Study Report 96-03

Development of an Army Prototype PC-Based Enlisted Personnel Allocation System

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The PC-based Enlisted Personnel Allocation System (EPAS) is designed to work in two modes--planning and simulation--with a design that can serve as the core of a production version. In planning mode the model provides analysis capability to Army managers by establishing the feasibility of new policy options, supply environments, and training restrictions. In simulation mode the model provides detailed analysis of impacts by simulating individual applicant flow and job assignment. As a research tool, EPAS will also be particularly useful in the examination of the effects of alternative selection and classification techniques under development by U.S. Army Research Institute psychologists. Linear programming is utilized to allocate 1 year's worth of recruit supply to MOS training requirements over a 24-month planning horizon so as to maximize the objective function (i.e., expected performance) while meeting manpower management and training constraints. This optimization planning problem has approximately 75,000 variables and 5,000 constraints. Reduced costs from the optimum planning solution are used to score and rank alternative (non-optional) training assignments for the current month's contractees. This produces an ordered list of training start dates for each supply group, ranked from best to worst in terms of objective function payoffs. This "optimal guidance" is input to a detailed procedure to classify (i.e., assign) individuals. Once the current month's contractees are assigned, the planning window is moved along 1 month and the cycle is repeated.

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Development of an Army Prototype PC-Based Enlisted Personnel Allocation System

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Personnel and Training
Analysis Activities

FOREWORD

This report describes the development of a PC-based Enlisted Personnel Allocation System (EPAS) prototype model. Both earlier research in the 1980's and ongoing work have indicated substantial payoffs from improvements in classification methodology and from optimal job-person match for new recruits.

PC-EPAS is designed to work in planning and simulation modes, with a design that can serve as the core of a production version. In planning mode the prototype provides analysis capability to Army managers by establishing the feasibility of new policy options, supply environments, and training restrictions. In simulation mode the prototype provides detailed job assignment. As a research tool, EPAS will also be particularly useful for examining the effects of improved selection and classification techniques being developed by U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) psychologists.

ARI's participation in this effort is part of a program of research designed to enhance the productivity of Army personnel. This work is an essential part of the Selection and Assignment Research Unit mission to improve the Army's ability to effectively and efficiently manage the force.

ZITA M. SIMUTIS
Deputy Director
(Science and Technology)

EDGAR M. JOHNSON
Director

DEVELOPMENT OF AN ARMY PROTOTYPE PC-BASED ENLISTED PERSONNEL ALLOCATION SYSTEM

EXECUTIVE SUMMARY

Research Requirement:

This paper describes a project, begun in 1994, at the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI) to develop, demonstrate, and document a PC-based prototype Enlisted Personnel Allocation System (EPAS) model. Earlier research had demonstrated optimal job-recruit match in a mainframe environment. That research showed that EPAS could increase recruits' expected job performance and reduce expected first-term attrition by significant amounts. The operations research challenge has been to develop techniques by which optimal strategies could be applied to an inherently sequential process.

Procedure:

Linear programming is utilized to allocate 1 year's worth of recruit supply to MOS training requirements over a 24-month planning horizon so as to maximize the objective function (i.e., expected performance) while meeting manpower management and training constraints. This optimization planning problem has approximately 75,000 variables and 5,000 constraints.

Reduced costs from the optimum planning solution are used to score and rank alternative (non-optical) training assignments for the current month's contractees. This produces an ordered list of training start dates for each supply group, ranked from best to worst in terms of objective function payoffs. This "optimal guidance" is input to a detailed procedure to classify (i.e., assign) individuals. Once the current month's contractees are assigned, the planning window is moved along 1 month and the cycle is repeated.

Findings:

PC-EPAS is designed to work in two modes--planning and simulation--with a design that can serve as the core of a production version. In planning mode the model provides analysis capability to Army managers by establishing the feasibility of new policy options, supply environments, and training restrictions. In simulation mode the model provides detailed job assignment. As a research tool, EPAS will also be particularly useful in the examination of the effects of alternative selection and classification techniques under development by ARI psychologists.

Utilization of Findings:

Results of the development and testing described in this paper indicated that the job-person match optimization problem is tractable in a PC environment and confirms that optimization can increase expected recruit performance by significant amounts, that the model (as research tool) offers the Army analytic and policy analysis capability not presently available, and that development of an optimization model for a production version of EPAS looks quite promising.

DEVELOPMENT OF AN ARMY PROTOTYPE PC-BASED ENLISTED PERSONNEL ALLOCATION SYSTEM

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Overview of PC-EPAS

Research Requirement

The RESEARCH-EPAS requirement was to develop methods that would prove the feasibility of enhancing the current REQUEST assignment system and allow it to function as an optimal allocation system. The enhancement is brought about by optimization of the job-person match and by incorporation of information about future as well as current recruit supply and training requirements into the JPM process. Within the Army classification system, this amounted to a two-phase procedure to introduce optimization into a sequential assignment process.

Figures 1A, 1B, and 1C depict the modular design of EPAS. These modules are grouped to function in several modes: planning, simulation, and operations. The JPM optimization problem is formulated and solved at a relatively aggregate level of detail -- to ensure a computationally feasible problem -- over the planning period. Subsequently, the results of the optimal aggregate allocation are disaggregated and utilized in guiding the sequential assignment of individuals for the current month.

The PC-EPAS project requirement was to improve upon and implement this approach, designed and developed in the earlier project, within a PC environment.[1] In the earlier project the optimization was initially accomplished with a network algorithm and subsequently attempted with a linear programming (LP) algorithm. The LP is the preferred approach because it is able to model the scheduling interrelationships not easily handled by the network formulation, but it is computationally more demanding. Accordingly, a major question for this project was the feasibility of accomplishing the optimization in an acceptable amount of time.

How EPAS Works

The Objective Function and EPAS as Research Tool

In addition to the development of methods which will enhance the REQUEST classification system, ARI has a research interest in developing a tool for examining the effects of alternative performance metrics and classification rules upon the job-person match.[2]

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[1] Initial planning and feasibility work as well as software selection were done by McWhite [2].

[2] A software tool of similar applicability has recently been developed by the USAF Armstrong Laboratory -- see Rue et. al. [4].

Within an LP framework the specification of an objective function as a generic "cost" of matching the supply of recruits to the demand for utilizing training seats provides the mechanism for measuring these effects.

This generic cost can refer to predicted performance in the job, to expected success in training, to the expected costs of training, to likelihood of completing the first term, and the like. Underlying the objective function is empirical research which relates the objective (e.g., predicted performance in a particular job) to characteristics of the soldiers found important for accomplishing that job (e.g., particular aptitudes, education, etc).

For the prototype model the objective function refers to the single aptitude area (AA) composite score. The objective is to assign soldiers to the job for which they have the highest aptitude score, subject to the variety of constraints that describe the assignment environment. However, in view of what we have recently learned about prediction of job performance and classification efficiency, this particular objective is rather simplistic and serves only as a place-holder in the development of the PC-EPAS tool.

<u>The Planning Mode</u>

See Figure 1A. In the planning mode the model is run once for the planning period -- over a twenty-four month horizon. In this mode there is an aggregate allocation of one year's worth of contractee supply to meet training requirements. We use the term "aggregate" allocation because in this mode we stop short of assigning <u>individual</u> soldiers to training seats.

Contractee supply is represented by the Quality Forecasting Module (QFM). The QFM is designed to accept either U.S. Army Recruiting Command (USAREC) gross contract mission boxes for the twelve month period or the forecasts of an econometric time series model. However, in the development and testing of PC-EPAS we have available the actual contract flow for 1991-93.

HOW EPAS WORKS: OVERVIEW
PLANNING MODE

USARI MPRL
Jun 95

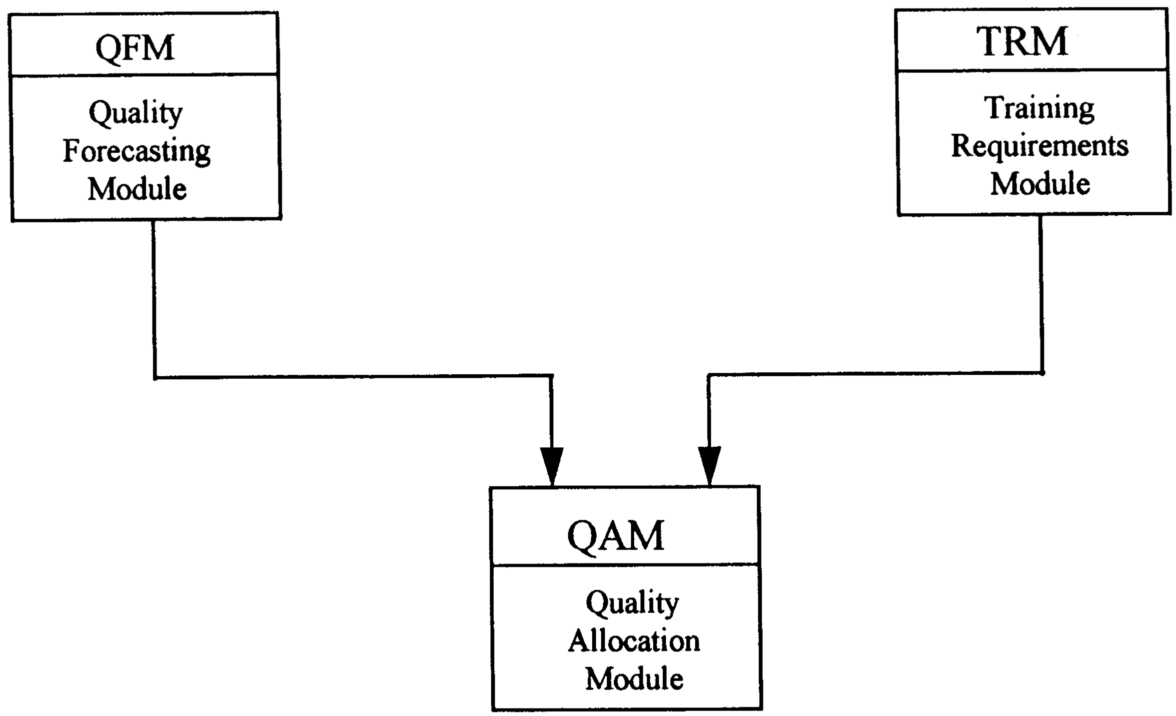

Figure 1A

HOW EPAS WORKS: OVERVIEW SIMULATION MODE

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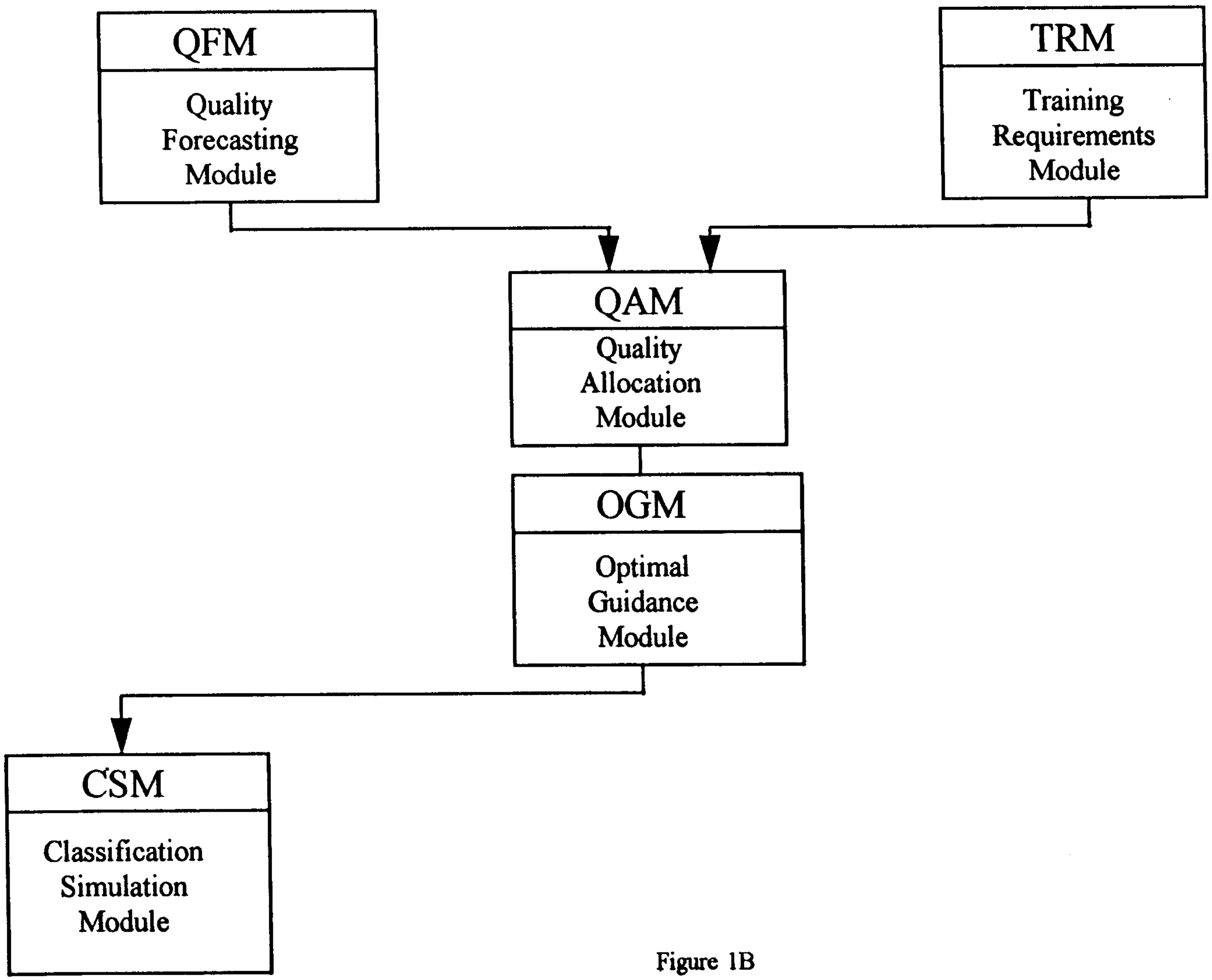

Figure 1B

HOW EPAS WORKS: OVERVIEW OPERATIONAL MODE

USARI MPRL
Jun 95

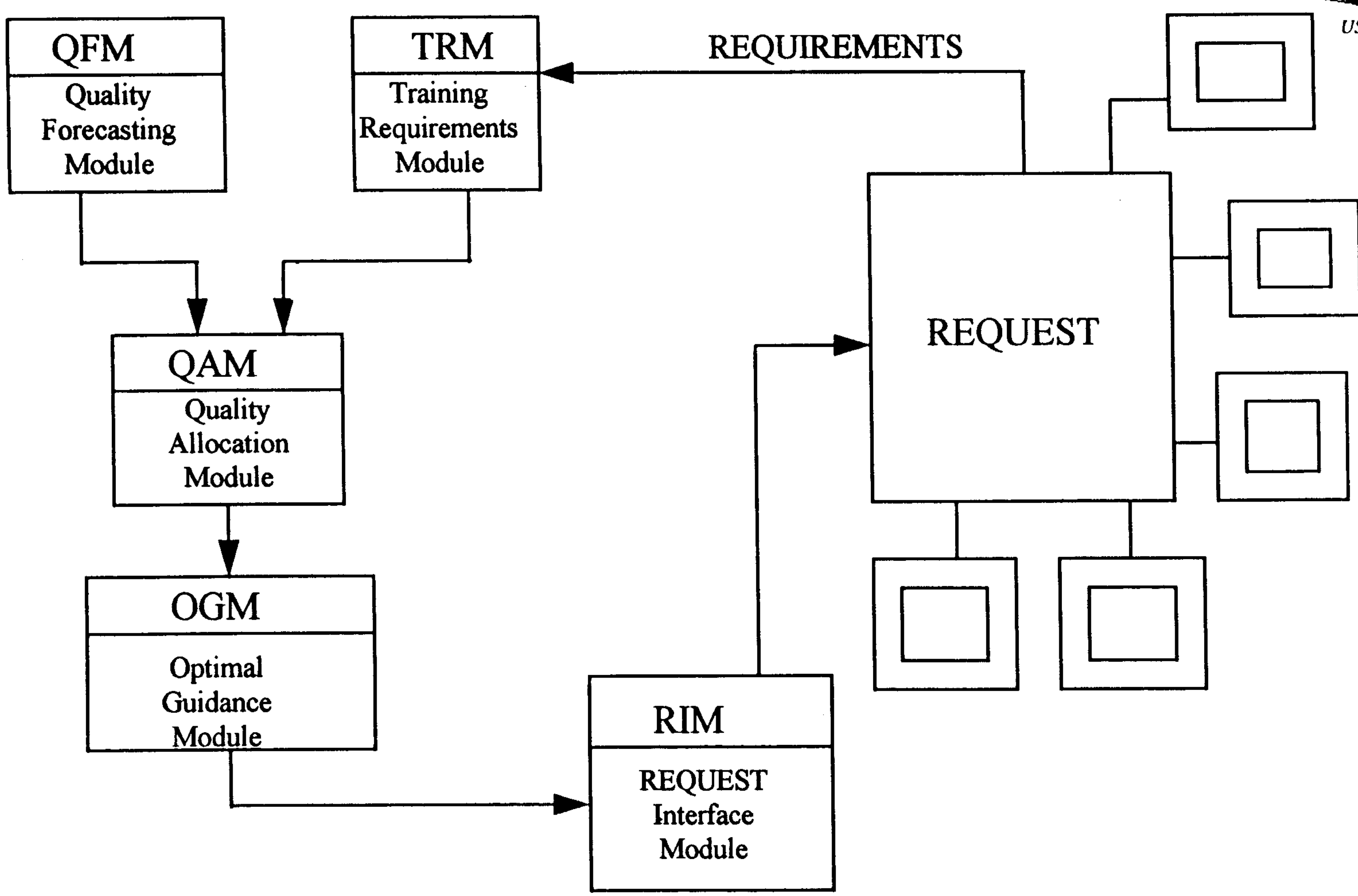

Figure 1C

Contractees are first stratified into 19 subpopulations based on USAREC mission categories of gender, education level, and AFQT.[3] Individuals in each subpopulation are grouped together based on similarity of aptitude area profiles. Aptitude area profiles are a set of average scores in nine aptitude areas that correspond to nine job families. A two-stage procedure was used to allow the number of supply groups per subpopulation to be determined based on the subpopulation's size and inherent differentiability. A total of 91 groups were delineated using FY 1991 recruit supply (see Appendix B). There is on-going research to build supply groups that facilitate classification efficiency.

Contractee demand is represented by the Training Requirements Module (TRM). The TRM would receive MOS training requirements, eligibility standards, and quality distribution goals from REQUEST. Training seats are viewed as a conduit through which supply flows to meet demand requirements.

To make the LP problem tractable we adapt procedures developed in RESEARCH-EPAS and utilize MOS clusters in the TRM. These clusters are presently defined by job family or aptitude area, AFQT category, gender, and education level. Eligibility for training in a particular MOS requires a score exceeding the minimum qualifying score in the corresponding aptitude area. These minimum or cut scores, together with the other criteria mentioned, are utilized to disaggregate the existing nine job families into approximately 60 MOS clusters. Once again, there is on-going research to build clusters that reflect similarity of tasks and facilitate classification efficiency.

The aggregate allocation of supply group to MOS cluster training seat is solved in the Quality Allocation Module (QAM). The allocation is formulated as an LP problem to determine an optimum classification strategy within the bounds of supply and demand constraints over the planning period. The output consists of optimal MOS cluster training start dates for each supply group. The QAM is described in detail in the next section.

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[3] As adjusted to the modeling approach -- two gender, three education level (high school graduate, high school senior, and non-graduate) categories, and four Armed Forces Qualification Test (AFQT). AFQT test categories (TC) and corresponding percentiles are TC-1-2 = 65-99, TC-3A = 50-64, TC-3B = 31-49, and TC-4 = 10-30. Female senior TC-4 and female non-grads are not taken.

The Simulation Mode

See Figure 1B. This mode is designed to simulate individual assignment procedures. As such it can be used in the development and testing of EPAS, and as a management tool with which to conduct JPM policy analysis. In this mode the focus is upon the assignment of individual recruits to MOS job training seats.

The aggregate allocation by itself is not suitable for making individual assignments for several reasons, the most important of which are as follows. First, individuals within supply groups may not meet the specific requirements for MOS recommendations. At the aggregate level these requirements cannot be delineated. For example, there may be citizenship requirements, or vision requirements, etc.[4] Second, MOS training seat availability is presumed at the aggregate level, but strictly speaking it will depend upon assignments made to individuals ahead in the queue. Third, contractees may choose not to accept a job from the optimal guidance list, even though they are qualified and training capacity exists.

In the Optimal Guidance Module (OGM) the optimization results from the QAM are first translated into a form that can be used in sequential assignment. Given the QAM solution, the reduced costs are used to score and rank alternative (non-optimal) training assignments for each supply group. At this point the MOS clusters are expanded into their component MOS's. In the present version the candidate MOS training classes are ordered according to the reduced cost (of the parent cluster), whether the cluster is part of the solution basis, the FY of the training start, the fill-rate of the class, and the month of the training start. The final product is an ordered list of MOS training start dates for each supply group, ranked from best to worst in terms of objective function payoffs. This is referred to as optimal guidance for the supply group.

The Classification Simulation Module (CSM) simulates assignment operations for the current contract month's contractees. The CSM determines the contractee's supply group; retrieves optimal guidance for that group; identifies training seats on the guidance list for which the contractee is eligible; determines current status of training seats; selects best 50 training seats for display to contractee; and simulates contractee behavior by using probabilistic choice (this last feature under development at this writing).

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[4] Specific requirements are not delineated in the current version of the simulation mode. They are, of course, spelled out in the REQUEST assignment procedures.

Turn now from a description of how an individual assignment is made to a description of the process as it would be carried out in a simulation policy analysis. To do this, the QAM and CSM modules are run iteratively for 12 cycles:

1. Run QAM to obtain the optimal allocation for one year's worth of recruit supply;

2. Run OGM to generate the optimal guidance for each supply group for the current month's (expected) contractees;

3. Assign the current month's individual (expected) contractees to training seats (as described above);

4. Advance the current month; obtain the contractee supply for the next 12-month period from the QFM; obtain training seat requirements for next 24-month period from the TRM, and update requirements to reflect assignments already made.

The Operations Mode

See Figure 1C. The PC-EPAS project stops short of implementation as a production system, and consequently the operations mode is beyond the scope of interest. It is worth discussing, however, how EPAS and REQUEST would be related in an operational setting. At the beginning of the period, training requirements data (i.e., the contents of the TRM) would come directly from REQUEST to match against recruit supply data (from the QFM). The aggregate allocation problem for the planning period is solved (in the QAM), and the resulting optimal policy guidance is passed back to REQUEST for use in the HIERARCHY assignment system during the current assignment period (week/two-weeks/month). The important point is that EPAS processing is done off-line -- possibly in a PC environment -- and there is no adverse impact upon REQUEST or the guidance counselor. Its workings are transparent to them. The systems are linked but clearly separable. EPAS implementation would necessitate the development of a REQUEST Interface Module (RIM in Figure 1C) to accept the optimal policy guidance and REQUEST'S Hierarchy system would be modified to properly utilize the guidance.

Linear Programming Model - Summary Description

Overview

In this section we summarize the formulation of the EPAS planning mode model (which carries out the aggregate allocation in the QAM). The equations are shown in Appendix A.

Supply of Recruits

The contract month is the month the members of a supply group sign the enlistment contract. Supply is characterized by supply groups and contract month and is defined as contractees[5] expected to access. In practice, USAREC does anticipate Delayed Entry Program (DEP) attrition and builds replacement into its contract mission. However, we have not yet taken into account further consequences of DEP loss.[6]

Training Requirements

Demand is given by FY MOS training requirements, and class seat availability can be characterized by MOS and month of class start. There are two kinds of class seats - those representing One Station Unit Training (OSUT) and those representing Advanced Individual Training (AIT). AIT class seats predominate and require a separate preliminary eight weeks of Basic Training (BT) which the model automatically allows for. The length of BT is a parameter in the formulation.

Matching Supply to Training Class Seats

The objective function of the prototype model is to assign members of supply groups to training classes so as to maximize the total AA score.

The model allows supply to flow to class seats with constraints restricting the flow: (a) the monthly accession flow into AIT and OSUT training is limited by the predetermined budget and training capacity; and (b) the annual flow must meet individual MOS training requirements. Monthly accession limits refer to the months when BT or OSUT begin. MOS requirements refer to the year in which AIT or OSUT training begins.

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[5] Strictly speaking, supply should refer to qualified applicants at the point of selecting an MOS and training start date.

[6] The fix would occur in the simulation mode, with the reinstatement of a certain proportion of training seats each month to reflect the DEP attrition -- unless the training requirement has already been inflated in anticipation of DEP attrition.

Due to attrition that accompanies delay and the relative attractiveness of different AFQT categories, the Army is more willing to allow the more qualified individuals to delay training (through the Delayed Entry Program) than the less qualified. In order to reflect this practice and to effectively match personnel to jobs based on aptitude, the model is given the flexibility to choose a class seat from several months, since all classes do not start each month. In addition, while high school seniors may contract, their training must be scheduled after they receive their degree. At this point the assumption is made that all seniors graduate in June.

In addition to the constraints imposed on allocation, there are MOS-level annual goals set by the Army which must be incorporated in the LP. Specifically, there are quality goals which refer to TC-1-3A recruits; there are goals for high school graduates; and there are limits on the lower aptitude or TC-4 recruits.[7]

In the present version of the model, high cost - high quality artificial supply (JOE) is made available to meet numerical / quality goals in both years 1 and 2 of the planning period. Its actual use by the model in year 1 serves as an indicator of a fundamental problem -- one that otherwise would have generated an infeasible solution. Accordingly, the utilization of JOE in year 1 is one of the first things checked. In contrast, the actual use of artificial supply in year 2 is necessary because one year's worth of supply can only partially fill year 2's requirements. In the next version of the model, artificial supply will be more realistically portrayed as a TC-3B supply; this will entail other changes to the formulation.

Description of the Model

Model Parameters

The following parameters set the upper bounds for the matrices.

```
I = 91        ! Maximum number of supply groups
J = 12        ! Number of contract periods in planning year
K = 24        ! Number of class start periods

MA = 53       ! Number of AIT MOS clusters
```

[7] In fact, during FY 1995 there are separate MOS-level annual goals by gender; there are monthly accession targets with two percent leeway, not just limits; and there are monthly accession targets with zero leeway for certain priority MOS's. The next version of the model will reflect these practices.

MU = 4	! Number of OSUT MOS clusters
Y = 12	! Number of periods remaining in the planning year
T = 2	! Number of periods for basic training
BIGM1 = 0.5	! Cost of artificial supply (JOE) in year 1
BIGM2 = 0.2	! Cost of artificial supply (JOE) in year 2

Inputs to the Model

The cluster index in the following matrices points to AIT data in the first 53 indices and OSUT data in the last 4 indices.

Matrix Name (Indices)	Identification
SUPPLY (91,12)	Supply group by contract month
CLMAX (57,24)	Class seats by cluster and month
COST (91,57)	Cost by supply group to cluster; if allocation not allowed, cost = 0
DEPLIM (91,12,24)	Allowable delays by supply group, contract period, training start period
AAMMP (22)	Active Army accession limit by month
FYREQ1 (57)	First year annual program by cluster
FYREQ2 (57)	Second year anual program by cluster
PCTQUAL (57)	Annual quality percentage by cluster
PCTCAT4 (57)	Annual TC-4 limit percentage by cluster
PCTGRAD (57)	Annual HSDG percentage by cluster

Outputs from the Model -- Variables

AIT (i,k,ma)	Number in Supply Group i to basic training in month k-2, and thence to AIT Cluster ma in month k
OSUT (i,k,mu)	Number in Supply Group i to OSUT Cluster mu in month k
SG (i,j,k)	Number in Supply Group i contracting in month j to start basic training or OSUT in month k
JOE1 (m)	Number of male TC-1 artificials used in 1st year
JOE2 (m)	Number of male TC-1 artificials used in 2nd year

Objective Function

The objective of the model is to maximize the pertinent aptitude area scores for personnel assigned to each cluster. This is accomplished by minimizing the cost of each allocation where cost is computed as the inverse of the supply group's AA score.

Feasibility

Allocation of recruits cannot exceed supply. Since the AIT and OSUT output variables are not indexed by contract month (in the planning mode), we establish an intermediate variable SG(i,j,k), indexed by supply group, contract month, and training start month. A defining constraint insures that, for each supply group and contract month, all the recruits that start training cannot exceed the supply available. A second constraint insures that, for each supply group that starts training in a given month, its AIT and OSUT allocations do not exceed recruit availability as summed over all contract months.

Supply-demand matches that are not allowed. Unallowable connections between supply groups and MOS clusters are accomplished using the XPRESS package which allows internal constraints to be imposed at time of variable definition. The COST matrix is loaded with zeros for those supply group to MOS cluster connections which are not allowed (e.g. female supply groups to combat MOS clusters). The above formulation allows all supply groups to flow to all MOS clusters provided that the cost associated with the connection is not zero. This manner of formulating the constraint has a beneficial side effect of reducing the number of variables in the LP, thus increasing solution speed.

Scheduling limitations. The same approach can be used to solve another feasibility problem. One of EPAS's strengths is its ability to consider class seats in a window, but the window as a reflection of DEP policy has limits. Since a model run encompasses a year's worth of supply, and almost two years' worth of requirements, there must be a bar for individuals in month 2, for example, being scheduled to train in month 24. The SG variable can prevent that from occurring by constraining it with a binary matrix where all unallowed combinations are set to zero. Since this matrix is created outside the model, DEP length limits and the one month delay (for in-processing purposes) can also be accommodated without modification to the LP itself.

Production Constraints

Fill class seats. The mechanism through which supply meets requirements is class seats. Supply is allowed to fill OSUT class seats in the first month it is available, but may not fill AIT class seats until the month after basic training is completed. Maximum class sizes form an upper bound for filling MOS cluster seats.

Annual MOS training requirement. The annual training requirements for each MOS cluster are reached with the use of artificial supply as needed (see earlier discussion). When the model is not run on a fiscal year boundary, the number of months left in the fiscal year is used to determine which training months count against which fiscal year.

Monthly accession limit. Budgeted resources put a limit on monthly accessions. The limit applies to the month in which a recruit begins basic training or OSUT. For a given training start month, AIT and OSUT allocations are summed over supply groups and MOS clusters. Together they may not exceed accession limits given in the Active Army Military Manpower Program (AAMMP).

Annual Goals and Limits

These are expressed as minimum or maximum percentage targets multiplied by fiscal year MOS cluster level requirements.

Annual quality goals. The annual goals for quality recruits differ by MOS. They are based on the needs of the individual MOS. AIT is summed over all of the supply groups representing TC-1-3A, contract months, and AIT training start months to reach the quality goal for each MOS, with the inclusion of artificial inventory if needed. The inventory targeted toward OSUT seats are handled in a similar fashion.

High school graduate goals. High school diploma graduate goals are handled in the same manner as quality goals.

TC-4 restrictions. Numeric limits for the lowest mental test-category recruits are handled in the same manner as quality goals.

Application: Illustrative Scenario Results

Data Preparation

Recruit supply and training class demand are approximated by extracting and building separate files from the contracts data for FY 1991-93. Contracts data -- the outcome of supply and demand interaction -- contains the training class assignments actually made by the REQUEST system. Historical contracts data can be found in the "MiniMaster" database maintained at U.S. Army Recruiting Command - Program and Evaluation Directorate (USAREC-PAE). Annual MOS training requirements and monthly accession limits are inferred from the actual training started and training seats sold. Note that training class demand excludes those FY 1991 requirements already filled by FY 1990 contractees.

This approach to data collection was done for expediency. The use of contracts data from which supply and demand are inferred effectively restricts the full range of recruits and training seats which are available for matching, and in so doing restricts the improvements which can be realized through optimization. Accordingly, one of the next steps in the development of EPAS will be to utilize independent sources of applicant/contract supply and training requirements.

Low aptitude category (TC-4) limits were set at 15 percent for those MOS clusters with cut scores of 90 or less, and at 10 percent for other clusters. During this period the overall policy limit was apparently 10 percent, while USAREC actually achieved around 2 percent. The higher limits we set were to ensure complete allocation of the data sample in use.

Quality (i.e., TC-1-3A) goals were set to 65 percent across all MOS's. In actuality there is some variation which can be easily incorporated.

The high school graduate goals are, in effect, superceded by the presence or absence of a MOS cluster requirement for high school graduates. Accordingly, they were redundantly set either to 100 or to zero percent.

Scenario Descriptions

A variety of policy analysis scenarios can be examined in order to demonstrate the concept and power of an automated, optimizing JPM system.

The baseline scenario serves as a basis for comparison with several illustrative cases:

(B) Reduction/increase in quality of recruit supply. TC-1-3A categories are reduced by 10 percent while there is a corresponding increase in TC-3B categories.

(C) Shift of training seats from winter to summer months (for those classes scheduled in both seasons) or vice-versa: (1) 10% shift from summer to winter months; (2) 30% shift from winter to summer months.

(D) Shift in gender composition of recruit supply: a 15 percent increase in females and a corresponding decrease in males.

(E) Female share of clerical / administrative occupations is intentionally capped at 20 percent.

(F) Change in DEP length management policies: allowable training delays for TC-1-2, 3A, 3B, and 4 changed from 8, 8, 8, 8 months to 8, 7, 6, 5 months.

Planning Mode Results

In these EPAS planning and simulation mode runs, the focus is upon one year's worth of contractees: FY 1991 contractees are allocated / assigned to training classes in FY 1991 (shown as FY1) and FY 1992 (FY2). In interpreting the results it should be kept in mind that with one year's worth of supply, the allocation to FY1 is complete but that to FY2 is partial.

The improvement brought about by optimization is shown in a comparison of EPAS with the actual REQUEST results. The EPAS planning allocation results are shown in Table 2. The actual REQUEST assignments (for the baseline set of observations) are shown in Table 1. For FY1 there is an improvement of 5.5 points in the average AA score. If both first and second years are considered, and remember that FY2 is very much a partial year, the average improvement is about 3 points. These improvements were obtained while meeting FY1 training requirements, and these requirements were met without utilization of artificial supply (in FY1). The FY1 improvement is about the same magnitude reported in the earlier RESEARCH-EPAS (see [3], [5]), and equates to an improvement of approximately 0.25 standard deviation units.

Table 1. Summary of Actual REQUEST Results

	Average AA score	Supply in / used
FY1	109.71	41,143
FY2	110.51	34,374
FY3	114.77	360
Overall	110.10	75,877

Table 2. Results of EPAS Planning Mode: Baseline and Other Scenarios

	Base-line	B	C(1)	D	E	F
FY1 AA score	114.84	113.84	113.90	114.91	114.76	114.19
FY2 AA score	111.35	109.72	112.57	111.61	111.09	112.01
AVG AA score	113.24	111.96	113.29	113.40	113.08	113.19
FY1 allocation	41143	41142	41039	41143	41143	41143
FY2 allocation	34734	34735	34838	34721	34734	34734
Supply in	75877	75877	75877	75864	75877	75877
Supply unused	0	0	0	0	0	0

A comparison of the planning mode results for scenario B with the baseline scenario reveal several interesting properties of the optimization. In scenario B we postulate a decrease in recruit quality: the TC-1-3A category is reduced by 10 percent and the TC-3B category increases by about 30 percent. The impact of this shift upon average AA scores is shown in Table 2 -- a drop of only 1.28 points (1.1 percent) relative to the baseline over both years. The impact is mitigated from what it might have been because the optimization produces a different allocation across FY1 and FY2. The allocation of TC-1-3A recruits is taken down by 6.5 percent in FY1 and by almost 15 percent in FY2. The inter-year allocation and AA scores are affected by the relative weights accorded the artificial variables (JOEs). These weights should therefore be used to reflect recruiting policy emphasis on the current versus next year.

We note that the objective function values obtained (not shown) as well as the overall average AA scores do not appear affected by the weights chosen. This could be an indication of multiple optima. Along the same line, a somewhat surprising result were average AA scores for FY2 that fell below those for FY1. This was surprising because the training opportunities are relatively more plentiful in FY2. Further testing is underway.

Results for the other planning mode scenarios are also shown in Table 2. They indicate a certain robustness of the optimization, probably due to the inter-year rearrangements just described. For the relatively moderate changes portrayed, the average AA scores achieved (especially FY1) do not decrease very much relative to the baseline scenario.

Compositional changes are likely to occur as the algorithm finds a new optimum in response to changed conditions as depicted by different scenarios. As an illustration, Table 3 portrays the gender composition of each cluster allocation, comparing the actual REQUEST composition to EPAS planning results for the baseline and scenarios D and E. (Refer to Appendix C for description of the clusters.) As can be seen the EPAS solutions vis-a-vis REQUEST are characterized by less dispersion of females across occupations.[8] In Scenario D, depicting the effects of more female contracts (by approximately 15 percent), we find that the distribution is somewhat different compared to the baseline. In scenario E, depicting the 20 percent limit for females in clerical / administrative occupations (Clusters 1 - 6, 32, 33), females are shifted towards more skilled technical (ST) job family allocations, including military police (Cluster 54) and chemical workers (Cluster 55). In response to the effects of this cap, we did find increased allocation of male TC-3B into MOS Cluster 3, the largest clerical / administrative family; their share increased from zero (in the baseline scenario) to almost 10 percent.

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[8] In part this can be explained by the absence of gender specific MOS-level annual goals in the current planning model; they will be incorporated into the next version.

Simulation Mode Results

The results of an EPAS simulation mode run for the baseline scenario are shown in Table 4. The improvement in AA score (over the actual REQUEST results) is about the same as that achieved in the planning mode -- a noteworthy accomplishment given the increased constraints of individual assignment. However, there were a number of individuals who could not be assigned training starts -- from approximately 90 to 220 over the 12 month cycle -- and this must be investigated and corrected. Preliminary indications point to shortcomings with the variety of jobs in the generation of the ordered list.

Model Size and Run Times

The size of the planning and simulation mode models is described below for the baseline scenario:

	Planning Mode	Simulation Mode (month 1)
Rows	4,631	2,629
Columns	78,328	315,603
Elements	487,010	2,139,034
Density	.134260	.257802

For the planning mode runs, the optimization times varied between 20 and 65 minutes depending on the scenario. For each month in the simulation mode the optimization itself took approximately twice as long, plus additional processing which extended the time by half again as much.

Conclusions / Next Steps

Results of the development and testing described in this paper indicate that the job-person match optimization problem is tractable in a PC environment and confirms that optimization can increase expected recruit performance by significant amounts; that the model (as research tool) offers the Army analytic and policy analysis capability not presently available; and that development of an optimization core model for a production version of EPAS looks quite promising.

Several technical problems have thus far been revealed in the development work. We intend to develop better methods for creating supply groups and MOS clusters for use in the classification problem and for ensuring the congruence between supply groups and MOS clusters; to improve procedures for the creation of the ordered list; and to learn more about the effects of alternative weights for artificial variables. Beyond these immediate problems, work is called for along these avenues: adapting / developing procedures for forecasting recruit supply; incorporating new performance prediction metrics into EPAS; and making organizational arrangements for the flow of current data during the ongoing development and testing period.

Table 3. Female Share of Cluster Allocations (percentages)

Cluster	Actual REQUEST	EPAS - Baseline	EPAS - Scenario D	EPAS - Scenario E
1	90.6	64.4	11.1	22.2
2	54.2	66.7	54.4	20.0
3	50.8	59.1	70.9	20.0
4	22.6	55.2	71.3	20.3
5	10.7	34.4	75.0	21.9
6	4.0	79.3	27.6	20.7
7	19.0	0	0	0
8	33.3	0	0	0
9	5.4	0	0	0
10	15.8	0	0	16.1
11	12.0	0	0	0
12	8.7	0	0	0
13	14.1	0	0	0
14	5.0	0	0	0
15	4.0	0	0	0
16	4.3	0	0	0
17	12.4	0	0	0
18	6.2	0	0	0
19	1.1	0	0	0
20	43.8	0	8.3	39.6
21	18.4	29.1	22.9	63.1
22	6.4	10.8	40.4	40.0
23	5.2	42.9	26.2	14.9
24	2.7	29.0	37.9	23.9
25	27.6	0	0	0
26	6.6	0	0	0
27	5.6	0	0	0
28	5.2	0	0	0
29	5.4	0	0	0

30	0	0	0	0
31	2.5	0	0	0
32	71.4	21.4	14.3	21.4
33	20.8	85.3	51.0	20.3
34	44.1	54.8	14.0	50.5
35	15.7	51.8	15.7	32.5
36	8.1	8.7	6.4	23.6
37	1.7	0	0	0
38 - 53	0	0	0	0
54	19.7	15.2	10.2	41.7
55	84.3	27.3	33.9	59.0
56 - 57	0	0	0	0

Table 4. Results of EPAS Simulation: Baseline Scenario

Month	Supply In	Supply not used	FY1	FY2	FY3	AA - FY1	AA - FY2	AA - FY3
1	7146	201	6297	648	0	112.0	110.8	
2	6515	221	5757	537	0	113.1	111.9	
3	5800	167	5030	603	0	112.6	112.9	
4	6719	202	5429	1088	0	113.9	109.9	
5	5905	163	4723	1019	0	115.1	111.6	
6	6562	139	4313	2110	0	116.2	107.3	
7	6383	120	3527	2736	0	116.5	107.7	
8	5467	111	2009	3347	0	116.0	111.9	
9	5800	87	1155	4558	0	122.6	111.7	
10	6841	111	987	5743	0	122.4	112.2	
11	7013	125	389	6499	0	121.0	113.0	
12	5726	103	0	5380	243		114.2	109.3

References

Konieczny, F., Brown, G., Hutton, J., & Stewart, J. (1990). Enlisted personnel allocation system: Final technical report. General Research Corp.

McWhite, P. E. (1993). Personal computer-enlisted personnel allocation system feasibility study. Rockville, MD: McWhite Scientific.

Nord, R. D., & Schmitz, E. J. (1989). Estimating performance and utility effects of alternative selection and classification policies. In J. Zeidner and C. D. Johnson (Eds.), Predicting job performance. Alexandria, VA: Institute for Defense Analyses.

Rue, R. C., et al. (1994). Development of the generic assignment test and evaluation simulator (GATES). San Antonio, TX: Systems Research and Applications Corp.

Schmitz, E. J., and McWhite, P. B. (1986). Evaluating the benefits and costs of the enlisted personnel allocation system (EPAS) (ARI Technical Report No. 721). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. (AD A177 619)

APPENDIX A: PLANNING MODEL EQUATIONS

Model Parameters

The following parameters set the upper bounds for the matrices.

I = 91	! Maximum number of supply groups
J = 12	! Number of contract periods in planning year
K = 24	! Number of class start periods DEP
MA = 53	! Number of AIT MOS clusters
MU = 4	! Number of OSUT MOS clusters
Y = 12	! Number of periods remaining in the planning year
T = 2	! Number of periods for basic training
BIGM1 = 0.5	! Cost of artificial supply (JOE) in year 1
BIGM2 = 0.2	! Cost of artificial supply (JOE) in year 2

Inputs to the Model

The cluster index in the following matrices points to AIT data in the first 53 indices and OSUT data in the last 4 indices.

Matrix Name (Indices)	Identification
SUPPLY (91,12)	Supply group by contract month
CLMAX (57,24)	Class seats by cluster and month
COST (91,57)	Cost by supply group to cluster; if allocation not allowed, cost = 0
DEPLIM (91,12,24)	Allowable delays by supply group, contract period, training start period
AAMMP (22)	Active Army accession limit by month
FYREQ1 (57)	First year annual program by cluster
FYREQ2 (57)	Second year anual program by cluster
PCTQUAL (57)	Annual quality percentage by cluster
PCTCAT4 (57)	Annual TC-4 limit percentage by cluster
PCTGRAD (57)	Annual HSDG percentage by cluster
iQUAL (91)	Indices of quality supply groups
iCAT4 (91)	Indices of TC-4 supply groups
iGRAD (91)	Indices of HSDG supply groups
iFEMS (91)	Indices of female supply groups (for Scenario E)
iCLER (57)	Indices of clerical MOS clusters (for Scenario E)
FEMPCT	Percent of requirements which can be met by females (Scenario F)
SCENE	Scenario (1=Baseline, 2=B, ..., 6=F)

Outputs from the Model -- Variables

AIT (i,k,ma)	Number in Supply Group i to basic training in month k-2, and thence to AIT Cluster ma in month k
OSUT (i,k,mu)	Number in Supply Group i to OSUT Cluster mu in month k
SG (i,j,k)	Number in Supply Group i contracting in month j to start basic training or OSUT in month k
JOE1 (m)	Number of male TC-1 artificials used in 1st year
JOE2 (m)	Number of male TC-1 artificials used in 2nd year

Objective Function

The objective of the model is to maximize the pertinent aptitude area scores for personnel assigned to each cluster. This is accomplished by minimizing the cost of each allocation where cost is computed as the inverse of the supply group's AA score.

$$\sum_{i=1}^{I} \sum_{k=T+1}^{K} \sum_{ma=1}^{MA} COST(i,ma) * AIT(i,k,ma)$$
$$+ \sum_{i=1}^{I} \sum_{k=1}^{K-T} \sum_{mu=1}^{MU} COST(i,MA+mu) * OSUT(i,k,mu) \qquad (1)$$
$$+ \sum_{m=1}^{MA+MU} BIGM1 * JOE1(m) \; + \; BIGM2 * JOE2(m)$$

Feasibility

Allocation of recruits cannot exceed supply. Since the AIT and OSUT output variables are not indexed by contract month, we establish an intermediate variable SG(i,j,k), indexed by supply group, contract month, and training start month. A defining constraint insures that, for each supply group and contract month, all the recruits that start training cannot exceed the supply available. A second constraint insures that, for each supply group that starts training in a given month, its AIT and OSUT allocations do not exceed recruit availability as summed over all contract months.

$$\sum_{k=j}^{K} SG(i,j,k) < SUPPLY(i,j) \qquad (2a)$$

$$\sum_{j=1}^{J} SG(i,j,k) > \sum_{ma=1}^{MA} AIT(i,k+T,ma) + \sum_{mu=1}^{MU} OSUT(i,k,mu) \quad (2b)$$

Supply-demand matches that are not allowed. Unallowable connections between supply groups and MOS clusters could be discouraged in the objective function by using a COST matrix containing high costs for unallowed connections. However, this approach would not prevent such connections. While a separate constraint could be written to achieve the desired effect, the XPRESS package allows internal constraints to be imposed at time of variable definition.

$$AIT(i,k,ma) \text{ defined for all } i,k,ma \text{ combinations for which } COST(i,ma) \neq 0 \text{ and } CLMAX(ma,k) \neq 0 \quad (3a)$$

$$OSUT(i,k,mu) \text{ is defined for all } i,k,mu \text{ combinations for which } COST(i,MA+mu) \neq 0 \text{ and } CLMAX(MA+mu) \neq 0 \quad (3b)$$

The COST matrix above is loaded with zeros in those supply groups to MOS clusters which are not allowed (e.g. female supply groups to combat MOS clusters). The above formulations allow all supply groups to flow to all MOS clusters provided that the cost associated with the connection is not zero. This manner of formulating the constraint has the beneficial side effect of reducing the number of variables in the LP, thus increasing solution speed.

Scheduling limitations. The same approach can be used to solve another feasibility problem. While one of EPAS's strengths is its ability to consider class seats in a window larger than that of REQUEST, the window must have limits. Since a model run encompasses a year's worth of supply, and almost two year's worth of requirements, there must be a bar for individuals in month one, for example, being scheduled to train in month 24. The following definition of the SG variable can prevent that from occurring.

$$SG(i,j,k) \text{ is defined for all } i,k,ma \text{ combinations for which } DEPLIM(i,j,k) \neq 0 \quad (4)$$

DEPLIM is defined as a binary matrix where all unallowed combinations are set to zero. Since the DEPLIM matrix is created outside the model, DEP length limits and the one month delay (for security purposes) can also be accommodated without modification to the LP itself.

Production Constraints

Fill class seats. The mechanism by which supply meets requirements is class seats. Supply is allowed to fill OSUT class seats in the first month it is available, but may not fill AIT class seats until the month after basic training is completed. Maximum class sizes form an upper bound for filling MOS cluster seats.

$$\sum_{i=1}^{I} AIT(i,k,ma) < CLMAX(ma,k) \tag{5a}$$

$$\sum_{i=1}^{I} OSUT(i,k,mu) < OCLMAX(MA+mu,k) \tag{5b}$$

Annual MOS training requirement. The annual training requirements for each MOS cluster are goaled with the use of artificial supply as needed. When the model is not run on a fiscal year boundary, the number of months left in the fiscal year is used to determine which training months count against which fiscal year.

$$\sum_{i=1}^{I} \sum_{k=1+T}^{Y} AIT(i,k,ma) + JOE1(ma) = FYREQ1(ma) \tag{6a}$$

$$\sum_{i=1}^{I} \sum_{k=1}^{K} OSUT(i,k,mu) + JOE1(MA+mu) = FYREQ1(MA+mu) \tag{6b}$$

$$\sum_{i=1}^{I} \sum_{k=Y+1}^{K} AIT(i,k,ma) + JOE2(ma) = FYREQ2(ma) \tag{6c}$$

$$\sum_{i=1}^{I} \sum_{k=Y+1}^{K-T} OSUT(i,k,mu) + JOE2(MA+mu) = FYREQ2(MA+mu) \tag{6d}$$

Monthly accession limit. Budgeted resources put a limit on monthly accessions. The limit applies to the month in which a recruit begins OSUT or basic training in preparation for AIT. For a given training start month, AIT and OSUT allocations are summed over supply groups and MOS clusters. Together they may not exceed accession limits given in the Active Army Military Manpower Program (AAMMP).

$$\sum_{i=1}^{I} \sum_{ma=1}^{MA} AIT(i,k+T,ma) + \sum_{i=1}^{I} \sum_{mu=1}^{MU} OSUT(i,k,mu) < AAMP(k) \quad (7)$$

Annual Goals and Limits

```
NQUAL1(m) = PCTQUAL(m) * FYREQ1(m)
NQUAL2(m) = PCTQUAL(m) * FYREQ2(m)
NGRAD1(m) = PCTGRAD(m) * FYREQ1(m)
NGRAD2(m) = PCTGRAD(m) * FYREQ2(m)
NCAT41(m) = PCTCAT4(m) * FYREQ1(m)
NCAT42(m) = PCTCAT4(m) * FYREQ2(m)
NFEMR1(m) = FEMPCT     * FYREQ1(m)
NFEMR2(m) = FEMPCT     * FYREQ2(m)
```

Annual quality goals. The annual goals for quality may differ by MOS. They are based on the needs of the individual MOS but are also designed to spread quality over all MOS's. They result in the model driving towards filling a certain percentage of requirements. If the demand for quality exceeds the supply, those MOS's with the highest demand will be the most negatively affected. Thus, any changes to balance supply and demand should be made in the direction of reducing percentages either overall or in the MOS's with less demand.

AIT is summed over all of the supply groups representing TC-1-3A, contract months, and AIT training months to produce QANAIT which drives toward QUAL for each MOS by the inclusion of artificial inventory. The inventory targeted toward OSUT seats are handled in a similar fashion.

$$\sum_{i \varepsilon iQUAL(i) \neq 0} \sum_{k=1}^{Y} AIT(i,k,ma) + JOE1(ma) > NQUAL1(ma) \tag{9a}$$

$$\sum_{i \varepsilon iQUAL(i) \neq 0} \sum_{k=1}^{Y} OSUT(i,k,mu) + JOE1(MA+mu) > NQUAL1(MA+mu) \tag{9b}$$

$$\sum_{i \varepsilon iQUAL(i) \neq 0} \sum_{k=Y+1}^{K} AIT(i,k,ma) + JOE1(ma) > NQUAL2(ma) \tag{9c}$$

$$\sum_{i \varepsilon iQUAL(i) \neq 0} \sum_{k=Y+1}^{K} OSUT(i,k,mu) + JOE1(MA+mu) > NQUAL2(MA+mu) \tag{9d}$$

High school graduate goals. High school diploma graduate goals are handled in the same manner.

$$\sum_{i \varepsilon iGRAD(i) \neq 0} \sum_{k=1}^{Y} AIT(i,k,ma) + JOE1(ma) > NGRAD1(ma) \tag{10a}$$

$$\sum_{i \varepsilon iGRAD(i) \neq 0} \sum_{k=1}^{Y} OSUT(i,k,mu) + JOE1(MA+mu) > NGRAD1(MA+mu) \tag{10b}$$

$$\sum_{i \varepsilon iGRAD(i) \neq 0} \sum_{k=Y+1}^{K} AIT(i,k,ma) + JOE1(ma) > NGRAD2(ma) \tag{10c}$$

$$\sum_{i \varepsilon iGRAD(i) \neq 0} \sum_{k=Y+1}^{K} OSUT(i,k,mu) + JOE1(MA+mu) > NGRAD2(MA+mu) \tag{10d}$$

TC-4 restrictions. Numeric limits for the lowest mental test-category recruits are handled in the same manner. The NCAT4 matrix contains the numeric limit for TC-4 supply by MOS cluster. Only the supply groups associated with TC-4 are considered. The indices of these supply groups are contained in iCAT4.

$$\sum_{i \epsilon iCAT4(i) \neq 0} \sum_{k=1}^{Y} AIT(i,k,ma) + JOE1(ma) \leq NCAT41(ma) \quad (11a)$$

$$\sum_{i \epsilon iCAT4(i) \neq 0} \sum_{k=1}^{Y} OSUT(i,k,mu) + JOE1(MA+mu) \leq NCAT41(MA+mu) \quad (11b)$$

$$\sum_{i \epsilon iCAT4(i) \neq 0} \sum_{k=Y+1}^{K} AIT(i,k,ma) + JOE1(ma) \leq NCAT42(ma) \quad (11c)$$

$$\sum_{i \epsilon iCAT4(i) \neq 0} \sum_{k=Y+1}^{K} OSUT(i,k,mu) + JOE1(MA+mu) \leq NCAT42(MA+mu) \quad (11d)$$

Scenarios

Most of the anticipated "what if" questions can be modeled by changes to the supply or demand data prior to input to the model. Scenario E, which puts a cap on female supply to clerical occupations, must be expressed as a constraint to the model.

$$for\ ma \epsilon iCLER(ma) \neq 0, \quad \sum_{i \epsilon iFEMS(i) \neq 0} \sum_{k=1+T}^{Y} AIT(i,k,ma) \leq NFEMR1(ma) \quad (12a)$$

$$for\ ma \epsilon iCLER(ma) \neq 0, \quad \sum_{i \epsilon iFEMS(i) \neq 0} \sum_{k=Y+1}^{K} AIT(i,k,ma) \leq NFEMR2(ma) \quad (12b)$$

APPENDIX B: SUPPLY GROUPS

SUPPLY GROUPS
BASED ON APTITUDE AREA CLUSTERING

SUP GRP	GNDR	EDUC LVL	AFQT CAT	CL	CO	EL	FA	GM	MM	OF	SC	ST	OK DEP DELAY	AVG AFQT SCORE
				-------AVERAGE AA SCORES-----------										
	MALE	HSDG	I-II	114	101	106	108	100	96	101	102	107	08	71
2	MALE	HSDG	I-II	119	110	120	116	118	110	111	113	120	08	79
3	MALE	HSDG	I-II	126	118	127	123	123	115	115	120	125	08	89
4	MALE	HSDG	I-II	114	105	115	108	114	107	108	110	114	08	72
5	MALE	HSDG	I-II	119	107	114	116	107	102	106	108	115	08	78
6	MALE	HSDG	I-II	114	114	114	113	115	115	116	116	116	08	71
7	MALE	HSDG	I-II	112	108	107	109	106	106	111	110	110	08	69
8	MALE	HSDG	I-II	113	122	113	116	115	120	121	122	115	08	71
9	MALE	HSDG	I-II	117	114	109	119	104	107	113	112	112	08	73
10	MALE	HSDG	I-II	123	123	126	124	127	124	123	125	127	08	85
11	MALE	HSDG	I-II	116	118	121	115	125	122	120	120	120	08	75
12	MALE	HSDG	I-II	127	126	123	132	118	117	120	122	125	08	90
13	MALE	HSDG	I-II	130	137	135	136	137	136	133	134	134	08	96
14	MALE	HSDG	I-II	122	117	116	123	110	109	114	115	119	08	82
15	MALE	HSDG	I-II	128	127	131	129	129	125	123	126	129	08	93
16	MALE	HSDG	I-II	127	133	131	132	132	132	130	131	131	08	92
17	MALE	HSDG	I-II	121	119	120	123	117	116	117	117	121	08	81
18	MALE	HSDG	I-II	114	127	117	119	122	129	127	126	119	08	73
19	MALE	HSDG	I-II	126	133	125	134	124	127	128	129	127	08	89
20	MALE	HSDG	I-II	120	125	118	123	118	121	122	123	120	08	79
21	MALE	HSDG	I-II	120	129	125	123	129	131	129	129	125	08	81
22	MALE	HSDG	IIIA	108	111	112	111	114	112	111	111	113	08	59
23	MALE	HSDG	IIIA	105	95	95	100	89	90	96	95	97	08	54
24	MALE	HSDG	IIIA	107	122	113	114	118	124	121	120	114	08	59
25	MALE	HSDG	IIIA	104	93	101	98	100	95	98	96	103	08	55
26	MALE	HSDG	IIIA	106	105	99	109	94	100	104	102	101	08	56
27	MALE	HSDG	IIIA	102	101	97	99	98	101	106	103	101	08	54
28	MALE	HSDG	IIIA	106	100	107	102	106	102	102	102	106	08	57
29	MALE	HSDG	IIIA	105	107	103	104	105	107	109	108	106	08	56
30	MALE	HSDG	IIIA	104	109	107	102	113	114	113	112	109	08	55
31	MALE	HSDG	IIIA	109	110	106	115	103	106	107	105	107	08	58
32	MALE	HSDG	IIIA	104	114	100	107	103	112	115	113	104	08	55
33	MALE	HSDG	IIIA	103	113	108	104	116	120	119	117	112	08	56
34	MALE	HSDG	IIIA	106	119	107	112	110	118	117	116	109	08	57
35	MALE	HSDG	IIIB	93	83	87	88	86	85	88	85	89	08	36
36	MALE	HSDG	IIIB	99	105	96	107	93	100	100	98	97	08	41
37	MALE	HSDG	IIIB	95	105	104	96	112	114	109	106	105	08	41
38	MALE	HSDG	IIIB	98	117	106	106	114	122	117	114	107	08	44
39	MALE	HSDG	IIIB	94	93	99	92	102	99	97	95	98	08	39
40	MALE	HSDG	IIIB	93	94	85	96	83	90	95	91	89	08	36
41	MALE	HSDG	IIIB	98	114	101	106	106	115	112	110	103	08	42
42	MALE	HSDG	IIIB	98	94	95	100	92	92	93	91	96	08	40
43	MALE	HSDG	IIIB	92	90	90	90	91	92	94	91	91	08	36
44	MALE	HSDG	IIIB	98	104	101	100	105	105	103	103	101	08	42
45	MALE	HSDG	IIIB	91	102	92	93	99	106	106	102	95	08	36
46	MALE	HSDG	IIIB	95	108	96	99	102	111	110	107	99	08	39
47	MALE	HSDG	IIIB	94	98	91	95	94	99	101	98	95	08	38
48	MALE	HSDG	IV	90	103	91	99	94	104	101	97	91	08	28
49	MALE	HSDG	IV	88	89	89	91	90	91	90	86	88	08	28
50	MALE	HSDG	IV	87	105	94	95	104	113	108	103	96	08	28
51	MALE	HSDG	IV	88	88	81	91	79	85	88	84	84	08	28
52	MALE	HSDG	IV	86	95	87	89	93	98	98	94	90	08	28
53	MALE	HSS	I-II	114	101	106	109	99	96	102	103	107	08	70
54	MALE	HSS	I-II	122	116	118	123	111	109	113	114	119	08	81
55	MALE	HSS	I-II	116	108	113	114	108	105	108	109	114	08	73
56	MALE	HSS	I-II	127	128	130	129	130	128	126	128	130	08	89

SUPPLY GROUPS
BASED ON APTITUDE AREA CLUSTERING

SUP GRP	GNDR	EDUC LVL	AFQT CAT	CL	CO	EL	FA	GM	MM	OF	SC	ST	OK DEP DELAY	AVG AFQT SCORE
				-------AVERAGE AA SCORES-----------										
[illegible]	MALE	HSS	I-II	120	116	123	119	122	117	116	118	122	08	80
58	MALE	HSS	I-II	114	114	114	113	115	115	116	116	116	08	71
59	MALE	HSS	I-II	121	123	122	124	121	122	122	123	123	08	80
60	MALE	HSS	IIIA	107	117	110	112	114	119	117	115	112	08	58
61	MALE	HSS	IIIA	106	96	101	102	96	94	98	97	102	08	55
62	MALE	HSS	IIIA	109	109	104	116	98	101	104	103	105	08	57
63	MALE	HSS	IIIA	107	100	108	106	106	101	102	101	109	08	57
64	MALE	HSS	IIIA	103	102	97	101	97	101	106	104	102	08	54
65	MALE	HSS	IIIA	107	108	110	108	112	111	110	109	111	08	57
66	MALE	HSS	IIIA	105	107	103	105	104	107	109	108	106	08	55
67	MALE	HSS	IIIB	97	110	103	103	108	114	110	107	104	08	42
68	MALE	HSS	IIIB	96	102	96	100	98	104	103	100	98	08	40
69	MALE	HSS	IIIB	95	93	92	96	91	93	95	91	94	08	38
70	MALE	HSS	IV	96	91	96	97	92	92	95	92	98	08	26
71	MALE	NHS	I-II	114	119	115	115	117	118	118	120	116	08	73
72	MALE	NHS	I-II	124	128	128	127	129	127	126	128	127	08	86
73	MALE	NHS	IIIA	104	101	101	101	100	101	103	104	102	08	55
74	MALE	NHS	IIIA	105	115	108	108	113	117	116	116	110	08	57
75	MALE	NHS	IIIB	95	100	95	96	98	102	101	100	97	08	40
76	MALE	NHS	IV	88	97	90	91	94	100	97	96	90	08	28
77	FEML	HSDG	I-II	115	95	104	107	97	89	97	97	106	08	71
78	FEML	HSDG	I-II	114	105	105	112	99	98	105	104	108	08	72
79	FEML	HSDG	I-II	124	120	122	126	117	114	117	118	123	08	88
80	FEML	HSDG	I-II	119	111	113	119	106	104	110	110	115	08	79
81	FEML	HSDG	IIIA	104	91	94	99	89	87	95	91	97	08	54
82	FEML	HSDG	IIIA	105	105	101	107	99	102	107	103	107	08	58
83	FEML	HSDG	IIIA	105	98	98	104	93	94	99	96	101	08	56
8[illegible]	FEML	HSDG	IIIA	108	104	101	112	94	97	101	98	103	08	58
8[illegible]	FEML	HSDG	IIIB	97	97	93	101	90	95	97	92	95	08	42
86	FEML	HSDG	IIIB	95	91	89	96	86	89	93	87	92	08	39
87	FEML	HSDG	IIIB	94	84	86	90	82	83	89	83	89	08	38
88	FEML	HSDG	IV	100	97	95	102	92	97	100	95	99	08	28
89	FEML	HSS	I-II	117	105	110	115	104	100	106	105	112	08	76
90	FEML	HSS	IIIA	106	97	99	105	94	93	98	95	101	08	56
91	FEML	HSS	IIIB	97	94	95	101	92	94	92	88	91	08	40

APPENDIX C: MOS CLUSTERS

MOS CLUSTERS
BASED ON APTITUDE AREA COMPOSITES

C__STER: 1 CUT SCORE: 85 TRAINING TYPE: AIT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
001	M/F	HSG/NHS	CL	76X		85	SUBSISTENCE SUPPLIER

CLUSTER: 2 CUT SCORE: 90 TRAINING TYPE: AIT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
002	M/F	HSG/NHS	CL	76P		90	MATERIAL CONTROL/ACCTING
003	M/F	HSG/NHS	CL	76V		90	MAT STORAGE/HANDLING
004	M/F	HSG/NHS	CL	77F	*	90	PETROLEUM SUP SPEC+OF90

CLUSTER: 3 CUT SCORE: 95 TRAINING TYPE: AIT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
005	M/F	HSG/NHS	CL	71G		95	PATIENT ADMIN SPEC
006	M/F	HSG/NHS	CL	71L		95	ADMINISTRATIVE SPEC
007	M/F	HSG/NHS	CL	71M		95	CHAPEL ACTIVITIES SPEC
008	M/F	HSG/NHS	CL	73C		95	FINANCE SPEC
009	M/F	HSG/NHS	CL	75B		95	PERSONNEL ADMIN SPEC
010	M/F	HSG/NHS	CL	75C		95	PERSONNEL MGMT SPEC
0	M/F	HSG/NHS	CL	75D		95	PERSONNEL RECORDS SPEC
012	M/F	HSG/NHS	CL	75E		95	PERSONNEL ACTIONS
013	M/F	HSG/NHS	CL	76C		95	EQUIPMENT REC/PARTS SPEC
014	M/F	HSG/NHS	CL	76J		95	MED SUPPLY SPEC
015	M/F	HSG/NHS	CL	76Y		95	UNIT SUPPLY SPEC
016	M/F	HSG/NHS	CL	92A	*	95	AUTO LOGISTICAL SPEC
017	M/F	HSG/NHS	CL	92Y	*	95	UNIT SUPPLY SPECIALIST

CLUSTER: 4 CUT SCORE: 100 TRAINING TYPE: AIT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
018	M/F	HSG/NHS	CL	88N	*	100	TRAFFIC MGMT COORD

CLUSTER: 5 CUT SCORE: 105 TRAINING TYPE: AIT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
019	M/F	HSG/NHS	CL	73D		105	ACCOUNTING SPECIALIST

MOS CLUSTERS
BASED ON APTITUDE AREA COMPOSITES

CLUSTER: 6 CUT SCORE: 110 TRAINING TYPE: AIT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
020	M/F	HSG/NHS	CL	46Q	*	110	JOURNALIST
021	M/F	HSG/NHS	CL	46R	*	110	BROADCAST JOURNALIST

CLUSTER: 7 CUT SCORE: 90 TRAINING TYPE: AIT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
022	M/F	HSG/NHS	SC	31K		90	COMBAT SIGNALER
023	M/F	HSG/NHS	SC	72E		90	TELECOM CTR OPER
024	M/F	HSG/NHS	SC	74C	*	90	REC TELCOM CTR REP+EL90

CLUSTER: 8 CUT SCORE: 95 TRAINING TYPE: AIT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
025	M/F	HSG/NHS	SC	96H		95	AERIAL SENSOR SPEC

CLUSTER: 9 CUT SCORE: 100 TRAINING TYPE: AIT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
026	M/F	HSG/NHS	SC	31C		100	SINGLE CHANNEL RADIO OPE
027	M/F	HSG/NHS	SC	31D	*	100	MSE TRSMSN SYS OPER+EL100

CLUSTER: 10 CUT SCORE: 90 TRAINING TYPE: AIT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
028	M/F	HSG/NHS	OF	88M	*	90	MOTOR TRANSPORT OPERATOR
029	M/F	HSG/NHS	OF	94B		90	FOOD SERVICE SPEC

CLUSTER: 11 CUT SCORE: 100 TRAINING TYPE: AIT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
030	M/F	HSG/NHS	OF	14D	*	100	HAWK MISSILE CREW
031	M/F	HSG/NHS	OF	14R	*	100	SIGHT FORWARD HVY CREW
032	M/F	HSG/NHS	OF	16D	*	100	HAWK MISSILE CREW
033	M/F	HSG/NHS	OF	16T	*	100	PATRIOT MISSILE CREW
034	M/F	HSG/NHS	OF	25L		100	AN/TSG 73 AIR DEF ART OP/REP
035	M/F	HSG/NHS	OF	91M	*	100	HOSP FOOD SVC SPECIALIST

MOS CLUSTERS
BASED ON APTITUDE AREA COMPOSITES

CLUSTER: 12 CUT SCORE: 85 TRAINING TYPE: AIT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
036	M/F	HSG/NHS	GM	43M		85	FABRIC REPAIR SPEC
037	M/F	HSG/NHS	GM	57E		85	LAUNDRY/BATH SPEC

CLUSTER: 13 CUT SCORE: 90 TRAINING TYPE: AIT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
038	M/F	HSG/NHS	GM	43E		90	PARACHUTE RIGGER
039	M/F	HSG/NHS	GM	44B		90	METAL WORKER
040	M/F	HSG/NHS	GM	45B		90	SMALL ARMS REPAIRER
041	M/F	HSG/NHS	GM	51B		90	CARPENTER/MASON
042	M/F	HSG/NHS	GM	51M		90	FIREFIGHTER
043	M/F	HSG/NHS	GM	57F		90	GRAVE REGISTRATION SPEC
044	M/F	HSG/NHS	GM	62E		90	HEAVY EQ OPERATOR
045	M/F	HSG/NHS	GM	62F		90	LIFT/LOAD EQ OPERATOR
046	M/F	HSG/NHS	GM	62H		90	CONCRETE EQ OPERATOR
047	M/F	HSG/NHS	GM	62J		90	GENERAL CONSTRUCTION
048	M/F	HSG/NHS	GM	77W	*	90	WATER TREATMT SPECIALIST
049	M/F	HSG/NHS	GM	88H	*	90	CARGO SPECIALIST

CLUSTER: 14 CUT SCORE: 95 TRAINING TYPE: AIT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
050	M/F	HSG/NHS	GM	41C		95	FIRE CONTROL INS REP
051	M/F	HSG/NHS	GM	55B		95	AMMO SPECIALIST
052	M/F	HSG/NHS	GM	62G		95	QUARRYING SPECIALIST

CLUSTER: 15 CUT SCORE: 100 TRAINING TYPE: AIT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
053	M/F	HSG/NHS	GM	42C		100	ORTHOTIC SPECIALIST
054	M/F	HSG/NHS	GM	42D		100	DENTAL LAB SPEC
055	M/F	HSG/NHS	GM	42E		100	OPTICAL LAB SPEC
056	M/F	HSG/NHS	GM	44E		100	MACHINIST
057	M/F	HSG/NHS	GM	45K		100	TANK TURRET REPAIRER
058	M/F	HSG/NHS	GM	45L		100	ARTILLERY REPAIRER
059	M/F	HSG/NHS	GM	51G		100	MATERIALS QUALITY SPEC
060	M/F	HSG/NHS	GM	52C		100	UTILITIES EQ REP
061	M/F	HSG/NHS	GM	52D		100	GENERATOR EQ REOR
062	M/F	HSG/NHS	GM	52F		100	TURBINE ENG GEN REP

MOS CLUSTERS
BASED ON APTITUDE AREA COMPOSITES

CLUSTER: 16 CUT SCORE: 105 TRAINING TYPE: AIT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
063	M/F	HSG/NHS	GM	55D		105	EXPL ORD DISPOSAL

CLUSTER: 17 CUT SCORE: 90 TRAINING TYPE: AIT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
064	M/F	HSG/NHS	MM	62B		90	CONSTRUCTION EQ REP
065	M/F	HSG/NHS	MM	63H		90	TRACK VEHICLE REPAIR
066	M/F	HSG/NHS	MM	63J		90	QUARTERMASTER REPR
067	M/F	HSG/NHS	MM	63W		90	WHEEL VEH REPAIR

CLUSTER: 18 CUT SCORE: 100 TRAINING TYPE: AIT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
068	M/F	HSG/NHS	MM	68J		100	AIRCRAFT FIRE CONTROL
069	M/F	HSG/NHS	MM	88K	*	100	WATERCRAFT OPERATOR

CLUSTER: 19 CUT SCORE: 105 TRAINING TYPE: AIT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
070	M/F	HSG/NHS	MM	24T		105	PATRIOT SYSTEM MECHANIC
071	M/F	HSG/NHS	MM	63G		105	FUEL SYSTEMS REPAIR
072	M/F	HSG/NHS	MM	63S		105	HEAVY WHEEL MECHANIC
073	M/F	HSG/NHS	MM	63Y		105	TRACK VEH MECHANIC
074	M/F	HSG/NHS	MM	67A	*	105	GENERAL AIRCRAFT REPAIR
075	M/F	HSG/NHS	MM	67H		105	OBSERV PLANE REPAIR
076	M/F	HSG/NHS	MM	67N		105	UTIL CHOPPER REPAIR
077	M/F	HSG/NHS	MM	67R		105	AH-64 ATTACK HELICOPTER
078	M/F	HSG/NHS	MM	67S		105	SCOUT HELICOPTER REP
079	M/F	HSG/NHS	MM	67T		105	TRANSPORT CHOPPER REPAIR
080	M/F	HSG/NHS	MM	67U		105	MEDIUM CHOPPER REPAIR
081	M/F	HSG/NHS	MM	67V	*	105	OBSV/SCOUT HELO REP
082	M/F	HSG/NHS	MM	67Y		105	ATTACK COPTER REP
083	M/F	HSG/NHS	MM	68B		105	AIRCRAFT P-PLANT REP
084	M/F	HSG/NHS	MM	68D		105	AIRCRAFT P-TRAIN REP
085	M/F	HSG/NHS	MM	68F		105	AIRCRAFT ELECTRICIAN
086	M/F	HSG/NHS	MM	68G		105	AIRCRAFT STRUCT REP
087	M/F	HSG/NHS	MM	68H		105	PNEUDRAULICS REPAIR
088	M/F	HSG/NHS	MM	88L	*	105	WATERCRAFT ENGINEER

MOS CLUSTERS
BASED ON APTITUDE AREA COMPOSITES

CLUSTER: 20 CUT SCORE: 85 TRAINING TYPE: AIT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
089	M/F	HSG/NHS	ST	25P	*	85	VISUAL/AUDIO DOC SYS SP
090	M/F	HSG/NHS	ST	81C		85	CARTOGRAPHER
091	M/F	HSG/NHS	ST	83E		85	PHOTO LAYOUT SPEC
092	M/F	HSG/NHS	ST	83F		85	PHOTOLITHOGRAPHER

CLUSTER: 21 CUT SCORE: 95 TRAINING TYPE: AIT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
093	M/F	HSG/NHS	ST	25Q	*	95	GRAPHICS DOC SPECIALIST
094	M/F	HSG/NHS	ST	25S	*	95	STILL DOCUMENTATION SPE
095	M/F	HSG/NHS	ST	77L	*	95	PETROLEUM LAB SPEC
096	M/F	HSG/NHS	ST	81B		95	TECH DRAFTING SPEC
097	M/F	HSG/NHS	ST	82B		95	CONSTRUCTION SURVEYOR
098	M/F	HSG/NHS	ST	82D		95	TOPOGRAPHIC SURVEYOR
099	M/F	HSG/NHS	ST	91A		95	MEDICAL SPECIALIST
100	M/F	HSG/NHS	ST	91B	*	95	MEDICAL SPECIALIST
101	M/F	HSG/NHS	ST	91D		95	OPERATING ROOM SPEC
102	M/F	HSG/NHS	ST	91E		95	DENTAL SPECIALIST
103	M/F	HSG/NHS	ST	91F		95	PSYCHIATRIC SPECIALIST
1[illegible]	M/F	HSG/NHS	ST	91H		95	ORTHOPEDIC SPECIALIST
1[illegible]	M/F	HSG/NHS	ST	91J		95	PHYSICAL THERAPY SPEC
106	M/F	HSG/NHS	ST	91L		95	OCCUPATIONAL THERAPY SPE
107	M/F	HSG/NHS	ST	91N		95	CARDIAC SPECIALIST
108	M/F	HSG/NHS	ST	91Q		95	PHARMACY SPECIALIST
109	M/F	HSG/NHS	ST	91S		95	ENVIR HEALTH SPEC
110	M/F	HSG/NHS	ST	91T		95	ANIMAL CARE SPEC
111	M/F	HSG/NHS	ST	91U		95	ENT SPECIALIST
112	M/F	HSG/NHS	ST	91Y		95	EYE SPECIALIST
113	M/F	HSG/NHS	ST	92B		95	MEDICAL LAB SPEC
114	M/F	HSG/NHS	ST	93P		95	FLIGHT OPER COORD
115	M/F	HSG/NHS	ST	96D		95	IMAGE INTERCEPTER
116	M/F	HSG/NHS	ST	97G		95	SIGNAL SECURITY SPEC
117	M/F	HSG/NHS	ST	98D	*	95	EMITTER LOC/IDENTIFIER
118	M/F	HSG/NHS	ST	98G		95	EW/SIGINT VOICE INTERCEP
119	M/F	HSG/NHS	ST	98H	*	95	MORSE INTERCEPTOR
120	M/F	HSG/NHS	ST	98K	*	95	NONMORSE INTERCEPT OPER
121	M/F	HSG/NHS	ST	98X	*	95	EW/SIGINT SPEC (LING)

MOS CLUSTERS
BASED ON APTITUDE AREA COMPOSITES

CLUSTER: 22 CUT SCORE: 100 TRAINING TYPE: AIT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
122	M/F	HSG/NHS	ST	74D		100	COMPUTER/MACHINE OPR
123	M/F	HSG/NHS	ST	74F		100	PROGRAMMER/ANALYST
124	M/F	HSG/NHS	ST	91P		100	X-RAY SPECIALIST
125	M/F	HSG/NHS	ST	91R		100	VETERINARY FOOD INSP
126	M/F	HSG/NHS	ST	93C	*	100	AIR TRAFFIC CONTROL OPER

CLUSTER: 23 CUT SCORE: 105 TRAINING TYPE: AIT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
127	M/F	HSG/NHS	ST	37F	*	105	PSYCHOLOGICAL OPS SPEC
128	M/F	HSG/NHS	ST	71C	*	105	EXEC ADMIN ASST
129	M/F	HSG/NHS	ST	93B	*	105	AEROSCOUT OBSERVER
130	M/F	HSG/NHS	ST	96F		105	PSYCHOLOGICAL OPS SPEC
131	M/F	HSG/NHS	ST	98C		105	EW/SIGINT ANALYST
132	M/F	HSG/NHS	ST	98J		105	NONCOMM INTERCEPTER

CLUSTER: 24 CUT SCORE: 115 TRAINING TYPE: AIT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
133	M/F	HSG/NHS	ST	33P		115	EW/I STRAT REC SUBSYS REP
134	M/F	HSG/NHS	ST	33Q		115	EW/I PROCESS STORAGE EQU
135	M/F	HSG/NHS	ST	33R		115	EW/I INTERCEPT AVN SYS RP
136	M/F	HSG/NHS	ST	33T		115	EW/I TAC SYS REP
137	M/F	HSG/NHS	ST	33Y	*	115	STRATEGIC SYSTEM REPAIT

CLUSTER: 25 CUT SCORE: 90 TRAINING TYPE: AIT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
138	M/F	HSG/NHS	EL	31L	*	90	WIRE SYSTEMS INSTALLER

MOS CLUSTERS
BASED ON APTITUDE AREA COMPOSITES

CLUSTER: 26 CUT SCORE: 95 TRAINING TYPE: AIT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
139	M/F	HSG/NHS	EL	27B		95	LAND COMBAT SUPPORT SYST
140	M/F	HSG/NHS	EL	27E		95	TOW/DRAGON REPAIRER
141	M/F	HSG/NHS	EL	27G		95	CHAPARRAL/REDEYE REPAIRER
142	M/F	HSG/NHS	EL	27H	*	95	HAWK FIRING SECTION REPAIR
143	M/F	HSG/NHS	EL	27L		95	LANCE SYSTEM REPAIRER
144	M/F	HSG/NHS	EL	27M		95	MLRS REPAIRER
145	M/F	HSG/NHS	EL	31M		95	MULTICHANNEL COMMUNICA OP
146	M/F	HSG/NHS	EL	31N		95	TACTICAL CIRCUIT CONTROLLR
147	M/F	HSG/NHS	EL	31Q	*	95	TACTICAL SAT/MICRO SYS OPER
148	M/F	HSG/NHS	EL	31U	*	95	SIG SUPT SYS SPEC+SC95
149	M/F	HSG/NHS	EL	31V		95	TACTICAL COMMUNICATIONS
150	M/F	HSG/NHS	EL	35K		95	AVIONIC MECHANIC
151	M/F	HSG/NHS	EL	45G		95	CONTROL SYSTEMS REP
152	M/F	HSG/NHS	EL	68N	*	95	AVIONIC MECHANIC
153	M/F	HSG/NHS	EL	93F		95	FLD ARTILLERY METEO CREW

CLUSTER: 27 CUT SCORE: 100 TRAINING TYPE: AIT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
154	M/F	HSG/NHS	EL	27F		100	VULCAN REPAIRER
1	M/F	HSG/NHS	EL	27T	*	100	AVENGER SYSTEM REPAIR
156	M/F	HSG/NHS	EL	29M		100	TACT SATEL/MICROWAVE REP
157	M/F	HSG/NHS	EL	35R		100	AVIONIC SPECIAL EQUIPMENT RE
158	M/F	HSG/NHS	EL	36M		100	WIRE SYSTEMS OPERATOR
159	M/F	HSG/NHS	EL	55G		100	NUCLEAR WEAP MAINT SPEC
160	M/F	HSG/NHS	EL	68L	*	100	AVIONIC COMM EQ REPAIR
161	M/F	HSG/NHS	EL	68Q	*	100	AVIONIC FLIGHT SYS REPAIR
162	M/F	HSG/NHS	EL	68R	*	100	AVIONIC RADAR REPAIR
163	M/F	HSG/NHS	EL	68X	*	100	AH-64 ARMT/ELEC SYS RE

CLUSTER: 28 CUT SCORE: 105 TRAINING TYPE: AIT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
164	M/F	HSG/NHS	EL	29S	*	105	COMSEC EQUIPMENT REPAIR
165	M/F	HSG/NHS	EL	31F	*	105	MSE NETWORK SWITCH OPR
166	M/F	HSG/NHS	EL	32D		105	STATION TECHNICAL CONTRO
167	M/F	HSG/NHS	EL	39E	*	105	SPEC ELECTRONIC DEVICE REP
168	M/F	HSG/NHS	EL	93D		105	AIR TRAFFIC SYSTEMS REP

MOS CLUSTERS
BASED ON APTITUDE AREA COMPOSITES

C__STER: 29 CUT SCORE: 110 TRAINING TYPE: AIT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
169	M/F	HSG/NHS	EL	23R	*	110	HAWK MISSILE SYS MECHANIC
170	M/F	HSG/NHS	EL	24C		110	IMPROVED HAWK FIRING SEC MEC
171	M/F	HSG/NHS	EL	24G		110	IMPROVED HAWK INFORMATIO MEC
172	M/F	HSG/NHS	EL	24H		110	IMPROVED HAWK FIRE CONTR REP
173	M/F	HSG/NHS	EL	24K		110	IMPROVED HAWK CONT WAVE REP
174	M/F	HSG/NHS	EL	25R	*	110	VISUAL INFO/AUDIO EQ REP
175	M/F	HSG/NHS	EL	27J	*	110	HAWK EQ/PULSE RADAR REP
176	M/F	HSG/NHS	EL	27K	*	110	HAWK FIRE CTL/CNTS RADAR REP
177	M/F	HSG/NHS	EL	27N		110	FORWARD AREA ALERTING RAD RE
178	M/F	HSG/NHS	EL	29E		110	COMMUNICAT-ELECT RADIO REP
179	M/F	HSG/NHS	EL	29J		110	TELETYPEWRITER EQ REP
180	M/F	HSG/NHS	EL	29V		110	START MICROWAVE SYS REP
181	M/F	HSG/NHS	EL	35G		110	BIOMEDICAL EQUIPMENT SPE
182	M/F	HSG/NHS	EL	35Y	*	110	INTEGR FAM TEST EQ OP/MAINT
183	M/F	HSG/NHS	EL	36L		110	ELECTRONIC SWITCHING REP
184	M/F	HSG/NHS	EL	39B		110	AUTOMATIC TEST EQUIP OP
185	M/F	HSG/NHS	EL	39D	*	110	DEC AUTO SER SUP SYS CMP REP
186	M/F	HSG/NHS	EL	39G	*	110	AUTO COMMO CMPTR SYS REP
187	M/F	HSG/NHS	EL	39L	*	110	FLD ARTLRY DIG SYS REP
188	M/F	HSG/NHS	EL	39Y	*	110	FLD ARTLRY FIRE DIR SYS REP

CLUSTER: 30 CUT SCORE: 115 TRAINING TYPE: AIT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
189	M/F	HSG/NHS	EL	39C	*	115	TARGET ACQ/SURV RADAR REP

CLUSTER: 31 CUT SCORE: 120 TRAINING TYPE: AIT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
190	M/F	HSG/NHS	EL	29Y	*	120	SAT COM SYS REPAIR
191	M/F	HSG/NHS	EL	35H		120	CALIBRATION SPECIALIST

CLUSTER: 32 CUT SCORE: 105 TRAINING TYPE: AIT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
192	M/F	HSG	CL	75F		105	PERS INFOSYS MGMT SPEC

MOS CLUSTERS
BASED ON APTITUDE AREA COMPOSITES

CLUSTER: 33 CUT SCORE: 110 TRAINING TYPE: AIT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
193	M/F	HSG	CL	71D		110	LEGAL CLERK

CLUSTER: 34 CUT SCORE: 95 TRAINING TYPE: AIT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
194	M/F	HSG	ST	97E		95	INTERROGATOR

CLUSTER: 35 CUT SCORE: 100 TRAINING TYPE: AIT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
195	M/F	HSG	ST	38A	*	100	CIVIL AFFAIRS SPECIALIST
196	M/F	HSG	ST	55R		100	AMMO STOCK CONTROL & ACC SP
197	M/F	HSG	ST	81Q		100	TERRAIN ANALYST

CLUSTER: 36 CUT SCORE: 105 TRAINING TYPE: AIT

S	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
198	M/F	HSG	ST	91G		105	BEHAVIORAL SCIENCE SPEC
199	M/F	HSG	ST	96B		105	INTELLIGENCE ANALYST

CLUSTER: 37 CUT SCORE: 100 TRAINING TYPE: AIT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
200	M/F	HSG	EL	29N		100	TELEPHONE CENTRAL OFF REP

CLUSTER: 38 CUT SCORE: 100 TRAINING TYPE: AIT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
201	M	HSG/NHS	SC	13R		100	FIELD ARTILLERY FIREFIND OP

MOS CLUSTERS
BASED ON APTITUDE AREA COMPOSITES

CLUSTER: 39 — CUT SCORE: 100 — TRAINING TYPE: AIT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
202	M	HSG/NHS	FA	13F		100	FIRE SUPPORT SPECIALIST
203	M	HSG/NHS	FA	13P	*	100	MLRS/LANCE FIRE DIR SPEC

CLUSTER: 40 — CUT SCORE: 90 — TRAINING TYPE: AIT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
204	M	HSG/NHS	OF	14S	*	90	AVENGER CREWMEMBER
205	M	HSG/NHS	OF	16S		90	MANPADS CREWMAN

CLUSTER: 41 — CUT SCORE: 100 — TRAINING TYPE: AIT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
206	M	HSG/NHS	OF	14J	*	100	EW SYS OPER ALERTING RADAR
207	M	HSG/NHS	OF	16J		100	DEFENSE ACQUISITION RADA
208	M	HSG/NHS	OF	16P		100	ADA SHORT RANGE MISSILE
209	M	HSG/NHS	OF	16R		100	ADA SHORT RANGE GUNNERY
210	M	HSG/NHS	OF	16X		100	AIR CREWMEMBER

CLUSTER: 42 — CUT SCORE: 105 — TRAINING TYPE: AIT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
211	M	HSG/NHS	OF	13M		105	MULTIPLE LAUNCH ROCKET S

CLUSTER: 43 — CUT SCORE: 90 — TRAINING TYPE: AIT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
212	M	HSG/NHS	GM	51K		90	PLUMBER

CLUSTER: 44 — CUT SCORE: 95 — TRAINING TYPE: AIT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
213	M	HSG/NHS	GM	45T		95	M2/BRADLEY FV MECH

MOS CLUSTERS
BASED ON APTITUDE AREA COMPOSITES

CLUSTER: 45 CUT SCORE: 100 TRAINING TYPE: AIT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
214	M	HSG/NHS	GM	45D		100	FIELDART TURRET MECH

CLUSTER: 46 CUT SCORE: 100 TRAINING TYPE: AIT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
215	M	HSG/NHS	MM	45E		100	TANK TURRET MECHANIC
216	M	HSG/NHS	MM	45N		100	M60A1 TANK TUR MECH
217	M	HSG/NHS	MM	63E		100	ABRAMS TANK MECH
218	M	HSG/NHS	MM	63N		100	M6 TANK SYS MECH

CLUSTER: 47 CUT SCORE: 105 TRAINING TYPE: AIT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
219	M	HSG/NHS	MM	63D		105	FIELD ART SYS MECH
220	M	HSG/NHS	MM	63T		105	ITV/IFV/CFV MECH

CLUSTER: 48 CUT SCORE: 95 TRAINING TYPE: AIT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
221	M	HSG/NHS	ST	13C		95	TACFIRE OPERATIONS SPECI
222	M	HSG/NHS	ST	13E		95	CANNON FIRE DIRECTION SP
223	M	HSG/NHS	ST	82C		95	FLD ARTILLERY SURVEYOR

CLUSTER: 49 CUT SCORE: 85 TRAINING TYPE: AIT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
224	M	HSG/NHS	EL	96R		85	GROUND SURVEILLANCE RADA

CLUSTER: 50 CUT SCORE: 95 TRAINING TYPE: AIT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
225	M	HSG/NHS	EL	51R		95	INTERIOR ELECTRICIAN

MOS CLUSTERS
BASED ON APTITUDE AREA COMPOSITES

CLUSTER: 51 CUT SCORE: 110 TRAINING TYPE: AIT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
226	M	HSG/NHS	EL	24M		110	VULCAN SYSTEM MECHANIC
227	M	HSG/NHS	EL	24N		110	CHAPARRAL SYSTEM MECHANIC

CLUSTER: 52 CUT SCORE: 105 TRAINING TYPE: AIT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
228	M	HSG/NHS	ST	97B	*	105	COUNTERINTELL ASST

CLUSTER: 53 CUT SCORE: 110 TRAINING TYPE: AIT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
229	M	HSG/NHS	ST	33V	*	110	EW/INTCPT AER SYS REP

CLUSTER: 54 CUT SCORE: 100 TRAINING TYPE: OSUT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
2[illegible]	M/F	HSG/NHS	ST	95B		100	MILITARY POLICE
231	M/F	HSG/NHS	ST	95C	*	100	CORRECTIONS SPECIALIST

CLUSTER: 55 CUT SCORE: 95 TRAINING TYPE: OSUT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
232	M/F	HSG/NHS	ST	54B	*	95	CHEMICAL OPER SPECIALIST

CLUSTER: 56 CUT SCORE: 85 TRAINING TYPE: OSUT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
233	M	HSG/NHS	FA	13B		85	CANNON CREWMAN

MOS CLUSTERS
BASED ON APTITUDE AREA COMPOSITES

C. ,STER: 57 CUT SCORE: 90 TRAINING TYPE: OSUT

SEQ	GNDR	EDUCLVL	AA	MOS	NEW	SCORE	JOB TITLE
234	M	HSG/NHS	CO	11X		90	INFANTRY (ACTIVE ARMY)
235	M	HSG/NHS	CO	12B		90	COMBAT ENGINEER AIRBORNE
236	M	HSG/NHS	CO	12C		90	BRIDGE CREWMAN
237	M	HSG/NHS	CO	12F		90	ENGINEER TRACKED VEHICLE
238	M	HSG/NHS	CO	19D		90	CAVALRY SCOUT
239	M	HSG/NHS	CO	19E		90	M48-M60 ARMOR CREWMAN
240	M	HSG/NHS	CO	19K		90	ARMOR SPECIALIST