(2)

NAVAL POSTGRADUATE SCHOOL

Monterey, California

THESIS

THE EFFECT OF A U.S. NAVY REDUCTION IN FORCES ON THE CAREER PATH OF SURFACE WARFARE OFFICERS PROGRESSING TO COMMAND AT SEA

by

Lawrence G. Bertolino

September, 1990

Thesis Advisor: P. R. Milch

Unclassified

security classification of this page

REPORT DOCUMENTATION PAGE

1a Report Security Classification Unclassified		1b Restrictive Markings	
2a Security Classification Authority		3 Distribution/Availability of Report	
2b Declassification Downgrading Schedule		Approved for public release; distribution is unlimited.	
4 Performing Organization Report Number(s)		5 Monitoring Organization Report Number(s)	
6a Name of Performing Organization Naval Postgraduate School	6b Office Symbol *(if applicable)* OR	7a Name of Monitoring Organization Naval Postgraduate School	
6c Address *(city, state, and ZIP code)* Monterey, CA 93943-5000		7b Address *(city, state, and ZIP code)* Monterey, CA 93943-5000	
8a Name of Funding Sponsoring Organization	8b Office Symbol *(if applicable)*	9 Procurement Instrument Identification Number	
8c Address *(city, state, and ZIP code)*		10 Source of Funding Numbers	
		Program Element No	Project No / Task No / Work Unit Accession No

11 Title *(include security classification)* THE EFFECT OF A U.S. NAVY REDUCTION IN FORCES ON THE CAREER PATH OF SURFACE WARFARE OFFICERS PROGRESSING TO COMMAND AT SEA

12 Personal Author(s) Lawrence G. Bertolino

13a Type of Report	13b Time Covered	14 Date of Report *(year, month, day)*	15 Page Count
Master's Thesis	From To	September 1990	70

16 Supplementary Notation The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.

17 Cosati Codes			18 Subject Terms *(continue on reverse if necessary and identify by block number)*
Field	Group	Subgroup	SWO Career path, Command Opportunity, FORECASTER model

19 Abstract *(continue on reverse if necessary and identify by block number)*

This thesis analyzes the effects of planned U.S. Navy reduction in forces on the career path of Surface Warfare Officers progressing towards Command at Sea. FORECASTER, a Markovian model for forecasting naval officer distributions, was utilized to conduct steady state and transient analyses of current and planned billet data for FY 1990 - FY 1995. The results of these analyses indicated that a larger portion of officers will be serving in follow-on division officer tours, single (longer) department head tours, and in second (split) tour department head tours. Additionally, both Executive Officer and Commander Command Opportunity will decrease as billet reductions and redistributions are enacted.

20 Distribution Availability of Abstract	21 Abstract Security Classification	
☒ unclassified unlimited ☐ same as report ☐ DTIC users	Unclassified	
22a Name of Responsible Individual P. R. Milch	22b Telephone *(include Area code)* (408) 646-2882	22c Office Symbol OR/Mh

DD FORM 1473,84 MAR 83 APR edition may be used until exhausted
All other editions are obsolete

security classification of this page

Unclassified

Approved for public release; distribution is unlimited.

The Effect of a U.S. Navy Reduction in Forces on the Career Path of Surface Warfare Officers Progressing to Command at Sea

by

Lawrence G. Bertolino
Lieutenant, United States Navy
B.A., Tulane University of Louisiana, 1983

Submitted in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE IN OPERATIONS RESEARCH

from the

NAVAL POSTGRADUATE SCHOOL
September 1990

Author: Lawrence G. Bertolino

Lawrence G. Bertolino

Approved by: Paul R. Milch

P. R. Milch, Thesis Advisor

Paul S. Bloch

P. S. Bloch, Second Reader

Peter Purdue

Peter Purdue, Chairman,
Department of Operations Rsearch

ABSTRACT

This thesis analyzes the effects of planned U.S. Navy reduction in forces on the career path of Surface Warfare Officers progressing towards Command at Sea. FORECASTER, a Markovian model for forecasting naval officer distributions, was utilized to conduct steady state and transient analyses of current and planned billet data for FY 1990 - FY 1995. The results of these analyses indicated that a larger portion of officers will be serving in follow-on division officer tours, single (longer) department head tours, and in second (split) tour department head tours. Additionally, both Executive Officer and Commander Command Opportunity will decrease as billet reductions and redistributions are enacted.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

I. INTRODUCTION

A. SURFACE FLEET IN TRANSITION

The surface fleet of the U.S. Navy is in the early stages of a major transition. No longer is the U.S. Navy building towards its goal of a 600 ship fleet; instead, the number of surface ships is declining. The primary reasons for this reduction are twofold. First, with the easing of tensions between the United States and the Soviet Union, Congress and the American people no longer perceive the need for the continued massive buildup of U.S. forces. In fact, with the perceived end of the Cold War, a so-called "Peace Dividend" is being sought after, presumably resulting from significant military budget cuts. These cuts in conjunction with the slowing of the growth of the fleet threaten to reduce the number of new construction ships to a trickle.

Secondly, the size of the U.S. fleet is declining through the natural process of aging. Of the almost 400 ships in the surface fleet today, over 24 percent are over 25 years old. Consequently, some entire ship classes are being decommissioned as they reach the end of their service life. An example of this is the DDG-2 Adams' class guided-missile destroyer. The 16 ships of this class still in the active fleet were all built between 1960 and 1965 and are in the process of being phased out at the end of their service life of 30 years. Other ships are undergoing service life extension programs (e.g., USS America CV-66) in order to forego the cost of replacement. Still others are being sold to foreign countries (e.g., USS Hermitage LSD-34) or are being transferred to the Naval Reserve Fleet, which in turn reduces manning requirements. In all, over seven different ship classes will have some or all ships in the class decommissioned over the next five years.

B. REPERCUSSIONS

As ships are decommissioned at a pace faster than new construction, the number of ships in the fleet will decline, so too will the number of at sea billets for Surface Warfare Officers (SWO's). However, these billets will not decrease in a uniform manner. The ships now entering the fleet tend to be larger and more complex than the ships that they are replacing. Consequently, the new ships require more senior officers to handle similar positions on ships that they are replacing.

The billet situation is most acute at the Commander Command level. Whereas the majority of the ships being decommissioned are Commander Command ships (e.g., DDG-2 Adams' class), the new ships entering the fleet are Captain Command (e.g.,

CG-47 Ticonderoga class). This disparity in billet replacement threatens to create a crisis in Command Opportunity.

Command Opportunity, in its simplest terms, is the ratio between the number of Command billets available at a particular point in time and the number of qualified personnel available to fill these billets. For example, if during the course of a year 25 command billets became available and the number of officers eligible to fill these billets during the same time period was 50, then the annual Command Opportunity could be expressed as 25/50 or 50 percent. Traditionally, Commander Command Opportunity for Surface Warfare Officers has been above 50 percent. However, at the present time it is at 55 percent.

With fewer ships and a changing billet structure, Commander Command Opportunity is predicted to decrease. The size of this reduction is dependent upon the size of future force cuts as well as the pace at which the older ships will be retired. Considering the uncertainty of the present world situation, any long range force level predictions are precarious. However, as the fleet ages, decline is inevitable, only the pace at which the fleet declines is uncertain. Given these uncertainties, an analysis of what effect "best guess" reductions in force will have on Commander Command Opportunity can still provide valuable insight into possible problems and solutions. Background information will be provided in the next chapter, to explain why Commander Command Opportunity is such an important issue.

C. PROBLEM STATEMENT

The purpose of this thesis is to analyze what effects the proposed reductions in forces will have on Surface Warfare Officers in general, and on Commander Command Opportunity in particular. FORECASTER (an officer flow model discussed in some detail in Chapter III) will be utilized to conduct the steady state and transient analyses of current and predicted billet data for FY 1990 - FY 1995 period. Conclusions and recommendations will complete this analysis.

II. BACKGROUND

A. CAREER GOALS OF A SURFACE WARFARE OFFICER

The primary goal of a Surface Warfare Officer (SWO) is to attain Command at Sea. Command at Sea is defined as being the Commanding Officer of an ocean going ship; therefore, command of a destroyer (DD) or a guided-missile frigate (FFG) is considered command at sea, while command of a minesweeper (MSO,MCM) or a hydrofoil (PHM) is not. At the present time, the first opportunity for command at sea occurs at the rank of Commander (O-5). Commanders who successfully complete a command sea tour are later eligible to command larger ships, designated as major commands, at the rank of Captain.

B. CAREER PATHS

A SWO follows a fairly rigid career path enroute to command. This path is composed of alternating sea and shore tours which vary in length and complexity. Sea tour performance is the primary means by which a SWO is evaluated. Sea tours provide the SWO with the opportunity to achieve warfare and command qualifications as well as sharpening leadership, tactical, and management skills. Shore tours provide a relief from the arduous pace of sea duty and allow a SWO to meet professional requirements such as postgraduate education and joint service. Besides serving in these tours, an officer must be selected by various selection boards at different points of his/her career in order to advance to more complex tours and ultimately toward the goal of command.

The career path that is modeled in Chapter III is the typical career path of an "on track" officer. The description "on track" means the officer is successfully completing the expected tours (required) and is progressing toward command at sea at the normal rate for his/her year group. If an officer follows a path other than the one described below, then he/she could be ahead or behind his/her year group and is not included in this analysis.

The first tour that a SWO serves is the division officer tour. This tour is for three years and provides the SWO trainee with an opportunity to earn his/her warfare qualifications. Additionally, the division officer has approximately 15-30 enlisted personnel (E-1 to E-9) under his control pertaining to a specific area of shipboard operations (e.g., the communications officer is in charge of radiomen and signalmen, personnel who handle the visual and electronic communication needs of the ship.). A division officer

is eligible to rotate to shore duty at the completion of his/her tour only if he/she has been selected by a department head selection board. The department head selection board chooses a division officer based upon his/her performance and selection signifies that the officer is ready to assume positions of greater responsibility and complexity. If an officer is not a department head selectee at the completion of his/her division officer tour, then he/she will serve an additional 18 month division officer tour. Officers who are department head selectees will be assigned a two year shore tour.

The shore tour following the first sea tour is primarily designed to give an officer a welcome break from the rigors of sea duty. A SWO has the opportunity to fill a multitude of billets during this tour. Shore tours can be in such diverse areas as recruiting, teaching, or staff duty. Alternately, SWO's can use this tour as a chance to obtain postgraduate education. Upon completion of this tour the SWO will proceed to department head training.

If an officer is assigned a second division officer tour, this tour must be taken in place of a shore tour in order that the officer remains "on track". The second division officer tour provides a SWO with the chance to gain the additional experience and evaluations required for department head selection. This tour is more complex than the first and is designed for an experienced division officer. While the number of enlisted personnel of whom a second tour division officer is in charge is also between 15 and 30, the division itself is one of the more critical and important divisions on the ship (e.g., damage control or navigation). Because of the need to fill these positions with competent and experienced officers, sometimes department head selectees are also assigned second division officer tours. Second division officer tours do provide qualified SWO's with the chance to obtain additional qualifications (such as Engineering Officer of the Watch) without the burden of concurrently trying to achieve their initial Surface Warfare qualification. Upon the completion of the second division officer tour, an officer will then proceed to department head school.

Surface Warfare Officer Department Head School is a six month school that prepares SWO's for duty as department heads. Additionally, upon completion of this school, many officers will attend follow-on schools that will cover specific aspects of their upcoming tours. Because of the duration of the period for department head school and any follow-on schools, department head preparation is considered a tour in itself. The school consists of two parts. The first seventeen weeks consist of combat systems training, engineering fundamentals, and other related training. Approximately three months after course commencement, officers receive their orders and are broken up into

groups which reflect the specific departments in which they will be serving. The second phase of the course is seven weeks long and focuses on the systems, requirements, and responsibilities of these departments. Upon completion of department head school and any follow-on training, SWO's will proceed to their department head tours.

The department head tour is a sea tour which consists of two 18 month tours or one 30 month tour. A department head is in charge of a general area of shipboard operations. For instance, the chief engineer is the department head responsible for all of the engineering functions of the ship. Specifically, this includes the ship's propulsion, auxiliary and electrical systems, as well as repair and damage control. Each of these individual areas is controlled by a division officer, while the department head has overall responsibility. Typically, the department head will have 2 to 4 division officers and 50 to 100 enlisted personnel under his command.

While serving his/her department head tour, a SWO is expected to make progress towards command at sea qualifications. This includes achieving a Tactical Action Officer (TAO) qualification. TAO qualification means that the Captain of the ship has given authority to the officer to fight the ship (i.e., fire weapons) in his absence. Additionally, a SWO is also expected to qualify as an Engineering Officer of the Watch in order to manage and/or supervise the running of the engineering plant. These specific qualifications can be obtained at any point prior to command qualification, but are usually achieved by the conclusion of the department head tour.

As mentioned previously, the department head tour can be served as one or two tours. The single 30 month department head tour is designed for those officers with extensive experience in a particular department, and on those ships where greater department head continuity is required for successful shipboard operations. For instance, this includes the chief engineer positions on fleet oilers (AO) and guided-missile destroyers (DDG). The two 18 month department head tours, or split tours as they are commonly referred to, usually take place on two different type ships. The second department head tour will be in a more complex position than the first. It will typically be on a larger ship and can include at sea staff duty instead of command of a department. Whatever the case, split touring puts experienced officers in the most challenging billets as well as exposing them to a variety of ships. Upon completion of the second department head tour or the single length department head tour, SWO's rotate to shore duty.

The second shore tour is typically three years in length and enables the officer with a chance to pursue further professional development. If an officer attains a postgrad-

uate education in specific areas, he/she can gain a subspecialty qualification. Officers who already have a subspecialty will most likely be assigned a shore duty position which puts it to use. Additionally, a SWO can attend joint training and serve a joint tour. Upon completion of this tour, and after selection by the executive officer selection board, a SWO will attend a six week executive officer course and will then proceed to his/her executive officer (XO) tour.

The XO tour is 18 months long and is by far the most demanding of the pre-command sea tours. The XO is second-in-command on the ship and typically has between 10-15 officers and 160-360 enlisted personnel under his/her charge. The XO is responsible for all facets of the ship's operation from personnel training to shipboard maintenance to navigation. While serving as XO, a SWO will complete his/her command qualifications if they have not already been completed. The command qualification process culminates with an eight hour written test and with an extensive oral board administered by the ship's Commanding Officer (CO) and two other CO's. In order to be screened for Command at Sea, a SWO must first have completed his/her command qualifications. If at the end of his/her XO tour a SWO has completed his/her command qualifications, then he/she is eligible to rotate to shore duty.

The third shore tour is three years in length and serves as a career catch-all. A SWO has the opportunity to serve in a joint, subspecialty, Washington D.C., major staff, or training command tour depending upon which type tour he/she has not yet served. Additionally, an officer may receive advanced training by attending the Naval War College or the Senior Service College. SWO's who are selected for Command at Sea attend a ten month pre-command course upon completion of their shore tour and then rotate to Command.

The Commanding Officer (CO) tour is a two year sea tour. The CO is responsible for all actions of his/her ship and its crew. The CO is typically in command of a ship's complement consisting of 180-400 officers and crew. SWO's who successfully complete a CO tour are eligible for Major Command, commanding larger ships such as guided-missile cruisers (CG), and promotion to the rank of Captain (O-6). After the CO tour, a SWO will rotate to a fourth shore tour. For the purposes of this thesis, the fourth shore tour and subsequent tours will not be examined or discussed.

C. PROMOTION/SELECTION BOARD POLICY

At different points throughout the progression of a SWO through his/her career, the officer is screened by various promotion and selection boards. At each board a pre-

established selection rate is applied to all of the officers of a given year group appearing before the board. For example, a SWO typically has four opportunities to screen for executive officer. At the first screening the SWO has a 40 percent chance of selection, at the second, third, and fourth, his/her chances of selection are 30, 20, and 10 percent, respectively. A similar method is used for promotion boards as well. In all, a SWO will be screened for each and every promotion from lieutenant through captain, and he/she will also face selection board screening for department head, executive officer, and command.

The Navy personnel structure is like a pyramid with a great many billets at the division officer level and fewer billets in more senior positions up through command. Promotion and selection rates influence the flow of officers up the pyramid and are utilized to ensure that only the highest quality officers are promoted to higher rank and positions of greater authority. Because of the decreasing number of billets at the higher levels, selection for one type of billet is not an automatic preselection for subsequent billets. Consequently, the Navy can maintain selectivity at all positions. However, any significant reductions or changes in the billet structure could cause serious repercussions in promotion and selection rates both up and down the pyramid.

III. MODEL DESCRIPTION AND IMPLEMENTATION

A. FORECASTER OVERVIEW

The model being used in order to study this problem of command selection is called FORECASTER, a Markovian model designed by Paul Milch in 1988 and redesigned in 1989. A detailed explanation of the mathematical aspects of FORECASTER is available in two reports by Milch [Refs. 1,2]. Written in APL, FORECASTER originally ran on an IBM 3033 mainframe computer and is now available on an IBM compatible PC. The version used for this analysis is PC based. FORECASTER is specifically designed to analyze the distribution of naval officers over any length of time and is a generic model that can be tailored to fit any community. FORECASTER uses a rectangular grid to represent an officer's career path. The rows of the grid represent mutually exclusive activities at any point of the officer's career. The columns of the grid represent the successive tours served by the officer. Assigned to each grid position are the corresponding number of officers presently serving in that specific activity and tour as well as the number of billets assigned to that position. Additionally, each grid position is assigned a tourlength, in any units of time the user desires, signifying the amount of time an officer spends in that activity. Tourlengths can vary from tour to tour and between activities. Probability transition matrices are used to control the flow of officers from one tour to the next.

FORECASTER has been used previously for naval officer career analysis. Joseph Johnson [Ref. 3] used FORECASTER to analyze the effects of joint duty requirements imposed by the Goldwater-Nichols Department of Defense Reorganization Act on the SWO community, and he is also responsible for a detailed explanation of the interactive user friendly interface associated with FORECASTER which he designed. Richard Drescher [Ref. 4] used FORECASTER to analyze the effects of joint duty requirements on the career of Tactical Aviation pilots and flight officers and he provided further documentation of the model.

In order to use FORECASTER several inputs are required. The user must define the number of activity types desired as well as the individual activity names. Additionally, input values are required for tourlengths, accessions, incumbents, hard and soft billets, and transition probability matrices. A brief description of each input area as well as its implementation now follows.

B. MODEL SPECIFICS

Data required by the model are typically in matrix form. The number of activities used in the system determines the number of rows in each matrix, while the number of tours in the system corresponds to the number of columns in the matrix. In this application, matrix dimensions for the majority of the variables, namely tourlength, accessions, incumbents, hard billets, and soft billets, are 4 x 9. There are eight transition probability matrices, each with 4 x 4 dimensions.

1. Activity Types

Activities are mutually exclusive sets where an officer may "reside" at any point in the "system". Therefore, activities represent a means by which to categorize all officers in the "system". Since the "system" here consists of those SWO's "on track" toward command, in this application the following four activities are used:

a. Sea Billets

This activity includes all officers on sea duty with the exception of split tour department heads. This activity does include those officers on single (longer) department head tours.

b. Shore Billets

This activity includes all officers on shore duty with the exception of those officers at division officer school or department head school.

c. Training

This activity includes all officers at department head school and/or any follow-on training in preparation for department head positions.

d. Department Head

This activity includes all officers on split tour (first or second) department head tours.

2. Tourlength

An integer matrix whose elements represent how long an officer spends at a given activity for a given tour. Here tourlength is in quarters. For example, the tourlength of the Sea Billets activity at tour one is 12 quarters.

3. Accessions

An integer matrix whose elements represent the number of new officers entering the SWO community on a quarterly basis. In this application, all accessions enter the "system" during tour one at the Sea Billets activity.

4. Incumbents

An integer matrix whose elements represent those officers who are occupying billets in the "system" at the commencement of the forecast.

5. Hard Billets

An integer matrix whose elements represent the number of billets which are specifically assigned to be filled by SWO's.

6. Soft Billets

An integer matrix whose elements represent the number of general unrestricted line billets which are apportioned to be filled by the SWO community.

7. Transition Probability Matrices

These are Matrices composed of real numbers between 0 and 1 which regulate the flow of officers through the "system". There are eight such matrices in the model, one less than the number of tours. When officers in the "system" complete a tour, these matrices are used to distribute them among the activities of the next tour depending upon the activity they are presently leaving. The transition probability values themselves are derived from a combination of officer promotion rates, selection board rates, and end of year attrition rates. Attrition is implicitly taken into account, because one less the sum of the transition probabilities for a given activity equals the attrition rate applicable when completing that tour.

C. DATA AND THEIR RELEVANCE TO THIS ANALYSIS

The data used in FORECASTER was provided by the SWO Community Manager (OP-130E1). The present SWO billet distribution throughout the fleet, planned billet distributions for FY 1991 through FY 1995, end of year continuation rates (e.g., the percentage of officers remaining in the Navy at the end of a year based on their years of completed service) for 1 through 20 years of completed service, and current selection and promotion board rates were provided. All of this data proved to be instrumental in setting up the model and creating a "system" which parallels the SWO career path of "on track" officers. Even though this data is very sensitive to current defense plans, with the possibility that the planned billet distributions for fiscal years 1991-1995 may already have changed; the main focus of this analysis and thesis remains as stated in Section I.C. The paramount issue is to demonstrate the utility of FORECASTER as an analytical tool and to show its application and adaptability to a real-world problem such as analysis of Commander Command Opportunity. The exact numbers in the analysis are not nearly as important as the feasibility and methodology of the analysis itself and the

trends and possible problems the analysis uncovers. If and when new and different data become available, the values of the variables can be changed and updated with ease in order to reach perhaps new conclusions.

D. ASSUMPTIONS

After defining the activities desired and inputting the required data into FORECASTER, the model is successfully tailored to represent the "on track" portion of the SWO community. This representation entails some basic assumptions. Since the career path modeled is for "on track" SWO's only, attrition between tours corresponds not only to officers leaving the service but officers falling "off track" as well. The career path starts with the SWO's first sea tour and continues for a total of nine tours up through Commander Command. SWO's only enter the model at the first sea tour and are considered to have completed division officer school and related training. SWO's leave the system through attrition and upon the completion of tour nine. Time spent at each tour is deterministic, although different for each activity and tour number combination, and no provisions are made for extensions. Additionally, the travel time from one tour to the next is considered to be negligible compared to tourlengths. In cases where travel time may be excessive, these times have been incorporated into the tourlength. Incumbents at a given tour and activity are assumed to have uniformly distributed experience levels. For example, if there were 120 incumbents at the Shore Billets activity in tour two (which has a tourlength of 12 quarters), then the experience levels of the officers would range from zero to eleven quarters with 10 officers at each level.

For a network flow diagram of the "on track" SWO career path used in the model, see Figure 1. The circles in this figure, later referred to as nodes, represent the billets in the specific activities and tours where SWO's serve. The arrows connecting the nodes indicate the path SWO's take as they progress through their career. The Dummy node was inserted to assure that these nodes fit a rectangular grid and will be further explained in Section IV.B.2.

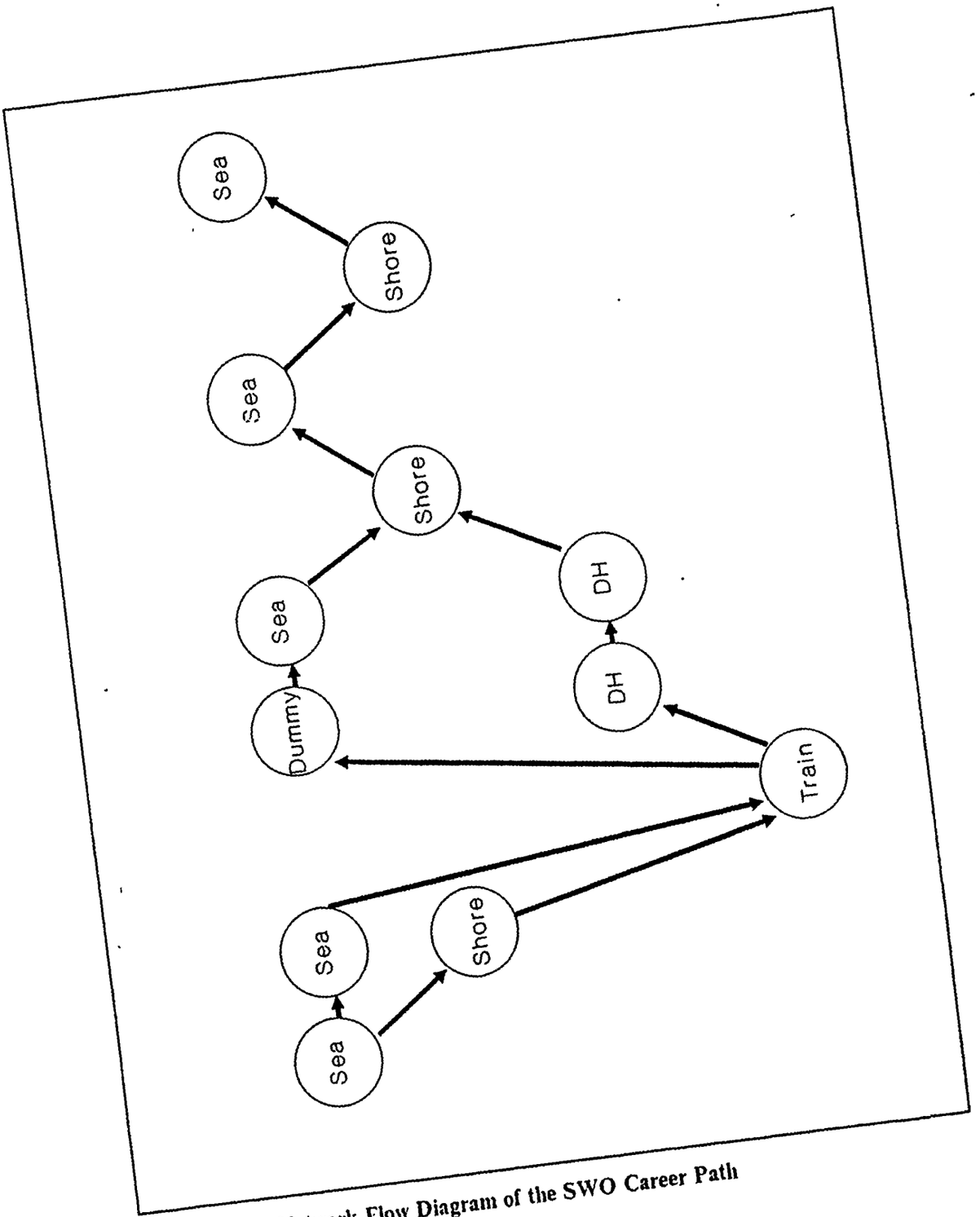

Figure 1. Network Flow Diagram of the SWO Career Path

IV. ANALYSIS

A. PRELIMINARY DISCUSSION

In order to analyze the long and short term effects the proposed reductions in force discussed in Section I.C posed to Command Opportunity , both a steady state and a transient analysis were performed on the planned billet data for the years FY 1990 through FY 1995. The FY 1990 transition probability matrices were used as the baseline case since they represented the current flow of officers through the "system". As the billet reductions and redistributions were applied, the transition probability matrices changed reflecting the adjustments needed if at-sea billet requirements were to be met. These changes were compared to the baseline case and analyzed. The following is a detailed explanation of the baseline analysis.

B. BASELINE ANALYSIS

1. Activity Types

As discussed in Section III.B, the four activity types listed there were chosen to model the SWO career path since they best categorize the areas where typical "on track" SWO's can be found at any point in their career.

2. Tourlength

Table 1. TOURLENGTHS IN QUARTERS

ACTIVITIES/TOURS	1	2	3	4	5	6	7	8	9
1. SEA BILLETS	12	8	-1	0	10	-1	6	-1	8
2. SHORE BILLETS	-1	8	-1	-1	-1	12	-1	14	-1
3. TRAINING	-1	-1	4	-1	-1	-1	-1	-1	-1
4. DEPT. HEAD	-1	-1	-1	6	6	-1	-1	-1	-1

The tourlength data was derived from the Surface Warfare Professional Development Path [Ref. 5] and is given in Table 1. Tourlengths can be positive integer values, zero, or negative one. A positive integer value represents the length of that billet in quarters. For example, the Sea Billets activity at tour number two has a tourlength of eight quarters. A negative one means that the billet is infeasible. For example, when leaving the Shore Billets activity in tour number six, the Sea Billets activity is the only

feasible billet to transfer to in tour seven and therefore all of the other activities in tour seven are shown to have negative one as a tourlength. Zero tourlength was used in case of a "dummy" node. This was needed in only one case (namely at the Sea Billets activity in tour number four) to make the SWO career path conform to a rectangular grid required by FORECASTER. Since an officer serves either a single (longer) department head tour or two split department head tours, it is possible for a SWO to reach his/her Command tour in eight or nine tours. The "dummy" node was added to make all career paths to command nine tours long. By making the single (longer) department head tour consist of two tours of zero and ten quarters tourlengths, respectively, it was possible to conform the SWO career path to a 4 x 9 rectangular grid. A zero tourlength necessitates a certainty of transition from that billet to an appropriate billet in the next tour as will be explained in Section B.7 of this chapter. All tourlengths were held constant for the baseline case and subsequent analyses.

3. Hard Billets for FY 1990

Table 2. HARD BILLETS

ACTIVITIES/TOURS	1	2	3	4	5	6	7	8	9
1. SEA BILLETS	3135	558	0	0	95	0	332	0	205
2. SHORE BILLETS	0	?	0	0	0	?	0	?	0
3. TRAINING	0	0	?	0	0	0	0	0	0
4. DEPT. HEAD	0	0	0	629	381	0	0	0	0

The Hard Billets matrix is given in Table 2. Hard billets in the Sea Billets and Department Head activities are filled on a one-to-one basis with the exception of tour one, Sea Billets. These latter billets represent the division officer tour and they are currently filled to 105 percent capacity. This overfill gives each Commanding Officer (CO) a large degree of flexibility in assigning his division officers throughout the ship. For example, with an extra division officer on board, a CO can elect to send a division officer off the ship to a much needed school without facing a shortage of junior officers. In Section B.7, the transition probability matrices were derived such that the tour to tour flow of officers met the hard billets requirements of the Sea Billets and Department Head activities. Hard billets in the Shore Billets and Training activities are usually filled to 100 percent capacity or above; however, shore and training billets, in general, exist primarily to support the fleet and billet requirements are filled, exceeded, or not filled in accord-

ance with the immediate needs of the surface fleet. Therefore, the hard billets for the Shore Billets and Training activities were left initially as question marks, or unknowns, until suitable values for them were derived in Section B.7. This was determined by the function of the tour to tour officer flow required to man the Sea Billets and Department Head activities in accordance with the above mentioned policy.

4. Total Billets for FY 1990

Table 3. TOTAL BILLETS

ACTIVITIES/TOURS	1	2	3	4	5	6	7	8	9
1. SEA BILLETS	3135	558	0	0	95	0	332	0	205
2. SHORE BILLETS	0	1202	0	0	0	808	0	792	0
3. TRAINING	0	0	648	0	0	0	0	0	0
4. DEPT. HEAD	0	0	0	629	381	0	0	0	0

The Total Billet matrix is given by Table 3. These billets are a combination of the hard and soft billet requirements and are included as a means by which to test the reasonableness of the billet requirements to be derived in SectionB.7 for the shore and training activities. Soft billets exist only under the Shore Billets activity and are those billets which are designated as general unrestricted line billets, meaning they can be filled by any officer with a warfare speciality as well as by officers of the General URL community. The soft billets used in this "system" represent that portion of such billets that are currently being filled by SWO's as given by the SWO Community Manager. The total billet requirements were held constant for the baseline case.

5. Incumbents

The Incumbents matrix is composed completely of zeros in the baseline analysis. Since this is a steady state analysis of the "system", the model was run for a sufficient amount of time (namely 76 quarters) to allow all current incumbents to exit the "system". Therefore, for the steady state analysis the number of incumbents is irrelevant and zeros were used for the sake of simplicity.

6. Accessions for FY 1990

Table 4. ACCESSIONS

ACTIVITIES/TOURS	1	2	3	4	5	6	7	8	9
1. SEA BILLETS	274	0	0	0	0	0	0	0	0
2. SHORE BILLETS	0	0	0	0	0	0	0	0	0
3. TRAINING	0	0	0	0	0	0	0	0	0
4. DEPT. HEAD	0	0	0	0	0	0	0	0	0

The Accessions matrix is given by Table 4. Accessions enter the system in numbers sufficient to man the Sea Billets activity, tour one to 105 percent of its hard billet requirements. Quarterly accessions are held constant for the baseline case.

7. Transition Probability Matrices

There are eight Transition Probability Matrices for the baseline case. These transition probability matrices were derived through a combination of end of year continuation rates displayed in percentages in Table 5 and tour to tour flow requirements. Transition probabilities were calculated beginning at tour one and proceeding through tour nine until the Sea Billet and Department Head hard billet requirements were met. Tour to tour flow requirements were determined using a simple ratio procedure. This ratio relied on the assumption that the baseline case was in a steady state condition, and therefore a quarterly input and output of officers for a given activity and tour must be equal. The quarterly output (and also input) of a given activity and tour is computed by dividing the number of officers at that node by the tourlength of the node. In cases where hard billet requirements had to be filled to 100 percent manning levels, a ratio between consecutive tour quarterly input and output levels yielded the required transfer rate to maintain officer flow requirements.

Table 5. CURRENT SWO END OF YEAR CONTINUATION RATES

YCS	CONTINUA-TION	YCS	CONTINUA-TION	YCS	CONTINUA-TION
1	100.0	8	90.7	15	96.8
2	100.0	9	92.9	16	97.0
3	91.0	10	88.5	17	97.2
4	84.5	11	92.9	18	97.1
5	85.3	12	95.9	19	93.4
6	83.5	13	95.5	20	77.8
7	84.9	14	96.3		

A detailed discussion of each transition probability matrix follows. Each matrix has 4 x 4 dimensions. The rows represent the activity from which an officer is leaving and the columns represent the activity to which an officer is going. The number of each column corresponds to the activity represented by the row with the same number.

Figure 2 provides a detailed network flow diagram of the baseline case which is useful in following the explanation of the computation of the individual transition probability matrix. The upper number in each node represents the number of officers in that node in an acceptable steady state case, while the lower number represents the node tourlength.

a. Transition Probability Matrix Number 1

Table 6. TRANSFER RATES WHEN LEAVING TOUR NUMBER 1

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0.255	0.514	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

The transfer rate from the tour one Sea Billet activity to the tour two Sea Billet activity was computed as the ratio between the quarterly output levels of these activities and is depicted in Table 6. The numerator was the tour two Sea Billets activity quarterly output level. That is, the number of officers in the node divided by the tourlength:

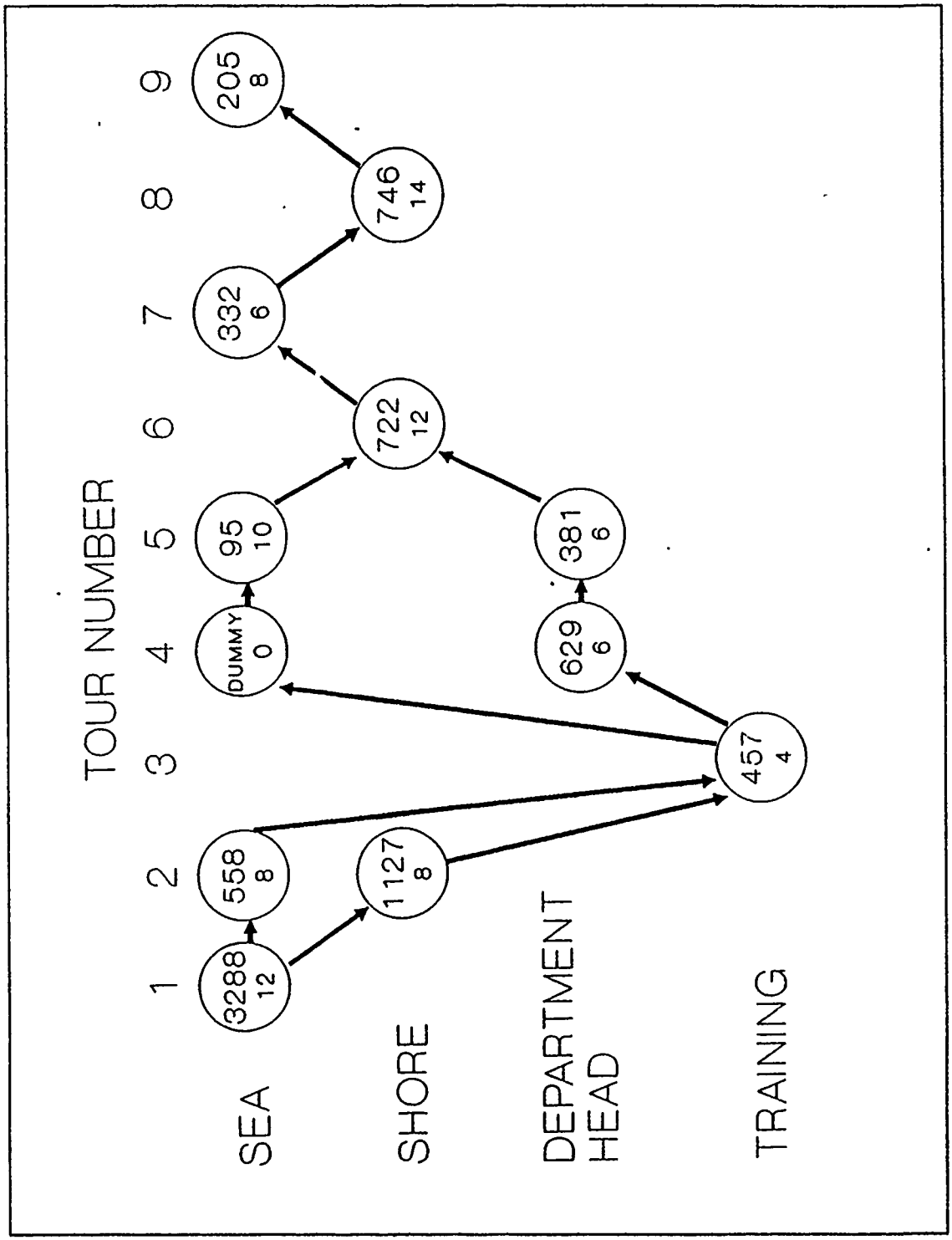

Figure 2. Detailed Network Flow Diagram of the Baseline Case

$$\frac{558}{8} = 69.75.$$

The denominator was the tour one Sea Billets activity quarterly output level:

$$\frac{3288}{12} = 274.$$

The quotient was used as the transfer rate from Sea Billets to Sea Billets:

$$\frac{69.75}{274} = 0.255.$$

The transfer rate from Sea Billets to the Shore Billets activity was computed in a two step process. The first step was to determine the percent of officers continuing to tour two after tour one. Using the data from Table 5, this percentage was calculated as the product of the continuation rates for officers with two, three, and four years of completed service, since a SWO begins this tour at the completion of one year of service and serves in this tour for the next three years. Since

$$(1.0)(0.91)(0.845) = 0.769$$

76.9% of the officers who begin tour one continue to tour two. The second step was to subtract the 25.5 percent of the officers who upon completing their first tour transferred to the Sea Billets activity, from the total percentage of officers continuing to tour two. The difference was used as the transfer rate to the Shore Billets activity:

$$0.769 - 0.255 = 0.514.$$

As previously mentioned in Section B.3, the steady state number of officers at the tour two Shore Billets activity can be derived as the product of the tour two quarterly output level, the transfer rate to this node, and tourlength of the Shore Billets tour:

$$(\frac{3288}{12})(0.514)(8) \approx 1127.$$

This number favorably compares to the Table 3, total billets number of 1202 for this same activity and tour.

b. Transition Probability Matrix Number 2

Table 7. TRANSFER RATES WHEN LEAVING TOUR NUMBER 2

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0	0.201	0
2. SHORE BILLETS	0	0	0.712	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

The transfer rate from the Shore Billets activity to the Training activity was computed as the product of an officer's fifth and sixth year of service continuation rates, since a SWO begins this tour at the completion of four years of service and serves in this tour for the next two years. This is depicted in Table 7. This transfer rate is:

$$(0.853)(0.835) = 0.712.$$

The Sea Billets to Training transfer rate depended on the requirements of tour four because that was where the next hard billets requirements were. As Figure 2 shows, the tour three Training activity acts as a funnel from all (Sea and Shore Billets) tour two activity billets to all (Sea Billets and Department Head) tour four activity billets. Therefore, the transfer rate, denoted by X, from the tour two Sea Billets activity to the tour three Training activity was found by equating the total tour three quarterly input level

$$(\frac{558}{8})(X) + (\frac{1127}{8})(0.712)$$

to the total tour three quarterly output level which is

$$\frac{95}{10} + \frac{629}{6}$$

due to the fact that virtually none of these officers attrited during or after completion of department head training. That is, X is the solution of the equation

$$(\frac{558}{8})(X) + (\frac{1127}{8})(0.712) = \frac{95}{10} + \frac{629}{6}$$

or X = 0.201. This transfer rate from the tour two Sea Billets activity to the Training activity may seem low but it must be remembered that the attrition from this tour represents officers who are falling "off track" as well as leaving the service. In that sense, the "attrition" after this tour is indeed quite high since many officers who serve in Sea Billets activities in tours one and two elect to go to a Shore Billets activity for their tour three and they fall "off track".

c. Transition Probability Matrix Number 3

Table 8. TRANSFER RATES WHEN LEAVING TOUR NUMBER 3

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0.083	0		0.917
4. DEPT. HEAD	0	0	0	0

As mentioned above, department head training attrition is typically negligible; consequentiy, the transfer rates depicted in Table 8 from the Training activity to the Sea (single longer department head tour) and Department Head (split tour department head tour) activities must sum to one. These rates were computed so that the billet requirements of the respective activities were filled exactly to 100 percent manning levels. The computation consisted of determining the ratio of the quarterly input levels of the respective activities in tour four to the total quarterly input level for that tour. Specifically, the transfer rate to the tour four Department Head activity was computed as the quarterly input level of this activity divided by the total tour four quarterly input level:

$$\frac{\frac{629}{6}}{\frac{629}{6}+\frac{95}{10}} = 0.917.$$

Consequently, the transfer rate to the Sea Billets activity was the complement of the transfer rate to the Department Head activity:

$$1 - 0.907 = 0.083.$$

d. Transition Probability Matrix Number 4

Table 9. TRANSFER RATES WHEN LEAVING TOUR NUMBER 4

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	1.000	0	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0.606

The Sea Billets activity in this tour, depicted in Table 9, is the "dummy" node that was previously discussed in Section III.B.7. This tour serves to increase the tour counter for officers serving a single (longer) department head tour. Therefore, all officers who transferred in to this "dummy" node are passed along instantaneously to the tour five Sea Billets activity with a transfer rate of 1.0.

The transfer rate from the tour four Department Head activity to the tour five Department Head activity was computed simply as the ratio between the quarterly input/output levels of the respective tours:

$$\frac{\frac{381}{6}}{\frac{629}{6}} = 0.606.$$

This low rate may seem surprising but can be explained by several factors. The first factor is the present billet structure of the fleet. Due to the complexity of most of the ships in the fleet today, the majority of the department head billets are considered suitable for SWO's who have no previous department head experience. The second is the lower than normal continuation rate for officers completing their first department head tour. This is in part due to the break point which occurs as officers reach the end of their obligated service requirements (two years) which were incurred at department head school. Finally, a large on-the-job attrition rate exists among first tour department heads. Many of these officers have unsuccessful tours and are not recommended to proceed to a position of greater responsibility. Consequently, those officers who do not leave the service are assigned to billets other than a second department head tour and are considered attrited from the "system" since they are no longer "on track".

e. Transition Probability Matrix Number 5

Table 10. TRANSFER RATES WHEN LEAVING TOUR NUMBER 5

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0.843	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0.822	0	0

For Table 10, the transfer rate from the Sea Billets activity to the Shore Billets activity was computed as the product of the continuation rates for an officer completing the eighth and ninth years of service, since an officer begins this tour at the completion of seven years of service and serves in this tour for the next two and one-half years. Therefore this rate is:

$$(0.907)(0.929) = 0.843.$$

The transfer rate from the Department Head activity to the Shore Billets activity was computed as the product of the continuation rates for an officer completing the ninth and tenth years of service, since an officer begins this tour at the completion of eight and one-half years of service and serves in this tour for the next year and one-half. Therefore this rate is:

$$(0.929)(0.885) = 0.822.$$

The number of officers at the tour six Shore Billets activity during steady state was derived as the product of the total tour six quarterly output level, the transfer rate and the tour six Shore Billets activity tourlength. This number is:

$$((\frac{95}{10})(0.843) + (\frac{381}{6})(0.822))(12) \approx 722.$$

This number favorably compares to the Table 3, total billets number of 808 for this same activity and tour.

f. Transition Probability Matrix Number 6

Table 11. TRANSFER RATES WHEN LEAVING TOUR NUMBER 6

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0	0	0
2. SHORE BILLETS	0.920	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

In Table 11, the transfer rate from the Shore Billets activity to the Sea Billets activity was computed as the ratio of the quarterly output/input levels of the given activities. That is:

$$\frac{\frac{332}{6}}{\frac{722}{12}} = 0.920.$$

This transfer rate is positively correlated to XO opportunity since the Sea Billets activity to which these officers are transferring represents the XO tour.

g. Transition Probability Matrix Number 7

Table 12. TRANSFER RATES WHEN LEAVING TOUR NUMBER 7

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0.963	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

The transfer rate from the Sea Billets activity to the Shore Billets activity, depicted in Table 12, was computed as the continuation rate for an officer completing the fourteenth year of service, 0.963, since the majority of the officers begin this tour at the completion of thirteen years of service and serve in this tour for the next year and one-half. The number of officers at the tour eight Shore Billets activity during steady

state was derived as the product of the tour six quarterly input level, the transfer rate and the tour six Shore Billets activity tourlength:

$$(\frac{332}{6})(0.963)(14)\approx 746.$$

This number favorably compares to the Table 5, total billets number of 792 for this same activity and tour.

h. Transition Probability Matrix Number 8

Table 13. TRANSFER RATES WHEN LEAVING TOUR NUMBER 8

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0	0	0
2. SHORE BILLETS	0.481	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

In Table 13, the transfer rate from the Shore Billets activity to the Sea Billets activity was computed as the ratio of the quarterly output/input levels of the given activities:

$$\frac{\frac{205}{8}}{\frac{746}{14}} = 0.481.$$

This transfer rate is positively correlated to Commander Command opportunity since the Sea Billets activity to which these officers are transferring represents the Commander Command sea tour.

8. Revised Hard Billets for FY 1990

With the baseline analysis complete, it is now possible to fill in the Shore Billets and Training activity hard billet requirements. The complete Hard Billets matrix is presented in Table 14.

Table 14. HARD BILLETS

ACTIVITIES/TOURS	1	2	3	4	5	6	7	8	9
1. SEA BILLETS	3135	558	0	0	95	0	332	0	205
2. SHORE BILLETS	0	1127	0	0	0	722	0	746	0
3. TRAINING	0	0	457	0	0	0	0	0	0
4. DEPT. HEAD	0	0	0	629	381	0	0	0	0

C. STEADY STATE ANALYSIS

The primary goal of the steady state analysis was to identify trends in the officer distributions. These trends could be detected through an analysis of the transition probability matrices. Starting with the FY 1990 data as a baseline and continuing through FY 1995, a steady state analysis was conducted on each year's planned billet data as summarized in Table 15. Using the same procedures as described in the baseline analysis transition probability matrices were derived for each year's set of billets. The Shore Billets and Training activity billets were held constant for each year since information on the planned reductions in these areas was unavailable. FORECASTER was used as an aid during these computations. After adjusting the values in the hard billet and accession matrices to reflect the new yearly billet levels, FORECASTER was used to derive the steady state transition probability matrices through trial and error. Transfer rates leaving tours were adjusted until an acceptable steady state was reached. This method proved to be more expedient than the hand calculations presented in Section B for the baseline (i.e., FY 1990) case. While this yearly steady state analysis may appear artificial, since an officer cannot progress through a career in the course of one year, it did provide insight into what the long term sustainability of each year's billet distribution would require. These steady state figures of the transition probabilities were unhampered by the constraints to meet next year's requirements. The alternative yearly analysis was conducted in Section D under the heading of Transient Analysis.

Table 15. CURRENT AND PLANNED YEARLY BILLET DATA

ACTIVITY TYPE	Tour	1990	1991	1992	1993	1994	1995
SEA BILLETS	1	3135	2823	2590	2377	2361	2398
SEA BILLETS	2	558	534	528	543	547	557
SHORE BILLETS	2	1202	1202	1202	1202	1202	1202
TRAINING	3	648	648	648	648	648	648
SEA BILLETS	4	95	92	96	99	101	109
DEPT. HEAD	4	629	547	493	444	445	442
DEPT. HEAD	5	381	398	400	410	403	402
SHORE BILLETS	6	808	808	808	808	808	808
SEA BILLETS (XO)	7	332	309	292	279	274	270
SHORE BILLETS	8	792	792	792	792	792	792
SEA BILLETS (CO)	9	205	180	159	142	143	145

The steady state transition probability matrices which were derived using the planned billet data (summarized in Table 15) are listed in Appendices A through F for each of the fiscal years 1990 through 1995. Whenever possible, transfer rates for the steady state analysis were left unchanged from the baseline case. Besides the tour four Dummy node to Sea transfer rate (which was set at one by definition), the rates which were not changed were: tour two Shore Billets to Training; tour five Sea and Department Head to Shore; and tour seven Sea to Shore. These rates remained unchanged since they were originally derived as a function of the officer continuation rates for officers in these tours and officer continuation was assumed to remain constant for the period of the analysis. A summary of those transfer rates which did change over the FY 1990 through FY 1995 analysis are presented in Table 16.

Table 16. MULTI-YEAR CHANGES IN STEADY STATE TRANSFER RATES

FROM		TO		YEAR					
TOUR	ACT.	TOUR	ACT.	1990	1991	1992	1993	1994	1995
1	SEA BILLETS	2	SEA BILLETS	0.255	0.270	0.291	0.327	0.331	0.332
1	SEA BILLETS	2	SHORE BILLETS	0.514	0.499	0.478	0.442	0.438	0.437
2	SEA BILLETS	3	TRAIN-ING	0.201	0.190	0.220	0.272	0.288	0.276
3	TRAIN-ING	4	SEA BILLETS	0.083	0.092	0.105	0.118	0.120	0.129
3	TRAIN-ING	4	DEPT. HEAD	0.917	0.908	0.895	0.882	0.880	0.871
4	DEPT. HEAD	5	DEPT. HEAD	0.606	0.728	0.811	0.923	0.906	0.909
6	SHORE BILLETS	7	SEA BILLETS	0.920	0.826	0.774	0.721	0.716	0.700
8	SHORE BILLETS	9	SEA BILLETS	0.481	0.454	0.424	0.396	0.406	0.419

The transfer rates leaving tour one revealed two distinct trends. The rates consistently increased for the case of Sea Billets to Sea Billets, and consistently decreased for the case of Sea Billets to Shore Billets. These tendencies were considered reasonable since the billet data in Table 15 showed a decrease in the number of first tour sea billets without a corresponding decrease in the number of second tour sea billets. Consequently, the transfer rate required to fully man the second tour sea billets increased as these second tour billets required an increasingly greater portion of the first tour transferees to fill them. In conjunction with the assumption that the percentage of officers remaining "on track" after the first tour remained unchanged, the transfer rate to the second tour Shore Billets activity decreased in direct proportion to the increase in the transfer rate to the Sea Billets activity. The long term results of these trends imply that more officers will be serving second tour sea tours and fewer officers will be available for shore duty.

The transfer rate from the tour two Sea Billets activity to the Training activity displayed an almost continuously increasing trend. This was due to the need to increase

the officer flow through the third tour Training activity in order to meet the billet requirements of tour four. Since the end of year continuation rates of SWO's was assumed to remain constant, the transfer rate from the Shore Billet activity was unchanged throughout the steady state analysis. Consequently, as more officers were needed to fill the tour four Sea Billets and Department Head activity requirements as discussed in Section B.7.b, these officers had to come from the tour two Sea Billets activity. Assigning more officers to department head training immediately following a second sea tour is a plausible means by which billet requirements can be filled. However, in reality, officers following this course of action can face "burnout" as they will be serving approximately eight of their first nine years of service on sea duty. The possibility exists that many of these officers may elect to fall "off track", by choosing to go to a shore duty tour, or may elect to leave the service altogether instead of submitting themselves to such an arduous career path. Therefore, the implications of this trend would require more careful analysis.

The total transfer rate leaving tour three remained at one; however, the distribution of officers leaving this tour steadily changed. With each successive year, a greater percentage of SWO's were assigned to the Sea Billets activity while a lesser percentage were assigned to the Department Head activity. This trend reflected the change in the planned billet requirements as the number of Sea Billet activity (single department head) billets increased while the number of Department Head activity (split tour) billets decreased. This transfer rate change could be incorporated into the fleet by simply making the necessary adjustments in officer assignments and orders. The implications of such a change at this tour are slight. In fact, by sending more SWO's on single (longer) department head tours, it would allow more officers the opportunity to reach command sooner (by six months). However, the repercussions of restructuring the department head billet organization manifested themselves in the transfer rates leaving tour four as well.

The total change from FY 1990 to FY 1995 in the transfer rate from the tour four Department Head activity to the tour five Department Head activity was 0.303. This was the largest total change of any transfer rate discovered during the steady state analysis. This dramatic change was the result of the tour four Department Head activity billets shift to tour five Department Head activity billets. As discussed previously in Section B.7.e, the transfer rate between these two activities in FY 1990 was quite low. The steady state analysis revealed a trend in which the billet ratio between these two activities approached one. The implications of this trend are great. The low current FY

1990 transfer rate between activities was the manifestation of the attitude that SWO's in the tour four Department Head activity billets were a plentiful asset. At present, these officers are allowed to "sink or swim" on their own since a high attrition rate can be tolerated. If the predicted trend is to be implemented, the attitude towards officers in this tour must change. SWO's in the tour four Department Head activity will become indispensable. The reason for this is that SWO's completing the tour four Department Head activity are the only officers with the experience and qualifications to man the tour five Department Head activity billets. Consequently, the retention and professional success of tour four department heads will be imperative as failure to do so could result in tour five department head shortfalls.

The transfer rate from the tour six Shore Billets activity to the tour seven Sea Billets activity displayed a continuously decreasing trend. This dramatic decrease was caused by the unequal redistribution of billets at the department head and XO levels. Specifically, the number of FY 1995 billets at the single (longer) department head tour (i.e., tour four Sea Billets activity) and the second (split) department head tour (i.e., tour five Department Head activity) composed 107 percent of the FY 1990 totals. On the other hand, the number of FY 1995 XO billets (i.e., tour seven Sea Billets activity) composed only 81 percent of the FY 1990 XO billets. Consequently, in order to keep the tour seven Sea Billets activity from being overmanned as the transfer rates between tours five and six remained unchanged, significant reductions had to occur in the above transfer rate. This trend could have significant implications since this transfer rate is positively correlated to XO opportunity. While the forecasted transfer rates could be implemented by adjusting XO selection board rates, the effect on mid-career retention would have to be considered.

The transfer rate from the tour eight Shore Billets activity to the tour nine Sea Billets activity also showed a decreasing trend. This is significant since this transfer rate is positively correlated to Commander Command Opportunity. The reason for this decrease is similar to the reason for the decrease in the above rate that was correlated to the XO opportunity. While the billet reduction is 19 percent in XO billets, the reduction in CO billets was 29 percent for this same time period. Consequently, the transfer rate from tour eight was similarly decreased to prevent an overfill of billets. This transfer rate reduction can be achieved by reducing CO selection board rates, but this too could effect mid-career retention. Additionally, a reduction of any kind in Commander Command Opportunity has a direct impact on the number of SWO's eligible for promotion to Captain, and ultimately Flag rank.

D. TRANSIENT ANALYSIS

The primary goal of the transient analysis was to identify the short term ramifications of the projected billet reductions and changes. By adjusting the transition probability matrices on a year to year basis, insight was gained on the magnitude of the changes that could conceivably take place in order to meet these yearly requirements. The transient analysis commenced with the assumption that the 1991 billet reductions and changes had been made and that the "system" was at steady state. The 1990 billet distributions were not used since it was assumed that the changes needed to meet the 1991 billet requirements were already initiated.

The transient analysis transition probability matrices were derived using a method slightly different than that used for the steady state cases. The transient analysis commenced with the FY 1991 steady state officer distributions as incumbents in the model. FORECASTER was then used to forecast the expected number and the distribution of officers for four quarters in the future. The transition probability matrices were adjusted by trail and error so that after four quarters the following year's (FY 1992's) billet requirements (see Table 15) were met exactly. Once the billet requirements were filled, the forecast distribution of officers were made the incumbents in the "system" and the procedure was repeated for another four quarters into the future. This procedure was followed until FY 1995 billet requirements were met exactly. A complete listing of the these transition probability matrices can be found in Appendices G through J. Table 17 comparatively displays those transfer rates that changed during the transient analysis as well as the FY 1990 and FY 1991 steady state figures.

Table 17. MULTI-YEAR CHANGES IN TRANSIENT CASE TRANSFER RATES

FROM		TO		YEAR					
TOUR	ACT.	TOUR	ACT.	1990	1991	91-92	92-93	93-94	94-95
1	SEA BILLETS	2	SEA BILLETS	0.255	0.270	0.264	0.285	0.268	0.390
1	SEA BILLETS	2	SHORE BILLETS	0.514	0.499	0.505	0.484	0.501	0.379
2	SEA BILLETS	3	TRAIN-ING	0.201	0.190	0.190	0.190	0.190	0.190
3	TRAIN-ING	4	SEA BILLETS	0.083	0.092	0.101	0.099	0.101	0.119
3	TRAIN-ING	4	DEPT. HEAD	0.917	0.908	0.773	0.718	0.748	0.721
4	DEPT. HEAD	5	DEPT. HEAD	0.606	0.728	0.733	0.818	0.920	0.913
6	SHORE BILLETS	7	SEA BILLETS	0.920	0.826	0.758	0.740	0.729	0.718
8	SHORE BILLETS	9	SEA BILLETS	0.481	0.454	0.348	0.368	0.353	0.378

The transient analysis revealed transfer rates and trends which generally paralleled the steady state analysis results. However, there were some differences between the transient and steady state results. The first difference was a frequent trend for related transfer rates to oscillate. This oscillation was caused by a combination of the following two factors. First, since billet requirements had to be filled in a year's time, transfer rates had to be initially adjusted sharply. Because of dissimilar tourlengths between many of the activities in consecutive tours, the changes in the transfer rates into given activities and tours took differing periods of elapsed time to effect the quarterly output levels of these same tours and activities. Consequently, transfer rates had to change sharply as yearly changes were made in billet requirements to compensate for the delay in the change of the quarterly output from the previous tour. This sharp change in the transfer rate eventually overcompensated and had to be later reversed. For example, the tour one Sea Billets activity had a tourlength of 12 quarters and started the transient analysis with 2964 incumbents in FY 1991, 105 percent of the Table 15 billet requirements. The quarterly output level of this tour was therefore 247. Regardless of the changes made

to the input level of officers entering this activity and tour (i.e., accessions) the output level remained unchanged for 12 quarters since this was the amount of time required for the FY 1991 incumbents to exit this node. Consequently, the quarterly output level of the tour one Sea Billets activity took 12 quarters to react to any input changes and only reduced transfer rates resulted in the tour two Sea Billets activity billet requirements being met exactly in FY 1992. For the FY 1994-95 period, the transfer rate was adjusted sharply upward as the results of reducing the number of accessions in FY 1992 finally took effect on the tour one output level.

The second difference between the transient and steady state analyses occurred with the transfer rates leaving tours two and three. As previously discussed in Section C, it was possible to adjust the transfer rate leaving the tour two Sea Billets activity such that the tour four billet requirements were filled to 100 percent manning levels. This was not the case in the transient analysis. Even if the transfer rate leaving the tour two Sea Billets activity was reduced to zero, the quarterly output level of the tour two Shore Billets activity alone exceeded the tour four billet requirements. Additionally, regardless of any changes made to the transfer rates leaving tour two for the transitional period from 1991 to 1992, the tour four billet requirements were exceeded because of the flow of incumbents leaving tour three. Therefore, for the sake of continuity and comparative purposes, the transient analysis was conducted while holding the transfer rates from tour two constant and adjusting the transfer rates from tour three as necessary. Consequently, for each transitional period the transfer rates leaving tour three now exhibited attrition (did not sum to one) so that the billet requirements of tour four were not exceeded.

In summary, the transient analysis revealed that meeting the planned billet requirements on a yearly basis was feasible. However, the dramatic and yearly transfer rate changes would have to be planned for and explained to the SWO community to prevent fostering negative perceptions concerning job security. With annual transfer rate changes throughout the career path, SWO's in tour one through nine may become uncomfortable with their career uncertainties and leave the service. Additionally, the other question remains on how to handle the officer excess at the tour four department head point. Officers could be attrited from department head training as was done in this analysis. Alternatively, the transfer rate from tour two could be reduced, even though for the FY 1991-92 transitional period attrition would also have to be applied from department head training. If significant reductions in the transfer rate from the tour two Sea Billets activity to the tour three Training activity are made, "on track" officers may

label that Sea Billets activity as a "dead end" and avoid assignments there. Conversely, reductions in the transfer rate from the tour two Shore Billets activity would most likely involve reducing officer continuation rates during this tour, an action not readily taken since officer continuation rates are not easily raised or lowered. Therefore, if attrition is instituted at department head training, provisions should be made to take care of those attrited since "attrition" signifies officers falling "off track" as well as leaving the service.

V. CONCLUSIONS

A. OVERVIEW

The personnel structure and requirements of the Navy are changing. Specifically, the surface fleet is aging and since budget cuts are on the horizon, a smaller fleet can be envisioned. Additionally, the new ships already scheduled to enter the fleet are more complex and require better and more experienced officers than ever before. These changes foreshadow a reduction and restructuring of SWO billets throughout the fleet. The impact of these changes on the SWO career has serious implications.

B. CONCLUSIONS AND RECOMMENDATIONS

The steady state and transient analyses of the current and planned billet data revealed some interesting trends. In both the short and long term, a larger portion of SWO's will be serving in follow on division officer tours, single (longer) department head tours, and in second (split) tour department head tours. These trends imply that the Navy is growing more complex and that more shipboard billets will require more experienced SWO's to fill them. Consequently, first tour division officers and department heads will have to be treated as valuable assets to be nurtured and groomed, so this experienced pool of officers will be available when needed.

Another trend involved Executive Officer and Commander Command Opportunity. In accordance with the projected reductions in XO and CO billets, the short term analysis suggests that a dramatic reduction in both Executive Officer and Commander Command Opportunity may be forthcoming. In the long term these changes in opportunity are less dramatic but no less significant, since they are still predicted to remain below current levels. Reductions in these opportunity areas pose a threat to mid-career continuation rates since mid-career continuation depends primarily on an officer's perception of his/her "chances" for command. At the mid-career level, approximately nine to ten years of completed service, a SWO typically evaluates his/her own performance to that point. If an officer believes that he/she is "on track" for Command, then that officer is likely to remain in the service in the hopes of serving until retirement (20 years of service minimum). As Executive Officer and Commander Command Opportunity decrease, more officers will likely perceive that their chances of falling "off track" are increasing and they will elect to leave the service while they are still able to embark on new careers. This could result in a shortfall of personnel in two areas where a greater

proportion of officers will be required, specifically, at the single (longer) department head and second (split) tour department head tours. Therefore, further study is recommended to determine the exact relationship among Executive Officer Opportunity, Commander Command Opportunity, and mid-career continuation.

APPENDIX A. FY 1990 STEADY STATE TRANSITION PROBABILITY MATRICES

Table 18. TRANSFER RATES WHEN LEAVING TOUR NUMBER 1

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0.255	0.514	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

Table 19. TRANSFER RATES WHEN LEAVING TOUR NUMBER 2

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0	0.201	0
2. SHORE BILLETS	0	0	0.712	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

Table 20. TRANSFER RATES WHEN LEAVING TOUR NUMBER 3

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0.083	0	0	0.907
4. DEPT. HEAD	0	0	0	0

Table 21. TRANSFER RATES WHEN LEAVING TOUR NUMBER 4

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	1.000	0	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0.606

Table 22. TRANSFER RATES WHEN LEAVING TOUR NUMBER 5

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0.843	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0.822	0	0

Table 23. TRANSFER RATES WHEN LEAVING TOUR NUMBER 6

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0	0	0
2. SHORE BILLETS	0.920	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

Table 24. TRANSFER RATES WHEN LEAVING TOUR NUMBER 7

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0.963	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

Table 25. TRANSFER RATES WHEN LEAVING TOUR NUMBER 8

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0	0	0
2. SHORE BILLETS	0.481	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

APPENDIX B. FY 1991 STEADY STATE TRANSITION PROBABILITY MATRICES

Table 26. TRANSFER RATES WHEN LEAVING TOUR NUMBER 1

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0.270	0.499	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

Table 27. TRANSFER RATES WHEN LEAVING TOUR NUMBER 2

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0	0.190	0
2. SHORE BILLETS	0	0	0.712	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

Table 28. TRANSFER RATES WHEN LEAVING TOUR NUMBER 3

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0.092	0	0	0.908
4. DEPT. HEAD	0	0	0	0

Table 29. TRANSFER RATES WHEN LEAVING TOUR NUMBER 4

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	1.000	0	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0.728

Table 30. TRANSFER RATES WHEN LEAVING TOUR NUMBER 5

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0.843	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0.822	0	0

Table 31. TRANSFER RATES WHEN LEAVING TOUR NUMBER 6

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0	0	0
2. SHORE BILLETS	0.826	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

Table 32. TRANSFER RATES WHEN LEAVING TOUR NUMBER 7

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0.963	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

Table 33. TRANSFER RATES WHEN LEAVING TOUR NUMBER 8

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0	0	0
2. SHORE BILLETS	0.454	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

APPENDIX C. FY 1992 STEADY STATE TRANSITION PROBABILITY MATRICES

Table 34. TRANSFER RATES WHEN LEAVING TOUR NUMBER 1

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0.291	0.478	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

Table 35. TRANSFER RATES WHEN LEAVING TOUR NUMBER 2

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0	0.220	0
2. SHORE BILLETS	0	0	0.712	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

Table 36. TRANSFER RATES WHEN LEAVING TOUR NUMBER 3

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0.105	0	0	0.895
4. DEPT. HEAD	0	0	0	0

Table 37. TRANSFER RATES WHEN LEAVING TOUR NUMBER 4

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	1.000	0	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0.811

Table 38. TRANSFER RATES WHEN LEAVING TOUR NUMBER 5

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0.843	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0.822	0	0

Table 39. TRANSFER RATES WHEN LEAVING TOUR NUMBER 6

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0	0	0
2. SHORE BILLETS	0.774	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

Table 40. TRANSFER RATES WHEN LEAVING TOUR NUMBER 7

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0.963	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

Table 41. TRANSFER RATES WHEN LEAVING TOUR NUMBER 8

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0	0	0
2. SHORE BILLETS	0.424	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

APPENDIX D. FY 1993 STEADY STATE TRANSITION PROBABILITY MATRICES

Table 42. TRANSFER RATES WHEN LEAVING TOUR NUMBER 1

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0.327	0.442	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

Table 43. TRANSFER RATES WHEN LEAVING TOUR NUMBER 2

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0	0.272	0
2. SHORE BILLETS	0	0	0.712	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

Table 44. TRANSFER RATES WHEN LEAVING TOUR NUMBER 3

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0.118	0	0	0.882
4. DEPT. HEAD	0	0	0	0

Table 45. TRANSFER RATES WHEN LEAVING TOUR NUMBER 4

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	1.000	0	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0.923

Table 46. TRANSFER RATES WHEN LEAVING TOUR NUMBER 5

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0.843	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0.822	0	0

Table 47. TRANSFER RATES WHEN LEAVING TOUR NUMBER 6

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0	0	0
2. SHORE BILLETS	0.721	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

Table 48. TRANSFER RATES WHEN LEAVING TOUR NUMBER 7

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0.963	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

Table 49. TRANSFER RATES WHEN LEAVING TOUR NUMBER 8

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0	0	0
2. SHORE BILLETS	0.396	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

APPENDIX E. FY 1994 STEADY STATE TRANSITION PROBABILITY MATRICES

Table 50. TRANSFER RATES WHEN LEAVING TOUR NUMBER 1

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0.331	0.438	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

Table 51. TRANSFER RATES WHEN LEAVING TOUR NUMBER 2

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0	0.288	0
2. SHORE BILLETS	0	0	0.712	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

Table 52. TRANSFER RATES WHEN LEAVING TOUR NUMBER 3

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0.120	0	0	0.880
4. DEPT. HEAD	0	0	0	0

Table 53. TRANSFER RATES WHEN LEAVING TOUR NUMBER 4

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	1.000	0	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0.906

Table 54. TRANSFER RATES WHEN LEAVING TOUR NUMBER 5

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0.843	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0.822	0	0

Table 55. TRANSFER RATES WHEN LEAVING TOUR NUMBER 6

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0	0	0
2. SHORE BILLETS	0.716	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

Table 56. TRANSFER RATES WHEN LEAVING TOUR NUMBER 7

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0.963	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

Table 57. TRANSFER RATES WHEN LEAVING TOUR NUMBER 8

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0	0	0
2. SHORE BILLETS	0.406	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

APPENDIX F. FY 1995 STEADY STATE TRANSITION PROBABILITY MATRICES

Table 58. TRANSFER RATES WHEN LEAVING TOUR NUMBER 1

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0.332	0.437	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

Table 59. TRANSFER RATES WHEN LEAVING TOUR NUMBER 2

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0	0.276	0
2. SHORE BILLETS	0	0	0.712	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

Table 60. TRANSFER RATES WHEN LEAVING TOUR NUMBER 3

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0.129	0	0	0.871
4. DEPT. HEAD	0	0	0	0

Table 61. TRANSFER RATES WHEN LEAVING TOUR NUMBER 4

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	1.000	0	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0.909

Table 62. TRANSFER RATES WHEN LEAVING TOUR NUMBER 5

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0.843	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0.822	0	0

Table 63. TRANSFER RATES WHEN LEAVING TOUR NUMBER 6

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0	0	0
2. SHORE BILLETS	0.700	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

Table 64. TRANSFER RATES WHEN LEAVING TOUR NUMBER 7

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0.963	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

Table 65. TRANSFER RATES WHEN LEAVING TOUR NUMBER 8

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0	0	0
2. SHORE BILLETS	0.419	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

APPENDIX G. TRANSITION PROBABILITY MATRICES FOR THE TRANSIENT ANALYSIS FY 1991-92

Table 66. TRANSFER RATES WHEN LEAVING TOUR NUMBER 1

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0.264	0.505	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

Table 67. TRANSFER RATES WHEN LEAVING TOUR NUMBER 2

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0	0.190	0
2. SHORE BILLETS	0	0	0.712	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

Table 68. TRANSFER RATES WHEN LEAVING TOUR NUMBER 3

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0.101	0	0	0.773
4. DEPT. HEAD	0	0	0	0

Table 69. TRANSFER RATES WHEN LEAVING TOUR NUMBER 4

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	1.000	0	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0.733

Table 70. TRANSFER RATES WHEN LEAVING TOUR NUMBER 5

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0.843	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0.822	0	0

Table 71. TRANSFER RATES WHEN LEAVING TOUR NUMBER 6

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0	0	0
2. SHORE BILLETS	0.758	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

Table 72. TRANSFER RATES WHEN LEAVING TOUR NUMBER 7

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0.963	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

Table 73. TRANSFER RATES WHEN LEAVING TOUR NUMBER 8

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0	0	0
2. SHORE BILLETS	0.348	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

APPENDIX H. TRANSITION PROBABILITY MATRICES FOR THE TRANSIENT ANALYSIS FY 1992-93

Table 74. TRANSFER RATES WHEN LEAVING TOUR NUMBER 1

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0.285	0.484	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

Table 75. TRANSFER RATES WHEN LEAVING TOUR NUMBER 2

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0	0.190	0
2. SHORE BILLETS	0	0	0.712	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

Table 76. TRANSFER RATES WHEN LEAVING TOUR NUMBER 3

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0.099	0	0	0.718
4. DEPT. HEAD	0	0	0	0

Table 77. TRANSFER RATES WHEN LEAVING TOUR NUMBER 4

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	1.000	0	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0.818

Table 78. TRANSFER RATES WHEN LEAVING TOUR NUMBER 5

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0.843	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0.822	0	0

Table 79. TRANSFER RATES WHEN LEAVING TOUR NUMBER 6

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0	0	0
2. SHORE BILLETS	0.740	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

Table 80. TRANSFER RATES WHEN LEAVING TOUR NUMBER 7

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0.963	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

Table 81. TRANSFER RATES WHEN LEAVING TOUR NUMBER 8

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0	0	0
2. SHORE BILLETS	0.368	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

APPENDIX I. TRANSITION PROBABILITY MATRICES FOR THE TRANSIENT ANALYSIS FY 1993-94

Table 82. TRANSFER RATES WHEN LEAVING TOUR NUMBER 1

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0.268	0.501	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

Table 83. TRANSFER RATES WHEN LEAVING TOUR NUMBER 2

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0	0.190	0
2. SHORE BILLETS	0	0	0.712	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

Table 84. TRANSFER RATES WHEN LEAVING TOUR NUMBER 3

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0.101	0	0	0.748
4. DEPT. HEAD	0	0	0	0

Table 85. TRANSFER RATES WHEN LEAVING TOUR NUMBER 4

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	1.000	0	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0.920

Table 86. TRANSFER RATES WHEN LEAVING TOUR NUMBER 5

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0.843	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0.822	0	0

Table 87. TRANSFER RATES WHEN LEAVING TOUR NUMBER 6

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0	0	0
2. SHORE BILLETS	0.729	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

Table 88. TRANSFER RATES WHEN LEAVING TOUR NUMBER 7

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0.963	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

Table 89. TRANSFER RATES WHEN LEAVING TOUR NUMBER 8

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0	0	0
2. SHORE BILLETS	0.353	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

APPENDIX J. TRANS "ION PROBABILITY MATRICES FOR THE TRANSIENT ANALYSIS FY 1994-95

Table 90. TRANSFER RATES WHEN LEAVING TOUR NUMBER 1

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0.390	0.379	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

Table 91. TRANSFER RATES WHEN LEAVING TOUR NUMBER 2

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0	0.190	0
2. SHORE BILLETS	0	0	0.712	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

Table 92. TRANSFER RATES WHEN LEAVING TOUR NUMBER 3

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0.119	0	0	0.721
4. DEPT. HEAD	0	0	0	0

Table 93. TRANSFER RATES WHEN LEAVING TOUR NUMBER 4

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	1.000	0	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0.913

Table 94. TRANSFER RATES WHEN LEAVING TOUR NUMBER 5

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0.843	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0.822	0	0

Table 95. TRANSFER RATES WHEN LEAVING TOUR NUMBER 6

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0	0	0
2. SHORE BILLETS	0.718	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

Table 96. TRANSFER RATES WHEN LEAVING TOUR NUMBER 7

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0.963	0	0
2. SHORE BILLETS	0	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

Table 97. TRANSFER RATES WHEN LEAVING TOUR NUMBER 8

ACTIVITIES/ACTIVITIES	1	2	3	4
1. SEA BILLETS	0	0	0	0
2. SHORE BILLETS	0.378	0	0	0
3. TRAINING	0	0	0	0
4. DEPT. HEAD	0	0	0	0

LIST OF REFERENCES

1. Milch, Paul R. An Analytical Model for Forecasting Navy Officer Career Paths ,Technical Report NPS55-88-009. Naval Postgraduate School, Monterey, CA, 1987.

2. Milch, Paul R. FORECASTER, A Markovian Model to Analyze the Distribution of Naval Officers ,Technical Report NPS55-90-007. Naval Postgraduate School, Monterey, CA, 1990.

3. Johnson, Joseph L., Jr., "Analysis of the Joint Reorganization Act's Impact on Personnel Flow in the Surface Warfare Officer Community," Master's Thesis, Naval Postgraduate School, Monterey, CA, 1989.

4. Drescher, Richard B., "The Effect of the Goldwater-Nichols Department of Defense Reorganization Act on Tactical Aviation Pilot and NFO Career Paths," Master's Thesis, Naval Postgraduate School, Monterey, CA, 1989.

5. The Naval Officer's Career Planning Guidebook (NAVPERS 15605); U.S. Government Printing Office, 1990.

INITIAL DISTRIBUTION LIST

		No. Copies
1.	Defense Technical Information Center Cameron Station Alexandria, VA 22304-6145	2
2.	Library, Code 52 Naval Postgraduate School Monterey, CA 93943-5002	2
3.	Dr. Paul R. Milch, Code OR Mh Department of Operations Research Naval Postgraduate School Monterey, CA 93940-5000	2
4.	CAPT Paul S. Bloch, Code OR Bl Department of Operations Research Naval Postgraduate School Monterey, CA 93940-5000	2
4.	CDR Thomas E. Halwachs, Code OR Ha Department of Operations Research Naval Postgraduate School Monterey, CA 93940-5000	1
5.	CDR Brad Kaplan (OP-130E1) Office of the Chief of Naval Operations Department of the Navy Washington, DC 20350-2000	1
6.	CDR William D. Ferree (NMPC-454) Officer Allocation and Distributable Strength Projection Branch Naval Military Personnel Command Department of the Navy Washington, DC 20350-2000	2
7.	Center for Naval Analysis 4401 Ford Avenue Post Office Box 16268 Alexandria, VA 22302-0268	1
8.	Dr. Richard S. Elster Deputy Assistant Secretary of Defense Resource Management and Support The Pentagon Room 3E767 Washington, DC 20301	1