and Select Appropriate Supply Group Methodologies
- Develop Supply Group Forecasts

DETERMINE/PROJECT MOS REQUIREMENTS
- Determine/Provide MOS Clustering
- Provide MOS Training Fill Information

GENERATE AGGREGATE ASSIGNMENTS
- Formulation of Models
- The Network Model
- Aggregate Allocation Model
- Quality Allocation Model Linear Program
- Utilization of Optimal Solution
- Aggregate Assignment Summaryyy

GENERATE DETAILED ASSIGNMENT
- The Applicant Classification Module
- REQUEST Interface Module

EPAS SYSTEM FRAMEWORK
- Determine Computer System and Development Language
- Investigate and Select Development Methodology
- Provide a User and Developer Interface
- Provide Execution Control
- Provide Execution Status Monitoring

TAB 1. FY 86 SUPPLY GROUPS
TAB 2. FY86 MOS CLUSTERS
TAB 3. EXAMPLE OF REDUCED COST PROCESSING
TAB 4. EPAS TREE-STRUCTURED ACCESS

FORECAST APPLICANTS/CONTRACTEES

The contract specifications for EPAS listed supply forecasting as one of its key system capabilities:

> "...the determination of a reasoned guess about the number and kind of people likely to be available for recruitment into the Army during some specific week, month, or year"

To meet this requirement, it was obvious that a supply forecasting capability would have to be implemented into EPAS. Project B, however, at the direction of the COR, was not to develop new forecasting methodologies but was, instead, to implement existing techniques. This explicit contractual obligation clearly required research to identify and select an appropriate forecasting methodology.

A related problem, the aggregation of supply, was not explicitly specified in the contract but became essential to the development of EPAS. The Army's non-prior service (NPS) assignment problem is unique in its size and complexity. Typically, 140,000 individuals apply each year for training seats in approximately 300 MOS. The total number of training classes available during the year is approximately 6,000. Without considering eligibility restrictions, this gives 140,000 x 6,000 or 840,000,000 possible assignments. A problem of this magnitude is well beyond the capabilities of any existing computer equipment.

To overcome this problem, the decision was made to aggregate supply forecasts into categories called Supply Groups. This categorization, along with a similar grouping for MOS (described in the next section), provided a reduction in the magnitude of the problem on the order of 10,000. This decision, however, led to two additional research issues:

(1) How should the supply be aggregated to provide the most benefit to the assignment problem?

(2) How should the projections from the forecasting model(s) be used to provide Supply Group projections?

Furthermore, a recruit's enlistment process can be divided into three distinct segments:

(1) Applicant -- an applicant is any recruit who has begun the enlistment process. Some of the individuals who begin this process will not be acceptable to the Army, for physical, moral, or mental reasons. Others may be acceptable, but may choose to not enter the Army.

(2) Contractee -- if an applicant is acceptable and agrees to enter the Army, s/he signs a contract to that effect. Contractees may enter the Army immediately as a Direct Ship or, more likely, enter the Army at some time in the future through the Delayed Entry Program (DEP).

(3) Accession -- not all personnel who sign contracts will actually enter the Army. Some will fail to perform some required action (for example, a high school senior who fails to graduate), some will become disqualified (for example, physical injury, or moral problems such as an arrest or drug problem), others may simply change their mind.[1] A recruit who continues through the entire process an actually enters the Army is called an Accession.

Extensive discussions were held early in the contract effort to determine which recruit "segment" should be forecast. The probability of a qualified recruit completing the recruiting process and accessing appears likely to be a function of the MOS offered. Would, for example, an applicant be more likely to sign a contract if offered one MOS instead of another? Would the likelihood of a contractee being a DEP loss be affected by the MOS in which s/he had contracted?

A related issue is determination of eligible recruits, given the development and implementation of new measures. For example, would a new ASVAB Composite formulation result in previously ineligible recruits becoming eligible for some skill?

The decision was made that these issues were beyond the scope of Project B. Accordingly, a decision was made to have EPAS forecast only accessions.

To support the research requirements arising from the need to forecast accessions, four functional areas were identified. These areas, described below, are:

(1) Conduct a literature and data review of forecasting techniques appropriate for estimating near- and long-term supply of Army accessions. This provided the groundwork for model development.

(2) Review the Army's recruit mission process. It was necessary to clearly understand the mission process before forecast of the supply could be developed.

(3) Select appropriate forecasting methodologies for EPAS.

(4) Investigate and select appropriate Supply Group formulation methodologies.

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[1] In theory, the Army may pursue contractees who simply chose not to fulfill the terms of their contract. In practice, however, such individuals are generally permitted to back out of their contract with impunity.

Conduct a Literature and Data Review of Forecasting Techniques

This functional requirement was specified as Subtask 2 of Task 1 in the EPAS contract. It was clearly undesirable for GRC personnel to replicate the efforts of other contracts and agencies in the development of forecasting methodologies. A survey of NPS supply forecasting technology was conducted to identify existing capabilities. Additionally, a subcontract was let to Adaptronics, Inc. to perform a survey of general forecasting techniques. The results of these surveys are summarize below.

Survey of NPS Supply Forecasting Technology

The majority of the NPS supply forecasting models could be classified as one of two categories, macro or micro, based on their level of aggregation. The traditional models regressed counts of enlistee supply against population counts, measures of unemployment, military and civilian pay measures, and other related socioeconomic variables. These model are regarded as macro models. These included models developed by Fernandez (1979, 1980) at Rand, Goldberg (1979, 1980) at CNA, and Morey (1979, 1980) at Duke University.

Micro models were developed using choice-based sampling methods. Daula (1982) criticized macro models as suffering from the effects of aggregation and measurement errors. He also maintained that macro models had a sampling bias, which he attributed to the fact that civilian wages and opportunities could not be observed for those individuals who enlisted in the military. Daula further conjectured that, because of these errors, the historical assessment of elasticities for pay and unemployment had been drastically underestimated.

Using a choice-based methodology like that of Hausman (1978) and Manski (1977), Daula and his colleagues at the U.S. Military Academy developed a micro model of individual behavior. Preliminary results were encouraging, but they did suffer from some counter-intuitive results, e.g., the mathematical formulation resulted in recruiter performance having a negative contribution to the final results.

The major problem with Daula's work was the lack of adequate data. Daula was using data from the National Longitudinal Survey (NLS) that had bee sponsored by the Department of Labor. This data base had only a small sample of military personnel records. Hosek (1982) of RAND Corporation was able to construct a much larger data base by merging data collected at the AFEES with the NLS data. The results of his choice-based model were not available.

The NPS supply forecasting survey indicated work had been done in this area but that much more was needed. Most of these models were developed for long-term, i.e., a year or more, forecasting. In addition, they all projected accessions of male high school graduates in AFQT Categories I-IIIA. EPAS, however, requires forecasts of all demographic groupings.

Survey of General Forecasting Techniques

EPAS' forecasting requirement were expected to pose problems not encountered by the current NPS supply forecasting research. Therefore, it was decided that a survey covering the current state of forecasting methodologies, in general, should be conducted. Mr. James Carrig (1983) of Adaptronics, Inc. carried out this survey.

The survey presented an overview of current forecasting methodologies along with a critique of how well these methods had done in the forecasting competition set up by Makridakis (1982). This competition contained 1,001 sets of time series of all types of data, including monthly, quarterly, and yearly; seasonal and non-seasonal; and micro and macro data.

Carrig also tested a new forecasting technique, the Adaptive Learning Network (ALN), This method was compared to the more accurate of the major forecasting methods using a randomly-selected subset of 111 time series from the 1,001 sets used in the Makridakis competition.

The major conclusion drawn from this survey was that no single forecasting method is best in all circumstances. It was evident that data analysis should be cone to determine if the time series exhibit any of several common characteristics, e.g., seasonality. Given these characteristics, one can then narrow down the possible model choice(s) to a subset of methods that have performed well with that type of data.

Review the Army's Recruit Mission Process

The Army currently states its requirements for recruits as "missions" grouped by gender, education level, and AFQT Category. The groups are:

(1) Gender
- -- male
- -- female

(2) Education level
- -- high school diploma graduate or senior
- -- less than high school diploma graduate (non-graduates)[2]

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[2] High school equivalency certificates, such as GED, are defined to be less than high school diploma graduate.

(3) AFQT Category
- -- I-IIIA, AFQT score 50-99
- -- IIIB, AFQT score 31-49
- -- IV, AFQT score 10-30[3]

The AFQT, which is a combination of four subtests from the Armed Services Vocational Aptitude Battery (ASVAB), is used to determine whether the individual is qualified for entry into the Army. In addition, various limits and goals are set on enlistee AFQT quality by Congress, the Department of Defense, and the Army. For example, Congressional limits are set on the number of recruits in AFQT Category IV, while Army targets are set on the number in AFQT Categories I-IIIA.

Gender and education level are other individual characteristics used in the Army's accession planning. High school diploma graduates are preferred to non-graduates. Seniors can't be accessed into an MOS until after graduation. Gender is important since women are restricted from combat arms, jobs which comprise about one third of the Army's entry population.

The Quality Requirement

Aggregate accession requirements are generated by the Office of the Deputy Chief of Staff for Personnel (ODCSPER), with the use of the Enlisted Loss Inventory Model and the Computation of Manpower Programs using Linear Programming System (ELIM-COMPLIP). This system minimizes the differences between established operating strength objectives and actual strength forecasts, incorporating a number of constraints such as total Army training capacities.

Army manpower planners review the aggregate accession requirements and Congressional limits to develop quality targets. A quality accession is defined as a high school graduate in AFQT Categories I-IIIA. Thus, AFQT Category IV accessions are capped by Army policy and Congressional limits, while AFQT Category I-IIIA targets are established by Army policy. AFQT Category IIIB personnel are neither targeted nor capped; instead, these accessions "float" to allow the Army to meet its overall accession requirement. Table C-1 shows the fiscal year 1987 accessions by mission area.

The Recruiting Accession Requirement

ELIM-COMPLIP accession requirements are on a calendar month basis. The U.S. Army Recruiting Command's (USAREC) missions, however, are done on a Reception Station Month (RSM) basis. A RSM consists of either four or five 7-day weeks beginning on Tuesday and ending on Monday. The RSM concept ties the recruiting program to the start of training. It also

[3] AFQT Category V, i.e., AFQT scores less than 10, are not eligible for military service.

Table C-1. FY87 Recruiting Mission.

GENDER	DIPLOMA	AFQT CATEGORY I-IIIA	IIIB	IV
Male	High School	54516	28080	4125
	No High School	7917	3	0
Female	High School	10958	4544	0
	No High School	0	0	0

will smooth the peaks and valleys of recruit arrival at training bases by eliminating the potential for large increases in accessions at the end of the calendar month. The ODCSPER converts the calendar month accession requirements into RSM objectives for USAREC on a quarterly basis. An accession is defined as the point when an individual arrives at a reception station to begin basic training.

USAREC apportions the accessions objectives into contract/recruiting missions to the District Recruiting Battalions, formerly referred to as Commands, on a recruit station month basis. Contracts are define at the point at which an individual takes the oath of military service and has a training seat reserved.

Contract Missions

A recruit signs a contract generating an obligation to report for active duty and training in an MOS. The Delayed Entry Program (DEP) enables recruits to report at a later time to be accessed. Management of the DEP is complex, because neither the supply of potential recruits nor the phasing of MOS training classes is constant throughout the year. A failure to contract with an adequate number of recruits to access in months where recruiting is difficult can cause shortfalls in accessions.

The Army uses nine aptitude area composites from the ASVAB to determine minimum qualifying score for the MOS. If an individual scores above the minimum qualifying score on the proper aptitude area composite, training for that MOS is permitted providing a training seat exists. Table C-2 gives the ASVAB aptitude areas and the major jobs in the Army associated with each.

Select Appropriate Forecasting Methodologies for EPAS

EPAS' main goal is to provide forecasts of the number and type of people who will accept Army enlistment contracts. EPAS requires these forecasts for all mission areas on an RSM basis. The literature and data review revealed very little work being done to project such people. Therefore, the decision was made that ARI would develop two new models. In the interim, GRC personnel developed and implemented two models to facilitate the implementation of the EPAS forecasting capability.

Table C-2. Composition of Aptitude Areas.

APTITUDE AREA	MAJOR JOBS IN APTITUDE AREA
CL (Clerical)	Administrative, Supply, Finance
CO (Combat)	Infantry, Armor, Combat Engineer
EL (Electronic)	Missile Repair, Air Defense Repair, Electronics Repair, Fixed Plant Communications Repair
FA (Field Artillery)	Field Cannon, Rocket Artillery
GM (General Maintenance)	Construction and Utilities, Marine, Chemical, Petroleum
MM (Mechanical Maintenance)	Mechanical and Aircraft Maintenance, Rails
OF (Operators and Food)	Missiles Crewman, Air Defense Crew, Driver, Food Services
SC (Surveillance and Communications	Target Acquisition and Combat Surveillance, Communications Operations
ST (Skilled Technical)	Medical, Military Police, Intelligence, Data Processing, Air Control, Topography and Printing, Information and Audio Visual

One analysis considered the USAREC mission goals as a forecasting model. This seemed a reasonable hypothesis given that recruiters are evaluated on how well they meet their goals, thus the mission goals tend to become a "self-fulfilling prophecy." The fundamental assumption with this approach is that the supply of recruits is sufficient to meet the training demand. This analysis, along with a description of the forecasting models developed for and evaluated by EPAS, is presented below.

USAREC Mission Goals as Forecasts

Historically, the Army's demand for quality males have not been met by the available supply. GRC performed and analysis to determine if this was still the case or whether the supply of this, and other, mission groups could be determined largely by their USAREC mission goals. The analysis used FY81 and FY82 data. Prior to FY81, mission statements did not provide the necessary detail; recruiting missions were stated only in terms of total accessions.

Table C-3 displays the overall goal achievement by mission for these two years. Success in recruiting increased in FY82 over FY81 with only two lower quality categories failing to reach their stated mission. During

Table C-3. FY81 and FY82 Mission Goal Achievement.

MISSION BOX	FY 81 GOAL	FY 81 ACHIEVEMENT	FY 81 % GOAL	FY 82 GOAL	FY 82 ACHIEVEMENT	FY 82 % GOAL
M/HS*/I-IIIA	27148	31957	117.7	45391	51431	113.3
M/NHS/I-IIIA	10200	9957	97.6	8953	10810	120.7
M/HS /IIIB	30920	16581	53.6	23549	25211	107.1
M/NHS/IIIB	16269	15859	97.5	0	600	**
M/HSDG/IV	26941	26060	96.7	22419	21321	95.1
M/NHS/IV	0	0	0.0	0	0	0.0
F/HS /I-IIIA	6660	8425	126.5	8897	11764	132.2
F/NHS/I-IIIA	246	469	190.7	0	50	**
F/HS /IIIB	9089	6913	76.1	3197	2673	83.6
F/NHS/IIIB	173	472	272.8	0	1	**
F/HS /IV	2674	3117	116.6	0	56	**
F/NHS/IV	0	0	0.0	0	0	0.0
TOTAL	130320	119810	91.9	112406	123917	110.2

HS* -- indicates both high school graduates and high school seniors

FY81, USAREC exceeded its combined contract mission for quality males (27,148 goal) by seventeen percent (31,957 contracted). In FY82, USAREC nearly doubled the size of this mission goal (to 45,391) and still exceeded it by thirteen percent (51,431 contracts). This was accomplished by recruiting fewer AFQT Category IIIB high school graduates than were permitted.

Table C-4 displays the monthly contract missions and achievements, aggregated by District Recruiting Command (DRC), for quality males. Approximately 30 percent of all observations apparently failed (by DRCs)

Table C-4. Failures to Achieve Quality Contract Missions.

FAILURE TO ACHIEVE	FY	NUMBER DRCs	NUMBER FAILURES	TOTAL OBS	% of TOTAL OBS
Monthly Quality Mission	81	49	219	684	32.0
	82	54	170	672	26.6
	81/2	103	398	1356	29.4
Monthly Quality Mission and Cumulative Year-to-date Quality Mission	81	19	88	684	12.9
	82	21	72	672	10.7
	81/2	40	160	1356	11.8
Monthly Quality Mission and Annual Quality Mission	81	15	113	684	16.5
	82	7	54	672	8.0
	81/2	22	167	1356	12.3
Monthly Quality Mission and 90% of Annual Quality Mission	81	8	72	684	10.5
	82	1	9	672	1.3
	81/2	9	81	1356	6.0

to achieve monthly quality contract missions. A closer look, however, revealed that less than twelve percent of all observations showed a cumulative year-to-date deficit in quality contract achievement, and only six percent failed to meet at least 90 percent of their annual quality goals and their monthly quality mission goals.

The FY81-FY82 data suggests, therefore, that quality contracts are not supply constrained relative to USAREC missions. In fact, the USAREC mission goals provide good forecasts of enlistment contracts.

Models Evaluated by EPAS

The first step in projecting supply at the EPAS level-of-detail is the forecasting of contracts at the mission level. Five forecasting methodologies, four models and the USAREC mission, were evaluated by EPAS. These were:

(1) Dale-Gilroy (ARI) econometric model.
(2) Horne (ARI) econometric model.
(3) GRC trend model.
(4) GRC econometric model.
(5) USAREC mission statements.

Since these models do not provide the detail required for EPAS, modifications had to be made. Only the USAREC mission statements provide forecasts for other than male, high-school graduate, AFQT Category I-IIIA populations. USAREC mission statements were used in all cases, therefore, to forecast all other population categories.

Three of the models generate forecasts by calendar month; the Horne model forecasts quarterly. Adjustments were necessary to provide forecasts by RSM. RSM forecasts were generated by summing together weighted calendar forecasts. The weight used is the percentage of the calendar month accounted for by the RSM.

Finally, the USAREC mission goals had to be broken down to provide contracts on an RSM basis. Historical contracts by RSM and by mission category were used to generate the necessary detail.

Dale-Gilroy Econometric Model. The econometric model developed by Dale and Gilroy (September, 1983) estimated the effects of business cycles on monthly military accessions. This model uses the ratio of quality male contracts signed (accession contracts and DEP contracts) to the civilian male population in the 16-19 age group as the dependent variable. The explanatory variables included:

- Unemployment rates for males, age 16-19 in the current month, and lagged both two and four months.
- The ratio of regular military compensation to average weekly civilian production wages with a four-month lead.

- Enlistment bonuses.
- Educational bonuses.
- Number of recruiters.

The model was estimated using generalized least squares (GLS) regression, correcting for the presence of first order auto-correlation. The data, obtained from the Defense Manpower Data Center (DMDC), covered the time period from October, 1975 to March, 1982. Findings showed that quality enlistees are especially affected by pay rates. An additional conclusion was that it is important for the Army to maintain military-civilian pay comparability, as well as educational benefits, in order to have continued success in recruiting quality soldiers.

Horne Econometric Model. Horne (May, 1984) estimated the quarterly supply of contracts from several economic variables. The dependent variable was the ratio of quality male contracts to the civilian male population in the 16-21 age group. The explanatory variables included:

- Military and civilian pay differential.
- Enlistment bonuses.
- Civilian unemployment in the 16-21 age group, lagged one quarter.
- Ratio of the number of recruiters to the civilian population in the 16-21 age group.

The Horne model was estimated using generalized least squares regression. The quarterly data covered the third quarter o 1977 through the second quarter of 1984. Findings showed that military pay has a large and significant impact on enlistments, and that meeting recruiting goals is strongly hampered by declining unemployment rates and declining population of eligible males.

Historical, monthly percentages were applied to the quarterly forecasts to provide the level of detail needed by EPAS.

GRC Econometric Model. The variables used in the Dale-Gilroy model are all highly correlated. To adjusts for this, and to avoid multi-colinearity problems in the regression analysis, GRC used the technique of principal components to create a new set of exogenous variables from linear combinations of the original explanatory variables. These new variables have the property of being mutually uncorrelated. A linear regression was performed to generate coefficient estimates for these new variables. The monthly ratio of the number of quality male contracts to the civilian male population in the 16-21 age bracket was used as the dependent variable. Corrections were also included for the presence of first-order autocorrelated errors.

GRC Trend Model. GRC also investigated a linear trend model. The monthly contractee data was seasonally adjusted and a linear trend fit performed without exogenous variables. The form of the model is:

$$Y = f(T,S)$$

where Y is the number of contractees, T is the time trend, and S are past values of Y from previous months.

The time trend was first estimated using regression. The remaining variation, or "forecast errors," were then modeled with autoregressive or lag parameters to arrive at the final form of the forecast model. An intuitive justification for this approach is that recruiters "bank" quality recruits at the end of the month once that month's recruit mission has been satisfied.

USAREC Monthly Mission Statement. As previously stated, analysis indicated that the USAREC monthly mission statements provided a good forecast of the contractee supply. Indeed, they provided the only forecast for mission populations other than AFQT Category I-IIIA, high school graduate males.

The results of the evaluations of these forecasting techniques indicated that the USAREC mission statements provided forecasts at least as good as those generated by the mathematical models. Additionally, the mathematical models suffered from several serious shortcomings not shared by the USAREC mission statements:

(1) They did not forecast the entire contractee population, but only a subset of the population.

(2) They require specialized data, such as unemployment rates and military-civilian pay ratios, not readily available.

(3) Even if accurate, their forecasts often vary from the "official" recruiting plan being exercised USAREC.

In light of these shortcomings, the decision was made to base all future EPAS supply forecasting analyses on the USAREC mission statements. "Hooks" were established with EPAS, however, to provide for ready inclusion of these or other forecasting models if desired at some point in the future.

Investigate and Select Appropriate Supply Group Methodologies

The goal in defining Supply Groups was a reduction in problem size, while maintaining differential (expected) performance characteristics that could be seen in the individual recruits. Four functional areas were identified to support this goal:

(1) Investigate and select clustering techniques.
(2) Evaluate and select the supply subpopulations.
(3) Develop Supply Group methodologies.
(4) Develop Supply Group forecasts.

Investigate and Select Clustering Techniques

The aim of a clustering technique is to develop groups, or clusters, of similar individuals or objects. Clustering techniques have been used and developed in many fields, including statistics, biology, and psychology. Their intricacy ranges simple intuitive approaches to complex graph theoretic and probabilistic models. The similarity criterion is one of the things that differentiates one method from another. For example, consider the Army's nine aptitude area composites as a measure the individual's expected performance. Some common criterions, stated in terms of these measures, are:

(1) Euclidian criterion, or metric, where the measure of similarity is the square root of the sum of squared differences in the aptitude area composites.

(2) City-block criterion, or metric, where the similarity is based on the sum of absolute differences in the respective composites.

(3) Standard correlation coefficient.

Most clustering algorithms can be classified as either hierarchical or non-hierarchical.

Hierarchical Methods. Hierarchical methods seek to produce a set of nested clusters ranging from one cluster containing all the objects to many clusters where each contain only one object. These methods can be further classified a either agglomerative of divisive approaches.

- Agglomerative algorithms start with each individual or object as a cluster, and proceed by a series of pair-wise mergings until one cluster containing all the objects is obtained.

- Divisive methods begin with all the objects or individuals as part of one cluster, and proceed by a series of successive splittings until a set of many clusters with one object in each is obtained.

Non-Hierarchical Methods. In non-hierarchical cluster analysis, the number of clusters is assumed to be known beforehand. The process is to identify the clusters. Some of the more common approaches to this process are:

(1) Nearest centroid sorting
(2) Hill climbing
(3) Mode seeking of density search

Based on the characteristics of the data being processed, EPAS currently uses a nearest centroid sorting approach. Details of the implementation of this technique are described in a subsequent section, Principal Components Based Supply Groups.

Evaluate and Select the Supply Subpopulations

Prior to any supply aggregation, the supply population is stratified into subpopulations based on the mission categories of gender, education level, and AFQT category. This stratification facilitates the assignment process, allowing the models to address the various Army policies, e.g., gender restrictions.

Since the jobs (MOS) side of the assignment problem states its eligibility requirements in terms of mission categories, a similar breakdown of the supply side was selected. Some minor modifications were made to these subpopulations to further improve the aggregate assignment model, specifically:

(1) The AFQT Category I-IIIA was split into its two quartiles: I-II and IIIA. This improved the differentiability of the subpopulations.

(2) A high school senior category was added to the education level. This allows EPAS to support education level differentiated programs, e.g., seniors aren't available for assignment until after graduation.

(3) The defined AFQT Categories were extended to include populations not defined in current mission areas. This allows EPAS to account for the entire supply population and to apply hypothetical policy alternatives.

Table C-5 displays a list of the subpopulations developed from these definitions. Table C-5 also lists the contracts within these subpopulations for FY86 and FY87.

Develop Supply Group Methodologies

Individuals were clustered in the supply population using the performance measures, or a function thereof, as the clustering variables. Currently, these measures consist of the aptitude area composites. The resulting clusters are the called Supply Groups. Their corresponding performance measure would be an aggregate measure of the individuals, e.g., the

Table C-5. EPAS Supply Subpopulations.

GP N°	GENDER	EDUCATION LEVEL	AFQT CATEGORY	FY86 NUMBER	FY86 PERCENT	FY87 NUMBER	FY87 PERCENT
1	M	HSDG	I-II	27672	20.7	24485	18.4
2	M	HSDG	IIIA	15273	11.4	14097	10.6
3	M	HSDG	IIIB	23089	17.3	21340	16.0
4	M	HSDG	IV	4832	3.6	4844	3.6
5	M	HSS	I-II	11749	8.8	12369	9.3
6	M	HSS	IIIA	8837	6.6	9456	7.1
7	M	HSS	IIIB	10159	7.6	10916	8.2
8	M	HSS	IV	81	<0.1	[illegible]7	<0.1
9	M	NHSG	I-II	4862	3.6	3488	2.6
10	M	NHSG	IIIA	7698	5.8	5461	4.1
11	M	NHSG	IIIB	54	<0.1	34	<0.1
12	M	NHSG	IV	5	<0.1	3	<0.1
13	F	HSDG	I-II	6141	4.6	5410	1.4
14	F	HSDG	IIIA	4707	3.5	4574	1.2
15	F	HSDG	IIIB	5360	4.0	5377	1.4
16	F	HSDG	IV	11	<0.1	8	<0.1
17	F	HSS	I-II	1500	1.1	1239	0.3
18	F	HSS	IIIA	1409	1.1	1355	0.4
19	F	HSS	IIIB	17	<0.1	8	<0.1
20	F	HSS	IV	0	0.0	0	0.0

average aptitude area composites taken over all individual in each cluster. The clustering algorithm is applied to the subpopulations and not to the supply population itself. This enabled definition of Supply Groups divided by differentiable performance measures while maintaining policy-unique attributes.

Two clustering approaches have been developed and implemented which, based on experience, were consistent with the data. The first approach used a nearest centroid sorting algorithm to cluster a function of the aptitude area composites; the second, Ward's minimum variance.

Principal Components Based on Supply Groups. The first Supply Groups were formulated for the FY84 supply of enlisted contracts using a nonhierarchical approach. The statistical technique, principal components, and a nearest centroid sorting algorithm (SAS procedure, FASTCLUS) were used for clustering. This approach was later used to generate Supply Groups for FY86 data.

One characteristic common to all of the mission-based subpopulations is the high intercorrelations exhibited by the aptitude area composites. (Table C-6 and Table C-7 show the intercorrelations among the aptitude

Table C-6. FY84 Correlations of Aptitude Area Composites for Male, High School Graduates, in AFQT Categories I-II

APTITUDE AREA	CL	CO	EL	FA	GM	MM	OF	SC	ST
CL	1.0	0.6	0.8	0.8	0.7	0.5	0.5	0.7	0.8
CO		1.0	0.6	0.8	0.7	0.8	0.8	0.9	0.7
EL			1.0	0.7	0.9	0.6	0.4	0.6	0.7
FA				1.0	0.6	0.6	0.5	0.7	0.7
GM					1.0	0.8	0.6	0.8	0.8
MM						1.0	0.9	0.9	0.8
OF							1.0	0.8	0.8
SC								1.0	0.8
ST									1.0

Table C-7. FY84 Correlations of Aptitude Area Composites for Male, High School Graduates in AFQT Category IIIA.

APTITUDE AREA	CL	CO	EL	FA	GM	MM	OF	SC	ST
CL	1.0	0.3	0.7	0.7	0.5	0.1	0.1	0.4	0.5
CO		1.0	0.4	0.7	0.7	0.8	0.7	0.9	0.6
EL			1.0	0.6	0.8	0.3	<0.1	0.5	0.4
FA				1.0	0.4	0.4	0.3	0.5	0.5
GM					1.0	0.8	0.6	0.8	0.7
MM						1.0	0.9	0.8	0.7
OF							1.0	0.8	0.8
SC								1.0	0.7
ST									1.0

areas). The principal components technique was used to transform the aptitude area composites into a set of uncorrelated scores, called principal components. These new scores account for the same amount of variability as exhibited by the original aptitude area composites.

A trait of this technique is that succeeding components account for a smaller proportion of the variability, e.g., the first principal component would account for the largest percentage. If a smaller number of components accounted for a large proportion of the variability, then one would only need to apply the clustering algorithm to this reduced set of scores.

Analysis confirmed that the first principal component accounted for a substantial portion of the aptitude area variability. As show in Table C-8, this typically ranged from 50 to 75 percent, increasing with higher AFQT categories. Adding the second principal component increased this to 75 to 90 percent.

Table C-8. Variability Accounted for by the First Principal Component.

GP No.	GENDER	EDUCATION LEVEL	AFQT CATEGORY	% of FY84 VARIABILITY	% of FY86 VARIABILITY
1	M	HSG	I-II	75	75
2	M	HSG	IIIA	63	65
3	M	HSG	IIIB	60	66
4	M	HSG	IV	54	55
5	M	HSS	I-II	72	73
6	M	HSS	IIIA	63	65
7	M	HSS	IIIB	58	67
8	M	HSS	IV	51	58
9	M	NHS	I-II	70	71
10	M	NHS	IIIA	63	65
11	M	NHS	IIIB	58	65
12	M	NHS	IV	51	63
13	F	HSG	I-II	75	76
14	F	HSG	IIIA	57	60
15	F	HSG	IIIB	55	51
16	F	HSG	IV	45	41
17	F	HSS	I-II	72	78
18	F	HSS	IIIA	60	59
19	F	HSS	IIIB	55	63
20	F	HSS	IV	61	43

For this first formulation, model simplicity was maintained by using only the first component. This was based on the assumption that it was more important to verify the operational feasibility of EPAS than to conduct extensive analyses in clustering theory.

To cluster the first principal component, a nearest centroid sorting algorithm was used, specifically, that used by the SAS procedure FASTCLUS. This algorithm is designed for clustering large data sets, as is the case with the supply subpopulations. A limit of no more than three clusters (Supply Groups) per subpopulation was imposed because of computer constraints.

For these clusters, an aggregate measure of performance was needed which could be used to differentially assign the Supply Groups. The average aptitude area composite scores were selected for this aggregate measure based on analysis performed by Project A which validated the ASVAB Aptitude Area Composite scores as a predictor of performance (McLaughlin, et al., 1984).

Some observations are in order: for subpopulations generally not recruited (e.g., females, seniors in AFQT Category IV), there wasn't enough variability in the aptitude area composites to get more than three Supply Groups. In fact, in the FY86 Supply Groups, there were no individuals in this category. The distribution of female, high school seniors in AFQT Category IIIB was truncated at AFQT score 40 and below, and used to develop the Supply Groups.

Also, the differentiability across Supply Groups within each mission subpopulation is considerable, whereas the individual Supply Groups tended not to be differentiable across their aptitude area composites. Considering the large size of the subpopulations and the used of only three categories to represent their aggregate behavior, this was not unexpected.

Supply Groups using Ward's Clustering Algorithm. Because of the observations noted above, an effort was initiated early in 1987 to improve Supply Groups. The goal was to increase differentiability while maintaining the policy-specific requirements.

A different approach was taken to deal with the high intercorrelations among the aptitude area composites. Instead of clustering on a function of these scores, i.e., the first principal component, clustering was performed on all nine of the composites.

A different clustering methodology was also implemented, one designed to utilize the correlation structure in its algorithm. In addition, a hierarchical approach was used, allowing the number of Supply Groups per subpopulation to be determined based on the subpopulation's size and inherent differentiability. A second set of Supply Groups was developed for the FY86 population using this new formulation.

As with the FY84 supply population, the FY86 supply exhibited high intercorrelations in its aptitude areas, as shown in Table C-9 and

Table C-9. FY86 Correlations of Aptitude Area Composites for Male, High School Graduates in AFQT Categories I-II.

APTITUDE AREA	CL	CO	EL	FA	GM	MM	OF	SC	ST
CL	1.0	0.5	0.8	0.8	0.6	0.4	0.4	0.6	0.8
CO		1.0	0.6	0.8	0.7	0.8	0.8	0.9	0.6
EL			1.0	0.7	0.9	0.7	0.6	0.7	0.9
FA				1.0	0.6	0.6	0.6	0.6	0.7
GM					1.0	0.8	0.7	0.8	0.8
MM						1.0	0.9	0.9	0.6
OF							1.0	0.9	0.7
SC								1.0	0.7
ST									1 0

Table C-10. FY86 Correlations of Aptitude Area Composites for Male, High School Graduates in AFQT Category IIIA.

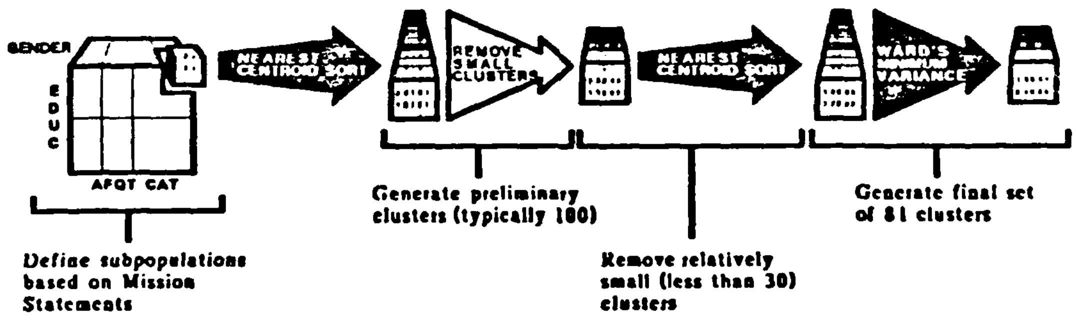
APTITUDE AREA	CL	CO	EL	FA	GM	MM	OF	SC	ST
CL	1.0	0.3	0.8	0.7	0.5	0.1	0.1	0.4	0.6
CO		1.0	0.5	0.7	0.6	0.8	0.8	0.8	0.5
EL			1.0	0.6	0.9	0.5	0.3	0.6	0.8
FA				1.0	0.4	0.4	0.3	0.5	0.5
GM					1.0	0.8	0.7	0.8	0.8
MM						1.0	0.9	0.8	0.5
OF							1.0	0.8	0.5
SC								1.0	0.7
ST									1.0

Table C-10. Wards' Minimum Variance Approach was chosen as the clustering algorithm to take advantage of this fact. This approach develops, used in conjunction with a nearest centroid sorting approach, clusters by minimizing the within-cluster variability.

The actual clustering, depicted in Figure C-1, is described in the following paragraphs:

(1) As previously described, the supply population was partitioned into subpopulations based on the USAREC mission statements, i.e., by gender, education, and AFQT category.

Figure C-1. Supply Group Formulation using Wards' Clustering Algorithm.



	CL	CO	EL	FA	GM	MM	OF	SC	ST
Male/NHS/I-IIIA	113 121 109	117 128 107	114 125 104	113 123 108	113 126 99	115 127 103	117 125 107	118 128 107	114 124 105
Male/NHS/IIIB	99	107	100	101	102	106	106	106	101
Male/NHS/IV	86	95	91	90	95	96	93	93	90

(2) A nearest centroid sorting routine (SAS procedure FASTCLUS) was used to generate a large number -- typically 100 -- of preliminary clusters. Using such a large number of clusters provided a better estimate of the wide range of different performance profiles.

(3) Remove those clusters which have a relatively small -- less than thirty -- number of individuals. These clusters represent those small number of individuals who fall outside the more typical performance profiles. Since nearest centroid sorting algorithms are sensitive to "outlying" observations, they were removed and the algorithm reapplied.

(4) Another large set of clusters was generated using the clusters generated by (2) as input to the nearest centroid sorting algorithm.

(5) Wards' Minimum Variance Algorithm was then applied to this last set of clusters to get the desired number of clusters (Supply Groups) for each subpopulation.

This methodology generated 81 Supply Groups. These Supply Groups with their average aptitude area scores are listed in TAB C-1. The process just described is the one currently implemented in EPAS. Additional analyses are needed to evaluate alternative formulations and to determine how Supply Groups should be developed using the Project A measures once they become available.

Develop Supply Group Forecasts

The aggregate assignment model requires Supply Group forecasts on an RSM basis. The forecasting models and USAREC mission goals provide mission-based forecasts on an RSM basis. To generate the necessary detail, the historical distributions of Supply Groups within their respective sub-populations were computed. The mission-based forecasts were then multiple by the distribution percentages to generate the requisite Supply Group forecasts.

DETERMINE/PROJECT MOS REQUIREMENTS

It is also necessary to project personnel requirements (quality targets, entry restrictions, etc.) and training information (class size, dates, etc.) to generate a viable assignment plan. This information is supplied to EPAS by exogenous sources (REQUEST, ATRRS) and is initially defined at the MOS level of detail.

As with supply forecasts, however, the MOS requirements must also be reduced to decrease the size of the assignment problem. Two functional areas represent the analysis necessary to provide the required MOS training projections:

(1) Determine/provide MOS clustering.

(2) Provide MOS training fill information.

Determine/Provide MOS Clustering

Just as methodology was developed to aggregate the supply forecasts into Supply Groups, so must means be developed to aggregate the demand (i.e., training "jobs" to be filled) forecasts into groups, which are called MOS Clusters. Both categorizations are based on demographic and performance characteristics, enabling EPAS to support the Army's person-job match assignment problem.

While numerous clustering techniques were developed and evaluated during the project, the number of Supply Groups and MOS Clusters never exceeded 81 and 59, respectively. Thus, the assignment problem was reduced to 81 x 59 x 12 [months], or 57,348 possible combinations -- a reduction of nearly 15,000 from the original problem size of 840,000,000 combinations. This significant reduction in the size of the problem enabled the formulation of an assignment problem within the realm of feasibility for existing computer systems, although new problems were introduced, as will be discussed in subsequent sections.

MOS Clustering Considerations

The goal was to cluster MOS into groups which would preserve those MOS characteristics that are important to the assignment process. The concept of clustering MOS is not new. Examples of MOS clustering routinely used within the Army today include:

- ASVAB Aptitude Areas -- clustering the, approximately, 300 initial-entry MOS into nine groups to facilitate matching applicants to MOS.

- Career Management Fields (CMFs) -- clustering MOS within the Army to facilitate achieving a variety of management objectives.

For EPAS, MOS clusters had to meet two requirements: they had to be able to provide sufficient detail to enable the models to process Army goals and restrictions, and the had to be functionally alike.

Provide Sufficient Detail. Analysis of the Army's recruiting process (describe above) showed that the Army used qualifications based on gender, education level, AFQT category, and aptitude area to determine MOS eligibility. For example, combat arms MOS can't accept women; other MOS will accept only high school diploma graduates. All MOS has at least one, and up to three, qualifying aptitude area composites score. Army and/or Congressional targets are established on the number of personnel in AFQT categories I-IIIA, IIIB, and IV for each MOS.

The assignment model must be able to cope with management goals and limits of these types. Failure to do so will result in assignments which are unacceptable as they violate one or more of the constraints.

Functional Similarity. Many recruits come to a MEPS knowing, basically, the type of work they want, but without an explicit knowledge of individual MOS. Usually, these recruits are amenable to any job which is functionally similar to the type they have specified as desireable. In addition, the skills required to perform successfully in potential MOS matches will be similar for skills which are functionally similar.

It is particularly important for EPAS to be able to differentiate among MOS based on their functional requirements. The aggregate assignment models make their PJM recommendations by matching the expected performance of Supply Groups against the requirements of the skills. Thus, EPAS MOS Clusters must exhibit a functional similarity to provide the requisite metrics for generating assignment options.

MOS Cluster Development

GRC first examined the possibility of utilizing existing clustering definitions, such as CMF, as the MOS clustering for EPAS. This approach has the inherently desirable attribute of expressing results in terms readily understandable to Army managers and consistent with other Army systems. Unfortunately, existing cluster definitions were found to be too heterogeneous.

For example, CMF group MOS requiring substantially different aptitudes. They also split functionally similar skills across multiple CMF. Similarly, ASVAB Aptitude Area Composites group MOS having a wide disparity of aptitude requirements.

Recruit performance in MOS was also examined as a clustering criterion. Performance measures examined included aptitude area, first-term attrition, and relative utility. Based on these analyses, the following criteria were identified for clustering MOS:

(1) Similar performance functions,
(2) Same gender and education restrictions,
(3) Similar quality targets,
(4) Similar qualifying aptitude area scores, and
(5) Similar functionality.

Three different formulations were developed for EPAS. Two were done for FY84 MOS: the first utilized first-term attrition; the second, relative utility. The third formulation, based on aptitude area, was performed for FY86 MOS. All formulations utilize a two-phase approach.

The first phase was essentially the same for all formulations. Restrictions imposed by the Army's assignment process were used to develop a preliminary set of MOS clusters. The criteria used were gender, education level, and AFQT category. Table C-11 gives the resulting categories.

Table C-11. MOS Qualification Categories.

GENDER	EDUCATION LEVEL	AFQT CATEGORY
M/F	HSG/NHS	I-IIIA
M/F	HSG/NHS	I-IIIB
M/F	HSG/NHS	I-IV
M/F	HSG	I-IIIB
M/F	HSG	I-IV
M	HSG/NHS	I-IIIA
M	HSG/NHS	I-IV
M	HSG	I-IV

Functionality criteria were also applied during the first phase. Job categories for the MOS were derived directly from the Department of Defense's (DoD) Occupational Conversion Manual. Table C-12 lists the DoD Occupational Areas with the number of [FY84] MOS associated with each. These areas were used to further partition the preliminary clusters.

The second phase of the formulation was dependent on the method being used to differentiate within the first phase groups. The following paragraphs describe the second phase processing for each method.

Attrition Clusters. Individuals with the same demographic characteristics can have different predicted attrition when assigned to different MOS. MOS-level attrition is primarily a function of gender and education, with male, high school diploma graduates having the lowest attrition.

Predicted MOS-level attrition methodology described by Manganaris and Schmitz (1984) was used as the basic measure. This work developed MOS-specific attrition estimates as a function of gender, education level, AFQT Category, and MOS assignment. MOS-unique equations were developed

Table C-12. DoD Occupational Codes.

CODE	DoD OCCUPATIONAL AREA	NBR MOS
0	Infantry, Gun Crews, Seamanship	19
1	Electronic Equipment Repair	58
2	Communications and Intelligence	32
3	Medical and Dental	20
4	Other Technical	18
5	Functional Support and Administrative	26
6	Electrical/Mechanical Repair	48
7	Craftsmen	16
8	Service and Supply	10

for the 76 MOS which accounted for the majority of the Army accessions. A generic equation, using aptitude area composites and qualifying scores, was also developed to predict MOS attrition for all other MOS.

These equations were used to further cluster the phase one groups. An excessive number of clusters resulted when generated as a function of both AFQT category and education level. To remedy this problem, clusters were generated only on male, high school diploma graduate attrition. With this revision, the within-cluster attrition rates for other gender and education levels stayed approximately the same. This resulted in 56 MOS clusters.

Relative Utility Clusters. Project A developed MOS-level relative utility measures which incorporated subjective judgements of the "utility" of a soldier's contribution to the Army (Wise, 1985). The measure gives five levels of utility, corresponding to predicted performance in the 90, 70, 50, 30, and 10th percentiles.

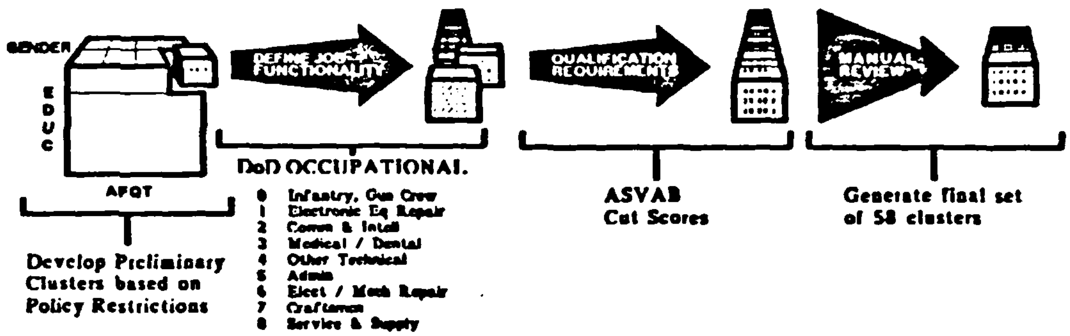
The Project A utility measures were developed for only 40 MOS. To obtain measures for other MOS, two Army officers (from ODCSPER and the Soldier Support Center) were asked to assign a value to the remaining MOS. (Relative utility measures have since been developed for all MOS).

The MOS within the phase one groups were further clustered by their 90th percentile measure of utility. Only this utility measure was used as it was highly correlated with the others. Cluster breaks were made where the measure differed by more than 10.

Mathematical clustering algorithms were not required since the groups were distinct. This procedure generated over 70 clusters. This number was reduced by joining small clusters with larger ones on the basis of their DoD Occupational Area. The final formulation consisted of 59 clusters.

Aptitude Area Clusters. For FY86, MOS clusters were generated on the basis of aptitude area composite scores. The process used to generate these clusters is depicted in Figure C-2. The individual steps are described in the following paragraphs.

Figure C-2. MOS Cluster Formulation.



MOS	JOB TITLE	GENDER	EDUCLVL	AFQTCAT	DODGRP	QUALAA	QUALCUT
26C	Weapons Support Radar Rep	M/F	HSG/NHS	I-IIIA	1	EL	115
29S	Field COMSEC Eq Rep	M/F	HSG/NHS	I-IIIA	1	EL	115
91P	X-Ray Specialist	M/F	HSG/NHS	I-IIIB	3	ST	100
91R	Veterinary Food Insp	M/F	HSG/NHS	I-IIIB	3	ST	100

(1) MOS were first clustered into qualifications categories as previously described and depicted in Table C-11.

(2) A slight variation on phase one processing was used with this formulation. The DoD Occupational Area was not incorporated until the second phase. Thus, the MOS within the phase one groups were ordered by qualifying aptitude area, qualifying cut score, and DoD Occupational Area.

(3) The phase two processing resulted in 99 MOS clusters, significantly more than were acceptable. GRC analysts reviewed the list of MOS clusters and, with the aid of the job descriptions given by the Enlisted Career Management Fields and Occupational Specialties, manually reduced the 99 clusters to 58. This was accomplished by preserving the aptitude area distinction at the expense of cut scores and DoD Occupational Areas. A weighting factor -- the number of accessions for the MOS in FY86 -- was used as a criterion for combining clusters.

This third formulation is the one currently employed by EPAS. The FY86 MOS Clusters generated are listed in TAB C-2.

<u>MOS Clustering Summary</u>

Due to the size and complexity of the Army's assignment process, the approximately 300 MOS were aggregated into roughly 60 groups, called MOS

Clusters. Three different approaches have been used in EPAS, each of which utilizes the assignment constraints to generate a preliminary set of clusters. The primary difference among the three approaches was the performance measure upon which the clustering was based.

The most recent version -- in which the clusters are based on aptitude area composite scores -- utilizes expert opinion to reduce the final set of clusters to a tractable size. Automating this process will be an important part of developing an operational capability based on the EPAS methodology.

Provide MOS Training Fill Information

Having developed the MOS Clusters to be used for any given execution of EPAS, some means is required to provide the current MOS training status in the form required by the assignment model(s). This requires three major steps:

(1) The class seat information in the exogenous data files must be transformed as needed by the assignment models. Principally, this means information on the minimum, maximum, and optimal class size, adjusted to eliminate seats against which a contract has already been assigned.

(2) The resulting class seat information must be aggregated into the appropriate MOS Clusters.

(3) The class seat information must be updated to represent the ongoing PJM process, whether simulated or actual allocations.

These requirements were met by developing a subsystem called the Training Requirements Module (TRM). The TRM takes the school seat information provided by EPAS' detailed assignment model (simulated data) or by the current classification system (REQUEST -- actual data) and generates the necessary information. The specifics of this process are described in Appendix D.

GENERATE AGGREGATE ASSIGNMENTS

The aggregate assignment model provides the optimization capabilities necessary to achieve the goal of improving the classification and utilization of Army NPS recruits. To fully meet the desired applications of EPAS, this aggregate model has to be flexible enough to use as a planning subsystem to analyze Army policy, as well as provide guidance to the classification subsystem used in assigning applicants to specific MOS.

The goal of the effort was to model the Army recruit management process to allow individual classification actions which met the overall goals and missions of the Army. GRC determined that an optimization model was necessary and appropriate for the model. Only an optimization routine would have the capability to "balance" all of the individual classification actions against the goals, thus making the individual actions consistent with the Army's goals. Clear-cut objectives exists, e.g., the annual training requirement for MOS, monthly accession values, quality distribution goals. Assignment cost criteria also exist, e.g., ASVAB Aptitude Area Composite scores. In addition, Project A is investigating new performance predictors.

Ample precedent exists for using linear optimization to support this goal: Charnes and Cooper (1961) and Glover and Klingman (1975) describe successful industrial and government applications of optimization in manpower planning, distribution,, and management. Holz and Wroth (1980) and Klingman and Mote (1983) describe Army applications of linear programming models with thousands of variables and constraints.

While such precedents indicated the feasibility of linear optimization, modeling the Army recruit management process introduced a problem an order of magnitude above previous efforts. Even with the aggregation of supply and demand -- described in previous sections -- and with additional steps to reduce problem size as described below, the model formulation is still larger than existing Army planning systems. Table C-13 shows the approximate sizes of three existing planning models using a network algorithm, compared with size of the EPAS network problem.

The principal research issue was the question of the type of optimization model which would best meet the needs of EPAS. High speed network algorithms, such as used in the Army's MOS Level System (MOSLS) model,

Table C-13. Optimization Problem Sizes.

SYSTEM	CONSTRAINTS	VARIABLES
ELIM	2,000	5,000
MOSLS-M	3,000	6,000
MOSLS-T	8,000	50,000
EPAS	5,000	150,000

have the inherent appeal of very rapid solution times for large problems. This speed, however, is achieved only at the expense of certain model capabilities. Some of the elements of a model of he Army recruit management process introduce "non-network" constraints. A network formulation, for example, can handle either gender or quality goals but not both.

A general linear programming (LP) model would be capable of modeling additional detail in the complex relationships between people and MOS assignments; but the resultant linear program would be quite large and would take an extensive amount of computer to solve.

Formulation of Models

The models which were developed each strove to simultaneously meet numerous, often competing, requirements. These requirements are:

(1) Fill Requirements. Both fiscal year (encompassing only those months remaining in the current recruit year) and twelve-month (encompassing the entire planning horizon) class-fill requirements had to be met for every MOS for every month.

(2) MOS-Specific Restrictions. Gender and education restrictions had to be enforced (e.g., excluding females from combat MOS).

(3) AFQT Category IV Limitations. The maximum allowable number of AFQT Category IV assignments to a given MOS must not be exceed, if feasible.

(4) AFQT Categories I-IIIA Missions. The minimum level of quality personnel must be met for each MOS, if feasible.

(5) Delayed Entry Program (DEP) Limitations. DEP policy for each demographic group had to be enforced. Recruits are not permitted to remain in the DEP beyond their associated demographic group's maximum. DEP limitations also include enforcement of the RUDEP, thus recruits may not DEP into months which, while less than the maximum, have been "closed" to that demographic group.

(6) Gender Missions. The annual female mission must be met for each MOS, if feasible.

Due to the size and run-time restrictions mentioned above, not all of these requirements could be explicitly modeled. Several models were developed during this research effort to address specific aspects of the greater problem.

The Network Model

A network formulation was the first developed for EPAS. It has been used in all three stages of EPAS' development: the baseline, full-size, and operational prototypes all used network formulations.

The ARCNET program was selected for the EPAS networking algorithm. This algorithm -- the proprietary product of Analysis, Research and Computation of Austin, TX -- was selected for several reasons:

- ARCNET has been demonstrated to be a state-of-the-art procedure which provides rapid and accurate solutions.
- The Army has had extensive, satisfactory experience with ARCNET and its predecessors.
- The Army currently has operational licensing for ARCNET on its ISC-P computer system. This will facilitate implementation of an operational EPAS.

The network model optimizes the allocation of NPS recruits (clustered into Supply Groups) among MOS (clustered into MOS Clusters). The model has been designed to reach a feasible solution regardless of the circumstances, e.g., whether or not the recruit supply is sufficient to meet the MOS demand.

Figure C-3 provides a diagrammatic representation of the network model. The symbols used in this figure is explained in Table C-14. Key elements of the network model formulation are described in the following paragraphs.

Basic Model Formulation

A "Super Source" (SS) contains artificial recruits who qualify for every MOS in every time period. These artificial recruits are used to insure an adequate supply of recruits regardless of the MOS demand. They are assigned a very high assignment cost, such that they will be used only as a last resort to insure feasibility. The supply "M" represents the number of artificial recruits which had to be entered into the model. In the event that artificial recruits were used, exception reports (defined below) will be generated identifying the location at which this substitution was required.

If the Super Source is not needed (that is, the forecasted supply satisfies the demand), these artificial recruits flow harmlessly to the Super Sink (SK). The Super Sink is described in more detail later.

The SG_{ij} (Supply Group) nodes collect forecasted supply (FS_{ij}) for each Supply Group i in month j.

Figure C-3. EPAS Network Formulation.

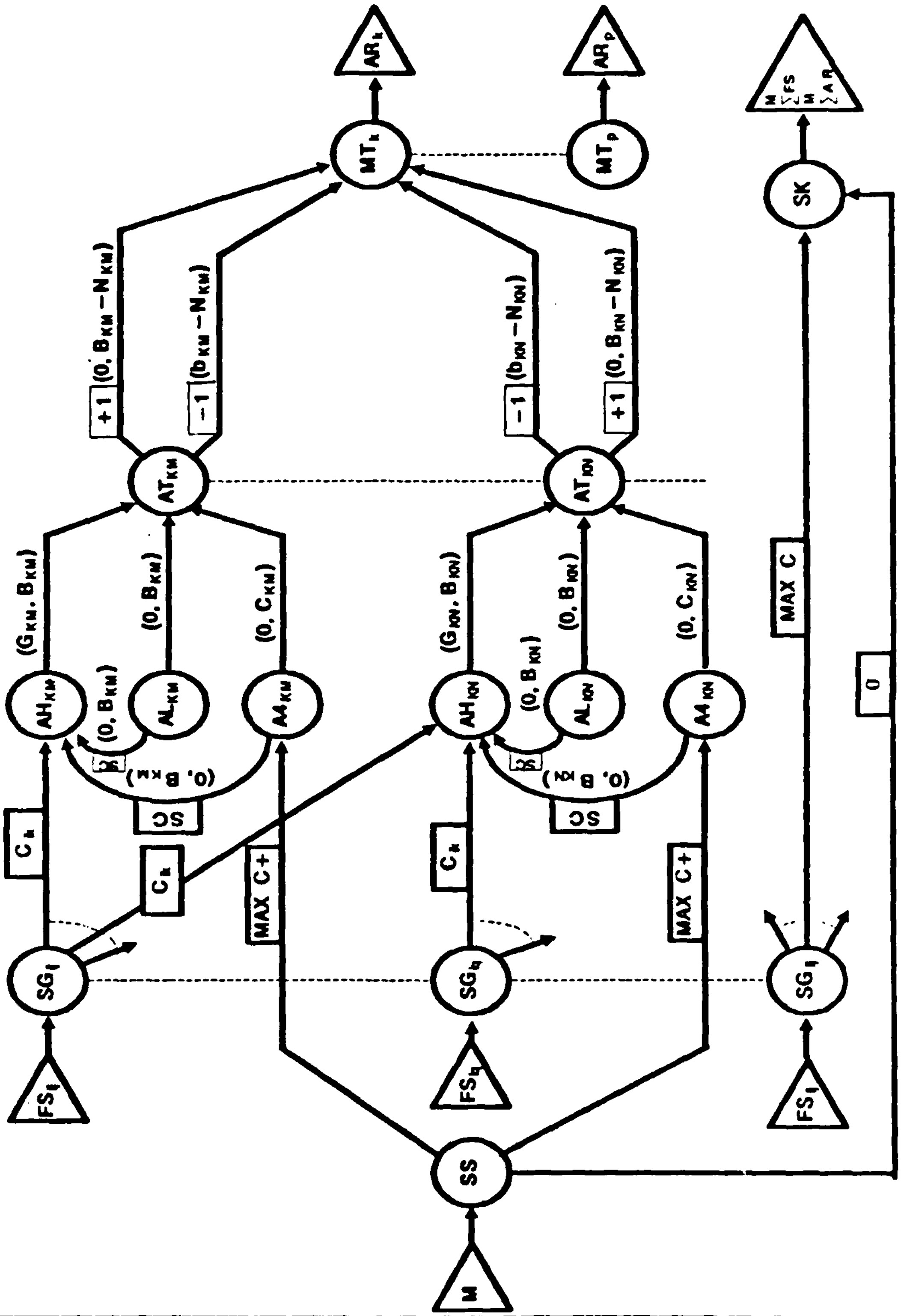


Table C-14. EPAS Network Symbols.

ITEM	DEFINITION OF TERMS
NODES:	
SG_{ij}	- Supply Group i recruits signing a contract in month j.
AH_{km}	- Collector for quality (AFQT Category I-IIIA) enlistees who are assigned to training class for job k starting in month m.
AL_{km}	- Collector for AFQT Category IIIB enlistees who are assigned to classes for job k starting in month m.
$A4_{km}$	- Collector for AFQT Category IV enlistees who are assigned to training classes for job k starting in month m
AT_{km}	- Collector for job k in month m.
MT_k	- Annual collector for job k
SS	- Super source, allowing for shortfalls in meeting minimum class size or annual requirements
SK	- Super sink, representing the year-end DEP pool
PARAMETERS:	
FS_{ij}	- Forecasted supply for Supply Group i in month j.
AR_k	- Annual job requirement for job k
b_{km}	- Lower bound of class size for job k in month m.
B_{km}	- Upper bound of class size for job k in month m.
G_{km}	- Goal for quality recruits for job k in month m.
N_{km}	- Optimal class size for job k in month m.
$C4_{km}$	- Cap on category IVs for job k in month m.
SC	- Cost of substituting an AFQT Category IIIB or IV when a quality goal cannot be met.
C_{ik}	- Cost of assigning an enlistee from Supply Group i to job k based on the selected objective function.

The AH_{km} nodes represent quality (AFQT Categories I-IIIA) recruits assigned to MOS Cluster k in month m; correspondingly, the AL_{km} and $A4_{km}$ nodes represent AFQT Category IIIB (AL) and AFQT Category IV (A4) recruits.

The AT_{km} nodes collect I-IIIA, IIIB and IV assignments to MOS Cluster k in month m. The MT_k nodes collect all assignments to MOS Cluster k in months one through twelve, with AR_k being the twelve-month demand for MOS k.

MOS Requirements. Enforcement of both the twelve-month and fiscal-year MOS requirements is accomplished by using these requirements as lower bounds in the network formulation, as explained in the MOS Cluster Collector Nodes section below.

AFQT Category Requirements. The AFQT category requirements are also modeled as arc bounds. AFQT Categories I-IIIA requirements appear as lower bounds (see the AH_{km} to AT_{km} arc in Figure C-3) while AFQT Category IV limits appear as upper bounds (see the AL_{km} to AT_{km} arc in Figure C-3).

MOS Restrictions. Education and gender restrictions are used at the start of an EPAS run in determining eligibility for a Supply Group's assignment to an MOS Cluster. Since both Supply Groups and MOS Clusters may be redefined by the user, and MOS restrictions may be changed (e.g. an MOS which previously disallowed females may now permit them), it is necessary to determine eligibility at the start of each new EPAS run.

These restrictions (e.g. no females in combat MOS; no AFQT Category IV recruits permitted; etc.) are used to build an eligibility matrix by Supply Group by MOS Cluster. Then, if a Supply Group is flagged as being ineligible for assignment to a certain MOS Cluster, that Supply Group is simply not "connected" to it. That way, no assignment recommendations will be made if they violate the policy environment under which EPAS.

DEP Limitations. Implementation of DEP limits is accomplished through the QAM Policy File. The user enters basic DEP policy as minimum and maximum allowable DEP length in months for each demographic group (defined by gender, education, and AFQT category). RUDEP is defined by specifying 0 (closed)/1 (open) flags for each demographic group, month, MOS combination.

Gender Missions. Modeling proportional gender missions is not possible in the pure network design used in EPAS. Gender missions (that is, specific goals for specific MOS) are not stated by AFQT category, whereas all remaining MOS missions are by AFQT category. Therefore, to incorporate the gender goal, a non-network set of constraints would have to be used. Although this is mathematically possible, the resultant model's solution time would be greatly increased, while the amount of additional information gained, relative to the cost of solving such a model, is slight.

However, the network structure permits testing the feasibility of total gender missions and includes gender constraints. In addition, when classification simulation is performed, the detailed assignment process meets these gender missions. Therefore, constraining the network model to incorporate gender missions is not required.

Detail of the Network Model

The following sections detail the network formulation. The arcs and nodes displayed in Figure C-3 are explained. Also, specific modeling features of the model are discussed.

Assignment Arcs. These arcs connect the Supply Group-month nodes (SG) and the MOS Cluster-month nodes (AH/AL/A4). The associated arc cost is a user-selected metric (see the Cost Criteria section) and is minimized in the problem's objective function. The AH, AL and A4 nodes act as collectors for recruits in the AFQT Categories I-IIIA (AH), AFQT Category IIIB (AL), and AFQT Category IV (A4). Each Supply Group-month node is only connected to the appropriate collector, as determined by the AFQT category associated with the Supply Group. The exclusion of some applicants to certain MOS is modeled by not connecting their associated Supply Group(s) to the restricted MOS Clusters (e.g. female Supply Group-month nodes are not connected to MOS Clusters containing male-only MOS).

MOS Cluster Requirements. This set of arcs transforms what would be a multi-commodity problem into a single commodity formulation. Class requirements, including quality requirements, define monthly, fiscal and twelve-month MOS class goals for each MOS Cluster while still requiring that monthly and annual quality goals be met. In other words, the model forces a time-phased distribution of quality applicants to MOS Clusters, while meeting both MOS-specific goals and Army-wide quality goals.

Monthly goals for quality applicants are enforced through the use of a lower bound on the AH to AT arcs. The AT nodes sum the AH, AL and A4 nodes for each MOS Cluster-month. The lower bound on flow from the AT nodes ensures the minimum MOS Cluster class size requirements are met for that particular month, while the upper bound limits the maximum MOS Cluster size.

MOS Cluster Collector Nodes. In Figure C-3 shows only one type of collector node for the sake of clarity. In the actual model, there are two types of collectors: the MT_k node, which collects the twelve-month demand for MOS Cluster k, and the FY_k (Fiscal Year) node (not shown), which collects the fiscal-year demand for MOS Cluster k.

For classes starting in month x -- where month x is within the fiscal-year boundary (remember...AT nodes are both month and MOS Cluster specific) -- flow from the AT_{kx} node feeds the FY_k node.

For classes starting in month z -- where month z is beyond the fiscal-year boundary -- the AT_{kz} node feeds the MT_k node. Then, the FY_k node feeds into the MT_k node, with a lower and upper bound of the fiscal-year requirement for MOS Cluster k. This ensures the fiscal-year requirement will be met.

Finally, the MT_k node flows into the Super Sink (SK) with a lower and upper bound of the twelve-month requirement for MOS Cluster k. This will ensure the twelve-month requirement is met.

<u>DEP Sink (DP) Node</u>. The model does not define specific assignments beyond the end of the twelve-month planning horizon. However, recruits late in the planning horizon can accept a DEP length beyond the class months represented by the AT nodes. This is modeled as a direct flow from the SG_{ij} node to the DEP sink (DP). The cost on this arc is set to the maximum cost of all permissible MOS assignments for that SG node, so as to encourage filling seats within the planning horizon.

<u>Super Sink (SK) Node</u>. In any network, total flow in must equal total flow out. To handle the exiting flow, the Super Sink (SK) is used. This node receives flow from the MT collector nodes for each MOS Cluster. In addition, any excess artificial supply from the Super Source (SS) flows into the Super Sink, with a cost of zero. Finally, the DEP sink feeds the Super Sink. Thus, the flow into the network (summation of all *SG* nodes and the Super Source) equals the flow out of the network (summation of all twelve-month demand (MT), DEP beyond the planning horizon, and unused artificial supply).

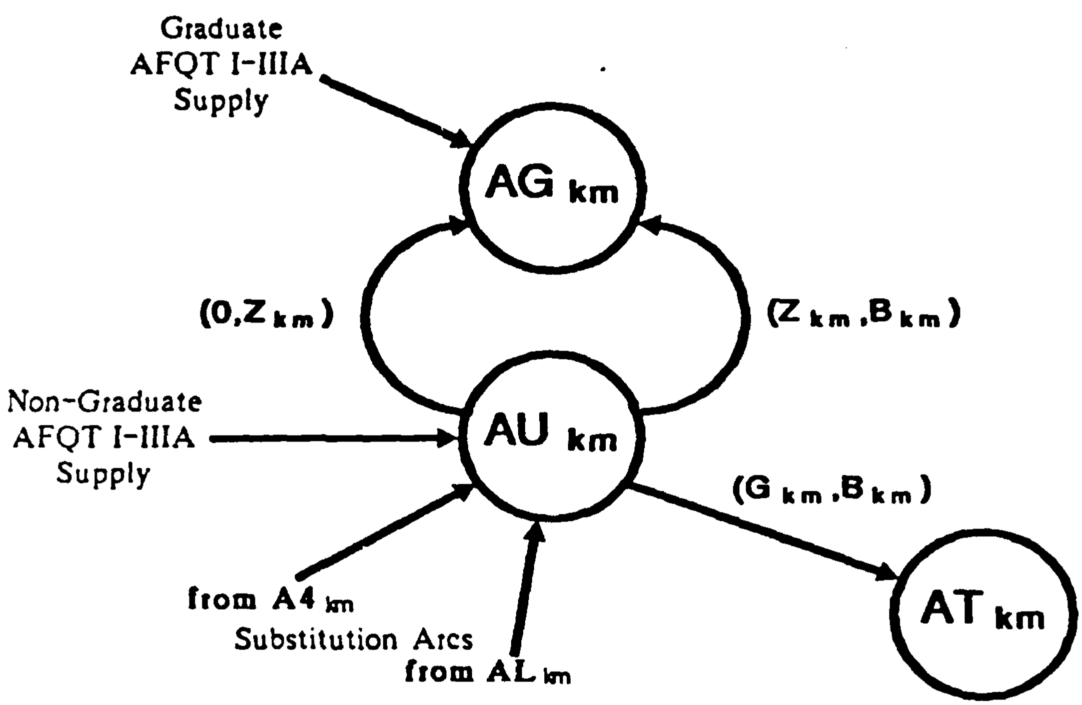
Additional modeling features were incorporated into the model to handle special cases (when supply is much greater than demand) and to goal toward results which alternatively could have been modeled as non-network constraints (distributing high school graduates equitably across MOS).

<u>Quality Substitution</u>. If the number of quality (AFQT Categories I-IIIA) recruits is insufficient to meet the quality requirement for any MOS Cluster in any given time period, the model is designed to permit AFQT Categories IIIB-IV recruits to fill quality class seats. This process, called quality substitution, permits the model to continue to a solution.

If quality supply is insufficient, the lower bound used to enforce the quality requirement (on the AU to AT arcs) could never be achieved. As a result, the optimization algorithm would be unable to reach a solution; no usable output would be produced. Through substitution, the model can meet the quality requirement and continue. Any substitution performed will be traced and reported to the exception report.

The representation of the model in Figure C-3 must be expanded before further explanation can be attempted. A "snapshot" of the portion of the network where quality substituting is modeled is shown in Figure C-4.

Figure C-4. EPAS Network Detail Snapshot.



This figure depicts the actual design of the network. The AH nodes of Figure C-3 are in actuality split into two nodes: AG_{km} nodes and AU_{km} nodes.

Both the AG and AU nodes still collect quality recruits; the AG nodes collect quality recruits with a high school diploma or equivalent, whereas the AU nodes collect quality non-graduate recruits. (This differentiation is necessary to model graduate targets, explained in the next section.)

Substitution is modeled as follows: first, the AL_{km} nodes are connected to the respective AU_{km} nodes, with a very high cost and an upper bound equal to the quality requirement for that MOS Cluster / month. Likewise, the $A4_{km}$ nodes are connected to the AU_{km} nodes, with an even higher cost and the same upper bound. The cost structure is such that the model will use all quality recruits first, the AFQT Category IIIB recruits next (from AL nodes), then, as a last resort, the AFQT Category IV recruits (from A4 nodes). Since the upper bound on these substitution arcs is the quality mission, excessive substituting will be avoided.

<u>High School Graduate Goals</u>. Once quality goals had been incorporated into the model, and testing had begun, we discovered an interesting

phenomenon. The network was indeed meeting the MOS Cluster quality goals as desired; however, the graduate quality recruits were being disproportionately distributed across MOS Clusters. Upon examination, the reason for this occurrence became clear: the model had no way of differentiating between graduate and non-graduate quality recruits.

Although supply forecasts were broken to the graduate/non-graduate level of detail, both graduate and non-graduate SG_{ij} nodes fed into the AH quality collector node. Once this happened, flow out of the AH node had no associated education level. There was no mechanism within the model to prevent a MOS Cluster from being assigned only graduate quality recruits.

This problem was circumvented by using graduate targets, calculated in the TRM, at the MOS Cluster level. The targets are applied in the AG_{km} and AU_{km} nodes shown in Figure C-4. Both nodes collect quality recruits. The only difference is that AG nodes collect high school graduates, whereas AU nodes do not.

Quality graduate SG_{ij} nodes now connect directly to the AG_{km} node; quality non-graduate now connect to the AU_{km} node. (In the diagram shown in Figure C-3, both flowed into the AH_{km} node.) The AU node is the only quality node connected to the AT_{km} collector, with a lower bound of the quality mission. To goal toward the graduate target (represented as Z_{km} in Figure C-4) the AG node is connected to the AU node with a lower bound of the graduate goal (Z_{km}) and a cost of zero.

An additional arc flows from the AU node to the AG node. This arc permits non-graduate substitution for graduate recruits, much the same as in quality substitution. Again, the costs are structured to ensure use of all graduates before substitution begins, and only non-graduates eligible for assignment to the MOS Cluster are substituted.

These quality targets guide the model toward a more equitable quality graduate distribution, without adversely affecting the quality goals themselves. A warning is written to the QAM exception report if any graduate goals are shorted; that is, if any non-graduates are used to fill graduate class seats.

DEP Management. DEP management is accomplished by use of the QAM policy editor. Minimum and maximum allowable DEP lengths are entered in the QAM policy editor by demographic group (Gender/Education/AFQT category). In addition, RUDEP is defined as 0/1 flags indicating which months are "open" to assignment. Assignment arcs in the model are then generated from the SG_{ij} nodes only to those MOS Cluster-month nodes (AG/AU/AL/A4) contained within that Supply Group's permissible DEP/RUDEP period.

Escape Arcs. As a proxy for rejection of marginal recruits, the model is designed to permit flow from the SG nodes directly to the Super Sink. Costs on these arcs ensure that any MOS Cluster assignment will be given over rejection. Escape arcs permit excess supply (usually in the AFQT Category IIIB and IV Supply Groups) to be rejected, without adversely affecting end strength or quality missions.

The major disadvantage of the network formulation is that, since it does not have a full description of all the system constraints, it can not be used to test the feasibility of certain policy alternatives. For example, as discussed above, one can not model gender-based objectives and quality goals at the same time. In an effort to expand the flexibility of the optimization procedures, GRC investigated the use of linear program (LP) formulations. Two LP formulations were investigated: the Aggregate Allocation Model (AAM) and the Quality Allocation Model Linear Program (QAM-LP).

Aggregate Allocation Model

The first LP formulation, called the Aggregate Allocation Model (AAM), was based on the network formulation and, therefore, shares most of the targets, constraints, costs, etc. described above. The primary additional objective included in the LP formulation was an attempt to include gender-based objectives.

In the network model, monthly quality goals are met, as are fiscal-year and twelve-month MOS requirements. In the AAM, annual MOS requirements are still met, as are annual quality requirements. Gender requirements are also enforced, unlike the network formulation. An initial attempt was made to model the AAM at the monthly level of detail as well. The resultant problem formulation, however, was much to large to be solved in a reasonable amount of time.

The allocation mapping is performed only at the Supply Group to MOS Cluster level of detail. The AAM ensures that recruits are allocated throughout the year such that all missions (MOS, quality, gender) are met while the overall performance of the recruit pool is maximized.

The mathematical representation of the AAM formulation is shown in Table C-15. Its objective is to minimize the total cost of all assignments, constrained to meet all requirements, using the available recruit pool. In addition, the following demand constraints are included in the AAM formulation:

(1) MOS Cluster Annual Missions. The summation of all recruits assigned to each MOS Cluster must meet or exceed the annual mission for each MOS Cluster.

(2) Female Mission. The summation of all female recruits assigned to each MOS Cluster must meet or exceed the female annual mission, but must not exceed the female limitation for that MOS Cluster.

Table C-15. Aggregate Allocation Model Formulation.

MINIMIZE: $\sum_{\forall ij} \sum_{\forall ij} C_{ij} \times X_{ij}$

where: X_{ij} is the number of recruits from Supply Group "i" assigned to MOS Cluster "j"

C_{ij} is the cost of assigning a recruit from Supply Group "i" to MOS Cluster "j"

SUBJECT TO:

$\sum_{\forall j} X_{ij} <= SUPPLY_i$ for all Supply Groups i

$\sum_{\forall i} X_{ij} >= DEMAND_j$ for all MOS Clusters j

$\sum_{\forall i\ female} X_{ij} >= FEMALE\_REQ_j$ for all MOS Clusters j

$\sum_{\forall i\ female} X_{ij} <= FEMALE\_CAP_j$ for all MOS Clusters j

$\sum_{\forall i\ AFQT\ I\text{-}IIIA} X_{ij} >= QUALITY_j$ for all MOS Clusters j

$\sum_{\forall i\ AFQT\ IV} X_{ij} <= CAPIV\_CAP_j$ for all MOS Clusters j

where:

$SUPPLY_i$	-	Supply of Supply Group i recruits
$DEMAND_j$	-	Demand for recruits in MOS Cluster j
$FEMALE\_REQ_j$	-	Female mission for MOS Cluster j
$FEMALE\_CAP_j$	-	Female limit for MOS Cluster j
$QUALITY_j$	-	Quality goal for MOS Cluster j
$CATIV\_CAP_j$	-	AFQT Category IV limit for MOS Cluster j

(3) Quality Targets. The summation of all quality (AFQT Categories I-IIIA) recruits assigned to each MOS Cluster must meet or exceed the quality targets for each MOS Cluster.

(4) AFQT Category IV Limits. The summation of all AFQT Category IV recruits must not exceed the AFQT Category IV capacity for each MOS Cluster.

Two parameters have been provided to allow the analyst to specify the stringency of the model's constraints to examine the effects of specific policy changes. These parameters are:

(1) Cut Score Requirement Flag. This flag indicates whether the average metric score of the Supply Group must meet the qualifying metric score for an MOS Cluster to be eligible for assignment. *If "1," the cut score requirement is imposed; if "0," it is not.*

(2) Demographic Constraint Flag. This flag may take on any of three values:

(a) "0" indicates only the cut score requirement is imposed. Gender and AFQT category goals/capacities are ignored.

(b) "1" indicates both the cut score and female requirements are imposed. The AFQT category goals/capacities are ignored.

(c) "2" indicates all demand constraints are imposed.

The principle function of the AAM was to examine the feasibility of utilizing an LP approach to problem formulation. The AAM, therefore, was developed and tested independently from EPAS' system framework. That is, while it uses many of the same data files, it has not been included the Process Test System (described below).

The results of this analysis indicated that LP formulations to overcome non-network constraints could be developed. Complete LP formulations, however, were unacceptably large, in terms of both problem size and execution time.

The AAM formulation was restricted to generalized problem formulations. Since all data are at the annual level, only a limited amount of information is available for the detailed allocation process. The long run time (compared to the network formulation) and limited information available led GRC to conclude that further efforts into the AAM were not warranted.

The AAM did, however, provide practical experience into the feasibility of LP formulations for the EPAS allocation problem. Based on this experience, further research was conducted into more practical LP formulations.

Quality Allocation Model Linear Program

The Network Shortcoming

The network formulation provides adequate solutions to the allocation problem, particularly in the Policy Analysis and Simulation Modes. Solution times within the 2-minute neighborhood for a 54 MOS Clusters by 81 Supply Groups problem provided excellent results in a rapid manner. This was particularly useful when performing repeated simulations as part of our ongoing research.

However, the network formulation model has one very important shortcoming when applied to the Operational Mode. MOS training within the network is modeled as a one-stage process. Some MOS do train in one step, known as One Station Unit Training (OSUT) training.

In the general case, however, MOS training is not a one-stage process. A majority of recruits are assigned to Basic Training (BT), lasting lasts eight weeks. Following successful conclusion of BT, the recruits then move on to specific MOS training classes (Advanced Individual Training - AIT).

The network models the BT/AIT reality implicitly. AIT start dates are backed off 8-weeks to approximate the BT delay.

Reasons for an LP Formulation

There are several reasons for developing a more rigorous problem formulation. One reason is policy related: the length of time between completion of BT and start of AIT is flexible, albeit minimal. This time lag is, presumably, a policy parameter; one which could be manipulated by Army managers.

A second reason is reality, one which is particularly important for the Operational Mode. The network formulation assumes that sufficient BT is always available to meet AIT start dates. This may not be the case. Given that AIT class space for an MOS often exceeds the annual requirement, thus providing management flexibility, care must be taken in how AIT seats are allocated so that available BT seats are not exceeded.

Yet another issue is managing accession limits versus training requirements. Recruits are charged against accession limits when they actual report for training.[4] They are not counted against the MOS training requirement, however, until they graduate from AIT. The network formulation directly relates the accession limits to the specified training program. This is inaccurate and results in overly restricting the possible solutions.

All of these issues cause non-network restrictions on the model and, therefore, can not be addressed in the current network formulation. GRC, therefore, investigated means of dealing with these issues.

GRC first investigated the possibility of a network model with side constraints, since significant advances in solution methods of such models has been made. However, we concluded that, even if the model could be revised as a network with side constraints, we would probably end up with an inflexible model. [We are considering the addition of loss modeling (i.e. attrition) to our formulation, and saw no way of incorporating it

[4] Recruits assigned to an OSUT class do not count against the BT limit, but are counted against the monthly accession limit at the point of accession.

in a network with side constraints.] We decided instead on an LP approach.

The Proposed LP Formulation

Subscripts have the following meaning throughout the following sections:

- i - Supply Group [1 ... 81]
- j - Contract Month [1 ... 12]
- k - Month training begins (BT or OSUT) [1 ... 12]
- m - "AIT" MOS Cluster [1 ... 54]
- $\underline{m}$ - "OSUT" MOS Cluster [1 ... 5]
- p - Month AIT training begins [1 ... 14]

Let: SG_{ijk} Number of Supply Group i contracting in month j to start Army training (either BT or OSUT) in month k.

AIT_{ikmp} Number of Supply Group i scheduled to start Basic Training in month k, with AIT training in MOS Cluster m to begin in month p.

$OSUT_{ik\underline{m}}$ Number of Supply Group i scheduled to start OSUT training in month k in OSUT-MOS Cluster $\underline{m}$.

JOE_m Number of male, graduate, AFQT Category I artificial recruits accessed in AIT MOS Cluster m some time during the recruit year. (these are "fake" people used to ensure feasibility)

$JOE_{\underline{m}}$ Similar to JOE_m, but for OSUT MOS Clusters.

In addition to the above decision variables, the following parameters are used as upper and lower bounds in the model (m here represents both AIT and OSUT MOS Clusters):

$SUPPLY_{ij}$ Number of available contracts projected for month j in Supply Group i.

$BTMAX_k$ Basic Training class maximums for month k. (BT maximums are weekly; we total the weeks to monthly number)

$AAMMP_k$ Active Army accession limit for month k.

$FYREQ_m$ Annual accession requirement for MOS Cluster m.

$QUAL_{mp}$ Quality (AFQT I-IIIA) goal for accessions in MOS Cluster m in month p.

$GRAD_{mp}$ High School Graduate goal for accessions in MOS Cluster m in month p.

$CAP4_{mp}$ AFQT IV cap for MOS Cluster m in month p.

$CLMIN_{mp}$ Min. required class size for MOS Cluster m in month p.

$CLMAX_{mp}$ Max. allowable class size for MOS Cluster m in month p.

Model Objective. The network formulation minimizes the objective. Since the model usually optimizes on aptitude area scores (for which bigger is better), it uses inverted scores. (Note that other measures could be optimized -- this is user-selected). For consistency, the LP also minimizes the inverted scores.

An additional cost is also needed: the cost of using an artificial JOE. An arbitrarily large cost, BIGM, is defined to be sufficiently large to discourage use of any JOEs, unless absolutely necessary to make feasibility. C_{im} is the "cost" (e.g. inverted aptitude score) of assigning a person of Supply Group i to MOS Cluster m; BIGM is larger than the largest C_{im}.

Table C-16 shows the basic LP formulation which meets these objectives.

Additional Constraints. Numerous additional constraints are required properly define the model. These additional constraints, shown in Table C-16 as separate sections, are described below.

Balancing. "BALANCING" constraints are a mechanism used to ensure that recruits used in a BT or OSUT class which start training in month k are actually available to start training in month k.

Monthly Targets. Constraints are also necessary to ensure "legal" class sizes. These constraints also spread quality and graduate recruits as evenly as possible across monthly classes, while enforcing annual quality and graduate goals by MOS cluster. These constraints are defined in "sets" of Supply Groups,[5] where:

Q = Supply Groups i representing AFQT I-IIIA recruits
G = Supply Groups i representing high school graduates
IV = Supply Groups i representing AFQT category IV recruits

Also, let PCT be some arbitrary percentage, say 75%. The LP uses PCT in an effort to spread quality and graduate recruits evenly across months. By applying PCT to each monthly target, the LP goals toward the target without forcing each target to be met. This allows for additional flexibility in the solution.

[5] These sets are NOT mutually exclusive. "Q" and "G" intersect, as do "G" and "IV". By definition, "Q" and "IV" are mutually exclusive (i.e. have no intersection).

Table C-16.QAM LP Formulation.

MINIMIZE:

$$\sum_{\forall i}\sum_{k=1}^{10}\sum_{\forall m}\sum_{p=k+2}^{12}(C_{im}*AIT_{ikmp}) + \sum_{\forall m}(BIGM*JOE_m) + \sum_{\forall i}\sum_{\forall m}(C_{im}*OSUT_{ikm}) + \sum_{\forall m}(BIGM*JOE_m)$$

SUBJECT TO:

$$\sum_{k=j}^{12} SG_{ijk} \le SUPPLY_{ij}$$ for all Supply Groups i in month j

$$\sum_{\forall i}\sum_{\forall m}\sum_{p=k+2}^{12} AIT_{ikmp} \le BTMAX_k$$ BT limits for all month k

$$\sum_{\forall i}\sum_{\forall m}\sum_{p=k+2}^{12} AIT_{ikmp} + \sum_{\forall i}\sum_{\forall m} OSUT_{ikm} \le AAMMP_k$$ monthly accession limits for each month k

$$\sum_{\forall i}\sum_{k=1}^{10}\sum_{p=k+2}^{12} AIT_{ikmp} + JOE_m = FYREQ_m$$ requirements for each AIT MOS Cluster m

$$\sum_{\forall i}\sum_{k=1}^{10} OSUT_{ikm} + JOE_m = FYREQ_m$$ requirements for each OSUT MOS Cluster m

BALANCING:

$$\sum_{j=1}^{k} SG_{ijk} \ge \sum_{\forall m}\sum_{p=k+2}^{12} AIT_{ikmp} + \sum_{\forall i}\sum_{\forall m} OSUT_{ikm}$$ for all Supply Groups i in month k

Table C-16. (continued)

MONTHLY TARGETS:

$$\sum_{i \in Q} \sum_{k=1}^{p-2} AIT_{ikmp} \geq PCT * QUAL_{mp}$$ (Quality-AIT) for all AIT Cluster m in month p

$$\sum_{i \in Q} OSUT_{ikm} \geq PCT * QUAL_{mk}$$ (Quality-OSUT) for all OSUT Cluster m in month k

$$\sum_{i \in G} \sum_{k=1}^{p-2} AIT_{ikmp} \geq PCT * GRAD_{mp}$$ (Graduate-AIT) for all AIT Cluster m in month p

$$\sum_{i \in G} OSUT_{ikm} \geq PCT * GRAD_{mk}$$ (Graduate-OSUT) for all OSUT Cluster m in month k

$$\sum_{i \in IV} \sum_{k=1}^{p-2} AIT_{ikmp} \leq CAP4_{mp}$$ (CatIV-AIT) for all AIT Cluster m in month p

$$\sum_{i \in IV} OSUT_{ikm} \leq CAP4_{mk}$$ (CatIV-OSUT) for all OSUT Cluster m in month k

$$CLMIN_{mp} \leq \sum_{\forall i} \sum_{k=1}^{p-2} AIT_{ikmp} \leq CLMAX_{mp}$$ (Capacities-AIT) for all AIT Cluster m in month p

$$CLMIN_{mk} \leq \sum_{\forall i} OSUT_{ikm} \leq CLMAX_{mk}$$ (Capacities-OSUT) for all OSUT Cluster m in month k

ANNUAL TARGETS:

$$\sum_{i \in Q} \sum_{k=1}^{10} \sum_{p=k+2}^{12} AIT_{ikmp} + JOE_m \geq QUAL_m$$ (Quality-AIT) for each MOS Cluster m

$$\sum_{i \in Q} \sum_{k=1}^{10} OSUT_{ikm} + JOE_m \geq QUAL_m$$ (Quality-OSUT) for each OSUT Cluster m

$$\sum_{i \in G} \sum_{k=1}^{10} \sum_{p=k+2}^{12} AIT_{ikmp} + JOE_m \geq GRAD_m$$ (Graduate-AIT) for each MOS Cluster m

$$\sum_{i \in G} \sum_{k=1}^{10} OSUT_{ikm} + JOE_m \geq GRAD_m$$ (Graduate-OSUT) for each OSUT Cluster m

Annual Targets. The models uses PCT to spread the quality and graduate accessions across months because the Army desires an even distribution for promotion purposes. However, if each month misses its monthly quality goal -- by lowering the goal using PCT -- the model could miss the annual target. Therefore, additional constraints are needed to force the annual targets.

The artificial variable JOE is again used to ensure feasibility. QUAL and GRAD with a single subscript m (or $\underline{m}$) indicate annual quality and graduate goals, respectively, for each MOS Cluster. Note that an annual constraint for the cap on AFQT IV is not necessary -- since this is an upper bound constraint enforced across all months, and the summation of the monthly caps equals the annual cap, the annual total will certainly be less than the annual cap.

Approximate Model Dimensions. This section presumes a model size of 81 Supply Groups and 54 [AIT] MOS Clusters. Previously, AIT and OSUT MOS were not differentiated. An additional five MOS Clusters were assumed to represent OSUT MOS Clusters. Finally, a twelve-month time horizon is used. These assumptions, as might be expected, result in an extremely larger problem formulation.

The network formulation encountered a similar size problem. To reduce the problem size, a heuristic routine was developed which eliminated potential Supply Group-to-MOS Cluster assignments based on the characteristics of both. For example, Army policy prohibits females in combat MOS; therefore, the heuristic disallows any female Supply Group to be eligible for any combat MOS Cluster. This technique was continued in the LP formulation. This results in an average eligibility of 30 MOS Clusters per Supply Group, down from the maximum of 59.

Within the network, the heuristic eliminated invalid assignments by eliminating the arc connecting the appropriate Supply Group and MOS Cluster nodes. Within an LP, the result is a reduction in the number of decision variables. Using the current number of Supply Groups and an average eligibility of 35, approximately 160,000 decision variables will appear in the EPAS LP.

A further reduction in the number of decision variables will result from the implementation of the RUDEP policy. RUDEP is used by the Army to control the types of people permitted to access in a given month. Previously, EPAS simply used a maximum DEP length of 6 months. In addition to a maximum DEP length, RUDEP policy closes certain months to certain types of recruits (e.g. Male graduate IIIA's may not access in October, November, or January). The effect in the LP will be to eliminate certain AIT_{ikmp} and $OSUT_{ik\underline{m}}$ from consideration, reducing the number of decision variables.

Table C-17 shows the approximate number of rows in the LP. The table is designed using i (Supply Groups), m (AIT MOS Clusters), $\underline{m}$ (OSUT MOS Clusters) as previously defined; (j,k,p) represent contract month, "start-training" month, and "AIT-start" month, respectively.

Table C-17. Number of Rows in QAM LP Formulation.

CONSTRAINT TYPE	COMBINATIONS	# CONSTRAINTS
Supply	i * j	972
BT Limits	k	12
AAMMP Limits	k	12
FY Req. - AIT	m	54
FY Req. - OSUT	$\underline{m}$	5
Balancing	i * k	972
Quality - AIT	m * p	648
Quality - OSUT	$\underline{m}$ * k	60
Graduate - AIT	m * p	648
Graduate - OSUT	$\underline{m}$ * k	60
Cap on IV - AIT	m * p	648
Cap on IV - OSUT	$\underline{m}$ * k	60
AIT-Capacities	2 * m * p	1296
OSUT-Capacities	2 * $\underline{m}$ * k	120
FYReq. AIT-QUAL	m	54
FYReq. OSUT-QUAL	$\underline{m}$	5
FYReq. AIT-GRAD	m	54
FYReq. OSUT-GRAD	$\underline{m}$	5
TOTAL		5685

One additional set of constraints is necessary. EPAS is designed to process 12 monthly iterations; therefore, two sets of "annual" accession goals are generated. The first set are 12-month goals which cover the entire twelve months in the model; the second set covers the remainder of the recruit year. (In the first iteration of EPAS, these goals are identical.) These constraints are similar to the "FYReq." constraints above; this results in an additional 3m + 3$\underline{m}$ constraints. (3*54 + 3*5 = 172 using the current number of MOS Clusters)

<u>Final Considerations</u>. All decision variables (SG, AIT, OSUT, and JOE) are restricted to be non-negative. JOEs have no associated upper bound. In an optimal solution, if any JOE is positive, the projected supply is not sufficient to meet all training requirements.

Since Basic Training lasts eight weeks, the model permits AIT_{ikmp} variables to exist only for pairs of (k,p) where p is at least 2 greater than k. In other words, a contract in month k can begin AIT training, at the earliest, in month k+2. Hence, p (start of AIT class) will always be greater than or equal to (k+2).

The model assumes the time a recruit can "sit idle" (i.e., the period between the end of BT and the start of AIT) is very short (probably less than a month). If this assumption is true, then the set of (k,p) pairs will be reduced further, such that legal values of p will be either (k+2) or (k+3). This assumption was imbedded within the QAM LP formulation for testing. Care must be taken in expanding this window, as it will significantly impact the size of the model.

The network model, in addition to class maxima and minima, makes use of "nominal" class sizes. This is the Army's desired fill (i.e. the "best" class size considering the classroom, available equipment, degree of instructor attention needed per student, etc.) for each class, and falls between $CLMIN_{mp}$ and $CLMAX_{mp}$. The LP formulation does not use this parameter.

Utilization of Optimal Solution

The successful implementation of an EPAS-generated optimal solution was a critical research issue for this project. As documented at the beginning of this section, extensive precedent had been established for the use of linear optimization models to solve personnel-related issues. The research associated with the actual formulation of the model, therefore, primarily dealt with problem definition and application of techniques.

The cited precedents, however, all differ from the EPAS requirement in one significant area: each of the precedents utilizes the generated, optimal solution directly. This is not possible with EPAS.

Application of Optimal Solution

The principal objective of the optimization is to support the detailed assignment process, whether simulated or actual. Many factors preclude using the optimal solution for actual classification of recruits. Some of these factors include:

- Individual Qualifications. Individuals within Supply Groups may not meet the specific requirements for MOS recommendations. For example, the optimization model does not deal with many types of MOS-specific requirements. An individual may appear qualified to the optimization model, but fail to qualify because of some addition restriction, such as a citizenship requirement.

- MOS Availability. The optimization is performed on a "snapshot" of the MOS status at some point in time. As individuals are assigned to training seats, some MOS may no longer be available. The optimal solution, however, would not recognize this fact until it is rerun. Running the optimization procedure in real-time, i.e., for each applicant, is clearly infeasible because of the required solution times.

- Individual Choice. Under current Army policy, the final decision regarding training is left to the individual recruit.

Thus, individuals may simply choose not to accept the optimal solution, even though they are qualified and training capacity exists.

Clearly, these factors prevent direct application of the optimal solution. Any applicant's deviation from the optimal solution would negate that solution. This problem led to two research issues: developing "optimal guidance" which would influence job selection and communicating the optimal guidance to the detailed assignment procedures.

Developing Optimal Guidance

The EPAS approach uses "ordered lists" through which the desirability of each Supply Group's alternative MOS assignments are defined. Ordered lists are time-specific, i.e., MOS by start date, recommendations defined from the "reduced costs"[6] generated by the optimization models.

The solution algorithms -- both ARCNET (network) and Whizard (LP) -- provide information on the non-basic (i.e., non-optimal) arcs (network) or variables (LP). In standard linear programming notation, this is the "$z_j - c_j$"; the cost of introducing the arc/variable into the basis. This information, used for sensitivity analysis in standard applications, is routinely provided as output by optimization algorithms.

GRC developed a methodology for utilizing the reduced cost information to generate a rank-ordered list providing the relative desirability of each MOS/start date combination. TAB 3 provides an empirical example of this process,. summarized in the following paragraphs.

The reduced cost for an MOS/start date which is part of the optimal solution will have the value of zero. Some MOS/start dates which are part of an alternate optimal solution will also have a value of zero. As assignments deviate further from the optimal solution, the value of their associated reduced costs increase. The list of possible assignments is sorted in ascending reduced cost order. Program logic ensures that optimal solutions are listed before alternate optimal solutions, even though both have reduced costs of zero. Ties are broken be DEP length, with shorter DEP length moving closer to the top of the list. MOS Clusters are then broken into their component MOS.

Finally, an algorithm is applied to individual MOS to identify critical MOS which may have been masked within the clusters. When MOS Clusters are formed, information on individual MOS with an immediate need to fill may be obscured by other MOS with considerable flexibility in meeting their requirements. The algorithm identifies critical MOS using criteria such as remaining training capacity, remaining requirement, difficulty of

[6] The reader is referred to the ARCNET User's Guide, 1980, for a discussion of reduced costs. This concept applies equally to the linear programming formulations.

fill, and time to fill. Critical MOS are moved closer to the top of the list.

The resulting ordered list contains the MOS, the start date, and a numeric score indicating the relative desirability of the assignment. The numeric score is adjusted so that the optimal solution always has a value of 1000, with successive options having lower values. The difference in values between any two assignments provides a indication of the relative desirability of the two.

This scheme has intuitive appeal because it selects those alternative jobs which would cause the least deviation from the optimal solution. A strict interpretation, however, would suggest that using reduced cost in this manner is only valid for one substitution of a job. The number of recruits which could be assigned to that MOS using the reduced cost as a substitution cost cannot be known without resolving the problem. Fortunately, there is considerable flexibility for the supply-limited, quality recruits. Furthermore, the solution is resolved frequently. This tend to maintain the system near optimal, since overfilling (or under filling) in one period will be compensated for in the next period.

Aggregate Assignment Summary

The generation and utilization of optimization techniques was a key element of the EPAS research. GRC developed and evaluated three linear optimization techniques: a network and two linear program formulations. Two of these, the network and the second LP, were imbedded in the EPAS Process Test System and extensively evaluated.

Both techniques offer significant advantages and disadvantages: the network provides rapid, generalized solutions by sacrificing model detail. The LP provides additional detail, but does so at the expense of significantly increased execution times (45-50 minutes for the LP versus 2 minutes for the network).

GRC recommends that both techniques be included in an operational system. The specific methodology to be employed will depend on the EPAS mode being exercised, specifically:

- Policy Analysis Mode -- Network Formulation. The Policy Analysis Mode provides rapid, feasibility analyses of policy alternatives. It presents an ideal application for the network approach, as exacting detail is less important than rapid response.

- Simulation Mode -- both Network and LP Formulations. The Simulation Mode allows more detailed analysis and, on the surface, would seem better suited to the LP. Simulations, however, provide an extended policy analysis capability. Both formulation may be suitable, therefore, depending on the specific intent of the analysis.

- **Operational Mode -- LP Formulation.** The Operational Mode provides specific assignment recommendations to the Army's guidance counselors, through the current classification system. It is essential, therefore, that maximum accuracy be employed in the development of the recommendations.

GENERATE DETAILED ASSIGNMENT

The restrictions on the optimization algorithms discussed in the previous section lead to long-range assignments that, while feasible and optimal in an aggregate sense, are unattainable in a detailed application. These restrictions generated a requirement to develop means for applying the optimal guidance to detailed, i.e., individual, optimal assignments.

Supporting this requirement requires a detailed Person-Job Match (PJM) process which matches single individuals to specific MOS/Start Date combinations. EPAS meets this requirement through two processes: one supporting the Simulation Mode; the second, the Operational Mode. The two processes are:

(1) The Applicant Classification Module (ACM). This module provides the detailed PJM processing necessary to support the Simulation Mode.

(2) The REQUEST Interface Module (RIM). This module provides information to support the detailed PJM processing performed by the REQUEST system.

The Applicant Classification Module

New recruits are processed in a sequential manner by the current reservation system REQUEST. One applicant at a time is processed by guidance counselors at the Military Entrance Processing Stations (MEPS). Automatic lock-outs prevent a single seat being accidentally allocated to more than one recruit. The net effect of these lock-outs is that of one applicant being processed to completion before the next applicant enters the system.

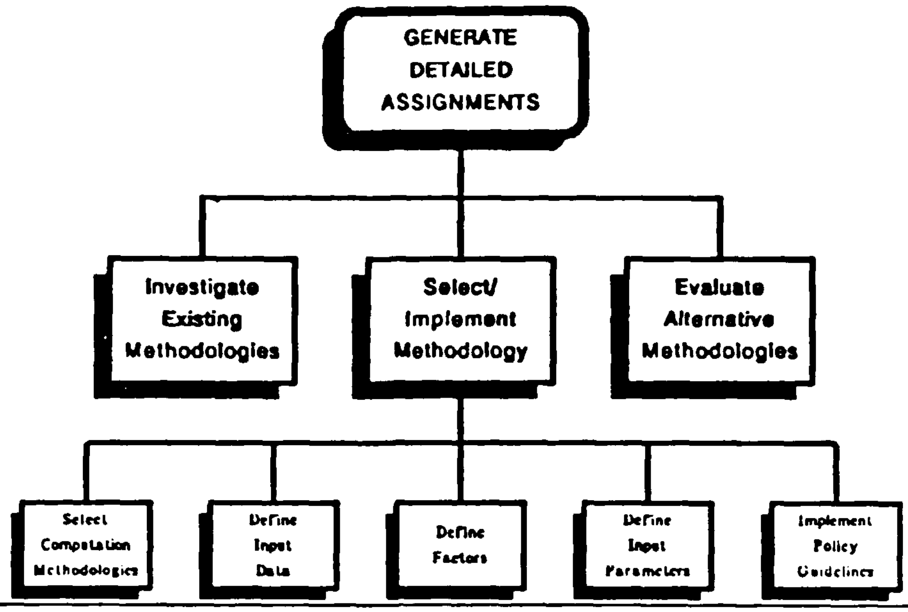
GRC designed the ACM as a sequential processing system to emulate this process and to provide a detailed allocation simulation capability. The ACM processes one individual to completion, evaluating that individual and simulating an assignment, before proceeding to the next individual. Since each individual's complete record is available, as are the requirements for each MOS, the ACM has the ability to go into great detail in determining the best job for each individual.

Identification and selection of the sequential classification methodology to be utilized involved several functions. These functions, depicted graphically in Figure C-5, are discussed below.

Investigate Existing Methodologies

The EPAS Scope of Work explicitly called for this activity, in addition to its being required to support the detailed assignment process. All three major branches of the Armed Forces use some form of sequential classification process to determine initial entry skill: for their NPS recruits. The existing systems are: Active Army Search Algorithm (Army),

Figure C-5. Detailed Assignments, Functional Areas.



the Procurement Management Information System (PROMIS, Air Force), and the Classification and Assignment within PRIDE (CLASP, Navy).

<u>Active Army Search Algorithm</u>. This algorithm, formerly called the MOS Match Module (MMM), is a subroutine within the Army's Recruit Quota System (REQUEST). This system is discussed in Section II, Current System, of the main body of this report. Only a brief summary is presented here.

The Search Algorithm uses a straightforward, linear weighting technique for generating PJM. Individual descriptive factors are transformed from their native metric to a dimensionless utile, in the range of 0 (zero) to 1000. The individual metrics are then multiplied by corresponding weighting factors and added together. The mathematical formulation for this process is:

(1)

$$MPI = \sum_{i=1}^{15} \omega_i T_i$$

where: ω_i — the weighting value for the i^{th} factor
T_i — the result of the transformation function for the i^{th} factor

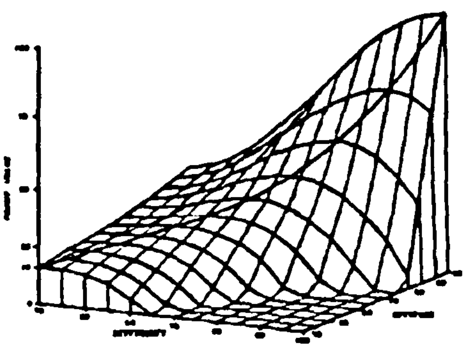
The Search Algorithm sorts the Military Priority Index (MPI) for each PJM computed. The top 25 are displayed to the recruit in five panels of five.

Procurement Management Information System (PROMIS).[7] GRC evaluated two versions of the Air Force's PROMIS system. Both versions are based on the concept of "Policy Specification," as described in Ward (1977). The underlying assumption behind this concept is that qualified managers will be able to assess the relative "value" to the Air Force of differing combinations of measures. Managers are asked to define extreme points and key inflection points for specific relationships. The managerial assessments are then input to a computer program which generates a mathematical equation representing the relative values.

Equation 2 is an example of the mathematical formulation which be generated by this methodology. This equation defines the relationship between the individual's aptitude for a specific skill and the skill's difficulty (Roberts, 1981). Figure C-6 graphically depicts the functional relationship described in Equation 2.

$$(2) \qquad y_{AD} = 35 + (3.636\times10^{-1})(A-95)^2 + (5.417\times10^{-2})(D-40)^2 + (1.136\times10^{-5})(A-95)^2(D-40)^3 + (9.843\times10^{-4})(A-95)(D-40)^2 - (6.019\times10^{-4})(D-40)^3$$

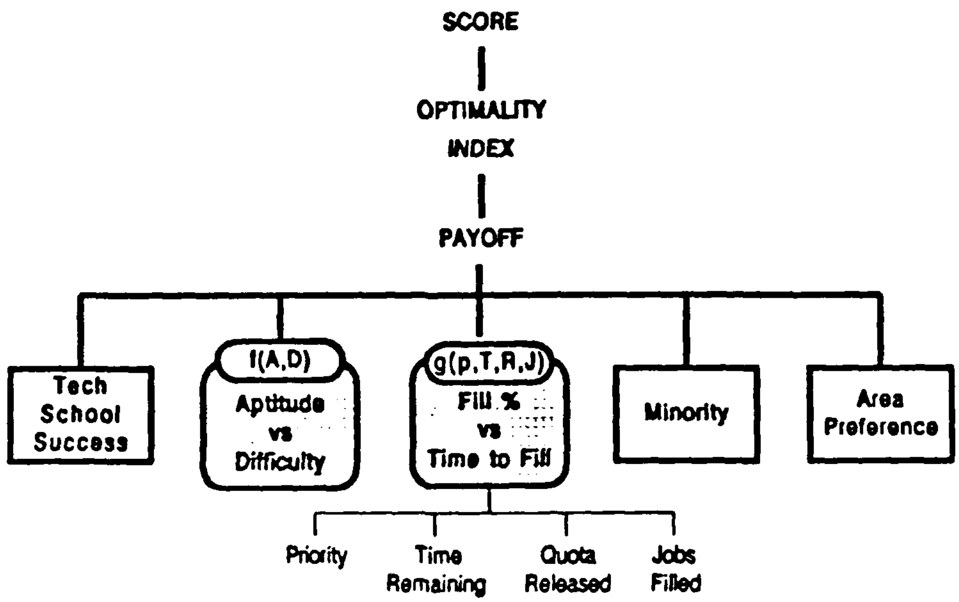
Figure C-6. PROMIS Aptitude vs. Difficulty Payoff Function.



The difference between the two versions of PROMIS, basic and enhanced, evaluated by GRC was the extent to which the Policy Specification methodology was implemented. The basic PROMIS, depicted in Figure C-7, has only a partial implementation of this methodology. Policy Specification techniques were used to develop equations for two factors, Aptitude vs. Difficulty (AD) and Fraction Filled vs. Time Used (FT). Other factors shown in Figure C-7 were defined by other methods; the Technical School Success component, for example, used an equation defined by linear regression analysis.

[7] More accurately, PROMIS is the complete recruit management system, corresponding to the Army's REQUEST. The PJM capability embedded within PROMIS does not have a separate acronym, but is simply called the PROMIS pre-enlistment person-job match system. For simplicity, we use PROMIS here meaning the PJM portions only.

Figure C-7. Basic PROMIS Formulation.



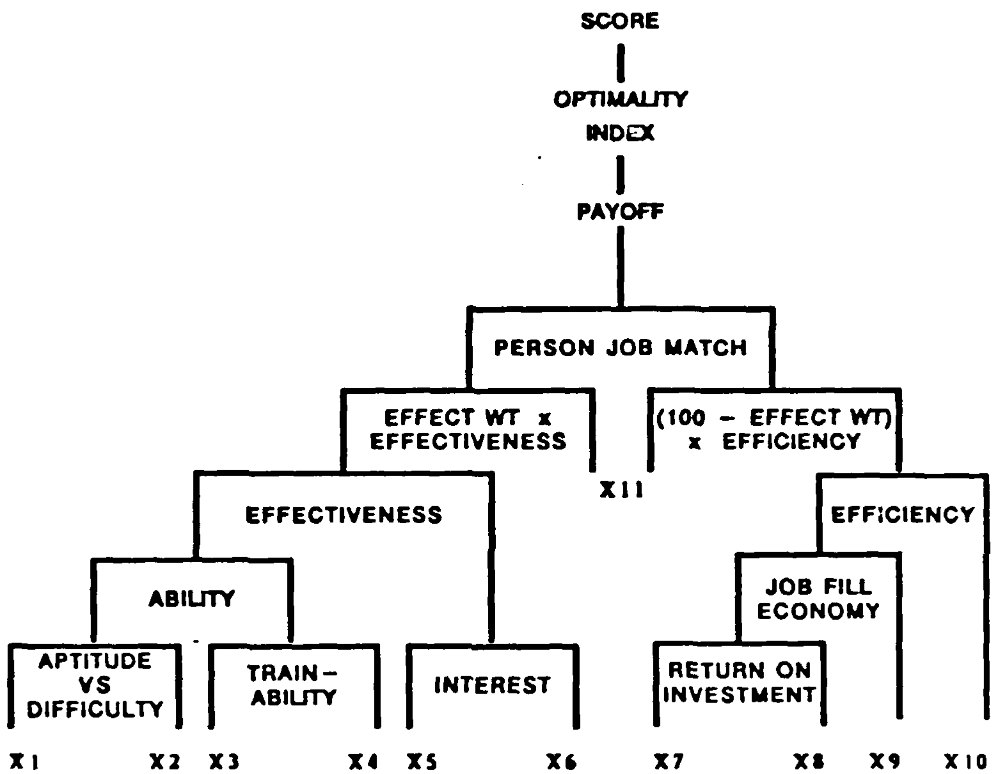
The equations for each of the factors are applied to the appropriate independent variables. The results, like the Army's Search Algorithm, are combined by linear weighting to yield a "Payoff" value.

The enhanced PROMIS, depicted in Figure C-8, carries the Policy Specification approach to its extreme. Instead of linear weighting, all factors are combined in a pair-wise manner until the payoff value is reached. Note that the fundamental factors (the Xn in Figure C-8) may be simple variables or complex definitions of multiple variables. Training Cost, for example, factor X7, is a simple dollar value extracted from a table; Intellectual Ability, factor X3, is the result of the regression equation predicting Technical School Success.

Both versions of PROMIS modify the generated payoff value based on a precomputed value called the "Optimality Index." Each Air Force Specialty (AFS) has an Optimality Index. Indexes define expected performance for recruits in the AFS based on historical accessions. Modification of the payoff based on the Optimality Index enables the Air Force to compare the individual being processed against other recruits who can be expected to qualify for the AFS, thus determining if the current recruit is of the expected quality. An individual who score very high in a particular AFS, for example, may in fact have a score lower than the expected quality and, therefore, be a poor fit for the skill. Conversely, an individual may have an apparently low score for an AFS, but still have scored higher than the expected average, thus being a good fit.

The scores resulting from adjusting payoffs by optimality indexes are sorted, high-to-low. The sorted AFS are then presented to the recruit.

Figure C-8. Enhanced PROMIS Formulation.



X1 -- Aptitude for the Job — M. A. G. or E composite from ASVAB.

X2 -- Job Difficulty -- related to task difficulty from AFHRL and occupational measurement center surveys.

X3 — Intellectual Ability — predicted technical training school grade from ASVAB subtest scores.

X4 -- Academic Background -- percent of desireable high school courses completed

X5 -- Objective Interest -- VOICE score indicating relative interest in the job compared to all jobs.

X6 — Restricted Interest — ranking of the job compared to jobs available for the 12-16 DOT group.

X7 — Training Cost — from ATC cost factors and other manuals.

X8 — Probability of Completing Term of Enlistment -- based on AFHRL research.

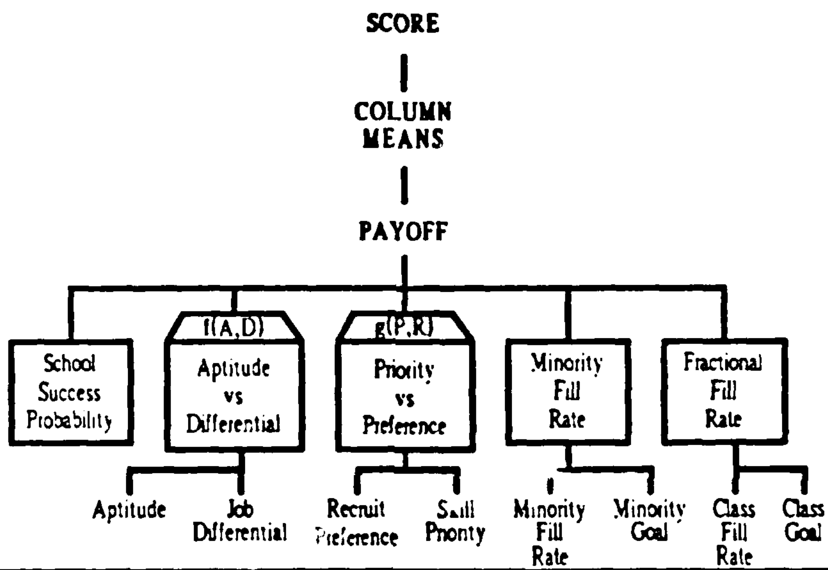
X9 — Casual Time — number of days between BMT graduation and technical training school entry.

X10 -- Fill Priority -- input at run time based on past fill rates, class frequency, class size, etc.

X11 -- Effectiveness Weight.

Classification and Assignment within PRIDE (CLASP). This, the Navy's allocation system, was derived from, and closely resembles, the basic PROMIS system. Figure C-9 depicts the CLASP formulation; the resemblance between this and Figure C-7 is immediately evident. The combination of Policy Specification and linear weighting discussed above is equally applicable for CLASP.

Figure C-9. CLASP Formulation.



Evaluating Alternative Methodologies

While each of the existing systems is unique, they all share a common approach to the classification and allocation problem. Specifically, each addresses one applicant at a specific point in time. PROMIS and CLASP attempt to evaluate applicants relative to others, but do so in a non-optimal, historically-based manner.

Each of these classification systems claims to perform the "optimal" allocation of personnel. (See, for example, Kroeker and Rafacz (1983); Hendrix, et al, (1979); and Kobbe, (1982).) In fact, however, each looks at a single applicant's record as that applicant enters the system. "Optimal" refers only to the identification of the best job for the individual and respective service at that particular point in time. None of the current systems generate solutions that, over time, generate the best overall solution for the service.

This failure to generate the long-range, optimal assignment pattern led to the second functional requirement pertinent to detailed assignment processing: the evaluation of alternative methodologies.

Utility Theory. It was readily apparent that any form of detailed assignment algorithm would have to deal with combinations of disparate measures. This observation led directly to the decision to evaluate Utility Theory, a discipline that specifically addresses this issue. Accordingly, GRC let a subcontract to The Maxima Corporation to investigate the potential application of Utility Theory to EPAS. The results of this study are reported in Stillwell (1983).

The conclusions of the Maxima study were disappointing. A key precept behind the approaches discussed was the need to relate all components to a common scale. Simply put, one cannot compare predicted retention to skill priority directly; a common, dimensionless measure, or utile, must be defined. Utility Theory deals with methods and rules by which such a common measure might be developed. Utility theorists were wont to argue that, until a mathematically rigorous technique could be developed to define this common measure, combinations of factors could not be performed. At its present state of development, Utility Theory was unable to offer appropriate techniques for measures as complex as those involved in the Army's recruit management process. The conclusion was that combinations of requisite factors could not be performed.

Experience with existing classification systems has shown, however, that the measure scan be meaningfully combined without requiring such a mathematically rigorous approach. Experienced managers have repeatedly demonstrated the ability to adjust the parameters of classification systems so that the information obtained is meaningful to, and meets the requirements of, the managers of the system.

Expert Systems. The initial stages of the EPAS contract required GRC personnel to visit MEPS sites and observe the operations of the guidance counselors. The knowledge and capabilities of the guidance counselors repeatedly impressed the observers. This observation, plus GRC's experience in the development and application of expert systems, led to the concept of developing an expert system which would automatically process applicants based on the expertise of guidance counselors.

GRC let a second subcontract, to Science Applications, Inc., to more thoroughly examine the process by which guidance counselors made their decisions. The results of this subcontract are documented in Unger (1984).

The research indicated several promising areas of application, especially in support of recruiters and in preliminary processing of applicants prior to their being interviewed by guidance counselors. It did not appear, however, that the expert system approach was suitable to the classification function required to support EPAS, particularly in view of the need to be able to evaluate alternative predictors being developed by ARI and Project A.

Selection of Methodology

The third functional requirement to support detailed assignments was the selection of a methodology to be utilized. GRC subdivided this functional requirement into three subordinate areas:

(1) Determining the methodology by which the payoff was to be computed.

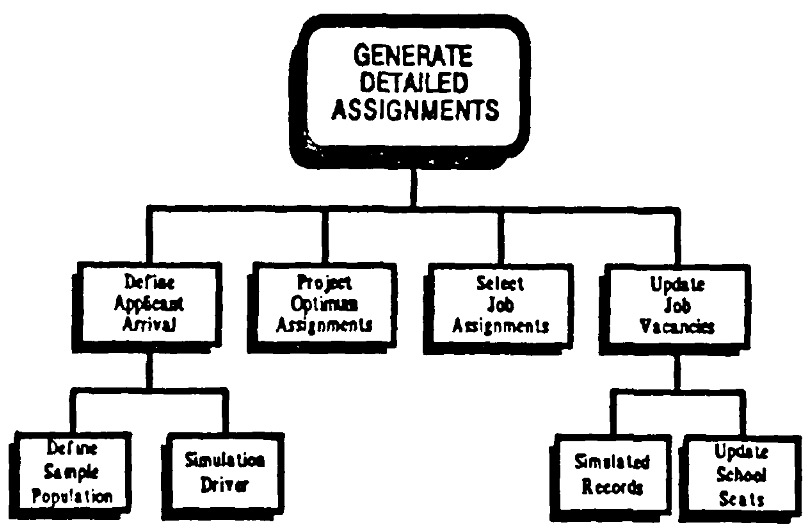
(2) Identifying the specific factors to be used as independent variables.

(3) Determining the means by which the detailed assignment module would ensure that the Army's various policy guidelines and/or restrictions would be met.

Determination of Methodology. The methodology chosen for the ACM comes not from a firm mathematical definition, but rather from the functional requirements of the system. The primary objective for EPAS was the provision of a system by which new techniques for selection and classification could be evaluated. This objective requires the resulting system to possess the ability to quickly implement and clearly identify the relative impacts of the new techniques being evaluated.

Thus, the ACM had to provide the sequential classification structure which enabled processing individual applicants, as well as the means to simulate the classification process. The ACM's simulation capabilities enabled EPAS to perform the requisite, detailed alternative evaluations. Figure C-10 depicts the key functional areas which GRC identified

Figure C-10. ACM Simulation Functional Areas.



as being required to provide the necessary simulation capabilities. These areas, discussed below, were:

(1) Simulate applicant arrivals.
(2) Compute assignment alternatives.
(3) Select PJM matches.
(4) Update system status.

Simulate Applicant Arrivals. Each iteration in a simulation represents a distinct period of elapsed time within the overall time frame of the simulation. For example, if monthly iterations were being used, each iteration would simulate one complete Recruit Station Month (RSM). For the ACM to define applicant arrivals, several capabilities are required:

(1) A sample population from which applicant records can be selected had to be developed. The user had to have the ability to adjust the applicant stream to do policy analysis. To provide this capability, two data files, known as the Primary Applicant File and the Secondary Applicant File were developed.

    The Primary Applicant File is generated directly from the raw data. This file contains edited information on all contractees for a given fiscal year. Statistical summaries were developed for each file, enabling rapid analysis of the actual contractee stream.

    The Secondary Applicant File was generated as a subset of the Primary Applicant File. Two types of secondary files were generated. One was a statistical subset of the Primary Applicant File, that is, the population distributions followed the same patterns as found in the Primary Applicant File. This statistical subset provided rapid simulation capability without loss of statistical significance.

    The second type of Secondary Applicant File was user-defined to address specific policy concerns. An ancillary routine enabled the analyst to define the desired demographic distribution. The Applicant File, Secondary (APS) ancillary procedure randomly selected actual records from the Primary Applicant File to which met the user-defined requirements. Thus, EPAS was able to simulate hypothetical applicant populations, while maintaining a realistic profile of probable applicants.

(2) Next, a means of controlling flow of the sample population through the classification routines had to be developed. GRC developed a simulation driver to perform this function. The driver selected records from the sample population, forwarded them for further processing, and returned control to the

Process Test System (PTS) when no further records are to be processed for the current iteration.

Initially, the process was developed as a subroutine within the PTS, allowing the PTS to control applicant flow. This approach was selected as it directly modeled the Army's current classification process. Simulation times proved excessive, however, with this structure.

A revised formulation was developed, therefore, in which the simulation driver existed as an independent procedure to which control was passed from the PTS to the simulation driver. The PTS defined the time period to be simulated (week, month, etc.) and the starting date.

The driver selected records by constructing a key based on the current iteration and the desired arrival sequence. If, for example, monthly iterations were being performed and RSM October was being simulated, sample population applicant records with an arrival date (door date) in RSM October were processed. The calendar door date was used as the second part of the key, allowing records to be processed in the same order in which they were historically processed.

Compute Assignment Alternatives. The next functional area required the computation of scores for alternative PJM possibilities. The means by which this functional area was implemented was critical, as it was here that alternative predictors could be, and were, implemented for evaluation.

The ACM had to be able "quickly implement" alternative methodologies for analysis. GRC determined that complex functional relationships, such as developed using Policy Specification techniques, would not support this requirement for two reasons: it would be extremely difficult to include radically new measures into function, and the impact of the measures would be masked by the functions themselves.

Accordingly, GRC utilized a the simple, linear weighting methodology such as found in the Army's Search Algorithm as the basic methodology for the ACM. Individual measures can be defined independently of, and developed separately from, all other measures. The ACM has a highly modular structure, enabling rapid inclusion of new, self-contained subroutines applying the techniques to be evaluated. The analyst has direct control over the impact of the new subroutines through suitable manipulation of the corresponding weighting term.

Select PJM Matches. The next functional requirement for short range assignments was the means to emulate an individual applicant's choosing jobs from the list of recommendations. This requirement arose from the need to consummate processing for one applicant before the next applicant is entered into the system. This, in turn, was necessary to ensure that multiple applicant's were not mistakenly allocated to the same position.

This functional area defined two, conflicting, capabilities:

(1) The capability to always have the system analyst define the job to be selected independently from [simulated] applicant choice. This capability eliminates random influences caused by applicant choice, allowing the analyst to evaluate the impact of policy alternatives.

(2) The capability to simulate applicant choice, that is, the applicant has the freedom to select any of the offered jobs with little to no influence by the Army. This capability provides the ability to test the robustness of policy alternatives, allowing the EPAS user to determine whether or not the policy alternative would be unduly affected by applicant choices.

The EPAS prototype's implementation provided the analyst with five options of how job selection was to be performed. These were:

(1) The same relative job is always selected. This was the standard option, with the first job on the list always being selected (although position on the list -- second, third, n^{th} -- can be specified). Random selection criteria do not impact policy options, making this the best option for determining the effect of a policy alternative. This was the only option providing the analyst with explicit control over the selected assignment; the four remaining options used some type of random selection.

(2) The second option used normally distributed random numbers to select one of the first fifteen jobs on the list.

(3) The third option was similar to the second in that it randomly selects one of the first fifteen jobs based on a normal distribution. It differs in that it also provided a 40% possibility that the applicant might have rejected all of the jobs on the list.

(4) The fourth option used uniformly distributed random numbers to select from any job on the list of available positions.

(5) The fifth option also used uniformly distributed random numbers to select a job, but the analyst had the additional ability of defining the number of jobs from which the selection may be made as a function of the type of applicant. For example, male, AFQT Category I-IIIA, high school graduates may be allowed to select any available jobs, while male, AFQT Category IIIB, non-high school graduates might be limited to the first ten jobs on the list.

Update System Status. The fourth, and final, functional area defined to support simulation methodology was the ability to update job vacancy indicators. This capability was required for two reasons:

(1) Most obviously, positions must be somehow marked as no longer available to prevent multiple filling of the same position.

(2) Secondly, the ACM had to track the type of fill which has occurred, e.g., how many quality accessions, for each MOS. This capability was required to provide the information needed to compute appropriate values for the factors being used to generate the applicant's PJM score.

This requirement is addressed by maintaining a special copy of a school seat requirement file. Each time an applicant is predicted to accept an MOS, appropriate counters are updated to reflect the characteristics of the individual and to decrement the required fill for the MOS.

Selection of Measures. Once the classification methodology was identified and developed, the measures to be included had to be defined. As with the determination of methodology, GRC selected measures to be implemented based on the functional requirements of EPAS rather than a formal analysis. A reasonable assumption was that specific measures will vary based on the results of parallel research being performed by Project A and ARI.

GRC's approach was to identify categories of measures based on its surveys of existing systems. Thus, "Predicted Job Performance" was identified as a requisite type of measure, without the need to explicitly define the specific measure to be used. Indeed, in many instances, multiple methodologies were identified and developed for a single category. The categories included in the ACM, with specific methodologies employed, are:

(1) Optimal Guidance. This factor, unique to EPAS, accepts optimally generated ordered lists. The lists are used both to select MOS to be processed and to determine part of the payoff for the PJM. The optimal ordered lists may be generated either by the network or LP formulations, as described in the preceding section.

(2) Predicted Job Performance. This factor defines how well the applicant can be expected to perform in any given PJM. The Project A research has focused extensively on this category, thus several options are available. While only one option can be selected for inclusion in the scoring routines, the ACM computes the other predictors and provides reports of these values as well. Implemented options are:

   (a) Aptitude Area Score. The applicant's score is his/her ASVAB Aptitude Area Composite score for the aptitude area with which the subject MOS is associated.

(b) Predicted SQT Score. Skill Qualification Test (SQT) scores are predicted as a function of the ASVAB subtest scores. This technique is based on Project A research as documented by McLaughlin, et al (1984).

(c) Relative MOS Utility. The relative utility (desirability) of an MOS is computed, using predicted SQT as the means of defining the applicant's percentile for the subject MOS. This technique was also derived from Project A research.

(d) Project A Composite Measure. This is a partially implemented technique based on Project A research to develop novel means of MOS classification. The tests used to generate these composites are not currently given to the general accession population. Thus, exercising this option requires prior definition of a special applicant file on which the requisite test scores have been identified.

(e) Project A TKS Score. The composite measures in (d) above consist of five separate predictors. One of these, Technical Knowledge Score (TKS), was implemented as a separate option. Like the composite measures, a special applicant file must be developed containing the TKS test results.

(3) Predicted Retention Behavior. This factor identifies the likelihood of the applicant to complete the first term of enlistment in the subject MOS. Two options were evaluated for this factor:

(a) Expected Survival (E(t)). GRC conducted extensive evaluations of the E(t) methodology developed by Baldwin, et al, (1982) in studies at the U.S. Military Academy. While presenting many desireable attributes, GRC elected not to implement this technique as a standard option due to its dependency on exogenous data not readily available.

(b) Predicted Attrition. This technique, based on analysis performed by Manganaris and Schmitz (1984) at ARI, predicts the applicant's probability of attriting from a specific MOS as a function of the applicant's demographic characteristics and ASVAB scores.

(4) Management Potential. This factor was intended to predict the applicant's promotion/leadership potential in the subject MOS. The current EPAS prototype utilizes the applicant's AFQT category as a surrogate for this factor.

(5) Affirmative Action/Equal Opportunity Programs. This factor enables evaluation of AA/EO specific programs. The ACM includes both gender- and racial-based factors.

(6) Reenlistment Potential. This factor provides an estimate of the applicant's propensity to reenlist based on the IET MOS. This factor is disabled in the ACM prototype, as neither an acceptable means for determining probability of reenlistment nor relative merit of reenlistment potential versus (for example) job performance could be identified.

(7) Probable Training Success. This factor provides a means of quantifying the likelihood of the applicant's completing the training in the subject MOS. This factor has not been implemented in the prototype EPAS.

(8) Time-to-Fill. This factor defines the Army's urgency in filling the MOS' annual program. It is currently implemented as a function of MOS Priority, difficulty of fill, remaining capacity, and time remaining to meet the annual requirement.

(9) Class Training Demand. This factor evaluates the urgency of filling specific MOS start dates. It is currently implemented as a function of the class' nominal capacity, time remaining to fill the class, and excess training capacity.

Application of Policy Guidelines. This function requirement enables the ACM to address specific policy restrictions and guidelines on a case-by-case basis. This ensures that general guideline received from the optimization procedures can be applied to the specific individual, while still meeting the Army's need to meet annual training requirements.

Examination of historical accessions shows the difficulty in fulfilling all of the requirements established for MOS given the entry restrictions applicable to MOS. Examples of situations which arise include "ineligible" personnel in skills (AFQT Category IV personnel in MOS excluding such personnel), failing to meet quality targets, and shortfalls in annual programs. Simply stated, if there are not enough accessions to meet certain missions, the Army must do the best it can with what it has.

The ACM treats these restrictions in two ways, representing the two types of problems involved: one technique is used with entry restrictions; the second, with "soft" missions.

Entry restrictions define [nominally] minimum requirements for MOS eligibility. The ACM rigorously enforces this type of policy issue. The ACM evaluates each applicant against potential MOS. Failure to meet any of the minimum qualifications for the MOS result in the individual being identified as ineligible for the MOS. The ACM then skips to the next MOS.[8]

"Soft" missions are areas in which the Army has specified goals, but in which the model has the flexibility to make adjustments as needed to meet the higher priority objectives. Quality goals, i.e., the percentage of an MOS' training requirement to be filled with AFQT Categories I-IIIA high school graduates, is an example of a "soft" mission. Rather than shortfall the annual training requirement, the ACM will fill training seats with otherwise qualified AFQT Category IIIB or IV personnel.[9] Substitution of this type, if it occurs, is a function of several factors, such as time remaining to meet the objectives, the applicant's suitability for the skill, etc.

REQUEST Interface Module

The ACM provides the detailed assignments in support of EPAS' Simulation Mode. In its Operational Mode, however, detailed assignments will continue to be the prerogative of REQUEST. In this mode, EPAS provides guidance to REQUEST enabling its utilization of the optimal guidance.

Tests of EPAS have repeatedly demonstrated the feasibility of using optimization techniques to improve classification and allocation of NPS recruits. The means has been developed -- the QAM ordered lists -- for communicating the optimal guidance to a detailed assignment algorithm. For the results of this research to be applied in an operational environment, REQUEST must be modified to utilize the ordered lists and a means of communicating between the two systems must be developed.

Two functional areas were defined to meet these two requirements: utilization of the optimal guidance by REQUEST and development of a communication capability.

REQUEST Utilization of Optimal Guidance

Modifications to the REQUEST system are clearly beyond the scope of GRC's research contract. If the EPAS research is to be fruitful, however, evaluation of potential means for REQUEST's utilizing the QAM output was essential. Three potential techniques were investigated for applying EPAS' optimal guidance in REQUEST.

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[8] Reviewing actual assignments show that these restrictions are not, in fact, absolute. Waivers may be granted in exceptional cases, as demonstrated by otherwise excluded situations occurring. GRC feels that such circumstances are anomalies which can not be reasonably simulated.

[9] GRC analysis has shown that such substitution, properly controlled, may actually result in a better qualified applicant. Some AFQT Category IIIB personnel, for example, will have better potential than low-end AFQT Category IIIA personnel. Recognition and exploitation of this fact is one of the significant features of the EPAS optimization procedures and, subsequently, the ACM.

Setting Control Switches. REQUEST uses an extensive suite of control switches to precisely regulate which factors are active, which MOS are open, etc. One potential means of using EPAS optimization results to direct the REQUEST Search Algorithm, therefore, appeared to be using EPAS guidance to automatically set appropriate switches.

The advantage of this approach would be that it requires minimal change to existing systems. The principal problem associate with this approach is identifying switches which actually would perform the desired control.

Preliminary investigations indicated that the existing switches do not provide sufficient control to allow interfacing EPAS and REQUEST in this manner. Further, the global nature of EPAS' methodology highly limit its ability to provide the necessary control. Since the REQUEST switches were designed for different requirements, extensive analysis and modification of REQUEST would likely be required before switches would provide the necessary functionality.

For example, REQUEST uses Definition of Quality (DQ) switches to ensure the quality recruits are spread across all MOS. The DQ switches prevent a highly desireable MOS being filled by all quality personnel, while less desirable skills go wanting. Control is exercised by manually "closing" MOS to quality recruits. EPAS' optimization methodology, however, guarantees that all MOS will meet their quality objectives, presuming sufficient supply exists. EPAS could not set a DQ switch indicating an MOS is filling to rapidly, as the optimization methodology will never allow this to happen.

Conversely, EPAS optimization may recommend a solution in which an MOS, or set of MOS, do meet quality objectives at a rate different from other MOS. EPAS accomplishes this by manipulating DEP flow to meet its overall objectives. From REQUEST's perspective, however, this would be problematical: the rate of fills would appear to be violating the restrictions which the DQ switches were designed to control.

New Hierarchy Factor. The second approach investigated was inclusion of a new factor in the Search Algorithm's Classification Hierarchy. The relative score on the QAM ordered lists could be weighted into the scoring function, providing an immediate and controllable affect based on the EPAS forecasts.

The advantages of this approach are that it will directly influence the resulting job list based on EPAS, that it could be readily implemented without major modifications to REQUEST, and that it closely follows the manner in which the ACM applies this factor. A minor, surface problem is the need to develop and monitor the requisite controls for a new hierarchy factor: weights, switches, etc.

Closer analysis, however, showed a deeper problem which invalidates this potential approach. The Search Algorithm only examines MOS within a narrow time window, defined by the guidance counselor. EPAS examines MOS within the entire DEP-eligible period. A high probability exists that MOS recommended by EPAS will not fall within the REQUEST window. Thus, the EPAS recommendations would never be seen by the Classification Hierarchy; hence, no guidance would be received.

Modify REQUEST. The third technique grew out of the fact that neither of the first two techniques appeared to be suitable. While only two specific options were examined, GRC observed that the problem lay in the fundamental assumptions behind the two systems. One, REQUEST, is a point-specific, highly manual system; the other, EPAS, is a global, highly automated system. We concluded that any attempt to interface the two systems utilizing an existing capability within REQUEST would run afoul of these basic, contradictory assumptions.

GRC determined, therefore, that modifications to REQUEST would be necessary if it was to be able to utilize the EPAS optimal guidance.[10] We identified two areas in which modifications appeared to be required.

MOS Selection Methodology. The number of possible combinations of initial entry MOS and training start dates for any given applicant number in the thousands, if not the tens of thousands. Computation times make it infeasible to determine the MPI for all possible PJM combinations.

This is equally true for both systems. The response times for REQUEST -- an on-line, interactive system -- would be unacceptable. Similarly, the execution time for EPAS -- in its Simulation Mode -- would be prohibitive. Both systems utilize computational logic, therefore, to reduce the number of PJM computations which must be performed to provide a reasonable selection of alternatives. This computational logic presents the fundamental conflict between the two systems.

REQUEST truncates the list of potential MOS by means of its Search Window. The guidance counselor defines the Search Window by specifying an initial date, called the Date of Availability. Ostensibly a means of enabling the recruit to define a desired reporting date, the Date of Availability is the means by which the guidance counselor manually manipulates REQUEST. The result is both inefficient (requiring multiple executions of the algorithm) and potentially effective (critical requirements may still be missed if the window is not properly defined).

EPAS truncates the list of potential MOS based on the optimal guidance. The EPAS optimization routines evaluate all possible, legal PJM combinations; it performs no preliminary truncation. As a result, the optimal guidance ordered list includes every alternative for each Supply Group.

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10 Modifications would, clearly, seem to have to be made on the REQUEST side rather than the EPAS side. The whole objective of the Project B research was development of an optimal allocation strategy. Regardless of detail variations, the EPAS technology would still be driven by a linear optimization procedure. Thus, EPAS modifications would not affect its underlying assumptions and would be ineffective in resolving the conflict between the two systems.

The key, of course, is that the list has already been sorted into a preferred order. The number of computations is reduced by truncating the list to a user-specified subset of the list.

The EPAS approach has several inherent advantages which make it very desireable. These include:

- Critical MOS sort to the top of the list and, therefore, are always on the list. The system will no longer be dependent on the guidance counselors' ability to correctly set windows to encompass critical skills.

- The definition (truncation) of the process lists is performed centrally by Army managers, rather than individually in the field. Thus, all guidance counselors will be utilizing the same list.

- The long-range, optimal guidance will be directly communicated to the detailed assignment process.

- Policy imperatives defined by Army managers and included in the formulation of the optimization problem will automatically be forwarded to the field.

Requisite REQUEST modification can be readily seen by referring to Figure C-11, which depicts the steps performed by REQUEST's Search Algorithm. This is, essentially, the same as Figure 3 in the main body of this report. Anticipated modifications are highlighted by shading.

Altering the MOS selection methodology would be performed by entering a new data file -- the EPAS Optimal Guidance -- and by extensively modifying the first process block. This first block, among other activities, determines the Search Window in the current system. The modifications would result in REQUEST processing in the same manner as EPAS, i.e., the MOS/start date combinations identified by EPAS would be processed.

Modify Classification Hierarchy. The second modification relates directly to the second alternative researched, New Hierarchy Factor (above). This modification, as depicted in Figure C-12, requires the addition of a new hierarchy category, equivalent to the MOS Status and Applicant Qualification categories. The proposed modification weights

Figure C-11. REQUEST Search Algorithm.

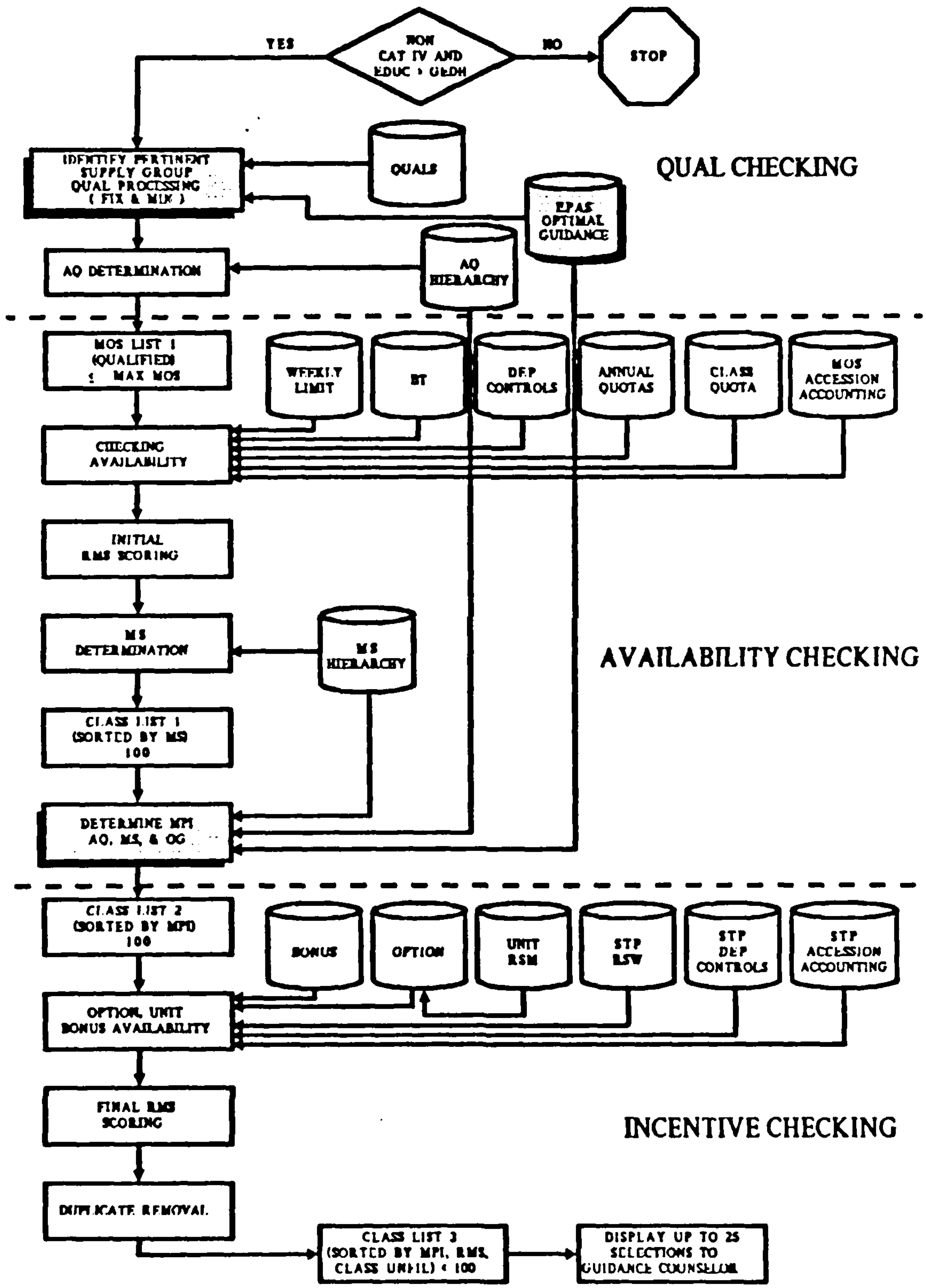
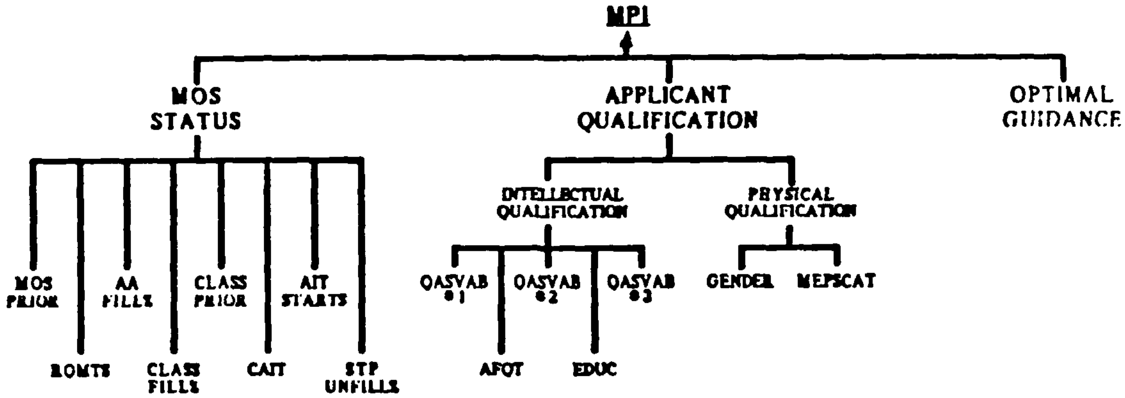


Figure C-12. EPAS-Modified Classification Hierarchy.



the score generated by the EPAS optimization procedures with the scores currently generated by the existing hierarchy factors.[11]

Successful implementation of the EPAS guidance requires making both modifications: the first to ensure that REQUEST evaluates the recommended PJM combinations; the second to ensure that the relative merits of the PJM alternatives are introduced into the scoring algorithm.

EPAS-REQUEST Communication Capability

The second functional area requires developing methodology to actually communicate EPAS guidance to REQUEST, and to receive update files in return. This functional area is well defined, with data already being routinely communicated among REQUEST and other computer facilities, including both HQDADSS and ISC-P.

GRC report 1317-33-89-TR, Data Requirements Document, defines anticipated data transfers from REQUEST to EPAS. Appendix D of this report contains the functional description of data flow from EPAS to REQUEST.

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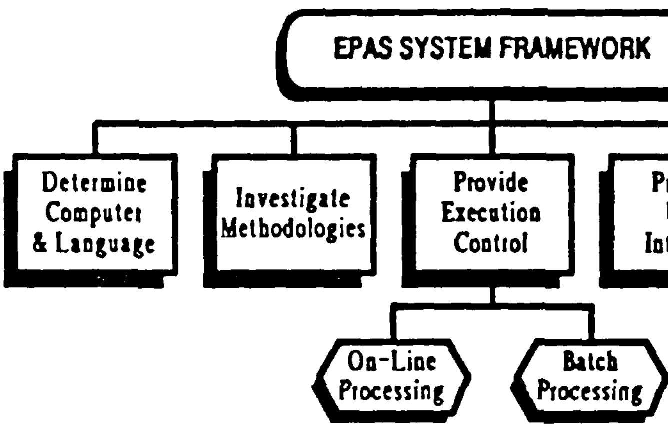
11 EPAS simulations typically weight these factors on the order of 40% for the optimal guidance and 30% each for the MOS Status and Applicant Qualifications. A significantly lower weight on the MOS Status component appears practical since the optimal routines utilize both the Army's requirements and the applicant's qualifications when it recommendations are generated.

EPAS SYSTEM FRAMEWORK

Early in this research, GRC determined that EPAS required a computerized, system framework. This framework provides a test bed for testing and evaluating individual components of the system. The GRC-developed framework supports evaluation of interdependent methodologies in a controlled environment and test scenarios. GRC developed a system framework to test and support the baseline prototype. The framework has continued to evolve as the prototype has evolved.

Five functional areas comprise establishing the system framework. These areas, depicted in Figure C-13, are:

Figure C-13. EPAS System Framework Functional Areas.



(1) Determine computer system and development language.
(2) Provide a user and developer interface.
(3) Investigate and select a development methodology.
(4) Provide execution control.
(5) Provide execution status monitoring.

Determine Computer System and Development Language

Demonstration Laboratory Facility

The contract scope of work called for development of a Demonstration Laboratory Facility (DLF) on which various PJM methodologies could be analyzed and evaluated. During the proposal evaluation phase of this contract, the Government recommended in an additional proposal information request letter (19 April 1982), and GRC concurred with, the use of A Programming Language (APL) for the EPAS prototype. In addition to the APL support requirement, GRC determined that the DLF would have to support:

- Multi-user access
- Graphics
- Word processing
- 9-Track tape processing
- Data communications
- Approximately 500MB of disk storage

Based on evaluations of several computers systems, GRC recommended use of a Wicat Model 150/160 computer for the DLF. After procuring the DLF hardware, GRC used APL to develop emulations of the classification systems then in use by the Army (MMM), Air Force (PROMIS), and Navy (CLASP). Analysis of the results of these simulations indicated that, while APL was well suited for small analytical test modules, it could not support the larger EPAS prototype system. The primary drawbacks were difficulties in supporting extensive data base manipulations and developing comprehensive user-interface development. GRC recommended, and the Government agreed to, the use of the Pascal language for further development. Pascal was recommended because it could support:

(1) Libraries of routines allowing all developers a common base of utilities.

(2) Creation and deletion of the large external files needed for developing different scenarios.

(3) Sequential and index sequential file structures.

(4) Character and string manipulation.

(5) Direct access to many operating system utilities allowing more flexibility in developing screen displays.

(6) Structured coding allowing efficient development effort and less maintenance.

National Institute of Health

The baseline and full-scale prototypes of EPAS were developed on the Wicat DLF. Simulations of the full-scale prototype, however, showed that the DLF was much to slow to support extensive analyses. A 12-month simulation, for example, using only 5,000 contractees required four days of wall clock time. Tests conducted on a mainframe environment indicated that a similar run could be performed in less than an hour.

Investigations of several candidate computers indicated that none supported the extended version of Pascal used to develop the full-scale prototype on the Wicat. Programming Language/1 (PL/I) was selected as an alternative as it: displays many characteristics similar to those found in Pascal, provides extensive support for file structures, and is extensively used by other Army personnel planning systems.

The computer facility at the National Institute of Health (NIH) was selected as the host computer facility. The NIH facility utilized an Amdahl computer, an IBM-mainframe look-alike. NIH provided the requisite PL/I language, file access techniques, and data communication facilities. In addition, ARI already used NIH for analytical support services, allowing ready access by GRC analysts.

GRC translated the full-scale prototype into PL/I. The file structures were also converted from Wicat's Keyed Sequential Access Method (KSAM) to IBM's Virtual System Access Method (VSAM). Numerous analyses were performed on the NIH facility, including the Benefit-Cost analyses, verifying the optimization-based methodology employed in EPAS.

Information Systems Command -- Pentagon

Executions of the full-scale prototype on NIH validated the EPAS concept, but the data storage and run-time requirements of the system proved it to be too expensive for routine operations on a commercial computer facility, such as NIH. This observation, plus the desire to develop the operational prototype of the system on an operational computer facility, dictated an additional conversion to an Army computer system.

GRC evaluated several Army computer facilities as potential sites for the operational prototype: the Keystone system, which hosts REQUEST; the USAREC support facility, at Fort Sheridan; the Headquarters, Department of the Army, Decision Support System (HQDADSS); and the Information Systems Command -- Pentagon (ISC-P).

The ISC-P computer facility was selected as the host environment for the operational system. Operations on the NIH facility were suspended, to conserve ARI computer costs, and EPAS was converted to the ISC-P facility. The EPAS Field Test was performed on the ISC-P facility.

Investigate and Select Development Methodology

GRC investigated alternative methodologies to develop and evaluate EPAS constructs in a controlled manner. We expected many changes would be made to EPAS to support its primary role as a research and development project designed to evaluate candidate PJM methodologies. Traditional software development methodology presented many problems: traditional methodology is strictly phased and includes data flow diagrams or flow charts to represent a fixed design.

EPAS required a systems development methodology that supported developing analytical models, rather than just making data base manipulations using panels (as with rapid prototyping). The initial approach constructed programs from "building block" modules and linked them together. This approach offered increased flexibility in including and evaluating new methodologies. Modules for this system framework were:

(1) Process Test System (PTS) to be the system controller and overall user interface, running the EPAS components and generating evaluation reports.

(2) Process Construction System (PCS) to support defining building block components used to construct EPAS modules.

(3) Process Link System (PLS) to link the building blocks into a coherent system structure.

Continued research determined, however, that the PCS and PLS components would not be cost effective. Reasons for this conclusion included:

(1) A building block approach did not efficiently support evaluating the methodologies under consideration for EPAS.

(2) The building blocks were so computationally complex that options and data base access could not be coded easily through the PCS.

(3) Switching in and out building block modules could be easily emulated using programming language constructs, such as the PL/I INCLUDE statement, with common module interfaces.

As a result of these observations, the Process Test System became the system framework and primary user interface into which candidate EPAS modules could be inserted and evaluated. The PTS continued as the system framework throughout the contract period.

The PTS, depicted in Figure C-14, provided access to all of the component modules, data, and procedures within EPAS. The procedures provided by the PTS can be divided into four basic categories:

(1) The EPAS Model. The center of the figure depicts the EPAS core procedures, i.e., TRM, QFM, QAM, and ACM. These routines define the simulation and classification procedures.

(2) The Data Base. The data base contains all data required by EPAS. Types of data within the data base include:

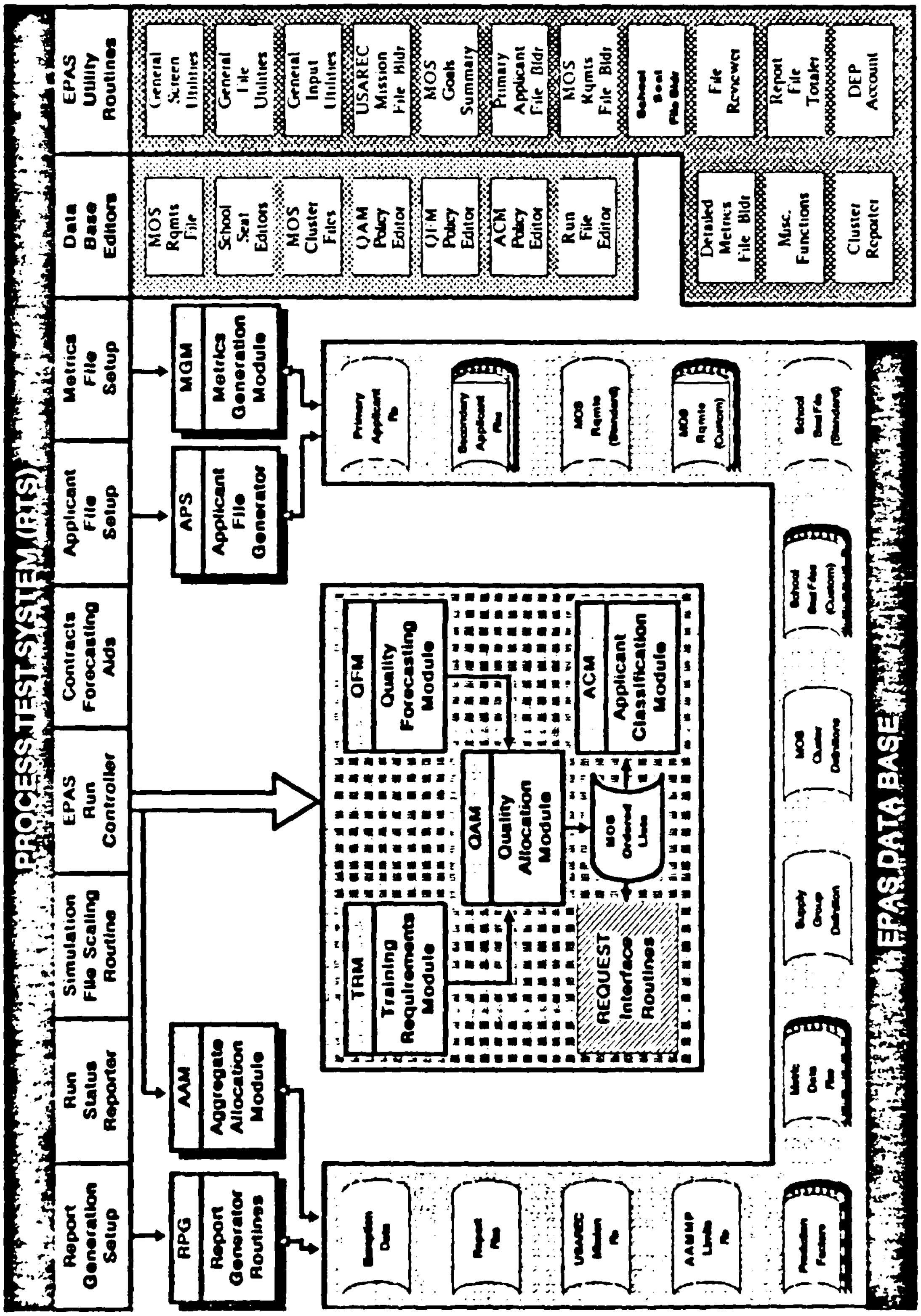
   (a) Standard data -- unedited data from external sources

   (b) Custom data -- data modified by analysts to test policy alternatives

   (c) Parameter data -- control data from previous executions providing convenient restart and rerun capabilities

   (d) Report data -- results of previous executions, including both pregenerated model output and exception reports.

Figure C-14. Process Test System.



(3) Editors. These are routines which allow the user to access and modify all data contained within the system. Editors also provide setup routines, enabling the user to interactively define executions. These routines automatically generate necessary job command streams to execute the models.

(4) Utilities. EPAS was developed to utilize common routines. These allow the system to present a uniform appearance to users and facilitate development and debugging.

Provide a User and Developer Interface

The complexity of the PTS required development of standardized procedures to simplify user access. Accordingly, GRC developed an extensive user-centered, interactive interface. The interface provided developers and users, alike, with a system interface and expedited debugging and fine tuning.[12] Numerous functional areas were defined to ensure the interface met EPAS requirements. These were:

(1) Menu-driven controls with choices indicated via a common, user-friendly access method.

(2) Consistent panel design, including header labeling, panel identification, data layout, and user options.

(3) Clear error messages identifying when erroneous data or parameters are entered.

(4) Use of full screen capabilities, including reverse video, colors, highlights, etc. as appropriate, to facilitate the user's understanding.

(5) Error correction before processing the next panel in the sequence.

(6) Capability to return to previous panel in a sequence without having to restart the sequence.

(7) Capability to abort an operation without adverse affects.

(8) On-line tutorials.

(9) A standard editor interface for adding, modifying, copying, or deleting data items.

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12 The alternative to an interactive interface was to require users and developers to edit input data using only the computer's standard editor. This would not have provide for data-specific editing, neither would it have provided cross-linking between related data elements.

Tree-Structured Access

A tree-structured, interactive menu capability was developed to implement these requirements. The tree-structure, depicted in TAB 4, enabled the system framework to automatically determine the next processing step based on the user's input. At each decision point (node) within the tree, EPAS presented the user with a set of options. The user's response, i.e., the option selected, defined the next path (branch) to follow within the tree. At the end (leaf) of each branch, the requisite actions (data entry, query, job submission, etc.) was automatically performed.

Standardized Panels

Each panel within the menu tree was designed to a common standard to facilitate the user's input. This standard, defined by GRC analysts, divided panels into three major sections. These were:

(1) Menu Header. The top portion of the panel displays identifying information. This information included:

- System--the name of the system, i.e., the EPAS Non-Prior Service Allocation system.
- Subsystem--identification of the subsystem, e.g., run control editor, within EPAS for which the panel applies.
- Description--a brief, clear-text explanation of the purpose of the current panel.
- Panel Identifier--a unique identification for the panel. The panel identifier facilitates debugging, error checking, and user assistance.

(2) Menu Body. The center of the panel contains all the action elements of the panel. The specific contents and format of the menu body are dependent on the panel being displayed and its location within the menu tree. Two fundamental types of panels exist: selection and data entry.

Figure C-15 depicts a typical selection panel. Selection panels provided the user with a list of options and a set of legal responses. The user's response determined the next action to be performed by EPAS. The menu body for a selection panel always had two components. First, instructions provided terse, clear-text explanations of the actions to be performed by the user. Second, the available options were displayed.

Figure C-16 depicts a typical data entry panel. Data entry panels provided a formatted structure in which the user could review, enter, or modify data. The format and content of a

Figure C-15. EPAS Selection Panel.

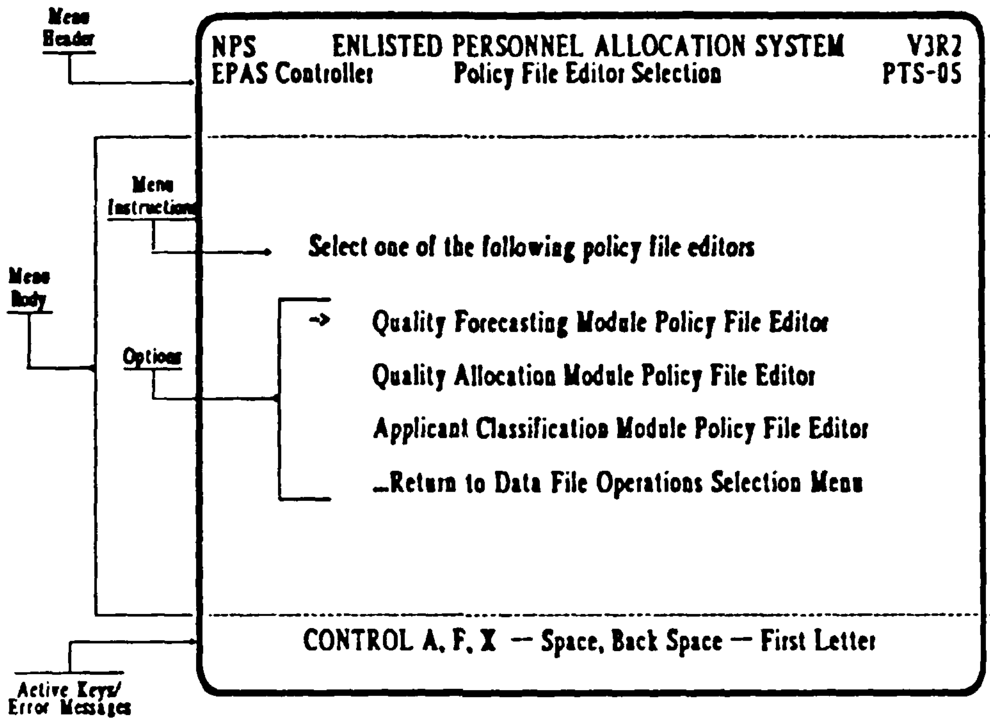
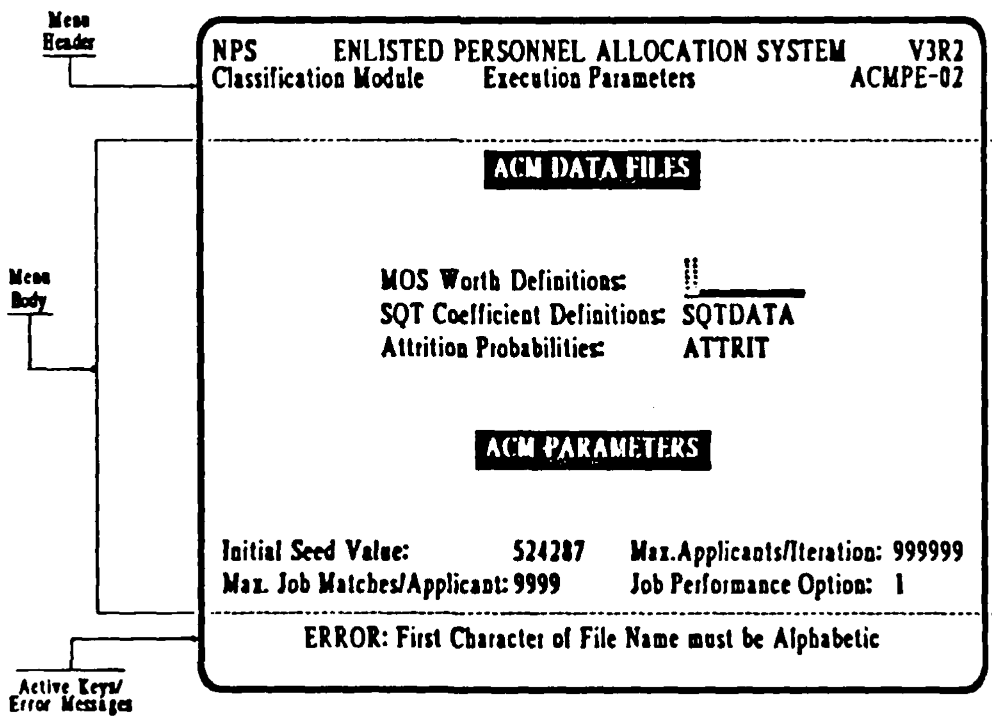


Figure C-16. EPAS Data Entry Panel.



data entry panel was, clearly, highly dependent on the specific data being processed. GRC standardized several features, however to facilitate data entry. These included:

-- Protected descriptor fields--terse, clear text descriptors identified the requisite data. These fields were protected to prevent inadvertent modification by the user.

-- Automatic tabbing--the cursor would automatically move to the next data entry field, skipping all protected descriptor fields.

-- Default Value--wherever possible, EPAS automatically filled data entry fields with previously-defined data, called "defaults." The user then had the option of accepting the EPAS-defined data or overriding it with new data. If no default data were available, a blank field would be displayed and user entry would be required.

-- Tutorials--single key, context-sensitive help panels were associated with each data entry panel. Thus, the user could obtain in-depth assistance for each data entry panel and item.

(3) Active Keys/Error Messages. The bottom portion of panels served two purposes. First, currently active special keys were displayed, with a one- or two-word explanation of their function. Second, if an error were detected, a brief error message would be displayed with instructions for corrective action.

<u>Wicat Implementation</u>

The initial panels were developed as part of the baseline prototype and, therefore, were based on the characteristics of the Wicat DLF. Specifically, this entailed using ANSI-standard ASCII codes to control user entry. The panel shown in Figure C-15 is an example of a Wicat-based selection panel. Special-purpose utilities, written in Pascal, standardized definition and application of keys within the system framework, for example:

- Control Keys--special purpose control keys were used for universal actions. These keys[13] included:

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13 "Control Keys" are activated by depressing and holding a special key, called the control key, and simultaneously pressing a designated alphabetic key. This action is similar to holding the shift key to get an uppercase letter during normal typing activities.

- -- Control/A -- Abort -- caused EPAS to cancel all entries on the current panel and reset the data values to their original state.
- -- Control/F -- Forward -- caused EPAS to accept all currently displayed entries and proceed to the next panel in the sequence.
- -- Control/T -- Tutorial -- displayed the help panel associated with the currently active panel.
- -- Control/X - eXit -- caused EPAS to abort all ongoing activities and return to the root of the menu tree.

- Movement Keys--keys enabling movement within a panel. These keys included:
  - -- Arrow Keys--moved the cursor one field in the direction of the selected arrow.
  - -- Space/Backspace--moved the cursor forward/backward one field.
  - -- Tab/Reverse Tab--moved the cursor forward/backward one field.
  - -- "Hot Keys"--entering the first letter of an option field (selection panels only) jumped the cursor to that field.

Special logic enabled the system framework to maintain current status as the user moved through the menu tree. Selected options/fields in a panel were highlighted, using reverse video. When the user returned to the panel in subsequent activities, the previously-selected option would remain highlighted, enabling the user to accept the option and proceed to the next panel without having to respecify the option.

National Institute of Health

GRC rewrote the panel utilities into PL/I as part of the move to the NIH computer facility. Moving EPAS to the NIH computer facility, however, introduced several problems into the user/developer interface. As just described, the EPAS user interface used standard ASCII control codes. The NIH computer, however, an IBM-type mainframe, was EBCDIC based and did not accept ASCII control codes. Procedures had to be developed, therefore, to enable continued application of the panel structures.

This requirement was met by continued use of the Wicat. GRC developed special-purpose procedures (called "BYPASS" routines) which enabled users to continue using the ASCII control codes. The BYPASS routine intercepted the control codes and translated them into unique EBCDIC character strings. Special procedures within the EPAS system framework recognized these strings and redefined them back to the special codes recognized by the existing EPAS procedures.

This approach allowed conversion of EPAS to the NIH facility with minimal impact on the existing code structure. It had, however, two significant drawbacks:

(1) It required the user to access the PTS through the Wicat computer, rather than directly through the NIH communications facilities.[14]

(2) It severely degraded system performance because of the character-by-character evaluation, translation, and redefinition required.

Information Systems Command -- Pentagon

These drawbacks, while serious, were acceptable in the research-oriented environment under which EPAS was being developed and analyzed. Clearly, however, they would be unacceptable in an operational environment. Therefore, as part of the development of the EPAS operational prototype, the user interface was totally rebuilt.

GRC investigated the standards then in force on the HQDADSS and ISC-P computer systems and redesigned the EPAS to meet these standards. At the same time, however, the EPAS user interface standards were continued to the maximum degree possible. Figure C-17, for example, depicts the same panel previously shown in Figure C-15. The panel structure still consists of the three divisions -- menu header, menu body, and active keys/error messages -- found in the Wicat panels.

The PL/I panel utilities were eliminated in the EPAS operational prototype. Panels were developed using an IBM product called Cross System Product (CSP). The Army has directed that CSP, marketed by IBM as a fourth generation development language, be the standard language for developing panels on the HQDADSS and ISC-P computer facilities.

CSP provides structures for defining panels, performing rudimentary editing and arithmetic operations, and accessing data bases. More complex edits and mathematics could not be performed using CSP directly. In these cases, special PL/I utilities were developed to meet the specific requirement and linked into the CSP structures.

Several major differences existed between the resulting ISC-P panels and their predecessors on the Wicat and NIH computers. These were:

14 Developers were able to access the source code and requisite system procedures (compilers, editors, etc.) directly through the NIH communications facilities.

(1) All control key sequences were replaced by function keys. Where applicable, HQDADSS/ISC-P standards were substituted for corresponding GRC standards, e.g., the Program Function key 1 (PF1--help) replaced the control/T (tutorial) sequence.

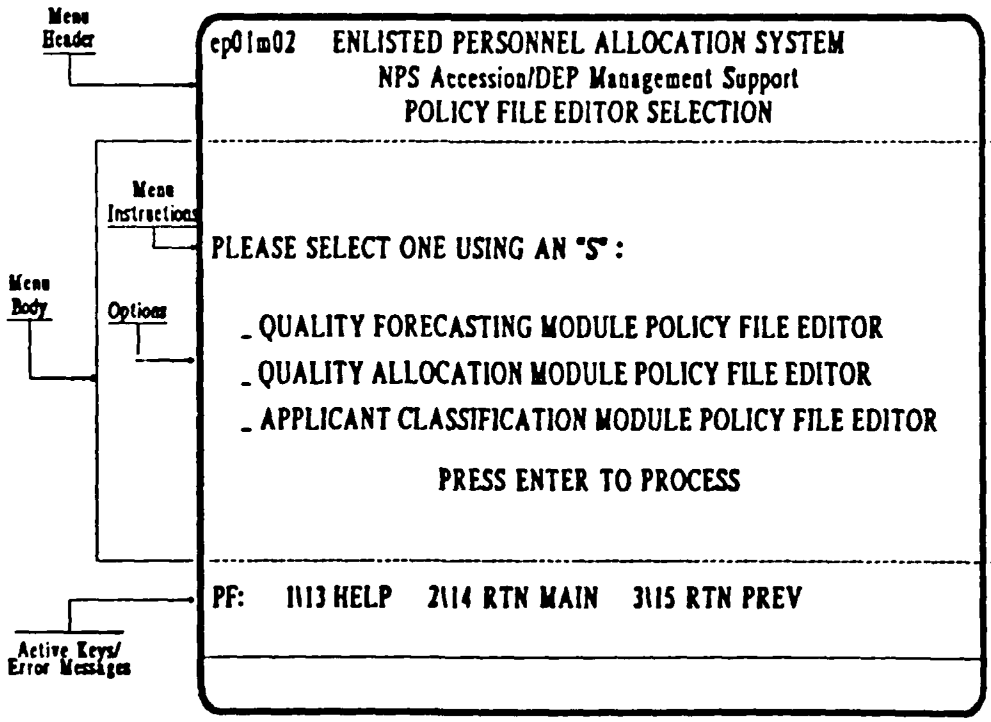
(2) HQDADSS/ISC-P standards were employed for selection panels. Thus, desired options were identified by type an "S" in front of the option. Special features, such as "hot Keying" an option were deleted; they did not exist within the HQDADSS/ ISC-P standards.

(3) Data entry edits became panel oriented instead of field oriented. The Wicat/NIH versions were able to monitor and edit data entry as it occurred. The ISC-P version did not recognize data entry until the entire panel had been completed and submitted.

(4) Special video effects, such as reverse video, highlighting, and blinking, were eliminated; HQDADSS/ISC-P standards do not allow for these features.

The CSP conversion demonstrated that EPAS' user interface would function within the operational environment and restrictions found on the hQDADSS/ ISC-P computer facilities. Performance, however, was extremely disappointing; routine editing activities required an exorbitant amount of

Figure C-17. ISC-P Selection Panel.



wall-clock time. Further research into existing capabilities, and implementation of newer releases of CSP, may improve performance to a more acceptable level.

Standardized Editors

The menu tree and panels provided the basic access to all data within EPAS. GRC developed editors to facilitate maintenance of these data. Editors provided the ability to easily alter any information within the system for policy analysis, as well as providing a means for on-line review of current or simulated values for any part of the system.

As with other parts of the user interface, GRC enforced standardization for all available editors, ensuring that EPAS provided for common user access to all parts of the system. The available editor options were maintained for each of the versions -- Wicat, NIH, and ISC-P -- of the user interface. These options were:

(1) List. Provided a listing of all current configurations for the data being addressed. This feature was particularly useful when generating multiple control files for alternative policy scenarios. The list option allowed the user to quickly review currently available alternatives.[15]

(2) Edit. Allowed update access to any of the data found within currently-defined configurations.

(3) Copy. Created a new configuration by copying an existing one and assigning a new name. This provided the user with the ability to quickly formulate new policy alternatives based on the characteristics of an existing policy. This option was particularly useful for performing analyses in which multiple variations to a baseline policy were being evaluated.

(4) Delete. Deleted any user-defined configuration. One configuration, the EPAS-generated default, was always available and could not be deleted.

(5) Review. Allowed read-only access to any data found within the currently-defined configurations.

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15 This option was explicit in the Wicat and NIH versions, i.e., the user had to specifically request the list option. The ISC-P version implemented an implicit list option, i.e., when a subsystem editor was requested, EPAS automatically listed all currently-defined configurations.

Provide Execution Control

Analyses clearly showed that EPAS has the capability of being a useful tool for the Army, capable of providing significant improvements in individual allocations. To be of practical benefit, however, EPAS must be usable as well as useful. The EPAS concept will not be practical if system's operation is so cumbersome or complex that Army analysts and managers are unable to operate the model.

Part of GRC's research, therefore, was to validate means for defining a user-friendly control environment. The following functional requirements were identified as necessary to support this objective:

(1) Support for any user-specified combinations of applicant policy, MOS requirements, school seat and training, etc. input data files.

(2) Support for any number of iterations, starting at any time point; further, the system should support rerunning iterations.

(3) Support for automatic, on-line submittal of batch (off-line) EPAS executions. These submittals should include any combination of EPAS modules, from individual submissions to full system.

(4) Support for programs to control and monitor batch EPAS executions.

On-Line Operations Control

A file interface, called the Run File, was developed to meet the first three of these requirements. The Run File provided an editable interface enabling users to specify and modify all execution-related files and parameters. It also provided the medium which the batch system used to report run status, temporary files being utilized, and other run-related information. The Run File editor provided the five basic editor functions -- list, edit, copy, delete, and review -- defined in the previous section. In addition, the Run File editor performed detailed error analyses to prevent infeasible execution requests, such as requesting the third iteration of a simulation before the first two have been executed.

Batch Operations Control

Batch job submittal procedures are highly dependent on the host computer system. In the Wicat system, the Pascal language provided utilities which gave direct access to the operating system. As a result, EPAS was coded to "fork," i.e., start execution of, batch jobs directly from within the executing on-line procedures.

The IBM systems at NIH and ISC-P, both operating under the MVS/XA operating system, did not provide this ability. Batch job submittal occurred upon termination of the on-line system. GRC developed procedures which, through file-based communications and dynamic error checking, generated and automatically submitted batch executions.

MVS/XA on-line procedures execute under the control of a Command List (CLIST) job command stream. Dynamic control was effected by modifying the PTS to generate return codes as a function of user-defined processing requests. The EPAS CLIST checked the return code to determine if any batch runs were to be scheduled. If so, the CLIST read a special interface file which specified the type of batch job (simulation, optimization, etc.) and the name of the controlling Run File. Based on this information, the CLIST edited a standard batch submittal Job Control Language (JCL) file, inserting the appropriate run file name and job card information. The edited file was then automatically submitted for batch execution.

A batch control program was developed for each of the batch operations. This program read the Run File name from the parameter (PARM) statement in the execution JCL. All other information regarding the execution of the system was contained within the specified Run File.

Provide Execution Status Monitoring

The final functional area defined for the system framework was the ability to monitor status of a batch execution. An execution status review module gave the user up-to-date feedback on current or previous batch jobs, including iteration information and exception reports.

The magnitude and complexity of EPAS made it highly desireable to allow the model to continue execution, even if errors were detected. Extensive error checking and error recovery procedures were encoded to provide this feature. Exception reports defined nonstandard conditions, both correctable and non-correctable, identified during the model's execution. On-line procedures provided the ability to monitor these exception reports.

TAB C-1
FY 86 SUPPLY GROUPS
BASED ON WARDS' MINIMUM VARIANCE METHOD

Male/HSG/AFQT Category I-II

Average Aptitude Area Composite Scores									%Mission
CL	CO	EL	FA	GM	MM	OF	SC	ST	
109	102	103	105	97	99	104	103	103	4.0
116	109	111	114	105	104	107	108	111	5.0
109	114	104	110	103	110	114	113	107	3.0
122	113	119	121	112	106	109	112	118	4.0
115	111	115	111	114	112	113	113	115	6.0
108	118	108	111	111	118	119	118	109	4.0
119	119	117	120	114	114	116	119	118	7.0
111	126	111	117	113	123	123	123	112	4.0
125	122	124	127	119	116	118	121	125	7.0
130	135	135	134	138	135	132	134	133	9.0
128	124	131	128	128	121	120	124	129	7.0
123	128	124	127	124	124	124	126	124	6.0
119	123	120	121	121	122	121	122	120	6.0
113	118	118	112	121	122	120	121	117	6.0
124	114	128	119	124	115	114	118	124	2.0
129	130	132	121	132	127	126	129	131	7.0
117	127	122	120	126	128	126	128	122	8.0
123	131	128	127	131	132	129	130	127	5.0

Male/HSG/AFQT Category IIIA

Average Aptitude Area Composite Scores									%Mission
CL	CO	EL	FA	GM	MM	OF	SC	ST	
100	95	94	97	89	93	98	95	95	7.0
109	102	102	109	94	95	98	99	101	5.0
103	109	99	107	98	105	107	106	100	10.0
117	126	124	122	129	125	120	125	123	4.0
115	115	118	118	116	112	110	114	116	10.0
103	98	103	98	102	101	102	101	102	7.0
109	121	115	113	120	122	119	120	115	16.0
111	105	111	110	106	102	103	105	110	7.0
101	110	102	101	106	111	112	111	104	10.0
106	108	112	102	116	113	111	112	112	8.0
105	116	106	110	109	115	115	114	108	17.0

TAB C-1 (continued)
FY 86 SUPPLY GROUPS
BASED ON WARDS' MINIMUM VARIANCE METHOD

Male/HSG/AFQT Category IIIB

Average Aptitude Area Composite Scores									%Mission
CL	CO	EL	FA	GM	MM	OF	SC	ST	
109	110	115	113	115	109	104	108	112	2.0
104	119	110	111	116	118	113	116	110	6.0
90	87	88	87	87	89	91	88	89	9.0
103	104	106	104	108	104	103	104	108	4.0
99	99	102	100	101	99	98	99	101	8.0
87	90	80	90	76	87	90	85	80	4.0
97	92	99	95	96	92	92	92	96	6.0
101	112	100	110	98	105	103	104	98	3.0
92	96	89	98	85	92	92	89	87	11.0
94	104	97	95	105	108	107	106	101	8.0
91	113	96	100	104	115	112	109	98	5.0
88	96	87	89	91	99	99	95	89	6.0
94	104	92	102	91	100	100	99	93	11.0
90	100	93	91	98	104	103	100	94	6.0
97	111	106	100	116	117	113	113	108	4.0
98	111	102	104	107	111	108	109	102	6.0

Male/HSG/AFQT Category IV

Average Aptitude Area Composite Scores									%Mission
CL	CO	EL	FA	GM	MM	OF	SC	ST	
89	105	95	97	102	106	101	101	95	29.0
86	89	85	80	83	88	87	84	83	34.0
86	97	88	92	81	97	95	93	89	37.0

Male/HSS/AFQT Category I-II

Average Aptitude Area Composite Scores									%Mission
CL	CO	EL	FA	GM	MM	OF	SC	ST	
118	118	119	119	117	116	117	118	119	65.0
127	128	130	129	130	127	125	128	130	21.0
111	107	106	109	101	103	108	107	107	16.0

TAB C-1 (continued)
FY 86 SUPPLY GROUPS
BASED ON WARDS' MINIMUM VARIANCE METHOD

Male/HSS/AFQT Category IIIA

Average Aptitude Area Composite Scores									%Mission
CL	CO	EL	FA	GM	MM	OF	SC	ST	
109	116	112	111	113	113	112	113	112	71.0
103	101	100	103	97	99	103	101	101	29.0

Male/HSS/AFQT Category IIIB

Average Aptitude Area Composite Scores									%Mission
CL	CO	EL	FA	GM	MM	OF	SC	ST	
92	92	90	92	88	92	93	90	91	30.0
98	106	102	102	105	106	105	105	103	70.0

Male/HSS/AFQT Category IV

Average Aptitude Area Composite Scores									%Mission
CL	CO	EL	FA	GM	MM	OF	SC	ST	
89	100	94	95	98	102	99	98	95	64.0
88	89	86	90	84	85	86	86	86	36.0

Male/NHS/AFQT Category I-II

Average Aptitude Area Composite Scores									%Mission
CL	CO	EL	FA	GM	MM	OF	SC	ST	
113	117	114	113	113	115	117	118	114	55.0
121	128	125	123	126	127	125	128	124	31.0
109	107	104	108	99	103	107	107	105	14.0

Male/NHS/AFQT Category IIIA

Average Aptitude Area Composite Scores									%Mission
CL	CO	EL	FA	GM	MM	OF	SC	ST	
99	96	93	96	88	94	98	96	93	9.0
102	107	101	103	101	106	108	108	102	40.0
105	114	108	107	110	114	116	115	109	28.0
109	119	115	112	120	120	117	120	115	23.0

TAB C-1 (continued)
FY 86 SUPPLY GROUPS
BASED ON WARDS' MINIMUM VARIANCE METHOD

Male/NHS/AFQT Category IIIB

Average Aptitude Area Composite Scores									%Mission
CL	CO	EL	FA	GM	MM	OF	SC	ST	
99	107	100	101	102	106	106	106	101	100.0

Male/NHS/AFQT Category IV

Average Aptitude Area Composite Scores									%Mission
CL	CO	EL	FA	GM	MM	OF	SC	ST	
86	95	91	90	95	98	96	93	90	100.0

Female/HSG/AFQT Category I-II

Average Aptitude Area Composite Scores									%Mission
CL	CO	EL	FA	GM	MM	OF	SC	ST	
112	106	105	111	98	99	105	105	106	32.0
125	121	124	126	118	115	117	119	124	31.0
117	113	113	117	107	106	111	111	114	29.0
108	96	98	102	89	90	98	96	99	8.0

Female/HSG/AFQT Category IIIA

Average Aptitude Area Composite Scores									%Mission
CL	CO	EL	FA	GM	MM	OF	SC	ST	
104	100	98	104	93	95	100	98	100	44.0
100	92	92	97	85	87	94	91	92	27.0
108	108	106	111	103	104	106	105	108	28.0

Female/HSG/AFQT Category IIIB

Average Aptitude Area Composite Scores									%Mission
CL	CO	EL	FA	GM	MM	OF	SC	ST	
93	87	89	92	84	82	89	85	89	39.0
94	97	89	99	85	91	94	90	91	39.0
100	101	99	105	96	97	98	96	100	22.0

TAB C-1 (continued)
FY 86 SUPPLY GROUPS
BASED ON WARDS' MINIMUM VARIANCE METHOD

Female/HSG/AFQT Category IV

Average Aptitude Area Composite Scores									%Mission
CL	CO	EL	FA	GM	MM	OF	SC	ST	
88	90	86	93	84	87	88	84	86	100.0

Female/HSS/AFQT Category I-II

Average Aptitude Area Composite Scores									%Mission
CL	CO	EL	FA	GM	MM	OF	SC	ST	
117	110	112	117	105	103	108	108	113	100.0

Female/HSS/AFQT Category IIIA

Average Aptitude Area Composite Scores									%Mission
CL	CO	EL	FA	GM	MM	OF	SC	ST	
105	100	100	105	95	95	100	98	102	100.0

Female/HSS/AFQT Category IIIB

Average Aptitude Area Composite Scores									%Mission
CL	CO	EL	FA	GM	MM	OF	SC	ST	
98	95	95	100	90	91	95	92	96	100.0

Female/HSS/AFQT Category IV

Average Aptitude Area Composite Scores									%Mission
CL	CO	EL	FA	GM	MM	OF	SC	ST	
93	89	90	93	86	87	89	86	89	100.0

TAB C-2
FY86 MOS CLUSTERS
BASED ON APTITUDE AREA COMPOSITES

CLUSTER #1

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M/F	HSG/NHS	I-IIIA	EL	29E	1	110	Communicat-Elect Radio Rep
				29F	1	110	Fixed COMSEC Equip Rep
				29J	1	110	Teletypewriter Eq Rep
				29V	1	110	Start Microwave Sys Rep
				34H	1	110	ADSME Rep
				35C	1	110	Automatic Test Eq Rep
				36L	6	110	Electronic Switching Rep

CLUSTER #2

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M/F	HSG/NHS	I-IIIA	EL	26C	1	115	Weapons Support Radar Rep
				29C	1	115	Field COMSEC Eq Rep

CLUSTER #3

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M/F	HSG/NHS	I-IIIA	EL	26Y	1	120	SATCOM Equipment Repairer
				35H	1	120	Calibration Specialist

CLUSTER #4

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M/F	HSG/NHS	I-IIIB	EL	93D	1	105	Air Traffic Systems Rep
				24C	1	110	Improved Hawk Firing Sec Mec
				24G	1	110	Improved Hawk Informatio Mec
				24U	1	110	Hercules Electronic Mech
				34F	1	110	DSTE Repairer
				34T	1	110	Tactical Computer Sys Rep

TAB C-2 (continued)
FY86 MOS CLUSTERS
BASED ON APTITUDE AREA COMPOSITES

CLUSTER #5

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M/F	HSG/NHS	I-IIIB	SC	96H	2	95	Aerial Sensor Spec
				05D	2	100	EW/SIGINT Emitter Identif

CLUSTER #6

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M/F	HSG/NHS	I-IIIB	ST	05H	2	95	EW/SIGINT Morse Intercep
				05K	2	95	EW/SIGINT Non-Morse Intercep
				96D	2	95	Image Interpreter
				97G	2	95	Signal Security Specialist
				98G	2	95	EW/SIGINT Voice Intercep

CLUSTER #7

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M/F	HSG/NHS	I-IIIB	ST	91P	3	100	X-Ray Specialist
				91R	3	100	Veterinary Food Insp

CLUSTER #8

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M/F	HSG/NHS	I-IIIB	ST	96F	2	105	Psycological Ops Specialist
				98C	2	105	EW/SIGINT Analyst
				98J	2	105	NonComm Interceptor
				71Q	2	105	Journalist
				71R	5	105	Broadcast Journalist

CLUSTER #9

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M/F	HSG/NHS	I-IIIB	ST	33P	1	115	EW/I Strat Rec Subsys Rep
				33Q	1	115	EW/I Process Storage Equ
				33R	1	115	EW/I Intercept Avn Sys Rep
				33T	1	115	EW/I TAC Sys Rep

TAB C-2 (continued)
FY86 MOS CLUSTERS
BASED ON APTITUDE AREA COMPOSITES

CLUSTER #10

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M/F	HSG/NHS	I-IV	CL	76X	5	85	Subsistence Supplier
				76P	5	90	Material Control/Accting
				76V	5	90	Mat Storage/Handling
				76W	8	90	Petro Supply Spec

CLUSTER #11

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M/F	HSG/NHS	I-IV	CL	71G	3	95	Patient Admin Spec
				76J	3	95	Med Supply Spec
				71L	5	95	Administrative Spec
				71M	5	95	Chapel Activities Spec
				73C	5	95	Finance Spec
				75B	5	95	Personnel Admin Spec
				75C	5	95	Personnel Mgmt Spec
				75D	5	95	Personnel Records Spec
				75E	5	95	Personnel Actions
				76C	5	95	Equipment Rec/Parts Spec
				76Y	5	95	Unit Supply Spec
				71N	5	100	Flight Oper Spec

CLUSTER #12

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M/F	HSG.NHS	I-IV	EL	36C	6	90	Wire Systems Installer
				21G	1	95	Pershing Electronic Mat Sp
				24L	1	95	Improved Hawk Launc/Mat Rep
				26H	1	95	Air Defense Radar Repairer
				27B	1	95	Land Combat Support Syst
				27E	1	95	TOW/Dragon Repairer
				27G	1	95	Chaparral/Redeye Repairer
				31V	1	95	Tactical Communications
				35E	1	95	Special Electronic Devic Rep
				35K	1	95	Avionic Mechanic
				41E	1	95	A-V Equipment Repair
				45G	1	95	Control Systems Rep
				26T	5	95	Radio/Television Systems
				27L	6	95	Lance System Repairer
				27M	6	95	MLRS Repairer

TAB C-2 (continued)
FY86 MOS CLUSTERS
BASED ON APTITUDE AREA COMPOSITES

CLUSTER #13

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M/F	HSG/NHS	I-IV	EL	26Q	2	95	Tactical Satellite/Micro Op
				31M	2	95	Multichannel Communicati Op
				31N	2	95	Tactical Circuit Controller
				93F	2	95	Fld Artillery Meteo Crew

CLUSTER #14

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M/F	HSG/NHS	I-IV	EL	27F	1	100	Vulcan Repairer
				29M	1	100	Tact Satel/Microwave Rep
				35L	1	100	Avionic Communications Eq Re
				35M	1	100	Avionic Navigation and FL Re
				35R	1	100	Avionic Special Equipment Re
				36M	6	100	Wire Systems Operator
				55G	6	100	Nuclear Weap Maint Spec

CLUSTER #15

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M/F	HSG/NHS	I-IV	EL	24E	1	105	Improved Hawk Firing Con Mec
				32D	1	105	Station Technical Contro
				46N	6	105	Pershing Elec/Mech Rep

CLUSTER #16

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M/F	HSG/NHS	I-IV	EL	21L	1	110	Pershing Electronics Rep
				24H	1	110	Improved Hawk Fire Contr Re
				24J	1	110	Improved Hawk Pulse Radar Re
				24K	1	110	Improved Hawk Cont Wave Rep
				26E	1	110	Aerial Surveillance Sens
				26F	1	110	Aerial Photoactive Senso Rep
				26K	1	110	Aerial El Warn/Def Eq Rep
				27N	1	110	Forward Area Alerting Rad Re
				34L	1	110	Field Art Dig Systems Rep
				34Y	1	110	Field Artillery Computer
				39B	2	110	Automatic Test Equip Op
				35G	3	110	Biomedical Equipment Spe

TAB C-2 (continued)
FY86 MOS CLUSTERS
BASED ON APTITUDE AREA COMPOSITES

CLUSTER #17

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M/F	HSG/NHS	I-IV	GM	43M	7	85	Fabric Repair Spec
				57E	8	85	Laundry/Bath Spec

CLUSTER #18

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M/F	HSG/NHS	I-IV	GM	51M	4	90	Firefighter
				57F	4	90	Grave Registration Spec
				43E	8	90	Parachute Rigger
				57W	8	90	Cargo Specialist

CLUSTER #19

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M/F	HSG/NHS	I-IV	GM	41J	6	90	Office Machine Repairer
				45B	6	90	Small Arms Repairer
				41C	6	95	Fire Control Ins Rep
				55B	6	95	Ammo Specialist
				68M	6	95	Weapons Sys Rep

CLUSTER #20

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M/F	HSG/NHS	I-IV	GM	44B	7	90	Metal Worker
				51B	7	90	Carpenter/Mason
				51C	7	90	Structures Spec
				51N	7	90	Water Treatment Spec
				62E	7	90	Heavy Eq Operator
				62F	7	90	Lift/Load Eq Operator
				62H	7	90	Concrete Eq Operator
				62J	7	90	General Construction
				62G	7	95	Quarrying Specialist

TAB C-2 (continued)
FY86 MOS CLUSTERS
BASED ON APTITUDE AREA COMPOSITES

CLUSTER #21

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M/F	HSG/NHS	I-IV	GM	42C	3	100	Orthotic Specialist
				42D	3	100	Dental Lab Spec
				42E	3	100	Optical Lab Spec

CLUSTER #22

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M/F	HSG/NHS	I-IV	GM	51G	4	100	Materials Quality Spec
				41B	6	100	Topographic Ins Repr
				45K	6	100	Tank Turret Repairer
				45L	6	100	Artillery Repairer
				52C	6	100	Utilities Eq Rep
				52D	6	100	Generator Eq Reor
				52F	6	100	Turbine Eng Gen Rep
				44E	7	100	Machinist

CLUSTER #23

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M/F	HSG/NHS	I-IV	GM	55D	4	105	Expl Ord Disposal

CLUSTER #24

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M/F	HSG/NHS	I-IV	MM	62B	6	90	Construction Eq Rep
				63B	6	90	Light Wheel Mechanic
				63H	6	90	Track Vehicle Repair
				63J	6	90	Quartermaster Repr
				63W	6	90	Wheel Veh. Repair

CLUSTER #25

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M/F	HSG/NHS	I-IV	MM	61B	0	100	Watercraft Operator

TAB C-2 (continued)
FY86 MOS CLUSTERS
BASED ON APTITUDE AREA COMPOSITES

CLUSTER #26

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M/F	HSG/NHS	I-IV	MM	68J	6	100	Aircraft Fire Control
				24T	6	105	Patriot System Mechanic
				61C	6	105	Watercraft Engineer
				63G	6	105	Fuel Systems Repair
				63S	6	105	Heavy Wheel Mechanic
				63Y	6	105	Track Veh Mechanic
				67G	6	105	Airplane Repair
				67H	6	105	Observ Plane Repair
				67N	6	105	Util Chopper Repair
				67R	6	105	AH-64 Attack Helicop Rep
				67S	6	105	Scout Helicopter Rep
				67T	6	105	Transport Chopper Repair
				67U	6	105	Medium Chopper Repair
				67Y	6	105	Attack Copter Rep
				68B	6	105	Aircraft P-Plant Rep
				68D	6	105	Aircraft P-Train Rep
				68F	6	105	Aircraft Electrician
				68G	6	105	Aircraft Struct Rep
				68H	6	105	Pneudraulics Repair

CLUSTER #27

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M/F	HSG/NHS	I-IV	OF	64C	8	90	Motor Transport Opr
				94B	8	90	Food Service Spec

CLUSTER #28

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M/F	HSG/NHS	I-IV	OF	15D	0	100	Lance Missile Crew Membe
				15E	0	100	Pershing Missile Crew Mem
				25L	1	100	AN/TSG 73 Air Def Art Op/Rep
				16H	2	100	Ada Operations & Intelli
				16E	4	100	Hawk Fire Control Crew Mem

TAB C-2 (continued)
FY86 MOS CLUSTERS
BASED ON APTITUDE AREA COMPOSITES

CLUSTER #29

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M/F	HSG/NHS	I-IV	OF	94F	3	100	Hospital Food Srvc

CLUSTER #30

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M/F	HSG/NHS	I-IV	SC	31K	2	90	Combat Signaler
				72E	2	90	Telecom Ctr Oper
				72G	2	90	Auto Data Telectr Opr

CLUSTER #31

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
31C	HSG/NHS	I-IV	SC	31C	2	100	Single Channel Radio Ope

CLUSTER #32

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M/F	HSG/NHS	I-IV	ST	81C	4	85	Cartographer
				84C	4	85	Motion Picture Spec
				83E	7	85	Photo Layout Spec
				83F	7	85	Photolithographer

TAB C-2 (continued)
FY86 MOS CLUSTERS
BASED ON APTITUDE AREA COMPOSITES

CLUSTER #33

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M/F	HSG/NHS	I-IV	ST	91A	3	95	Medical Specialist
				91D	3	95	Operating Room Spec
				91E	3	95	Dental Specialist
				91F	3	95	Psychiatric Specialist
				91H	3	95	Orthopedic Specialist
				91J	3	95	Physical Therapy Spec
				91L	3	95	Occuaptional Therapy Spe
				91N	3	95	Cardiac Specialist
				91Q	3	95	Pharmacy Specialist
				91S	3	95	Envir Health Spec
				91T	3	95	Animal Care Spec
				91U	3	95	ENT Specialist
				91Y	3	95	Eye Specialist
				92B	3	95	Medical Lab Spec

CLUSTER #34

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M/F	HSG/NHS	I-IV	ST	54E	4	95	NBC Specialist
				81B	4	95	Tech Drafting Spec
				82B	4	95	Construction Surveyor
				82D	4	95	Topographic Surveyor
				84B	4	95	Still Photo Spec
				92C	4	95	Petro Lab Specialist
				93P	5	95	Flight Oper Coord)

CLUSTER #35

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M/F	HSG/NHS	I-IV	ST	93H	2	100	ATC Tower Operator
				93J	2	100	ATC Radar Controller

TAB C-2 (continued)
FY86 MOS CLUSTERS
BASED ON APTITUDE AREA COMPOSITES

CLUSTER #36

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M/F	HSG/NHS	I-IV	ST	74D	5	100	Computer/Machine Opr
				74F	5	100	Programmer/Analyst
				03C	5	105	Physical Activities Spec
				73D	5	105	Accounting Specialist

CLUSTER #37

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M/F	HSG/NHS	I-IV	ST	95B	8	100	Military Police

CLUSTER #38

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M/F	HSG	I-IIIB	ST	97E	2	95	Interrogator

CLUSTER #39

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M/F	HSG	I-IIIB	ST	96B	2	105	Intelligence Analyst
				91G	3	105	Behavioral Science Spec

CLUSTER #40

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M/F	HSG	I-IV	CL	75F	5	105	Pers Infosys Mgmt Spec
				71D	5	110	Legal Clerk

CLUSTER #41

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M/F	HSG	I-IV	EL	29N	6	100	Telephone Central Off Rep

TAB C-2 (continued)
FY86 MOS CLUSTERS
BASED ON APTITUDE AREA COMPOSITES

CLUSTER #42

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M/F	HSG	I-IV	ST	81E	4	95	Illustrator
				84F	4	95	Audio/TV Specialist

CLUSTER #43

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M/F	HSG	I-IV	ST	81Q	4	100	Terrain Analyst
				55R	5	100	Ammo Stock Control & Acc Sp
				00J	8	110	Club Manager

CLUSTER #44

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M	HSG/NHS	I-IIIB	EL	96R	2	85	Ground Surveillance Rada

CLUSTER #45

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M	HSG/NHS	I-IIIB	EL	24M	1	110	Vulcan System Mechanic
				24N	1	110	Chaparral System Mechanic

CLUSTER #46

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M	HSG/NHS	I-IV	CO	11X	0	90	Infantry (Active Army)
				12B	0	90	Combat Engineer Airborne
				12C	0	90	Bridge Crewman
				12F	0	90	Engineer Tracked Vehicle
				19E	0	90	M48-M60 Armor Crewman
				19K	0	90	Armor Specialist
				19D	2	90	Cavalry Scout
				12E	0	100	Atomic Demolition Munitions

TAB C-2 (continued)
FY86 MOS CLUSTERS
BASED ON APTITUDE AREA COMPOSITES

CLUSTER #47

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M	HSG/NHS	I-IV	EL	51R	7	95	Interior Electrician
				52G	7	95	Transmission/Distrib Spec

CLUSTER #48

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M	HSG/NHS	I-IV	FA	13B	0	85	Cannon Crewman AA

CLUSTER #49

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M	HSG/NHS	I-IV	FA	15J	0	100	MLRS/Lance Operation/Fir
				13F	2	100	Fire Support Specialist

CLUSTER #50

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M	HSG/NHS	I-IV	GM	51K	7	90	Plumber

CLUSTER #51

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M	HSG/NHS	I-IV	GM	45T	6	95	M2/Bradley FV Mech
				54C	0	100	Smoke Operator
				45D	6	100	Fieldart Turret Mech

CLUSTER #52

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M	HSG/NHS	I-IV	MM	45E	6	100	Tank Turret Mechanic
				45N	6	100	M60A1 Tank Tur Mech
				63E	6	100	Abrams Tank Mech
				63N	6	100	M6 Tank Sys Mech

TAB C-2 (continued)
FY86 MOS CLUSTERS
BASED ON APTITUDE AREA COMPOSITES

CLUSTER #53

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M	HSG/NHS	I-IV	MM	63D	6	105	Field Art Sys Mech
				63T	6	105	ITV/IFV/CFV Mech

CLUSTER #54

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M	HSG/NHS	I-IV	OF	16S	0	90	MANPADS Crewman

CLUSTER #55

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M	HSG/NHS	I-IV	OF	16P	0	100	ADA Short Range Missile
				16R	0	100	ADA Short Range Gunnery
				16X	0	100	Air Crewmember
				16J	2	100	Defense Acquisition Rada

CLUSTER #56

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M	HSG/NHS	I-IV	OF	13M	0	105	Multiple Launch Rocket S

CLUSTER #57

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M	HSG/NHS	I-IV	SC	13R	2	100	Field Artillery FIREFIND Op
				17B	2	100	Field Artillery Radar Crew

CLUSTER #58

GNDR	EDUCLVL	AFQT CAT.	AA	MOS	DoD Gp.	SCORE	JOB TITLE
M	HSG/NHS	I-IV	ST	13C	2	95	TACFIRE Operations Speci
				13E	2	95	Cannon Fire Direction Sp
				82C	4	95	Fld Artillery Surveyor

TAB C-3
EXAMPLE OF REDUCED COST PROCESSING

This Tab presents an empirical example of the processing performed by EPAS to generate its optimal guidance from the single, optimal solution generated by the optimization algorithm. In the steps which follow, the following column definitions apply:

NBR: A simple ordering number.

SUPPLY GROUP: Each Supply Group will have a separate list generated by the network. For simplicity, only one is shown in this example.

MOS CLUSTER/START DATE: Each legal combination of an MOS Cluster and start date will have its solution shown.

FLOW: The number of applicants from the Supply Group which were used in the optimal solution. Only combinations which were part of the optimal solution will have flow. In the example shown above, only row numbers one and two were part of the optimal solution.

COST: This is the cost (metric) of the flowing one person from the Supply Group into the MOS Cluster/Start Date. The optimization uses the product of this value and the flow to determine the optimal solution.

REDUCED COST: This is the "$z_j - c_j$" value. Optimal flows (rows one and two) have a reduced cost of zero. Alternate optimal solution, such as row three, have a reduced cost of zero with no associated flow. In other words, flow could be redirected to this combination without adversely affecting the optimal cost. Non-optimal solutions (rows four and five) have zero flow and non-zero reduced costs.

TAB C-3 (continued)
EXAMPLE OF REDUCED COST PROCESSING

STEP 1: GENERATE OPTIMAL SOLUTION:

The optimization algorithm, whether network or LP, generates an optimal solution at the Supply Group/MOS Cluster/Start Date level of detail. The standard reports produced by the algorithm will have information such as depicted in the table, below:

NBR	SUPPLY GROUP	MOS CLUSTER	START DATE	FLOW	COST	REDUCED COST
1	10	C01	8603	100	250	0
2		C03	8602	50	100	0
3		C02	8602	0	250	0
4		C02	8605	0	250	15
5		C03	8604	0	100	15

STEP 2: SORT OPTIMAL SOLUTION:

The optimal solution is sorted in ascending reduced cost order, with ties broken by DEP length. In this example, rows 1 and 2, and rows 4 and 5, have been flipped. Note that row 3, was not changed even though it has a reduced cost of zero and a start date of 8602. Row three is an alternate optimal solution and, therefore, sorts after all optimal solutions regardless of the date. [The start date would be used to break ties among alternate optimal solutions if more than one were on the list.]

NBR	SUPPLY GROUP	MOS CLUSTER	START DATE	FLOW	COST	REDUCED COST
2	10	C03	8602	50	100	0
1		C01	8603	100	250	0
3		C02	8602	0	250	0
5		C03	8604	0	100	15
4		C02	8605	0	250	15

TAB C-3 (continued)
EXAMPLE OF REDUCED COST PROCESSING

STEP 3: COMPUTE SCORES:

The reduced costs in the sorted list are now modified based on the range of reduced costs in the possible solution. In addition, the top recommendation on the list is adjusted to ensure a value of 1000. Note that, in case of equal reduced costs, the algorithm forces different values. The results, however, maintain, the ordering associated with the reduced costs and DEP lengths.

NBR	SUPPLY GROUP	MOS CLUSTER	START DATE	FLOW	COST	SCORE
2	10	C03	8602	50	100	1000
1		C01	8603	100	250	995
3		C02	8602	0	250	950
5		C03	8604	0	100	800
4		C02	8605	0	250	795

STEP 4: EXPAND THE MOS LIST:

The individual MOS Clusters are now expanded into their component MOS. Each MOS retains the score of its parent MOS Cluster. The flow and cost columns are deleted as they are not used by the detailed assignment routines.

NBR	SUPPLY GROUP	MOS	START DATE	SCORE
1	10	26Y	8602	1000
2		35H	8602	1000
3		26C	8603	995
4		29S	8603	995
5		26C	8602	950
6		29S	8602	950
7		26Y	8604	800
8		35H	8604	800
9		26C	8605	795
10		29S	8605	795

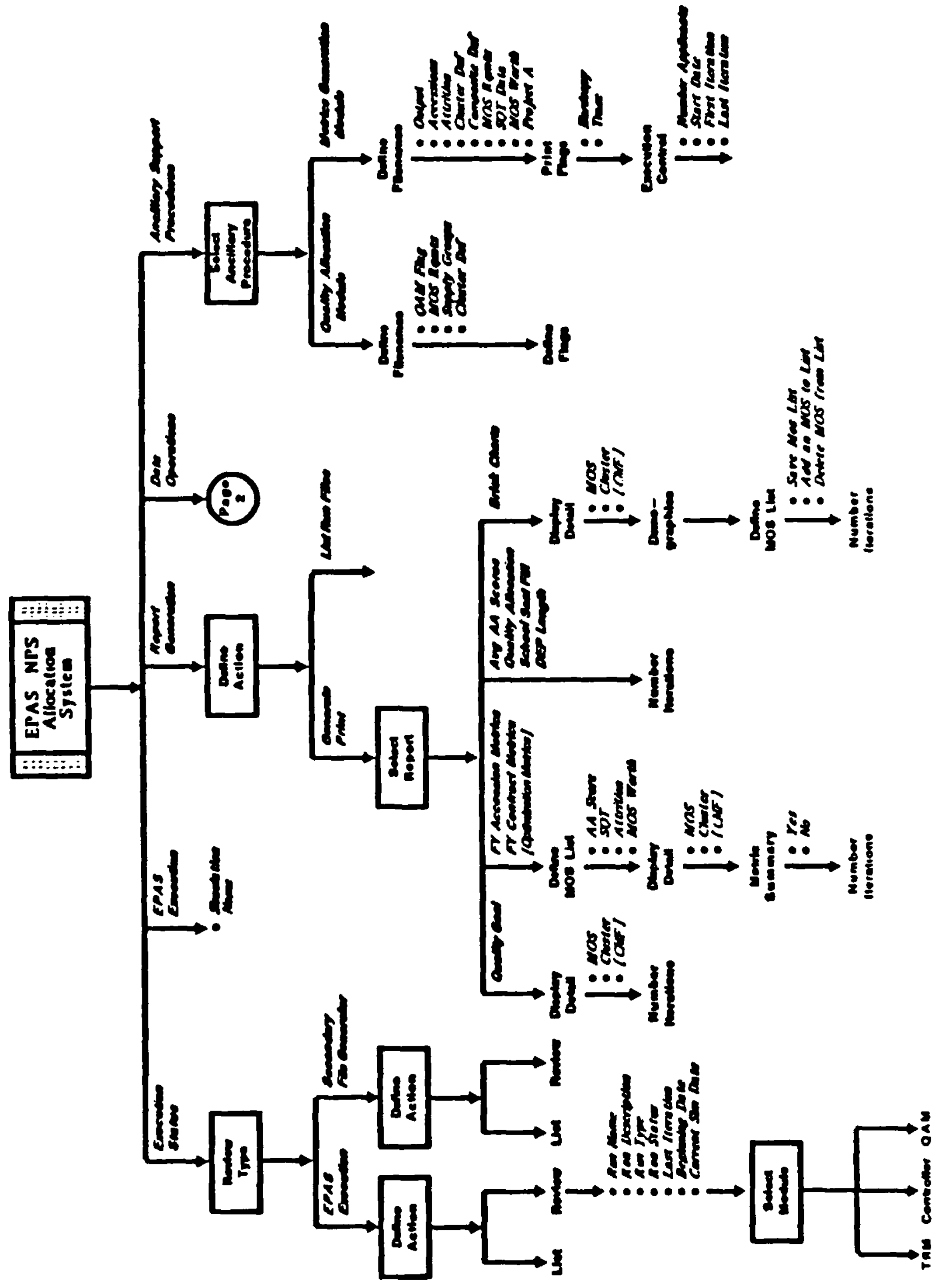
TAB C-3 (continued)
EXAMPLE OF REDUCED COST PROCESSING

STEP 5: EVALUATE CRITICALITY:

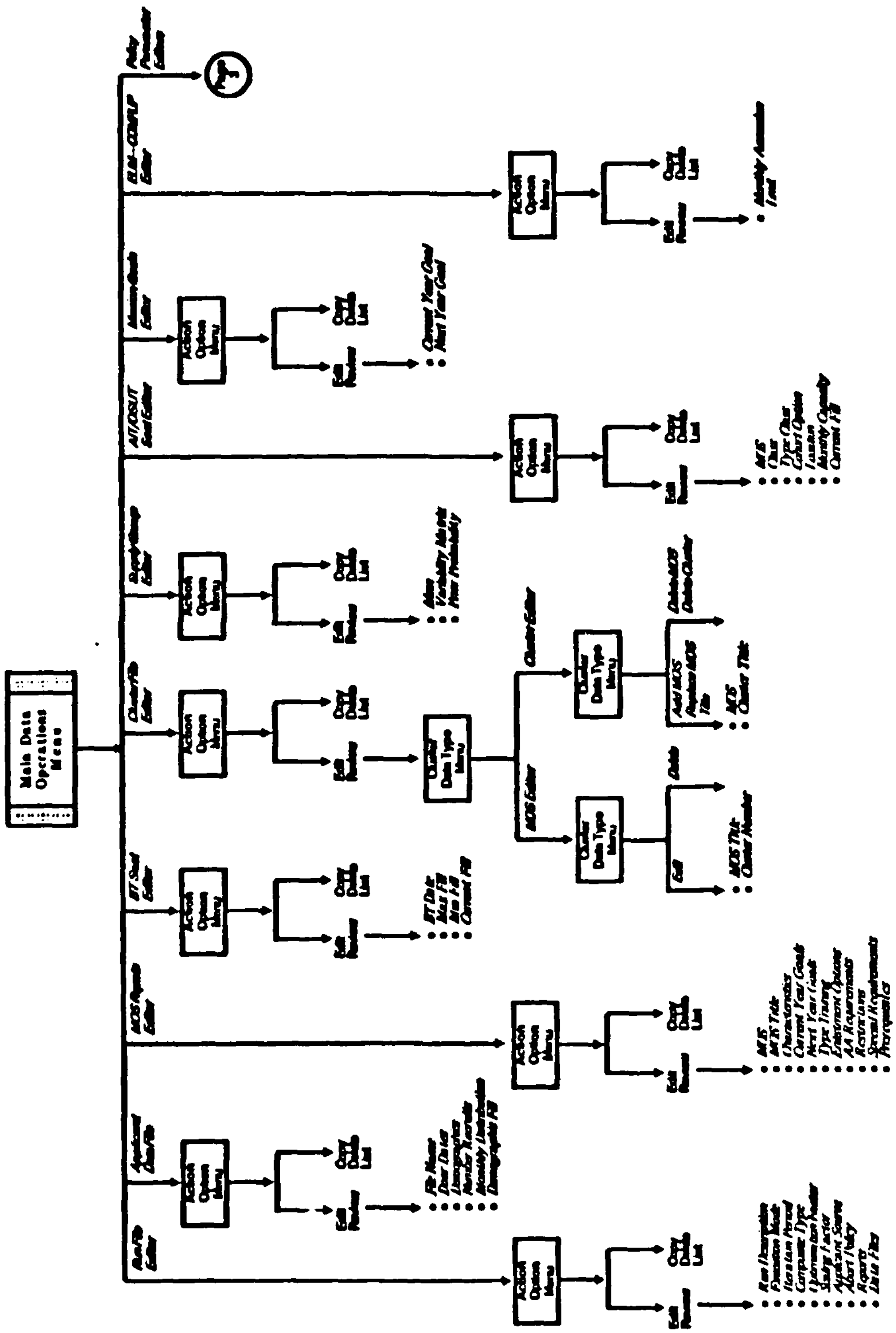
The final step is to examine each MOS/Start Date for criticality, i.e., has critical fill information been masked because of the clustering routines. If such MOS are found, heuristic algorithms recompute their score based on the severity of the problem. The MOS list is then resorted. The resulting lists, by Supply Group, of MOS, start dates, and scores are then written to a file for subsequent use by the detailed assignment routines.

NBR	SUPPLY GROUP	MOS	START DATE	SCORE
1	10	35H	8602	1000
2		26Y	8602	1000
3		35H	8604	999
4		26C	8603	995
5		29S	8603	995
6		26C	8602	950
7		29S	8602	950
8		26Y	8604	800
9		26C	8605	795
10		29S	8605	795

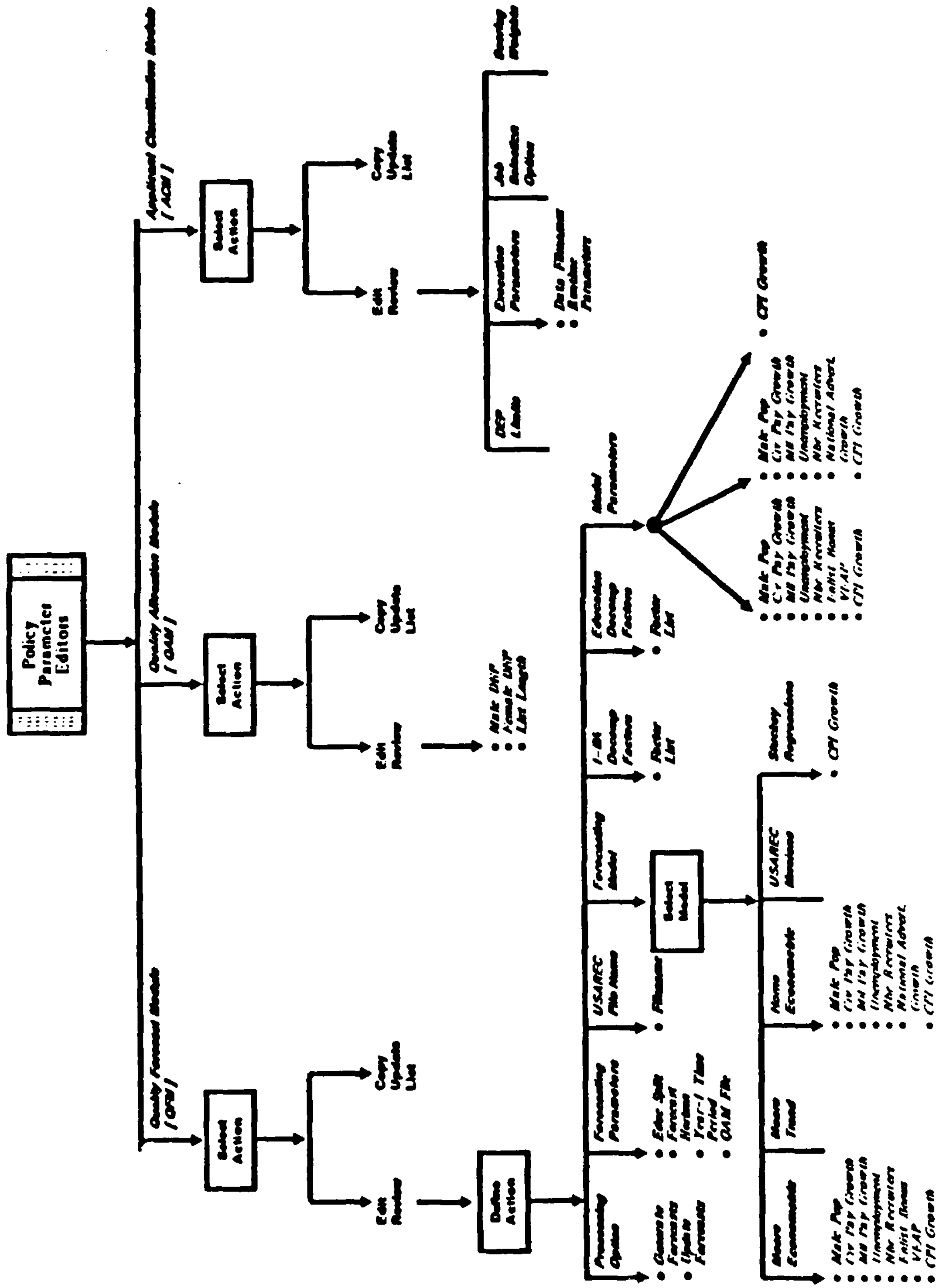
TAB C-4
EPAS TREE-STRUCTURED ACCESS



TAB C-4 (continued)
EPAS TREE-STRUCTURED ACCESS



TAB C-4 (continued)
EPAS TREE-STRUCTURED ACCESS



APPENDIX D

FUNCTIONAL DESCRIPTION OF EPAS

APPENDIX D
FUNCTIONAL DESCRIPTION OF EPAS

The analyses which led to the current version of EPAS were documented in the main body of this report and in Appendix C. This appendix provides a functional description of the operational prototype of EPAS. While reviewing this appendix, the reader needs to keep in mind that EPAS was primarily a research effort. The system resulting from this contract and described herein was designed with this orientation in mind. Much of the prototype system described in this appendix, particularly the EPAS core modules, will be applicable in a fully operational system. Other aspects, however -- notably the Process Test System (PTS), interfaces (both data and user-centered), and output requirements -- will require redefinition in accordance with operationally-oriented functional requirements as opposed to research-oriented ones.

This appendix documents the EPAS implementation as of December 1989. This version of EPAS, the operational prototype, was implemented on the Army's Information Systems Command -- Pentagon (ISC-P) computer facility. At the time of this report, ISC-P was an IBM computer system, using a MVS/XA operating system. All program coding was performed in PL/1, excepting the user interface panels and the optimization algorithms. User interface panels were written using IBM's Cross System Product (CSP), Release 3.2.

Two proprietary optimization algorithms were employed by EPAS. One, a network solution algorithm, ARCNET, is a proprietary software package developed by Analysis, Research Corporation, Inc. of Austin, Texas. The other, Whizard, is a proprietary linear programming algorithm developed by Ketron, Inc. of Arlington, VA.

For the convenience of the reader, the procedures documented in this appendix are presented detailed in the same order as in other sections of the final report. Contents of this Appendix are:

ESTABLISH SYSTEM FRAMEWORK
- PTS Standardization
- Provide Execution Control

REPORT RESULTS
- Report Metrics
- Report Procedures
- Report Assignments
- Graphics

SAMPLE EPAS REPORTS

FORECAST APPLICANTS/CONTRACTEES

This section documents the functional description for the generation of applicant/contractee forecasts. It contains three main subsections:

(1) The forecasting model.
(2) The Supply Group methodology.
(3) The user interface.

The Forecasting Model

As discussed in Appendix C, EPAS evaluated a number of forecasting techniques for the model. Recapping, these techniques were:

(1) Dale-Gilroy (ARI) econometric model.
(2) Horne (ARI) econometric model.
(3) GRC trend model.
(4) GRC econometric model.
(5) USAREC mission statements.

Analyses indicated that the first four models required extensive, exogenous data not readily available. Additionally, the failed to project all requisite demographic groups.

The fifth technique, USAREC mission statements, on the other hand was readily available and provided acceptable forecasts for all demographic groups. Accordingly, the operational prototype implemented only the USAREC model. Programming "hooks" were left in place, however, to facilitate installation of the other technique, or of new forecasting techniques were they identified by other research.

The EPAS forecasting routines first distributed the annual mission into Supply Groups and Recruit Station Months based on historical trends. The system then monitored actual contracts and compared them to the initial forecast. The forecasts were updated as variations from the anticipated arrivals occurred, ensuring that the annual mission statement remains constant.

Supply Group Methodology

The subject population was deterministically divided into subpopulations based on fixed demographics. This initial division enabled the models to deal with demographically-based Congressional and Army policies and guidance, such as the exclusion of females from skills with combat requirements.

The subpopulations were further subdivided into differentiable clusters based on the nine ASVAB Aptitude Area Composite Scores. The standard technique for generating Supply Groups combined the nearest centroid sorting and Ward's minimum variance techniques. This approach dealt well with the high intercorrelations found among the composite scores and resulted in clearly differentiable clusters within the demographic subpopulations.

A more detailed description of the analysis involved in generating the Supply Groups, along with the current formulations based on the FY86 population, may be found in Appendix C. EPAS uses the SAS procedure FASTCLUS as its clustering algorithm.

Provide User Interface

An important part of the EPAS design was to provide the means whereby Army managers and analysts could test alternative methodologies, e.g. forecasting models and Supply Groups. To satisfy this requirement, a file interface called the Quality Forecasting Module (QFM) Policy File was developed. The contents of this file are shown in Table D-1.

Table D-1. QFM Policy File Record Structure.

NAME	TYPE	SIZE	DESCRIPTION
FNAME	CHAR	7	Unique name assigned to a QFM policy file
MISGOAL(10)	CHAR	11	USAREC mission statements, one per forecast year.
SPLITFLAG	INT	2	Flag indicating if high school seniors should be forecast.
MOPT	INT	2	Flag denoting whether forecasts should be done monthly or quarterly.
MODEL	INT	2	Coded value indicating which forecasting model is to be used.
FFLAG	INT	2	Flag indicating whether the QAM input file should be created
MPARM(6,8)	FLOAT	4	Parameter values indicating whether the QAM input file should be created.
MAXYRS	INT	2	Number of years to forecast
MAINOPT	INT	2	Policy analysis mode flag, i.e., to generated or update forecasts
SPLIT(7)	FLOAT	4	Male and female, AFQT Categories I-IIIA quartile split factors
EDSPLIT	FLOAT	4	Monthly high school graduate/high school senior split factors

This file contained the parameters required by the forecasting models. (Supply Group specifications and parameters were defined in another file interface, the Run file, defined later in this appendix). An editor provided the user interface. The editor's functions included:

(1) Creation of a new QFM policy file from a current QFM policy file or from a standard policy file template.

(2) Modification of the parameters of a policy file.

(3) Review of the current parameter settings for a policy file.

(4) Deletion of a policy file.

(5) Listing of all policy files.

The information contained within the QFM Policy File can be classified into four categories:

(1) Execution-related Parameters. These included the policy analysis mode, i.e. whether forecasts should be generated or updated, and the specification of whether the generation of an input file for the quality allocation module (QAM) was needed. The QAM input file wasn't necessary when the forecasting model was being tested.

(2) File and Record Name Parameters. This included the specification of the files containing the USAREC mission goals.

(3) Forecasting Parameters. These included the specification of the forecasting model, number of years to forecast, whether seniors should be forecasted, the time increment to forecast (quarterly or monthly), and the specification of values for the independent variables e.g. the military and civilian pay differential.

(4) Supply-related Parameters. These included the percentages for splitting the AFQT Category I-IIIA into its two quartiles, I-II and IIIA, and for splitting the high school graduate category into graduates and seniors by calendar month. This provided the user control over the supply characteristics. There are QFM policy file templates provided which already have this information entered.

DETERMINE/PROJECT TRAINING AND MOS REQUIREMENTS

This section documents the implementation of EPAS' MOS requirements capabilities. It contains three main subsections:

(1) MOS Clustering Considerations
(2) The Training Requirements Module.
(3) Quality Allocation Module Cluster File

MOS Clustering Considerations

The primary goal in the generation of MOS Clusters was the preservation of characteristics necessary to support the assignment process. An additional goal was that the MOS within a clusters should be functionally alike. To support these goals, MOS were deterministically clustered based on:

- Gender -- male, female
- Education Requirements -- high school only, other
- Quality Goals -- AFQT I-IIIA only, AFQT I-IIIB only, other
- DoD Occupational Categories
- Minimum ASVAB Aptitude Area Composite Score

A discussion of the analysis leading to these clustering factors, the specific methodology employed, and a listing of the MOS Clusters formed based on the FY86 MOS may be found in Appendix C.

The Training Requirements Module

The Training Requirements Module (TRM) performed all actions necessary to generate summary class seat information for the optimization routines. (The detailed assignment routines access the class file directly). The TRM had two primary activities:

(1) Exception checking
(2) Generating current class fill information

Exception Checking

After each iteration, the model checked its status to see if any exceptions had occurred. If an exception occurred, an attempt was made to take corrective action and continue the simulation execution. If unable to continue, the TRM returned control to the Process Test System (PTS) with the information describing the uncorrectable error.

The Exception Report contained information on missing data, the under/over filling of class seats for individual MOS, etc. This provided information to the analyst about the status of the MOS Training Seat fill. Examples of the exception reports messages generated by the Training Requirements Module can be seen in Table D-2.

Table D-2. TRM Exception Reports.

(1)	AFQT Category IV bounds exceeded for MOS: XXX.
(2)	Annual requirement cannot be met for MOS: XXX.
(3)	Annual requirement for MOS: XXX has been overfilled.
(4)	Annual requirement for MOS: XXX has been overfilled in FY2.
(5)	Cannot meet annual high quality requirement for MOS: XXX.
(6)	Error finding MOS: XXX for fiscal year YYYY in MOS Requirements File.
(7)	Error finding MOS: XXX for fiscal year YYYY in School Seat File.
(8)	The Actuals have exceeded the Optimal Goals in month MM.

where: MM ::= Month number
XXX ::= MOS name
YYYY ::= Year

Generating Current Class Fill Information

The Training Requirements Module (TRM) generated the MOS training information at the cluster level of detail as required by the QAM. Two files contained the basic data necessary to perform the TRM functions: the School Seat and MOS Information Files.

School Seat File. The record structure for the School Seat File is shown in Table D-3. This file contained data for classes, summed by month, for every MOS. The monthly totals were sufficient for the needs of EPAS. (Real-time classification, for which individual class detail is required, will be performed in the REQUEST system. When the REQUEST Interface Module has been implemented, REQUEST will continue to perform this function using the guidance provided by EPAS.)

The data contained within the School Seat File was dynamic, that is it was updated by the model during execution. This updating allowed the system to track its current fill, dynamically alter its payoff values, and insure that annual requirements were met in accordance with policies being evaluated.

Most of the data element descriptions for the School Seat File are self-explanatory. The information can be broken into six categories:

(1) File Directory Information. Needed to keep track of valid File Names and number of files contained in the School Seat File.

(2) File/Record Information. This data was used to access the individual MOS at a given point in the simulation. It includes the File Name, Fiscal Year, Iteration Number and MOS Class Code.

Table D-3. School Seat File Data Record.

NAME	TYPE	SIZE	DESCRIPTION
FNAME	CHAR	7	Name by which the School Seat file is to be identified
FISCAL_YR	CHAR	4	The Fiscal Year for which the data is applicable
ITERNMBR	CHAR	2	The iteration for which the data is applicable. iteration "00" is the information before any simulation has occurred.
MOS_CLASS	CHAR	3	Military Occupational Specialty
CLASS_CODE	CHAR	1	Unique class identifier
METRICS	INT	4	An array containing summary information on metric values
MINORITY_CONT	INT	4	The total number of contracts signed by minorities
CAPACITY_MAX	INT	2	The maximum classroom capacity for AA for each month
CAPACITY_MIN	INT	2	The minimum classroom capacity for AA for each month
CAPACITY_NOM	INT	2	The optimal classroom capacity for AA for each month
CLASS_FILL	INT	2	The current classroom fill by month and demographic
COHORT_FILL	INT	2	The current cohort fill by month and demographic
COHORT_RQMT	INT	2	The portion of the classroom capacity reserved for cohort
RESERVE_NG	INT	2	The number of seats reserved for AR and NG personnel
TNG_WK	INT	2	The weeks portion of the course length
TNG_DAYS	INT	2	The days portion of the course length
AVAIL	CHAR	1	Flags indicating if course is available for males/females
COURSE_TYPE	CHAR	1	Type of training (AIT, OSUT)
LOCATION	CHAR	23	Location at which training is to occur
START_DATE	CHAR	6	The class starting dates

(3) <u>Date Information</u>. This data was used to determine when a class took place so that recruits could be placed in the DEP for the correct amount of time.

(4) <u>Class Capacity Information</u>. These fields contained information on the minimum, optimal and maximum number of recruits that could be placed in an MOS during a given class.

(5) <u>Current Class Fill Information</u>. These fields contained information on the number of seats all ready filled by month. This was used in determining the number of recruits that could be placed in a given class.

(6) <u>Metric Information</u>. These fields contained information on the average metric scores for the seats already filled, by month.

<u>MOS Information File</u>. The data record structure for the MOS Information File is given in Table D-4. This file contained information necessary to describe the characteristics and requirements of each MOS. Unlike the School Seat File, the data within this file was static, i.e., the model did not update the data during execution.

Most of the data element descriptions for the School Seat File are self-explanatory. The information can be broken into five categories:

(1) <u>Unique Identification</u>. As different policy alternatives were defined and tested by the EPAS user, some means had to be available to distinguish the various options. For example, simulations may be desired to determine the impact of raising the minimum cut scores in highly technical skills; this would require having at least two MOS Information Files, one containing the standard cut scores, the other containing the proposed increased scores. Identifier fields within the data record provided the ability to select the appropriate file.

(2) <u>Skill Restrictions</u>. The second type of data elements within the record defined the various restrictions which applied to the MOS. Before an applicant could be considered for an MOS, checks were made to ensure that the applicant met all of the entry restrictions associated with the MOS. Failure to meet <u>any</u> of the restrictions resulted in that applicant being rejected from consideration. Entry restrictions processed were:

(a) <u>Aptitude Cut Scores</u>. Every initial entry MOS has a minimum ASVAB composite score associated with at least one, and as many as three, ASVAB Composite Aptitude Areas. Applicants had to meet the minimum score for all applicable aptitude areas.

Table D-4. MOS Information File Data Record.

NAME	TYPE	SIZE	DESCRIPTION
FNAME	CHAR	7	Unique file name
CURRENT_FY	CHAR	4	Fiscal year for which data is applicable
MOS_NAME	CHAR	3	MOS for which data is applicable
AA_RQMT	INT	4	Annual MOS accession requirement
BONUS_NBR	INT	4	Number of cash bonuses available
QUAL_GOAL_F(6)	INT	4	Female goals divided by AFQT Category and education
QUAL_GOAL_M(6)	INT	4	Male goals divided by AFQT Category and education
APT_LEVEL(3)	INT	2	Minimum cut scores
FEMALE_PERCENT	INT	2	Percentage of annual requirement to be filled by females
JOB_DIFF_SCORE	INT	2	Measure of job difficulty corresponding to new aptitude measures -- for future use
MINORITY	INT	2	Percentage of annual requirement to be filled by minority accessions
PERCENT_AVAIL	INT	2	Probability of the MOS being available -- for future use
PRIORITY	INT	2	MOS priority relative to other entry MOS
RST_FIELDS(10)	INT	2	Fields in applicant's record for which MOS restrictions apply
RST_OPS(10)	INT	2	Type of operator applicable to restricted fields
CAS	BIT	1	Flag indicating civilian acquired skills are applicable
COMBAT_ARMS	BIT	1	Flag indicating skill closed to females
ENLIST_BONUS	BIT	1	Flag indicating enlistment bonuses are available
HI_TECH	BIT	1	Flag indicating MOS is classified as highly technical
LANG_RQMT	BIT	1	Flag indicating MOS has a special language requirement
MODERN	BIT	1	Flag indicating MOS has been classified as a force modernization skill
SEC_INT	BIT	1	Flag indicating MOS requires special security interview
XTRA_FLAGS	BIT	9	Reserved for future flag fields
APT_AREA	CHAR	2	MOS Aptitude Area
APT_RQMTS(3)	CHAR	2	Aptitude areas for which minimum cut scores are applicable
CMF	CHAR	2	Career Management Field to which MOS belongs

Table D-4. MOS Information File Data Record (continued)

NAME	TYPE	SIZE	DESCRIPTION
MOS_TITLE	CHAR	24	Clear-text name of MOS
OPTION_FLAG(10)	CHAR	2	Options available to MOS
PREREQ(3)	CHAR	3	Prerequisite MOS for this hOS
REMARKS	CHAR	79	Field for general remarks
RST_VALUES(10)	CHAR	7	Restricted data values corresponding to fields in applicant record
TERM_ENLIST	CHAR	3	Initial term of enlistment, in years

(b) Combat Arms Restrictions. The second type of entry restriction prohibited female recruits from serving in MOS which were identified as having a combat requirement.

(c) Skill Specific Restrictions. The third type of entry restrictions were those unique to the MOS skill requirements. For example, electronic maintenance pr repair MOS require the ability to clearly distinguish colors; other MOS may require a valid driver's license, or a certain typing speed, or a minimum score on a specialized aptitude test.

(3) Policy Guidelines. The next type of data provided policy guidelines, e.g., annual training requirement and quality goals. These data provided the information used to manage the distribution of applicants.

(4) Enlistment Options. These data supported the Army's bonus option programs.

(5) Descriptive Information. The final category of data described attributes of the MOS within the system. This data provided the potential for managers to selectively identify MOS for special handling or processing considerations.

TRM Processing

Before each iteration of the model, the TRM used the information contained in the School Seat and MOS Information files to generate class requirements for the optimization model.

The TRM first identified the remaining (i.e., unfilled) seats for each MOS class. This value was determined as the difference between the current contracts for the class and the maximum class size. (The maximum class size was used to ensure that the optimization routines had the flexibility necessary to meet requirements). This value was then scaled so that the sum of the remaining seats did not exceed the remaining annual fill requirement.

The resulting value was used by the QAM to define the optimal flow values for its arcs. If each of these is met precisely, the resulting MOS fill will precisely match the annual requirement, meet quality targets, and be guaranteed to be no greater than the maximum class size. The realities of the simulation process, of course, are such that precise matching will generally not occur.

The TRM, therefore, also generated a maximum flow value for each class, providing the optimization model with the ability to shortfall a class in one month while overfilling the optimal value in another. The maximum flow value was computed as a predefined percentage over the largest of the optimal flow values. Each class for a given MOS was assigned the same maximum flow value.

Checks were then made for classes which have a minimum size. The number of seats which must be filled to bring the class to this value was computed directly as the difference between the current fill and the minimum fill.

Next, the minimum, optimal, and maximum values were compared to insure that they lie in the proper logical order, that is:

$$\text{minimum} \leq \text{optimal} \leq \text{maximum}$$

Adjustments were made when necessary to guarantee that this relationship occurred for each MOS/RSM. If adjustments were made, the appropriate error message was sent to the Exception Report enabling the analyst to track any corrective action performed by the TRM.

This process was performed for both the total MOS requirement and the quality goals. The final step performed by the TRM was to sum the MOS into the appropriate MOS Clusters.

An explanation of how the optimization routines utilized these flow values is found in this appendix's next major section, GENERATE AGGREGATE ASSIGNMENTS, and in the Appendix C section of the same name.

Quality Allocation Module Cluster File

To communicate the information generated by the TRM to the optimization model, the Quality Allocation Module (QAM), an interface file known as the Requirements Module Cluster File (Cluster File) was developed. The information contained in this file is shown in Table D-5. In addition to the generated class bounds, the TRM communicated information such as the Aptitude Area with which an MOS Cluster was associated, the ASVAB cut score (i.e., the minimum ASVAB Aptitude Area Composite Score necessary to qualify for MOS within a cluster), and the total and remaining annual demand.

Table D-5. TRM Output File Record Structure.

NAME	TYPE	SIZE	DESCRIPTION
FNAME	CHAR	7	Name of data file
ITERNUMBER	CHAR	2	Iteration number
CLUST_NUM	CHAR	2	Cluster number
ASVAB_CUT	INT	2	ASVAB cut score
SUM_LOW_BOUNDS	INT	4	Minimum bounds on number of school seats to be filled for cluster
SUM_NOM_BOUNDS	INT	4	Nominal bounds on number of school seats to be filled for cluster
SUM_MAX_BOUNDS	INT	4	Maximum bounds on number of school seats to be filled for cluster
SUM_CATIV_BOUNDS	INT	4	Category IV bounds on number of school seats to be filled for cluster
SUM_HS_BOUNDS	INT	4	High School Graduate targets on number of school seats to be filled for cluster
SUM_ANNUAL_DMD	INT	4	Total number of school seats to be filled for this cluster
REAL_ANNUAL_DMD	INT	4	Total number of school seats left to be filled for this cluster
CLUST_ID	CHAR	3	Cluster ID
APT_AREA	CHAR	2	Aptitude area
COMBAT_ARMS	CHAR	1	Used to exclude female personnel from cluster

Most of the information contained in the Cluster File is self-explanatory. The information was divided into four categories:

(1) Execution related parameters. These included the name of the run, the current iteration number and the cluster number. This information was used by the QAM as a key to access information for a specific run, iteration and cluster in the Cluster File.

(2) Eligibility Requirements. The Army Standard Vocational Aptitude Battery (ASVAB) score for a specific Aptitude Area was used by the QAM to determine recruit eligibility for the given cluster. A value was also used to indicate if females may be accepted.

(3) Annual Demands. The total annual demand was given in number of school seats available for the current fiscal year. The total number of school seats yet to be filled in the current fiscal year was also given.

(4) School Seat Bounds. Information was given for the following areas:

a. The minimum number of school seats to be filled.

b. The optimal number of school seats to be filled.

c. The maximum number of school seats to be filled.

d. The number of AFQT Category IV recruits that may be placed in class seats.

e. The number of High School Graduates that need to be placed in class seats.

GENERATE AGGREGATE ASSIGNMENTS

The aggregate model provided the optimal policy guidance necessary to achieve the goal of improving the selection, classification, and utilization of Army enlisted personnel. It provided support for all three processing modes of EPAS: Policy Analysis, Simulation, and Operational.

EPAS utilized both network and LP formulations to generate the requisite optimal guidance, depending on the type of analysis being performed. Specific aspects of this implementation discussed in this section are:

(1) Determining assignment cost criteria
(2) Optimization procedures

Determine Assignment Cost Criteria

Optimization algorithms, whether network or LP, require specification of the "cost" (or penalty) of allocating a particular type of supply to a demand. In EPAS, this was complicated by the clustering of both the supply (contractees, into Supply Groups) and demand (MOS, into MOS Clusters). This clustering mandated a similar aggregation of the cost factors.

EPAS performed this function through the Metric Generation Module (MGM). The MGM was an ancillary program whose sole purpose was the generation of aggregate cost metrics consistent with the Supply Group and MOS Cluster formulations being employed. Note that the MGM had to be executed each time alternative Supply Groups or MOS Clusters were developed to maintain the necessary correspondence.

MGM Processing

EPAS provided the user several options from which the optimization metric might be selected. These include:

(1) Aptitude Area score.
(2) Predicted Skill Qualifications Test (SQT) score.
(3) Relative Utility of MOS Assignment.
(4) Predicted Attrition Behavior.
(5) Delayed Entry Program (DEP)/Attrition Costs.

The underlying methodology behind the MGM was a weighted mean. The MGM read records of actual accessions, determining the Supply Group with which each was associated based on their individual characteristics and the Supply Group formulation being used. It then computed metric scores for each applicant for every MOS, whether or not the recruit actually qualified for the MOS. For example, a recruit who did not have a high school diploma would be scored against MOS requiring a diploma, even though current policy excluded the individual from the MOS. This action was taken for two reasons:

(1) It provided flexibility for analysis of policy alternatives. This flexibility enabled analysts to determine the impact of previously invalid person-job. An example of such an analysis might be allowing females into previously (traditionally) male-only skills. Were cost values not generated for this type configuration, such analyses would not have been possible.

(2) Analysis of actual records showed that some recruits had, in fact, been assigned to skills for which they were nominally ineligible. For example, non-high school graduates with exceptionally high AFQT scores may have been granted a waiver for an MOS requiring a high school diploma. EPAS required the cost metrics corresponding to these PJMs for its summary report procedures.

The MGM avoided erroneous aggregate scores by maintaining two separate arrays, one for eligible MOS, the other for ineligible ones. The arrays were indexed by Supply Group and MOS Cluster. The MGM kept running totals of the computed scores for each metric, as well as the number of recruits processed to generate the totals.

When all records in the applicant file were processed, the average value for each cell in both the eligible and ineligible arrays was computed. Separate files were then written for each metric.

<u>MGM Input</u>

The average metric values generated by the MGM was sensitive to two factors:

(1) The definitions of the aggregations, i.e., how the Supply Groups and MOS Clusters were defined.

(2) The data used to generate the individual metrics.

The system had to have, therefore, the means to input which aggregations and data sources were to be used. This input was defined through a series of interactive menus within the system framework. Actual MGM execution was performed as a batch submission from the Process Test System (PTS) driver routines. Required inputs to the MGM were:

(1) <u>Filenames</u>. The first panel displayed to the user requested the names of the data files which defined the environment in which the MGM was to operate. The necessary files were:

(a) Output Name. The name by which the generated metrics and all associated hard-copy reports were to be identified.

(b) Historical Accessions File. The file containing the input stream of historical accessions records on which the average metrics were to be computed.

(c) Attrition Data File. The file containing the data needed to compute first term attrition.

(d) Cluster Definition File. This file defined the MOS Clusters to be used.

(e) Composite Definition File. This file defined the methodology and values to be used in computing the Aptitude Area Composite scores from the ASVAB subtest scores.

(f) MOS Information File. This file defined the various restrictions applicable to an MOS, e.g., male only, quality goals, etc.

(g) SQT Prediction File. This file contained the detailed ridge regression coefficients upon which the average SQT scores were computed.

(h) Utility Coefficients File. This file contained the tables providing the relative utility associated with predicted job performance.

(2) Printer Control. The second panel requested printer output control information. In addition to the detailed metric data files (which were automatically generated), the user could request additional, hard-copy output. The two options were:

(a) Printer-Ready Output. A hard copy of the data values contained in the metric files.

(b) Log Trace File. A file which traced key points within the MGM. If selected, contained trace messages and error messages monitoring the progress of the computations.

(3) Iteration Control. The final panel requested iteration control information. This data allowed testing and checkpointing capabilities. Input parameters were:

(a) Maximum Applicants. This parameter limited the number of accessions records to be scored in each processing month. It provided the ability to decrease run time, at the expense of obtaining accurate data for the entire file.

(b) Beginning Date. This defined the recruit month corresponding to the first iteration, that is, iteration number one.

(c) First Iteration Number. This parameter defined the first month to be processed; in effect, providing the checkpoint restart capability. That is, if the first month was any value other than one, the MGM restarted from the previous month.

(d) Last Iteration Number. This parameter defined the last month to be processed. It provided the ability to run partial year tests on new input files. The MGM final computations on the data and generation of the output occurred when the last iteration number was twelve.

MGM Output

The MGM generated two types of record structures. Each metric file produced -- recall that separate files were generated for each metric being processed -- each had the same record structures.

The first record structure, METRICCHAR, applied only to the first record in the file. This structure, show in Table D-6, defined the character-

Table D-6. MGM, Metric Characteristics Record Structure.

NAME	TYPE	SIZE	DESCRIPTION
FILENAME	CHAR	7	Name of data file
METRIC_TYPE	CHAR	1	Type of metric data
RECORD_NBR	CHAR	2	Always "00" in first record
SUPPLYGP	INT	2	Always zero in first record
NBRSUPPLYGPS	INT	2	Number of supply group records which follow
MINMAX	INT	2	Flag indicating if metric is to be minimized (0) or maximized
MINMETRIC	INT	4	Smallest metric value for eligible population
MAXMETRIC	INT	4	Largest metric value for eligible population
MININELIG	INT	4	Smallest metric value for ineligible population
MAXINELIG	INT	4	Largest metric value for ineligible population
SCALEFACTOR	INT	4	Scaling factor used to convert metric values to real
SOURCEFILE	CHAR	93	Name of the file from which the metrics were generated
FILLER	CHAR	483	Padding to end of record

istics of the data records which follow. Key elements of this data record were:

(1) FILENAME -- separate metric files had to be generated as changes occurred in the definitions of Supply Groups, MOS Clusters, and/or metric computations. This field provided the unique identifier for each combination.

(2) MINMAX -- some of the metrics, for example, SQT score represent metrics which were maximized; others, such as attrition, were to be minimized. This field told the QAM's preprocessor what type of optimization was to be performed.

(3) MINMETRIC/MAXMETRIC -- metrics differed in the scale by which they were measured. Attrition, for example, varied from 0.0 to 1.0, while Aptitude Area varied from 40 to 160. The QAM scaled the metric values to a consistent range using the minimum and maximum values to bound the necessary computations.

(4) SCALEFACTOR -- for computer speed, all numeric values were defined to be integers. In fact, they were real numbers with varying precision. This data element defined the adjustment necessary to compute the actual value. An attrition value of 0.185, for example, would be entered as 185 with a SCALEFACTOR of 1000.

(5) SOURCEFILE -- this was the name of the raw data file from which the metrics were computed. This variable provided documentation if needed for future reference.

All subsequent records used the structure as shown in Table D-7, called METRICREC. One data record existed for each supply group being used. Key variables within this record structure were:

(1) FILENAME -- separate metric files had to be generated as changes occurred in the definitions of Supply Groups, MOS Clusters, and/or metric computations. This field provided the unique identifier for each combination.

Table D-7. MGM Data Record Structures (METRICREC).

NAME	TYPE	SIZE	DESCRIPTION
FILENAME	CHAR	7	Name of data file
METRIC_TYPE	CHAR	1	Type of metric data
RECORD_NBR	CHAR	2	The number of the supply group
SUPPLYGP	INT	2	The number of the supply group
NBRCLUSTERS	INT	2	Number of MOS Clusters
METRIC (75)	INT	4	Metric value for eligibles
INVMETRIC (75)	INT	4	Metric value for ineligibles

(2) NBRCLUSTERS -- this variable defined the number of MOS Clusters which follow in the data record. It was used to determine how many elements of the metric arrays which follow contain viable data.

(3) METRIC -- this variable defined the average metric value for the eligible populations. This was the value that used by the optimization model and the report generators as the cost value.

(4) INVMETRIC -- the average metric value for ineligible populations. This was the value that used by the optimization model and the report generator for combinations deemed invalid by current policy.

The MGM also generated hard copy output of the average metric values. A typical page from this output is shown in Figure D-1. The title at the top of the report identifies the type of data being displayed (in this example, "Predicted SQT Performance") and the file name under which the data has been saved ("PSSDATA/R84NEWB.M2"). The column headers identify the MOS Cluster number for which the data is applicable; the rows identify the Supply Groups.

Each supply group has two lines of data: the first (e.g., "1/E") is the average scores for the eligible population; the second (" /I") is the average scores for the ineligible populations. A score of zero (0.00) indicates that no records were found for that Supply Group/Category/MOS Cluster. When this occurs, the data for the complementing category will be used. For example, Supply Group #11 has no eligibles for MOS Cluster #1. If policies are changed to allow Supply Group #11 personnel into MOS Cluster #1, the models will use the average score generated for the ineligible population (57.05 in this example).

Optimization Procedures

EPAS used two types of optimization algorithms: a linear network technique and a more traditional linear programming (LP) technique. The network formulation provided rapid solution times at the expense of modeling accuracy; this formulation was used for the Policy Analysis and Simulation modes. The LP formulation provided additional modeling detail at the expense of execution time; this formulation was used with the Simulation mode and is anticipated to be the formulation for the Operational mode if fully implemented.

The two algorithms, with their supporting procedures, were collectively called the Quality Allocation Module (QAM) of EPAS. Both formulations optimized the allocation of NPS recruits (clustered into Supply Groups) among MOS (clustered into MOS Clusters). The models were designed to reach a feasible solution regardless of the circumstances, e.g., whether or not the recruit supply was sufficient to meet the MOS demand. Appendix C contains a discussion of both models' formulation.

Figure D-1. Sample MGM Output.

AGGREGATE METRIC VALUES
Predicted SQT Performance
PSSDATA/R84NEWB.M2

SUPPLY GROUP	CLUSTER NUMBER 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1/E	91.67	78.05	89.50	81.87	75.22	83.19	77.99	77.57	79.75	81.21	77.19	79.73	74.29	80.87	74.29	83.28	82.90
/I	65.99	72.59	82.82	72.35	76.80	81.93	76.64	77.97	66.03	75.00	71.04	72.97	61.70	71.73	72.94	80.47	70.70
2/E	85.81	84.27	98.37	89.48	88.94	95.70	88.46	88.55	85.49	93.47	89.83	90.87	96.84	91.21	96.84	96.56	90.72
/I	84.93	87.51	98.37	90.19	91.45	96.20	88.49	89.32	85.49	84.12	89.83	86.48	96.84	91.21	96.41	96.62	80.17
3/E	78.13	76.52	94.10	81.29	79.00	87.66	81.54	81.60	75.29	87.02	80.40	83.04	85.68	84.71	85.68	88.84	86.53
/I	73.65	78.82	94.10	78.98	82.43	88.47	81.47	82.56	70.39	79.05	74.07	78.71	85.68	69.29	84.89	88.70	74.10
4/E	79.22	72.38	92.42	79.05	71.76	85.25	78.18	78.25	67.22	85.79	73.51	78.69	84.83	82.57	84.83	85.59	80.59
/I	75.15	75.01	92.42	77.96	75.85	86.14	78.14	79.33	63.11	81.52	68.13	78.42	84.83	71.68	84.03	85.52	71.69
5/E	91.60	83.47	85.32	87.06	76.11	87.25	79.71	77.59	84.27	75.95	80.93	78.24	71.14	83.79	71.14	81.64	85.03
/I	64.15	69.00	81.57	69.69	69.98	76.58	71.52	72.79	61.45	71.91	63.72	69.16	57.29	69.49	65.20	73.99	69.31
6/E	88.12	70.25	88.02	72.55	66.39	79.71	74.29	74.19	65.42	79.89	69.39	74.06	72.64	78.50	72.64	79.58	79.5[illegible]
/I	61.49	69.25	83.37	69.88	69.47	78.93	74.06	75.36	58.30	75.21	65.10	70.88	62.71	69.30	71.24	77.96	67.91
7/E	90.86	77.14	84.71	72.71	59.19	77.30	70.84	70.53	72.71	74.96	65.18	69.60	66.72	76.64	66.72	75.36	78.31
/I	55.07	65.12	85.96	64.32	60.54	73.74	70.28	71.47	48.72	72.31	57.70	64.92	59.01	66.93	63.65	72.48	64.37
8/E	77.17	69.12	89.67	72.81	64.47	80.89	74.60	74.65	60.61	81.62	67.88	73.33	79.00	79.42	79.00	80.99	79.84
/I	66.47	69.83	89.67	73.58	68.60	81.28	74.62	75.90	55.81	79.35	63.62	74.11	79.00	69.64	78.11	80.83	67.89
9/E	91.07	84.03	83.32	86.97	79.28	87.37	79.59	78.25	83.62	73.93	80.62	77.89	73.52	87.33	73.52	84.26	85.54
/I	59.94	66.26	80.10	66.24	61.93	72.90	68.37	69.39	55.64	68.33	60.23	64.89	55.18	66.97	59.85	70.61	67.30
10/E	0.00	0.00	80.45	0.00	0.00	0.00	0.00	78.25	0.00	72.05	79.97	79.66	76.68	88.02	76.68	82.23	81.73
/I	45.37	60.02	78.37	55.42	48.89	65.75	65.52	65.97	37.30	64.00	47.56	58.24	21.02	62.95	51.33	65.12	60.92
11/E	0.00	0.00	84.66	0.00	0.00	0.00	0.00	68.12	0.00	71.43	56.75	57.51	70.07	75.21	70.07	73.04	76.86
/I	57.05	62.35	85.66	65.06	53.96	72.88	68.10	69.05	41.13	74.48	52.00	64.68	67.00	65.93	68.72	72.31	61.76
12/E	0.00	0.00	80.03	0.00	0.00	0.00	0.00	64.43	0.00	67.53	60.47	57.81	59.87	73.27	59.87	68.95	74.48
/I	46.43	58.76	81.92	56.84	47.96	67.07	64.92	65.81	33.98	67.38	46.21	58.60	55.58	62.86	55.80	66.47	59.24
13/E	80.20	79.54	93.43	82.04	82.60	87.80	82.35	82.85	77.53	86.56	81.79	83.92	83.67	84.78	83.27	89.26	84.67
/I	71.86	72.80	93.43	75.45	74.12	78.98	79.52	79.41	70.66	78.26	74.49	77.00	73.54	72.46	73.02	80.61	73.70
14/E	91.97	83.55	90.87	89.16	83.26	88.19	81.96	81.30	85.49	80.68	83.45	84.49	79.86	85.77	79.71	87.65	88.46
/I	77.31	71.62	80.39	76.53	73.32	74.53	71.75	71.16	71.43	76.63	72.92	75.73	61.52	73.78	60.92	76.61	73.92
15/E	87.30	88.09	98.41	91.05	93.08	96.76	90.67	91.06	88.82	94.53	92.49	92.79	96.98	91.99	96.79	97.80	92.63
/I	82.00	74.61	98.41	82.96	93.08	96.76	90.67	91.06	78.55	83.85	92.49	93.17	96.98	91.99	96.79	97.80	74.98

QAM Input

The definition of the optimization problem was performed automatically by one of the QAM ancillary routines, the Pre-Processor. This routine read information from files defined elsewhere in this appendix, specifically the TRM and QFM output, and used the information found in these files to create the problem to be optimized. Thus, for example, the Pre-Processor would detect a male-only MOS Cluster and ensure that no flow into the cluster was possible from female Supply Groups. Explicit user input was neither required nor provided for this activity.

A QAM Policy File was defined, however, to provide user control over implementation of DEP limits and communication with the detailed assignment procedures. The data elements associated with the QAM Policy File are shown in Table D-8. Two types of data were available:

Table D-8. QAM Policy File Record Structure.

NAME	TYPE	SIZE	DESCRIPTION
QAMPOLNAME	CHAR	7	Policy File Name--unique name for identifying the policy.
MINDEP(18)	INT	2	Minimum DEP length in months by demographic group.
MAXDEP(18)	INT	2	Maximum DEP length in months by demographic group.
ACMLISTLEN	INT	2	Number of recommendations to be forwarded to the detailed assignment algorithm.

(1) The user could enter minimum and maximum allowable DEP lengths in months for each demographic group (defined by gender, education, and AFQT category).

(2) The user could define the number of recommendations to be provided to the detailed assignment routines. The longer the list, the more likely the detailed assignment would be consistent with the QAM's global objectives, but the slower the processing.

QAM Output

Both formulations of the QAM produced an exception report, four reports detailing the network solution itself, and data files for use in report generation. In addition, an ordered list of time-specific MOS Cluster recommendations was generated for use as guidance in the detailed classification process. A hard-copy version of this recommendation list was also generated.

QAM Exception Report. This report was written to a data file keyed by the user-designated simulation name, iteration number representing the month of the simulation, and the module acronym "QAM". All file processing problems causing abnormal termination of the model, and certain arc activity, were recorded in the exception report. Each of the following types of activity appeared in its own tabular structure on the exception report:

(1) Shortfalls in Quality Goals. This portion showed, by month, the shortfall in achieved quality by MOS Cluster. This indicated substitution activity was necessary to solve the model. Only those MOS Clusters experiencing a shortfall were reported.

(2) Shortfalls in Meeting MOS Requirements. This portion showed MOS Clusters for which monthly class requirements were not met. This indicated the Super Source had to be tapped to permit solution of the model. Again, only those MOS clusters experiencing a shortfall were reported.

(3) Deviation from Annual Requirements. This portion listed the desired fill, the achieved fill, and the percentage fill of the annual requirement for each MOS Cluster. Underfill was marked with an asterisk in the right-most column. This indicated also that the Super Source had to be used in order to obtain a network solution.

If the model met all quality goals and all monthly and annual MOS requirements, these three reports were not written to the exception report.

Descriptive Solution Reports. Four reports were sent directly to the printer. These reports showed detailed aspects of the solution:

(1) Demographic Flows. This report showed the number of each demographic type (defined by gender, education, and AFQT category) assigned to each MOS Cluster aggregated across the planning horizon.

(2) MOS Class Fill. This report showed details on each MOS cluster by month. Included are AFQT Categories I-IIIA, AFQT Categories IIIB-IV, and total assignments, class minimums and maximums, and the number of "artificial" assignments (from the Super Source) necessary to meet the class minimum. A value of "0" indicated a given MOS Cluster-month met its minimum fill without using the Super Source.

(3) Quality Goal. This report compared the desired percentage of quality recruits by MOS Cluster to the achieved percentage. Shortfalls were marked by an asterisk.

(4) Demographic DEP. This report showed the number of each demographic type (defined as in (1) above) assigned to a class beyond the planning horizon; that is, flowed to the DEP sink node.

Each of these reports were generated regardless of the processing mode. Also, all reports were generated, whether the recruit supply pool was sufficient or not (use of the Super Source indicates insufficient supply). One additional report was produced in Simulation mode runs: a hard-copy version of the ordered list containing the optimal guidance for the detailed allocation routines.

Data Files for Report Generators. Two types of data files were produced for use in report generation. The user-supplied EPAS run name, along with the iteration number (representing the month being processed), uniquely identify the files produced. The report generator and its outputs will be discussed later in this appendix. The two types of data files produced by the QAM were:

(1) Assignment Flows. This data file contained counts of the number of assignments made in this iteration from Supply $Group_i$ to MOS $Cluster_j$ with a DEP period of k months. This file was used in generating the various metrics reports. The three *dimensions* (Supply Group, MOS Cluster, and DEP length) were required in calculating the various metric values.

(2) Aggregate Flows. This data file contained counts of all assignments made in this iteration, aggregated across all supply groups and all MOS Clusters. Two dimensions were necessary: Time-IN (the month in which the assignment was made) and Time-OUT (the month in which the class begins). This file was used in generating the Brick Chart as described below.

These data files were created regardless of the processing mode. As with other EPAS data files, the use of iteration number for file identification permitted the user to restart a simulation or rerun the same simulation.

Recommendation List for Use in Detailed Assignment. Optimal guidance was provided for the detailed assignment routines, both the ACM and [anticipated] REQUEST Interface Module, through ordered lists of alternative MOS assignments. The QAM generated an optimal configuration for assigning Supply Groups to MOS Cluster/Recruit Station Month (RSM) combinations. Specific output from the optimization procedure included the optimal solution and "reduced costs," i.e., the penalty for moving a single unit out of the optimal solution. A post-processor manipulated this output, generating a score for each MOS. A detailed description of this process is found in Appendix C.

The possible MOS/RSM for each Supply Group were sorted on the computed score. The sorted list was written to a file, shown in Table D-9, for use by the detailed assignment procedures.

Table D-9. QAM Ordered List File.

NAME	TYPE	SIZE	DESCRIPTION
FNAME	CHAR	7	Unique name identifying the execution
ITERNUM	CHAR	2	Iteration number
FROMDATE	CHAR	4	Year/Month of the Supply Group's arrival
QAMAGID	CHAR	3	Supply Group identification number
QAMLISTNUM	CHAR	3	Recommendation's position on the ordered list
QAMSCORE	CHAR	4	The value computed by the post-processor
QAMCLUSTER	CHAR	3	The recommended MOS†
TODATE	CHAR	4	The Year/Month in which the recommended MOS training begins

† In earlier versions of EPAS, the ordered list was defined by MOS Cluster rather than by MOS, hence the name "QAMCLUSTER" in the record structure.

GENERATE DETAILED ASSIGNMENT

The ultimate objective of EPAS was developing a methodology for generating optimal assignments for individual recruits. Supporting this requirement required a detailed Person-Job Match (PJM) process which matched single individuals to specific MOS/class start date combinations.

In the Simulation Mode, this requirement was met by developing the Applicant Classification Module (ACM). (In the Operational Mode, the Army's existing classification routines within REQUEST will be utilized to perform the detailed assignment function). EPAS optimal guidance will be communicated to REQUEST through the REQUEST Interface Module (RIM). Both of these modules were discussed in detail in Appendix C.

Applicant Classification Module

The ACM provided a purely analytical simulation capability, that is, its PJM allocations support analysis of policy alternatives, not assignment of actual recruits. Accordingly, the ACM had to be entirely self-contained -- it cculd not, for example, examine actual applicants as he presented themselves at a Military Entrance Processing Station (MEPS), neither could it utilize school seat information found in operational data files.

The basic activities performed by the ACM's sequential processing were discussed in Appendix C. To recap, the activities were:

(1) Simulate Applicant Arrivals. Determine the order in which hypothetical applicants "arrive" for processing.

(2) Compute Assignment Alternatives. Evaluate each hypothetical applicant against available jobs to determine the best possible match.

(3) Select PJM Matches. Simulate the applicant's selecting a job from among the options.

(4) Update System Status. Adjust current state of the recruiting mission to reflect acceptance of a position.

This appendix discusses the implementation of these activities.

Simulate Applicant Arrival

A critical requirement to support the ACM's simulation capability was the definition of a hypothetical, yet functionally accurate, flow of "recruits" to be processed. Ancillary procedures, the applicant file generators and editors, were developed to meet this requirement. Two types of applicant files were generated: primary and secondary.

Primary Applicant File. The primary applicant file contained edited extracts for all contractees actually processed in a specified fiscal year. Table D-10 displays the information contained within the primary applicant file. Data elements within this file are self-explanatory; they can be divided into five broad categories:

(1) File/Record Information. This data was used to access the information for any given applicant in the Secondary Applicant File. It included the File Name and a Unique Record Identifier.

(2) Personal Information. This category contained data such as Gender, Citizenship, Race, Ethnic Group, Marital Status, Number of Dependents, and Date of Birth.

(3) Accession Information. This category included information about the Date of Physical, Aptitude Scores, AFQT Category, Contract Data, Ship Date, Bonus Data and Term of Enlistment.

(4) Education Information. This category contained data about Education Certification, Year of Education and Level of Math and Science Achievement.

(5) Physical Profile. This category included information about Physical Stamina, Upper and Lower Extremities, Hearing, Vision, Psychological Data, Height, Weight and Medical Failure Codes.

Secondary Applicant File. The secondary applicant files were statistical, random extracts of the primary applicant file, i.e., records primary file records were randomly extracted in accordance with a defined distribution. These extracts met the requirement of having hypothetical populations (the distributions could be defined in any desired ratios) which were functionally accurate (randomly selecting actual records ensured the resulting files maintained realistic attributes as would found in an actual population).

A special editor program was developed, enabling the user to define the desired secondary file population. The editor automatically submitted a batch (i.e., off line) job, called the Applicant Procedure, Secondary (APS) to generate the desired file. The secondary file had two record structures. The first, depicted in Table D-11, provided summary information about the file.

The second record structure, depicted in Table D-12, provided the detailed data. Most of the information contained this record is self explanatory; it was divided into six categories:

(1) File Directory Information. This was needed to keep track of valid file names and number of files contained in the Secondary Applicant File.

Table D-10. Primary Applicant File Record Structure.

NAME	TYPE	SIZE	DESCRIPTION
REC_YEAR	CHAR	4	Recruit Year
REC_MONTH	CHAR	2	Recruit Month
DEMOGRAPH_KEY	CHAR	2	Demographic Number
RECORD_ID	CHAR	6	Unique Record Identifier
REC_WEEK	CHAR	2	Recruit Week
REC_WEEK_OF_MONTH	INT	2	Recruit Week of Month
RAW_SCORES (16)	INT	2	Raw Aptitude Scores
COMPOSITS (10)	INT	2	Composite Aptitude Score
DOOR_DATE	CHAR	6	Date of Physical Exam
SEX	CHAR	1	Gender
EDCERT	CHAR	1	Education Certification
MENTCAT	CHAR	2	AFQT Category
CONTRACT_STAT	CHAR	1	Contract Signed Flag
AFEESCD	CHAR	2	AFEES ID Code
FINAL_STATUS	CHAR	2	Shipped Status and DEP Status
CITIZ	CHAR	2	Citizenship Codes
RACE	CHAR	1	Racial Code
EGPCD	CHAR	1	Ethnic Group Code
CONTRACT_DATE	CHAR	6	Date Contract was Signed
SHIPED_DATE	CHAR	6	Date Accession Shipped
AFQTSCR	CHAR	2	AFQT Score
PHY_STAM	CHAR	1	Physical Stamina
UP_EXTREM	CHAR	1	Upper Extremities
LOW_EXTREM	CHAR	1	Lower Extremities
HEARING	CHAR	1	Hearing
EYES	CHAR	1	Vision
PSYCH	CHAR	1	Psychological
EXP_WEIGHT	CHAR	1	Weight Lift
HGT	CHAR	2	Height in Inches
WGT	CHAR	3	Weight in Pounds
MEDFAIL1	CHAR	2	Medical Failure Code 1
MEDFAIL2	CHAR	2	Medical Failure Code 2
MEDFAIL3	CHAR	2	Medical Failure Code 3
PROG1	CHAR	1	VEAP Option Flag
DESGOP	CHAR	1	Designated Option
TRENMOS	CHAR	3	Training/Enlistment MOS
WAIVER	CHAR	1	Waiver Type
ENLOP	CHAR	1	Enlistment Option Guaranteed
BONLVL	CHAR	1	Enlistment Level Bonus
NODEPR	CHAR	3	Reason for DEP Loss
MARST	CHAR	1	Marital Status
NRDEP	CHAR	2	Number of Dependents
DOB	CHAR	6	Date of Birth
EDYRS	CHAR	2	Years of Education
DRIVER	CHAR	1	Drivers Licence Flag

Table D-10. Primary Applicant File Record Structure (continued).

NAME	TYPE	SIZE	DESCRIPTION
MATH_LEV	CHAR	3	Level of Math Achievement
SCIENCE_LEV	CHAR	3	Level of Science Achievement
DATE_OF_AVAIL	CHAR	6	Date Available
PREF	CHAR	9	Preferences
REQ_BONUS	CHAR	1	Bonus Request Flag
COLLEGE_FUND	CHAR	1	VEAP Request Flag
ADD_TESTS	CHAR	40	Additional Tests
SCR_ADD_TEST	CHAR	30	Scores of Additional Tests
OPTION	CHAR	3	Enlistment Option
TESTID	CHAR	2	ASVAB Test Series
ENLTERM	CHAR	2	Term of Enlistment

Table D-11. Secondary Applicant File Information Record.

NAME	TYPE	SIZE	DESCRIPTION
Record Name: SECOND_REC			
FNAME	CHAR	7	File Name
RECORD_ID	CHAR	6	Always set t
DEMOGRAPH_KEY	CHAR	2	Always set t[illegible]
REC_YEAR	INT	2	Always set to 0
REC_WEEK	INT	2	Always set to 0
YEAR_TOT (25)	INT	4	Yearly Totals
DEM_TOTALS (60)	INT	2	Demographic Totals
FILLER	CHAR	17	Alignment Characters

(2) File/Record Information. This data was used to access the information for any given applicant in the Secondary Applicant File. It included the File Name and a Unique Record Identifier.

(3) Personal Information. This category contained data such as Gender, Citizenship, Race, Ethnic Group, Marital Status, Number of Dependents, and Date of Birth.

(4) Accession Information. This category included information about the Date of Physical, Aptitude Scores, AFQT Category, Contract Date, Ship Date, Bonus Data and Term of Enlistment.

(5) Education Information. This category contained data about Education Certification, Year of Education and Level of Math and Science Achievement.

Table D-12. Secondary Applicant File Data Record.

NAME	TYPE	SIZE	DESCRIPTION
Record Name: ACC_REC			
FNAME	CHAR	7	File Name
RECORD_ID	CHAR	6	Unique Record Identifier
REC_MONTH	CHAR	2	Recruit Month
DEMOGRAPH_KEY	CHAR	2	Demographic Number
FNAME2	CHAR	7	Repeat of File Name
REC_YEAR	CHAR	4	Recruit Year
REC_WEEK	CHAR	2	Recruit Week
DOOR_DATE	CHAR	6	Date of Physical Exam
REC_WEEK_OF_MONTH	INT	2	Recruit Week of Month
RAW_SCORES (16)	INT	2	Raw Aptitude Scores
COMPOSITS (10)	INT	2	Composite Aptitude Score
SEX	CHAR	1	Gender
EDCERT	CHAR	1	Education Certification
MENTCAT	CHAR	2	AFQT Category
CONTRACT_STAT	CHAR	1	Contract Signed Flag
AFEESCD	CHAR	2	AFEES ID Code
FINAL_STATUS	CHAR	2	Shipped Status and DEP Status
CITIZ	CHAR	2	Citizenship Codes
RACE	CHAR	1	Racial Code
EGPCD	CHAR	1	Ethnic Group Code
CONTRACT_DATE	CHAR	6	Date Contract was Signed
SHIPED_DATE	CHAR	6	Date Accession Shipped
AFQTSCR	CHAR	2	AFQT Score
PHY_STAM	CHAR	1	Physical Stamina
UP_EXTREM	CHAR	1	Upper Extremities
LOW_EXTREM	CHAR	1	Lower Extremities
HEARING	CHAR	1	Hearing
EYES	CHAR	1	Vision
PSYCH	CHAR	1	Psychological
EXP_WEIGHT	CHAR	1	Weight Lift
HGT	CHAR	2	Height in Inches
WGT	CHAR	3	Weight in Pounds
MEDFAIL1	CHAR	2	Medical Failure Code 1
MEDFAIL2	CHAR	2	Medical Failure Code 2
MEDFAIL3	CHAR	2	Medical Failure Code 3
PROG1	CHAR	1	VEAP Option Flag
DESGOP	CHAR	1	Designated Option
TRENMOS	CHAR	3	Training/Enlistment MOS
WAIVER	CHAR	1	Waiver Type
ENLOP	CHAR	1	Enlistment Option Guaranteed
BONLVL	CHAR	1	Enlistment Level Bonus
NODEPR	CHAR	3	Reason for DEP Loss
MARST	CHAR	1	Marital Status
NRDEP	CHAR	2	Number of Dependents

Table D-12. Secondary Applicant File Data Record (continued).

NAME	TYPE	SIZE	DESCRIPTION
DOB	CHAR	6	Date of Birth
EDYRS	CHAR	2	Years of Education
DRIVER	CHAR	1	Drivers Licence Flag
MATH_LEV	CHAR	3	Level of Math Achievement
SCIENCE_LEV	CHAR	3	Level of Science Achievement
DATE_OF_AVAIL	CHAR	6	Date Available
PREF	CHAR	9	Preferences
REQ_BONUS	CHAR	1	Bonus Request Flag
COLLAGE_FUND	CHAR	1	VEAP Request Flag
ADD_TESTS	CHAR	40	Additional Tests
SCR_ADD_TEST	CHAR	30	Scores of Additional Tests
OPTION	CHAR	3	Enlistment Option
TESTID	CHAR	2	ASVAB Test Series
ENLTERM	CHAR	2	Term of Enlistment

(6) Physical Profile. This category included information about Physical Stamina, Upper and Lower Extremities, Hearing, Vision, Psychological Data, Height, Weight and Medical Failure Codes.

The Secondary Applicant File Editor. This editor had limited functionality when compared to the other editors in EPAS, since it only allowed the user to create new files. Due to the volume of data to be produced, the actual file generation took place in batch mode. A communication file, the Applicant Communication File, was used to communicate between the on-line editor and batch file generator.

The Applicant Communication File also utilized two types of record structures. The first, shown in Table D-13, provided aggregate targeting information by demographic group by month. This record was used by the batch generators to generate the secondary applicant file.

The second record structure, shown in Table D-14, provided summary information regarding the structure of the secondary file. The information contained in the Applicant Communication File is self-explanatory. It can be divided into three categories as follows:

(1) File/Record Information. This data was used to access the communications information for any given Secondary Applicant File to be generated. It included the File Name, Fiscal Year and Month.

Table D-13. Secondary Applicant File Communication File.

NAME	TYPE	SIZE	DESCRIPTION
Record Name:	APPCOM_REC		
FNAME	CHAR	7	File Name
YEAR	CHAR	4	Record Year
MONTH	CHAR	2	Record Month
FILLER	CHAR	1	Alignment Characters
GOALS (2)	INT	2	Total goals for month by recruit type
DISTRIBUTION (60)	REAL	4	Distribution of demographic groups for month

Table D-14. Secondary Applicant File Tree Record.

NAME	TYPE	SIZE	DESCRIPTION
Record Name:	APPCOM_TREE		
FNAME	CHAR	7	File Name
SIX_BLANKS	CHAR	6	Six Blanks
FILLER	CHAR	1	Alignment Character
TRACE	INT	2	Trace Flag
NUM_MONTHS	INT	2	Number of months of data to be generated
TREE (60)	INT	2	Flags of Demographics that have been selected
YYYY (60)	INT	2	Alignment Characters

(2) Demographic Information. The area included information on the demographics that need to be included in the Secondary Applicant File and the Distribution of the demographics by month.

(3) Mission Information. This area included information on Recruit missions for the current month by recruit type.

<u>Execution Status Monitoring</u>. The APS, in addition to the secondary applicant file itself, generated exception status data. These data provided provide feedback to the user regarding the execution of the Secondary Applicant File generation run and was available for review through an execution status review module. This module provided up-to-date monitoring of the generation process and displayed all exception

reports generated for the run. Table D-15 provides a list of the possible exception reports generated by the Secondary Applicant File generator.

Compute Assignment Alternatives

The ACM, EPAS' detailed assignment procedure, was principally a set of programming "hooks" which enabled analysts to evaluate the impacts of alternative performance predictors. Appendix C describes the various modules developed for, and tested in, the ACM.

GRC focused attention on three areas to support implementation of the requisite structure for detailed simulations. These were:

- Design flexibility.
- Simulation efficiency.
- Parametric control.

Table D-15. Secondary Applicant File Exception Messages.

(1) 75% level reached for demogroup TT in month PP.
(2) Aborting: Unable to find record in APPCOM file.
(3) Aborting: Unable to open/create files.
(4) Aborting: Unable to open APPCOM file.
(5) Aborting: Unable to open STDDIST file.
(6) Begin building the Secondary Applicant File.
(7) Beginning file open/create sequence.
(8) Error finding valid accession data due to invalid data.
(9) Error: Unable to find primary record.
(10) Generating secondary file SS.
(11) No primary file records for demogroup TT in month PP.
(12) No requirements specified for month PP.
(13) Recycling applicants for demogroup TT in month PP.
(14) Secondary file completed: RR records generated.
(15) Secondary file creation canceled: No acceptable recruits found on primary file.
(16) Secondary file creation canceled: Program aborted.
(17) Starting the PP iteration out of QQ.
(18) The secondary file was aborted in month PP.
(19) Unable to open ACCESS file.
(20) Unable to open ACCSCR file.
(21) Unable to open secondary file.

where:
PP - Current iteration number.
QQ - Number of iterations that the file is being generated for.
RR - Number of records generated for the secondary file.
SS - Name of secondary file being created.
TT - Number indicating demographic group.

Design Flexibility. New predictors were, generally, fully novel; that is, they could not be implemented by simply recoding existing predictor modules. Additionally, even if such recoding were possible, it would not have been desirable. GRC analysts frequently evaluated new predictors by examining the impact on other predictors.

Effecting the requisite flexibility required a highly structured, modular shell. New predictors could be developed separately as independent object blocks and linked into the shell for evaluation. Data structures were also artificially expanded to provide for the needed flexibility. For example, the ACM Statistical Output record, described below, contained multiple fields for metric scores. These fields, not all of which need be actively used at any one time, could be quickly changed to reflect scores of different measures.

Simulation Efficiency. Typical EPAS simulations processed a large number of individual applicants. An execution with 20,000 simulation applicants, for example, averaged over 1,500 applicants per simulation month; in peak months, the figure might exceed 2,000 applicants. Several techniques were implemented to speed processing.

One of the key techniques was establishing the ACM as a stand-alone process. In addition, the ACM was implemented as three distinct sections: the first loaded all data from files into internal arrays; the second processed all applicants for the period, updating the internal arrays; the third stored the updated arrays into data files for subsequent iterations and post-execution analyses. This implementation substantially reduced input/output (I/O) times, resulting in a significant improvement in processing time. The major disadvantage with this technique was its limiting flexibility in terms of problem size and iteration periods, limitations imposed by the need to predefine array structures.

A second key technique was in the generation of ordered lists for individual applicants. The ACM, with one exception, utilized only those PJM options found on the QAM ordered guidance. The QAM's formulation included factors such as DEP/RUDEP restrictions, female exclusions, high school graduate requirements, etc. The ACM, therefore, did not have to check for this type of restriction but could directly process each recommendation on the list.

The exception to this processing technique occurred when no jobs were found from the QAM list. When this transpired, the ACM shifted to an alternate technique -- called its "null processing" mode -- and exhaustively searched for any position for which the applicant qualified. The length of the QAM optimal guidance list had a clear cut impact on the processing times. Longer lists required more processing for each individual, but significantly reduced the amount of [computationally expensive] null processing to be performed. Conversely, shorter lists decreased normal processing, with increased an amount of null processing. GRC typically set the ordered guidance list to 100-250 combinations.

An additional technique implemented for generating PJM lists involved using dynamic memory allocation with linked lists. When a valid PJM was identified for an applicant, a new "link" containing pertinent information was dynamically created. The link was then inserted into a linked list, based on the generated score. This process eliminated the need for special sort routines; when all possible PJM combinations had been analyzed, the resulting linked list contained all valid PJM, presorted in descending order of desirability. This technique also had the advantage of not requiring a predefinition of the number of available PJM to be evaluated. Use of linked lists resulted in a increased flexibility and a significant reduction of processing time over the usual table generation and sorting techniques. It required, however, a viable dynamic, memory management capability.

Parametric Control. Effecting the control necessary for evaluation of alternative formulations and simulation capability required provision of extensive parametric control of the ACM's processing. Definition of the ACM policy parameters was accomplished through an ACM Policy Editor. GRC developed series of interactive panels in the PTS driver routines allow EPAS users to quickly and easily modify the parameters to be employed for any given simulation.

The editor associated a named record, called the ACM Policy Record, with each set of policy parameters as they were defined. The ACM Policy Record was then saved in a file for future reference. Standard editor functions -- List, Edit, Copy, Delete, Review -- were available.

Upon entering the ACM Policy Editor, the user first declared which ACM Policy Record was to be utilized. The editor routines then prompted for the requisite parameters through a sequence of panels. The presented panels, and the parameters which to be input, were:

Execution Parameters. The first panel requested a series of parameters which controlled the execution in general. These parameters included:

(1) MOS Worth Definitions. The name of the file containing the data for determining the relative worth of specific MOS assignments.

(2) SQT Coefficients. The name of the file containing the ridge regression coefficients to be used in predicting the SQT score for individual MOS.

(3) Attrition Probabilities. The name of the file containing the data for computing first term attrition probabilities.

(4) Initial Seed Value. If one of the applicant choice options was selected, random numbers were required for the ACM's simulation. The analyst had the ability to alter the initial value used by the computer's random number generator, thus

altering the sequence of random numbers. This provided the ability to verify the robustness of the simulated solutions.

(5) Maximum Applicants per Iteration. This parameter provided the ability to limit the number of accession records to be processed during a single iteration. This enabled a quick check of system modifications, in minimum execution time, prior to executing a full-scale simulation.

(6) Maximum Job Matches per Applicant. This parameter limited the number of possible job opportunities computed for a single individual.

(7) Job Performance Option. This parameter defined which of the performance prediction measures was to be used.

Delayed Entry Program (DEP). The second panel requested information to be used in controlling the length of the DEP. This panel defined the maximum length of time (in months) that individuals were allowed to delay their entry. The ACM allowed the analyst to define these limits separately based on gender, education, and AFQT Category.

Job Selection Method. The third panel provided the capability to define the technique the ACM used to select jobs from the list of alternatives. Alternatives for this panel are discussed in the next section, Select PJM Matches.

Scoring Routine Weights. The ACM determined the best job match, as described in Appendix C, as a linear combination of a series of individual scoring factors. The fourth, and final, panel defined the relative weights to be associated with each of the criteria.

Additional ACM Input. In addition to the parametric data just described, the ACM also required the names of the files which defined the policies, options, limitations, etc. within which the model is to function. Each of these files were defined in the simulation's Run Record. The requisite files were:

(1) Accessions File -- the sample population to be used by the simulation.

(2) AAMMP Limits File -- the Active Army Military Manpower Program (AAMMP) defining the number of personnel who are to be accessed in any given month.

(3) Cluster Definition File -- the currently active MOS and the cluster with which they are associated.

(4) Composite Definition File -- the technique to be used in generating the Aptitude Area Composite scores from the ASVAB subtest scores.

(5) MOS Information File -- descriptive information for each of the currently active MOS. This included such data as minimum cut scores, quality missions, entry restrictions, etc.

(6) QAM Input File -- the QAM's optimal guidance list.

(7) School Seat File -- the number of school seats actually available for each MOS. It included information such as start date, maximum capacity, etc.

Select PJM Matches

Accurate simulation of policy alternatives required the ability to effectively simulate the impact of applicant choice on the results. At the same time, however, the need to eliminate apparently random choice existed. Random applicant choice obscured the true affect of a policy option; thus analysts had the need to explicitly control applicant choice to eliminate this unwanted influence.

GRC addressed these conflicting demands by implementing several methods of job selection. The analyst could define the method separately as a function of gender, education, and AFQT category. Two type of selection methods were implemented: fixed and random.

Fixed Selection. With this method, each individual selected the n^{th} job on the list, where "n" ranged from one to the number of jobs in the individual's list. This was the standard (i.e., default) option, with "n" set to 1. This option eliminated random applicant choice and allowed specific analysis of the affect of the policy alternative being evaluated.

Random Selection. With this method, the ACM randomly chose a job, using any of several alternative distributions. Four alternatives were implemented in the operational prototype:

(1) A normal distribution,

(2) A normal distribution, with a 40% probability of rejecting all jobs on the list.

(4) A uniform distribution across all available jobs.

(5) A uniform distribution from a maximum of "m" jobs.

Update System Status

The principle "output" from the ACM consisted of updates to the status of training requirements. These updates were used by the next iteration of the TRM to update the optimal guidance. A second type of output was implicitly required from the detailed assignment routines; namely, a tracking of each individual processed by the ACM. This second type of output allowed statistical evaluation of the results of the simulations and provided updates to the QFM.

School Seat Updates. When operating in a Simulation Mode EPAS could not, for obvious reasons, update the actual file of school seat requirements. A substitute school seat file was created, therefore, by making a copy of, or extracting from, the actual master file.

The ACM loaded the school seat information into internal arrays and updated the arrays as the simulation progresses. At the end of each iteration, a new copy of the substitute file was created; the input file was not altered. This allowed identification and analysis of the specific changes made during each iteration.

School Seat Policy File. The information contained in this file was shown in Table D-3.

School Seat File Editor. Since supporting analysis of alternative accession plans requires providing the user with the ability to generate alternative school seat plans, an editing capability was also provided for the School Seat File.

The editing capabilities for the School Seat File allowed the user to create new MOS records or alter existing records. Both provided the ability to perform policy analysis, allowing the user to selectively define new system requirements and/or to alter the historical state to determine the affect of significant changes in historical accession patterns.

If a new MOS were created, the user was required to first define the new MOS in the MOS History File. This definition gave EPAS the necessary transitional definitions. The School Seat Policy Editor verified the existence of the new MOS in the MOS History File and, if not present, prevented further definition until the analyst defined the proper linkages.

Data elements within the School Seat record which could be modified, and the implications of their modification, were:

(1) Class Start Date. The class start dates defined the necessary arrival distribution of accessions. Altering the dates for some MOS allowed the user to determine the impact which such changes would have on the Army's overall ability to meet its

annual goals, both for the specific MOS which were altered and force wide.

(2) Capacities. The School Seat record had three capacity fields: minimum fill, optimal fill and maximum fill. Altering these fields, like altering the start dates, allowed the user to assess the overall impact of changing the accessions program part way through the accession year.

(3) Current Fills. The School Seat data record had several fields -- CLASS_FILL, COHORT_FILL, MINORITY_CONT, METRICS -- which defined the current fills of the classes contained in the record. Since each of these fields defined actions which had already been accomplished, altering any of them had the affect of "changing history." Changes to these fields were only used for policy analysis simulations designed to determine the impact of sudden changes in the actual accessions available.

(4) Metric Fields. The School Seat File maintained the average metric scores, that is, Aptitude Area, Predicted SQT, Relative Worth, Predicted Attrition, and DEP/Attrition Savings, for personnel who already had contracted. Altering any of these values had the affect, like changing the current fills, of changing history and was available only for simulating advanced "what if" conditions.

Statistical Output. The second type of output generated by the ACM was a trace record giving summary information about the scores generated for the applicant. This type of output allowed analysis of the transactions generated by EPAS.

The format for the records with this output is given in Table D-16. Key data elements within the record were:

(1) FNAME. This variable was used to distinguish between different simulations or alternatives. This allowed the user to execute multiple simulations and save the results for subsequent analysis.

(2) ITERNUM. Separate output files were created for each iteration, i.e., each time period, for the simulations. This provided the ability to restart from a partial simulation as well as enabling detailed analysis on an iteration by iteration basis.

(3) PJMMOS. The MOS simulated as the contracted MOS. (This field will contain "NON" if no contract was signed.) All variable names which begin with "PJM..." pertain to this specific MOS.

(4) PJMSCORE. If the applicant being processed signed a contract, this field contains the ACM-generated PJM score for the MOS/class which was selected. If the applicant did not sign

Table D-16. ACM Statistical Output Record.

NAME	TYPE	SIZE	DESCRIPTION
FNAME	CHAR	7	Simulation Name
ITERNUM	CHAR	2	Simulation period for which data applies
APPLICANTID	CHAR	9	Unique record ID identifying the applicant
PJMMOS	CHAR	3	The MOS which was selected
PJMATT	INT	4	The predicted attrition associated with the PJMMOS
PJMSQT	INT	4	The predicted SQT score associated with the PJMMOS
PJMWRT	INT	4	The relative utility associated with the PJMMOS
PJMAA	INT	2	The Aptitude Area Composite score associated with the PJMMOS
PJMSCORE	INT	2	The ACM-generated score for the PJMMOS
PJMRANKING	INT	2	The relative position of the PJMMOS on the ordered list of recommendations
PJMPRIORITY	INT	2	The priority of the PJMMOS
APPGPID	INT	2	The Supply Group with which this applicant is associated
PJMMOSCLUSTER	INT	2	The MOS Cluster with which the PJMMOS is associated
T25SCORES (25)	INT	2	The ACM-generated scores for the first 25 recommendations
T25MOS (25)	CHAR	3	The MOS associated with the first 25 ACM recommendations
T25DATES (25)	CHAR	6	The class start dates for the first 25 ACM recommendations
CONTRACTDATE	CHAR	6	The contract date
PJMCLASSCODE	CHAR	1	The class identification code for PJMMOS
PJMSTARTDATE	CHAR	6	The starting date for PJMMOS
PJMOPTIONS(10)	CHAR	2	List of contract options selected by the applicant
PJMENLISTTERM	CHAR	3	The term of enlistment for the contract (in years)

a contract, this field will contain a negative number indicating the reason that no contract was issued. The code values this field contained are shown in Table D-17.

Table D-17. ACM Rejection Codes.

CODE	REJECTION CAUSE
- 1	No Jobs. The ACM was unable to find any jobs for which the applicant was qualified.
- 3	Bad Supply Group. An error was generated when determining the supply group with which the applicant should be associated.
- 4	ASVAB Scores. The applicant had invalid ASVAB scores in his/her record and could not be processed.
- 5	Applicant Choice. The applicant elected not to accept any of the jobs which were available.

(5) PJMRANKING. This is the relative ranking of the PJMMOS on the ordered list which passed to the ACM from the QAM. If the PJMMOS was not on the QAM list, i.e., null processing was performed, this field will have a -88 flag value. If not MOS was selected, the filed will have a -99 flag value.

REQUEST Interface Module

The REQUEST Interface Module (RIM) provides the link from EPAS into REQUEST. It will be required for the Operational Mode and has not been implemented at this time. GRC conducted analyses, however, to determine what form the RIM would require were it implemented in an operational system. This section describes this anticipated interface.

Two types of data will be required by REQUEST: (1) weekly optimal guidance and (2) Supply Group definitions.

Weekly Recommendations

GRC anticipates weekly executions of EPAS in the Operational Mode. The generated optimal guidance would be applicable for the entire week. The record format for weekly data to REQUEST is shown in Table D-18. This information contains the recommended training/initial-entry MOS (TRENMOS) and start date for the AIT/OSUT training. Weekly data are:

(1) SGROUP. This field contains the number of the Supply Group for which the recommendations are applicable. A block of recommendations will exist for each supply group. Each block will have a user-specified number of recommendations, typically 100. Each recommendation will be in the format depicted

Table D-18 Weekly Data

EPAS VARIABLE NAME	TYPE	DESCRIPTION
SGROUP	INTEGER	Supply Group ID Number
QAMSCORE	INTEGER	Relative score (1000 [best] to 0 [worst] generated by the EPAS optimization procedures
QAMMOS	CHAR(3)	Three-character, recommended MOS
STDATE	INTEGER	Year-month of recommended training start date (BT or OSUT)
AITDATE	INTEGER	If non-OSUT MOS, AIT start date; else zero

in Table D-18 and will contain 11 bytes of data. Thus each weekly transmission would contain approximately 82,500 (11 x 100 x 75) bytes of information.

(2) QAMSCORE. This field contains the relative value of the MOS/start date recommendation expressed as a numerical score in the range of 0-1000, inclusive. The range and form of this value allows its direct use in the Hierarchy scoring algorithm.

(3) QAMMOS. The 3-character designator of the MOS for which training is recommended. Note that the EPAS optimization routines are not sensitive to the fourth character used in the REQUEST system. Thus, an "11X1" is viewed identically to an "11XP" by EPAS. This provides REQUEST with flexibility as to selecting the specific class to be used.

(4) STDATE. The Recruit Year/Recruit Month in which training is recommended to begin. For traditional BT/AIT sequences, this is the date on which basic training is to begin. For OSUT classes, it is the date on which the OSUT training is to begin. The specific week within the month is not addressed by the optimization routines. Here, again, REQUEST is provided the flexibility of selecting the specific class within the recommended month.

(5) AITDATE. The Recruit Year/Recruit Month in which AIT training is recommended to begin. For traditional BT/AIT sequences, this is the date on which AIT is to begin. For OSUT classes, this field will always be zero.

Supply Group Definition Data

EPAS uses groupings, called Supply Groups, of the Army's supply of contractees. The Supply Groups are statistically determined using automated clustering routines. The current formulations are defined by Mission Category (see Table D-19) and Aptitude Area Composite Scores (CL, CO, EL, FA, GM, MM, OF, SC, and ST).

The Mission Category with which an applicant is associated can be explicitly determined based on the individual's demographic characteristics. Within that Mission Category, however, the specific Supply Group must be computed based on which group the individual's composite scores fit most closely. Each Mission Category may have a different number of Supply Groups associated with it.

The data necessary to perform the computations to determine Supply Groups are shown in . The approximate number of bytes to be transferred is 75 x 464 = 34,800; this will typically be transmitted annually as the Supply Groups are recomputed. Supply Group data are:

(1) SGROUP. The Supply Group number in the form of a right-justified, three-digit number ranging from 1-999, inclusive.

Table D-19 Mission Categories

GENDER	EDUCATION	AFQT CATEGORY
MALE	HSDG	I-II
MALE	HSDG	IIIA
MALE	HSDG	IIIB
MALE	HSDG	IV
MALE	HSSR	I-II
MALE	HSSR	IIIA
MALE	HSSR	IIIB
MALE	HSSR	IV
MALE	NHSG	I-II
MALE	NHSG	IIIA
MALE	NHSG	IIIB
MALE	NHSG	IV
FEMALE	HSDG	I-II
FEMALE	HSDG	IIIA
FEMALE	HSDG	IIIB
FEMALE	HSDG	IV
FEMALE	HSSR	I-II
FEMALE	HSSR	IIIA
FEMALE	HSSR	IIIB
FEMALE	HSSR	IV

Table D-20 Supply Group Data

VARIABLE NAME	DATA TYPE	DESCRIPTION
SGROUP	CHAR(3)	Supply Group Number
GENDER	CHAR(1)	Physiological characteristic
EDUC	CHAR(4)	Education level at contract signing
AFQT	CHAR(1)	AFQT Category
MEAN	9*CHAR(5)	Aptitude Area Scores
MATRIX	81*CHAR(5)	Aptitude Area variability Matrix
PRIOR	CHAR(5)	Prior probabilities adjustment factor
	Total Record Length: 464 Bytes	

This number will correspond to the SGROUP in the weekly recommendation list.

(2) GENDER. The applicant's gender, where "M" = Male and "F" = Female.

(3) EDUC. The applicant's education level at the time the initial contract was signed. Codes for this field, based on defini-

Table D-21 Education Codes

EPAS CODE	DEFINITION	REQUEST CODE
NHSG	Non-High School Grad	5 - NHSG
		10 - COMP
		15 - ATTN
		20 - CIHS
		25 - GEDH
HSSR	High School Senior	30 - HSSR
HSDG	High School Graduate	35 - HSDG
		40 - CLEP
		45 - ASSC
		50 - NURS
		55 - BACL
		60 - MAST
		65 - PMAS
		70 - DOCT
		75 - PROF

tions for the EDUC field in the AARCRT-AA Recruit File, Label AARCDD, are depicted in Table D-21.

(4) AFQT. A one-digit, numeric code defining the applicant's AFQT category, where:

1 - AFQT Category I-II
2 - AFQT Category IIIA
3 - AFQT Category IIIB
4 - AFQT Category IV

(5) MEAN. A nine-element array containing the mean aptitude area scores[1] associated with the Supply Group. Each element of the array corresponds to an aptitude area as shown in Table D-22.

Table D-22 Aptitude Areas

#	AA
1	CL
2	CO
3	EL
4	FA
5	GM
6	MM
7	OF
8	SC
9	ST

(6) MATRIX. A nine × nine element array[1] containing the aptitude area variability matrix.

(7) PRIOR. A single number[1] providing an adjustment factor based on prior probabilities.

Supply Group Computations

The Supply Group with which an individual is associated is computed in the following steps:

1) Determine the individual's Mission Category based on the demographic characteristics (GENDER, EDUC, and AFQTCAT) as defined above. The Mission Category thus defined determines the set of Supply Groups with which the applicant may be associated.

[1] Numeric values, CHAR(5) in the data record, are of the form XXX.XX. Thus the value "12345" in the Supply Group Data records would be interpreted as "123.45" in resulting computations

2) For each of the possible Supply Groups, perform the following steps:

a. Assume the applicant's composite scores have been moved into an array names "SCORES" arranged in the same order as shown in Table D-22, i.e., SCORES(1) = CL [AARCDD word 20, bits 0-15]; SCORE(2) = CO [AARCDD word 21, bits 16-31]; etc.

b. Let TMP1 and TMP2 be two nine-element work arrays of type REAL. They will be used to hold intermediate computations. TMP1 is computed as:

```
    DO 1  IAA = 1, 9
       TMP1(IAA) = SCORES(IAA) - MEAN(IAA)
  1 CONTINUE
```

c. TMP2 is computed as:

```
    DO 2  IAA = 1, 9
       TMP2(IAA) = 0
       DO 22  JAA = 1, 9
          TMP2(IAA) = TMP2(IAA) +
   x              TMP1(JAA)*MATRIX(IAA,JAA)
 22    CONTINUE
  2 CONTINUE
```

d. Next, compute a temporary VALUE as:

```
    VALUE = PRIOR
    DO 3 IAA = 1, 9
       VALUE = VALUE + (TMP1(IAA) * TMP2(IAA))
  3 CONTINUE
```

e. Determine which Supply Group generated the smallest VALUE. This is the Supply Group to which the applicant belongs; the number in SGROUP defines the weekly recommendation list which should be used.

ESTABLISH SYSTEM FRAMEWORK

The support computer for the EPAS' operational prototype was the Army's Information Systems Command -- Pentagon (ISC-P) facility. This facility utilized IBM 3090 mainframes operating under the VMS/XA computer system. Data access is through IBM's VSAM facility. Excepting the optimization procedures (ARCNET and Whizard), all programs have been developed in the PL1 programming language. User interface panels were coded using IBM's Cross System Product (CSP) facility.

PTS Standardization

The Process Test System (PTS) provided the overall system control and user interface procedures necessary to run EPAS. An interactive, user-friendly front-end provided the necessary interface between user and system. It provided developers and users with an easy system interface and expedited debugging and fine tuning. The front-end provided the following capabilities:

(1) Fully Menu Driven. Access to all components of EPAS was achieved through menu panels. The user controlled selection of options via explicit preference from a menu of alternatives. Data entry was into defined fields on appropriate panels. A tree structure allowed the user to easily identify the path into the specific action to be performed.

(2) Use of Video Attributes. Full use of color video attributes facilitates rapid identification of selected options.

(3) Standardized Control Keys. While each menu panel displayed information unique to the process being performed, the control functions available to the user remained consistent at all levels within the system.

(4) Data Editing. Data was automatically edited by the system as it is entered. This provided the user with immediate feedback and verification of ongoing transactions.

(5) Error Messages. Error messages and warnings were displayed at the bottom of the screen when the erroneous data or parameters were entered.

(6) Standardized Editors. A standard editor to add, modify, copy or delete categories of EPAS parameters such as policies, MOS requirements, and the training program.

Provide Execution Control

EPAS provided a blend of interactive (foreground) and batch (background) execution. The interactive portion of the system allowed the user to define policy parameters, examine model status, and review reports with immediate feedback and access. Once the desired job parameters were fully defined, the models were automatically submitted for batch execution, freeing the user's terminal for other activities. The system execution controls design featured the following capabilities:

(1) Support for any user-specified combinations of applicant, policy, MOS requirements, school seat and training, etc. input data files.

(2) Support the EPAS iteration methodology.

(3) Support for any number of iterations, starting at any time point; further, the system supported rerunning iterations.

(4) Support for automatic, on-line submittal of batch (off-line) EPAS runs. These submittals included simulations and optimizations, report generation, metrics reference generation and applicant/contractee file generation.

(5) Batch control programs control and monitor batch EPAS run submittals.

The Run File

A file interface, called the Run File supported the first three items on the list, above. Table D-23 shows the information contained within this file. It provided the interface for users to specify all execution-related files and parameters for batch operation. It also was the medium which the batch system used to report on run status, temporary files to be used and other run-related information. A standard editor provided the user interface.

<u>Run File Categories</u>. Most of the information contained in the Run File record description is self explanatory. This information is divided into five categories:

(1) <u>Execution-related Parameters</u>. These included the run name and description, the type of run (MODULES), the run start date of the analysis in Reception Station Date terminology (year, month, week, week of month in the year) and in fiscal year terminology, the iteration time span (week, month, year), the number of iterations, the starting iteration (would be greater than 1 if restarting from a previous analysis), and the system abort indicator flag.

Table D-23. Run File Record Structure.

NAME	TYPE	SIZE	DESCRIPTION
***** EXECUTION RELATED PARAMETERS *****			
SIMNAME	CHAR	7	Unique name of the EPAS run
DESCRIPTION	CHAR	40	Text description of run
MODULES	INTEGER	2	Type of run: 1 - Optimization 2 - Simulation 3 - Contractee Forecast 4 - Applicant Assignment
OPTIM_ANALYSIS	INTEGER	2	Optimization Analysis: 0 - Regular 1 - Mission Goal 2 - Reserved 3 - Sensitivity
BEGINYR	INTEGER	2	Starting Recruit Year
BEGINMTH	INTEGER	2	Starting Recruit Month
BEGINWK	INTEGER	2	Starting Recruit Week
BEGINWKOFMTH	INTEGER	2	Starting Recruit Week of Month
BEGINDAY	INTEGER	2	Starting Recruit Week Day
BEGIN_FYYR	CHAR	4	Starting FY Year
BEGIN_FYMTH	CHAR	2	Starting FY Month
BEGIN_FYDAYOFMTH	CHAR	2	Starting FY Day of Month
ITERMODE	INTEGER	2	Iteration Mode: 0 - No iterations 1 - Weekly 2 - Monthly 3 - Yearly
ITERNUMBER	INTEGER	2	Number of Iterations
ITERSTART	INTEGER	2	Starting Iteration Number
ABORTFLAG	INTEGER	2	System Abort: 0 - Abort as required 1 - Fatal abort only
DEPLOSSFLAG	INTEGER		DEP Loss Processing: 0 - No processing 1 - Processing
***** FILE PARAMETERS *****			
APPFILE	CHAR	7	Applicant/Contractee Filename
CLUSTERFILE	CHAR	7	Cluster Filename
DEPFILE	CHAR	7	DEP Loss Filename
METRICFILE	CHAR	7	Metrics Filename
MOSFILE	CHAR	7	MOS Requirements Filename
SCHFILE	CHAR	7	School Seat/Plan Filename
POLICYFILE(10)	CHAR	7	Policy Parameter Filenames: (1)-TRM Policy (2)-QFM Policy (3)-QAM Policy (4)-ACM Policy (5)-ELIM Accessions

Table D-23. Run File Record Structure (continued).

NAME	TYPE	SIZE	DESCRIPTION
***** OUTPUT OPTIONS *****			
REPORTS(20)	INTEGER	2	Report Select Flag: 0 - Not selected 1 - Selected
METRICS(10)	INTEGER	2	Metrics Flag: 0 - Not selected 1 - Selected
ACMBRICK(10)	CHAR	3	Demographic Tree Flag: 0 - Not selected 1 - Selected
QAMBRICK(10)	INTEGER	2	Brick Chart Cluster List (1)=99 indicates all
TRACEFLAG(10)	INTEGER	2	Trace flag: (1) - TRM (2) - QFM (3) - QAM (4) - ACM (5) - PTS (6) - Metrics Generator
***** PROCESSING OPTIONS *****			
COMPOSITE	INTEGER	2	Composite Type: 1 - Old Composite/1980 Norm 2 - New Composite/1980 Norm 3 - Old Composite/1944 Norm 4 - New Composite/1944 Norm (2 is default)
SCALEFLAG	INTEGER	2	Demand Scale Flag: 0 - No scaling 1 - Scaling
SCALEFACTOR	INTEGER	2	Scaling Factor: -1 - Down To 0 - Equal 1 - Up From Applicants Population
SCALEPER	REAL	4	Scaling percentage
YRAPPTOTAL	INTEGER	4	Applicant Yearly Population
QFMMATCH	INTEGER	2	Simulation population match with QFM forecast flag: 0 - No match 1 - Match

Table D-23. Run File Record Structure (continued).

NAME	TYPE	SIZE	DESCRIPTION
OPTIMFACTOR	INTEGER	2	Optimization Metric: 1 - Aptitude Area Score 2 - SQT Score 3 - 1st term Attrition 4 - Worth Measure 5 - DEP/Attrition $
OPTIMWEIGHT(3)	REAL	4	Metrics Weighting Factors
***** HISTORICAL DATA *****			
CURRENTITRER	INTEGER	2	Current Iteration Number
LASTITER	INTEGER	2	Last Iteration Completed
CURRYR	INTEGER	2	Current Recruit Year
CURRMTH	INTEGER	2	Current Recruit Month
CURRWKOFMTH	INTEGER	2	Current Recruit Week of Mth
CURRDAY	INTEGER	2	Current Recruit Day
LASTYR	INTEGER	2	Last Iteration Rec Year
LASTMTH	INTEGER	2	Last Iteration Rec Month
LASTWK	INTEGER	2	Last Iteration Rec Week
LASTWKOFMTH	INTEGER	2	Last Iteration Rec Wk of Mth
LASTDAY	INTEGER	2	Last Iteration Rec Day
TMOSFILE	CHAR	7	Simulation used Rqmts File
TSCHFILE	CHAR	7	Simulation used Sch Seat File
ABORTMOD(3)	CHAR	3	Aborting Module
CURR_FYYR	CHAR	4	Current FY
CURR_FYMTH	CHAR	2	Current FY Month
CURR_FYDAYOFMTH	CHAR	2	Current FY Day of Month

(2) File and Record Name Parameters. These included files on applicants and contractees, MOS clusters, DEP loss, metrics, MOS requirements, school seats and training plans, and EPAS policy.

(3) Output-related Parameters. These specified the reports generated after each iteration and the level of trace and debugging for each batch component.

(4) Processing Options. These included the ASVAB composite used (default is new composites, 1980 norm), scaling factors for the MOS requirements and training program. An applicant and contractee forecast match flag (if on, a contractee simulation population will be generated for each iteration that matches the projected population), and the optimization metric used with weights which permitted linear combinations of up to three metrics. Scaling changed the relationship between the contractee supply and MOS requirements; demand requirements were scaled up or down while holding supply constant.

(5) Historical Data Parameters. These were read only and could not be changed by the user. They included processing iteration information, run termination code, aborting module (if abnormal termination), last and current processing dates, and temporary file names for MOS requirements and school seat/training program information. These files were altered during EPAS processing so copies were maintained for each iteration in order to retain the original information.

Batch Operations Control

The submittal of batch jobs occurred after the on-line system completed running. A Command List (CLIST) was developed to execute the on-line system which, at on-line system termination, checked a return code to determine if any batch runs were to be scheduled. If so, the CLIST read an interface file specifying the type of batch job (simulation, optimization, reports, metric generation, contractee file generation) and the Run File name. Based on this information, the CLIST edited a standard batch submittal JCL file by inserting the run file name and job card information. The CLIST then submitted the edited file for batch execution.

A batch control program was developed for each of the batch operations. This program read the Run File name from the parameter (PARM) statement in the execution JCL. All other information regarding the execution of the system was contained in the Run File.

REPORT RESULTS

While not explicitly identified as one of the major functional categories for the research effort, one additional requirement existed for the prototype system, namely the ability to report results. Reports displayed the outcome of EPAS assignment analyses and plans. The reports generated for the EPAS prototypes were geared toward supporting the analysis and research being performed. Thus, they were of limited utility to Army functional [operational] proponents. Fourteen reports were developed, within which the user could select options such as:

(1) Iteration(s). A representation of the interval of time (weekly or monthly) that EPAS was simulating.

(2) Demographic Grouping. This grouping encompassed gender, level of education, and AFQT category.

(3) Performance Measures. The utilities of measure that were used in the execution.

(4) Level of Detail. This option was available on MOS aggregation to cluster and MOS.

Report Metrics

The capability of displaying performance measures (metrics) was provided for two reasons. First, the metric(s) on which optimization had been performed had to be reported to enable analysis of the results of the optimization. Secondly, other metrics, on which optimization was not performed, were shown for comparison purposes. This enabled the analyst to determine the effects of the runs on alternative metrics.

The metrics that could be displayed on the reports were:

(1) Attrition (ATT). Values ranged from 0.0 to 1.0, representing the average probability of applicants attriting from the Army before expiration of their initial enlistment.

(2) Projected Aptitude Area. Scores ranged from 40 to 155, representing the applicants average Aptitude Area Composite score (i.e. clerical, technical, etc.) associated with the MOS.

(3) MOS Utility. Scores ranged from 0 to 100, representing the relative utility to the Army of an assignment in the MOS.

(4) Skills Qualification Test Scores. Scores ranged from 0 to 100, representing the predicted scores on the SQT for the MOS.

(5) DEP/ATT savings, which estimated of how much the Army saves in aborted training costs by placing an recruit in the DEP.

Due to space considerations, only three of the five metrics could be displayed at a time.

Report Procedures

Two issues drove the design of the report generation procedures. The first was the accommodation of the analyst's requirements for reports. The second was the need to reduce the processing time for the creation of reports. The user wanted the ability to create report(s) at any point in time (i.e. during and/or after a simulation). Once selected, however, reports needed to be produced as quickly as possible.

The implemented design had two report generators operating in batch mode. The first, the during-simulation generator, produced reports while the simulation was running. The second, the post-simulation generator, produced reports after the simulation had completed and the user requested reports.

The during-simulation generator allowed the user to select which reports and options were desired from a menu prior to the beginning of the simulation. As the simulation ran, these reports were generated at the end of each iteration.

The post-simulation generator allowed the user to select reports from a menu following the completion of a simulation. These requests were written to a command file. A batch job was submitted which used the command file for its parameters.

Support for Report Generators

Two routines were developed that created data files to minimize the processing time of the report generators. Both routines are only executed once for each secondary and ACM output file. These routines were:

- The Metrics File routine, which performed calculations on the metric scores from each record in the user selected applicant-contract file (secondary).
- The Brick Chart routine, which computed data for the Brick Charts.

Data files created by the Metrics File routine enabled the generators to readily access the heavily used metric data when creating future reports. Table D-24 and Table D-25 depict information contained in these files.

The second data file, created by the Brick Chart routine, enabled future creation of Brick charts without having to read sequentially through each ACM output file. Table D-26 shows the information generated by the Brick Chart routine.

Table D-24. Metrics File, Information Record Structure.

NAME	TYPE	SIZE	DESCRIPTION
Record Name:	ACTMETINFO		
FILENAME	CHAR	7	The name of the file
INFOKEY	CHAR	3	Dummy Key always "000"
MOSCLFILE	CHAR	7	MOS to Cluster File
MODIFYFLAG	CHAR	6	Flag indicating whether MOS to Cluster File has been modified
SQTFILE	CHAR	7	SQT Metric File
ATTFILE	CHAR	7	Attrition Metric File
WRTFILE	CHAR	7	Worth Metric File
FILLER	CHAR	7	Fills out the record

Table D-25. Metrics File, Data Record Structure.

NAME	TYPE	SIZE	DESCRIPTION
Record Name: ACTMETRECORD			
FILENAME	CHAR	7	The name of the file
ACCESSMOS	CHAR	3	Military Occupational Skill
CONMETRICS(6,12,6)	INT	2	CON - Contract Date within Recruit Year & Ship date is within the Recruit Year also
CON2METRICS(6,12,6)	INT	2	CON2 - Contract Date within Recruit Year & Ship date is outside of the Recruit Year
ACCMETRICS(6,13,6)	INT	2	ACC - Accession Date

First Dimension AFQT Category where:

1 — MCAT 1
2 — MCAT 2
3 — MCAT 3A
4 — MCAT 3B
5 — MCAT 4
6 —MCAT 5 .. Just in case they exist on the file

Second Dimension Accession (or Contract) Month where:

1 — January of Current Recruit Year
2 — February of Current Recruit Year
. . .
12 — December of Current Recruit Year
13 — Next Recruit Year

Third Dimension Metric Total Counts where:

1 — Aptitude Area Score
2 — Projected SQT Score
3 — Attrition Rate
4 — AIR Worth Measure
5 — Dep/Att Savings
6 — Total Number of Actual Accessions

Table D-26. Brick Chart Data Record Structure.

NAME	TYPE	SIZE	DESCRIPTION
Record Name: CONTREC			
FILENAME	CHAR	7	The name of the file
MONTHMOS	CHAR	6	Cont month & MOS : OCT11X
NUMCONTS(12,2,2,3)	INT	15	Number of contracts by demographics.
	First dimension:		Accession month of FY, Jan..Dec order
	Second dimension:		Gender 1 - male, 2 - female
	Third dimension:		MCAT 1 - 1-3A, 2 - 3B-V
	Fourth dimension:		Edcert 1 - HSSR, 2 - HSDG, 3 - NHSG
DEP(2,2,3)	INT	15	The total number that DEP to the next FY
	First dimension:		Gender 1 - male 2 - female
	Second dimension:		MCAT 1 - 1-3A 2 -3B-V
	Third dimension:		Edcert 1 - SNR 2 - HSG 3-NHG

Report Assignments

The QAM determined the global assignments using optimization; the ACM determined detailed assignments through the use of heuristic simulations. Reports of QAM assignments only displayed on the cluster level because only data at that level was available. The user had the option of choosing summary reports, which provided the data over a cumulative number of iterations. The reports displayed a comparison among the QAM assignments, ACM assignments, and historical assignments (i.e., actual assignments as shown on reports under the "ACT" column) in the cluster reports.

At the MOS level, the data was displayed by AFQT Category and overall for the detailed and historical assignments. These assignments were displayed at the cluster level and MOS level. The two types of assignments were contracts and accessions.

Contracts. Contracts is the term used to describe those applicants who signed a contract to join the Army. Reports were developed to display metrics on assignments which both contracted and accessed in the fiscal year. A second report displayed assignments made in the fiscal year which were accessed beyond the fiscal year. Another metric report showed total contracts, i.e., a cumulative report on those who sign a contract during the fiscal year without regard to when they access.

Several reports displayed contract information: including five metric reports, two brick charts, and a quality goal report. An example of a contract metric report is provided in TAB D-1, Figure D-1.

Optimization Metrics. This report was generated for an optimization-only execution encompassing one year of data. In addition to the assignments, this report also displayed metrics. The actual metrics were calculated from the fiscal year applicant-contract (primary) file. This differed from other metric reports, which used the user-selected applicant-contract (secondary) file. The primary file was used because, during this type of execution, the secondary file was not utilized. The DEP values that appeared on this report represent the historical DEP pool. An example can be seen in TAB D-1, Figure D-2.

Accessions. This is the term used for those applicants that have reported for duty. EPAS accession reports related only to accessions which occur during the fiscal year. Several reports were available for this population, including two metric, an average aptitude area, and a quality goal report. An example of a MOS-level Metric Accessions report can be seen in TAB D-1, Figure D-3. Note data on all MOS are not provided for simplicity.

Average Aptitude Area. This report presented a breakdown of total assignments and average aptitude area score by demographic grouping and aptitude area (i.e. CL, CO ... ST) for the ACM, secondary applicant file (ACTUAL), and primary applicant file (PRIMARY). TAB D-1, Figure D-4 depicts an example of this report. Note that data has not been provided for each aptitude area for simplicity.

Quality Mission. This report displayed the degree to which the quality missions were met for the ACM and historical assignments, by gender. It was available for both the cluster and MOS level of assignments.

Contracts and Accessions. There were two reports that displayed both the number of contracts and accessions. They were in the form of brick charts.

Brick charts report the number of accessions, contracts, and entry DEP by each month in the fiscal year, as well as cumulative totals. Brick Charts are used by USAREC to manage contract and accession flow by mission block and by MOS. The QAM and ACM versions were at the cluster and MOS level, respectively. The user had the capability of displaying the data by demographic grouping over ten user selected MOS or clusters, or over all MOS or clusters. An example of a QAM brick chart report follows in TAB D-1, Figure D-5.

Graphics

GRC demonstrated the ability to display graphics in the form of line drawings and histograms in the Version 2 of EPAS on the DLF (the WICAT minicomputer). Graphics was not supported on the ISC-P computer facility, however, so this reporting capability was eliminated from the operational prototype.

An indirect graphic capability should be available in a fully operational system using existing methodology. Specifically, this would entail extracting appropriate data from EPAS files. These data would then be made available to the Army's HQDADSS Management Information System (MIS). Graphic displays, similar to those already available in the FORECAST systems, would then be available to Army mangers.

TAB D-1
SAMPLE EPAS REPORTS

Figure D-1. Metric Report.

METRICS BY CLUSTER: CONTRACTS ACCESSING WITHIN FISCAL YEAR 1984

ITERATION: 1

SIMULATION NAME: 84BASE

	CLUSTER TITLE	INVENTORIES GAR	INVENTORIES ACR	INVENTORIES ACT	PROJECTED AA GAR	PROJECTED AA ACR	PROJECTED AA ACT	ATTRITION GAR	ATTRITION ACR	ATTRITION ACT	MOS WORTH GAR	MOS WORTH ACR	MOS WORTH ACT
(36)	CLUSTER 36	27	3	3	126.9	*****	112.0	0.156	*****	0.261	76.2	*****	32.6
(27)	CLUSTER 27	209	11	20	109.7	111.7	116.9	0.193	0.197	0.261	49.8	67.4	72.5
(50)	CLUSTER 50	8	1	0	109.0	102.0	*****	0.241	0.200	*****	51.5	25.0	*****
(42)	CLUSTER 42	1	0	2	109.0	*****	123.0	0.172	*****	0.178	38.8	*****	73.7
(39)	CLUSTER 39	4	0	1	114.0	*****	116.0	0.183	*****	0.385	40.4	*****	54.0
(1)	CLUSTER 1	9	1	0	127.9	134.0	*****	0.187	0.187	*****	64.5	19.3	*****
(56)	CLUSTER 56	76	2	3	112.2	101.5	113.7	0.196	0.361	0.193	77.6	64.4	67.3
(30)	CLUSTER 30	38	4	3	101.6	88.0	101.3	0.228	0.299	0.216	25.0	47.9	56.8
(52)	CLUSTER 52	104	0	9	98.6	*****	101.8	0.231	*****	0.235	66.7	*****	75.1
(9)	CLUSTER 9	1	1	0	116.0	117.0	*****	0.178	0.178	*****	9.7	4.1	*****
(34)	CLUSTER 34	16	0	0	127.0	*****	*****	0.209	*****	*****	70.2	*****	*****
(43)	CLUSTER 43	0	0	0	*****	*****	*****	*****	*****	*****	*****	*****	*****
(47)	CLUSTER 47	6	0	1	116.2	*****	107.0	0.208	*****	0.397	43.0	*****	6.9
(4)	CLUSTER 4	62	13	3	127.0	127.8	115.3	0.210	0.208	0.300	71.9	23.6	46.3
(17)	CLUSTER 17	43	6	0	109.5	111.5	104.6	0.333	0.236	0.300	57.2	28.9	49.8
(37)	CLUSTER 37	43	0	3	116.0	*****	121.7	0.226	*****	0.261	48.2	*****	63.0
(21)	CLUSTER 21	8	1	0	111.6	95.0	*****	0.229	0.246	*****	33.4	4.1	*****
(25)	CLUSTER 25	77	20	9	107.4	101.0	100.2	0.269	0.262	0.343	27.4	40.1	20.5
(32)	CLUSTER 32	364	7	27	116.1	97.7	109.9	0.297	0.369	0.291	77.3	88.9	71.7
(41)	CLUSTER 41	5	0	0	116.0	*****	*****	0.213	*****	*****	8.6	*****	*****
(2)	CLUSTER 2	2	2	0	114.0	115.5	*****	0.219	0.181	*****	40.6	28.7	*****
(14)	CLUSTER 14	7	4	0	110.4	117.0	*****	0.235	0.240	*****	38.0	12.1	*****
(11)	CLUSTER 11	14	4	0	114.0	116.5	*****	0.236	0.238	*****	27.6	32.2	*****
(12)	CLUSTER 12	17	3	3	115.0	114.3	119.7	0.245	0.239	0.317	30.4	0.0	22.0
(29)	CLUSTER 29	12	0	0	107.8	*****	*****	0.258	*****	*****	15.8	*****	*****
(48)	CLUSTER 48	6	0	0	112.0	*****	*****	0.237	*****	*****	32.9	*****	*****
(55)	CLUSTER 55	6	0	0	127.0	*****	*****	0.252	*****	*****	93.3	*****	*****
(20)	CLUSTER 20	154	26	9	103.5	106.4	113.2	0.449	0.424	0.257	29.0	30.4	65.6
(7)	CLUSTER 7	7	5	0	109.3	110.4	*****	0.266	0.263	*****	32.4	6.9	*****
(26)	CLUSTER 26	600	43	26	103.0	103.4	111.5	0.330	0.342	0.347	44.3	46.7	67.3
(53)	CLUSTER 53	218	4	22	117.7	102.8	108.5	0.279	0.300	0.301	85.3	32.6	84.3
(38)	CLUSTER 38	6	0	0	107.7	*****	*****	0.401	*****	*****	36.4	*****	*****
(3)	CLUSTER 3	0	0	0	*****	*****	*****	*****	*****	*****	*****	*****	*****
(6)	CLUSTER 6	7	0	1	113.6	*****	132.0	0.385	*****	0.300	45.5	*****	82.7

Figure D-1. Metric Report (continued).

METRICS BY CLUSTER: CONTRACTS ACCESSING WITHIN FISCAL YEAR 1986

ITERATION: 1

SIMULATION NAME: 86BASE

	CLUSTER TITLE	INVENTORIES			PROJECTED AA			ATTRITION			MOS WORTH		
		OAM	ACM	ACT	OAM	ACM	ACT	OAM	ACM	ACT	OAM	ACM	ACT
(5)	CLUSTER 5	29	12	4	106.1	103.9	102.0	0.269	0.267	0.421	36.2	23.6	28.9
(18)	CLUSTER 18	109	32	16	109.0	108.6	106.5	0.290	0.368	0.405	55.8	49.5	38.1
(46)	CLUSTER 46	10	0	2	112.8	*****	110.5	0.385	*****	0.292	55.0	*****	36.8
(23)	CLUSTER 23	31	15	3	103.8	116.9	105.0	0.495	0.291	0.391	24.1	72.2	29.8
(40)	CLUSTER 40	1	0	0	108.0	*****	*****	0.385	*****	*****	8.9	*****	*****
(54)	CLUSTER 54	139	2	17	118.4	97.5	108.6	0.272	0.393	0.294	88.6	98.0	77.1
(15)	CLUSTER 15	48	1	1	108.0	115.0	108.0	0.284	0.284	0.483	49.8	26.3	48.1
(44)	CLUSTER 44	0	0	0	*****	*****	*****	*****	*****	*****	*****	*****	*****
(16)	CLUSTER 16	35	10	4	104.7	104.8	117.5	0.300	0.309	0.296	43.0	34.5	44.5
(8)	CLUSTER 8	5	4	0	99.0	98.8	*****	0.385	0.385	*****	6.2	1.2	*****
1(35)	CLUSTER 35	47	0	2	108.0	*****	104.5	0.428	*****	0.301	58.1	*****	48.3
(45)	CLUSTER 45	7	0	1	104.6	*****	107.0	0.321	*****	0.608	59.3	*****	65.2
(26)	CLUSTER 26	365	76	33	116.1	116.8	99.7	0.355	0.290	0.360	61.9	44.5	26.7
(28)	CLUSTER 28	54	0	5	115.7	*****	110.0	0.295	*****	0.317	29.7	*****	17.3
(33)	CLUSTER 33	264	8	14	104.5	90.3	94.3	0.471	0.455	0.434	29.9	41.4	38.2
(51)	CLUSTER 51	748	12	73	99.5	92.8	106.0	0.348	0.350	0.373	50.3	68.9	75.0
(10)	CLUSTER 10	19	5	2	100.0	100.8	119.5	0.408	0.402	0.292	10.5	4.1	33.3
(22)	CLUSTER 22	40	3	2	95.2	92.3	97.0	0.391	0.383	0.366	3.7	3.1	13.3
(49)	CLUSTER 49	3	0	0	124.0	*****	*****	0.326	*****	*****	66.9	*****	*****
(19)	CLUSTER 19	261	25	18	97.7	96.7	110.1	0.410	0.389	0.450	23.3	61.5	53.6
(13)	CLUSTER 13	42	2	6	107.1	122.0	105.0	0.576	0.354	0.622	49.6	53.6	40.2
(31)	CLUSTER 31	28	6	1	104.1	96.3	[illegible]	0.453	0.445	0.445	56.4	26.7	52.9
	TOTALS	4242	369	357	107.6	107.5	107.6	0.329	0.321	0.339	50.0	43.5	58.9

TAB D-1 (continued)
SAMPLE EPAS REPORTS

Figure D-2. Optimization Report.

METRIC COMPARISON BY CLUSTER

GLOBAL OPTIMIZATION VS HISTORIC DATA

		ASSIGNMENTS			APTITUDE AREA			PROJECTED SQI			ATTRITION		
(#)	CLUSTER NAME	DEP	GAM	ACT	DEP	GAM	ACT	DEP	GAM	ACT	DEP	GAM	ACT
(36)	COM/INT 1-3B HS	0	600	336	119.8	126.4	118.2	78.44	91.98	85.39	0.298	0.160	0.275
(27)	E/M REP 1-4	55	4099	4376	115.6	107.9	113.7	86.80	82.42	87.07	0.205	0.198	0.250
(50)	E/M REP 1-4 HS	5	116	107	117.2	109.2	114.9	81.17	84.97	88.03	0.255	0.223	0.215
(42)	E/M REP 1-3B HS	1	32	47	121.0	108.5	116.5	82.76	84.73	91.91	0.225	0.211	0.279
(39)	MED/DENT SP 1-3B HS	1	87	82	126.0	118.2	112.2	89.95	84.04	74.51	0.204	0.189	0.250
(1)	EE REP 1-3A	3	171	172	128.0	123.0	126.5	86.25	95.59	84.07	0.233	0.167	0.251
(56)	E/M REP 1-4 MALE	16	1561	1535	115.8	109.3	112.8	75.94	74.43	76.06	0.244	0.215	0.258
(30)	CRAFTS 1-4	16	602	644	105.8	108.5	104.4	82.54	84.71	80.32	0.251	0.232	0.267
(52)	INF 1-4 MALE	51	2204	2154	103.1	104.8	103.9	88.75	88.90	87.38	0.244	0.234	0.271
(9)	OIN TECH SP 1-3B	0	28	44	*****	113.2	121.1	*****	71.89	83.48	*****	0.188	0.248
(34)	EE REP 1-3B HS	1	64	83	124.0	114.2	119.9	86.78	74.24	82.86	0.416	0.192	0.278
(43)	SERV/SUP 1-3B HS	0	7	19	*****	103.1	114.6	*****	74.77	88.75	*****	0.178	0.203
(47)	MED/DENT SP 1-4 HS	2	104	98	107.0	116.5	109.9	86.03	90.44	83.80	0.316	0.274	0.342
(4)	EE REP 1-3B	16	1194	1167	121.6	114.8	118.6	84.79	75.40	81.87	0.241	0.210	0.294
(17)	EE REP 1-4	33	419	1107	104.8	111.5	111.2	78.17	82.20	79.34	0.267	0.249	0.310
(37)	COM/INT 1-3B HS	18	821	723	116.1	112.4	113.1	87.98	79.71	81.81	0.274	0.234	0.290
(21)	OIN TECH SP 1-4	1	184	150	116.0	109.7	115.0	72.03	88.38	90.05	0.254	0.249	0.324
(25)	FUNC SUP/AD 1-4	20	1342	1388	101.7	114.1	102.4	54.18	71.55	52.56	0.333	0.230	0.353
(32)	SERV/SUP 1-4	124	8210	8488	109.6	113.6	105.4	83.91	87.23	80.52	0.271	0.254	0.317
(41)	FUNC SUP/AD 1-3B HS	1	95	81	122.0	109.2	115.2	79.63	79.16	87.43	0.276	0.225	0.309
(2)	EE REP MALE 1-3A	1	69	79	114.0	113.3	115.6	75.25	84.65	85.51	0.238	0.242	0.272
(14)	INF 1-4	0	188	213	*****	109.6	110.9	*****	85.09	83.64	*****	0.272	0.282
(11)	FUNC SUP/AD 1-3B	10	194	232	117.5	112.3	114.6	84.51	76.70	78.11	0.273	0.249	0.308
(12)	E/M REP 1-3B	6	294	325	117.0	112.6	113.1	82.34	84.25	85.98	0.262	0.262	0.331
(29)	CRAFTS 1-4	7	127	136	113.6	104.4	111.4	84.02	76.84	80.18	0.271	0.285	0.332
(48)	FUNC SUP/AD 1-4 HS	1	148	185	112.0	110.4	107.9	59.29	64.91	58.90	0.329	0.261	0.289
(55)	E/M REP 1-4 MALE	0	142	120	*****	101.8	106.9	*****	57.31	72.31	*****	0.287	0.319
(20)	MED/DENT SP 1-4	53	3304	3505	109.4	103.8	107.3	89.88	78.51	78.72	0.303	0.304	0.332
(7)	MED/DENT SP 1-3B	3	153	173	114.0	104.8	109.7	81.78	83.22	82.36	0.280	0.274	0.338
(26)	E/M REP 1-4	84	8224	8305	108.8	108.7	106.1	78.96	79.84	77.21	0.320	0.282	0.347
(53)	INF 1-4 MALE	64	4718	4763	105.1	111.6	108.3	81.42	85.56	81.44	0.315	0.284	0.318
(38)	MED/DENT SP 1-3B HS	1	182	149	111.0	99.9	109.6	74.07	72.17	76.77	0.308	0.392	0.322
(3)	COM/INT SP 1-4	4	142	92	107.3	103.1	101.0	89.98	88.96	82.78	0.307	0.446	0.347
(6)	COM/INT SP 1-3B	7	101	148	114.6	108.4	112.5	87.74	84.71	83.99	0.292	0.305	0.318
(5)	EE REP 1-3B	4	620	632	115.3	105.1	112.0	81.58	80.76	85.69	0.331	0.275	0.343

Figure D-2. Optimization Report (continued).

METRIC COMPARISON OF CLUSTER

GLOBAL OPTIMIZATION VS HISTORIC DATA.

(#) CLUSTER NAME	ASSIGNMENTS DEP	ASSIGNMENTS GAM	ASSIGNMENTS ACT	APTITUDE AREA DEP	APTITUDE AREA GAM	APTITUDE AREA ACT	PROJECTED SQT DEP	PROJECTED SQT GAM	PROJECTED SQT ACT	ATTRITION DEP	ATTRITION GAM	ATTRITION ACT
(18) COM/INT SP 1-4	33	2124	2433	107.4	105.1	109.0	73.25	73.84	76.30	0.340	0.295	0.374
(44) MED/DENT SP 1-4 HS	7	147	338	111.9	105.1	107.8	89.83	71.67	70.77	0.312	0.309	0.326
(23) OTH TECH SP 1-4	14	384	509	111.1	106.5	109.4	91.30	61.83	76.73	0.303	0.358	0.343
(40) OTH TECH SP 1-30 HS	1	17	19	104.0	104.5	107.1	76.39	84.29	80.01	0.338	0.387	0.335
(34) COM/INT 1-4 MALE	60	2699	3033	107.9	108.4	107.7	84.36	83.67	79.33	0.300	0.306	0.335
(15) INF 1-4	2	1122	1152	107.0	105.2	110.1	72.10	74.05	80.49	0.433	0.297	0.355
(44) EE DEP 1-4 HS	0	11	11	*****	103.1	113.0	*****	79.84	88.43	*****	0.289	0.320
(16) EE DEP 1-4	9	694	649	111.0	102.9	107.2	85.61	73.84	76.53	0.335	0.309	0.355
(8) OTH TECH SP 1-30	4	79	82	113.8	101.6	108.2	78.74	74.94	78.97	0.325	0.387	0.338
(35) COM/INT SP 1-30 HS	5	1098	777	121.8	101.1	119.0	93.83	64.15	88.72	0.310	0.404	0.328
(45) COM/INT 1-4 HS	1	148	135	90.0	110.9	104.4	85.43	79.33	71.45	0.321	0.372	0.395
(24) FUNC SUP/AD 1-4	134	7348	6041	98.7	103.0	102.2	51.36	60.99	58.65	0.348	0.410	0.370
(20) CRAFTS 1-4	18	971	1041	100.4	99.7	102.4	78.04	71.68	72.10	0.331	0.417	0.364
(33) SERV/SUP 1-4	47	5467	5447	99.8	106.8	100.8	70.54	75.24	65.77	0.398	0.453	0.387
(51) INF 1-4 MALE	259	16930	17252	104.1	109.2	106.2	81.30	79.34	76.43	0.354	0.333	0.366
(10) FUNC SUP/AD 1-30	7	307	240	101.6	99.6	105.7	79.83	63.27	67.73	0.343	0.394	0.373
(22) OTH TECH SP 1-4	7	918	714	108.6	101.2	107.3	87.27	67.73	72.01	0.343	0.386	0.363
(49) E/M DEP 1-4 HS	3	69	79	116.7	108.9	111.6	82.33	89.32	88.38	0.333	0.494	0.411
(19) COM/INT SP 1-4	37	2642	6155	103.2	109.9	106.2	69.44	75.89	69.10	0.399	0.341	0.404
(13) INF 1-4	7	770	773	110.7	116.3	112.6	76.23	85.35	79.09	0.430	0.366	0.409
(31) SERV/SUP 1-4	5	571	337	103.0	103.1	102.1	60.35	77.46	69.45	0.310	0.412	0.444
AVERAGE	1325	85436	90534	106.3	108.5	106.9	77.49	70.17	75.60	0.321	0.316	0.344

TAB D-1 (continued)
SAMPLE EPAS REPORTS

Figure D-3. Accessions Report.

SUMMARY OF ACCESSIONS IN THE FISCAL YEAR 1984
ITERATION # 1 & SIMULATION NAME: 84BASE

MOS	INVENTORIES DEP	INVENTORIES ACM	INVENTORIES ACTUAL	PROJECTED ATTRITION RATE:0-1.0 DEP	ACM	ACST	PROJECTED MOS WORTH:0-100 DEP	ACM	ACTUAL	PROJECTED AA RANGE:40-155 DEP	ACM	ACTUAL
00J	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
03C	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
05D	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
05H	1	0	0	0.25	0.00	0.00	70.40	0.00	0.00	118.00	0.00	0.00
05K	1	1	0	0.35	0.25	0.00	61.90	13.60	0.00	112.00	123.00	0.00
11H	59	9	9	0.35	0.36	0.38	78.90	100.00	87.22	107.00	91.00	110.00
12B	18	1	1	0.24	0.20	0.23	79.20	100.00	100.00	107.00	99.00	118.00
12C	2	1	0	0.30	0.47	0.00	74.50	100.00	0.00	105.00	110.00	0.00
12E	1	1	0	0.30	0.24	0.00	68.90	51.40	0.00	106.00	130.00	0.00
12F	2	1	0	0.32	0.27	0.00	64.10	51.40	0.00	99.00	124.00	0.00
13B	18	3	2	0.34	0.34	0.42	42.10	80.50	61.70	98.00	91.00	105.00
13C	0	1	0	0.00	0.28	0.00	0.00	34.00	0.00	0.00	108.00	0.00
13E	2	0	0	0.32	0.00	0.00	77.10	0.00	0.00	112.00	0.00	0.00
13F	4	0	1	0.24	0.00	0.23	64.80	0.00	63.40	111.00	0.00	111.00
13M	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13R	1	1	0	0.31	0.27	0.00	53.00	34.00	0.00	104.00	109.00	0.00
15D	2	0	0	0.37	0.00	0.00	49.30	0.00	0.00	108.00	0.00	0.00
15E	1	0	0	0.44	0.00	0.00	51.10	0.00	0.00	110.00	0.00	0.00
15J	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16H	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16J	0	1	0	0.00	0.28	0.00	0.00	34.00	0.00	0.00	11 1	
93H	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
93J	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
93P	1	1	0	0.34	0.00	0.00	20.40	0.00	0.00	102.00	97.00	0.00
94B	9	1	0	0.41	0.52	0.00	44.20	80.50	0.00	100.00	97.00	0.00
94F	0	1	0	0.00	0.48	0.00	0.00	6.90	0.00	0.00	130.00	0.00
95B	25	3	3	0.25	0.33	0.37	81.40	100.00	69.70	113.00	112.00	106.67
95C	1	1	0	0.34	0.40	0.00	14.30	6.90	0.00	97.00	85.00	0.00
96B	1	0	0	0.27	0.00	0.00	57.10	0.00	0.00	118.00	0.00	0.00
96D	0	1	0	0.00	0.38	0.00	0.00	23.60	0.00	0.00	109.00	0.00
96H	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
96R	0	1	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	127.00	0.00
97E	1	1	0	0.30	0.00	0.00	74.80	0.00	0.00	123.00	106.00	0.00
97G	0	1	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	125.00	0.00
TOTALS	415	70	55	0.32	0.30	0.35	53.04	51.49	52.73	106.18	107.81	107.31

Figure D-4. Average Aptitude Area Report.

AIRBORNE AVERAGE APTITUDE AREA SCORE FOR CL   ITERATION #1

DEMOGRAPHIC GROUP	INVENTORIES ACH	INVENTORIES ACTUAL	INVENTORIES PRIMARY	AVERAGE AA SCORE ACH	AVERAGE AA SCORE ACTUAL	AVERAGE AA SCORE PRIMARY
MALE/I-IIIA/SEN	0	0	0	0.00	0.00	0.00
MALE/I-IIIA/HSG	16	4	0	116.36	117.75	0.00
MALE/I-IIIA/NHSG	1	0	0	118.00	0.00	0.00
MALE/IIIB-IV/SEN	0	0	0	0.00	0.00	0.00
MALE/IIIB-IV/HSG	0	3	0	0.00	95.33	0.00
MALE/IIIB-IV/NHSG	0	2	0	0.00	86.00	0.00
FEMALE/I-IIIA/SEN	0	0	0	0.00	0.00	0.00
FEMALE/I-IIIA/HSG	1	12	0	107.00	103.58	0.00
FEMALE/I-IIIA/NHSG	0	0	0	0.00	0.00	0.00
FEMALE/IIIB-IV/SEN	0	0	0	0.00	0.00	0.00
FEMALE/IIIB-IV/HSG	1	1	0	92.00	98.00	0.00
FEMALE/IIIB-IV/NHSG	0	0	0	0.00	0.00	0.00
SUB TOTALS	17	22	0	114.47	103.18	0.00

AIRBORNE AVERAGE APTITUDE AREA SCORE FOR CO   ITERATION #1

DEMOGRAPHIC GROUP	INVENTORIES ACH	INVENTORIES ACTUAL	INVENTORIES PRIMARY	AVERAGE AA SCORE ACH	AVERAGE AA SCORE ACTUAL	AVERAGE AA SCORE PRIMARY
MALE/I-IIIA/SEN	0	0	0	0.00	0.00	0.00
MALE/I-IIIA/HSG	1	7	0	109.00	118.86	0.00
MALE/I-IIIA/NHSG	3	0	0	108.00	0.00	0.00
MALE/IIIB-IV/SEN	0	0	0	0.00	0.00	0.00
MALE/IIIB-IV/HSG	4	4	0	92.83	101.50	0.00
MALE/IIIB-IV/NHSG	0	0	0	0.00	0.00	0.00
FEMALE/I-IIIA/SEN	0	0	0	0.00	0.00	0.00
FEMALE/I-IIIA/HSG	0	0	0	0.00	0.00	0.00
FEMALE/I-IIIA/NHSG	0	0	0	0.00	0.00	0.00
FEMALE/IIIB-IV/SEN	0	0	0	0.00	0.00	0.00
FEMALE/IIIB-IV/HSG	0	0	0	0.00	0.00	0.00
FEMALE/IIIB-IV/NHSG	0	0	0	0.00	0.00	0.00
SUB TOTALS	10	15	0	99.00	110.85	0.00

Figure D-5. Brick Chart, by MOS Cluster.

FY 84 BRICKS ACROSS ALL CLUSTERS AND ALL DEMOGRAPHICS

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	FY85	TOTAL	CUMULATIVE TOTALS	TOTAL ACCESS
OCT ACCESSIONS	10024													10024	10024	
ENTRY DEP	10790	8429	3993	4088	1210	313	82	310	3549	3513	1046	168	0	37720		37720
CONTRACTS	-775	158	77	3416	1811	591	206	51	229	733	1129	833	1	8440	8440	
NOV ACCESSIONS		8394												8394	18418	
ENTRY DEP		8707	4070	7504	3021	904	288	341	3790	4244	2175	1001	1	36156		46180
CONTRACTS		-393	609	1639	1553	947	196	87	191	553	1363	974	0	7719	16179	
DEC ACCESSIONS			4356											4356	22774	
ENTRY DEP			4679	9143	4576	1051	484	448	3989	4799	3538	1975	1	35481		53099
CONTRACTS			-323	1070	1672	1655	344	90	238	603	1335	1053	4	7741	23920	
JAN ACCESSIONS				10202										10202	32976	
ENTRY DEP				10213	6246	3506	828	538	4227	5402	4873	3828	5	38844		61640
CONTRACTS				-11	3982	1243	269	184	536	917	1245	1480	15	9840	33780	
FEB ACCESSIONS					9849									9849	42845	
ENTRY DEP					10228	4749	1097	722	4763	6319	6118	4508	20	38524		71500
CONTRACTS					-359	4149	617	262	264	887	597	1451	165	8011	41791	
MAR ACCESSIONS						8798								8798	51643	
ENTRY DEP						8898	1714	984	5027	7206	6715	5959	163	34444		79511
CONTRACTS						-100	3378	436	313	872	616	1248	266	7227	49018	
APR ACCESSIONS							5967							5967	57610	
ENTRY DEP							5092	1420	5340	8078	7329	7207	429	35095		84738
CONTRACTS							875	3344	349	1032	638	1490	304	8054	57072	
MAY ACCESSIONS								5955						5955	63565	
ENTRY DEP								4966	5709	9110	7967	8497	733	37182		94792
CONTRACTS								989	997	1496	1486	846	811	6825	63897	
JUN ACCESSIONS									5788					5788	69353	
ENTRY DEP									6706	10006	9493	9543	1544	38052		101617
CONTRACTS									-918	344	1391	1255	4898	6984	70881	
JUL ACCESSIONS										11172				11172	80325	
ENTRY DEP										11172	10844	10798	6434	39248		108401
CONTRACTS										0	135	898	8295	9328	80209	
AUG ACCESSIONS											10979			10979	91504	
ENTRY DEP											10979	11696	14729	37404		117929
CONTRACTS											0	0	8481	8481	88690	
SEP ACCESSIONS												11696		11696	103200	
ENTRY DEP												11696	23210	34906		126410
CONTRACTS												0	8042	8042	96752	

EXIT DEP TO NEXT FY 31272

APPENDIX E

REFERENCES

APPENDIX E
REFERENCES

ARCNET User's Guide, Cleveland Consulting Associates, 3415 Greystone, Suite 204, Austin, TX 78731, Page 72, 1980.

BASIC CONCURRENT VALIDATION RESULTS, Project A Scientific Advisory Group Meeting, September 17-19, 1986, Alexandria, VA.

Charnes, A., and Cooper, W., Management Models and Industrial Applications of Linear Programming, 2 Vols., John Wiley and Sons, Inc., New York, New York, 1961.

Curtis, W., et al, "The FORECAST System Master Plan," FORECAST Development Office, Office of the Assistant Secretary of the Army, Manpower and Resource Allocation, 1983.

Dale, C. and Gilroy, C., "The Economic Determinants of Military Enlistment Rates," Technical Report 587, ARI, Alexandria, VA, September, 1983. (AD A146 235)

Dantzig, G. B., Linear Programming and Extensions, Princeton University Press, Princeton, New Jersey, 1962.

Daula, T., et al, "A Microdata Model of Enlistment in the Armed Forces," *Presentation to The Econometric Society Summer Meeting*, Ithaca, New York, June 1982

Daula, T., The Retention of First-Term Soldiers: Theory and Empirical Evidence, Doctoral Dissertation, Massachusetts Institute of Technology, Boston, Massachusetts, October, 1981.

Fernandez, R., "Enlisted Supply in the 1980s," WD-515, RAND, Santa Monica, California, February 1980.

Fernandex, R., "Forecasting Enlisted Supply: Projection for 1979-1980," N-1297-MRAL, RAND, Santa Monica, California, September 1979.

Glover, F. and Klingman, D., "Capsule View of Future Developments of Large Scale Network and Network-related Problems," Research Report CSS 238, Center of Cybernetic Studies, University of Texas at Austin, 1975.

Goldberg, L., "The Supply of Navy Enlistments," Report 80-1771, Center for Naval Analyses, Alexandria, Virginia, December 1980.

Goldberg, L., "Long Range Planning of Requirements for Navy Recruiters and Advertising," Report 79-1625, Center for Naval Analyses, Alexandria, Virginia, May 1980b.

Goldberg, L., "CNA and RAND Forecasts of Navy Enlistments," Report 80-0393, Center for Naval Analyses, Alexandria, Virgina, April 1980c.

Goldberg, L., "Recruiters, Advertising, and Navy Enlistments," Professional Paper 275, Center for Naval Analyses, Alexandria, Virginia, March 1980d.

Goldberg, L., "Recruiters, Advertising, and Nave Enlistments," CRC409, Center for Naval Analyses, Alexandria, Virginia, October 1979.

Hausman, J. and Wise, D., "A Conditional Probit Model for Qualitative Choice: Discrete Decisions Recognizing Interdependence and Heterogeneous Preference," Econometrica, 46, March 1978.

Hendrix, W., et al, "Pre-Enlistment Person-Job Match System," AFHRL-TR-79-29, Occupation and Manpower Research Division, Air Force Human Resources Laboratory, Brooks Air Force Base, TX, September, 1979.

Holz, B. and Wroth, J., "Improving Strength Forecasts: Support for Army Manpower Management," Interfaces, Vol. 10, No. 6, December 1980.

Horne, D., An Economic Analysis of Army Enlistment Supply, ARI Working Paper, May, 1984.

Hosek, J. and Peterson, C., "The AFEES-NLS Database: A Choice-Based Sample for Studying Enlistment and Post-Enlistment Outcomes," N-1930-MRAL, RAND, Santa Monica, California, January 1983.

Kobbe, M., REQUEST Hierarchy, Memorandum for Record, 28 Oct 1982.

Kroeker, L. and Rafacz, B., "Classification and Assignment within PRIDE (CLASP): A Recruit Assignment Model," NPRDS TR 84-9, Naval Personnel Research and Development Center, San Diego, CA, November 1983.

Makridakis, S., et al, "The Accuracy of Extrapolation (Time Series) Methods: Results of a Forecasting Competition," Journal of Forecasting, 2, 1982.

Manganaris, A. and Schmitz, E., "Projecting Attrition by Military Occupational Specialty." Technical Report 637, U.S. Army Research Institute, Alexandria, VA, May 1984. (AD A168 183)

Manski, C. and Lerman, S., "The Estimation of Choice Probabilities from Choice-Based Samples," Ecometrica, 45, November 1977.

McLaughlin, D., et al, "Validation of Current and Alternative ASVAB Area Composites, Based on Training and SQT Information on FY1981 and FY1982 Enlisted Accessions," Human Resources Research Organization, Alexandria, VA, May 1984.

Midlam, D. and Brown, G., "R/EPAS Concept Overview," General Research Corporation, May 1986

Morey, R., "Comparison of the Marginal Cost-Effectiveness of Various Recruiting Resources for High School Graduate Enlistments: Analyses of National, Local and "Walk-In" Leads and Yield Rates," ONR-200-7, Duke University, Durham, North Carolina, November 1982.

Morey, R. and McCann, "Evaluating and Improving Resource Allocation for Navy Recruiting," Management Science, December 1980a.

Morey, R., "The Impacts of Various Types of Advertising Media, Demographics, and Recruiters on Quality Enlistments: Results from Simultaneous and Heteroscedastic Models," Duke University, Durham, North Carolina, July 1980b.

Morey, R. "Budget Allocation and Enlistment Prediction Model's for the Navy's Recruiting Command: Testing and Validation," Duke University, Durham, North Carolina, October 1979.

Stilwell, W., "A Review and Comparison of Personnel Assignment Systems with Suggestions for a Person-Job Matching Model," The MAXIMA Corporation, Bethesda, MD, December 1983.

Unger, K., "Identification of Interviewing Techniques Used by Experienced Army Guidance Counselors," Behavioral Sciences Research Center, Science Applications, Inc., McLean, VA, March 1984.

Ward, J., "Creating Mathematical Models of Judgment Processes: From Policy-Capturing to Policy-Specifying," AFHRL-TR-77-47, Occupation and Manpower Research Division, Air Force Human Resources Laboratory, Brooks Air Force Base, TX, August 1977.

Ward, J. H., "Hierarchical Grouping to Optimize an Objective Function," Journal of the American Statistical Association, 58, pp 236-244, 1963.

Wise, L., "Relative Performance Weights," American Institute for Research, Computer Listing, June 1985.

APPENDIX F

CSP INTERACTIVE PANELS

APPENDIX F
CSP INTERACTIVE PANELS

```
                         CSP/AD               DATE: 11/18/89  TIM

   MAPGROUP: EC01G          MAP: EC01M01   MSL: Q5MGM01
        1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#EC01M01#          #ENLISTED PERSONNEL ALLOCATION SYSTEM#
]          #     ELIM-COMPLIP MONTHLY ACCESSION LIMITS EDITOR#
]          #              ACCESSION PLAN LIMITS          #
]
+                  #MONTH      FISCAL YEAR     RECRUIT YEAR#
]                  #-----      -----------     ------------#
]                   ^    #        ^      #          ^      #
]                   ^    #        ^      #          ^      #
]                   ^    #        ^      #          ^      #
10                  ^    #        ^      #          ^      #
]                   ^    #        ^      #          ^      #
]                   ^    #        ^      #          ^      #
]                   ^    #        ^      #          ^      #
]                   ^    #        ^      #          ^      #
+                   ^    #        ^      #          ^      #
]                   ^    #        ^      #          ^      #
]                   ^    #        ^      #          ^      #
]                   ^    #        ^      #          ^      #
]                  #-----        -------#         -------#
20                 #TOTAL         ^      #          ^      #
]                                ^          #
]#PF: #   1:13 HELP   2:14 RTN MAIN   3:15 RTN PREV
]        ^           ^              ^
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                         CSP/AD               DATE: 11/18/89  TIM
   MAPGROUP: EC01G          MAP: EC01M02   MSL: Q5MGM01
        1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#EC01M02#          #ENLISTED PERSONNEL ALLOCATION SYSTEM#
]          #     ELIM-COMPLIP MONTHLY ACCESSION LIMITS EDITOR#
]          #             NEW TOTAL VALUES SELECTION     #
]
+#PLEASE SELECT ONE USING AN#'S'#:#
]
]                              ^ #- FISCAL YEAR#
]
]                              ^ #- RECRUIT YEAR#
10
]                           #PRESS#ENTER#TO PROCESS#
]
]
]
+
]
]
]
]
20
]
]#PF: #   1:13 HELP   2:14 RTN MAIN   3:15 RTN PREV
]    #
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                                 CSP/AD                   DATE: 11/18/89  TIM
       MAPGROUP: EP01G          MAP: EP01M01   MSL: Q5EPM01
             1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]øEP01M01ø                            BQDA DSS                            ø
]        ø              ENLISTED PERSONNEL ALLOCATION SYSTEM              ø
]        ø                    SUBSYSTEM SELECTION MENU                    ø
]
+øPLEASE SELECT ONE USING AN 'S' :ø
]
]
]                 ^ ø- NPS ACCESSION/DEP MANAGEMENT SUPPORTø
]
10                ^ ø- REENLIST, RECLASS & PS ACCESSION MANAGEMENT SUPPORTø
]
]                   øPRESSøENTERøTO PROCESSø
]
]
+
]
]
]
]
20
]
]øPF: ø    1:13 HELP               3:15 EXIT
]     ø
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0

                                 CSP/AD                   DATE: 11/18/89  TIM
       MAPGROUP: EP01G          MAP: EP01M02   MSL: Q5EPM01
             1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]øEP01M02ø             øENLISTED PERSONNEL ALLOCATION SYSTEMø
]        ø              NPS ACCESSION/DEP MANAGEMENT SUPPORTø
]        ø                    MAIN SELECTION MENU        ø
]
+øPLEASE SELECT ONE USING ANø'S'ø:
]
]                            ^ ø- EPAS EXECUTION/STATUSø
]                            ^ ø- DATA SUPPORT OPERATIONS
]                            ^ ø- REPORT GENERATION/DISPLAY   ø
10                           ^ ø- ANCILLARY SUPPORT PROCEDURESø
]
]                              øPRESSøENTERøTO PROCESSø
]
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]
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]
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]
]øPF: ø    1:13 HELP   2:14 RTN MAIN   3:15 RTN PREV
]     ø
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                                   CSP/AD                    DATE: 11/18/89  TIM
      MAPGROUP: EP01G           MAP: EP01M03   MSL: Q5EPM01
              1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#EP01M03#          #ENLISTED PERSONNEL ALLOCATION SYSTEM#
]           # REENLIST, RECLASS & PS ACCESSION MANAGEMENT SUPPORT #
]           #                  MAIN SELECTION MENU            #
]
+
]
]
]         #THIS MAJOR COMPONENT OF EPAS HAS NOT BEEN IMPLEMENTED.  THIS
]    COMPONENT WILL PROVIDE CAPABILITY, SIMILAR TO THE NPS VERSION FOR THOSE
10   PERSONNEL WHO ARE AT REENLISTMENT, RECLASSIFICATION OR HAVE HAD PRIOR
]    SERVICE AND DESIRE REENLISTMENT.#
]
]
]
+
]
]
]
]
20
]
]#PF: #   #   1:13 HELP   2:14 RTN MAIN   3:15 RTN PREV
]   #
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0

                                   CSP/AD                    DATE: 11/18/89  TIM
      MAPGROUP: EP01G           MAP: EP01M13   MSL: Q5EPM01
              1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#EP01M13#          #ENLISTED PERSONNEL ALLOCATION SYSTEM#
]         #                DATA SUPPORT OPERATIONS        #
]         #                  MAIN SELECTION MENU          #
]
+#PLEASE SELECT ONE USING AN#'S'#:
]
]                            ^ #- RUN FILE EDITOR#
]                            ^ #- SIMULATION POPULATION GENERATION EDITOR#
]                            ^ #- MOS REQUIREMENTS EDITOR
10                           ^ #- BASIC TRAINING SEAT EDITOR  #
]                            ^ #- AIT/OSUT TRAINING SEAT EDITOR#
]                            ^ #- POLICY PARAMETER EDITORS     #
]                            ^ #- JOB SELECTION PROBABILITY EDITOR      #
]                            ^ #- MOS CLUSTERS EDITOR                   #
+                            ^ #- SUPPLY GROUP EDITOR     #
]                            ^ #- USAREC MISSION GOALS EDITOR     #
]                            ^ #- ELIM-COMPLIP MONTHLY ACCESSION LIMITS EDITO
]
]                              #PRESS#ENTER#TO PROCESS#
20
]
]#PF: #   1:13 HELP   2:14 RTN MAIN   3:15 RTN PREV
]   #
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
                                   CSP/AD                    DATE: 11/18/89  TIM
```

```
      MAPGROUP: EP01G          MAP: EP01M14    MSL: Q5EPM01
               1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#EP01M14#            ENLISTED PERSONNEL ALLOCATION SYSTEM#
]         #                 POLICY PARAMETER EDITORS       #
]         #                   MAIN SELECTION MENU          #
]
+#PLEASE SELECT ONE USING AN#'S'# :#
]
]                              ^ #- QUALITY FORECASTING POLICY EDITOR
]
]                              ^ #- QUALITY ALLOCATION POLICY EDITOR

]                              ^ #- APPLICANT CLASSIFICATION POLICY EDITOR
]
]                                 #PRESS#ENTER#TO PROCESS
]
+
]
]
]
]

]
]#PF:#    1:13 HELP   2:14 RTN MAIN   3:15 RTN PREV
]   #
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                                      CSP/AD                 DATE: 11/18/89  TIM
      MAPGROUP: EP01G          MAP: EP01M21    MSL: Q5EPM01
               1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#EP01M21#            #ENLISTED PERSONNEL ALLOCATION SYSTEM#
]         #              ANCILLARY SUPPORT PROCEDURES      #
]         #                  MAIN SELECTION MENU           #
]
+#PLEASE SELECT ONE USING AN#'S'#:
]
]                             ^ #- SIMULATION POPULATION GENERATION#
]                             ^ #- METRICS GENERATION#
]

]
]                               #PRESS#ENTER#TO PROCESS#
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]

]
]#PF: #    1:13 HELP   2:14 RTN MAIN   3:15 RTN PREV
]    #
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                                  CSP/AD                    DATE: 11/18/89  TIM
     MAPGROUP: EP02G            MAP: EP02M11    MSL: Q5EPM01
             1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#EP02M11#      #      ENLISTED PERSONNEL ALLOCATION SYSTEM        #
]               ^                                                  #
]               #              MAIN SELECTION MENU                 #
]
+                         #PLEASE SELECT#ONE# USING AN 'S' :#
]
]
] ^ ^_^      #  ^ ^_^     #  ^ ^_^     #  ^ ^_^     #  ^ ^_^
]
10
] ^ ^_^      #  ^ ^_^     #  ^ ^_^     #  ^ ^_^     #  ^ ^_^
]
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] ^ ^_^      #  ^ ^_^     #  ^ ^_^     #  ^ ^_^     #  ^ ^_^
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] ^ ^_^      #  ^ ^_^     #  ^ ^_^     #  ^ ^_^     #  ^ ^_^
]
]
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]
]#PF:# 1:13 HELP  2:14 MENU  3:15 RTN # 4:16 EDIT  5:17 DELETE#7:18 BCK
]    # 8:20 FWD # 9:21 REVW#10:22 COPY TO^       #11:23 RESET#12:24 FIND^
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                                  CSP/AD                    DATE: 11/18/89  TIM
     MAPGROUP: EP02G            MAP: EP02M21    MSL: Q5EPM01
             1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#EP02M21 #     #      ENLISTED PERSONNEL ALLOCATION SYSTEM        #
]               ^                                                  #
]               #              MAIN SELECTION MENU                 #
]
+               #         PLEASE SELECT ONE USING AN 'S':          #
]
] ^ ^ ^       ^  # ^ ^ ^       ^  # ^ ^ ^       ^  # ^ ^ ^       ^
]
]
10 ^ ^ ^      ^  # ^ ^ ^       ^  # ^ ^ ^       ^  # ^ ^ ^       ^
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] ^ ^ ^       ^  # ^ ^ ^       ^  # ^ ^ ^       ^  # ^ ^ ^       ^
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] ^ ^ ^       ^  # ^ ^ ^       ^  # ^ ^ ^       ^  # ^ ^ ^       ^
20
]#PF:#  1:13 HELP       2:14 MENU       3:15 RETURN     #4:16 EDIT      #
]    #  5:17 DELETE#    7:18 PAGE BACK  8:20 PAGE FWD   #9:21 REVIEW    #
]    # 10:22 COPY TO^        ^     #    11:23 RESET    #12:24 FIND^     ^
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                                  CSP/AD                  DATE: 11/18/89  TIM
      MAPGROUP: EP03G           MAP: EP03M11    MSL: Q5EPM01
             1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#EP03M11#           ENLISTED PERSONNEL ALLOCATION SYSTEM           #
]              ^                                                    #
]              #               RECORD DELETION                      #
]
+                       #RECORD^       ^              #
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]                       ^     ^     ^                 #
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]#PF:# 1:13 HELP  2:14 MENU  3:15 RTN
]    #
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                                  CSP/AD                  DATE: 11/18/89  TIM
      MAPGROUP: EP03G           MAP: EP03M21    MSL: Q5EPM01
             1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#EP03M21#           ENLISTED PERSONNEL ALLOCATION SYSTEM           #
]              ^                                                    #
]              #               RECORD DELETION                      #
]
+                       #RECORD^       ^    ^              #
]
]                       ^     ^     ^                 #
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]
]#PF:# 1:13 HELP  2:14 MENU  3:15 RTN
]    #
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                              CSP/AD                    DATE: 11/18/89  TIM
    MAPGROUP: EP04G          MAP: EP04M11   MSL: Q5EPM01
         1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#EP04M11#           ENLISTED PERSONNEL ALLOCATION SYSTEM              #
]              ^                                                       #
]              #                  RECORD COPY                          #
]
+               #RECORD^       ^                #RECORD^               #
]
]               ^     ^     ^                   #
]
]
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]
]
20
]
]#PF:# 1:13 HELP  2:14 MENU  3:15 RTN
]   #
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                              CSP/AD                    DATE: 11/18/89  TIM
    MAPGROUP: EP04G          MAP: EP04M21   MSL: Q5EPM01
         1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#EP04M21#           ENLISTED PERSONNEL ALLOCATION SYSTEM              #
]              ^                                                       #
]              #                  RECORD COPY                          #
]
+          #RECORD^       ^    ^                #RECORD^       ^    #
]
]               ^     ^     ^                   #
]
]
10
]
]
]
]
+
]
]
]
]
20
]
]#PF:# 1:13 HELP  2:14 MENU  3:15 RTN
]   #
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                                     CSP/AD                         DATE: 11/18/89  TIM
        MAPGROUP: MG01G             MAP: MG01M01    MSL: Q5MGM01
             1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#RF01M60 #             #ENLISTED PERSONNEL ALLOCATION SYSTEM#
]                       #          RUN FILE EDITOR          #
]                       #          FILE SELECTION           #
]
+
]
]                       ^- APPLICANT FILE.............^       #
]                       ^- MOS REQUIREMENTS FILE......^       #
]                       ^- METRICS FILE...............^       #
10                      ^- MOS CLUSTER FILE...........^       #
]                       ^- BT SCHOOL SEAT FILE........^       #
]                       ^- AIT/OSUT SCHOOL SEAT FILE..^       #
]                       ^- QFM POLICY FILE............^       #
]                       ^- QAM POLICY FILE............^       #
+                       ^- ACM POLICY FILE............^       #
]                       ^- ELIM ACCESSION LIMITS FILE.^       #
]                       ^- SUPPLY GROUP FILE..........^       #
]
]
20
]
]#PF: #    1:13 HELP    2:14 RTN MAIN    3:15 RTN PREV
]     #                 9:21 ACCEPT      10:22 RESET
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                                     CSP/AD                         DATE: 11/18/89  TIM
        MAPGROUP: RF01G             MAP: RF01M01    MSL: Q5RFM01
             1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#RF01M01#        #     ENLISTED PERSONNEL ALLOCATION SYSTEM        #
]                 ^                                                 #
]
]             ^         #--^
+
]^
]^
]^
]^   ^  ^    ^                          ^  ^        #
10^                        ^     #MONTH: ^  #WEEK OF MONTH: ^  #
]^
]^
]^                                             ^  ^     ^ #
]^                                     ^                 ^    #
+^                                       ^        #
]
]#FILE SPECIFICATIONS:#
]      #APPLICANT...^      #   BT SCHOOL SEATS.....^       #   ELIM..^
]      #MOS RQMTS...^      #   AIT/OSUT SCHOOL.....^       #   QFM...^
20     #METRICS.....^      #   POLICY FILES:.......#       #   QAM...^
]      #CLUSTER.....^      #   SUPPLY GROUP DEF....^       #   ACM...^
]                             ^    ^    ^
]#PF: #    1:13 HELP    2:14 RTN MAIN    3:15 RTN PREV
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                                    CSP/AD                       DATE: 11/18/89  TIM
     MAPGROUP: RF01G              MAP: RF01M02   MSL: Q5RFM01
              1         2         3         4         5         6         7
 ----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#RF01M02 #          #ENLISTED PERSONNEL ALLOCATION SYSTEM#
]                    #          RUN FILE EDITOR             #
]                    #        ITEM SELECTION MENU           #
]
+#PLEASE SELECT USING AN 'S' :
]
]                        ^ #- RUN FILE DESCRIPTION#
]                        ^ #- EXECUTION OPTIONS#
]                        ^ #- ITERATION INFORMATION#
10                       ^ #- COMPOSITE SELECTION#
]                        ^ #- OPTIMIZATION FACTOR SELECTION#
]                        ^ #- GOAL:SCHOOL DATA SCALING#
]                        ^ #- APPLICANT DATA SOURCE SELECTION#
]                        ^ #- EPAS ABORT POLICY#
+                        ^ #- DEP LOSS INFORMATION              #
]                        ^ #- REPORT SELECTION#
]                        ^ #- FILE SELECTION#
]                        ^ #- ANCILLARY FILE DELETION#
]
20                         #PRESS#ENTER#TO EDIT
]
]#PF: #    1:13 HELP    2:14 RTN MAIN    3:15 RTN PREV
]   #    ^4:16 SAVE CHANGES#          ^5:17 ABORT CHANGES#
]^
 ----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
          0         0         0         0         0         0         0
```

```
                                    CSP/AD                       DATE: 11/18/89  TIM
     MAPGROUP: RF01G              MAP: RF01M10   MSL: Q5RFM01
              1         2         3         4         5         6         7
 ----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#RF01M10 #          #ENLISTED PERSONNEL ALLOCATION SYSTEM#
]                    #          RUN FILE EDITOR             #
]                    #       RUN FILE DESCRIPTION           #
]
+
]
]              #THIS IS THE DESCRIPTION OF RUN FILE #^        # : #
]
]                  #^                                        #
10
]
]
]
]
+     # TO CHANGE THE DESCRIPTION, TYPE OVER THE CURRENT ONE AND PRESS PF9.#
]
]
]
]
20
]
]#PF: #    1:13 HELP    2:14 RTN MAIN    3:15 RTN PREV
]   #               9:21 ACCEPT     10:22 RESET
]^
 ----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
          0         0         0         0         0         0         0
```

```
                                        CSP/AD                  DATE: 11/18/89  TIM
        MAPGROUP: RF01G          MAP: RF01M15   MSL: Q5RFM01
             1         2         3         4         5         6         7
 ----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#RF01M15 #            #ENLISTED PERSONNEL ALLOCATION SYSTEM#
]                      #          RUN FILE EDITOR          #
]                      #         EXECUTION OPTIONS         #
]
+
]#PLEASE SELECT ONE USING AN 'S' : #
]
]
]               ^ #- OPTIMIZATION RUN -- TRM:QFM:QAM EXECUTION#
10
]               ^ #- ITERATIVE SIMULATION RUN -- TRM:QFM:QAM:ACM EXECUTION#
]
]               ^ #- FORECASTING CONTRACTS RUN -- QFM EXECUTION#
]
+               ^ #- APPLICANT CLASSIFICATION RUN -- ACM EXECUTION#
]
]
]
]
20
]
]#PF: #    1:13 HELP   2:14 RTN MAIN   3:15 RTN PREV
]    #                 9:21 ACCEPT    10:22 RESET
]^
 ----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
          0         0         0         0         0         0         0
```

```
                                        CSP/AD                  DATE: 11/18/89  TIM
        MAPGROUP: RF01G          MAP: RF01M20   MSL: Q5RFM01
             1         2         3         4         5         6         7
 ----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#RF01M20 #            #ENLISTED PERSONNEL ALLOCATION SYSTEM#
]                      #          RUN FILE EDITOR          #
]                      #       ITERATION INFORMATION       #
]
+#PLEASE SELECT ONE USING AN 'S' :   #
]
]                              ^ #- WEEKLY ITERATIONS  #
]
]                              ^ #- MONTHLY ITERATIONS #
10
]                              ^ #- ANNUAL ITERATIONS #
]
]
]
+
]
]
]
]
20
]
]#PF: #    1:13 HELP   2:14 RTN MAIN   3:15 RTN PREV                        #
]    #                 9:21 ACCEPT    10:22 RESET
]^
 ----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
          0         0         0         0         0         0         0
```

```
                              CSP/AD                  DATE: 11/18/89  TIM
        MAPGROUP: RF01G      MAP: RF01M21   MSL: Q5RFM01
             1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#RF01M21 #           #ENLISTED PERSONNEL ALLOCATION SYSTEM#
]                     #           RUN FILE EDITOR          #
]                     #       ITERATION INFORMATION        #
]
+
]
]
]               #ENTER NUMBER OF ITERATIONS TO BE PERFORMED:  ^ #
]               #ENTER THE STARTING ITERATION NUMBER.......:  ^ #
10              #ENTER THE TYPE OF STARTING DATE           :
]               #  R-RECRUIT DATE, C-CALENDER DATE.........:  ^ #
]
]
]
+
]
]
]
]
20
]
]#PF: #    1:13 HELP   2:14 RTN MAIN   3:15 RTN PREV                        #
]    #                 9:21 ACCEPT    10:22 RESET
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                              CSP/AD                  DATE: 11/18/89  TIM
        MAPGROUP: RF01G      MAP: RF01M22   MSL: Q5RFM01
             1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#RF01M22 #           #ENLISTED PERSONNEL ALLOCATION SYSTEM#
]                     #          RUN FILE EDITOR           #
]                     #       STARTING RECRUIT DATE        #
]
+
]
]
]               #ENTER RECRUIT YEAR (E.G. 1988)............:   ^   #
]               #ENTER THE RECRUIT MONTH (E.G. OCT)........:    ^  #
10              #ENTER THE RECRUIT WEEK OF MONTH (E.G. 1)..:     ^ #
]
]
]
]
+
]
]
]
]
20
]
]#PF: #    1:13 HELP   2:14 RTN MAIN   3:15 RTN PREV                        #
]    #                 9:21 ACCEPT    10:22 RESET
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                                  CSP/AD                      DATE: 11/18/89  TIM
      MAPGROUP: RF01G           MAP: RF01M23    MSL: Q5RFM01
            1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#RF01M23 #             #ENLISTED PERSONNEL ALLOCATION SYSTEM#
]                       #          RUN FILE EDITOR         #
]                       #      STARTING CALENDAR DATE      #
]
+
]
]
]                 #ENTER CALENDAR YEAR(E.G. 1988)............:   ^  #
]                 #ENTER THE CALENDAR MONTH(E.G. 10 )........:    ^ #
10                #ENTER THE CALENDAR DAY OF MONTH (E.G. 01).:    ^ #
]
]
]
]
+
]
]
]
]
20
]
]#PF: #    1:13 HELP   2:14 RTN MAIN   3:15 RTN PREV                    #
]     #                9:21 ACCEPT    10:22 RESET
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                                  CSP/AD                      DATE: 11/18/89  TIM
      MAPGROUP: RF01G           MAP: RF01M25    MSL: Q5RFM01
            1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#RF01M25 #             #ENLISTED PERSONNEL ALLOCATION SYSTEM#
]                       #          RUN FILE EDITOR         #
]                       #       COMPOSITE SELECTION        #
]
+#PLEASE SELECT ONE USING AN 'S' :    #
]
]
]                         ^ #- OLD COMPOSITES - 1980 NORM#
]
10                        ^ #- NEW COMPOSITES - 1980 NORM#
]
]                         ^ #- OLD COMPOSITES - 1944 NORM#
]
]                         ^ #- NEW COMPOSITES - 1944 NORM#
+
]
]
]
]
20
]
]#PF: #    1:13 HELP   2:14 RTN MAIN   3:15 RTN PREV
]     #                9:21 ACCEPT    10:22 RESET
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                                   CSP/AD                   DATE: 11/18/89  TIM
      MAPGROUP: RF01G            MAP: RF01M30   MSL: Q5RFM01
          1         2         3         4         5         6         7
 ----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#RF01M30 #             #ENLISTED PERSONNEL ALLOCATION SYSTEM#
]                       #         RUN FILE EDITOR            #
]                       #       OPTIMIZATION FACTOR          #
]
+#PLEASE SELECT ONE USING AN 'S' :    #
]
]
]                         ^ #- PROJECTED APTITUDE AREA SCORES#
]
10                        ^ #- PROJECTED SQT SCORES        #
]
]                         ^ #- FIRST-TERM ATTRITION        #
]
]                         ^ #- AIR WORTH MEASURE (VER 1) #
+
]                         ^ #- DEP/ATTRITION SAVINGS       #
]
]
]
20
]
]#PF: #    1:13 HELP    2:14 RTN MAIN    3:15 RTN PREV
]     #                 9:21 ACCEPT     10:22 RESET
]^
 ----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
          0         0         0         0         0         0         0
```

```
                                   CSP/AD                   DATE: 11/18/89  TIM
      MAPGROUP: RF01G            MAP: RF01M35   MSL: Q5RFM01
          1         2         3         4         5         6         7
 ----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#RF01M35 #             #ENLISTED PERSONNEL ALLOCATION SYSTEM#
]                       #         RUN FILE EDITOR            #
]                       #  GOAL/SCHOOL INFORMATION SCALING   #
]
+#PLEASE SELECT ONE USING AN 'S' :    #
]
]
]              ^ #- NO SCALING OF MOS/SCHOOL GOALS (ORIGINAL DEMAND) #
]
10             ^ #- SCALE GOALS LESS THAN APPLICANTS (SUPPLY > DEMAND) #
]
]              ^ #- SCALE GOALS EQUAL TO APPLICANTS (SUPPLY = DEMAND) #
]
]              ^ #- SCALE GOALS GREATER THAN APPLICANTS (SUPPLY < DEMAND)#
+
]
]
]
]
20
]
]#PF: #    1:13 HELP    2:14 RTN MAIN    3:15 RTN PREV
]     #                 9:21 ACCEPT     10:22 RESET
]^
 ----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
          0         0         0         0         0         0         0
```

```
                                    CSP/AD                    DATE: 11/18/89  TIM
       MAPGROUP: RF01G            MAP: RF01M36   MSL: Q5RFM01
            1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#RF01M36 #           #ENLISTED PERSONNEL ALLOCATION SYSTEM#
]                     #          RUN FILE EDITOR         #
]                     #  GOAL/SCHOOL INFORMATION SCALING         #
]
+#PLEASE SPECIFY SCALING PERCENTAGE (E.G. 20.5 ): ^     #%#
]
]
]
]
10
 ]
 ]
 ]
 ]
 +
 ]
 ]
 ]
 ]
20
 ]
]#PF: #   1:13 HELP   2:14 RTN MAIN   3:15 RTN PREV
]    #                9:21 ACCEPT    10:22 RESET
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                                    CSP/AD                    DATE: 11/18/89  TIM
       MAPGROUP: RF01G            MAP: RF01M40   MSL: Q5RFM01
            1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#RF01M40 #           #ENLISTED PERSONNEL ALLOCATION SYSTEM#
]                     #          RUN FILE EDITOR          #
]                     #    APPLICANT SOURCE SELECTION     #
]
+#PLEASE SELECT ONE USING AN 'S' :#
]
]              ^ #- APPLICANTS FROM PREBUILT HISTORICAL-BASED FILE #
]
]              ^ #- APPLICANTS WILL MATCH QFM FORECAST              #
10
 ]
 ]
 ]
 ]
 +
 ]
 ]
 ]
 ]
20
 ]
]#PF: #   1:13 HELP   2:14 RTN MAIN   3:15 RTN PREV
]    #
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                                CSP/AD                     DATE: 11/18/89  TIM
      MAPGROUP: RF01G         MAP: RF01M41    MSL: Q5RFM01
              1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#RF01M41 #          #ENLISTED PERSONNEL ALLOCATION SYSTEM#
]                    #      APPLICANT SOURCE SELECTION    #
]                    #   APPLICANT TOTAL SPECIFICATION              #
]
+#PLEASE SPECIFY THE TOTAL NUMBER OF YEARLY APPLICANTS: ^      #
]
]
]
]
10
]
]
]
]
+
]
]
]
]
20
]
]#PF: #    1:13 HELP    2:14 RTN MAIN    3:15 RTN PREV
]     #                 9:21 ACCEPT     10:22 RESET
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                                CSP/AD                     DATE: 11/18/89  TIM
      MAPGROUP: RF01G         MAP: RF01M45    MSL: Q5RFM01
              1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#RF01M45 #          #ENLISTED PERSONNEL ALLOCATION SYSTEM#
]                    #          RUN FILE EDITOR           #
]                    #          EPAS ABORT POLICY         #
]
+#PLEASE SELECT ONE USING AN 'S' : #
]
]                 ^ #- INFEASIBLE:OUT-OF-BOUNDS ABORTS ALLOWED #
]
]                 ^ #- NO EPAS RELATED ABORTS ALLOWED          #
10
]
]
]
]
+
]
]
]
]
20
]
]#PF: #    1:13 HELP    2:14 RTN MAIN    3:15 RTN PREV
]     #                 9:21 ACCEPT     10:22 RESET
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                                 CSP/AD                     DATE: 11/18/89  TIM
       MAPGROUP: RF01G          MAP: RF01M50    MSL: Q5RFM01
            1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#RF01M50 #             #ENLISTED PERSONNEL ALLOCATION SYSTEM#
]                       #          RUN FILE EDITOR           #
]                       #       DEP LOSS INFORMATION         #
]
+
]
]                         #THIS MODULE IS NOT YET AVAILABLE#
]
]
]
]
]
]
+
]
]
]
]
]
]#PF: #    1:13 HELP    2:14 RTN MAIN    3:15 RTN PREV
]    #
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                                 CSP/AD                     DATE: 11/18/89  TIM
       MAPGROUP: RF55G          MAP: RF55M01    MSL: Q5RFM01
            1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#RF55M01 #             #ENLISTED PERSONNEL ALLOCATION SYSTEM#
]                       #          RUN FILE EDITOR           #
]                       #         REPORT SELECTION           #
]
+#PLEASE SELECT USING AN 'S': #
]
]                         ^ #- FY ACCESSIONS METRICS         #
]                         ^ #- FY CONTRACTEES METRICS         #
]                         ^ #- OPTIMIZATION METRICS  #
]                         ^ #- QUALITY GOALS                 #
]                         ^ #- QUALITY ALLOCATION            #
]                         ^ #- SCHOOL SEAT FILL      #
]                         ^ #- DEP LENGTH #
]                         ^ #- BRICK CHARTS#
+                         ^ #- AVERAGE APTITUDE AREA SCORE#
]
]
]
]
]
]#PF: #    1:13 HELP    2:14 RTN MAIN    3:15 RTN PREV
]    #                  9:21 ACCEPT     10:22 RESET
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                                  CSP/AD                      DATE: 11/18/89  TIM
      MAPGROUP: RF55G           MAP: RF55M10   MSL: Q5RFM01
           1          2          3          4          5          6          7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#RF55M10 #          #ENLISTED PERSONNEL ALLOCATION SYSTEM#
]                    ^                                   #
]                    #         METRIC SELECTION          #
]
+#PLEASE SELECT USING AN 'S' (UP TO 3 SELECTIONS):#
]
]                      ^ #- APTITUDE AREA SCORE (AA)     #
]                      ^ #- SKILL QUALIFICATION TEST (SQT)#
]                      ^ #- ATTRITION RATES        #
10                     ^ #- UTILITY OF ASSIGNMENT (WORTH)#
]                      ^ #- PROBABILITY OF RETENTION     #
]
]   #NOTE: ANY METRIC CHANGES ARE APPLICABLE TO ALL METRIC DEPENDENT REPORTS
]
+
]
]
]
]
20
]
]#PF: #    1:13 HELP   2:14 RTN MAIN   3:15 RTN PREV
]   #                  9:21 ACCEPT    10:22 RESET
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0          0          0          0          0          0          0
```

```
                                  CSP/AD                      DATE: 11/18/89  TIM
      MAPGROUP: RF55G           MAP: RF55M20   MSL: Q5RFM01
           1          2          3          4          5          6          7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#RF55M20 #          #ENLISTED PERSONNEL ALLOCATION SYSTEM#
]                    ^                                   #
]                    #          DISPLAY DETAIL           #
]
+#PLEASE SELECT USING AN 'S' :
]
]                      ^ #- BY MOS                      #
]                      ^ #- BY MOS CLUSTER              #
]
10
]
]
]
]
+
]
]
]
]
20
]
]#PF: #    1:13 HELP   2:14 RTN MAIN   3:15 RTN PREV
]   #                  9:21 ACCEPT    10:22 RESET
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0          0          0          0          0          0          0
```

```
                               CSP/AD                  DATE: 11/18/89  TIM
     MAPGROUP: RF55G          MAP: RF55M21   MSL: Q5RFM01
         1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#RF55M21 #           #ENLISTED PERSONNEL ALLOCATION SYSTEM#
]                     ^                                   #
]                     #          DISPLAY DETAIL           #
]
+#PLEASE SELECT USING AN 'S' :
]
]                       ^ #- GENERATE SUMMARY METRIC REPORT(S)#
]
]
10
]
]
]
]
+
]
]
]
]
20
]
]#PF: #    1:13 HELP   2:14 RTN MAIN   3:15 RTN PREV
]    #                 9:21 ACCEPT    10:22 RESET
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                               CSP/AD                  DATE: 11/18/89  TIM
     MAPGROUP: RF55G          MAP: RF55M30   MSL: Q5RFM01
         1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#RF55M30 #           #ENLISTED PERSONNEL ALLOCATION SYSTEM#
]                     ^                                   #
]                     #        ITERATION SELECTION        #
]
+#PLEASE ENTER NUMBER OF ITERATIONS ( 0  => ALL ITERATIONS):      #
]
]                       ^  #- ITERATION NUMBER FOR REPORT(S) GENERATION#
]
]
10
]
]
]
]
+
]
]
]
]
20
]
]#PF: #    1:13 HELP   2:14 RTN MAIN   3:15 RTN PREV
]    #                 9:21 ACCEPT    10:22 RESET
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                               CSP/AD                  DATE: 11/18/89  TIM
      MAPGROUP: RF55G         MAP: RF55M80    MSL: Q5RFM01
          1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#RF55M80 #               #ENLISTED PERSONNEL ALLOCATION SYSTEM#
]                         #           RUN FILE EDITOR          #
]                         #             BRICK CHARTS           #
]
+
]
]
]                          #BRICK CHARTS ARE NOT YET AVAILABLE.#
]
10
]
]
]
]
+
]
]
]
]
20
]
]#PF: #    1:13 HELP    2:14 RTN MAIN    3:15 RTN PREV
]    #                  9:21 ACCEPT      10:22 RESET
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                               CSP/AD                  DATE: 11/18/89  TIM
      MAPGROUP: RF60G         MAP: RF60M01    MSL: Q5RFM01
          1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#RF60M01 #               #ENLISTED PERSONNEL ALLOCATION SYSTEM#
]                         #           RUN FILE EDITOR          #
]                         #           FILE SELECTION           #
]
+#PLEASE ENTER FILE SELECTION:#
]
]                          ^                              ^       #
]                          ^                              ^       #
]                          ^                              ^       #
10                         ^                              ^       #
]                          ^                              ^       #
]                          ^                              ^       #
]                          ^                              ^       #
]                          ^                              ^       #
+                          ^                              ^       #
]                          ^                              ^       #
]                          ^                              ^       #
]
]
20
]
]#PF: #    1:13 HELP    2:14 RTN MAIN    3:15 RTN PREV
]    #                  9:21 ACCEPT      10:22 RESET
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                                  CSP/AD                        DATE: 11/18/89  TIM
     MAPGROUP: RF65G             MAP: RF65M01    MSL: Q5RFM01
              1          2          3          4          5          6          7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#RF65M01 #          #ENLISTED PERSONNEL ALLOCATION SYSTEM#
]                    #         RUN FILE EDITOR              #
]                    #      ANCILLARY FILE DELETION         #
]
+         #PRESS#ENTER#TO DELETE THE ANCILLARY FILES FOR ALL ITERATIONS#
]
]
]
]
10
]
]
]
]
+
]
]
]
]
20
]
]#PF: #    1:13 HELP    2:14 RTN MAIN    3:15 RTN PREV
]    #
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0          0          0          0          0          0          0
```

```
                                  CSP/AD                        DATE: 11/18/89  TIM
     MAPGROUP: RG01G             MAP: RG01M11    MSL: Q5RGM01
              1          2          3          4          5          6          7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#RG01M11#      #     ENLISTED PERSONNEL ALLOCATION SYSTEM      #
]               #             REPORT GENERATION                 #
]               #             RUN FILE LISTING                  #
]
+                         #PLEASE SELECT#ONE#USING AN'S':    #
]
]
] ^ ^-^        #  ^ ^-^     #  ^ ^-^     #  ^ ^-^     #  ^ ^-^
]
10
] ^ ^-^        #  ^ ^-^     #  ^ ^-^     #  ^ ^-^     #  ^ ^-^
]
]
] ^ ^-^        #  ^ ^-^     #  ^ ^-^     #  ^ ^-^     #  ^ ^-^
+
]
] ^ ^-^        #  ^ ^-^     #  ^ ^-^     #  ^ ^-^     #  ^ ^-^
]
]
20
]
]#PF:# 1:13 HELP  2:14 MENU     3:15 RTN                  #     7:19 BCK
]    # 8:20 FWD  #9:21 PROCESS#             11:23 RESET    #12:24 FIND^
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0          0          0          0          0          0          0
```

```
                              CSP/AD                  DATE: 11/18/89  TIM
   MAPGROUP: RG02G          MAP: RG02M01   MSL: Q5RGM01
        1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#RG02M01#          #ENLISTED PERSONNEL ALLOCATION SYSTEM#
]                            #REPORT GENERATION#
]                           #MAIN SELECTION MENU #
]
+#PLEASE SELECT USING AN#'S'#:#
]
]                      ^ #- REPORT SELECTION#
]                      ^ #- GENERATION#
]                      ^ #- GENERATION STATUS  #
10                     ^ #- REPORT DISPLAY     #
]                      ^ #- REPORT PRINTING    #
]
]                         #PRESS#ENTER#TO PROCESS#
]
+
]
]
]
]
20
]
]#PF: #    1:13 HELP   2:14 RTN MAIN   3:15 RTN PREV
]    #
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                              CSP/AD                  DATE: 11/18/89  TIM
   MAPGROUP: RG12G          MAP: RG12M01   MSL: Q5RGM01
        1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#RN22M01#      #     ENLISTED PERSONNEL ALLOCATION SYSTEM        #
]                     #SIMULATION POPULATION GENERATION #
]               #            STATUS SELECTION MENU                #
]
+#PLEASE SELECT USING AN#'S'#:#
]
]                         ^ #- BATCH JOBS STATUS      #
]                         ^ #- EXECUTION STATUS       #
]                         ^ #- EXCEPTIONS REPORT        #
10
]                            #PRESS#ENTER#TO PROCESS#
]
]
]
+
]
]
]
]
20
]
]#PF:# 1:13 HELP  2:14 MENU     3:15 RTN
]   #
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                              CSP/AD                       DATE: 11/18/89  TIM
     MAPGROUP: RG12G          MAP: RG12M10   MSL: QSRGM01
          1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#RN22M10      #      ENLISTED PERSONNEL ALLOCATION SYSTEM         #
]                     #SIMULATION POPULATION GENERATION            #
]                          #EXECUTION STATUS #
]
+
]
]
]                        #PRESS#ENTER#TO CONTINUE#
]
10
]
]
]
]
+
]
]
]
]
20
]
]#PF:# 1:13 HELP          2:14 MAIN        3:15 RETURN
]    #                    7:19 PAGE BACK   8:20 PAGE FWD
]-
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                              CSP/AD                       DATE: 11/18/89  TIM
     MAPGROUP: RG12G          MAP: RG12M30   MSL: QSRGM01
          1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#RN22M30      #      ENLISTED PERSONNEL ALLOCATION SYSTEM         #PAGE^  #OF
]              #        SIMULATION POPULATION GENERATION           #
]                        #       EXCEPTIONS REPORT#
]
+
]
]
]
]
10
]
]
]
]
+
]
]
]
]
20
]                     #PRESS#ENTER#TO CONTINUE TO NEXT REPORT#
]#PF:# 1:13 HELP          2:14 MAIN        3:15 RETURN
]    #                    7:19 PAGE BACK   8:20 PAGE FWD
]-
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                                    CSP/AD                       DATE: 11/18/89  TIM
         MAPGROUP: RG13G          MAP: RG13M01   MSL: Q5RGM01
                 1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#RG13M01 #          #ENLISTED PERSONNEL ALLOCATION SYSTEM#
]                    #         REPORT GENERATION          #
]                    #         REPORT SELECTION           #
]
+#PLEASE SELECT USING AN 'S': #
]
]                        ^ #- FY ACCESSIONS METRICS        #
]                        ^ #- FY CONTRACTEES METRICS        #
]                        ^ #- OPTIMIZATION METRICS  #
10                       ^ #- QUALITY GOALS                 #
]                        ^ #- QUALITY ALLOCATION            #
]                        ^ #- SCHOOL SEAT FILL       #
]                        ^ #- DEP LENGTH #
]                        ^ #- BRICK CHARTS#
+                        ^ #- AVERAGE APTITUDE AREA SCORE#
]
]
]
]
20
]
]#PF: #    1:13 HELP   2:14 RTN MAIN   3:15 RTN PREV
]  #              ^             ^                #
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                                    CSP/AD                       DATE: 11/18/89  TIM
         MAPGROUP: RG13G          MAP: RG13M03   MSL: Q5RGM01
                 1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#RG13M03 #          #ENLISTED PERSONNEL ALLOCATION SYSTEM#
]                    #         REPORT GENERATION          #
]                    #         METRIC SELECTION           #
]
+#PLEASE SELECT USING AN 'S' (UP TO 3 SELECTIONS):#
]
]                        ^ #- APTITUDE AREA SCORE (AA)      #
]                        ^ #- SKILL QUALIFICATION TEST (SQT)#
]                        ^ #- ATTRITION RATES        #
10                       ^ #- UTILITY OF ASSIGNMENT (WORTH)#
]                        ^ #- PROBABILITY OF RETENTION      #
]
]
]
+
]
]
]
]
20
]
]#PF: #    1:13 HELP   2:14 RTN MAIN   3:15 RTN PREV
]  #               9:21 ACCEPT    10:22 RESET
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                                            CSP/AD                  DATE: 11/18/89  TIM
        MAPGROUP: RG13G                    MAP: RG13M04     MSL: Q5RGM01
SPECIFICATION FOR FOLLOWING DEVICE TYPES
                  1            2            3            4            5            6            7
    ----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
  ]#RG13M04 #              #ENLISTED PERSONNEL ALLOCATION SYSTEM#
  ]                        #            REPORT GENERATION          #
  ]                        #           ITERATION SELECTION         #
  ]
  +#PLEASE ENTER NUMBER OF ITERATIONS ( 0  => ALL COMPLETED ITERATIONS)#
  ]
  ]                          *  #- ITERATION NUMBER FOR REPORT(S) GENERATION#
  ]
  ]
 10
  ]
  ]
  ]
  ]
  +
  ]
  ]
  ]
  ]
 20
  ]
  ]#PF: #    1:13 HELP    2:14 RTN MAIN    3:15 RTN PREV
  ]   #                   9:21 ACCEPT      10:22 RESET
  ]*
    ----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
             0            0            0            0            0            0            0
```

```
                                            CSP/AD                  DATE: 11/18/89  TIM
        MAPGROUP: RG13G                    MAP: RG13M10     MSL: Q5RGM01
                  1            2            3            4            5            6            7
    ----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
  ]
  ]
  ]
  ]
  +
  ]
  ]
  ]
  ]
 10
  ]
  ]
  ]
  ]
  +
  ]
  ]
  ]
  ]
 20
  ]
  ]
  ]
  ]
    ----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
             0            0            0            0            0            0            0
```

```
                              CSP/AD                  DATE: 11/18/89  TIM
     MAPGROUP: RG13G         MAP: RG13M20   MSL: Q5RGM01
         1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#RG13M20 #          #ENLISTED PERSONNEL ALLOCATION SYSTEM#
]                    ^                                  #
]                    #          DISPLAY DETAIL          #
]
+#PLEASE SELECT USING AN 'S' :
]
]                     ^ #- BY MOS                      #
]                     ^ #- BY MOS CLUSTER               #
]
10
]
]
]
]
+
]
]
]
]
20
]
]#PF: #   1:13 HELP   2:14 RTN MAIN   3:15 RTN PREV
]  #                  9:21 ACCEPT    10:22 RESET
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0

                              CSP/AD                  DATE: 11/18/89  TIM
     MAPGROUP: RG13G         MAP: RG13M21   MSL: Q5RGM01
         1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#RG13M21 #          #ENLISTED PERSONNEL ALLOCATION SYSTEM#
]                    ^                                  #
]                    #          DISPLAY DETAIL          #
]
+#PLEASE SELECT USING AN 'S' :
]
]                     ^ #- GENERATE SUMMARY METRIC REPORT(S)#
]
]
10
]
]
]
]
+
]
]
]
]
20
]
]#PF: #   1:13 HELP   2:14 RTN MAIN   3:15 RTN PREV
]  #                  9:21 ACCEPT    10:22 RESET
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                                    CSP/AD                      DATE: 11/18/89  TIM
          MAPGROUP: RG13G           MAP: RG13M80     MSL: Q5RGM01
                1         2         3         4         5         6         7
      ----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
     ]#RG13M80 #               #ENLISTED PERSONNEL ALLOCATION SYSTEM#
     ]                         #          RUN FILE EDITOR           #
     ]                         #           BRICK CHARTS             #
     ]
     +
     ]
     ]
     ]                          #BRICK CHARTS ARE NOT YET AVAILABLE.#
     ]
    10
     ]
     ]
     ]
     ]
     +
     ]
     ]
     ]
     ]
    20
     ]
     ]#PF: #    1:13 HELP    2:14 RTN MAIN    3:15 RTN PREV
     ]    #                  9:21 ACCEPT     10:22 RESET
     ]^
      ----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
               0         0         0         0         0         0         0

                                    CSP/AD                      DATE: 11/18/89  TIM
          MAPGROUP: RN01G           MAP: RN01M11     MSL: Q5RNM01
                1         2         3         4         5         6         7
      ----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
     ]#RN01M11#          #     ENLISTED PERSONNEL ALLOCATION SYSTEM      #
     ]                   #          RUN FILE EXECUTION/STATUS            #
     ]                   #             MAIN SELECTION MENU               #
     ]
     +                          #PLEASE SELECT#ONE# USING AN 'S' :#
     ]
     ]
     ] ^ ^-^        #  ^ ^-^      #  ^ ^-^      #  ^ ^-^      #  ^ ^-^
     ]
    10
     ] ^ ^-^        #  ^ ^-^      #  ^ ^-^      #  ^ ^-^      #  ^ ^-^
     ]
     ]
     ] ^ ^-^        #  ^ ^-^      #  ^ ^-^      #  ^ ^-^      #  ^ ^-^
     +
     ]
     ] ^ ^-^        #  ^ ^-^      #  ^ ^-^      #  ^ ^-^      #  ^ ^-^
     ]
     ]
    20
     ]
     ]#PF:# 1:13 HELP  2:14 MENU     3:15 RTN                  #    7:19 BCK
     ]    # 8:20 FWD # 9:21 EXECUTE 10:22 STATUS# 11:23 RESET    #12:24 FIND^
     ]^
      ----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
               0         0         0         0         0         0         0
```

```
                                    CSP/AD                       DATE: 11/18/89  TIM
       MAPGROUP: RN12G           MAP: RN12M01    MSL: Q5RNM01
             1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#RN12M01#     #     ENLISTED PERSONNEL ALLOCATION SYSTEM       #
]                        #  RUN FILE STATUS  #
]              #         STATUS SELECTION MENU                  #
]
+#PLEASE SELECT USING AN#'S'#:#
]
]                       ^ #- BATCH JOBS STATUS       #
]                       ^ #- RUN FILE EXECUTION STATUS#
]                       ^ #- TRM EXCEPTION REPORTS  #
10                      ^ #- QAM EXCEPTION REPORTS  #
]                       ^ #- INTERACTIVE EXCEPTION REPORTS#
]                       ^ #- BATCH EXCEPTION REPORTS     #
]
]                         #PRESS#ENTER#TO PROCESS#
+
]
]
]
]
20
]
]#PF:# 1:13 HELP  2:14 MENU     3:15 RTN
]   #
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
                                    CSP/AD                       DATE: 11/18/89  TIM
       MAPGROUP: RN12G           MAP: RN12M10    MSL: Q5RNM01
             1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#RN12M10#     #     ENLISTED PERSONNEL ALLOCATION SYSTEM       #
]                        #RUN FILE EXECUTION  #
]              #            STATUS DISPLAY                      #
]
+       #RUN FILE NAME................................^        #
]       #DESCRIPTION.........^                                 #
]       #EXECUTION OPTION....^                                 #
]       #COMPLETION STATUS...^                                 #
]       ^                       ^  #
10      ^                          #
]              ^              ^    #
]              ^                ^  #
]              ^                 ^ #
]       ^                          #
+              ^              ^    #
]              ^                ^  #
]              ^                 ^ #
]
]                         #PRESS#ENTER#TO CONTINUE#
20
]
]#PF:# 1:13 HELP  2:14 MENU     3:15 RTN
]   #
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                              CSP/AD                      DATE: 11/18/89  TIM
      MAPGROUP: RN12G          MAP: RN12M20   MSL: Q5RNM01
            1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#RN12M20#     #      ENLISTED PERSONNEL ALLOCATION SYSTEM          #
]              ^                                                    #
]              #           ITERATION SELECTION MENU                 #
]
+#PLEASE SELECT USING AN#'S'#:#
]
]                    - -          - #       - -          - #
]                    - -          - #       - -          - #
]                    - -          - #       - -          - #
10                   - -          - #       - -          - #
]                    - -          - #       - -          - #
]                    - -          - #       - -          - #
]                    - -          - #       - -          - #
]                    - -          - #       - -          - #
+                    - -          - #       - -          - #
]                    - -          - #       - -          - #
]                    - -          - #       - -          - #
]                    - -          - #       - -          - #
]
20                         #PRESS#ENTER#TO REVIEW #
]
]#PF:# 1:13 HELP  2:14 MENU     3:15 RTN
]   #
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                              CSP/AD                      DATE: 11/18/89  TIM
      MAPGROUP: RN12G          MAP: RN12M30   MSL: Q5RNM01
            1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#RN12M30      #      ENLISTED PERSONNEL ALLOCATION SYSTEM          #PAGE^  #OF
]              ^                                                    #
]                             #ITERATION^  #
]
+
]
]
]
]
10
]
]
]
]
+
]
]
]
]
20
]                   #PRESS#ENTER#TO CONTINUE TO NEXT REPORT#
]#PF:# 1:13 HELP          2:14 MAIN          3:15 RETURN
]   #                     7:19 PAGE BACK     8:20 PAGE FWD
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                                         CSP/AD                  DATE: 11/18/89  TIM
      MAPGROUP: RN22G                  MAP: RN22M01    MSL: Q5RUM01
              1          2          3          4          5          6          7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#RN22M01#      #      ENLISTED PERSONNEL ALLOCATION SYSTEM           #
]                       #SIMULATION POPULATION GENERATION #
]               #              STATUS SELECTION MENU                  #
]
+#PLEASE SELECT USING AN#'S'#:#
]
]                             ^ #- BATCH JOBS STATUS        #
]                             ^ #- EXECUTION STATUS         #
]                             ^ #- EXCEPTIONS REPORT          #
10
]                               #PRESS#ENTER#TO PROCESS#
]
]
]
]
+
]
]
]
]
20
]
]#PF:# 1:13 HELP   2:14 MENU      3:15 RTN
]    #
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                                         CSP/AD                  DATE: 11/18/89  TIM
      MAPGROUP: RN22G                  MAP: RN22M10    MSL: Q5RUM01
              1          2          3          4          5          6          7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#RN22M10       #      ENLISTED PERSONNEL ALLOCATION SYSTEM           #
]                       #SIMULATION POPULATION GENERATION             #
]                                #EXECUTION STATUS #
]
+
]
]
]                               #PRESS#ENTER#TO CONTINUE#
]
10
]
]
]
]
+
]
]
]
]
20
]
]#PF:# 1:13 HELP          2:14 MAIN         3:15 RETURN
]    #                    7:19 PAGE BACK    8:20 PAGE FWD
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                          CSP/AD                 DATE: 11/18/89  TIM
     MAPGROUP: RN22G          MAP: RN22M30   MSL: Q5RUM01
          1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#RN22M30      #      ENLISTED PERSONNEL ALLOCATION SYSTEM        #PAGE^  #OF
]              #        SIMULATION POPULATION GENERATION          #
]                        #     EXCEPTIONS REPORT#
]
+
]
]
]
]
10
]
]
]
]
+
]
]
]
]
20
]                     #PRESS#ENTER#TO CONTINUE TO NEXT REPORT#
]#PF:# 1:13 HELP          2:14 MAIN        3:15 RETURN
]   #                     7:19 PAGE BACK   8:20 PAGE FWD
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                          CSP/AD                 DATE: 11/18/89  TIM
     MAPGROUP: AP51G          MAP: AP51M11   MSL: Q5APM01
          1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#AP51M11#     #      ENLISTED PERSONNEL ALLOCATION SYSTEM        #
]              #        SIMULATION POPULATION GENERATION          #
]              #         SIMULATION POPULATIONS LISTING           #
]
+                       #PLEASE SELECT#ONE#USING AN'S':   #
]
]
] ^ ^-^      # ^ ^-^      # ^ ^-^      # ^ ^-^      # ^ ^-^
]
10
] ^ ^-^      # ^ ^-^      # ^ ^-^      # ^ ^-^      # ^ ^-^
]
]
] ^ ^-^      # ^ ^-^      # ^ ^-^      # ^ ^-^      # ^ ^-^
+
]
] ^ ^-^      # ^ ^-^      # ^ ^-^      # ^ ^-^      # ^ ^-^
]
]
20
]
]#PF:# 1:13 HELP  2:14 MENU    3:15 RTN                 #    7:19 BCK
]    # 8:20 FWD  #9:21 PROCESS#              11:23 RESET    #12:24 FIND^
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                                      CSP/AD                    DATE: 11/18/89  TIM
        MAPGROUP: AP52G            MAP: AP52M01    MSL: Q5APM01
                 1         2         3         4         5         6         7
    ----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
    ]#AP52M01#               #ENLISTED PERSONNEL ALLOCATION SYSTEM#
    ]                       #   SIMULATION POPULATION GENERATION   #
    ]                                #MAIN SELECTION MENU #
    ]
    +#PLEASE SELECT USING AN#'S'#:#
    ]
    ]                          ^ #- POPULATION SPECIFICATIONS#
    ]                          ^ #- GENERATION#
    ]                          ^ #- GENERATION STATUS  #
    10
    ]                            #PRESS#ENTER#TO PROCESS#
    ]
    ]
    ]
    +
    ]
    ]
    ]
    ]
    20
    ]
    ]#PF: #   1:13 HELP   2:14 RTN MAIN   3:15 RTN PREV
    ]    #
    ]^
    ----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
             0         0         0         0         0         0         0
```

```
                                      CSP/AD                    DATE: 11/18/89  TIM
        MAPGROUP: AP63G            MAP: AP63M01    MSL: Q5APM01
                 1         2         3         4         5         6         7
    ----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
    ]#AP63M01 #              #ENLISTED PERSONNEL ALLOCATION SYSTEM#
    ]                       #   SIMULATION POPULATION GENERATION #
    ]                        #     POPULATION SPECIFICATIONS      #
    ]
    +#PLEASE SELECT USING AN 'S': #
    ]
    ]                          ^ #- SAMPLING DATES ENTRY         #
    ]                          ^ #- DEMOGRAPHIC GROUPS SELECTION #
    ]                          ^ #- SCALING PARAMETERS   #
    10
    ]                               #PRESS#ENTER#TO PROCESS#
    ]
    ]
    ]
    +
    ]
    ]
    ]
    ]
    20
    ]
    ]#PF: #   1:13 HELP   2:14 RTN MAIN   3:15 RTN PREV
    ]   #                                         #
    ]^
    ----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
             0         0         0         0         0         0         0
```

```
                                     CSP/AD                       DATE: 11/18/89  TIM
      MAPGROUP: AP63G              MAP: AP63M10    MSL: Q5AFM01
              1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#AP63M10#              #ENLISTED PERSONNEL ALLOCATION SYSTEM#
]                      #SIMULATION POPULATION GENERATION EDITOR#
]                              #DATE ENTRY#
]
+#PLEASE ENTER THE HISTORICAL TIME WINDOW TO GENERATE THE POPULATION FROM:#
]
]                          #STARTING CALENDAR DOOR DATE:#
]                            #   YEAR (E.G. 1988):^     #
]                            #  MONTH (E.G. OCT) : ^    #

]
]                          #ENDING CALENDAR DOOR DATE:  #
]                            #   YEAR (E.G. 1989):^     #
]                            #  MONTH (E.G. SEP) : ^    #
+
]
]
]
]

]
]#PF: #    1:13 HELP    2:14 RTN MAIN    3:15 RTN PREV#
]                      #9:21 ACCEPT     10:22 RESET#
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                                     CSP/AD                       DATE: 11/18/89  TIM
      MAPGROUP: AP63G              MAP: AP63M20    MSL: Q5AFM01
              1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#AP62M20#              #ENLISTED PERSONNEL ALLOCATION SYSTEM#
]                      #    SIMULATION POPULATION GENERATION    #
]                           #DEMOGRAPHIC GROUPS SELECTION#
]
+#PLEASE SELECT USING AN#'S'#:#
]                                   ^ #ALL GROUPS#
]                                         #|#
]                                         #|#
]                    #|-------------------|--------------------|#
              #APPLICANT                                          CONTRACT #
]             #|---------|---------|                       |---------|---------|#
]         #MALE                  FEMALE                         MALE             FEMALE#
]   #|-----|-----|       |-----|-----|             |-----|-----|    |-----|-----|
]#  HSS   HSG   NHS   HSS   HSG   NHS         HSS   HSG   NHS   HSS   HSG   NH
+
] ^ #1   ^ #1   ^ #1   ^ #1   ^ #1   ^ #1   #   ^ #1   ^ #1   ^ #1   ^ #1   ^ #1   ^ #1
] ^ #2   ^ #2   ^ #2   ^ #2   ^ #2   ^ #2   #   ^ #2   ^ #2   ^ #2   ^ #2   ^ #2   ^ #2
] ^ #3A  ^ #3A  ^ #3A  ^ #3A  ^ #3A  ^ #3A  #   ^ #3A  ^ #3A  ^ #3A  ^ #3A  ^ #3A  ^ #3
] ^ #3B  ^ #3B  ^ #3B  ^ #3B  ^ #3B  ^ #3B  #   ^ #3B  ^ #3B  ^ #3B  ^ #3B  ^ #3B  ^ #3
  ^ #4   ^ #4   ^ #4   ^ #4   ^ #4   ^ #4   #   ^ #4   ^ #4   ^ #4   ^ #4   ^ #4   ^ #4
]
]#PF: #    1:13 HELP    2:14 RTN MAIN    3:15 RTN PREV#
]                      #9:21 ACCEPT     10:22 RESET#
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                                        CSP/AD                DATE: 11/18/89  TIM
      MAPGROUP: AP63G             MAP: AP63M30    MBL: Q5APM01
              1           2           3           4           5           6           7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#AP63M30#          #ENLISTED PERSONNEL ALLOCATION SYSTEM#
]               #    SIMULATION POPULATION GENERATION    #
]                      #   SCALING OPTION INPUT    #
]
+#PLEASE SELECT USING AN#'S'#:#
]
]                        ^ #SCALED SIMULATION POPULATION#
]
]
10
]
]
]
]
+
]
]
]
]
20
]
]#PF: #    1:13 HELP    2:14 RTN MAIN    3:15 RTN PREV#
]               #9:21 ACCEPT     10:22 RESET#
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0           0           0           0           0           0           0
```

```
                                        CSP/AD                DATE: 11/18/89  TIM
      MAPGROUP: AP63G             MAP: AP63M31    MBL: Q5APM01
              1           2           3           4           5           6           7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#AP63M31#          #ENLISTED PERSONNEL ALLOCATION SYSTEM#
]               #    SIMULATION POPULATION GENERATION    #
]                      # YEARLY SAMPLE SIZE INPUT  #
]
+#PLEASE ENTER THE NUMBER OF PEOPLE/RECRUITS TO GENERATE FROM EACH FISCAL YE
]
]
]               #  FISCAL YEAR      NUMBER      PERCENT#
]               #  -----------      ------      -------#
10                   ^    #         ^    #      ^    #
]                    ^    #         ^    #      ^    #
]                    ^    #         ^    #      ^    #
]                    ^    #         ^    #      ^    #
]                    ^    #         ^    #      ^    #
+               #  -----------      ------      -------#
]               #  TOTAL  #         ^    #      ^    #
]
]
]
20
]
]#PF: #    1:13 HELP    2:14 RTN MAIN    3:15 RTN PREV#
]               #9:21 ACCEPT     10:22 RESET#
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0           0           0           0           0           0           0
```

```
                                   CSP/AD                     DATE: 11/18/89  TIM
        MAPGROUP: AP63G           MAP: AP63M36    MSL: Q5APM01
               1         2         3         4         5         6         7
 ----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
 ]#AP63M36#             #ENLISTED PERSONNEL ALLOCATION SYSTEM#
 ]                     #   SIMULATION POPULATION GENERATION   #
 ]                     #    DESIRED DEMOGRAPHIC BREAKDOWN        #
 ]
 +#PLEASE SELECT USING AN#'S'#:#
 ]
 ]                               #YEAR:^      #
 ]
 ]                          ^ #OCT             ^ #APR  #
                            ^ #NOV             ^ #MAY  #
 ]                          ^ #DEC             ^ #JUN  #
 ]                          ^ #JAN             ^ #JUL  #
 ]                          ^ #FEB             ^ #AUG   #
 ]                          ^ #MAR             ^ #SEP      #
 +
 ]
 ]
 ]
 ]

 ]#PF: #    1:13 HELP   2:14 RTN MAIN   3:15 RTN PREV#
 ]                      #9:21 ACCEPT    10:22 RESET#
 ]^
 ]
 ----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
          0         0         0         0         0         0         0
```

```
                                   CSP/AD                     DATE: 11/18/89  TIM
        MAPGROUP: AP63G           MAP: AP63M37    MSL: Q5APM01
               1         2         3         4         5         6         7
 ----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
 ]#AP01M04#             #ENLISTED PERSONNEL ALLOCATION SYSTEM#
 ]                     #SIMULATION POPULATION GENERATION EDITOR#
 ]                         # DESIRED NUMBERS PER MONTH:#
 ]
 +       #MONTH      APPLICANTS            CONTRACTS             TOTAL     #
 ]       #            NUMBER  PERCENT      NUMBER  PERCENT      NUMBER  PERCENT#
 ]        #OCT     ^       # ^   #      ^       # ^   #      ^       # ^   #
 ]        #NOV     ^       # ^   #      ^       # ^   #      ^       # ^   #
 ]        #DEC     ^       # ^   #      ^       # ^   #      ^       # ^   #
          #JAN     ^       # ^   #      ^       # ^   #      ^       # ^   #
 ]        #FEB     ^       # ^   #      ^       # ^   #      ^       # ^   #
 ]        #MAR     ^       # ^   #      ^       # ^   #      ^       # ^   #
 ]        #APR     ^       # ^   #      ^       # ^   #      ^       # ^   #
 ]        #MAY     ^       # ^   #      ^       # ^   #      ^       # ^   #
 +        #JUN     ^       # ^   #      ^       # ^   #      ^       # ^   #
 ]        #JUL     ^       # ^   #      ^       # ^   #      ^       # ^   #
 ]        #AUG     ^       # ^   #      ^       # ^   #      ^       # ^   #
 ]        #SEP     ^       # ^   #      ^       # ^   #      ^       # ^   #
 ]        #---     -------   ----       -------   ----       -------   ----#
          #TOT     ^       # ^   #      ^       # ^   #      ^       # ^   #
 ]
 ]#PF: #    1:13 HELP   2:14 RTN MAIN   3:15 RTN PREV#
 ]                      #9:21 ACCEPT    10:22 RESET#
 ]^
 ----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
          0         0         0         0         0         0         0
```

```
                                 CSP/AD                       DATE: 11/18/89  TIM
      MAPGROUP: AP63G           MAP: AP63M38   MSL: Q5APM01
              1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#AP63M38#            #ENLISTED PERSONNEL ALLOCATION SYSTEM#
]                    #    SIMULATION POPULATION GENERATION    #
]                    # DESIRED DEMOGRAPHIC BREAKDOWN BY MONTH  #
]
+#PLEASE ENTER THE % FILL FOR EACH SELECTED CATEGORY:#
]
]                              ^                     #
]                              #---------------------#
]                  #MALE                                   FEMALE#
                   #----                                   ------#
]#EDUC.       I   II  IIIA IIIB  IV        EDUC.        I   II  IIIA IIIB  IV
]#-----     ---- ---- ---- ---- ----       -----      ---- ---- ---- ---- ----
]#HSS       ^    ^    ^    ^    ^    #     HSS        ^    ^    ^    ^    ^
]#HSG       ^    ^    ^    ^    ^    #     HSG        ^    ^    ^    ^    ^
+#NHS       ^    ^    ^    ^    ^    #     NHS        ^    ^    ^    ^    ^
]#-----     ---- ---- ---- ---- ----                  ---- ---- ---- ---- ----
]#TOTAL     ^    ^    ^    ^    ^    #     TOTAL      ^    ^    ^    ^    ^
]
]

]
]#PF: #   1:13 HELP   2:14 RTN MAIN   3:15 RTN PREV#
]                    #9:21 ACCEPT    10:22 RESET#
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                                 CSP/AD                       DATE: 11/18/89  TIM
      MAPGROUP: AP63G           MAP: AP63M99   MSL: Q5APM01
              1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#AP01M03#            #ENLISTED PERSONNEL ALLOCATION SYSTEM#
]                    #SIMULATION POPULATION GENERATION EDITOR#
]                             #POPULATION SIZE ENTRY #
]
+#PLEASE ENTER THE NUMBER OF PEOPLE TO GENERATE:^      #
]
]
]
]

]
]
]
]
+
]
]
]
]

]
]#PF: #   1:13 HELP   2:14 RTN MAIN   3:15 RTN PREV#
]                    #9:21 ACCEPT    10:22 RESET#
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                                  CSP/AD                  DATE: 11/18/89  TIM
     MAPGROUP: MS01G            MAP: MS01M01    MSL: Q5MSM01
              1         2         3         4         5         6         7
 ----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]♦MS01M01 ♦             ENLISTED PERSONNEL ALLOCATION SYSTEM
]                              MOS REQUIREMENTS EDITOR
]                                   MOS SELECTION
]
+♦    PLEASE SELECT^'ONE' MOS TO BE MODIFIED USING AN 'S':♦
]     MOS        MOS        MOS        MOS        MOS        MOS        MOS
]^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^
]^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^
]^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^
10^ ^-^   ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^
]^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^
]^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^
]^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^
]^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^
+^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^
]^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^
]^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^
]^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^    ♦ ^ ^-^
]                                  PRESS♦ENTER♦TO PROCESS
20^SPECIFY MOS TO BE LOCATED:^    ♦THEN PRESS PF12/14
]
]♦  PF:♦ 1/13 HELP     2/14 RTN MAIN    3/15 RTN PREV
]        7/19 PG BCK   8/20 PG FWD     10/22 RESET SELECTIONS     ♦12/24 FIND
]^
 ----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
          0         0         0         0         0         0         0
```

```
                                  CSP/AD                  DATE: 11/18/89  TIM
     MAPGROUP: MS01G            MAP: MS01M02    MSL: Q5MSM01
              1         2         3         4         5         6         7
 ----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]♦MS01M02♦              ENLISTED PERSONNEL ALLOCATION SYSTEM
]                           MOS REQUIREMENTS EDITOR
]                       OPTION SELECTION MENU FOR MOS^   ♦
]
+                                FISCAL YEAR^    ♦
]
]
]               ♦PLEASE SELECT WITH AN 'S' OR AN 'A' IN FIRST OPTION:
]
10                         ^ ♦- GENERAL CHARACTERISTICS
]                          ^ ♦- QUALITY GOALS
]                          ^ ♦- PREREQUISITES
]                          ^ ♦- RECRUITING OPTIONS
]                          ^ ♦- APTITUDE AREA REQUIREMENTS
+                          ^ ♦- ENTRY RESTRICTIONS
]                          ^ ♦- SPECIAL REQUIREMENTS
]                          ^ ♦- MOS TITLE/REMARKS
]
]
20                          ♦PRESS♦ENTER♦TO^REVIEW♦
]
]  PF:      ♦1:13 HELP       2:14 RTN MAIN     3:15 RTN PREV
]           ^4:16 ACCEPT     5:17 ABORT      ^9:21 REVIEW      10:22 RESET♦
]^
 ----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
          0         0         0         0         0         0         0
```

```
                                  CSP/AD                  DATE: 11/18/89  TIM
     MAPGROUP: MS01G            MAP: MS01M90    MSL: Q5MSM01
              1         2         3         4         5         6         7
 ----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]♦MS01M11 ♦             ENLISTED PERSONNEL ALLOCATION SYSTEM
]                            MOS REQUIREMENTS EDITOR
]                                 CHILDERN MOS
]
+♦    PLEASE SELECT ONE OR MORE MOS(S) TO BE^MODIFIED♦USING AN 'S':
]♦
]                                    MOS
]                                 ^ ^-^  ♦
]                                 ^ ^-^  ♦
10                                ^ ^-^  ♦
]                                 ^ ^-^  ♦
```

```
]                                      ^ ^-^  #
]                                      ^ ^-^  #
]                                      ^ ^-^  #
+                                      ^ ^-^  #
]                                      ^ ^-^  #
]                                      ^ ^-^  #
]
]                                  PRESS#ENTER#TO PROCESS

]
]#  PF:#  1/13 HELP    2/14 RETURN TO MAIN MENU   3/15 RETURN TO PREVOIUS SC
]
]  ^
 ----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+

          0         0         0         0         0         0         0
                                  CSP/AD                        DATE: 11/18/89  TIM
      MAPGROUP: MS01G          MAP: MS10M01   MSL: QSMSM01
          1         2         3         4         5         6         7
 ----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#MS10M01#                  ENLISTED PERSONNEL ALLOCATION SYSTEM
]                                  MOS REQUIREMENTS EDITOR
]                               CHARACTERISTICS FOR MOS^   #
]
+
]
]                              MOS DATA FOR FISCAL YEAR:^   #
]
]     APTITUDE AREA: ^    #                       TERM OF ENLISTMENT: ^    #

]     JOB DIFFICULTY SCORE: ^   #                 NUMBER OF BONUSES: ^   #
]
]     PRIORITY: ^   #                             PERCENTAGE AVALIABILITY: ^
]
+     CAREER MANAGEMENT FIELD: ^    #             MINORITY PERCENTAGE GOAL: ^
]
]
]
]                                   PRESS#ENTER#TO^REVIEW #

]
] PF:       #1:13 HELP              2:14 RTN MAIN           3:15 RTN PREV
]           ^4:16 ACCEPT CHANGES    5:17 ABORT CHANGES#
]^
 ----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
          0         0         0         0         0         0         0
```

```
                              CSP/AD                    DATE: 11/18/89  TIM
     MAPGROUP: MS01G          MAP: MS20M01   MSL: Q5MSM01
         1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#MS20M01           #ENLISTED PERSONNEL ALLOCATION SYSTEM
]                           MOS REQUIREMENTS EDITOR
]                         QUALITY GOALS FOR MOS^   #
]                              FISCAL YEAR^   #
+
]                       TOTAL ANNUAL REQUIREMENT: ^      #
]
]       #------HIGH SCHOOL GRADUATES------ |-----NON HIGH SCHOOL GRADUATES-
]         I-IIIA ] IIIB  ]  IV   ]] TOTALS  | I-IIIA ] IIIB  ]  IV   ]] TOTA
          ---------]-------]-------]]------- |---------]-------]-------]]-----
]#MALE    ^     # ]^     #]^     #]]^     #|^     # ]^     #]^     #]]^
]         ^   #% #]^   #%#]^   #%#]] ^   #%#|^   #%# ]^   #%#]^   #%#]] ^
]                 ]       ]       ]]        |         ]       ]       ]]
] FEMALE  ^     # ]^     #]^     #]]^     #|^     # ]^     #]^     #]]^
+         ^   #% #]^   #%#]^   #%#]] ^   #%#|^   #%# ]^   #%#]^   #%#]] ^
]
]                     TOTAL NUMBER                 PERCENTAGE TOTAL
]       #MALE            ^     #                         ^     #%
]       #FEMALE          ^     #                         ^     #%#

]                          PRESS#ENTER#TO^REVIEW#
] PF:     #1:13 HELP            2:14 RTN MAIN           3:15 RTN PREV
]          ^9:21 ACCEPT CHANGES    10:22 ABORT CHANGES                      #
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                              CSP/AD                    DATE: 11/18/89  TIM
     MAPGROUP: MS01G          MAP: MS30M01   MSL: Q5MSM01
         1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#MS30M01#              ENLISTED PERSONNEL ALLOCATION SYSTEM
]                           MOS REQUIREMENTS EDITOR
]                         PREREQUISITES FOR MOS:^   #
]
+                       NUMBER OF PREREQUISITE MOS:^ #
]                            (MAXIMUM OF THREE)
]
]
]^*************************************************************************

]
]                       ^FIRST PREREQUISITE MOS: ^    #
]
]                       ^SECOND PREREQUISITE MOS:^    #
+
]                       ^THIRD PREREQUISITE MOS: ^    #
]
]
]                          PRESS#ENTER#TO^CONTINUE#

]
]    PF:#  1:13 HELP     2:14 RTN MAIN     3:15 RETN PREV
]          ^9:21 ACCEPT CHANGES    10:22 ABORT CHANGES#
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                              CSP/AD                    DATE: 11/18/89  TIM
     MAPGROUP: MS01G          MAP: MS40M01   MSL: Q5MSM01
         1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#MS40M01           #ENLISTED PERSONNEL ALLOCATION SYSTEM
]                           MOS REQUIREMENTS EDITOR
]                              FISCAL YEAR^   #
]
+                       RECRUITING OPTIONS FOR MOS^    #
]
]                         SELECT UP TO 10 USING AN 'S'
]
]    ^ #-  3 TRAINING OF CHOICE              ^ #-  4 AIRBORNE
     ^ #-  8 BAND                            ^ #- 11 OFFICER CANDIDATE SCHOOL
]    ^ #- 12 WO FLIGHT TRAINING              ^ #- 13 COMBAT ARMS UNIT OF CHOIC
```

```
      ^ #- 14 COMMUNICATIONS COMMAND          ^ #- 17 CASH BONUS
      ^ #- 18 SPECIAL UNIT                    ^ #- 19 STATION OF CHOICE
      ^ #- 24 SECURITY DEPOT                  ^ #- 25 ELECT WARFARE:CRYPTOLOGIC
      ^ #- 26 TWO-YEAR ENLISTMENT             ^ #- 27 VEAP
      ^ #- 29 BUDDY EUROPEAN ENLISTMENT




                             #PRESS#ENTER#TO^REVIEW#

 PF:      #1:13 HELP              2:14 RTN MAIN          3:15 RTN PREV
          ^9:21 ACCEPT CHANGES   10:22 ABORT CHANGES                   #
^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+


         0         0         0         0         0         0         0
                                   CSP/AD                    DATE: 11/18/89  TIM
      MAPGROUP: MS01G            MAP: MS50M01    MSL: Q5MSM01
         1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
#MS50M01#                 ENLISTED PERSONNEL ALLOCATION SYSTEM
                                 MOS REQUIREMENTS EDITOR
                          APTITUDE AREA REQUIREMENTS: MOS^    #

 SELECT FROM 1 TO 3 APTITUDE AREAS:

         ^ #CL -- CLERICAL                           ^ #CO -- COMBAT ARMS
         ^ #EL -- ELECTRONICS                        ^ #FA -- FIELD ARTILLERY
         ^ #GM -- GENERAL MAINTENANCE                ^ #GT -- GENERAL TECHNICAL
         ^ #MM -- MECHANICAL MAINTENANCE             ^ #OF -- OPERATOR:FOOD
         ^ #SC -- SURVEILLANCE:COMMUNICATIONS        ^ #ST -- SKILLED TECHNICAL

                ^**************************************************#


                                ^AREA    CUTSCORE#
                                 ^ #        ^  #
                                 ^ #        ^  #
                                 ^ #        ^  #

                             PRESS#ENTER#TO^CONTINUE#

PF:      #1:13 HELP    2:14 RTN MAIN    3:15 RTN PREV
         ^9:21 ACCEPT CHANGES        #^10:22 ABORT CHANGES                  #
^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                                    CSP/AD                  DATE: 11/18/89  TIM
      MAPGROUP: MS01G            MAP: MS80M01   MSL: Q5MSM01
           1          2          3          4          5          6          7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#MS80M01#               ENLISTED PERSONNEL ALLOCATION SYSTEM
]                               MOS REQUIREMENTS EDITOR
]                           MOS TITLE/REMARKS FOR MOS: ^   #
]
+
]
]
]
]
10          MOS TITLE: ^                                              #
]
]           REMARKS:
]
]^
+
]
]
]
]
20
]
]PF:#      1:3 HELP                2:14 RTN MAIN            3:15 RTN PREV
]         ^9:21 ACCEPT CHANGES    10:22 ABORT CHANGES        #
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0          0          0          0          0          0          0
```

```
                                    CSP/AD                  DATE: 11/18/89  TIM
      MAPGROUP: MS01G            MAP: MS99M30   MSL: Q5MSM01
           1          2          3          4          5          6          7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#MS01M30                #ENLISTED PERSONNEL ALLOCATION SYSTEM
]                               MOS REQUIREMENTS EDITOR
]                             TYPE OF TRAINING FOR MOS^   #
]
+              PLEASE SELECT ONE OR MORE OF THE FOLLOWING USING AN 'S' :
]
]                              ^ #- MALE AIT AVALIABLE
]
]                              ^ #- MALE OSUT AVALIABLE
10
]                              ^ #- FEMALE AIT AVALIABLE
]
]                              ^ #- FEMALE OSUT AVALIABLE
]
+^*********************************************************************
]^                  TRANING COURSE LENGTH            WEEKS       DAYS
]^                     AIT COURSE LENGTH........  ^   #       ^   #
]^                     OSUT/OST COURSE LENGTH...  ^   #       ^   #
]
20                             PRESS#ENTER#TO^CONTINUE#
]
]PF:#  1:13 HELP                 2:14 RTN MAIN            3:15 RTN PREV
]     ^9:21 ACCEPT CHANGES      10:22 ABORT CHANGES#
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0          0          0          0          0          0          0
```

```
                                CSP/AD                          DATE: 11/18/89  TIM
      MAPGROUP: MS01G          MAP: MS99M98   MSL: Q5MSM01
          1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
}#CL01M50
}#                      ENLISTED PERSONNEL ALLOCATION SYSTEM
}                              CLUSTER FILE EDITOR
}                               WARNING  MESSAGE
+
}
}
}
}
10
}
}                            PRESS#ENTER#TO#CONTINUE#
}
}                            PRESS#PF 3/15#TO#ABORT#
+
}
}
}
}
20
}
}  PF:  #1/13  HELP   2/14 RETURN TO MAIN MENU   3/15 RETURN TO PREVIOUS SCR
}
}
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0

                                CSP/AD                          DATE: 11/18/89  TIM
      MAPGROUP: MS01G          MAP: MS99M99   MSL: Q5MSM01
          1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
}# CL01M11#             ENLISTED PERSONNEL ALLOCATION SYSTEM
}                              CLUSTER FILE EDITOR
}                                  MOS EDITING
}
+
}
}#MOS NUMBER:  ^   #
} MOS TITLE:   ^                                   #
} MOS CLUSTER: ^   #
10
}#                              PRESS#ENTER#TO SAVE
}
}
}
+NOTE:  CLUSTER 0 IS AN UNUSED CLUSTER CONTAINING MOS' THAT ARE AVAILABLE WI
}       THE POLICY BUT ARE NOT CURRENTLY ASSIGNED TO ANY CLUSTER.  A CLUSTER
}       MOS IS ACTIVATED BY ASSIGNING IT TO A POLICY CLUSTER.  PLACING A MOS
}       CLUSTER 0 PLACES IT INTO THE AVIALABLE LIST AND REMOVES IT FROM USE.
}
20
}
}#PF:# 1/13 HELP    2/14 RETURN TO MAIN MENU       3/15 RETURN TO PREVIOUS SC
}#                  5/17 ABORT CHANGES             12/24 LIST AVAILABLE CLUSTE
}   ^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                                  CSP/AD                  DATE: 11/18/89  TIM
       MAPGROUP: MS60G           MAP: MS60M00   MSL: Q5MSM01
           1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#
]
]
]
+                    SELECT#ONE#OF THE FOLLOWING WITH AN 'S':
]
]
]
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                                  CSP/AD                  DATE: 11/18/89  TIM
       MAPGROUP: MS60G           MAP: MS60M01   MSL: Q5MSM01
           1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]^MS60M10#              ENLISTED PERSONNEL ALLOCATION SYSTEM
]                              MOS REQUIREMENTS EDITOR
]                         ENTRY RESTRICTIONS FOR MOS:^    #
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                                  CSP/AD                  DATE: 11/18/89  TIM
       MAPGROUP: MS60G           MAP: MS60M02   MSL: Q5MSM01
           1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#***************************^  #RESTRICTIONS DEFINED *********************
]
]  ^ #-^ 1^               ^  ^     ^:OR:#  ^ #-^ 2^              ^  ^      ^:O
]  ^ #-^ 3^               ^  ^     ^:OR:#  ^ #-^ 4^              ^  ^      ^:O
+  ^ #-^ 5^               ^  ^     ^:OR:#  ^ #-^ 6^              ^  ^      ^:O
]  ^ #-^ 6^               ^  ^     ^:OR:#  ^ #-^ 8^              ^  ^      ^:O
]  ^ #-^ 7^               ^  ^     ^:OR:#  ^ #-^10^              ^  ^      ^:O
]                              PRESS#ENTER#TO^END REVIEW#
]
10  PF:#1:13 HELP          2:14 RTN MAIN     3:15 RTN PREV
]     ^4:17 INS LINE       5:18 DEL LINE    ^9:21 ACCEPT CHG      10:22 ABORT CH
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                                  CSP/AD                  DATE: 11/18/89  TIM
       MAPGROUP: MS60G           MAP: MS60M10   MSL: Q5MSM01
           1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#
]                   SELECT#ONE#OF THE FOLLOWING WITH AN 'S':
]
]     ^ #AGE                   ^ #CITIZENSHIP          ^ #DLAB
+     ^ #DRVR LICENSE          ^ #HEIGHT               ^ #MARITAL STAT
]     ^ #MATH LEVEL            ^ #MEDICAL CODE         ^ #MVDB
]     ^ #NBR DEPENDENT         ^ #PHYSICAL PROF        ^ #SCIENCE LVL
]     ^ #TYPING SPEED          ^ #WAIVER CODE          ^ #WEIGHT
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                                  CSP/AD                  DATE: 11/18/89  TIM
       MAPGROUP: MS60G           MAP: MS60M20   MSL: Q5MSM01
           1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#
]                   SELECT#ONE#OF THE FOLLOWING WITH AN 'S':
]                     ^ #- EQ - EQUAL TO
]                     ^ #- GE - GREATER THAN OR EQUAL TO
+                     ^ #- GT - GREATER THAN
]                     ^ #- LE - LESS THAN OR EQUAL TO
]                     ^ #- LT - LESS THAN
]                     ^ #- NE - NOT EQUAL TO
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                              CSP/AD                 DATE: 11/18/89  TIM
      MAPGROUP: MS60G        MAP: MS60M3C   MSL: Q5MSM01
          1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#
]                  SELECT#ONE#OF THE FOLLOWING WITH AN 'S':
]
]                        ^ #- GEN-GENERAL SCIENCE
+                        ^ #- BIO-BIOLOGY
]                        ^ #- CHE-CHEMISTRY
]                        ^ #- PHY-PHYSICS
]
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0

                              CSP/AD                 DATE: 11/18/89  TIM
      MAPGROUP: MS60G        MAP: MS60M30   MSL: Q5MSM01
          1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]
]
]
]
+                        #ENTER LIMITING VALUE:^     #
]
]
]
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0

                              CSP/AD                 DATE: 11/18/89  TIM
      MAPGROUP: MS60G        MAP: MS60M32   MSL: Q5MSM01
          1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#
]                  SELECT#ONE#OF THE FOLLOWING WITH AN 'S':
]  ^ #- CA-BORN CITIZEN                  ^ #- CB-NATURALIZATION OF PARENTS
]  ^ #- CC-BORN OF U.S. CITIZEN PARENTS  ^ #- CD-CITIZEN, NATURALIZATION PR
+  ^ #- AA-NATIONAL BORN IN US POSSESION ^ #- CZ-CITIZEN, UNDETERMINED ORIG
]  ^ #- NA-NON-CITIZEN BORN IN U.S.      ^ #- AZ-US NATIONAL, UNKNOWN ORIGI
]  ^ #- NY-NON-US CITIZEN                ^ #- AY-US NATIONAL, NOT CITIZEN
]  ^ #- ZZ-UNKNOWN
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0

                              CSP/AD                 DATE: 11/18/89  TIM
      MAPGROUP: MS60G        MAP: MS60M34   MSL: Q5MSM01
          1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#
]                  SELECT#ONE#OF THE FOLLOWING WITH AN 'S':
]
]                      ^ #- YES = DRIVER'S LICENSE
+
]                      ^ #- NO = NO DRIVER'S LICENSE
]
]
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0

                              CSP/AD                 DATE: 11/18/89  TIM
      MAPGROUP: MS60G        MAP: MS60M36   MSL: Q5MSM01
          1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#
]                  SELECT#ONE#OF THE FOLLOWING WITH AN 'S':
]
]     ^ #- A=ANNULLED                    ^ #- D=DIVORCED
+     ^ #- I=INTERLOCUTORY               ^ #- J=MARRIED TO SERVICE MEMBER
]     ^ #- L=LEGALLY SEPARATED           ^ #- M=MARRIED
]     ^ #- P=SOLE PARENT                 ^ #- S=SINGLE
]     ^ #- W=WIDOWED
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                         CSP/AD                  DATE: 11/18/89  TIM
  MAPGROUP: MS60G        MAP: MS60M37   MSL: Q5MSM01
         1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#
]                SELECT#ONE#OF THE FOLLOWING WITH AN 'S':
]
]                      ^ #- GEN-GENERAL MATHEMATICS
+                      ^ #- ALG-ALGEBRA
]                      ^ #- GEO-GEOMETRY
]                      ^ #- TRI-TRIGONOMETRY
]
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                         CSP/AD                  DATE: 11/18/89  TIM
  MAPGROUP: MS60G        MAP: MS60M40   MSL: Q5MSM01
         1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#
]                SELECT#ONE#OF THE FOLLOWING WITH AN 'S':
]
]                        #IS "OR" LOGIC DESIRED ?
+
]                      ^ #- YES, USE OR LOGIC
]                      ^ #- NO, DO NOT USE OR LOGIC
]
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                         CSP/AD                  DATE: 11/18/89  TIM
  MAPGROUP: MS70G        MAP: MS70M01   MSL: Q5MSM01
         1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#MS70M01           #ENLISTED PERSONNEL ALLOCATION SYSTEM
]                          MOS REQUIREMENTS EDITOR
]                     SPECIAL REQUIREMENTS FOR MOS^    #
]
+
]              PLEASE SELECT ANY OF THE FOLLOWING WITH AN 'S'
]               OR SELECT ALL WITH AN 'A' IN THE FIRST ROW:
]
]                   ^ #- CIVILIAN ACQUIRED SKILLS APPICABLE
10                  ^ #- COMBAT ARMS SKILL
]                   ^ #- ENLISTMENT BOUNUS
]                   ^ #- HIGHLY TECHNICAL
]                   ^ #- LANGUAGE REQUIREMENT EXISTS
]                   ^ #- FORCE MODERNIZATION SKILL
+                   ^ #- SECURITY INTERVIEW REQUIRED        #
]
]
]
]
20                         PRESS#ENTER#TO^REVIEW#
]
]PF:    #1:13 HELP              2:14 RETURN MAIN       3:15 RETURN PREVIOUS
]       ^9:21 ACCEPT CHANGES   10:22 ABORT CHANGES     #
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                              CSP/AD                    DATE: 11/18/89  TIM
      MAPGROUP: QA01G        MAP: QA01M01   MSL: Q5QAM01
             1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]
]♦ QA01M01♦           ENLISTED PERSONNEL ALLOCATION SYSTEM
]                 QUALITY ALLOCATION MODULE POLICY FILE EDITOR
]                             ITEM SELECTION MENU
+
]
]
]♦    PLEASE SELECT "ONE" USING AN "S":
]
                        ^ ♦- MALE DEP SELECTION
]
]                       ^ ♦- FEMALE DEP SELECTION
]
]                       ^ ♦- ACM LIST LENGTH
+
]
]
]♦                           PRESS♦ENTER♦TO^REVIEW♦
]

]
]♦  PF:♦ 1/13 HELP   2/14 RETURN TO MAIN MENU  3/15 RETURN TO PREVIOUS SCRE
]                   ^4/16 SAVE CHANGES         5/17 ABORT CHANGES♦
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                              CSP/AD                    DATE: 11/18/89  TIM
      MAPGROUP: QA01G        MAP: QA01M10   MSL: Q5QAM01
             1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]♦ QA01M10♦           ENLISTED PERSONNEL ALLOCATION SYSTEM
]                   QUALITY ALLOCATION MODULE POLICY EDITOR
]                            ^ MALE DEP SELECTION ♦
]
+                                      SPECIFY DEP IN WEEKS:
]♦                                  MINIMUM DEP          MAXIMUM DEP
]♦ ASVAB CATEGORY 1-3A
]♦   HIGH SCHOOL GRADUATE              ^ ♦                  ^ ♦
]    NON HIGH SCHOOL GRADUATE          ^ ♦                  ^ ♦
     HIGH SCHOOL SENIOR                ^ ♦                  ^ ♦
]♦ ASVAB CATEGORY 3B
]♦   HIGH SCHOOL GRADUATE              ^ ♦                  ^ ♦
]    NON HIGH SCHOOL GRADUATE          ^ ♦                  ^ ♦
]    HIGH SCHOOL SENIOR                ^ ♦                  ^ ♦
+♦ ASVAB CATEGORY 4
]♦   HIGH SCHOOL GRADUATE              ^ ♦                  ^ ♦
]    NON HIGH SCHOOL GRADUATE          ^ ♦                  ^ ♦
]    HIGH SCHOOL SENIOR                ^ ♦                  ^ ♦
]
 ♦         NOTE: SENIOR DEP IS WEEKS AFTER AVAILABILITY DATE(E.G. JUNE)
]
]♦  PF:♦ 1/13 HELP    2/14 RETURN TO MAIN MENU   3/15 RETURN TO PREVIOUS SC
]                    ^                                   ♦
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                                  CSP/AD                 DATE: 11/18/89  TIM
     MAPGROUP: QA01G            MAP: QA01M20    MSL: Q5QAM01
          1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]# QA01M20#                 ENLISTED PERSONNEL ALLOCATION SYSTEM
]                          QUALITY APPLICANT MODULE POLICY EDITOR
]                                   ACM LIST LENGTH
]
+
]
]
]#     THE MAXIMUM NUMBER OF RECOMMENDATIONS TO BE SENT TO THE ACM IS:
]
10                                     ^  #
]
]
]
]
+
]
]
]
]
20
]
]#   PF:# 1/13 HELP   2/14 RETURN TO MAIN MENU    3/15 RETURN TO PREVIOUS SCR
]                    ^                                     #
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
          0         0         0         0         0         0         0
```

```
                                  CSP/AD                 DATE: 11/18/89  TIM
     MAPGROUP: SH01G            MAP: SH01M00    MSL: Q5SHM01
          1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#SH01M00 #                 ENLISTED PERSONNEL ALLOCATION SYSTEM
]                              AIT/OSUT  TRAINING SEAT EDITOR
]                                       MOS SELECTION
]
+#    PLEASE SELECT^'ONE' MOS TO BE MODIFIED USING AN 'S':#
]       MOS        MOS        MOS        MOS        MOS        MOS        MOS
]^ ^-^     # ^ ^-^    # ^ ^-^    # ^ ^-^    # ^ ^-^    # ^ ^-^    # ^ ^-^    # ^ ^-^
]^ ^-^     # ^ ^-^    # ^ ^-^    # ^ ^-^    # ^ ^-^    # ^ ^-^    # ^ ^-^    # ^ ^-^
]^ ^-^     # ^ ^-^    # ^ ^-^    # ^ ^-^    # ^ ^-^    # ^ ^-^    # ^ ^-^    # ^ ^-^
10^ ^-^    # ^ ^-^    # ^ ^-^    # ^ ^-^    # ^ ^-^    # ^ ^-^    # ^ ^-^    # ^ ^-^
]^ ^-^     # ^ ^-^    # ^ ^-^    # ^ ^-^    # ^ ^-^    # ^ ^-^    # ^ ^-^    # ^ ^-^
]^ ^-^     # ^ ^-^    # ^ ^-^    # ^ ^-^    # ^ ^-^    # ^ ^-^    # ^ ^-^    # ^ ^-^
]^ ^-^     # ^ ^-^    # ^ ^-^    # ^ ^-^    # ^ ^-^    # ^ ^-^    # ^ ^-^    # ^ ^-^
]^ ^-^     # ^ ^-^    # ^ ^-^    # ^ ^-^    # ^ ^-^    # ^ ^-^    # ^ ^-^    # ^ ^-^
+^ ^-^     # ^ ^-^    # ^ ^-^    # ^ ^-^    # ^ ^-^    # ^ ^-^    # ^ ^-^    # ^ ^-^
]^ ^-^     # ^ ^-^    # ^ ^-^    # ^ ^-^    # ^ ^-^    # ^ ^-^    # ^ ^-^    # ^ ^-^
]^ ^-^     # ^ ^-^    # ^ ^-^    # ^ ^-^    # ^ ^-^    # ^ ^-^    # ^ ^-^    # ^ ^-^
]^ ^-^     # ^ ^-^    # ^ ^-^    # ^ ^-^    # ^ ^-^    # ^ ^-^    # ^ ^-^    # ^ ^-^
]                                PRESS#ENTER#TO PROCESS
20^SPECIFY MOS TO BE LOCATED:^   #THEN PRESS PF12/14
]
]#  PF:# 1/13 HELP     2/14 RTN MAIN     3/15 RTN PREV
]        7/19 PG BCK   8/20 PG FWD     10/22 RESET SELECTIONS      #12/24 FIND
]   ^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
          0         0         0         0         0         0         0
```

```
                             CSP/AD                  DATE: 11/18/89  TIM
      MAPGROUP: SH01G       MAP: SH01M10   MSL: Q5SHM01
               1         2         3         4         5         6         7
 ----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#SH01M10 #            ENLISTED PERSONNEL ALLOCATION SYSTEM
]                         AIT/OSUT  TRAINING SEAT EDITOR
]                                 CLASS SELECTION
]
+#    PLEASE SELECT A^MOS CLASS TO BE MODIFIED USING AN 'S':#
]
]       CLASS                CLASS                CLASS                CLASS
]       --------             --------             --------             --------
]       ^ ^-^ #              ^ ^-^ #              ^ ^-^ #              ^ ^-^ #
10      ^ ^-^ #              ^ ^-^ #              ^ ^-^ #              ^ ^-^ #
]       ^ ^-^ #              ^ ^-^ #              ^ ^-^ #              ^ ^-^ #
]       ^ ^-^ #              ^ ^-^ #              ^ ^-^ #              ^ ^-^ #
]       ^ ^-^ #              ^ ^-^ #              ^ ^-^ #              ^ ^-^ #
]       ^ ^-^ #              ^ ^-^ #              ^ ^-^ #              ^ ^-^ #
+       ^ ^-^ #              ^ ^-^ #              ^ ^-^ #              ^ ^-^ #
]       ^ ^-^ #              ^ ^-^ #              ^ ^-^ #              ^ ^-^ #
]       ^ ^-^ #              ^ ^-^ #              ^ ^-^ #              ^ ^-^ #
]       ^ ^-^ #              ^ ^-^ #              ^ ^-^ #              ^ ^-^ #
]
20                              ^PRESS^ENTER^TO PROCESS#
]
]#  PF: ^1/13 HELP# 2/14 RTN MAIN      ^3/15 RTN PREV   10/22 RESET SELECTI
]                  ^                                          #
]^
 ----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
          0         0         0         0         0         0         0

                             CSP/AD                  DATE: 11/18/89  TIM
      MAPGROUP: SH01G       MAP: SH01M20   MSL: Q5SHM01
               1         2         3         4         5         6         7
 ----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#SH01M20#             ENLISTED PERSONNEL ALLOCATION SYSTEM
]                         AIT/OSUT TRAINING SEAT EDITOR
]                          GENERAL CLASS INFORMATION
]
+#INFORMATION FOR CLASS ^    ^ #
]
]
]                       TYPE OF COURSE:       ^ #
]                       TRAINING SITE:        ^                     #
10
]
]
]
]
+
]                          #PRESS#ENTER#TO^REVIEW #
]
]
]
20
]
] PF: #   1:13 HELP        2:14 RTN MAIN      3:15 RTN PREV
]       ^9:21 ACCEPT                         10:22 RESET
]^
 ----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
          0         0         0         0         0         0         0
```

```
                                   CSP/AD                     DATE: 11/18/89  TIM
      MAPGROUP: SH01G            MAP: SH01M25   MSL: Q5SHM01
          1          2          3          4          5          6          7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#SH01M25#              ENLISTED PERSONNEL ALLOCATION SYSTEM
]                          AIT/OSUT TRAINING SEAT EDITOR
]                             CLASS SESSION SELECTION
]
+#PLEASE SELECT ONE OR MORE CLASS SESSIONS USING A 'S':
]
]                                     START DATE
]                                  ^ #-^      #
]                                  ^ #-^      #
10                                 ^ #-^      #
]                                  ^ #-^      #
]                                  ^ #-^      #
]                                  ^ #-^      #
]                                  ^ #-^      #
+                                  ^ #-^      #
]                                  ^ #-^      #
]                                  ^ #-^      #
]                                  ^ #-^      #
]                                  ^ #-^      #
20
]                               PRESS#ENTER#TO PROCESS
]
]#PF: #1:13 HELP     2:14 RTN MAIN     3:15 RTN PREV     10:22 RESET SELECTIO
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0          0          0          0          0          0          0
```

```
                                   CSP/AD                     DATE: 11/18/89  TIM
      MAPGROUP: SH01G            MAP: SH01M30   MSL: Q5SHM01
          1          2          3          4          5          6          7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#SH01M30#              ENLISTED PERSONNEL ALLOCATION SYSTEM
]                          AIT/OUST TRAINING SEAT EDITOR
]                                CLASS STATISTICS
]
+#                     DATA FOR CLASS^   ^ #; MONTH NUMBER ^  #
]                            START DATE: ^      #  (YYMMDD)
]
]                                     CAPACITIES
]#MINIMUM: ^    #     NOMINAL: ^    #    MAXIMUM: ^    #    COHORT RQMT: ^
10
]                                  CURRENT FILL  ^   #
]        HIGH SCHOOL GRADUATES                  NON HIGH SCHOOL GRADUATES
]  -------- I-IIIA ] IIIB ]  IV ------------- I-IIIA ] IIIB ]  IV ------
]#  MALE    ^    # ]^    #]^    #       MALE    ^    # ]^    #]^    #
+   FEMALE  ^    # ]^    #]^    #       FEMALE  ^    # ]^    #]^    #
]
]                                  METRIC STATISTICS
]#                              AA SCR    SQT       ATT       WORTH
]#          DELAYD ENTRY:      ^    #    ^    #    ^    #    ^    #
20          IMMEDIATE SHIP:    ^    #    ^    #    ^    #    ^    #
]                              PRESS#ENTER#TO^REFRESH#
] PF:#1:13 HELP  2:14 RTN MAIN  3:15 RTN PREV ^4:16 DEL MTH  5:17 INS MTH
]^    6:18 DUPLICATE TO END    ^9:21 ACCEPT    10:22 RESET#
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0          0          0          0          0          0          0
```

```
                          CSP/AD                 DATE: 11/18/89  TIM
   MAPGROUP: SH01G          MAP: SH02M00    MSL: Q5SHM01
         1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#MS02M00 #            ENLISTED PERSONNEL ALLOCATION SYSTEM
]                            MOS REQUIREMENTS EDITOR
]                                 CHILDERN MOS
]
+#    PLEASE SELECT ONE OR MORE MOS(S) TO BE MODIFIED#USING AN 'S':
]#
]                                      MOS
]                                  - -_-  #
]                                  - -_-  #
10                                 - -_-  #
]                                  - -_-  #
]                                  - -_-  #
]                                  - -_-  #
]                                  - -_-  #
+                                  - -_-  #
]                                  - -_-  #
]                                  - -_-  #
]
]                            PRESS#ENTER#TO PROCESS
20
]
]#  PF:#  1/13 HELP    2/14 RETURN TO MAIN MENU    3/15 RETURN TO PREVOIUS SC
]
]   -
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                          CSP/AD                 DATE: 11/18/89  TIM
   MAPGROUP: SH01G          MAP: SH99M99    MSL: Q5SHM01
         1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#SH99M99
]#                     ENLISTED PERSONNEL ALLOCATION SYSTEM
]                             SCHOOL FILE EDITOR
]                              WARNING  MESSAGE
+
]
]
]
]
10
]
]                           PRESS#ENTER#TO#CONTINUE#
]
]                           PRESS#PF 3/15#TO#ABORT#
+
]
]
]
]
20
]
]  PF:  #1/13  HELP   2/14 RETURN TO MAIN MENU   3/15 RETURN TO PREVIOUS SCR
]
]
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                              CSP/AD                       DATE: 11/18/89  TIM
     MAPGROUP: AC01G         MAP: AC01M01   MSL: Q5ACM01
          1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]
]# AC01M01#          ENLISTED PERSONNEL ALLOCATION SYSTEM
]               APPLICANT CLASSIFICATION MODULE POLICY EDITOR
]                           ITEM SELECTION MENU
+
]
]#    PLEASE SELECT "ONE" USING AN "S":
]
]                       ^ #- EXECUTION PARAMETERS

]                       ^ #- DELAYED ENTRY PROGRAM LIMITS
]
]                       ^ #- JOB SELECTION METHOD
]
+                       ^ #- SCORING ROUTINE WEIGHTS
]
]
]#                          PRESS#ENTER#TO^REVIEW#
]

]
]#   PF:# 1/13 HELP   2/14 RETURN TO MAIN MENU    3/15 RETURN TO PREVIOUS SC
]                    ^4/16 SAVE CHANGES TO FILE    5/17 ABORT ALL CHANGES#
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0

                              CSP/AD                       DATE: 11/18/89  TIM
     MAPGROUP: AC01G         MAP: AC01M10   MSL: Q5ACM01
          1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]# AC01M10#          ENLISTED PERSONNEL ALLOCATION SYSTEM
]                APPLICANT CLASSIFICATION MODULE POLICY MENU
]                           EXCUTION PARAMETERS
]
+
]#                             ACM DATA FILES
]
]#                     MOS WORTH DEFINITIONS:       ^       #
]                      SQT COEFFICIENT DEFINITIONS: ^       #
                       ATTRITION PROBABLITIES:      ^       #
]
]
]
]                              ACM PARAMETERS
+
]#INITIAL SEED VALUE:          ^       # MAX. APPLICATIONS ITERATION:  ^
] MAX. JOB MATCHES/APPLICANT:  ^       # JOB PERFORMANCE OPTION:            ^
]
]

]
]#   PF:# 1/13 HELP    2/14 RETURN TO MAIN MENU   3/15 RETURN TO PREVIOUS SC
]                     ^                                      #
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                              CSP/AD                     DATE: 11/18/89  TIM
      MAPGROUP: AC01G         MAP: AC01M20    MSL: Q5ACM01
         1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]# AC01M20#              ENLISTED PERSONNEL ALLOCATION SYSTEM
]                     APPLICANT CLASSIFICATION MODULE POLICY MENU
]                            DELAYED ENTRY PROGRAM LIMITS
]
+
]#
]#        ]]_______________________________________________________________]]
]         ]]#       MAXIMUM DEP LENGTH (IN MONTHS) BY DEMOGRAPHIC          #]]
]         ]]_______________________________________________________________]]
10        ]]#>>>>>>>>>>>>MALE<<<<<<<<<<<<#]]#>>>>>>>>>>>FEMALE<<<<<<<<<<<<#]]
]  _______]]__I___II__IIIA_IIIB__IV_]]__I___II__IIIA_IIIB__IV_]]
] ]]      ]]                            ]]                              ]]
] ]]#HSDG#]] ^ # ^ # ^ # ^ # ^ # ]] ^ # ^ # ^ # ^ # ^ # ]]
] ]]      ]]                            ]]                              ]]
+ ]]#SENR#]] ^ # ^ # ^ # ^ # ^ # ]] ^ # ^ # ^ # ^ # ^ # ]]
] ]]      ]]                            ]]                              ]]
] ]]#NHSG#]] ^ # ^ # ^ # ^ # ^ # ]] ^ # ^ # ^ # ^ # ^ # ]]
] ]]______]]____________________________]]______________________________]]
]
20
]
]#   PF:# 1/13 HELP    2/14 RETURN TO MAIN MENU   3/15 RETURN TO PREVIOUS SC
]                     ^                                      #
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0

                              CSP/AD                     DATE: 11/18/89  TIM
      MAPGROUP: AC01G         MAP: AC01M30    MSL: Q5ACM01
         1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]# AC01M30#              ENLISTED PERSONNEL ALLOCATION SYSTEM
]                     APPLICANT CLASSIFICATION MODULE POLICY MENU
]                                JOB SELECTION METHOD
]
+
]#
]         ]]_______________________________________________________________]]
]         ]]#         JOB SELECTION OPTION BY DEMOGRAPHIC GROUP            #]]
]         ]]_______________________________________________________________]]
10        ]]#>>>>>>>>>>>>MALE<<<<<<<<<<<<#]]#>>>>>>>>>>>FEMALE<<<<<<<<<<<<#]]
]  _______]]__I___II__IIIA_IIIB__IV_]]__I___II__IIIA_IIIB__IV_]]
] ]]      ]]                            ]]                              ]]
] ]]#HSDG#]]^   #^   #^   #^   #^   #]]^   #^   #^   #^   #^   #]]
] ]]      ]]                            ]]                              ]]
+ ]]#SENR#]]^   #^   #^   #^   #^   #]]^   #^   #^   #^   #^   #]]
] ]]      ]]                            ]]                              ]]
] ]]#NHSG#]]^   #^   #^   #^   #^   #]]^   #^   #^   #^   #^   #]]
] ]]______]]____________________________]]______________________________]]
]
20
]
]#   PF:# 1/13 HELP   2/14 RETURN TO MAIN MENU   3/15 RETURN TO PREVIOUS SCR
]                    ^                                      #
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                                CSP/AD                       DATE: 11/18/89  TIM
     MAPGROUP: AC01G          MAP: AC01M40   MSL: Q5ACM01
          1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]# AC01M40#             ENLISTED PERSONNEL ALLOCATION SYSTEM
]                   APPLICANT CLASSIFICATION MODULE POLICY MENU
]                            SCORING ROUTINE WEIGHTS
]
+
]
]#                          QAM RECOMMENDATION .....^   #
]
]      AA/EO PROGRAMS .........^  #         JOB PERFORMANCE ........^   #
10
]      MANAGEMENT POTENTIAL ...^  #         REELISTMENT PROB .......^   #
]
]      RETENTION PROBABILITY ..^  #         ANNUAL TNG DEMAND ......^   #
]
+      PROB. TNG SUCCESS ......^  #         IMMEDIATE FILL RQMT ....^   #
]
]
]                           RACE VS. GENDER ........^   #
]
20
]
]#   PF:# 1/13 HELP    2/14 RETURN TO MAIN MENU    3/15 RETURN TO PREVIOUS SC
]                    ^                                       #
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                                CSP/AD                       DATE: 11/18/89  TIM
     MAPGROUP: CL01G          MAP: CLBKM11   MSL: Q5CLM01
          1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]# CL01M11#             ENLISTED PERSONNEL ALLOCATION SYSTEM
]                               CLUSTER FILE EDITOR
]                                   MOS EDITING
]
+#MOS NUMBER:  ^   #
] MOS TITLE:   ^                                      #
] MOS CLUSTER: ^  #
]
] MOS NUMBER:  ^   #
10 MOS TITLE:  ^                                      #
] MOS CLUSTER: ^  #
]
] MOS NUMBER:  ^   #
] MOS TITLE:   ^                                      #
+ MOS CLUSTER: ^  #
]
] MOS NUMBER:  ^   #
] MOS TITLE:   ^                                      #
] MOS CLUSTER: ^  #
20#                             PRESS#ENTER#TO PROCESS
]
]#  PF:# 1/13 HELP  2/14 RETURN TO MAIN MENU     3/15 RETURN TO PREVIOUS SC
]#                  5/17 LIST CLUSTERS AVAILABLE
]  ^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                              CSP/AD                DATE: 11/18/89  TIM
     MAPGROUP: CL01G        MAP: CL01M01   MSL: Q5CLM01
         1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]# CL01M01#           ENLISTED PERSONNEL ALLOCATION SYSTEM
]                            CLUSTER FILE EDITOR
]                           OPTION SELECTION MENU
]
+
]
]#    PLEASE SELECT 'ONE' USING AN 'S':
]
]
10
]              ^ #- MOS^REVIEW #
]              ^ #- CLUSTER^REVIEW #
]
]
+
]
]
]                           PRESS#ENTER#TO^REVIEW #
]
20
]
]   PF:#   1/13 HELP  2/14 RETURN TO MAIN MENU   3/15 RETURN TO PREVIOUS SC
]                    ^                                                #
]   ^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                              CSP/AD                DATE: 11/18/89  TIM
     MAPGROUP: CL01G        MAP: CL01M10   MSL: Q5CLM01
         1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]# CL01M10#           ENLISTED PERSONNEL ALLOCATION SYSTEM
]                            CLUSTER FILE EDITOR
]                               MOS EDITING
]
+#    PLEASE SELECT^'ONE' MOS TO BE MODIFIED USING AN 'S':#
]     MOS       MOS       MOS       MOS       MOS       MOS       MOS
]^ ^-^   # ^ ^-^  # ^ ^-^  # ^ ^-^  # ^ ^-^  # ^ ^-^  # ^ ^-^  # ^ ^-^
]^ ^-^   # ^ ^-^  # ^ ^-^  # ^ ^-^  # ^ ^-^  # ^ ^-^  # ^ ^-^  # ^ ^-^
]^ ^-^   # ^ ^-^  # ^ ^-^  # ^ ^-^  # ^ ^-^  # ^ ^-^  # ^ ^-^  # ^ ^-^
10^ ^-^  # ^ ^-^  # ^ ^-^  # ^ ^-^  # ^ ^-^  # ^ ^-^  # ^ ^-^  # ^ ^-^
]^ ^-^   # ^ ^-^  # ^ ^-^  # ^ ^-^  # ^ ^-^  # ^ ^-^  # ^ ^-^  # ^ ^-^
]^ ^-^   # ^ ^-^  # ^ ^-^  # ^ ^-^  # ^ ^-^  # ^ ^-^  # ^ ^-^  # ^ ^-^
]^ ^-^   # ^ ^-^  # ^ ^-^  # ^ ^-^  # ^ ^-^  # ^ ^-^  # ^ ^-^  # ^ ^-^
]^ ^-^   # ^ ^-^  # ^ ^-^  # ^ ^-^  # ^ ^-^  # ^ ^-^  # ^ ^-^  # ^ ^-^
+^ ^-^   # ^ ^-^  # ^ ^-^  # ^ ^-^  # ^ ^-^  # ^ ^-^  # ^ ^-^  # ^ ^-^
]^ ^-^   # ^ ^-^  # ^ ^-^  # ^ ^-^  # ^ ^-^  # ^ ^-^  # ^ ^-^  # ^ ^-^
]^ ^-^   # ^ ^-^  # ^ ^-^  # ^ ^-^  # ^ ^-^  # ^ ^-^  # ^ ^-^  # ^ ^-^
]^ ^-^   # ^ ^-^  # ^ ^-^  # ^ ^-^  # ^ ^-^  # ^ ^-^  # ^ ^-^  # ^ ^-^
]                            PRESS#ENTER#TO PROCESS
20^SPECIFY MOS TO BE LOCATED:^   #THEN PRESS PF12/14
]
]#  PF:# 1/13 HELP    2/14 RTN MAIN MENU   3/15 RTN PREV SCREEN
]        7/19 PG BCK  8/20 PG FORWARD    10/22 RESET SELECTIONS #12/24 FIND
]   ^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                                  CSP/AD                       DATE: 11/18/89  TIM
      MAPGROUP: CL01G            MAP: CL01M11   MSL: Q5CLM01
               1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]# CL01M11#             ENLISTED PERSONNEL ALLOCATION SYSTEM
]                               CLUSTER FILE EDITOR
]                                   MOS EDITING
]
+
]
]#MOS NUMBER:  ^   #
] MOS TITLE:   ^                                     #
] MOS CLUSTER: ^   #

]#                               PRESS#ENTER#TO SAVE
]
]
]
+NOTE:   CLUSTER 0 IS AN UNUSED CLUSTER CONTAINING MOS' THAT ARE AVAILABLE WI
]        THE POLICY BUT ARE NOT CURRENTLY ASSIGNED TO ANY CLUSTER.  A CLUSTER
]        MOS IS ACTIVATED BY ASSIGNING IT TO A POLICY CLUSTER.  PLACING A MOS
]        CLUSTER 0 PLACES IT INTO THE AVIALABLE LIST AND REMOVES IT FROM USE.
]

]
]#PF:# 1/13 HELP     2/14 RETURN TO MAIN MENU      3/15 RETURN TO PREVIOUS SC
]#                   5/17 ABORT CHANGES           12/24 LIST AVAILABLE CLUSTE
]  ^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                                  CSP/AD                       DATE: 11/18/89  TIM
      MAPGROUP: CL01G            MAP: CL01M12   MSL: Q5CLM01
               1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]# CL01M12#             ENLISTED PERSONNEL ALLOCATION SYSTEM
]                               CLUSTER FILE EDITOR
]                                   MOS EDITING
]
+#CLUSTER NUMBER  CLUSTER TITLE            CLUSTER NUMBER   CLUSTER TITLE
]      ^   #      ^                    #      ^   #      ^
]      ^   #      ^                    #      ^   #      ^
]      ^   #      ^                    #      ^   #      ^
]      ^   #      ^                    #      ^   #      ^
       ^   #      ^                    #      ^   #      ^
]      ^   #      ^                    #      ^   #      ^
]      ^   #      ^                    #      ^   #      ^
]      ^   #      ^                    #      ^   #      ^
]      ^   #      ^                    #      ^   #      ^
+      ^   #      ^                    #      ^   #      ^
]      ^   #      ^                    #      ^   #      ^
]      ^   #      ^                    #      ^   #      ^
]      ^   #      ^                    #      ^   #      ^
]      ^   #      ^                    #      ^   #      ^
]          #                           #          #
                               #PRESS#ENTER#TO PROCESS
]
]#  PF:#   1/13 HELP   2/14 RETURN TO MAIN MENU   3/15 RETURN TO PREVIOUS SC
]                      7        19 PAGE FORWARD        8        20 PAGE BACK
]  ^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                            CSP/AD                     DATE: 11/18/89  TIM
     MAPGROUP: CL01G        MAP: CL01M30    MSL: Q5CLM01
          1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]# CL01M30#          ENLISTED PERSONNEL ALLOCATION SYSTEM
]                            CLUSTER FILE EDITOR
]                              CLUSTER EDITING
]
+#   PLEASE SELECT 'ONE' USING AN 'S':
]
]#CLUSTER NUMBER  CLUSTER TITLE            CLUSTER NUMBER   CLUSTER TITLE
] ^ ^-^  #     ^                     #   ^ ^-^  #      ^
] ^ ^-^  #     ^                     #   ^ ^-^  #      ^
10^ ^-^  #     ^                     #   ^ ^-^  #      ^
] ^ ^-^  #     ^                     #   ^ ^-^  #      ^
] ^ ^-^  #     ^                     #   ^ ^-^  #      ^
] ^ ^-^  #     ^                     #   ^ ^-^  #      ^
] ^ ^-^  #     ^                     #   ^ ^-^  #      ^
+ ^ ^-^  #     ^                     #   ^ ^-^  #      ^
] ^ ^-^  #     ^                     #   ^ ^-^  #      ^
] ^ ^-^  #     ^                     #   ^ ^-^  #      ^
] ^ ^-^  #     ^                     #   ^ ^-^  #      ^
] ^ ^-^  #     ^                     #   ^ ^-^  #      ^
20                         #PRESS#ENTER#TO^REVIEW#
]
]  PF:#   1/13 HELP      2/14 RTN TO MAIN MENU     3/15 RTN TO PREVIOUS SCR
]         7/19 PG BCK    8/20 PAGE FOWARD         #9/21 ADD A NEW CLUSTER
]  ^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                            CSP/AD                     DATE: 11/18/89  TIM
     MAPGROUP: CL01G        MAP: CL01M31    MSL: Q5CLM01
          1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]# CL01M31#          ENLISTED PERSONNEL ALLOCATION SYSTEM
]                            CLUSTER FILE EDITOR
]                              CLUSTER EDITING
]
+#CLUSTER NUMBER  CLUSTER TITLE           TO     NUMBER OF MOS IN THE CLUSTE
]     ^  #     ^                     #    ^     #
]
]              #MOS    TITLE
]              ^  ^ - ^                                           #
10             ^  ^ - ^                                           #
]              ^  ^ - ^                                           #
]              ^  ^ - ^                                           #
]              ^  ^ - ^                                           #
]              ^  ^ - ^                                           #
+              ^  ^ - ^                                           #
]              ^  ^ - ^                                           #
]              ^  ^ - ^                                           #
]              ^  ^ - ^                                           #
]
20                         #PRESS#ENTER#TO^CONTINUE#
]
]PF:#1/13 HELP  2/14 RTN MAIN  3/15 RTN PREV  #4/16 SAVE CLUSTR  5/17 DEL CL
]   6/18 RESET#7/19 PG BCK    8/20 PG FWD    #9/21 ADD MOS       10/22 DEL MO
]  ^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                                    CSP/AD                  DATE: 11/18/89  TIM
      MAPGROUP: CL01G              MAP: CL01M50    MSL: Q5CLM01
          1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#CL01M50
]#                         ENLISTED PERSONNEL ALLOCATION SYSTEM
]                                  CLUSTER FILE EDITOR
]                                   WARNING  MESSAGE
+
]
]
]
]
10
]
]                                PRESS#ENTER#TO#CONTINUE#
]
]                                PRESS#PF 3/15#TO#ABORT#
+
]
]
]
]
20
]
]  PF:  #1/13  HELP   2/14 RETURN TO MAIN MENU   3/15 RETURN TO PREVIOUS SCR
]
]
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0

                                    CSP/AD                  DATE: 11/18/89  TIM
      MAPGROUP: CL01G              MAP: CL02M10    MSL: Q5CLM01
          1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]# CL02M10#                ENLISTED PERSONNEL ALLOCATION SYSTEM
]                                  CLUSTER FILE EDITOR
]                                      MOS EDITING
]
+#    PLEASE SELECT ONE OR MORE MOS(S) TO BE^MODIFIED#USING AN 'S':
]#
]                                         MOS
]                                    ^ ^_^    #
]                                    ^ ^_^    #
10                                   ^ ^_^    #
]                                    ^ ^_^    #
]                                    ^ ^_^    #
]                                    ^ ^_^    #
]                                    ^ ^_^    #
+                                    ^ ^_^    #
]                                    ^ ^_^    #
]                                    ^ ^_^    #
]
]                                PRESS#ENTER#TO PROCESS
20
]
]#  PF:#  1/13 HELP    2/14 RETURN TO MAIN MENU   3/15 RETURN TO PREVOIUS SC
]
]  ^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                              CSP/AD                      DATE: 11/18/89  TIM
     MAPGROUP: EC01G         MAP: EC01M01    MSL: Q5ECM01
          1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#EC01M01#          #ENLISTED PERSONNEL ALLOCATION SYSTEM#
]       #        ELIM-COMPLIP MONTHLY ACCESSION LIMITS EDITOR#
]       #                 ACCESSION PLAN LIMITS          #
]
+                   #MONTH      FISCAL YEAR      RECRUIT YEAR#
]                   #-----      -----------      ------------#
]                    -    #         -    #           -    #
]                    -    #         -    #           -    #
]                    -    #         -    #           -    #
]                    -    #         -    #           -    #
10                   -    #         -    #           -    #
]                    -    #         -    #           -    #
]                    -    #         -    #           -    #
]                    -    #         -    #           -    #
]                    -    #         -    #           -    #
+                    -    #         -    #           -    #
]                    -    #         -    #           -    #
]                    -    #         -    #           -    #
]                    -    #         -    #           -    #
]                   #-----      -------#         -------#
20                  #TOTAL          -    #           -    #
]                                -      #
]#PF: #   1:13 HELP   2:14 RTN MAIN   3:15 RTN PREV
]     -          -          -
]-
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                              CSP/AD                      DATE: 11/18/89  TIM
     MAPGROUP: EC01G         MAP: EC01M02    MSL: Q5ECM01
          1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#EC01M02#          #ENLISTED PERSONNEL ALLOCATION SYSTEM#
]       #        ELIM-COMPLIP MONTHLY ACCESSION LIMITS EDITOR#
]       #               NEW TOTAL VALUES SELECTION       #
]
+#PLEASE SELECT ONE USING AN#'S'#:#
]
]                              - #- FISCAL YEAR#
]
]                              - #- RECRUIT YEAR#
10
]                            #PRESS#ENTER#TO PROCESS#
]
]
]
+
]
]
]
]
20
]
]#PF: #   1:13 HELP   2:14 RTN MAIN   3:15 RTN PREV
]    #
]-
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```

```
                                   CSP/AD                 DATE: 11/18/89  TIM
      MAPGROUP: UG01G            MAP: UG01M01   MSL: Q5UGM01
              1         2         3         4         5         6         7
 ----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#UG01M01#           #ENLISTED PERSONNEL ALLOCATION SYSTEM#
]        #                 USAREC MISSION GOALS EDITOR        #
]        #                    MAIN SELECTION MENU             #
]
+#PLEASE SELECT USING AN#'S'#:
]
]                    ^ #- JANUARY            ^ #- JULY
]                    ^ #- FEBRUARY           ^ #- AUGUST
]                    ^ #- MARCH              ^ #- SEPTEMBER
10                   ^ #- APRIL              ^ #- OCTOBER
]                    ^ #- MAY                ^ #- NOVEMBER
]                    ^ #- JUNE               ^ #- DECEMBER
]                          ^ ^      #
]
+                           #PRESS#ENTER#TO^      #
]
]
]
]
20
]
]#PF: #   1:13 HELP   2:14 RTN MAIN   3:15 RTN PREV
]
]^
 ----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
          0         0         0         0         0         0         0
```

```
                                   CSP/AD                 DATE: 11/18/89  TIM
      MAPGROUP: UG01G            MAP: UG01M02   MSL: Q5UGM01
              1         2         3         4         5         6         7
 ----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#UG01M02#           #ENLISTED PERSONNEL ALLOCATION SYSTEM#
]        #                 USAREC MISSION GOALS EDITOR        #
]                             ^      #
]                   MALE                                         FEMALE
+                 #                                                  #
]                   AFQT CATEGORY                                AFQT CATEGORY
]#EDUCATION    I-IIIA   IIIB      IV   TOTAL  EDUCATION   I-IIIA   IIIB     IV
]#---------    ------   ----      --   -----  ---------   ------   ----     --
]#HSG            ^       ^       ^       ^   # HSG          ^       ^       ^       ^
10#
]#HSS            ^       ^       ^       ^   # HSS          ^       ^       ^       ^
]#
]#NO DIPLOMA     ^       ^       ^       ^   #
]#              ------  ------  ------  ------             ------  ------  ------  -
+#TOTAL          ^       ^       ^       ^   # TOTAL        ^       ^       ^       ^
]#
]
]                              #REVIEW ONLY#
]
20                           #PRESS#ENTER#TO CONTINUE#
]
]#PF: #   1:13 HELP   2:14 RTN MAIN   3:15 RTN PREV
]
]^
 ----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
          0         0         0         0         0         0         0
```

```
                               CSP/AD                      DATE: 11/18/88  TIM
     MAPGROUP: UG01G          MAP: UG01M03   MEL: Q5UGM01
         1         2         3         4         5         6         7
----+----0----+----0----+----0----+----0----+----0----+----0----+----0----+
]#UG01M03#           #ENLISTED PERSONNEL ALLOCATION SYSTEM#
]        #                 USAREC MISSION GOALS EDITOR     #
]                                ^         #
]                    MALE                                       FEMALE
+               #                                                  #
]                    AFQT CATEGORY                              AFQT CATEGORY
]#EDUCATION    I-IIIA   IIIB     IV  TOTAL  EDUCATION  I-IIIA   IIIB     IV
]#----------   ------   ----     --  -----  ---------  ------   ----     --
]#HSG          ^     ^      ^      ^      # HSG        ^      ^      ^      ^    10#
]#HSS          ^     ^      ^      ^      # HSS        ^      ^      ^      ^
]#
]#NO DIPLOMA   ^     ^      ^      ^      #
]#              ------ ------ ------ ------             ------ ------ ------ -
+#TOTAL        ^     ^      ^      ^      # TOTAL      ^      ^      ^      ^
]#
]
]
]
20
]
]#PF: #   1:13 HELP    2:14 RTN MAIN    3:15 RTN PREV
]     #                9:21 ACCEPT     10:22 RESET
]^
----+----1----+----2----+----3----+----4----+----5----+----6----+----7----+
         0         0         0         0         0         0         0
```