NPRST
Navy Personnel Research, Studies, and Technology
5720 Integrity Drive • Millington, Tennessee 38055-1000 • www.nprst.navy.mil

research at work

NPRST-TN-10-1

October 2009

Comprehensive Optimal Manpower and Personnel Analytic Simulation System (COMPASS)

Rodney S. Myers
Kimberly A. Crayton
Colin J. Osterman
David K. Dickason

NPRST-TN-10-1
October 2009

Comprehensive Optimal Manpower and Personnel Analytic Simulation System (COMPASS)

Rodney S. Myers
Kimberly A. Crayton
Colin J. Osterman
David K. Dickason

Reviewed and Approved by
David M. Cashbaugh
Institute for Force Management Sciences

Released by
David L. Alderton, Ph.D.
Director

Navy Personnel Research, Studies, and Technology (NPRST)
Bureau of Naval Personnel (BUPERS-1)
5720 Integrity Drive
Millington, TN 38055-1000
www.nprst.navy.mil

REPORT DOCUMENTATION PAGE	*Form Approved* *OMB No. 0704-0188*

1. REPORT DATE *(DD-MM-YYYY)*	**2. REPORT TYPE**	**3. DATES COVERED** *(From - To)*
31-10-2009	Technical Note	10/2006 - 9/2008

4. TITLE AND SUBTITLE
Comprehensive Optimal Manpower and Personnel Analytic Simulation System (COMPASS)

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)
Rodney S. Myers
Kimberly A. Crayton
Colin J. Osterman
David K. Dickason

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) AND ADDRESS(ES)
Navy Personnel Research, Studies, and Technology (NPRST)
Bureau of Naval Personnel (BUPERS)
5720 Integrity Dr.
Millington, TN 38055-1000

8. PERFORMING ORGANIZATION REPORT NUMBER
NPRST-TN-10-1

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Office of Naval Research
800 North Quincy Street
Ballston Tower One
Arlington, VA 22217-5660

10. SPONSOR/MONITOR'S ACRONYM(S)
ONR

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION / AVAILABILITY STATEMENT
A - Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES

14. ABSTRACT
The Navy system for accessing, training, assigning, developing, and maintaining Sailors' careers consists of numerous semi-autonomous organizations whose interdependence is well-known but not well understood. Each organization within the personnel management network maintains independent operational and archival information technology systems, measures success locally, and makes management decisions without the benefit of fully understanding the impacts that their decisions have on the extended enterprise. To overcome the inherent inefficiency of independently operating organizations, Navy Personnel Research, Studies, and Technology (NPRST) set out to develop a prototype simulation system to evaluate the implications of resource and policy alternatives across the entire manpower and personnel enterprise.

The COMPASS simulation model is designed to evaluate the feasibility of supply chain management, stochastic simulation, service-oriented architecture, and optimization. It functionally represents the Navy's system of recruiting, selecting, and classifying Sailor candidates; losing and separating Sailors; training Sailors in basic and specialized skills; advancing Sailors in paygrades; re-enlisting Sailors; and distributing Sailors to job assignments. Additionally, this effort explored the concept of three necessary skill sets to design, develop, analyze, and maintain the simulation model. These skill sets include software development, model design/development, and analysis.

15. SUBJECT TERMS
simulation, supply chain, model, enterprise, separations, training, losses, re-enlistment, stochastic, verification, policy, classify, accession, Sailors

16. SECURITY CLASSIFICATION OF: UNCLASSIFIED			**17. LIMITATION OF ABSTRACT**	**18. NUMBER OF PAGES**	**19a. NAME OF RESPONSIBLE PERSON**
a. REPORT	**b. ABSTRACT**	**c. THIS PAGE**			Genni Arledge
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	UNLIMITED	41	**19b. TELEPHONE NUMBER** *(include area code)* 901-874-2115 (DSN 882)

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std. Z39.18

Foreword

This report is one facet of NPRST's efforts to foster the use of Supply Chain Management (SCM) concepts, language, and thinking by Navy Manpower, Personnel, Education, and Training (MPT&E) leadership and functional experts. For a number of years NPRST has promulgated and argued for the adoption of SCM for conceptualizing the Navy's Human Resources (HR). We have produced a number of briefings, papers, reports, and tools to support this. The Comprehensive Optimal Manpower and Personnel Analytic Simulation System (COMPASS) is another in this series. It integrates a series of lower level functional process models (e.g., recruiting, advancement) into a larger, integrated, simulation that models the entire enlisted force at the entity (i.e., Sailor) level which further emphasizes the supply chain nature of Navy HR processes. Importantly, COMPASS is our first attempt to integrate recursive optimization within a manpower simulation. It is an important step forward to more effective policy analysis, manpower forecasting, and personnel war gaming.

This report was prepared as part of the COMPASS project, originally sponsored by the Office of Naval Research (ONR) as prototype development, and ultimately sponsored by the Deputy Chief of Naval Operations (PE 0604703N) for Manpower, Personnel, Training, and Education's (N1) engineering development program.

This report documents the science and technology concepts explored through this effort, including: supply chain management, stochastic simulation, service oriented architecture, and optimization.

We especially thank Mr. David Cashbaugh (NPRST) for originating and leading this project. In addition, we acknowledge the multiple research and development partners, including TechTeam/NewVectors, Computer Science Corporation (CSC), Icosystem, OptTek, and N104 (Research, Modeling and Analysis Division) for their technical and functional contributions to the COMPASS project.

David L. Alderton, Ph.D.
Director

Executive Summary

The Navy system for accessing, training, assigning, developing, and maintaining Sailors' careers consists of numerous semi-autonomous organizations whose interdependence is well-known but not well understood. Each organization within the personnel management network maintains independent operational and archival information technology systems, measures success locally, and makes management decisions without the benefit of fully understanding the impacts that their decisions have on the extended enterprise. To overcome the inherent inefficiency of independently operating organizations, Navy Personnel Research, Studies, and Technology (NPRST) set out to develop a prototype simulation system to evaluate the implications of resource and policy alternatives across the entire manpower and personnel enterprise.

The COMPASS simulation model is designed to evaluate the feasibility of supply chain management, stochastic simulation, service-oriented architecture, and optimization. It functionally represents the Navy's system of recruiting, selecting, and classifying Sailor candidates; losing and separating Sailors; training Sailors in basic and specialized skills; advancing Sailors in paygrades; re-enlisting Sailors; and distributing Sailors to job assignments. Additionally, this effort explored the concept of three necessary skill sets to design, develop, analyze, and maintain the simulation model. These skill sets include software development, model design/development, and analysis.

The primary result of this effort was the creation of an enterprise-level Navy workforce analysis simulation model which combines stochastic simulation and the use of optimization; and a team of software and model developers.

Further success of this effort will be realized through the model's acceptance by Navy workforce analysts and through future modeling and simulation efforts where computer simulation and optimization analysis are combined. Additionally, future models (where appropriate) should include multiple system functional areas, use probabilistic variables to represent the stochastic behaviors of the real world, and use service-oriented architecture to supply the model's data and other analysis processes.

Contents

Introduction

This report documents the science and technology concepts explored through the COMPASS project. It explains the simulation model's function and software features, modeling assumptions, stochastic nature, service-oriented architecture, optimization, operation and use of the COMPASS tool, as well as verification measures.

Simulation Model

The COMPASS simulation model is an entity-based, continuous-time computer model, which functionally represents the Navy's enlisted workforce as a supply chain for delivering trained Sailors to fill vacant positions (see Figure 1). A supply chain management paradigm provides an enterprise-level representation for optimizing the inter-connections among Navy workforce processes and analysis and evaluation of policies (e.g., recruit aptitude requirements and Sailor retention). The model uses probabilistic variables to represent stochastic behaviors witnessed in the real world (e.g., number of Sailor's being assigned to particular Enlistment Management Community [EMC]).

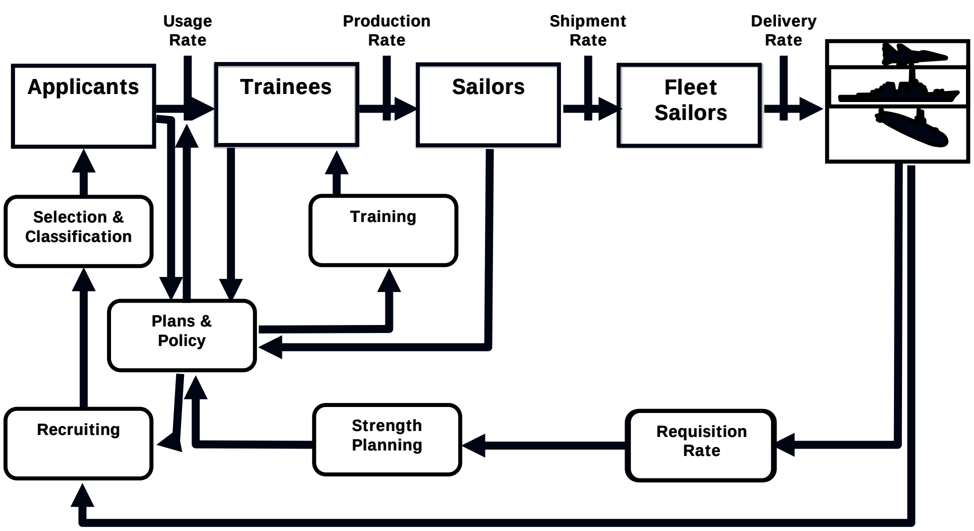


Figure 1. Navy workforce supply chain diagram.

COMPASS simulates process and policy decisions applied to individual Sailor agent attributes as their career proceeds from recruitment through separation, including six Navy workforce functional areas: recruitment, selection and classification, training, advancement, reenlistment, loss and separation, and distribution. The COMPASS simulation model was designed by creating process flow diagrams (option trees) representing Sailor career distribution paths within each functional area. Each option tree identifies a series of decision nodes, the sequence in which these nodes are traversed as the Sailor's attributes evolve during his career (simulated over time), and the inputs to and outputs of each decision node. The design of each decision node is specified by process descriptions for the rate model logic and decision node logic. The process descriptions documentation (see Appendix A) defines the algorithms for employing the input rates, Sailor attributes, policy vectors, probability distributions, and other inputs to simulate the change in the Sailor's attributes (e.g., paygrade, years of service (YOS), trained skill, etc.) before deciding the Sailor's distribution path. As a high-level perspective, COMPASS is a complex multidimensional process, but at the lowest level (i.e., the node-level), COMPASS consists of a sequence of functional areas that simulate the impact of policy on an individual Sailor as he/she proceeds through a Navy career.

Software and Hardware Platform

The COMPASS tool is a stand-alone software application developed in the Java programming language. There are three main software components: application, database, and configuration. The application consists of the graphical user interface (GUI) and the simulation engine. The database, developed in Microsoft SQL Server, contains the model's initialization data required by the application (i.e., Sailor inventories). The configuration allows the user to save and restore sessions within the application and share results and common parameters among multiple users. The application and database can be run from a single machine or the database can be run as a separate server and shared among multiple users. The hardware requirements are modest, requiring at a minimum a 1 Ghz CPU with at least 1GB of random access memory (RAM).

Upon loading the application, the user can specify the parameters and policies they wish to simulate; click "Run" to generate a list of reports detailing the predictions of the application. The application contains a flexible reporting mechanism that allows the creation of custom reports aggregating parameters daily, monthly, quarterly, and yearly. The COMPASS application allows for the modification of various Navy policies (Selective Reenlistment Bonus [SRB] budget, high year tenure [HYT], National Call-to-Service enrollment, etc.). COMPASS allows the user to compare two scenarios side-by-side in the charting/reporting window. This allows the user to run two simulations varying a single (or multiple) parameters and evaluate the differing outcomes.

The COMPASS application is designed in a categorized decision-tree fashion (see Appendix A). Various common functions are grouped and executed within a decision tree. There is a separate decision tree for each functional area (e.g., training, reenlistment, loss and separation, etc.).

The simulation executes in this order; first the initial set of Sailors and Navy policies is loaded from the database. Then the simulation is run in monthly time-steps applying every decision tree to every Sailor per simulation time-step, where only those Sailors eligible for the particular option are affected.

Modeling Assumptions

There were many assumptions of the operations and functions of the Navy manpower, personnel, and training enterprise used to develop the COMPASS model. Although policies are typically not static for an entire year our assumptions are such to simplify the model. For example, personnel policies seldom change within fiscal years; therefore, policy related parameters are only altered at the start or end of a simulated fiscal year. The simulation time step is represented as one month. The qualification of an applicant (potential recruit) is embodied in the generation of a single random number. Recruits classify for particular enlistment management codes with the lowest manning and highest Armed Forces Qualifying Test (AFQT) scores for which they qualify. Appendix B provides a detailed summary of assumptions in general and by functional area.

Stochastic Nature

Many Navy workforce analysis models do not contain any probabilistic (random) components; these models are classified as deterministic models (where the model's output is determined once the set of quantities and relationships have been specified, then evaluated). Since random occurrence is a fact of real-world systems, the researchers sought to explore stochastic modeling in an effort to increase the analyst's ability to further explore the impacts of policy. In a stochastic model like COMPASS, each run with a different random seed produces a different result. To arrive at a statistically significant characterization of the output, analysts are expected to execute (run) the model several times. The larger the variation in the output of the model, the greater the number of runs are required. If the number of runs requires excessive computational cycles then techniques to reduce the variation in the model can be considered where appropriate.

There are two basic kinds of uncertainty in any model that can lead to variation in the output. Aleatory uncertainty is the inherent variation in the physical system; it is stochastic, irreducible. For example, analysts are not expected to predict individuals' decisions with total certainty. In the COMPASS model this uncertainty is represented by the stochastic variation in the application of the policy that affects changes made to individual Sailor attributes. Epistemic uncertainty arises from lack of knowledge of quantities or processes identified with the system; it can be subjective, is reducible and may be identified with model uncertainty. For example, subject matter expert estimates might be used to set a parameter's mean, distribution type, and standard deviation where historical data is not available. Reducing this kind of uncertainty could (but may not necessarily) reduce the overall variation in the outputs of the model. A further discussion of the recommended method for verifying COMPASS is included later in this report.

Service-Oriented Architecture

Service-Oriented Architecture (SOA) is an approach to software applications development where the various functionalities usually found within a single legacy application are loosely coupled and any specific functionality is instantiated as a service. The intent of SOA is to construct software services that have greater interoperability and reuse as a result of their standardization. For COMPASS, the intent was to build a service that would both improve access to the input data set needed to run COMPASS and to provide a method whereby updates to this input data set could be readily generated. This service of accessibility and updating was termed the Enterprise Data Broker (EDB).

Enterprise Data Broker

The specific purpose of the EDB is to implement a universal messaging system by which to request, transform, route, and receive data from/to disparate databases and applications across the enterprise. The EDB is a first step in moving towards a more comprehensive Enterprise Service Bus that allows for a full range of needed services within the Manpower, Personnel, Training and Education (MPT&E) enterprise. The EDB has been instantiated as a limited prototype used to access the various data inputs COMPASS requires and to store database queries that were used to generate the data inputs. These queries can be re-used to update data inputs for COMPASS. There is also a limited capability to construct and store new data queries related to MPT&E. This instantiation of the EDB is the COMPASS Parameter Tool Set. Some technical aspects of the EDB follow.

EDB System Architecture

A high-level architecture diagram of the EDB can be found in Figure 2 below.

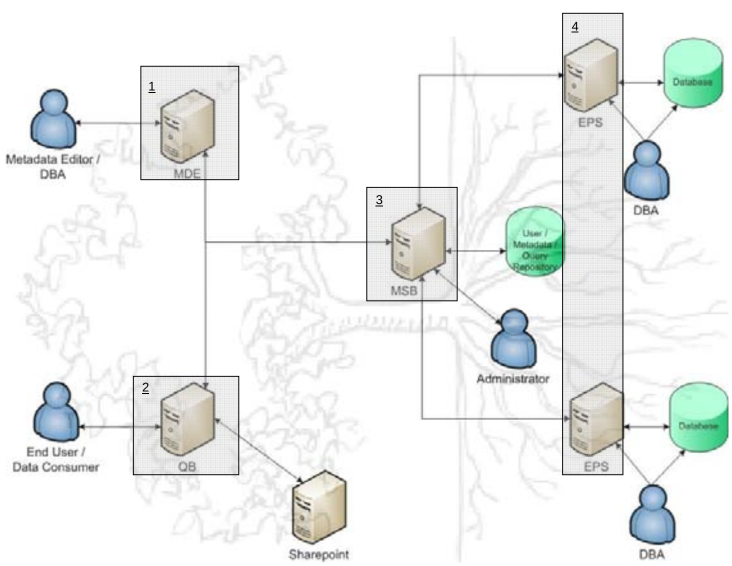


Figure 2. High-level EDB architecture.

The EDB consists of 4 major components (some of which are re-usable):

1. Metadata Editor (MDE): Also considered a leaf node, the metadata editor application is responsible for the maintenance of EDB metadata. The editor is intended to be used by a Data Base Administrator (DBA) with intimate knowledge of the target database(s), who can abstract the data into measures and calculated measures effectively so that they can later be added to end-user queries via the QB. The EDB supports multiple instances of the MDE, although currently, only a single instance is recommended.

2 Query Builder (QB): Considered a leaf node because it is user-facing, the query builder application is responsible for the addition, modification, deletion, and execution of end-user query “scenarios” (user-specified combinations of metadata filtered or extended in a desired way). The EDB supports multiple instances of the QB, although currently, only a single instance is recommended.

3 Metadata Service Bus (MSB): Considered the “trunk” of the EDB, the MSB is a central collection of web services, responsible for the authentication and authorization of users, maintenance of the EDB metadata, maintenance of the end-user queries, and the handling of query execution. The EDB supports only a single instance of the MSB.

4 Endpoint Service (EPS): Considered a root node, the EPS is a web service wrapper for the end point, or database engine. All queries from anywhere in the EDB domain must pass through the endpoint service corresponding to the query's target database. The EPS contains the connection information for the target database and services all queries for the target database. The EDB supports the use of multiple EPSs, one for each discrete database in the target environment.

Optimization

Use of optimization as part of this effort included the development, implementation, and testing of an optimizer for an entity-based simulation model capable of assessing the implication of various policy decisions on overall effectiveness and cost. This work illustrated the use of new methodologies that integrate simulation and optimization capabilities whose underlying search processes make use of integer programming methodology that goes beyond classical procedures.

The emergence of metaheuristics has revolutionized the field of optimization in recent years. The underlying principle of metaheuristics involves the creation of methods that oversee and guide other methods to overcome the trap of local optimality, as introduced in Glover (1986), and first brought together on an international scale in the body of work reported in Kelly and Osman (1996). The application of this principle has become the source of new solution procedures providing an ability to solve many important problems beyond the realm of classical optimization. One of the most significant application areas in the solution of real world problems is represented by the domain of simulation optimization, where the use of appropriately designed meta-heuristics has enabled many forms of simulation models to be optimized effectively that previously were beyond the state of the art (see, e.g., Law & Kelton, 2000; Gosavi, 2003). The primary goal of this research was to create a prototype optimization system capable of determining optimal human resource planning policies that meet the performance objectives of the COMPASS system.

Optimization Model and Algorithm

The optimizer developed for the COMPASS system is capable of producing optimal and near-optimal solutions to the following class of optimization problems:

Max or Min $F(x)$

Subject to $A_x < b$ (Constraints)

$g_l < G(x) < g_u$ (Requirements/Non-linear constraints)

$l < x < u$ (Bounds)

where x can be continuous or discrete with arbitrary step sizes.

The objective $F(x)$ may be any mapping from a set of values x to a real value. The set of constraints must be linear and the coefficient matrix A and the right-hand-side values b must be known. The requirements are simple upper and/or lower bounds imposed on a function that can be linear or non-linear. The values of the bounds g_l and g_u must be known constants. All the variables must be bounded and some may be restricted to be discrete with arbitrary step sizes.

A typical example might be to maximize effectiveness by judiciously choosing policies subject to budget restriction and limited on risk. In this case, x represents the specific policy participation levels, while $F(x)$ is the expected effectiveness. The budget restriction is modeled as $A_x < b$ and the limit on risk is achieved by a requirement modeled as $G(x) < g_u$ where $G(x)$ is a measure of performance variability. Each evaluation of $F(x)$ and $G(x)$ requires a simulation of the system for the policy vector x. By combining simulation and optimization, a powerful design tool results.

The optimization procedure uses the outputs from the system evaluator (COMPASS Simulation), which measures the merit of the inputs that were fed into the model. On the basis of both current and past evaluations, the optimization procedure decides upon a new set of input values (see Figure 2).

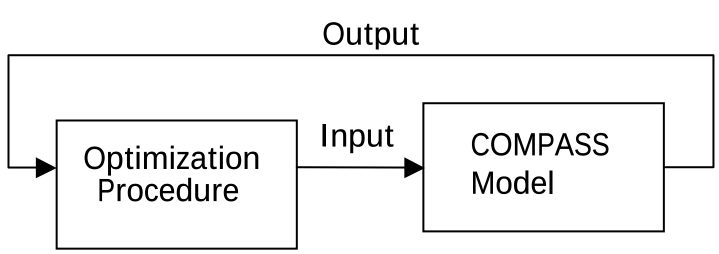


Figure 2. Coordination between optimization and system evaluation.

The optimization procedure is designed to carry out a special "non-monotonic search," where the successively generated inputs produce varying evaluations, not all of them improving, but which, over time, provide a highly efficient trajectory to the best solutions. The process continues until an appropriate termination criterion is satisfied (usually based on the user's preference for the amount of time to be devoted to the search). The efficiency of the optimization procedure is particularly important in the context of simulation of complex systems. Finding the best policy in such an environment can easily require thousands of simulations.

Optimization Software

The goal of the optimization software (developed separately from the simulation software) was to produce a working integrated system that effectively demonstrates the advantages of optimization. Use of the optimization engine within the software engages a mode of operation separate from the more traditional simulation mode. The optimization scenario user interface allows the user to define a policy vector that is then mapped to decision variables in the optimizer. The optimization then automates the process of systematically manipulating the policy vector and running the simulation iteratively. The objective function is defined as a combination of a cost component and a measure of effectiveness component that results from a single run of the simulation upon each iteration. The user can also specify the number of solutions to be evaluated and the number of scenarios to be saved when the optimization completes. The policy vectors that produce the best objective function values are then saved as scenarios which can then be examined in detail using the COMPASS user interface.

Operation and Use

There are three necessary skill sets for continuous development, operation, and application of the tool's result. Those skills are software development, model design/development, and analysis, often termed programmers, modelers, and analysts. Analysts provide internal verification and validation for specific policy analysis within for the organization. Because of their intimate familiarity with the functional operation of the real world system, they can effectively articulate the system issue(s) necessary to perform analysis. For our purposes, analysts include NPRST research personnel and analysts embedded in various Navy organizations (e.g., community management, detailing). Model developers are individuals with an academic background and professional experience in computer simulation. Programmers are individuals with an academic background and professional experience in developing software (e.g., computer simulations). Researchers recommend the complement of these skills working as a team for any further development, maintenance, and use of COMPASS. Furthermore, these skills are recommended for the success of other modeling and simulation efforts.

Verification

The objective of verifying the COMPASS model was to certify the model's representation of the Navy's real world systems, and verify the model's process behaviors with subject matter expert experiences and perceptions. Although accreditation is not referenced as typically conducted in modeling exercises, the research team intended successful completion of the verification and involvement with Navy workforce analyst would increase the likelihood of the model's creditability. The process description documentation represented in Appendix A was thoroughly verified by Navy subject matter experts.

Conclusions and Recommendations

This effort resulted in the development of an enterprise-level Navy workforce analysis simulation model that combines stochastic simulation and use of optimization. Navy workforce analysts agreed with the use of stochastic variables, but were concerned that their level of expertise and workload would not allow them to learn the operations and utilize the model. They expressed further concerns with the model's method for assigning Sailors to jobs. To the extent this effort continues, the model's verification will continue, a complete empirical validation should be performed, and the skill sets described in this report should be employed and maintained throughout the model's lifecycle.

It is recommended, and our plan is, that NPRST research staff continues to brief Navy workforce analysts on the capabilities of the COMPASS simulation model, and that lessons learned from the development of COMPASS be shared with analysts who are developing future workforce strategy models. Where appropriate, future models should combine simulation and optimization, include multiple system functional areas, use probabilistic variables to represent the stochastic behaviors of the real world, and use service-oriented architecture to supply the model's data and other analysis processes.

References

Glover, F. (1986). Future paths for integer programming and links to artificial intelligence. *Computers and Operations Research*, Vol. 13 (5), pp. 533-549.

Glover, F., & Laguna, M. (1997). *Tabu Search*. Boston: Kluwer Academic Publishers.

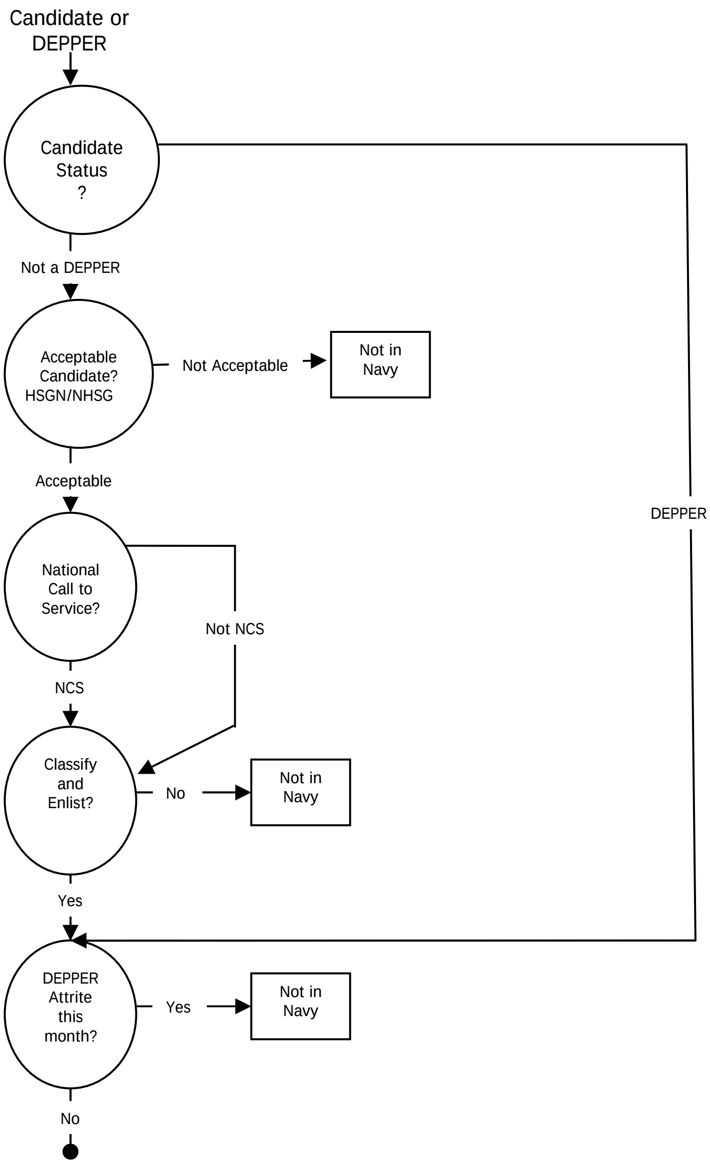
Gosavi, A. (2003). *Simulation-Based Optimization*. Boston: Kluwer Academic Publishers.

Kelly, J. P., & Osman, I. H. (1996). *Metaheuristics: Theory & Applications*. Boston: Kluwer Academic Publishers.

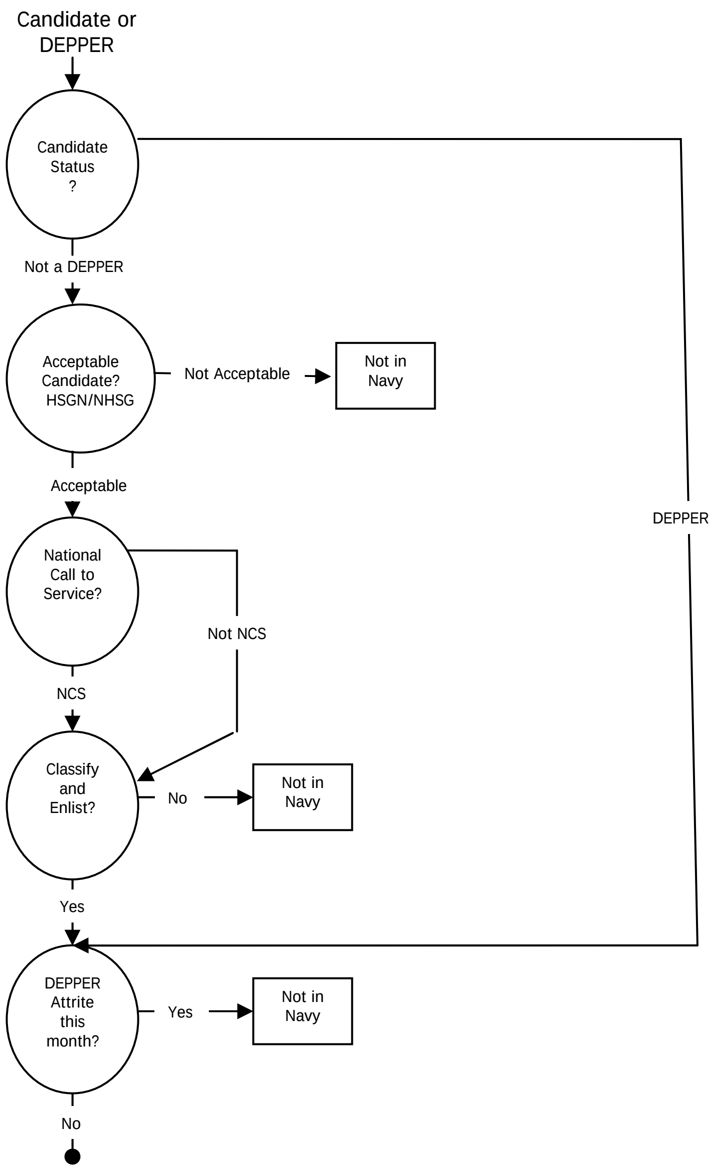
Law, A. M., & Kelton, W. D. (2000). *Simulation Modeling and Analysis*. New York: McGraw Hill.

Appendix A:
Process Description Documentation

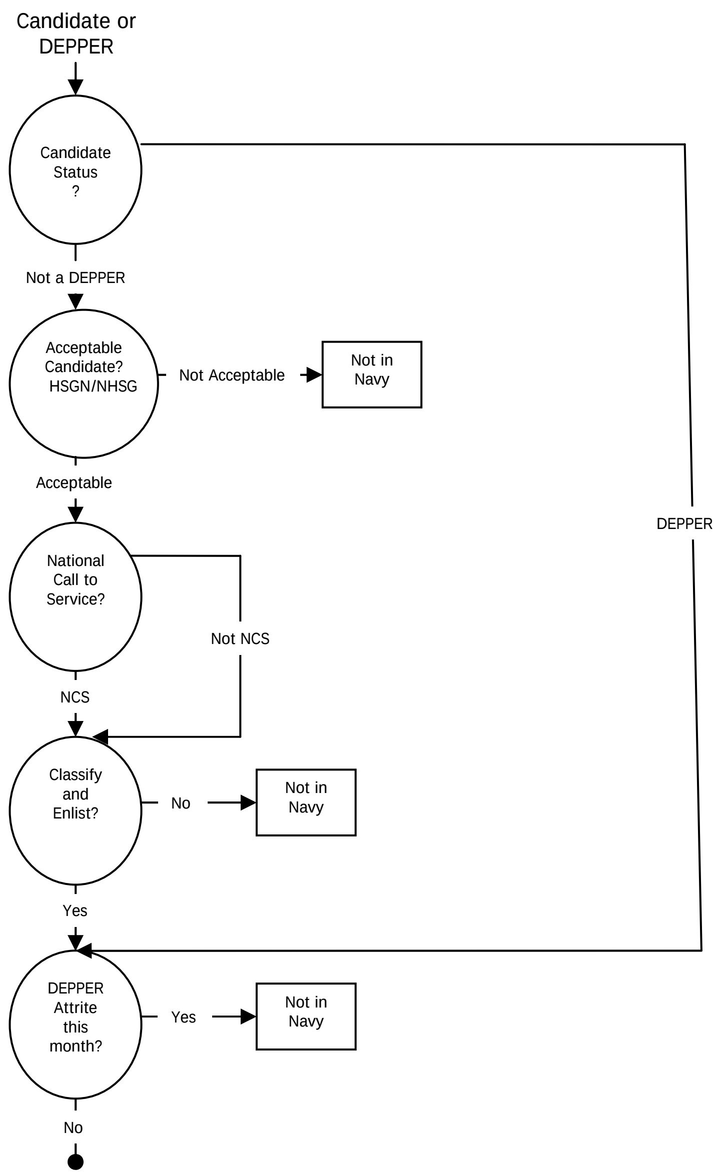
Recruit, Select, and Classify



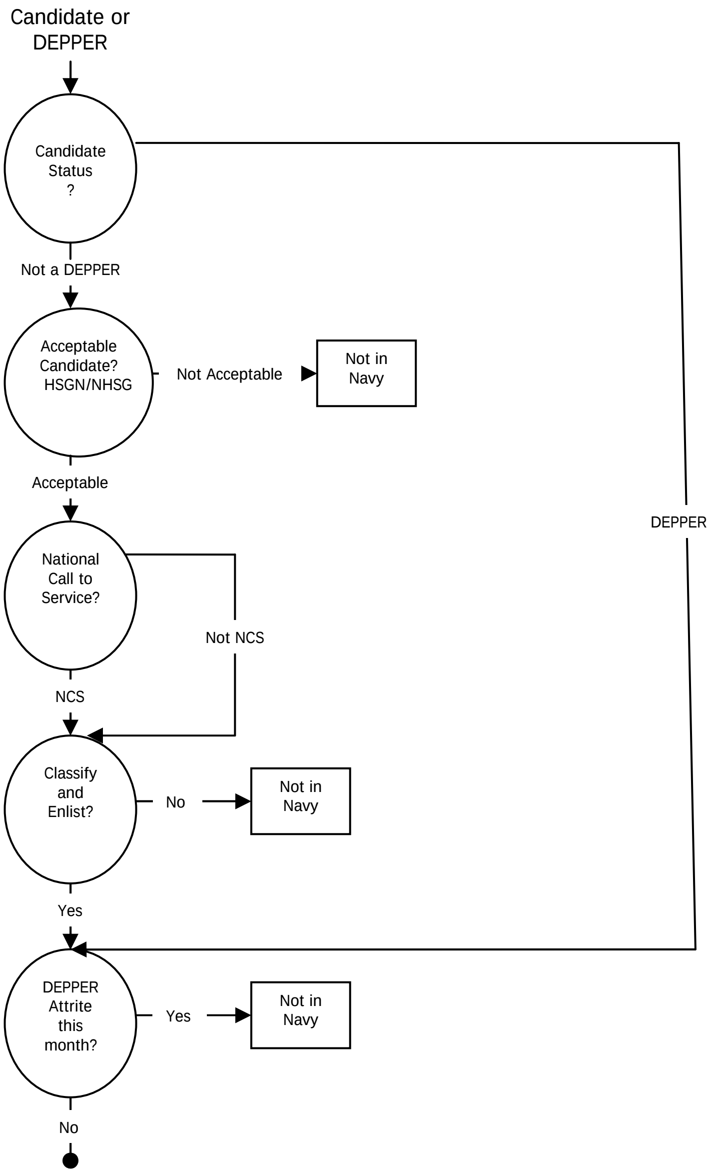
Loss and Separation



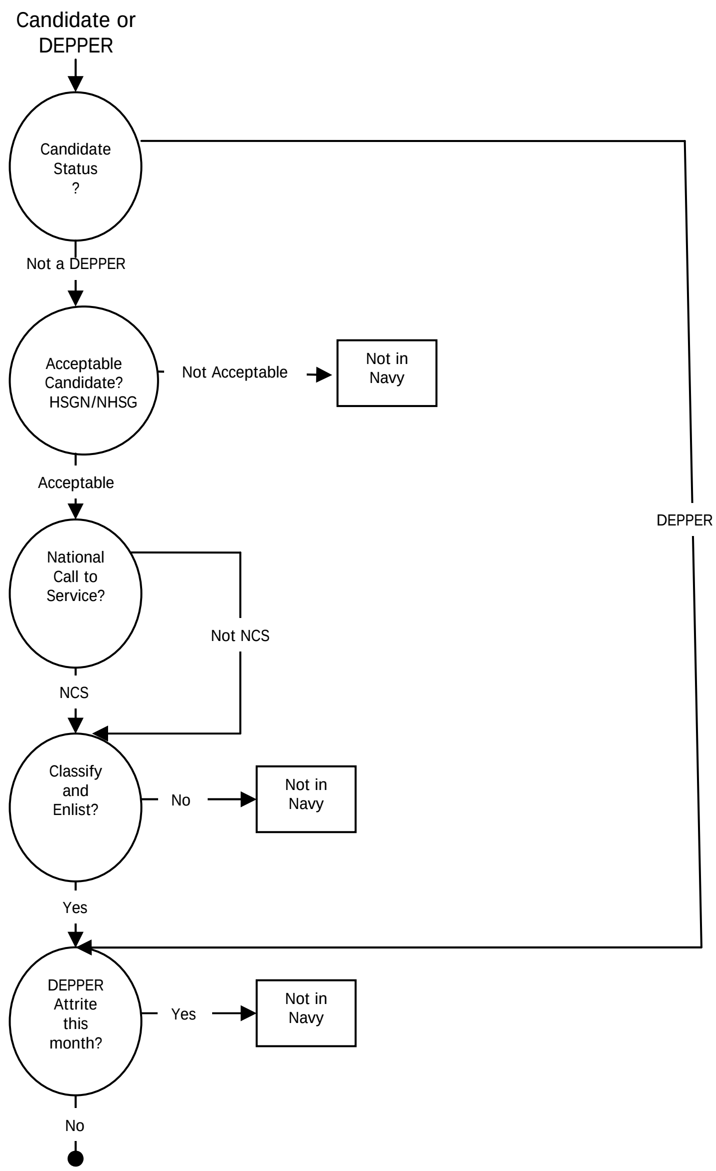
Training


Candidate or DEPPER
Candidate Status ?
Not a DEPPER
Acceptable Candidate? HSGN/NHSG
Not Acceptable
Not in Navy
Acceptable
DEPPER
National Call to Service?
Not NCS
NCS
Classify and Enlist?
No
Not in Navy
Yes
DEPPER Attrite this month?
Yes
Not in Navy
No

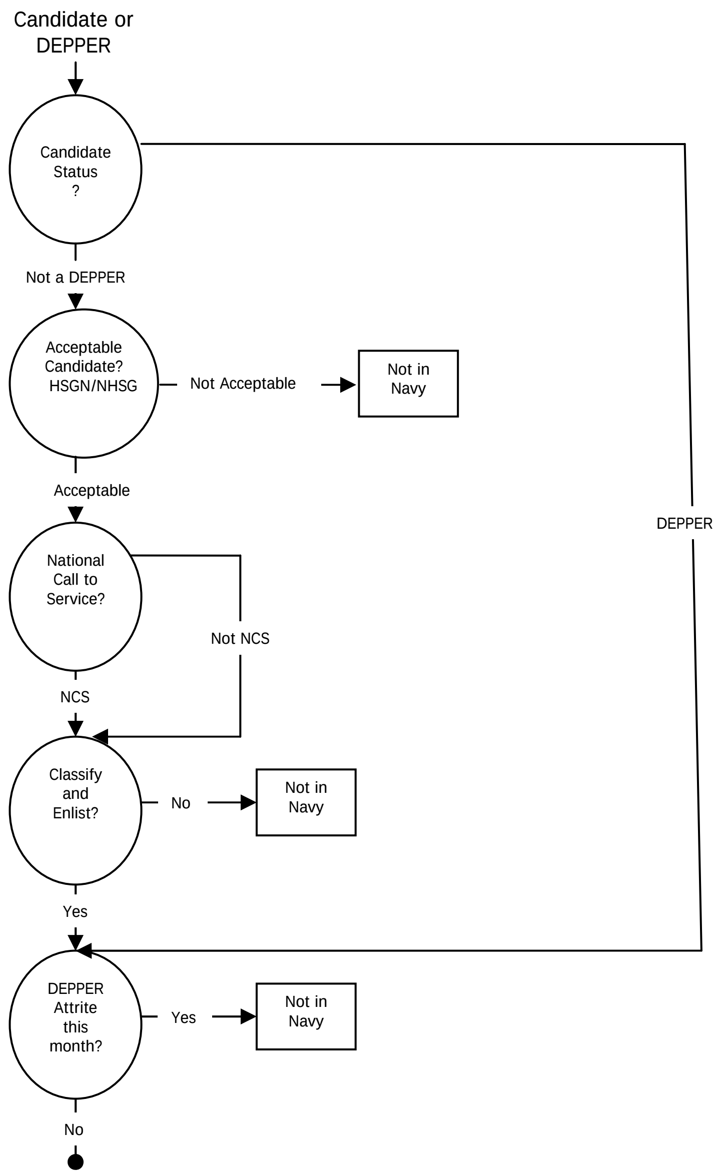
Advancement



Re-enlistment



Distribution



Appendix B:
Functional Area Model Assumptions

General Assumptions

General Assumptions

- A schedule for availability of the products necessary for validation will be provided by the contractor participants in this effort with completion dates. The following are some of the products needed to effectively and efficiently perform the validation
  - The input data and metrics necessary to run and evaluate the COMPASS validation simulations
    - Per the prototype design many of the current rate distributions in the database are notional. Distributions based on actual data are needed to achieve reasonable validation results
    - Policy parameter values and input data matching the actual state of the Navy MPT&E enterprise at the relevant validation time frames
  - The COMPASS database updated with archival data
  - Missing computations for the metrics necessary to evaluate the 20 observable behaviors implemented in COMPASS for validation of the Functional Area (FA) simulations
  - FAs audited, fixed and regression-tested needed for qualitative validation against outcomes expected by SMEs
  - Complementary automated GUI functionality that supports flexible nesting of: parameter (e.g., SRB Level Delta for a Zone) sweeps; varying random seed runs; and input (e.g., NHSG%) changes, as well as organization and collection of the outputs and metrics.
- Completion of the validations depends upon
  - Timely delivery of the products above
- For the purposes of COMPASS FY-level decisions it was deemed that policy parameters only changing at the start of a fiscal year and applying to an entire fiscal year was sufficient.
- COMPASS runs at the monthly level, but validation comparisons at that level are not within the scope of the current work.

Recruit-Select-Classify (RSC)

- The qualification of an applicant to enlist is embodied in one single random number draw. There is no modeling at a lower level of detail such as having an interview with the recruiter and a battery of mental and physical tests

- Recruits classify for the EMC with the lowest manning and highest AFQT scores for which they are qualified
- DEP Duration ≤ 12 months

Training

- GENDETs in RTC may classify for the EMC with the lowest manning and highest AFQT scores for which they are qualified
- A Sailor who has already recycled through training and then attrites from training is a loss to the Navy

Advancement

- Time-In-Grade (TIG) and a random Sailor ID approximate the Final Multiple Scoring for the advancement process. Sailors with higher TIG are advanced first to fill vacancies at PG + 1; the random ID number ensures that advancements are not biased by unintended internal ordering of the Sailors
- Each Sailor eligible to advance is assumed to be a test passer and is frocked for advancement in a month in which boards meet for advancement if there are projected vacancies
- Frockees for E-7/8/9 at end of year are advanced irrespective of vacancies
- Frockees for E-5/6 at six months after their frocking date will be advanced irrespective of vacancies
- B-3 Sailors gets advanced immediately whether or not there a vacancy
- Every B-3 upon "A" School graduation is advanced to E-4 immediately regardless of vacancies or quota

Reenlistment

- In simulating a random reenlistment in the current FY, if the sum of the SRB for that reenlistment plus the SRB accumulations spent in the current FY exceeds the current FY SRB budget, the reenlistment is still allowed. Then the reenlistment date is set forward to October 1st of the next FY and is amortized over the term of the reenlistment
- Sailors in paygrades less than E-4 are not eligible to reenlist
- A Sailor ineligible to reenlist in-rate may accept conversion, but the details of PTS such as rack and stack are not modeled
- Eligibility to reenlist in-rate may be restricted based on over manning, but never flatly denied

Loss and Separation

- The take rates for the programs that the Sailor is eligible for, has available quota, and benefits a Sailor of his age are used to generate a cumulative take rate distribution for probability choice of a particular program such as TERA, VSI , SSB, or TIPS. Each Loss Program has two age parameters, Minimum Age and Maximum Age as well as LOS parameters which constrain the Sailor's eligibility to take the program
- The probability of separation is sufficiently determined by a random draw against the take rate for the program selected

Distribution

- GENDETs who are not on Sea Duty will have 1.0 probability of assignment to a generic Sea Duty billet
- GENDETs on Sea Duty will have 1.0 probability of assignment to a generic Shore Duty billet
- For their first tour, 95 percent of GENDETs will go to Sea Duty, and the remaining 5 percent will go to Shore Duty
- In the case where the Sailor does not have sufficient Obliserve, a check that the Sailor is willing to add months to EAOS uses a probability based on the number of months required to be added and the Sailor Term. The probability per month of Obliserve is set notionally at 0.043 for Term = 1, and .02 for any other Term

Striking for an EMC

- GENDETs with between 9 and 24 months remaining on their current tour have an equal chance at striking for EMCs they are qualified for. By the 24 month mark 95 percent of GENDETs will have decided to strike with a distribution clustered around the 18–22 month mark
- The remaining 5 percent will remain GENDETs and become losses at EAOS
- GENDETs strike for the EMC with the lowest manning and highest AFQT scores for which they are qualified

Appendix C: Glossary

Glossary

AFQT—Armed Forces Qualifying Test is a multiple choice test, administered by the United States Military Entrance Processing Command, used to determine qualification for enlistment in the United States armed forces. It is often optionally administered to American high school students when they are in the 11th grade, though anyone eligible to and interested in enlisting can take it.

Attrite—An individual who separates from service prior to nine months of their end of obligated service date.

Deterministic Model—The output is determined once the set of input quantities and relationships in the model have been specified; does not include any stochastic (random) components.

EAOS—End of Active Obligated Service is the date on which the obligation stated in the original Form DD 4 falls. Usually 4 to 6 years after the date of the contract.

EMC—Enlistment Management Code, a program-generated code that identifies the enlisted community to which a member is designated. Community Managers use it to determine the strength and personnel needs of their communities.

Frocking—An administrative authorization to assume the title and wear the uniform of a higher paygrade without an entitlement of the pay and allowances of that grade. Frocking provides early recognition for members selected for petty officer third class through master chief petty officer.

FA—Functional Area is used to describe a grouping of activities or processes on the basis of their need in accomplishing one or more tasks (e.g., training).

GENDET—General Detail. A non-rated enlisted member.

LOS—Length of Service. A term used to describe the amount of time an individual members has served.

Obliserve—Obligated service. A term used to describe the obligated time an individual member is contracted to serve.

Perform-to-Serve—Is a long-term force-shaping tool that aids in leveling rating manning between overmanned and undermanned ratings, while managing the equality of reenlistment applicants by controlling the authority for reenlistment.

Sailor Term—The Enlistment Term. For the initial enlistment, "Term" = 1. After the first reenlistment, "Term" = 2 and then 3 and so on. Today, the expression Zone is used, however, there is not a one-to-one correspondence of “Term” and Zone since a Sailor can be in Zone A while also in his first or second “Term.”

SME – Subject Matter Expert is an individual(s) who understands a business process or area well enough to represent it to others. This understanding is typically gained by experience working within the business process or area.

SRB—Selected Reenlistment Bonus. Bonus used as an incentive to reenlist for members of selected ratings or Navy Enlisted Codes (NEC).

Stochastic—Involving random variable(s), or referring to patterns resulting from random effects.

SSB—Special Separation Benefit. One-time payment to the eligible military member to separate from active service if they have served less than 20 or more than 6 years of service. There may be other eligibility requirement such as skill or rating, rank or grade, and remaining period of obligated service. This program is authorized by the Fiscal Year 1992 defense Authorization Act, as codified at Title 10, United States Code, sections 1174a and 1175.

Striking—The process of moving from being a non-rated Gendet (airmen, firemen, seamen) to a rated Sailor, for example a striker for IT might become an IT3.

TERA—Temporary Early Retirement Authority. National Defense Authorization Act for FY 1993, provided the Secretary of Defense a temporary additional force management tool with which to effect the drawdown of military forces.

VSI—Voluntary Separation Incentive. The VSI program is a separation benefit program offered to certain mid-career service members of the Armed Forces in over-strength career fields to encourage the members to leave active duty voluntarily. This program is authorized by the Fiscal Year 1992 defense Authorization Act, as codified at Title 10, United States Code, sections 1174a and 1175.

Distribution

AIR UNIVERSITY LIBRARY
ARMY RESEARCH INSTITUTE LIBRARY
ARMY WAR COLLEGE LIBRARY
CENTER FOR NAVAL ANALYSES LIBRARY
HUMAN RESOURCES DIRECTORATE TECHNICAL LIBRARY
JOINT FORCES STAFF COLLEGE LIBRARY
MARINE CORPS UNIVERSITY LIBRARIES
NATIONAL DEFENSE UNIVERSITY LIBRARY
NAVAL HEALTH RESEARCH CENTER WILKINS BIOMEDICAL LIBRARY
NAVAL POSTGRADUATE SCHOOL DUDLEY KNOX LIBRARY
NAVAL RESEARCH LABORATORY RUTH HOOKER RESEARCH LIBRARY
NAVAL WAR COLLEGE LIBRARY
NAVY PERSONNEL RESEARCH, STUDIES, AND TECHNOLOGY SPISHOCK LIBRARY (3)
OFFICE OF NAVAL RESEARCH (CODE 34)
PENTAGON LIBRARY
USAF ACADEMY LIBRARY
US COAST GUARD ACADEMY LIBRARY
US MERCHANT MARINE ACADEMY BLAND LIBRARY
US MILITARY ACADEMY AT WEST POINT LIBRARY
US NAVAL ACADEMY NIMITZ LIBRARY