Navy Personnel Research, Studies, and Technology Department
Navy Personnel Command (NPRST/PERS-1)
Millington, TN 38055-1000 NPRST-TN-02-6 September 2002

Assignment Policy Management System (APMS), A Decision [illegible]

Tony Benson

NPRST-TN-02-6 September 2002

Assignment Policy Management System (APMS): A Decision Support Tool for Application in the Distribution and Assignment Department in the Navy Personnel Command

Tony Benson

Reviewed and Approved by
Dr. Janet Spoonamore
Institute for Distribution and Assignment

Released by
Murray W. Rowe
Director

Navy Personnel Research, Studies, and Technology
5720 Integrity Drive
Millington, Tennessee 38055-1200

REPORT DOCUMENTATION PAGE		*Form Approved* *OMB No. 0704-0188*
Public reporting burden for this collection of information is limited to average 1 hour per response, including the time for reviewing instructions, seArching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of infonnation. Send comments regarding the burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.		
1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE 30 Sep 02	3. REPORT TYPE AND DATE COVERED Technical Note
4. TITLE AND SUBTITLE Assignment Policy Management System (APMS), A Decision Support Tool for Application in the Distribution and Assignment Department in the Navy Personnel Command		5. FUNDING NUMBERS Job Order:
6. AUTHOR(S) Tony Benson		
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Navy Personnel Research, Studies, and Technology Navy Personnel Command 5720 Integrity Drive Millington, Tennessee 38055-1000		8. PERFORMING ORGANIZATION AGENCY REPORT NUMBER NPRST-TN-02-6
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)		10. SPONSORING/MONITORING
11. SUPPLEMENTARY NOTES		
12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution is unlimited.		12B. DISTRIBUTION CODE A

13. ABSTRACT *(Maximum 200 words)*

A decision support model was developed to assist Enlisted Detailers in making informed decisions when assigning personnel to jobs in the assignment distribution process within the Enlisted Assignment Division, PERS-40 at the Navy Personnel Command. A large-scale optimization model with trade-off analysis is used to integrate assignment policies and goals, allocation policies and person/job eligibility criteria. The model provides an automated means for detailers to determine the maximum assignment possibilities to find the optimal solution set for a group of personnel and jobs.

14. SUBJECT TERMS			15. NUMBER OF PAGES
Decision support models, personnel assignment, distribution, assignment			24
			16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT UNLIMITED

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. Z39-18
298-102

Foreword

This report was prepared as part of the Modeling and Information Advances for Enlisted management project under Program Element 0604703N (Personnel, Training, Simulation & Human Factors), Project Work Unit L1822, Task Assignment Policy Management System (APMS). The objective of the work unit was to develop a prototype decision support tool to assist Enlisted Detailers and managers in the execution of the personnel assignment process and management of assignment policies and goals.

This report contains an overview of the development of the Assignment Policy Management System as well as a technical description of the system's architecture and methodology.

MURRAY W. ROWE
Director

Executive Summary

Problem

The enlisted detailing process is an important and complex element of the distribution and assignment function in the Navy. There has been considerable research to develop tools to assist Detailers in the assignment process, but many of these tools have faltered in getting to the production phase of development to become operational tools that can be utilized by Detailers. The purpose of the enlisted detailing process is to match the right person with the correct skills to the right available job. There are other factors that must be considered in this process. For instance, Detailers must manage myriad policies such as permanent change of station cost and Navy Enlisted Classification skill reutilization along with over 40 other policies.

In the current detailing process, assigning personnel to jobs takes place as a one-dimensional process. In this process, Detailers are limited in considering assignment possibilities for individuals seeking their next assignment. The major reason for this is the assignment consideration process on the part of the detailer is manual. Detailers have to review the Enlisted Transfer Manual for eligibility requirements and job requirements, manage policies and goals, all while considering the career needs of the individual. When dealing with multiple individuals and jobs, the assignment process can become quite a burden on the detailer to effectively execute the detailing process. Some Detailers are negotiating as many as 700 assignments in any given Projected Rotation Date (PRD) (9 month) window. This research was undertaken to develop a more efficient method for Detailers in the execution of the assignment process.

Objective

The objective of this effort was to develop a prototype decision support model, which would assist enlisted Detailers in the effective execution of the assignment process. Such a tool could help Detailers make better assignment decisions and at the same time assist in the management of assignment policies and goals.

Approach

Intelligent, graphical user interfaces, expert systems, optimization and relational database design techniques were used in the model development. Policies and goals were quantified to develop measures of effectiveness so that the process of managing policies and goals could be automated. Linear programming techniques were utilized to develop a model to optimize the assignment of personnel to jobs based on the measures of effectiveness. Eligibility assignment rules were automated to determine the eligibility of individuals for jobs.

Results

The research and development of a decision support system to support the Enlisted assignment process was completed in September 2002. The effort yielded the Assignment

Policy Management System (APMS). The system has been tested by Enlisted Detailers at the Navy Personnel Command within the PERS-40 division.

Conclusion

This research demonstrated the importance of a decision support tool to assist in the assignment process. Further, test results show that a tool such as APMS can enhance the Enlisted Detailers' ability to effectively execute the detailing assignment process and improve policy management.

Recommendation

The APMS model prototype should be transitioned from a research and development tool to an operational system by the Information Technology Center in New Orleans, LA to assist the detailing community in meeting many of its new detailing initiatives.

Contents

List of Figures

List of Tables

Introduction

Problem

This report describes efforts to develop a decision support model to assist Enlisted Detailers (PERS-40) in Navy Personnel Command (NPC) with execution of the enlisted assignment process. Enlisted Detailers in NPC are responsible for ensuring that approximately 300,000 Navy personnel are assigned to the right job on time with the right skills. In today's distribution and assignment environment, the detailing process is often referred to as a manual, one-dimensional, or sequential process. Detailers make over 110,000 assignments per year for enlisted personnel and of those, 55,000 people need technical training in order to meet job requirements. In this approach to assigning personnel, Detailers can only deal with a limited number of assignment alternatives at one time. To compound the matter, Detailers must also consider Sailor job preference and a number of policies, (i.e., permanent change station (PCS), fleet balance, billet gap) when assigning personnel to jobs. Often times, Detailers find that there are mismatched assignments (e.g., NEC, gap), PCS cost over-estimates and not all assignment possibilities are identified.

In the past, a number of different methods have been developed to address the assignment of Navy enlisted personnel. None of these methods was able to make it to the life cycle management phase of development. One of the main reasons for this was that technology had not advanced enough to handle the mathematical computations for optimization of large assignment sets (e.g., people, jobs). This led to the demise of previous models that addressed the distribution assignment problem. Detailers continued to rely on pencil and paper to determine whether an individual sailor was qualified for a job while having to adhere to a number of policies established by distribution managers. Detailing in today's environment is often described as a one-dimensional approach to assigning personnel to jobs. In this process, Detailers can only deal with one sailor at a time and cannot possibly determine the many possible assignment permutations when dealing with multiple Sailors and jobs. According to Liang and Thompson, 1986, there are over a million possible matches with only 7 persons and 11 jobs. It is humanly impossible for one to consider all the possible matches when dealing with such numbers.

There are many forces at work in the distribution and assignment community. For example, changes in PCS costs could have far-reaching impact on the sea/shore rotation that in turn can have a positive (or negative) effect on fleet balance, which impacts Job Advertisement Selection System (JASS) preference and Navy Enlisted Classification (NEC) reutilization. A detailer's ability to counter negative PCS cost policy is directly related to his/her ability to justify the necessity for meeting JASS preferences.

Detailers must be able to accurately assess the assignments of enlisted personnel under alternative policy scenarios. The Assignment Policy Management System (APMS) is a decision support model that was designed to assist Detailers in multi-dimensional (batch) execution of the assignment process and management of distribution policies. Multi-dimensional detailing gives Detailers the capability to consider a number of assignment scenarios while utilizing a variety of policies to manage the assignment process.

Background

In the late 1980s and early 1990s, research and development tools like the Enlisted Personnel Allocation and Nomination System (EPANS) (Buclatin, Liang & Thompson, 1988) and Computer Enhanced Detailing and Distribution (CEDAD) were prototyped for the enlisted assignment process in an effort to provide decision support for the Detailers. As mainframe applications, these products were unable to adapt to the many differing detailing requirements throughout PERS-40. They proved to be labor-intensive programs, which often generated unrealistic goals and recommendations for the individual Detailers.

With the recent advancement of personal computer technologies and their integration into the detailing process, a decision support tool capable of achieving the required flexibility and speed to effectively enhance the assignment decision-making process became more feasible. The Navy Personnel Research and Development Center (NPRDC), currently the Navy Personnel Research, Studies, and Technology (NPRST) Department, PERS-1 at NPC, conceived APMS as such a tool.

Initially, APMS was designed as a potential tool that would provide enlisted assignment managers, namely Branch Heads and Rating Assignment Officers (RAOs), with the capability to assess the tradeoffs among conflicting assignment policies. For example, when attempting to minimize permanent change of station (PCS) costs while maximizing Navy Enlisted Classification (NEC) code reutilization, managers would be unable to determine the optimal compromise without the necessary tool. In APMS, the primary detailing policies would be quantified and converted into Measures of Effectiveness (MOE) and then optimized for a particular data set. The program would provide users with minimum and maximum obtainable values with the optimal value for each of the measures as it related to the detailing group. Managers would have more realistic and obtainable detailing goals when executing the assignment process.

NPC quickly realized that they also needed a decision support tool which helped managers and Detailers achieve and monitor these optimal detailing goals. Over the next two years, APMS evolved into a management and detailing tool capable of implementing a multi-dimensional approach to the execution of the enlisted assignment process. In 1995 and 1996, beta versions 1.x through 3.x were installed and used in the detailing groups represented by PERS-401 through PERS-408. Enlisted Assignment Managers and Detailers provided feedback and development guidance to NPRDC, helping to make APMS a more user-friendly and effective tool.

During this period, the Model became a tool that could be used by managers to analyze policy tradeoffs and set specific targets for a particular group of assignments. These targets were realistic because they were based on the current Sailors scheduled for re-assignment and current requisition requirements. The targets were also unique because they were tailored to each user's goals and requirements. Since each detailing branch's requirements and objectives are different, the Model was designed to allow managers the ability to set customized targets based on the MOEs that maximized the group's objective. For example, PERS-406, a highly technical branch, could maximize NEC reutilization while minimizing PCS costs. At the same time, PERS-405 could minimize PCS costs and on-time arrival.

Detailers could view the slate of assignments created by their manager's targets and compare the optimal assignment to all feasible alternatives. This process was very different from the existing detailing process because Detailers were finally able to understand the global impacts of each decision. When considering each alternative assignment for a sailor, Detailers could view the impact of each decision against the entire group of assignments. The decisions were no longer one-dimensional and each assignment decision was made in an effort to obtain the overall detailing goals.

Also during this period, an executive summary tool was added to the APMS package in an effort to help managers and Detailers better understand historical achievements. The Monitor was developed as a graphing and reporting tool that analyzed enlisted assignments to determine how well the assignment process met the established policy goals. The program, used by Detailers and their managers, allowed for the quick and easy creation of summary graphs and reports through user-friendly wizards. For the first time, PERS-40 had the ability to look at assignment data for a particular group and analyze the data quickly and dynamically. This tool helped the Detailers and managers better understand the impact of complicated detailing policies on their assignment goals.

In 1997, new features were added to APMS to make it an integral part of the modern assignment process. Appendix A provides the concept of operation for APMS in the current distribution and assignment environment. In beta version 4.x, APMS began using the Jobs Advertisement and Selection System (JASS) inputs in a Billet Preference MOE to account for Sailor's inputs. Detailers and managers could now maximize the sailor's billet preferences against other policy goals (e.g., PCS costs, on-time arrival, NEC reutilization, and Requisition Priority). APMS gave Detailers a tool to manage the JASS inputs from Sailors in the fleet. During this period, APMS was enhanced by the addition of tradeoff curves in the Model. These curves showed marginal tradeoffs among conflicting assignment policies in a continuous manner. By showing the tradeoffs in this manner, managers were informed better and could choose MOE targets in a more efficient manner.

To prepare for the development of a production version, NPRDC conducted two crucial studies in 1998. First, a comprehensive and in-depth analysis of existing and prospective MOEs was completed. If APMS was going to be a flexible tool, all potential detailing measures needed to be identified and quantified. In the analysis, 43 potential measures were identified and documented. The MOE Science and Technology report, dated 7 April 1998, resulted from this study. Finally, NPRDC conducted a systematic and comprehensive analysis of the rules contained in the Enlisted Transfer Manual (and other official eligibility policy documents), which serves as the official guidance for determining the enlisted personnel eligibility criteria. NPRDC documented this analysis and the results in the Person-Job Eligibility Science and Technology report, dated 31 July 1998.

APMS was developed as a decision support model designed to determine the tradeoffs of assignment policy goals, optimize the execution of detailing measures of effectiveness (MOEs), and assist in the execution of the assignment element of the distribution process. First, we will describe the design of APMS. Second, we will introduce assignment eligibility rules utilized by Detailers in the assignment process. Third, we will discuss measures of effectiveness to quantify policies and goals along with the optimization of the assignment process based on these policies and goals. Last, we will disclose the APMS test results from concept of operation testing conducted with Detailers from NPC.

APMS Model Development

System Design

The Assignment Policy Management System (APMS) is a decision support system designed to determine the tradeoffs of assignment policy goals, optimize the execution of detailing measures of effectiveness (MOEs), and assist in the execution of the detailing process. The original design was modified from five major system components as described in the APMS Concept of Operation (Appendix A) to three major system components. The three components represent the following computer software configuration items (CSCIs): the Assignment Policy Model (APM) referred to as the model, the Assignment Monitoring System (AMS) referred to as the monitor, and the Assignment Transfer Subsystem (ATS) referred to as the transfer. Figure 1 is a graphical depiction of the three APMS CSCIs. APM analyzes the tradeoffs of assignment policy goals. Using a model of key policy goals, it analyzes pre-assignment data (persons, jobs, and schools) to optimize assignment results given certain minimum or maximum values assigned to these policy goals. AMS measures how well the assignment process meets established policy goals by allowing users to generate reports on assignments made during one or more completed assignment cycles. Lastly, ATS supports the APM and the AMS by acquiring and pre-processing raw jobs, persons, schools, and assignment data as well as ancillary lookup tables keeping the APM and the AMS master and shared databases up-to-date.

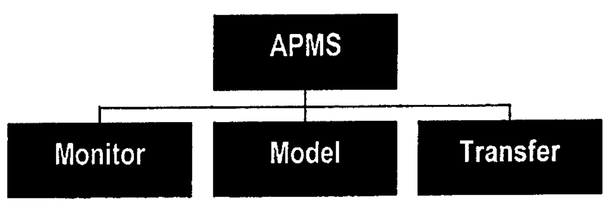


Figure 1. APMS Computer Software Configuration Items

Assignment Policy Model (APM)

APM is the first of three major CSCIs that make up APMS. There are four Computer Software Components (CSCs) in the APM. Figure 2 is a graphical depiction of the four APM components. The first, the graphical user interface (GUI), allows the user to input and analyze data, make selections, and view results. It interacts with the other three components to present the user with organized and easy-to-use information. The second component, the optimization engine interacts with the GUI to optimize the assignment choices for the eligible data. It also computes the tradeoffs among different MOEs selected in the GUI. The third component is the MOE Library. This dynamic link library (DLL) contains the code for all of the MOEs. It will calculate the value for every MOE for each potential assignment match as determined by the GUI. The last component, the Eligibility Module (also a DLL) calculates the potential eligibility for each assignment possibility for the GUI.

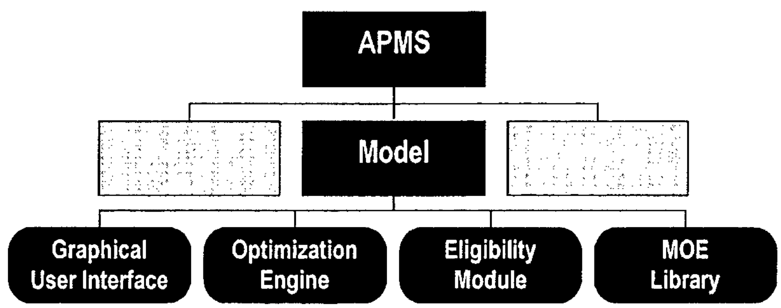


Figure 2. Model and Components

Assignment Monitoring System (AMS)

The AMS is the second of the three CSCIs that make up APMS. Figure 3 is a graphical depiction of the four AMS components. The AMS reports Assignments made during one or more completed requisition periods and allows users to determine how well the assignment process meets the assignment policy goals. There are three Computer Software Components (CSCs) in the AMS. The first, the graphical user interface (GUI), allows users to easily select criteria and view charts and reports on historical assignment data. Charts can be viewed individually or as a group for easy comparison. The second component, the ChartWizard, allows users to create and customize charts. As chart properties are selected, a sample chart displays the results of the selection. The third component, ReportWizard, visually guides the user through the steps necessary to create a report. Currently there are two different reports in the ReportWizard: MOE Summary and Graph Summary.

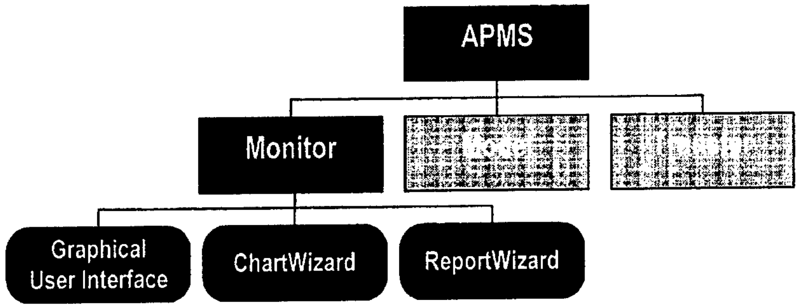


Figure 3. Monitor and Components

Assignment Transfer Subsystem (ATS)

The ATS, the third CSCI that makes up APMS, supports the main modules (APM and AMS) by providing pre-processed jobs, persons, and assignments data. In addition, it is responsible for keeping various lookup tables in APMS' shared databases up-to-date. ATS' outputs are inputs to the APM and AMS subsystems.

ATS is made up of three main components: the Mainframe Interface, Table Updates, and Master Database Updates. Figure 4 is a graphical depiction of the three ATS components. The module names briefly describe what each component does.

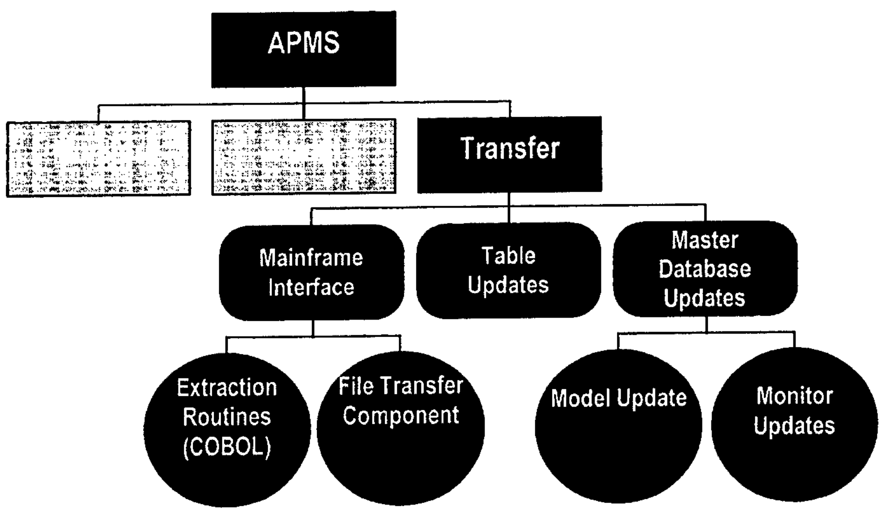


Figure 4. Transfer and Components

The Mainframe Interface has two computer software units (CSUs). First are the COBOL (Common Business Oriented Language) extraction routines that generate raw data for APMS from mainframe files and the JCL (Job Control Language) routines that run them. Second is the transfer component, which enables Transfer to download data files from various mainframe, ftp (file transfer protocol), and LAN (Local Area Network) servers to the APMS server hard drive(s).

The Table Updates component imports the raw data files into Transfer's databases where it can be processed for use by the rest of APMS.

The Master Database Updates component performs the pre-processing of raw data to prepare it for use by the Model and Monitor components and updates their respective master databases. It is composed of two CSUs: Model Update and Monitor Update.

Figure 5 illustrates the flow of APMS data from Enlisted Assignment Information System (EAIS) mainframes to APMS master databases and client (Model and Monitor) workstations. Transfer also updates many lookup tables such as PCS Costs, Enlisted Management Community (EMC) Codes, and per diem rates. This data comes from various sources and updates are required at various intervals. APMS data sources and update intervals are listed in Table 1.

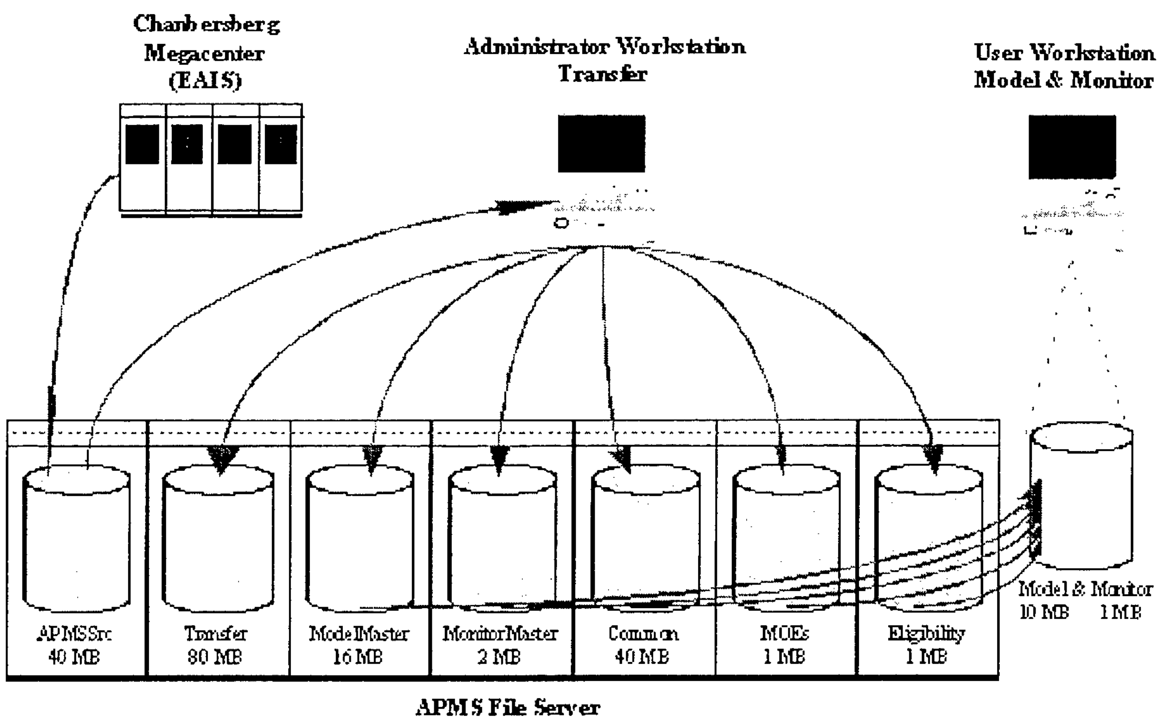


Figure 5. APMS Data Flow

Table 1. APMS Source Data

APMS Table	Description	Source File/System	Periodicity	Origin	Comments
APMSJOBS	Requisitions	RPM/EAIS	Req. Cycle	EPMAC. NRISO	
APMPRSN AMSPRSN	PRD Rollers	EMR/EAIS	Req. Cycle (All Quarterly)	EPMAC, NRISO	
ASSMNTS	Assignments	EAIS	Req. Cycle	EPMAC, NRISO	
APMSSCHL	Schools	NITRAS	Monthly	NITRAS	
JASS	Billet Preferences	JASS	Req. Cycle After 1st Week.	NCTS	
APSPINPM	D10 Flag File	EAIS	Req. Cycle	EPMAC. NRISO	
ACTIVITY	Activity Status	EAIS	Req. Cycle	EPMAC, NRISO	Used to add ATC to Schools
ReadinessDeficiencyList		?/ARIS		ARIS. EPMAC	(Readiness MOEs Not to be implemented initially.)
ManningLevelsByMCA	Allocation Tracking	ATM/ARIS		ARIS	(Fleet Balance MOEs Not to be implemented initially.)
Various PCS tables	Permanent Change of Station Costs	PCS Costing Tables/DFAS	Yearly	DFAS	Currently using AutoCost databases as source.
PerDiemRates	Per Diem Rates	Per Diem Rates	Yearly	DFAS	(TEMDUINS MOEs not currently implemented)
	Bunks for women at sea	Women At Sea Database	Dynamic	NPC 409	
TourLengths	Standard Tour Length Data	Enlisted Training Manual (ETM)	Quarterly	NAVADMIN BUPERS CD	
	Special UIC Restrictions List		As Needed	NPC 401.403. and/or 409	(e.g., submarines, SEAL Teams. SBUs. nuclear powered units). Data system needs to be created and maintained by BUPERS (Not to be implemented initially.)
NECs	NEC list	NEC	Quarterly	NAVMAC	
Deskcodes	NPC Lookup Table	As Needed		BUPERS	(Deskcode/Rating/Section/Branch), Data system needs to be created and maintained by BUPERS.

Detailing Eligibility Rules

There are many factors that Detailers must consider when assigning a Sailor to a job. For example, the reason for which a Sailor is moving is of great importance and there may be eligibility rules specific to the 'Reason for Move.' While "PRD Roller" is perhaps the most common reason for moving, there are also many others. The eligibility rules discussed in this document are organized by reasons for moving. These reasons are listed in Table 2. Reasons for Moving with the number of eligibility rules associated with the reason.

Table 2. Reasons for Moving

Reason	Number of Rules
PRD Roller	28
Split Tour Request	1
Cross-Deck	1
Spouse Collocation	1
Family Duty	1
Terminate shore duty	1
Terminate neutral duty	1
Construction Rating Rotation	2
Boot Camp Graduate	1
'A' School Graduate (J* Avail)	1
Return to Duty after LIMDU (Y* Avail)	1
Brig Release (X* Avail)	1
GENDETS Advancing to AS3	1
Assignments to Special Programs	71
All Moves	5

Additionally, there are three eligibility phases in the assignment decision process. Phase I eligibility applies to the nomination phase. In the future detailing process, Phase I could be used as a method of providing nominations for optimization in APMS or providing realistic choices for users of JASS when selecting their five choices. Phase II eligibility applies to the order-writing phase. Phase III eligibility applies to the order execution phase. The eligibility rules recommended for implementation listed in this document apply to one of the three phases.

Eligibility Rules

Many interviews, meetings, and conference calls were held with PERS-4 and PERS-2 (now N132) in an effort to capture all eligibility criteria used in the assignment process for incorporation into APMS. Eligibility rules were extracted from the Enlisted Transfer Manual (ETM), Standard Detailing Procedure Memorandum (SDPM), and other official policy documents. In addition, an e-mail forum was established that allowed thoughts and questions relating to eligibility rules to be posed to multiple recipients in a user-friendly environment. This manner of discussion encouraged careful thought to be given to each topic, while also documenting the discussions for ease of reference. Because of this extensive effort to identify eligibility criteria, a total of 117 eligibility rules were defined, reviewed, and documented. Many of the eligibility rules are dependent upon the reason for the move, as discussed in the previous section. The eligibility rules utilized in APMS are documented in the Person-Job Eligibility Science and Technology report, dated 31 July 1998.

A thorough investigation of the data required and the calculation methodology was conducted for each of the eligibility rules. Table 3 indicates whether implementation of a rule into APMS is recommended.

Table 3. Rule Recommendations

Eligibility Rules	
PRD Roller	
Back-To-Back Type 6	No
DOD Sea Duty	Yes
DOD Shore Duty	Yes
Minimum Activity Tour	Yes
PCS/DOD	Yes
Non-Careerist	No
Inter-Fleet Transfer	No
Restricted Duty for Women	Yes
Women In Ships	Yes
Pregnant Overseas	Yes
First-Term Assignment	Yes
Overseas Exceptional Family Member (EFM)	No
Family Advocacy Program (FAP)	No
Dental Fitness	No
Physical Fitness	No
Drug Related Problems	No
Alcohol Related Problems	No
Psychiatric Disorders	No
Personnel Performance	No
Disciplinary History	No
Financial Stability	No
Individual and Family Characteristics	No
OBLISERV for Hawaii	No
Time-On-Station (TOS)	Yes
Initial Training	Yes
Split Tour Request	
Split Tour	No
Cross-Deck	
Pers-Tempo	Yes
Spouse Collocation	
Spouse Collocation	Yes
Family Duty	
Family Duty	Yes
Terminate Shore Duty	
Shore Duty Curtailment	Yes
Terminate Neutral Duty	
Neutral Duty Curtailment	Yes
Construction Rating Rotation	
Boot Camp Graduate	

Eligibility Rules	
Initial Traning	No
All Availabilities Listed in Ch. 20, ETM)	
Pregnancy (DP)	
'A' School Graduate (J*)	
Initial Assignment	Yes
Return to Duty After LIMDU (Y*)	
Post LIMDU Assignment	Yes
Brig Release (X*)	
Post Brig Release	Yes
Applies to All	
Legal Hold	Yes
School Break	No
Body Fat Percentage	Yes
Nuclear Unit U.S. Citizen Requirement	Yes
Nuclear Repair U.S. Citizen Requirement	Yes

Arc Set Creation Model

The Enlisted assignment problem is a classic example of elements of a typical network flow model. APMS creates an arc set for those Sailors that qualify for jobs in a data set based on ETM rules. The data set is comprised of jobs (requisitions), training (classes), and personnel (sailors). This concept of the Arc Creation Model is similar to the Capacitated Transshipments Model (Liang, 1984) and the Capacitated Transportation Model (Liang and Thompson, 1987). The Arc Creation Model differs in the sense that training is taken into consideration to determine a service member qualification for a job. Figure 6 illustrates the concept of the Arc creation model utilized in the APMS model. Let a set of nodes, $\{S_1 \ldots S_s \ldots S_m\}$ represent sailors, $\{C_1 \ldots C_c \ldots C_m\}$ represent training, and $\{J_1 \ldots J_r \ldots J_m\}$ represent jobs. An ARC exists between S_s (person) and J_r (job) if a sailor passes rules in the ETM for his or her rating. An arc can also exist between S_s and J_r if a sailor gets C_c (training) and meets rules as defined in the ETM. For example, sailor S_1 qualifies for job J_3, whereas to qualify for job J_4, C_2 training is needed to meet criteria as illustrated in the Arc creation model. The model can be represented as an array of cells.

So, let **I** represent the total Personnel and **J** represent the total Jobs. A_{ij} denotes the element in the *ith* row and *jth* column of a matrix **A**. If an arc exists between a person and job, it is represented as $A_{ij}=1$. An Arc can also exist between a person, class, and job which is also represented as $A_{ij}=1$. If an Arc does not exist between a person and job, it is represented as $A_{ij}=0$. The size of the matrix is determined by multiplying the total number of personnel by the total number of jobs (i.e., **I** x **J**). The process of determining a solution set of assignments is a linear assignment problem, which is a discrete optimization problem.

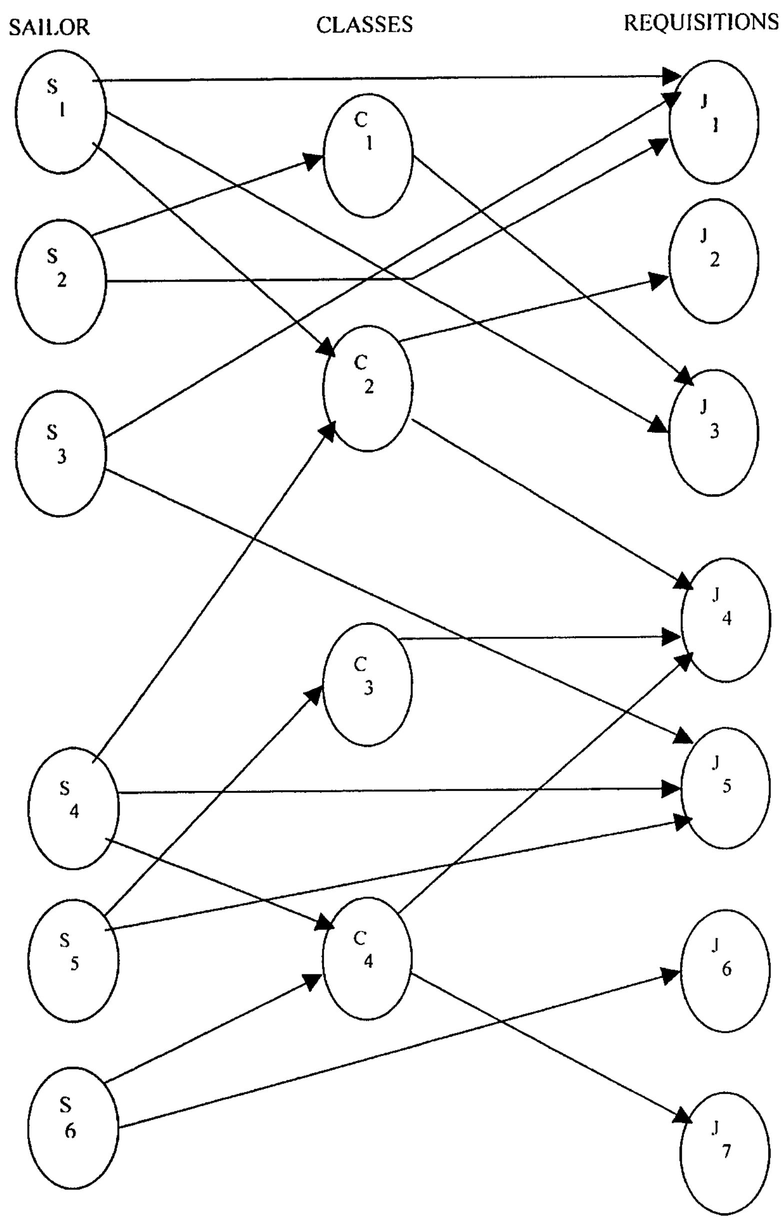


Figure 6. Arc Set Creation Model

Measures of Effectiveness

APMS has been designed to aid the detailing process by providing Detailers and enlisted assignment management personnel with two tools. The first is a monitoring tool that measures how well the assignment process meets established policy goals. It allows the user to generate reports on assignments made during one or more completed assignment cycles. The second is a modeling tool designed to assist Detailers in making informed assignment decisions by computing recommended assignments within the confines of current assignment policy. A comprehensive and in-depth analysis of current and prospective policies was conducted to quantify policies in the form of measures of effectiveness. These measures of effectiveness can provide the Detailers a clear understanding of costs and benefits of their decisions. According to Rardin (1998), "virtually every model...can be thought about in terms of costs and benefits. Optimization model objective functions usually can be interpreted as minimizing some measure of cost or maximizing some measure of benefit" (p. 300). These measures are referred to as MOEs in the assignment distribution process. All MOEs were defined, reviewed, and documented with active participation from the enlisted detailing community.

A total of 43 potential MOEs resulted from the meetings, interviews, and discussions with PERS-4 and PERS-2 (now N132). These MOEs can be divided into the following categories: Manning, Arrival, Personnel Preference, Budget, Policy, Location, and Readiness as shown in Table 4. Table 4 also identifies the objective of the MOE, type of calculation, system applicability, and whether the MOE can be optimized.

Table 4. Potential MOEs

MOE	Objective	MOE Type	Applicable to the Model	Applicable to the Monitor	Optimizable[1]
Manning MOEs					
Fleet Balance	Maximize	Percentage	✓	✓	Yes
OFRP PAC	Maximize	Percentage	✓	✓	Yes
OFRP LANT	Maximize	Percentage	✓	✓	Yes
PAC Fleet	Maximize	Percentage	✓	✓	Yes
LANT Fleet	Maximize	Percentage	✓	✓	Yes
BUPERS	Maximize	Percentage	✓	✓	Yes
Reserve	Maximize	Percentage	✓	✓	Yes
Arrival MOEs					
Gap	Minimize	Average	✓	✓	No
Overlap	Minimize	Average	✓	✓	No
Gap/Overlap	Minimize	Average	✓	✓	Yes
Billet Preference	Maximize	Percentage	✓	✓	Yes
Billet Preference	Maximize	Average	✓	✓	Yes

[1] This column indicates the optimization potential using the current optimization methods. Appendix B lists MOE alternative optimization methods.

MOE	Objective	MOE Type	Applicable to the Model	Applicable to the Monitor	Optimizable[1]
Priority					
On-time Arrival	Maximize	Percentage	✓	✓	Yes
Requisition Priority	Minimize	Percentage	✓	✓	Yes
Homebasing	Maximize	Percentage	✓	✓	No
Budget MOEs					
PCS Cost	Minimize	Average	✓	✓	No
Orders Cost	Minimize	Average	✓	✓	Yes
No-cost Moves	Maximize	Percentage	✓	✓	Yes
TEMDUINS	Minimize	Average	✓	✓	No
Current FY PCS Dollars	Minimize	Sum	✓	✓	Yes
Next FY PCS Dollars	Minimize	Sum	✓	✓	Yes
Total PCS Dollars	Minimize	Sum	✓	✓	Yes
Current FY TEMDUINS Dollars	Minimize	Sum	✓	✓	Yes
Next FY TEMDUINS Dollars	Minimize	Sum	✓	✓	Yes
Total TEMDUINS Dollars	Minimize	Sum	✓	✓	Yes
Policy MOEs					
Women at Sea	Maximize	Percentage	✓	✓	No
NEC Reutilization	Maximize	Percentage	✓	✓	Yes
NEC Match	Maximize	Percentage	✓	✓	No
Paygrade Match	Maximize	Percentage	✓	✓	Yes
Location MOEs					
Time on Tour	Maximize	Average	✓	✓	Yes
Time on Tour Early	Minimize	Average	✓	✓	No
Time on Tour Late	Minimize	Average	✓	✓	No
Time on Station	Maximize	Average	✓	✓	Yes
Geographic Location	Minimize	Percentage	✓	✓	Yes
Readiness					
Alternative 1	Maximize	Percentage	✓	✓	Yes
Alternative 2	Maximize	Percentage	✓	✓	Yes
Alternative 3	Maximize	Average	✓	✓	Yes
Alternative 4	Minimize	Average	✓	✓	Yes
Other MOEs					
User Defined	Various	Various	✓		Yes
Order Delivery	Minimize	Sum		✓	N/A
OP	Minimize	Sum		✓	N/A
ROT	Minimize	Sum		✓	N/A
TRA	Minimize	Sum		✓	N/A

Measures of Effectiveness Optimization

One of the key challenges to the assignment problem is to determine what should be the MOEs and their values for a particular assignment solutions. Since the APMS assignment problem is a network flow model with objectives to maximize or minimize MOE values, it can be represented in linear programming form. According to Krass (1987), "the optimal assignment should provide a minimum total cost for *n* persons" (p. 2) which is one of the primary objectives of the APMS model. MOEs can be classified in terms of their mathematical form and type of computation required for optimization. The optimization method available to the group largely depends on the condition of the assignment data and the classification of the MOE. There are four potential conditions for the assignment data. To explain each of the conditions and the calculations required, we denote the value for the k^{th} MOE value of the potential assignment of person $p = 1,2,...,P$ to requisition $r = 1,2,...,J$ as c^k_{pr}. Further let

$$x_{pr} = \begin{cases} 1, & \text{if person } p \text{ is assigned to requisition } r \\ 0, & \text{otherwise.} \end{cases}$$

A <u>potential assignment</u> of person p to requisition r is denoted (p,r) and the set of such potential assignments is denoted A. To explain the calculation of an objective, it is useful to clarify all of the assignment possibilities. In each case, no more assignments than $\min(P, J)$ are possible. However, fewer assignments usually result because not all persons are eligible to perform all jobs.

We let the number of assignments made, $\sum_{(p,r)\in A} x_{pr}$ be denoted N.

Each assignment scenario must conform to one of the following four potential conditions:

> ***Condition 1:*** For each particular objective, i.e., the MOE being optimized, a different set of persons might be assigned and a different set of jobs might be filled. This would be the case, for example, when $N<\min(P,J)$ or the number of assignments is less than the minimum number of combinations of all subsets of persons and jobs.
>
> ***Condition 2:*** The same persons are assigned for any two objectives. This would be the case, for example, when $N=P<J$ or the number of assignments equals the number of people which is less than the number of jobs.
>
> ***Condition 3:*** The same jobs are filled for any two objectives. This would be the case, for example, when $N=J<P$ or the number of assignments equals the numbers of jobs which is less than the number of people.
>
> ***Condition 4:*** The same persons are assigned and the same jobs are filled for any two objectives. This would be the case, for example, whenever $N=P=J$ or the number of assignments equals the number of people, which equals the number of jobs.

Calculations

The MOE Type for each measure can be sum, average, or percentage. Using a linear optimization method to solve a solution requires that the denominator in the computation of a solution set's MOE value is constant over all possible solutions. Since there is no denominator in the sum calculations, linear optimization techniques can always be applied. However, there are some instances where the denominator can fluctuate when computing an average or percentage.

Sum

An objective that is defined as a sum is computed very simply. This is simply given as:

$$\sum_{(p,r)\in A} c^k_{pr} x_{pr}$$

where A is the set of all potential assignments. Here the value for the k^{th} MOE for the potential assignment (p,r), c^k_{pr} is any integer. Such objectives can be optimized under any of the four potential conditions of assignment data.

Average or Percentage

There are several ways which an average or percentage can be calculated. The most basic is an average or percentage over the total number of assignments. Since the number of assignments remains constant, linear optimization techniques can be applied. An MOE can also require an average or percentage over a subset of potential assignments or an average or percentage over a subset of assigned persons or subset of jobs filled.

Average or Percentage over the Total Number of Assignments

This is simply given as:

$$\{1/N\} \sum_{(p,r)\in A} c^k_{pr} x_{pr}$$

where c^k_{pr} is any integer.

In theory, a percentage is the same with a minor modification that each c^k_{pr} is either 0 or 1. The above fraction is then converted to a percentage by multiplying by 100 as follows:

$$(100/N) \sum_{(p,r)\in A} c^k_{pr} x_{pr}$$

Such objectives can be optimized under any of the four potential conditions of assignment data.

Average or Percentage over a Subset of Potential Assignments

An MOE might have MOE values that can be dichotomized or classified in general. For example, consider the situation where O^k is a subset of the set of potential assignments defined as $c_{pr}^k = 0, \quad \forall(p,r) \in O^k$. Let $N^k = \sum_{(p,r)\in O^k} x_{pr}$. Then an average over a subset of potential assignments based on non-membership in O^k is defined as:

$$\frac{\sum_{(p,r)\notin O^k} c_{pr}^k x_{pr}}{\sum_{(p,r)\notin O^k} x_{pr}}.$$

An example of this type of MOE is *Gap* and *PCS Cost*. *Gap* is defined as the average number of months that Sailors are being assigned late for the assignments that have gaps. *PCS Cost* is defined as the average step 1 cost for all costed PCS moves (or for the assignments that have a cost). Such averages are not linear because the denominator is not constant over all possible solutions.

However, such objectives could be sub-optimized using linear techniques. Depending on the assignment data, it is possible that linear techniques will result in optimal values most of the time. If the membership in O^k is based on a dichotomy of zero and nonzero values, then $\sum_{(p,r)\in A} c_{pr}^k x_{pr} = \sum_{(p,r)\notin O^k} c_{pr}^k x_{pr}$ and the approximation of this objective is possible by using the objectives $\sum_{(p,r)\in A} c_{pr}^k x_{pr}$ and $\sum_{(p,r)\notin O^k} x_{pr}$.

Average over a Subset of Assigned Persons or Subset of Jobs Filled

An MOE might have MOE values that can be dichotomized based on the persons or jobs. For example, consider the situation where P^k is a subset of persons (or a subset of jobs) with a particular characteristic. Let $N^k = \sum_{p\in P^k} x_{pr}$ (or $N^k = \sum_{r\in P^k} x_{pr}$). Then an average over a subset of assigned persons based on membership in P^k is defined as:

$\frac{\sum_{(p,r)\notin A} c_{pr}^k x_{pr}}{\sum_{p\notin P^k} x_{pr}}$ or, for a subset of jobs filled as $\frac{\sum_{(p,r)\notin A} c_{pr}^k x_{pr}}{\sum_{r\notin P^k} x_{pr}}$.

An example of this type of MOE is *NEC Reutilization,* defined as the percentage of Sailors whose existing NECs are required by the requisition. Note that any person who has a skill or NEC would be included in the subset. With the various potential assignments for each person, some would reuse their skill (indicated by an MOE value of 1) and some would not (indicated by an MOE value of 0). Under either condition 2 or 4, this percentage would be easily computed since the denominator would always be fixed.

The APMS prototype ensures that the above assignment conditions are always satisfied. This is achieved by first determining the maximum number of assignments and then removing all unassigned persons from further consideration. It is because of this condition that an average or percentage over a subset of persons can be optimized. APMS also performs a sequence of initial optimizations to determine the sizes of various subsets of persons (and possibly jobs). By then locking down the size of subsets used, the percentages and averages defined for subsets of persons or jobs can be optimized using linear techniques.

APMS Testing

APMS Beta Version 5.0 validation testing was conducted by Enlisted Detailing Managers and Detailers at the Navy Personnel Command from December 5 thru 16, 1999. The testing was conducted in two phases. Phase 1 Testing consisted mainly of orientation and training of personnel involved in APMS testing. At the conclusion of Phase 1 testing, a survey was conducted to gauge Detailers' opinions of APMS. Phase 2 consisted of hands on use of APMS to manage policies and make actual assignment of Navy enlisted personnel to jobs. During this phase, data was captured and analyzed to measure APMS' ability to assist Detailers in the execution of the assignment process versus that of the manual assignment process.

Overall Assessment of the Software Tested

The data collected during the testing of APMS supports the conclusion that multi-dimensional (batch) detailing is superior to the current detailing process of making the assignment decisions one individual at a time. By identifying all potential assignments at once, Detailers were able to accomplish detailing objectives in order of importance.

By using the Monitor to capture and analyze the assignment data for the test period, it was apparent that even when Detailers manually create batch assignment slates, they accomplished their objectives better than the current assignment process. Of course, it was also apparent by looking at the Model results, that Detailers cannot consistently accomplish their objectives in an optimal manner when creating the assignment slates manually. Detailers identified only 2.9 percent of the jobs recommended by the Model when creating the manual slate. When using the Model to determine assignment recommendations, Detailers performed much more efficiently and effectively. Measures of effectiveness were quantified and results were predicted. Specifically, the Model assisted the multi-dimensional detailing process in the following ways:

- Detailers made assignment decisions in a much more consistent manner
  - Ensured compliance with eligibility rules and detailing constraints
  - Without Model support, Detailers violated an average of 8.67 soft eligibility rules
- Helped Detailers identify an average of 34 percent more assignments
- Assignment recommendations were identified in minutes versus days
- Detailers were able create reasonable MOE objectives and better accomplish the objectives
  - Primary objectives were always accomplished
  - Top MOEs (1, 2, and 3) were 91.1 percent better

The qualitative results of this test also indicate that the Model would make the detailing process easier to understand—especially for new Detailers and RAOs. Testers agreed that use of both the Model and Monitor in the detailing process would make the detailing process more efficient while also making it easier to collaborate with managers and provide feedback up the chain of command.

Test results indicate that the APMS concept would significantly improve the enlisted detailing process. Testers agreed that NPC should continue its efforts in developing APMS. There is reason to expect that one would see very good results and potential improvements demonstrated by APMS in an operational setting. The test environment was essentially the same work environment used daily by Detailers. Further, utilization by all Detailers should provide synergy regarding the knowledge and use of the system, thereby increasing the productivity of the product.

Clearly APMS is a decision support tool, which will aid the Detailers; however, as the results of this test showed, APMS' value as a detailing instrument increase significantly when Detailers use simultaneous detailing vice the current sequential case-by-case approach. Consequently, NPRST is currently working with NPC on the transition of APMS from its prototype phase of development to a production phase.

Conclusion

Throughout the design and development of the prototype, NPC was heavily involved and directly contributed to the production-ready design now being developed. The APMS prototype demonstrates all that can be accomplished when there is a close relationship between R&D efforts at NPRST and the end-users at NPC. This version of APMS has yielded a decision support tool that with a few refinements can be fielded by NPC. The APMS software does adhere to the programming standards of the Information Technology Center, who will implement and maintain the final product.

References

Ali, I. A., Kennington, J. L., & Liang, T. T. (1993). *Assignment with En Route Training of Navy Personnel.* Naval Research Logistics. (Vol. 40 pp. 581-592). John Wiley & Son Inc.: New York.

Buclatin, B.B., Liang, T. T., & Thompson, T.J. (1988). *The Enlisted Allocation and Nomination System (EPANS): Prototype for the Aviation Ratings* (#112-88-04). San Diego: Navy Personnel Research and Development Center.

Blatt, R.N., & Cass, D. E. (1966). *A Model for Automation of Personnel Assignment* (4898850). Monterey, CA: United States Naval Postgraduate School.

Conley, William. (1980). *Computer Optimization Techniques.* New York: Princeton.

Cook William J., Cummingham, William H., Pulleyblank, William R., & Schrijver, Alexander. (1998). *Combinatorial Optimization.* John Wiley & Son Inc.: New York.

Gregory, D., & Schwartz, S. P. (1994). *Measures of Effectiveness for the Enlisted Distribution System: Gapped Billets and Requisition Priority Compliance* (015957). Alexandria, VA: Center for Naval Analyses.

Krass, Iosif A. (1987). *An Alternative Algorithm for Optimizing Personnel Assignment in the Navy.* (NPRDC-TR-87-35). San Diego, CA: Navy Personnel Research and Development Center.

Liang, T. T. (1984). *Network Formulation of Multiple-Criterion Problems For Developing an Integrated Personnel Distribution System in the Navy.* (NPRDC-TR-84-49). San Diego, CA: Navy Personnel Research and Development Center.

Liang, T. T., & Thompson, T. J. (1986). *Optimizing Personnel Assignment in the Navy: The Seaman, Fireman, and Airman Application.* (NPRDC-TR-86-2). San Diego, CA: Navy Personnel Research and Development Center.

Liang, T. T., & Thompson, T. J. (1987). *Applications and Implementation A Large-Scale Personnel Assignment Model For The Navy.* Decision Sciences.

Liang, T. T., Thompson, T. J., & Zimmerman, G. L. (1986). *The Enlisted Personnel Allocation and Nomination System (EPANS): Prototype for the Administrative/Deck/Supply Ratings.* (NPRDC-TR-87-11). San Diego, CA: Navy Personnel Research and Development Center.

Malone, J. S., Pehl, DP1 R. R., Thorpe, R. P. & Tate, PNC M. W. (1974). *A Prototype Computer-Assisted Distribution and Assignment (CADA) System for Application in the Bureau of Naval Personnel. Part I: System Description.* (NPRDC-SR-75-2). San Diego: Navy Personnel Research and Development Center.

Parker, Gary R. & Rardin, Ronald L. (1988). *Discrete Optimization.* San Diego: Academic Press.

Randolph, Paul H. & Meeks, Howard D. (1978). *Applied Linear Optimization.* Columbus: Grid.

Rardin, Ronald L. (1998). *Optimization in Operations Research.* Upper Saddle River: Prentice Hall.

Assignment Policy Management System Test Report, GS-35F-5077H, K0999BH3449, January 2000.

Enlisted Transfer Manual (NAVPERS 15909F, version 4.0, BUPERS Compact Disc (CD), January 1999.

Manual of Navy Enlisted Manpower and Personnel Classifications and Occupational Standards, Volume II—Navy Enlisted Classifications (NECs), April 1998.

Measures of Effectiveness for Assignment Policy Management System, Science and Technology Report, N6600Q-93-D-9503, 7J13, NPRDC, April 1998.

Navy Enlisted System (NES) Enlisted Master File (EMF) Data Element Dictionary, Revision 4, prepared by the Bureau of Naval Personnel, Corporate Systems Division, Personnel Systems Branch, Pers-1023, December 1, 1992.

Navy Military Personnel Distribution System User Manual: Volume III; Enlisted Assignment Information System (EAIS), Bureau of Naval Personnel, August 1992.

Person-Job Eligibility for Assignment Policy Management System, Science and Technology Report, GS-35F-5077H, N68 221-98-F-0001, July 1998.

Standard Detailing Procedure Memorandums listed as effective in SDPM 3-98, List of Effective and Cancelled Standard Detailing Procedures Memoranda (SDPM), February 1998.

APPENDIX A

APMS CONCEPT OF OPERATION

Concept of Operation 12/18/98

Assignment Policy Management System (Developed by Navy Personnel Research and Development Center)

Background

The Assignment Policy Management System (APMS) is a decision support system designed to determine the tradeoffs of assignment policy goals, optimize the execution of detailing measures of effectiveness (MOEs), and assist in the execution of the detailing process. APMS is currently in the final year of prototyping, which is being developed to prove the concept. If successful and fully implemented, this process will yield a decision support tool that can be readily fielded by the Navy Personnel Command (NPC) which will adhere to system and programming standards of the SPACE Warfare System Command (SPAWAR) Information Technology Center (ITC), who will implement and maintain the final product.

Figure A-1 shows the five major components of APMS. The Assignment Policy Model (Model) is a modeling tool designed to analyze conflicting policy goals while assisting Detailers in making more informed assignment decisions. The Assignment Monitoring System (Monitor) allows users to generate graphs and reports on historical assignments to analyze how well the assignment process met established policy goals. The transfer program is designed to prepare mainframe-based data for dynamic use by APMS on a client platform. The MOE module computes the values of quantified policies for each assignment choice. Finally, the Eligibility module automatically computes the eligibility for a sailor as documented in the Enlisted Transfer Manual and other related sources. Both the MOE and Eligibility modules are designed for used by any assignment and distribution program developed as a Windows application.

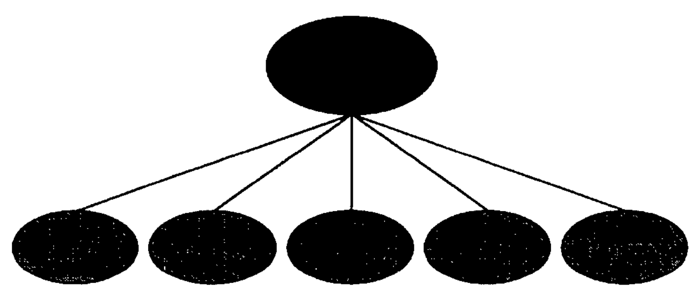


Figure A-1. APMS Components

Operational Use of APMS

We envision three primary groups of users of APMS within NPC-4 as illustrated in Figure A-2. The first group of users who will benefit from the use of APMS is the Enlisted Distribution Managers. NPC-4, NPC-40, and NPC-45 constantly strive to make the detailing process more efficient. APMS gives Detailers and their managers the necessary tool to quantify the impact and tradeoffs between new manning and detailing policies. The second group is the Enlisted Detailing Managers. Branch Heads and Rating Assignment Officers (RAOs) will use APMS to determine and set goals for their applicable group of PRD rollers and requisitions. The goals will be set based on quantified detailing policies (MOEs) and will represent realistic and obtainable targets. Finally, the third group of users is the Enlisted Detailers. APMS will produce an optimized slate of assignments based on the Enlisted Detailing Manager's targets. In the slate, the primary and all potential alternative billet recommendations for each PRD roller is presented to the detailer.

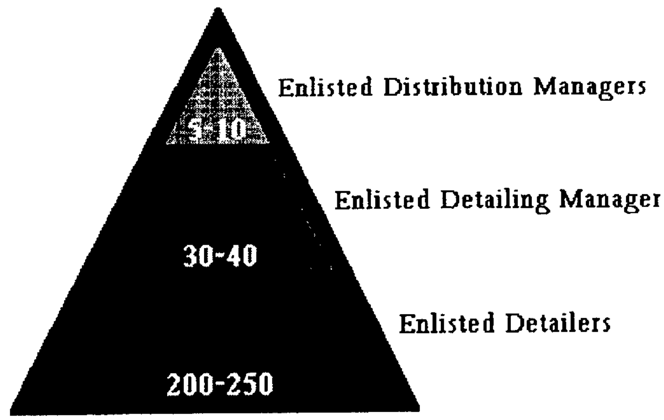


Figure A-2. APMS Users

Enlisted Detailing Managers

By using the modeling component of APMS, Branch Heads and RAOs in NPC-40 can analyze a group of potential assignments using MOEs. These metrics represent the applicable detailing policies that have been quantified for the enlisted detailing process. For example, a PCS Cost MOE might represent the average cost of each set of orders. By selecting all the measures important to a manager, the MOEs can be balanced against each other to achieve an optimal mix.

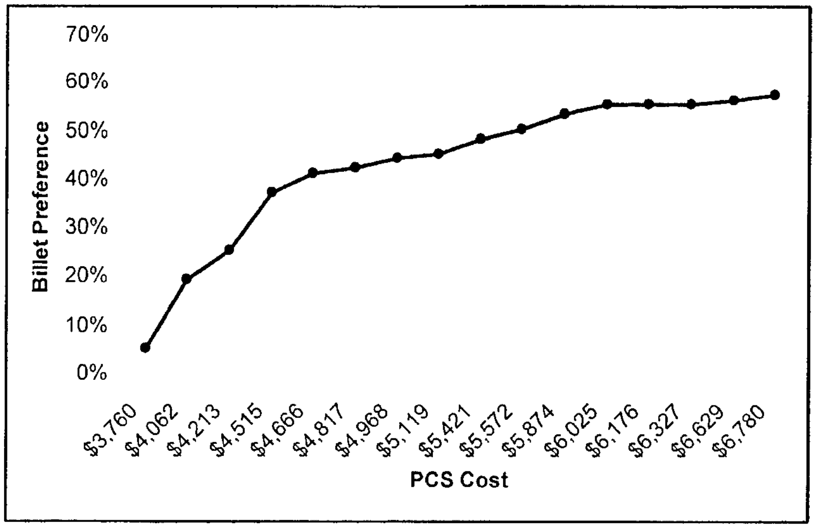


Figure A-3. Sample Tradeoff Curve

After selecting the MOEs important to that manager's process, users can display the continuous tradeoffs between MOEs and their underlying policies. Using tradeoff curves for a specific set of PRD rollers and requisitions, Detailing Managers can set realistic and obtainable goals for their Detailers. For example, Figure A-3 illustrates the tradeoff between average move costs and the percent of requisitions where billet preferences (JASS) are satisfied. A manager might choose to set the target for Billet Preference at 42 percent. If the target were set higher, the Average PCS Cost would greatly increase with little gain in Billet Preference satisfaction. A higher average PCS target would generate very little Billet Preference gain. With each tradeoff curve, managers can better determine appropriate MOE targets.

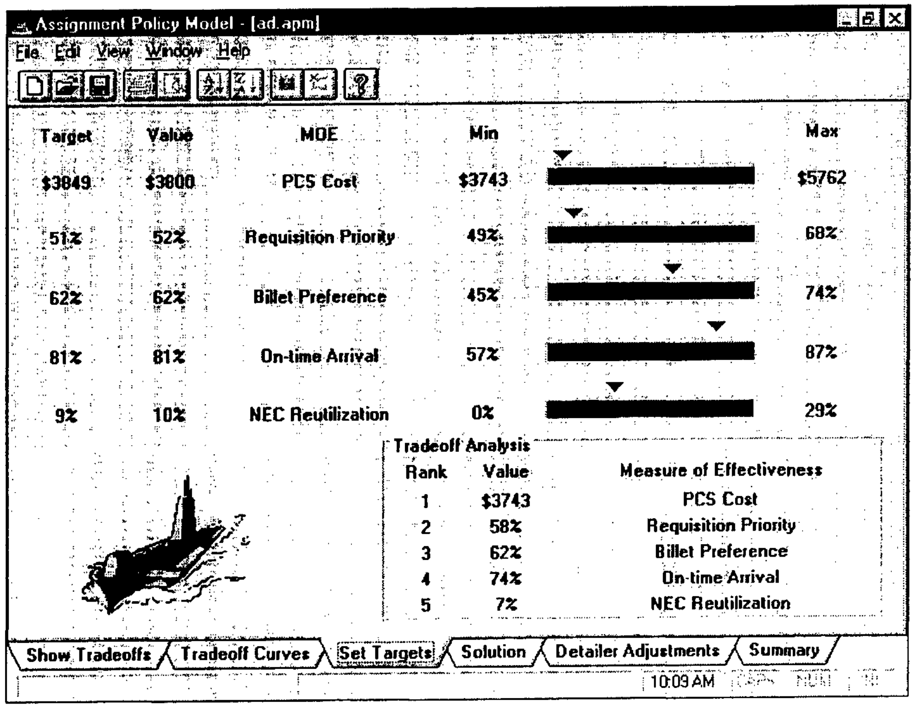


Figure A-4. APMS Screen Shot

When setting targets, Detailing Managers are balancing the goals of each of the selected MOEs. For each measure, there is a minimum and maximum obtainable value that users consider when setting their goals (see Figure A-4). Using actual data, Branch Heads and RAOs can set realistic, obtainable targets, and for the first time, immediately understand the impact of their decisions. Realistic MOE targets can then be passed to each detailer.

Enlisted Detailers

In the current detailing process, Detailers make sequential, one-dimensional decisions often without fully understanding the impact of each set of orders on the entire slate of assignments. The necessary information or tools needed to make decisions from a more global perspective do not exist in the current process. APMS is a detailing decision support tool capable of implementing a multi-dimensional approach in the execution of the enlisted assignment process.

Once Enlisted Detailing Managers have set MOE targets for a particular set of PRD rollers and current requisitions, APMS can produce a slate of optimal potential assignments. The primary billet recommendation for each assignable roller is presented to the detailer. From there, Detailers can review the assignment and analyze potential alternatives. When viewing the alternative assignments for either a PRD roller or a requisition item, the impacts of each decision on the entire group of assignments are instantly calculated and displayed for each MOE, as shown in Figure A-5. This information allows the detailer to make a more informed and global detailing decision.

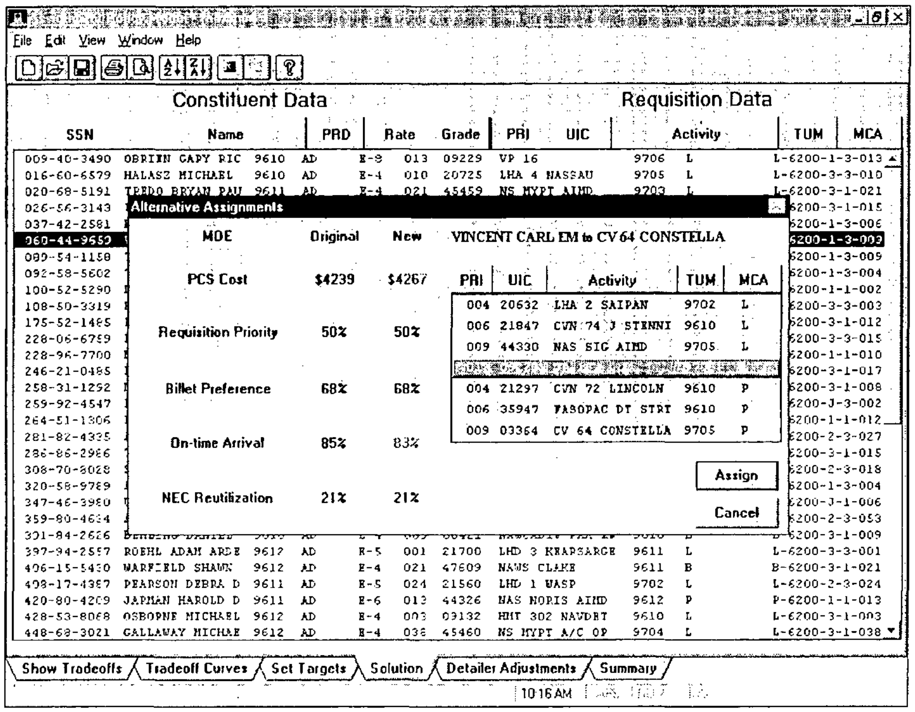


Figure A-5. Assignment Policy Model

When making an assignment where the match does not fully comply with all eligibility rules, Detailers are informed about any distribution policy violations and required waivers. This module computes all eligibility requirements in a consistent and uniform manner, thereby eliminating the need for Detailers to manually calculate eligibility from multiple, and sometimes conflicting sources.

Enlisted Distribution Managers

Distribution Managers must constantly make adjustments to the guidance given to Detailing Managers and Detailers in the execution of the enlisted detailing process. APMS gives Enlisted Detailing Managers and Detailers the necessary tool to quantify the impact of new detailing guidance and policy execution for Distribution Managers. For example, often during the execution of a fiscal year PCS budget, Distribution Managers must assess the impact of reduced PCS funds. However, without the proper tools, NPC-40 is unable to quantify the impact quickly and accurately. APMS will give Detailers and their managers the ability to compare the potential loss of PCS funds to other quantified MOEs. Distribution Managers will understand the impact of decreased PCS funding in terms of manning, billet preference, NEC reutilization, and other MOEs.

Enlisted Distribution Community

As assignments are made, all three groups of APMS users can benefit from the use of the executive summary component to track and analyze historical performance.

This module will help users determine how well the assignment process meets established policy goals. Assignment data are graphed and reported using MOEs against selected criteria (see Figure A-6). This program represents the feedback portion of the decision support tool allowing users to learn more about the enlisted assignment process and evolve it into a better and more informed process.

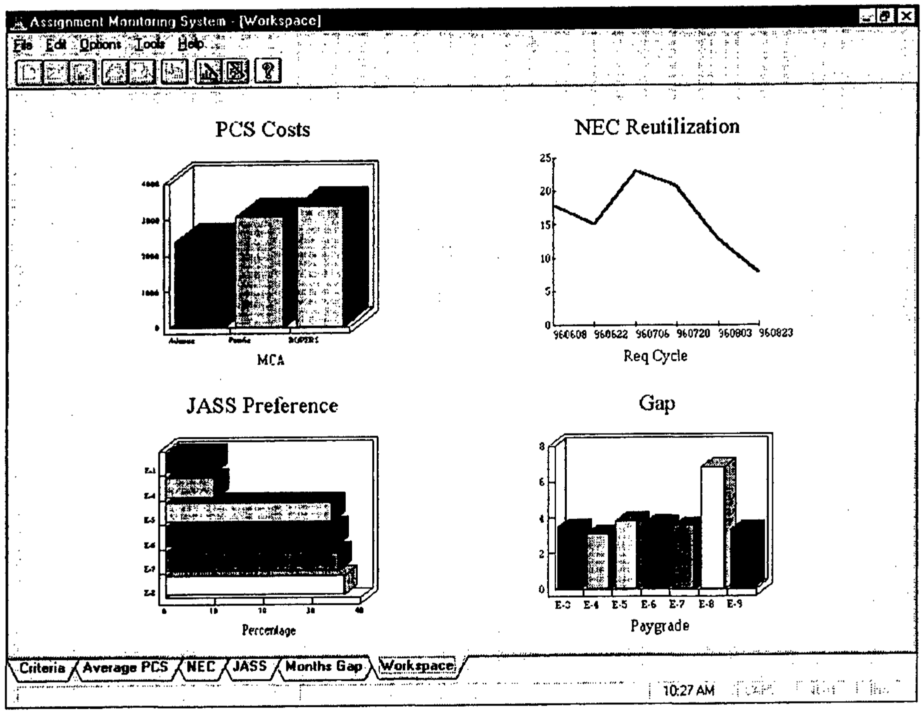
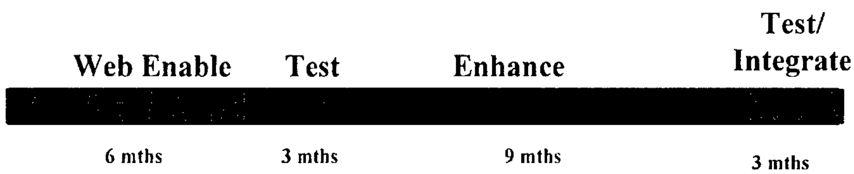


Figure A-6. Assignment Monitoring System

Implementation Plan

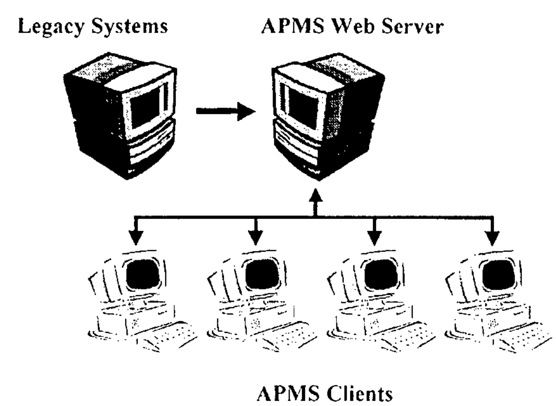
The prototype APMS is a PC-based system written in Visual Basic 6 and C and uses Microsoft Access as its database. APMS can be converted from a prototype to a production ready version in three phases. In Phase I, APMS components will be redesigned to operate as a web application server offering web services that adheres to the web development standards of Task Force Web and SPAWAR ITC. Two of the modules—the MOE module, which computes the values of measures associated with each assignment option, and the eligibility module—will functions as separate web services, which can be called from APMS. This modularity of design allows the functions to be easily updated. Other web-based applications will be able call the APMS services resulting in a common and single source for all future MOE and eligibility related computations. The APMS database system will also be convert from Access to SQL Server doing this phase. At the end of Phase 1, APMS will undergo a pilot test using three Enlisted ratings. The test group using APMS will be compared to a control group to measure the effectiveness of the new detailing process supported by a decision support tool. Also, testers will be surveyed to help determine any increases in productivity. APMS will transition to SPAWAR ITC for implementation into the detailing process. Throughout Phase II, NPRST will provide technical assistance as needed during implementation.



During Phase II, APMS will be enhanced to include functionality to support detailing of all Enlisted ratings. Additional eligibility rules and measures of effectiveness will be added to APMS web services. APMS will be fully integrated into the Navy's Enlisted detailing process providing support for EAIS order writing system. The system will also undergo full functionality testing in the detailing environment to demonstrate and prove its effectiveness in the assignment process. A test group using APMS will be compared to a control group of the existing process to measure the effectiveness of the new detailing process supported by a decision support tool. Also, testers will be surveyed to help determine any increases in productivity. .

During Phase III, will be deployed as a web application decision support system for operational use by the Enlisted detailing community meeting design standards of SPAWAR ITC. The final version will allow users to optimize up to five MOEs and display values for an additional ten. The user-friendly package will quickly compute hundreds of thousands of potential solutions presenting the user with a smaller, optimal, and manageable slate of assignments. Users will be able to make decisions with all of the necessary information and devote more of their time to important detailing objectives. For the first time, Detailers and their managers will have the tools necessary to detail in a multi-dimensional environment.

Host Environment



APMS will operate as a web based application system in a Client/ Web Server environment. Until a NPC Single Integrated Human Resource (SIHRS) Strategy data warehouse is online with all distribution data, APMS will be supported by biweekly data extractions from the existing BUPERS mainframe data files (e.g., EAIS, EMR, ARIS, etc.). These data extractions will allow users to dynamically view data and perform calculations from either their local machine or the APMS Server. Once a data warehouse is online, the APMS Server will contain a mirror image of the assignment data in the data warehouse server. This will allow APMS users to dynamically view distribution data without affecting the performance of the data warehouse server. This configuration will eliminate the need for any manual pre-processing of the data.

APMS Maintenance

Identifying and obtaining the data required for APMS to provide accurate and realistic assignment recommendations is critical to the success of this effort. Until enlisted assignment data (e.g., personnel, requisition, and schools data) is transitioned from the mainframe environment to a data warehouse environment under the SIHRS, mainframe-based data will need to be extracted and manipulated biweekly for dynamic use by APMS on the web services platform. Additionally, the creation and maintenance of several new database tables (e.g., bunk data, PCS costing tables, tour lengths, etc.) will need to be addressed in conjunction with the development of APMS. This new data requirement is necessary to automate the eligibility and MOE calculations in APMS. Other enlisted distribution programs under the SIHRS umbrella, current and future, will benefit from the availability of this data on-line.

After the first phase of development and testing are complete, APMS will be transitioned to SPAWAR ITC for implementation and maintenance. NPRST is coordinating the production ready development with SPAWAR ITC to ensure the conversion is as seamless as possible minimizing the time and effort required to bring the product online. NPRST will coordinate the assignment of maintenance responsibility to applicable parties to ensure long-term survival.

APMS Management

NPRST is currently developing the APMS production ready version with the assistance of EDS, Corporation. The project manager for NPRST is Mr. Tony Benson. For additional information on the APMS prototype, please contact Mr. Benson at DSN 882-4658 or commercial (901) 874-4658.

APPENDIX B

MOE Optimization Method Alternatives

MOE Optimization Method Alternatives

Three methods can be used to optimize the potential MOEs: Limited Linear, Linear, and Fractional. Table 3 displays those methods documented in *Measures of Effectiveness for Assignment Policy Management System, Science and Technology Report* dated April 1998.

Table 3. Optimization Methods

MOE	Linear	Limited Linear	Fractional
Manning MOEs			
Fleet Balance	✓	✓	✓
OFRP PAC	✓	✓	✓
OFRP LANT	✓	✓	✓
PAC Fleet	✓	✓	✓
LANT Fleet	✓	✓	✓
BUPERS	✓	✓	✓
Reserve	✓	✓	✓
Arrival MOEs			
Gap			✓
Overlap			✓
Gap/Overlap	✓	✓	✓
Billet Preference		✓	✓
Billet Preference Priority		✓	✓
On-time Arrival	✓	✓	✓
Requisition Priority	✓	✓	✓
Homebasing		✓	✓
Budget MOEs			
PCS Cost			✓
Orders Cost	✓	✓	✓
No-cost Moves	✓	✓	✓
TEMDUINS			✓
Current FY PCS Dollars	✓	✓	✓
Next FY PCS Dollars	✓	✓	✓
Total PCS Dollars	✓	✓	✓
Current FY TEMDUINS Dollars	✓	✓	✓
Next FY TEMDUINS Dollars	✓	✓	✓
Total TEMDUINS Dollars	✓	✓	✓
Policy MOEs			
Women at Sea		✓	✓
NEC Reutilization		✓	✓
NEC Match		✓	✓
Paygrade Match	✓	✓	✓
Location MOEs			
Time on Tour		✓	✓
Time on Tour Early		✓	✓
Time on Tour Late		✓	✓
Time on Station		✓	✓

MOE	Linear	Limited Linear	Fractional
Geographic Location	✓	✓	✓
Readiness			✓
Alternative 1	✓	✓	✓
Alternative 2	✓	✓	✓
Alternative 3	✓	✓	✓
Alternative 4	✓	✓	✓
Other MOEs			
User Defined	✓		✓
Order Delivery	✓	✓	✓
OP	✓	✓	✓
ROT	✓	✓	✓
TRA	✓	✓	✓

Distribution List

Assistant Secretary of the Navy (Manpower and Reserve Affairs)
Deputy Assistant Secretary of the Navy (Manpower and Reserve Affairs)
Chief of Naval Operations (N1, N1B, N091, N813)
Office of Naval Research (Code 342)
Chief of Naval Personnel (PERS-00, PERS-00B, PERS-07, PERS-4, PERS-40, PERS-45)
Commander in Chief, U.S. Atlantic Fleet (N1)
Commander in Chief, U.S. Pacific Fleet (N1)
Commander in Chief, U.S. Naval Forces, Europe (2)
Naval Post Graduate School
Director of Research, U.S. Naval Academy
Pentagon Library
Defense Technical Information Center (DTIC)