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THE CONSTRAINED OFFICER FORCE PROGRESSION MODEL: A STEADY-STATE--ETC(U)
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The Constrained Officer Force Progression Model: A Steady-State Mathematical Model of the U.S. Air Force Officer Structure

Herbert J. Shukiar, Sidney H. Miller, Laura Critchlow Sammis

A report prepared for

UNITED STATES AIR FORCE PROJECT RAND

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(10) Herbert J. Shukiar, Sidney H. Miller, Laura Critchlow Sammis

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PREFACE

This report was prepared as part of The Rand Corporation's Manpower, Personnel, and Training Program, sponsored by U.S. Air Force Project RAND. It presents work done under the study project, "Supply and Retention of Air Force Officers." The work was initiated at the request of the Deputy Chief of Staff/Personnel, Headquarters U.S. Air Force, and is designed to assist the Air Force in achieving stable accession and training rates, smooth career progression, and control of officer inventory by year group. The report is part of a series examining the mutual impact of changes in personnel policy and in the supply and retention of officers, as well as the number and flow of officers by component, years of service, source of commission, and aeronautical rating.

The ability to manage Air Force personnel in general and officers in particular is important, because people are the most critical resource in the Air Force. "People costs" have increased until they now constitute more than half of each annual Air Force or Department of Defense budget. Moreover, the acquisition of newer and more sophisticated weapon systems lends increasing importance to the attraction and retention of qualified officers. The discontinuation of the draft and the transition to an all-volunteer force have changed the value, and hence the use, of traditional personnel planning factors.

The Constrained Officer Force Progression Model* described here is one of a projected set of computer-based models designed to provide personnel planners with broadly based aggregated data and detailed officer inventories and flows reflecting the effects of policies and conditions under investigation.

Other models are described in two Rand reports:

- R-1607-PR, *The Officer Force Progression Model: A Steady-State Mathematical Model of the U.S. Air Force Officer Structure*, November 1974.

*The actual computer program for the model is available from The Rand Corporation.

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- R-1632-PR, *The Officer Grade Limitations Model: A Steady-State Mathematical Model of the U.S. Air Force Officer Structure*, July 1975.

SUMMARY

The Constrained Officer Force Progression Model is designed to supplement TOPLINE/DOPMS* long-term or steady-state computer models in a way that permits the personnel planner to examine the effect of changes in personnel policy on the structure and flows of the officer force.

Air Force personnel planners often face policy alternatives that lead to changes in the size of the officer force, the rated officer force, accessions, training rates, loss rates, promotion policies, or augmentation opportunities (the acceptance of reserve officers into the regular force). The personnel planner may input these changes into the constraints model in terms of such common characteristics as component, grade, aeronautical rating, source of commission, and year of service. The model then computes the effects of the changes on the number of officers with these characteristics who are lost, promoted, augmented, or otherwise changing from one state to another.

For example, the constraints model can be used to investigate the combined impact of changes in both promotion and augmentation opportunity, while keeping the size of the entire officer force and rated officer force constant. The impact of these policy alternatives on the officer force grade structure can be determined, as well as the impact on accessions and training rates. Additionally, trade-offs between promotion and augmentation policies can be examined, with an eye toward their impact on the officer force.

Thus, the personnel planner has a tool that enables him to measure the effects of policies imposed on him (i.e., those beyond his control) and to select from alternative policies when he does have a choice. The constraints model provides this tool by computing the long-range

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*Department of the Air Force, *The USAF Personnel Plan*, Vol. 2, *Officer Structure (TOPLINE)*, Washington, D.C., May 1971 (For Official Use Only). TOPLINE is a short title for *total officer personnel objective structure for the line officer force*. DOPMS is a short title for *defense officer personnel management system*.

effects of these changes in terms of promotion opportunities, promotion phase points, augmentations, force cuts or expansions, and the inventory of officers by component, grade, aeronautical rating, source of commission, and years of service.

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I. INTRODUCTION

The Air Force has been an innovator in officer force structure policy planning and implementation by means of computer models using a systems approach to Air Force personnel management, the concepts of which are contained in the several volumes of *The USAF Personnel Plan* [1]. Volume Two, *Officer Structure (TOPLINE) 1971*,* describes the philosophy and computer models that apply to the officer force structure. The TOPLINE and DOPMS† static personnel planning models are used by Headquarters USAF to develop its long-range objective officer structure, under the assumption that, for long-term planning purposes, ideal and steady-state conditions‡ will apply.

The Rand Corporation has developed a system or family of officer force personnel planning models to supplement and extend the TOPLINE and DOPMS static personnel planning models. These "second generation" planning models provide increased capability to analyze the long-range effects on the officer force structure of changes in policy or in external or environmental influences. This system of officer force planning models, described in this and companion reports,** includes the following computer models:

- Officer force progression model (short title: progression model).

---

*TOPLINE is a short title for *total officer personnel objective structure for the line officer force.*

†DOPMS is a short title for *defense officer personnel management system.*

‡Steady-state conditions are hypothetical conditions and apply when loss rates and other planning factors do not change from year to year; that is, the system is in equilibrium, gains equal losses, and the inventory of officers and their characteristics do not change from year to year.

**S. H. Miller, L. C. Sammis, and H. J. Shukiar, *The Officer Force Progression Model: A Steady-State Mathematical Model of the U.S. Air Force Officer Structure*, The Rand Corporation, R-1607-PR, November 1974; L. C. Sammis, S. H. Miller, and H. J. Shukiar, *The Officer Grade Limitations Model: A Steady-State Mathematical Model of the U.S. Air Force Officer Structure,* The Rand Corporation, R-1632-PR, July 1975.

- o Constrained officer force progression model (short title: constraints model).
- o Officer grade limitations model (short title: grade limitations model).
- o Officer retention model (short title: retention model).*

The use of these models provides increased planning capabilities in the following ways:

- o Expansion of inputs† and outputs.
- o Allowance for interaction of changes in policies, officer behavior, and the officer structure.
- o Provision for the impact of grade limitations.

This section presents an overview of these models, describing each model briefly to familiarize the reader with the concepts and vocabulary employed. The concept of an officer's state as his *status* at a given point in time is discussed first. For example, one element of an officer's state is his rating: Is he a pilot, navigator, or non-rated? The movement (or flow) between states is described; non-rated officers might, for instance, become pilots. This is followed by a definition of what is meant by a steady-state or static model. Finally, each of the four computer models is described in nonmathematical terms.

Section II presents several simplified constraints model examples to provide a flavor for the modeling approach employed. Section III

---

*Also called the officer force behavioral model.

†The constraints model is similar to the TOPLINE and DOPMS steady-state personnel planning models even though it differs from those models in some of the details of input preparation. For the most part, these differences provide the personnel planner with increased control over the flow of officers through (and thereby the structure of) the officer force. For example, while the constraints model limits the size of a promotion zone to a maximum of four years of service, it allows the specification of selection rates to a grade in terms of rating and source of commission, e.g., ROTC pilots can have selection rates that differ from those of OTS navigators. Similarly, the constraints model does not distinguish between voluntary and mandatory losses to the force, but does allow loss rates to be specified in terms of component, grade, rating, source of commission, and year of service.

describes the constraints model's inputs, and Sec. IV, selected model outputs. Section V takes a closer look at the model's logic, and Sec. VI examines how the constraints and grade limitations models may be used in concert. Finally, Apps. A through E deal with several programming and model logic details.

OFFICER STATES

In each of the three officer force personnel planning models, the following characteristics are used to group the officer force into subsets (or "states" or "nodes"):

- Component
  - Reserve
  - Regular
- Grade
  - Lieutenant (first or second)
  - Captain
  - Major
  - Lieutenant colonel
  - Colonel and higher grades combined
- Rating
  - Pilot
  - Navigator
  - Non-rated
- Source of commission
  - Academy (Air Force, Military or Naval)
  - ROTC
  - OTS and all others
- Year of service*
  - 1 through 35

---

*Year of service (YOS) refers to total active federal *commissioned* service. An officer is in his ith YOS when he has completed i-1 but not i years of total active federal commissioned service.

For example, the state defined by

(Reserve, Captain, Pilot, ROTC, 4)

refers to all captains with four years of service who entered the officer force via ROTC, are pilots, and hold reserve commissions. Further, all ROTC captains with four years of service will be in one and only one of the following states:

(Reserve, Captain, Pilot, ROTC, 4)
(Regular, Captain, Pilot, ROTC, 4)
(Reserve, Captain, Navigator, ROTC, 4)
(Regular, Captain, Navigator, ROTC, 4)
(Reserve, Captain, Non-rated, ROTC, 4)
(Regular, Captain, Non-rated, ROTC, 4)

FLOWS BETWEEN OFFICER STATES

In addition to the officer states, the three officer force models identify and keep track of the following flows of officers between the officer states:

- o Loss
- o Lateral
- o Rating transfer
- o Augmentation
- o Rating transfer-augmentation
- o Promotion
- o Promotion-augmentation

Figure 1 illustrates some of these flows for ROTC lieutenants with three or fewer years of service. ROTC officers enter the force as non-rated reserve officers--state nr_1 in Fig. 1.* From this state the officers can *flow* along any of seven possible paths: the loss path or

*Officer states labeled with lower case characters (nr_1, nv_3) are reserve states, and those with upper case labels (PL_2, NR_3) are regular states.

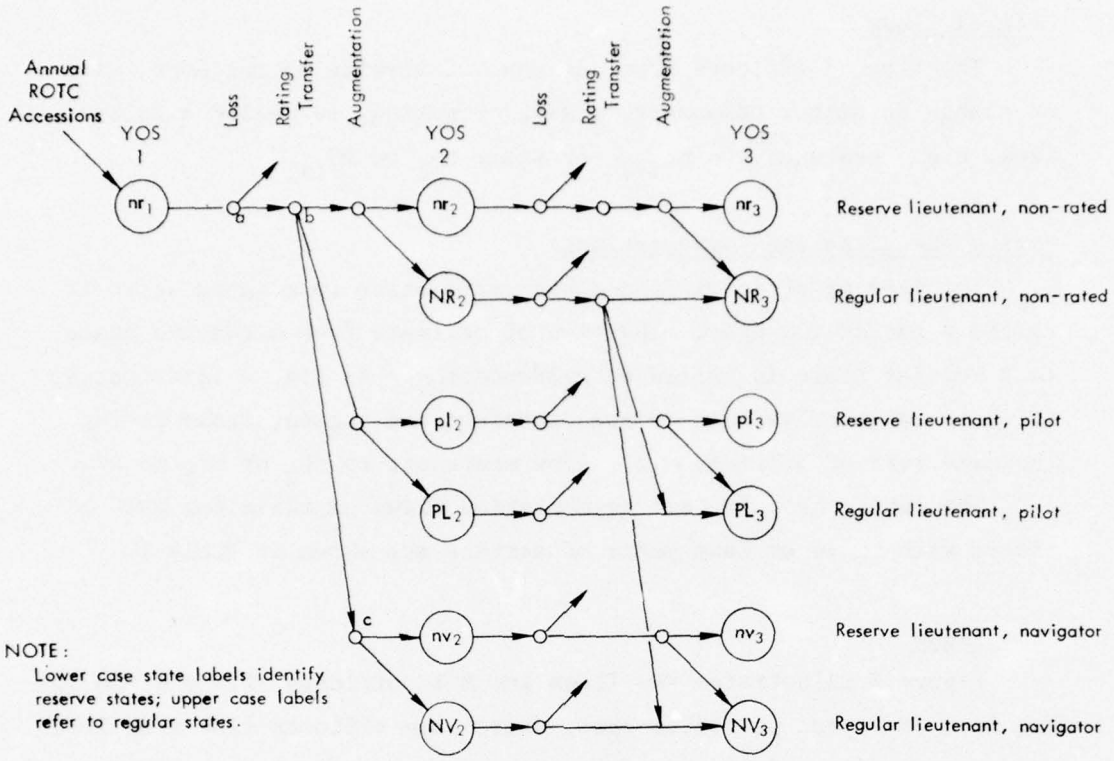


Fig. 1 — ROTC officer states and flows in nonpromotion years of service

to one of the six states defined for the second year of service. Thus no pilot or navigator states exist during the first year of service.

Officers move from one state to the next in a series of steps. For example, officers who are reserve navigators in year 2 (state nv_2 in the figure) came from nr_1 to the loss step (a), then to the rating transfer step (b), next to the augmentation step (c), and finally to nv_2. Regular navigators with two years of service got there along path nr_1-a-b-c-NV_2. Path b-c represents a rating change from non-rated to navigator. Path c-NV_2 represents a component change from reserve to regular.

Losses

A loss path leading out of the officer force exists for each officer state. The officers taking this path either separate, retire, or are otherwise lost to the Air Force.

Lateral Flows

The flow of officers from one year of service to the next, with no change in either component, grade, or rating, is called a lateral flow, e.g., state nr_i to nr_{i+1}, or state NV_i to NV_{i+1}.

Rating Transfers and Augmentations

The flow of officers from a non-rated state to a rated state is called a *rating transfer*. The flow of officers from a reserve state to a regular state is called an *augmentation*. As Fig. 1 illustrates, officers can receive both rating transfers and augmentations during the same year of service, e.g., from state nr_1 to PL_2 or nr_1 to NV_2.

The rating transfer and augmentation flows possible for ROTC officers with three or less years of service are shown in Table 1.

Promotions

Figure 2 illustrates the flows for ROTC officers with a given rating in a four-year promotion zone, where some officers flow from lower grade states (lg and LG states) to higher grade states (hg and HG states). Rating transfer flows do not appear in the figure because they are not permitted by the model in the promotion zone or in grades other than lieutenant.

As Fig. 2 shows, officers being promoted can receive both promotions and augmentations in the same year (state lg_i to HG_{i+1}), or just promotions (lg_i to hg_{i+1} or LG_i to HG_{i+1}). Officers not being promoted can flow laterally (e.g., lg_i to lg_{i+1}, or HG_i to HG_{i+1}) or be augmented (lg_i to LG_{i+1}, or hg_i to HG_{i+1}).

STEADY-STATE DEFINED

The officer force models are called steady-state or static models because they assume the officer force to be in equilibrium, where the number of officers in each state and the flows of officers between the states remain constant as time passes. A steady-state officer force is one where the flows into each officer state equal the flows out of the state.

Figure 3 illustrates the flows into and out of the captain states

Table 1

SAMPLE RATING TRANSFER AND AUGMENTATION FLOWS[a]

Rating Transfer Only

nr_1 to pl_2
nr_1 to nv_2
nr_2 to pl_3 (not illustrated in Fig. 1)
nr_2 to nv_3 (not illustrated in Fig. 1)
NR_2 to PL_3
NR_2 to NV_3

Augmentations Only

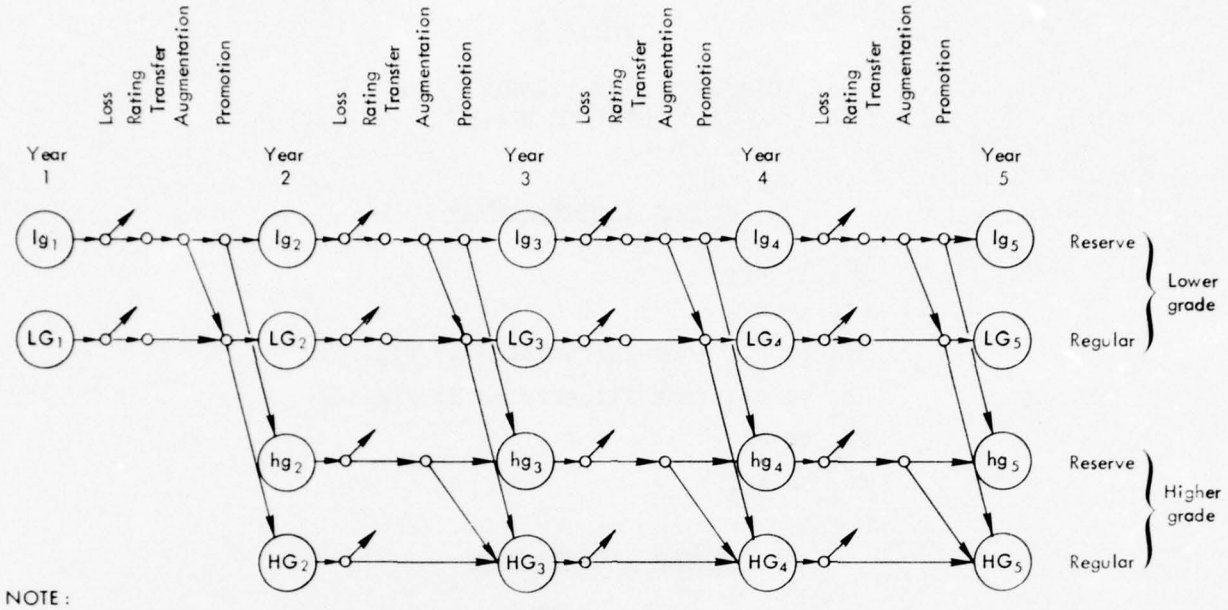
nr_1 to NR_2
nr_2 to NR_3
pl_2 to PL_3
nv_2 to NV_3

Rating Transfer-Augmentations

nr_1 to PL_2
nr_1 to NV_2
nr_2 to PL_3 (not illustrated in Fig. 1)
nr_2 to NV_3 (not illustrated in Fig. 1)

[a]For ROTC officers with three or less years of service.

for the fifth year of service with a given source of commission and rating. Reserve captains with five YOS (the k_5 state) can come from two states (l_4 to k_4) and can go to four states (k_6, K_6, m_6, or M_6) or be lost (a_5). Regular captains with five YOS (the K_5 state) can come from four states (l_4, L_4, k_4, or K_4) and can go to two states (K_6 or M_6) or be lost (A_5). If we denote the flow between states s and t by (st), then the steady-state condition for state k_5 is:



NOTE:
Lower case state labels identify reserve states; upper case labels refer to regular states.
"lg" and "LG" identify the lower grade's states; "hg" and "HG" refer to higher grade states.

Fig. 2 — ROTC officer states and flows for a given rating in the promotion zone

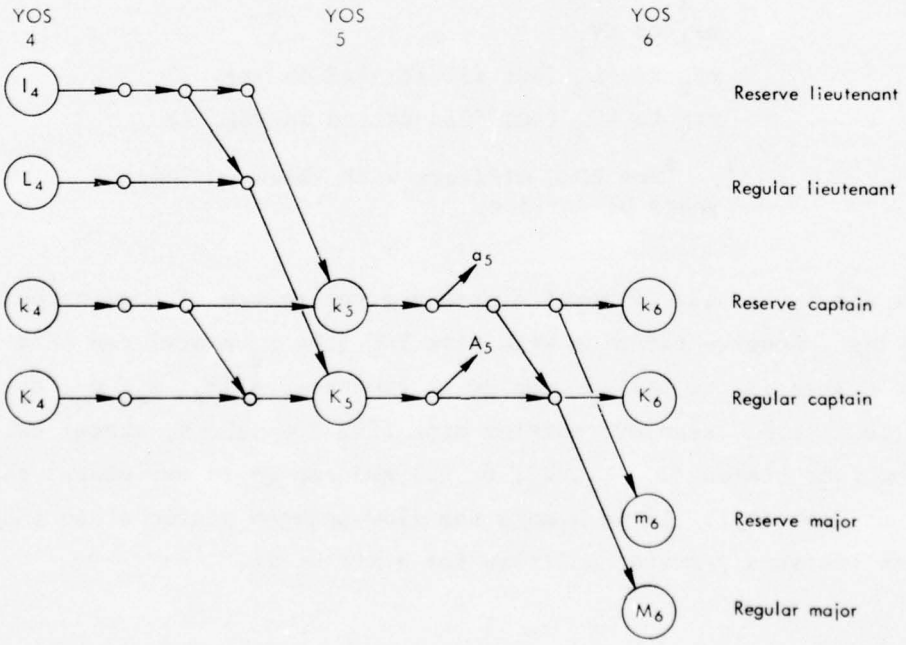


Fig. 3 — Flows associated with captains with 5 YOS

$$(1_4k_5) + (k_4k_5) = (k_5a_5) + (k_5k_6) + (k_5K_6) + (k_5m_6) + (k_5M_6)$$

and for state K_5 is:

$$(1_4K_5) + (L_4K_5) + (k_4K_5) + (K_4K_5) = (K_5A_5) + (K_5K_6) + (K_5M_6)$$

MODEL DESCRIPTIONS

In this subsection we first describe each officer force model in terms of the inputs needed by the models and the outputs produced, and then describe the behavioral model.

One type of input is common to all three, namely, loss data. Each officer force model must be provided with the loss rate associated with each officer state, i.e., the fraction of officers in a state that leave the officer force.

Officer Force Progression Model

The progression model requires as inputs annual accessions and such personnel policy parameters as promotion opportunity, augmentation opportunity, and training rates. A grade's promotion opportunity indicates the percentage of eligible officers that will be promoted to the grade. An augmentation opportunity indicates the percentage of eligible reserve officers that are augmented into the regular force. And a rating's training rate is the number of annual pilot or navigator graduates (from UPT or UNT).*

These personnel policy parameters, combined with annual accessions and loss rates, are sufficient to determine the number of officers in each state of the officer force structure. For example, Fig. 4 illustrates the non-rated ROTC officer force structure. ROTC annual accessions enter the officer force as non-rated reserve lieutenants in year 1. The year 1 loss rate determines the number of officers leaving the force in year 1. The year 1 training rates determine the number of officers trained in year 1 who receive rating transfers to pilot and

*Precise definitions of promotion, augmentation, and training rate inputs can be found in Sec. III.

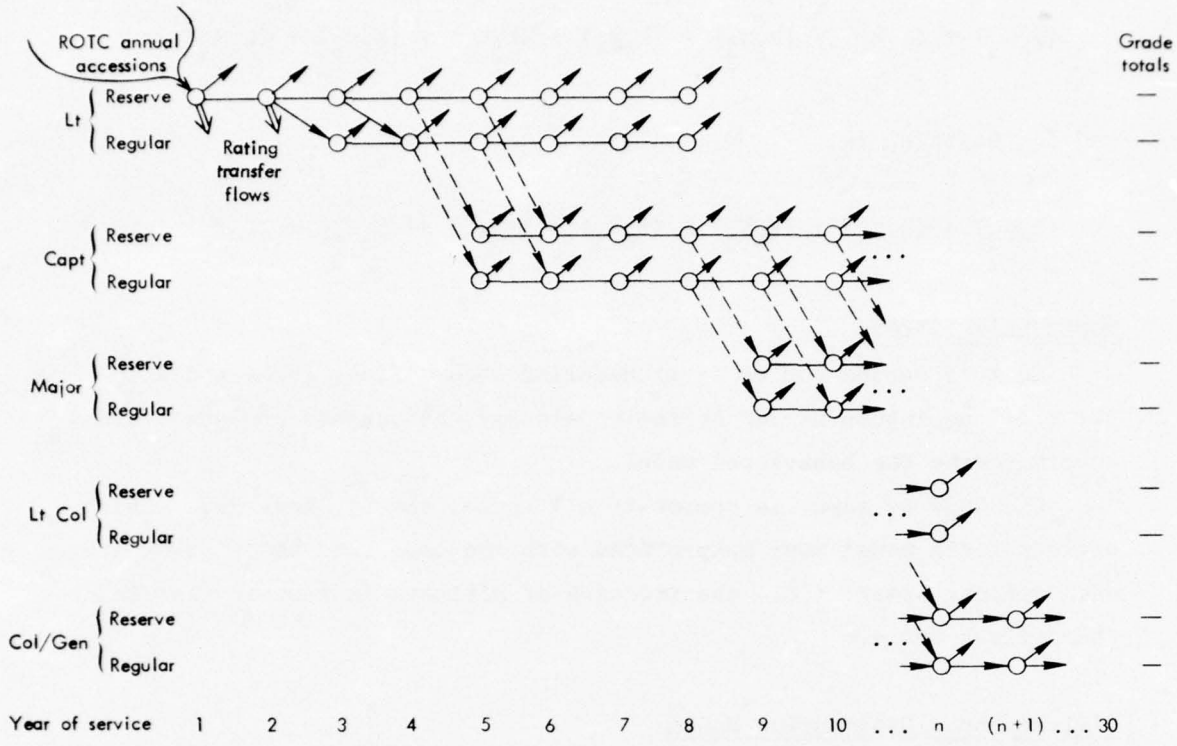


Fig. 4 — Non-rated ROTC officer structure

navigator in year 2 (the => flow). Thus, we can determine the number of non-rated reserve ROTC lieutenants in year 2. The year 2 augmentation input determines the number of reserve non-rated lieutenants with 2 YOS augmented into the regular force. Similarly, the year 4 promotion inputs determine the number of lieutenants in year 4 who are promoted to captain in year 5. Proceeding in this manner the entire non-rated ROTC officer structure is determined. And beginning with the rating transfers into the pilot and navigator force structures, we completely determine the rated force compositions. Thus, given annual accessions, loss rates, and personnel policy parameters, the progression model determines the officer force structure--its size by component, grade, rating, source of commission, and year of service.

Constrained Officer Force Progression Model

The constraints model is similar to the progression model with several exceptions. The constraints model permits the specification in the inputs of the following manpower constraints and requirements:

- o Regular force size.
- o Pilot force size (lieutenant colonel and below).
- o Navigator force size (lieutenant colonel and below).
- o Total force size.
- o Career reserve requirement.

The career reserve requirement inputs provide, for the reserve sources of commission, a mechanism for the selection of career reserve officers.

The model--given Academy and ROTC annual accessions (not OTS accessions), loss rates, personnel policy parameters, and the manpower constraints and requirements mentioned above--attempts to derive an officer force structure that satisfies the manpower constraints and requirements. In doing so, the model is given the freedom to lower OTS augmentation rates, modify OTS training rates, increase selected ROTC and OTS loss rates, and determine OTS annual accessions. The constraints model utilizes the progression model when trying to find a force structure that satisfies the manpower constraints and requirements.

To gain an intuitive appreciation for the modeling approach of both the progression model and the constraints model, the reader is referred to Sec. II, where several simplified numerical examples are presented. A detailed and thorough treatment of constraints model logic is given in Sec. V and App. D.

Officer Grade Limitations Model

The progression and constraints models each begin with the personnel policy parameters as well as annual accessions and loss rates, to determine how the annual accessions are distributed over the officer force structure. In fact, these models perform their computations starting with lieutenants, then captains, majors, lieutenant colonels, and colonels. In other words, the flows into a grade must be completely known before either the progression or constraints models can determine the distribution of officers over the states within the grade.

The grade limitations model takes exactly the opposite approach. This model starts with the grade requirements specified in terms of component, rating, and source of commission and combines them with loss

rates and other inputs that indicate how flows such as promotions into a grade and augmentations into the regular component should be distributed over the years of service.* These input parameters are sufficient to determine the officer force structure and thereby the annual accessions and personnel policy parameters implied by the force structure. Thus, where the progression and constraints models determine the grade requirements implied by personnel policy parameters, the grade limitations model determines the personnel policy parameters implied by grade requirements.

Figure 5 is a graphic presentation of the grade limitations model in its computation of the final states and flows of ROTC non-rated officers. The grade limitations model determines the highest grade first;

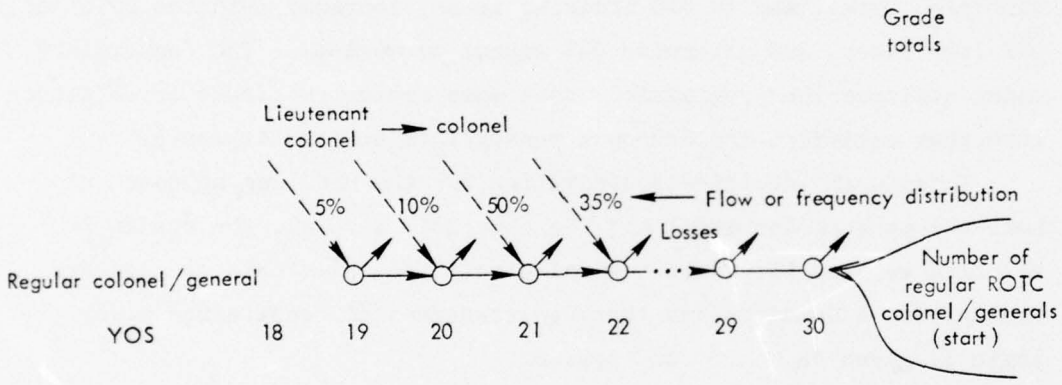


Fig. 5 — Grade limitations (backward) model, final states and flows of non-rated officers

this is done because all flows into a grade in the grade limitations model occur only to fill vacancies created by losses in that or higher grades. For the highest grade (colonel/general combined) the losses in that grade completely determine the number of promotions required from the grade of lieutenant colonel to colonel. Thus by knowing the total

*The progression or constraints models can be very useful in helping to estimate these and other grade limitations model inputs if they are not available from other sources. See Sec. VI.

number of colonel/generals authorized, the loss rates, and the flow or frequency distribution of promotions into colonel/generals, the model is able to compute a unique mathematical solution for (1) the losses from the grade, (2) the number of officers in each state, (3) the total number of promotions into the grade, and (4) the distribution of promotions into the grade by year of service. Similarly, because the model knows the promotion flows out of the grade of lieutenant colonel, the total number of lieutenant colonels authorized, the loss rates, and the flow or frequency distribution of promotions into the grade of lieutenant colonel, it can compute a unique mathematical solution for the flows into the grade of lieutenant colonel and the quantity of officers in each lieutenant colonel state. Working backward, the model continues until this type of computation is made for all grades through and including the grade of lieutenant, as is shown in Fig. 6.

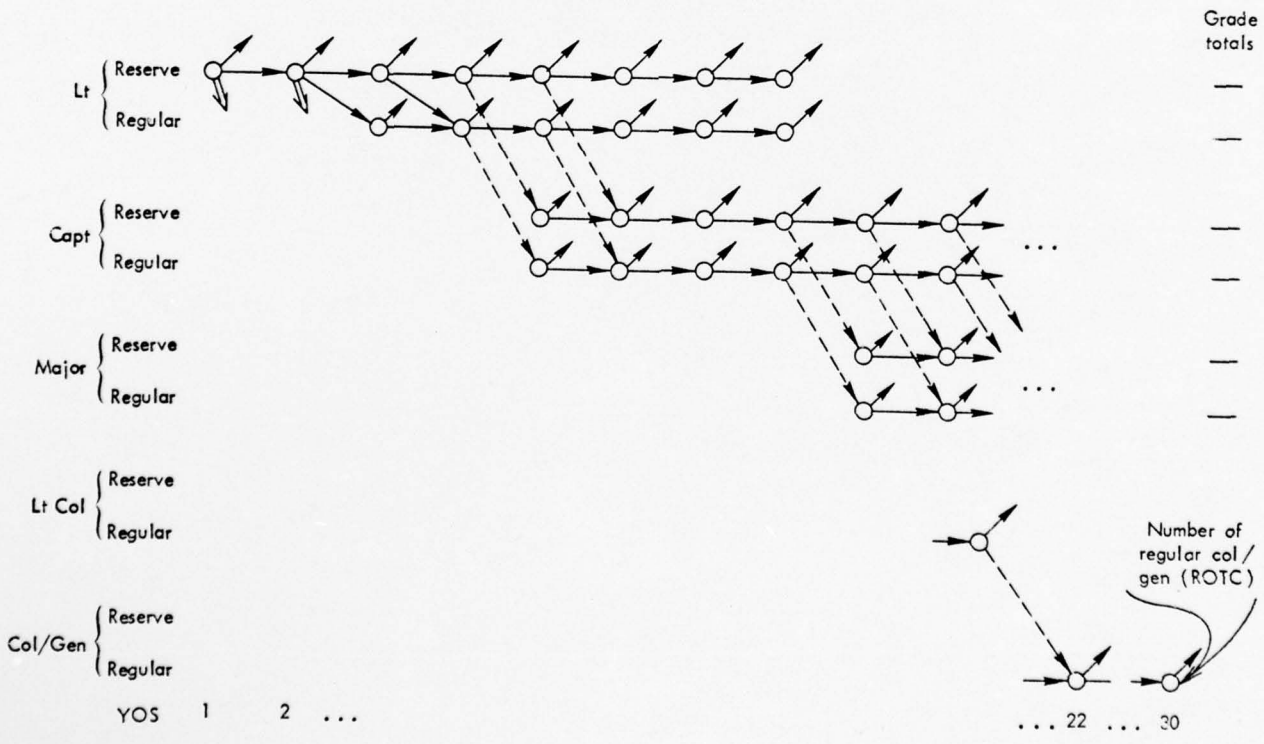


Fig. 6 — Non-rated officer structure states and flows

Officer Retention Model

In the discussion of the three officer force models, we noted that loss data must be provided as well as other appropriate input parameters. For example, the constraints model, in determining the impact on the officer force of changes in promotion opportunity, requires loss rates. Yet the loss rates themselves may be affected by changes in promotion opportunity. And changes in other personnel policy parameters may also affect loss rates. The officer retention model is designed to capture the responsiveness of officer loss rates to changes in personnel policy parameters, while taking into consideration factors external to the Air Force, e.g., officer pay and alternative civilian pay. The retention model, when used in conjunction with the progression, constraints, and grade limitations models, will permit consideration of the interaction between changes in personnel policy and loss rates as well as their mutual impact on the officer force structure.

II. NUMERICAL EXAMPLES

As discussed in Sec. I, the constrained officer force progression model is similar to the unconstrained officer force progression model, the primary distinction being that the constraints model allows the user to impose several manpower constraints on the force structure. The unconstrained progression model distributes officers over the force structure, treating policy variables such as annual accessions, promotion opportunity, augmentation, and training rates as exogenous. The constraints model, on the other hand, by allowing the user to impose personnel constraints on the force structure, treats accessions, augmentation, and training rates as partially endogenous. In other words, the model has the ability to determine, within certain bounds, what the accessions, augmentation, and training rates should be.

To help the reader become familiar with the constraints model, this section presents several highly simplified numerical examples. They are furnished to provide an intuitive flavor of the concepts and not mathematical rigor. Further, to keep the examples simple, we avoid several complicated options available in the constraints model. We start with an unconstrained progression model example, enhancing the example in a series of steps.

UNCONSTRAINED PROGRESSION MODEL EXAMPLE

Consider a hypothetical officer force with the following characteristics:

- o 1 source of commission (reserve commissions awarded only).
- o 2 components (reserve and regular).
- o 2 grades (lieutenant and captain).
- o 2 ratings (non-rated and pilot).
- o 6 years of service.

The following inputs are also provided:

- Annual accessions: 1000.
- Losses: 100 percent in year 6 and none prior to year 6.
- Rating transfer rates: 60 percent rating transfer rate to pilot in year 1, i.e., 60 percent of the non-rated officers in year 1 become pilots in year 2.
- Augmentation rates: 25 percent for non-rated and 75 percent for pilot in year 2, i.e., 25 percent of the non-rated reserve officers in year 2 become non-rated regular officers in year 3, and 75 percent of the reserve pilots in year 2 become regular pilots in year 3.
- Promotion opportunities: 40 percent non-rated promotion opportunity and 50 percent pilot promotion opportunity into year 4, i.e., 40 percent of the non-rated officers in year 4 are captains, and 50 percent of the pilots in year 4 are captains.*

Figure 7, a schematic of the officer force implied by these inputs, illustrates the number of states in the officer force as well as the flows between the states, but not the number of officers in each state. In year 1 there are only non-rated reserve lieutenants. As officers move from year 1 to year 2, they can go in one of two directions--they can become pilots, or they can remain non-rated. Similarly, the year 2 officers can be augmented into the regular force or can remain reserve. And the year 3 officers can be promoted to captain, or they can remain lieutenants.

The progression model first determines the distribution of reserve non-rated officers as illustrated in Fig. 8. During this process the flows out of non-rated reserve are saved. The number of officers in year 1 is simply the number of annual accessions. Since the input rating transfer rate is 60 percent, 600 of the accessions flow out of reserve non-rated into reserve pilot, leaving 400 reserve non-rated lieutenants in the second year.

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*Air Force policy is to provide equal promotion opportunity for all ratings within a grade. We use unequal opportunities here solely to demonstrate the model's capabilities.

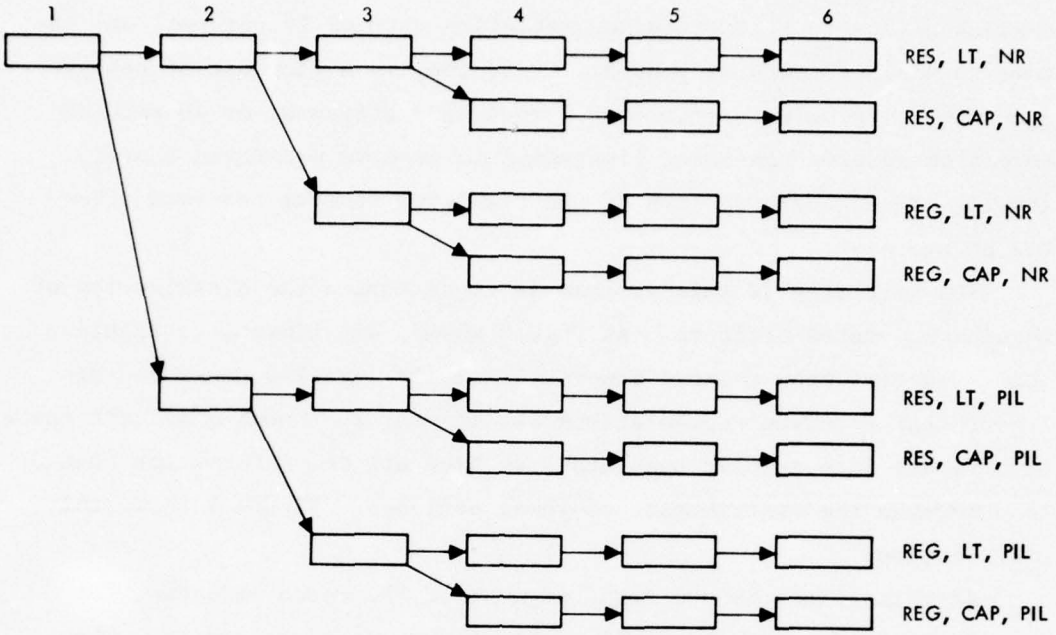


Fig. 7 — Force structure schematic

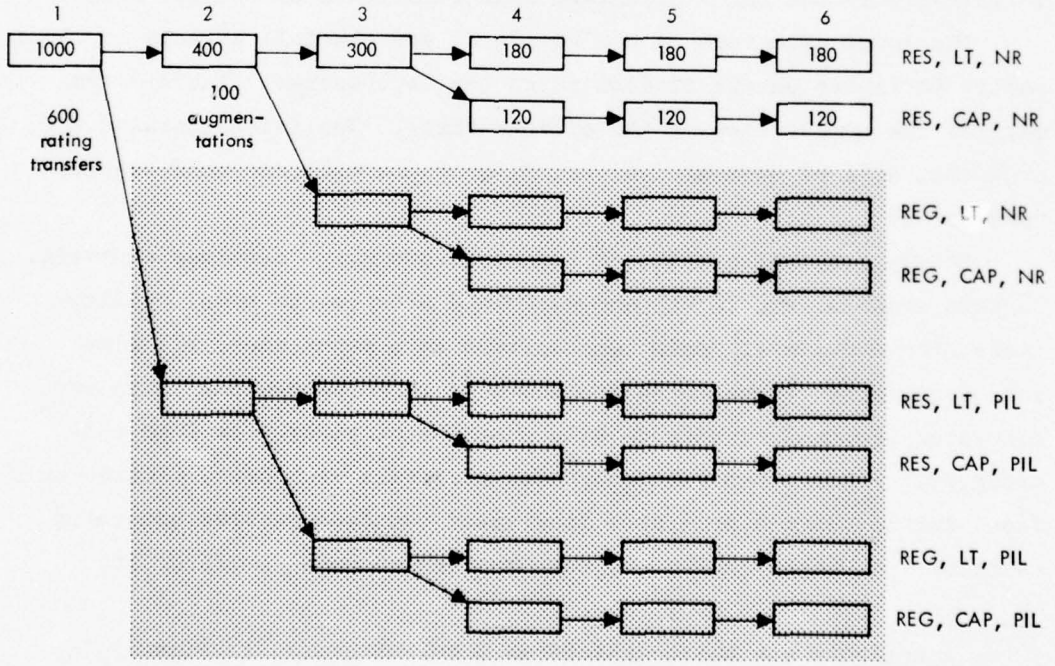


Fig. 8 — Reserve non-rated officer distribution

Of the 400 reserve non-rated officers in year 2, 100 of them are augmented (due to a non-rated augmentation rate of 25 percent) and become regular officers in year 3. This, too, is a flow out of reserve non-rated. As we move from year 3 to 4, 120 officers, or 40 percent, move from reserve non-rated lieutenant to reserve non-rated captain, leaving 180 officers in each of the remaining reserve non-rated lieutenant states.

The next step in this process is to determine the distribution of regular non-rated officers. As Fig. 8 shows, all flows into regular non-rated come from reserve non-rated, namely, the 100 non-rated officers that received augmentations out of year 2. Knowing all the flows of officers into regular non-rated, we have all the information needed to determine the distribution of those officers. Figure 9 shows that distribution.

At this point the non-rated segment of the force structure has been determined, as well as all of the flows out of non-rated. The next steps in the process are to first determine the distribution of reserve pilots, and second, the distribution of regular pilots. Figure 10 illustrates the force structure upon completion of the two steps.

The force structure is now complete, and the full effects of the policy variables on the officer force can be observed. Table 2 summarizes the composition of the officer force. The force contains 6000 officers, half of whom are pilots; 2200 of the officers hold regular commissions.

Before continuing with the examples, one point deserves emphasis. In this example, and in all unconstrained progression model applications, the model must begin computations at a point where all flows into a category of the force are known.* Hence we begin with reserve non-rated lieutenants because only annual accessions flow into this category. Reserve non-rated captains are dealt with next, because only flows out of reserve non-rated lieutenant can feed reserve non-rated captains. As shown in Fig. 7, the progression model performs its

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*A category may be thought of as a row of states in Figs. 7-10, i.e., all the states associated with a given component, grade, and rating.

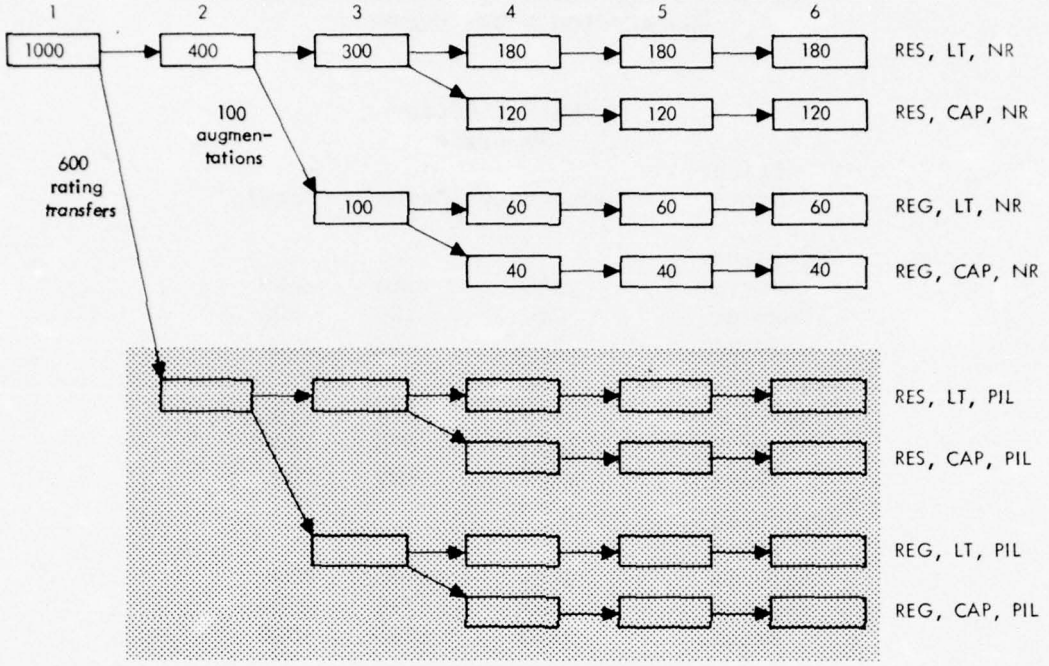


Fig. 9 — Non-rated officer distribution

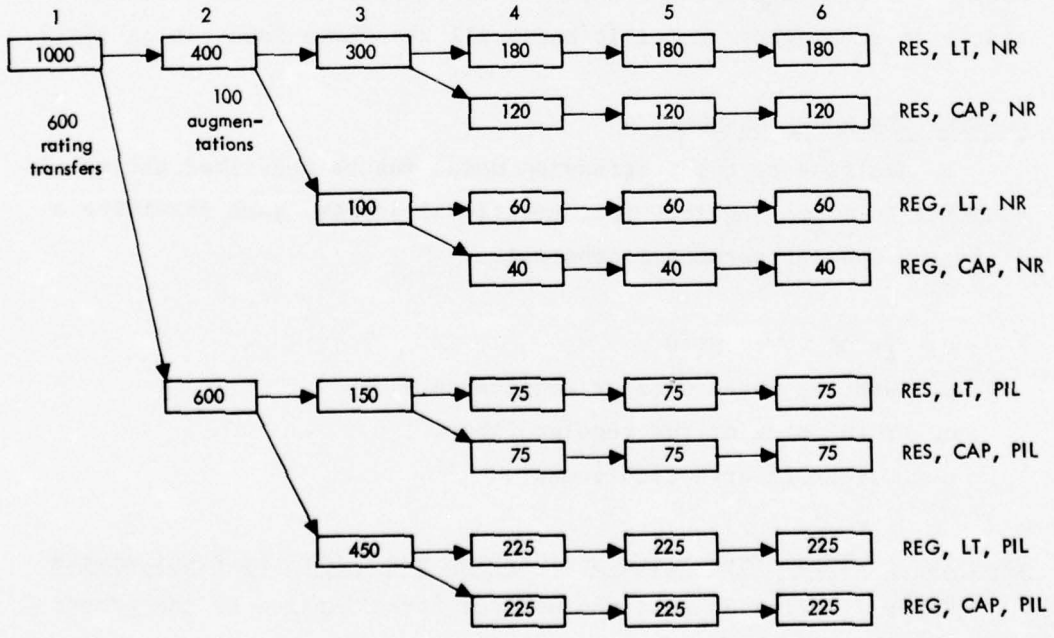


Fig. 10 — Officer force distribution

Table 2

OFFICER FORCE SUMMARY: OFFICER FORCE PROGRESSION MODEL EXAMPLE

Officer State	Number of Officers in Grade: Lieutenant	Captain	Total
Non-rated			
Reserve	2240	360	2600
Regular	280	120	400
Total	2520	480	3000
Pilot			
Reserve	975	225	1200
Regular	1125	675	1800
Total	2100	900	3000
Non-rated and pilot			
Reserve	3215	585	3800
Regular	1405	795	2200
Total	4620	1380	6000

computations a row at a time, moving from the top to the bottom row. Stated differently, the model cannot distribute the officers over the states in a category, unitl it knows all the flows into the category.

CONSTRAINTS MODEL EXAMPLES

In addition to the progression model inputs described above, the constraints model requires four additional inputs, each providing a different type of personnel constraint:

- Total force size.
- Wartime rated officer requirements.
- Total size of the regular force.
- Career reserve requirement.

Example 1: Total Force Size and Wartime Rated Officer Requirements

Table 2 indicates that the officer force implied by the progression model inputs is 6000 officers strong, and that 3000 of them are

pilots. Suppose, however, only 2600 pilots and a total force size of 7200 officers are desired. The constraints model will work in the following five steps to build a force structure satisfying the requirement and to determine the annual accessions and rating transfer rates needed to meet the requirements:

1. The model determines the frequency distribution of pilots over the pilot states, i.e., the percentage of total pilots in each of the states that contain pilots. Using the unconstrained progression model, the constraints model focuses on the pilot section of the force structure. For example, as shown in Fig. 10, in year 2 there are 600 reserve lieutenant pilots, or 20 percent of all pilots in the force structure. In year 3, 5 percent of all pilots are reserve lieutenants, and 15 percent of all pilots are regular lieutenants. Proceeding in this manner, the pilot frequency distribution, illustrated in Fig. 11, is computed.

2. The model distributes the 2600 pilots over the pilot states and determines the number of non-rated officers needed to support the rating transfer flows into pilot. Figure 12 shows the officer force with pilots distributed. The 520 reserve lieutenant non-rated officers in year 1 are in Undergraduate Pilot Training (UPT) and are in addition to the 2600 pilots. Stated differently, it takes 3120 officers to satisfy the 2600 pilot requirement, leaving a balance of 4080 to be distributed over the non-rated states.

At this point, the pilot requirement has been satisfied and the number of non-rated officers needed to support the flows into the pilot states determined.

3. The model constructs an *exclusively non-rated force profile* of officers in the non-rated states. To do this the model sets to zero the rating transfer rate and employs the unconstrained progression model to send one annual accession through the exclusively non-rated force structure. Figure 13, which illustrates this, can be interpreted in the following way. For every accession into this exclusively non-rated force, .1 regular non-rated captains with 6 years of service will be generated, .25 regular non-rated lieutenants will be generated with 3 years of service, *and a total of 6 non-rated officers will be generated.* Therefore, to determine the number of accessions needed to generate

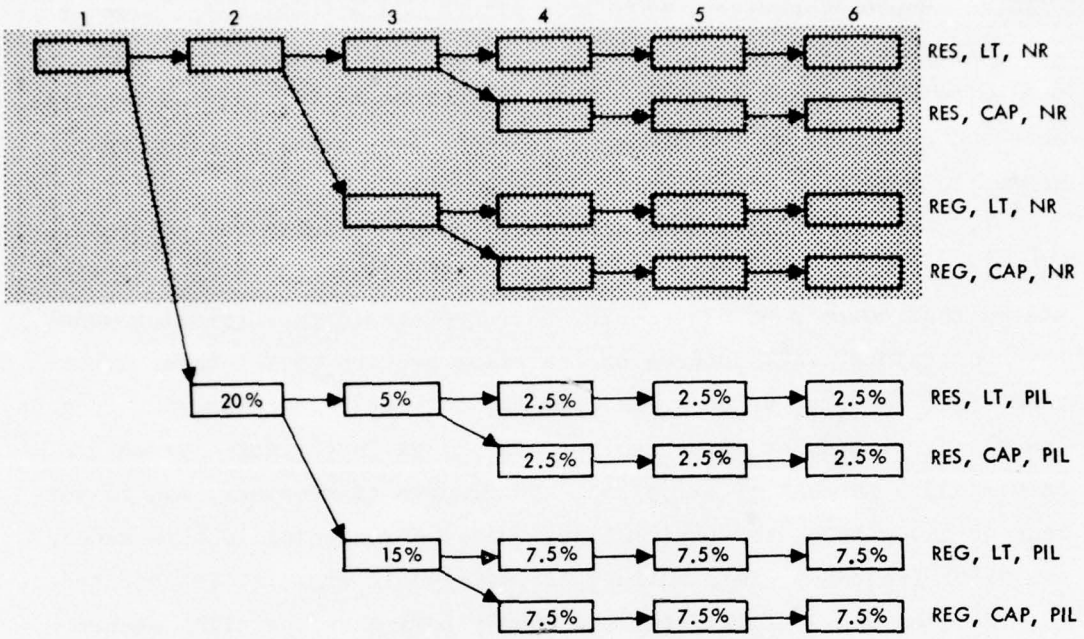


Fig. 11 — Frequency distribution of pilots

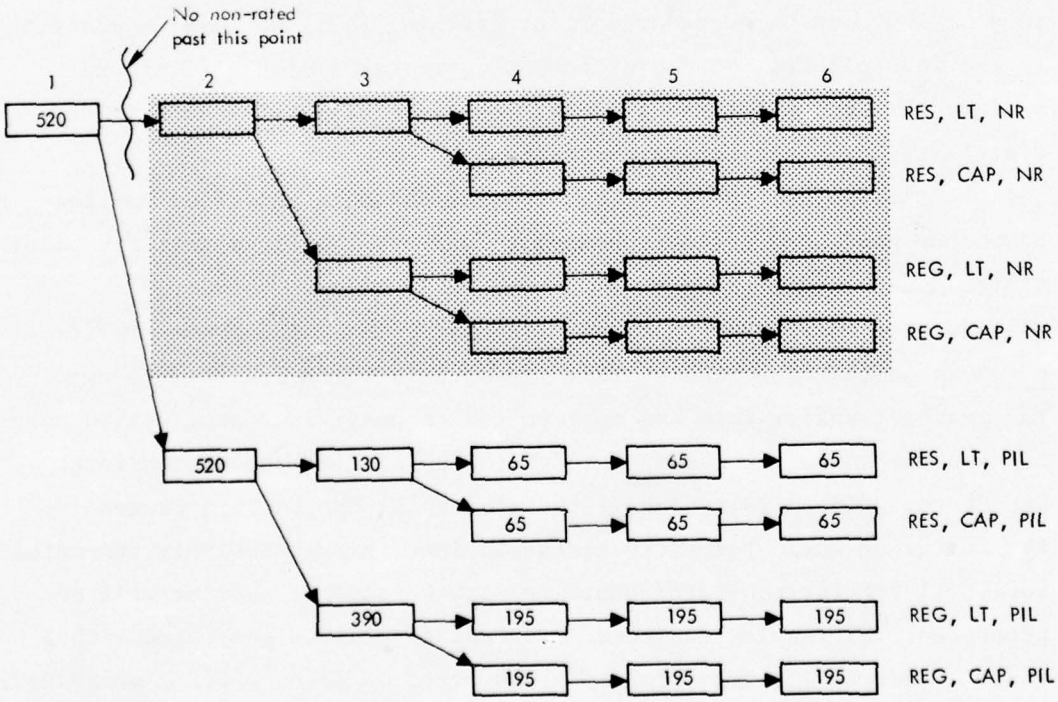


Fig. 12 — Distribution of 2600 pilots plus those non-rated officers in Undergraduate Pilot Training (UPT)

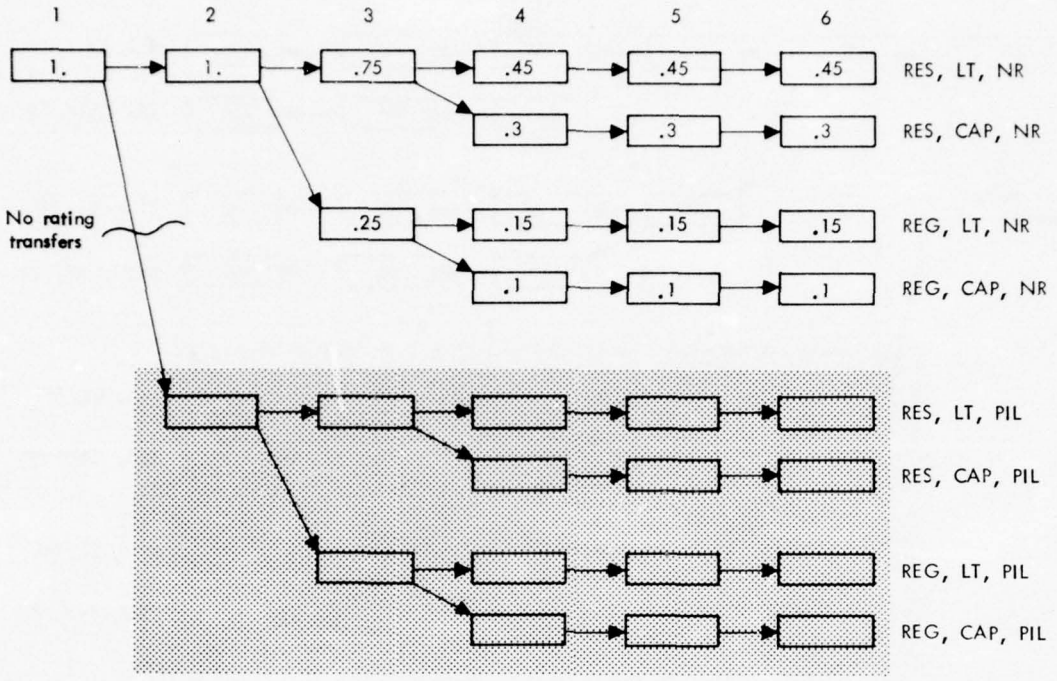


Fig. 13 — Force profile of an exclusively non-rated force structure

4080 non-rated officers, it is necessary to divide 4080 by 6. Thus, 680 accessions will be required. These accessions will be *exclusively non-rated*, in contrast to the 520 accessions destined to become pilots which were determined in step 2 above.

4. The 4080 officers are distributed over the non-rated states. To determine the number of officers in each non-rated state, each force profile entry is multiplied by the 680 accessions. The resultant non-rated force structure is illustrated in Fig. 14.

At this point, both the non-rated and pilot force structures have been determined, as illustrated in Figs. 13 and 14.

5. The two structures from step 4 are combined to yield the total force structure, illustrated in Fig. 15.

The force structure is also summarized in Table 3, which indicates that accessions have risen to 1200 as compared to 1000 in the unconstrained

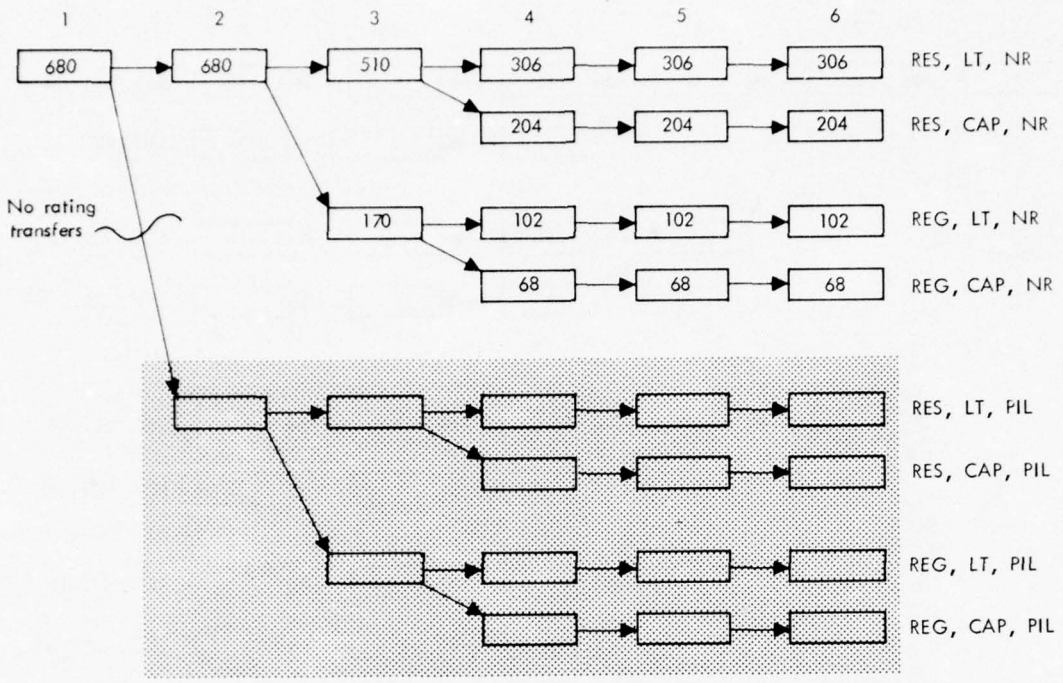


Fig. 14 — Distribution of 4080 non-rated officers when rating transfers are not permitted

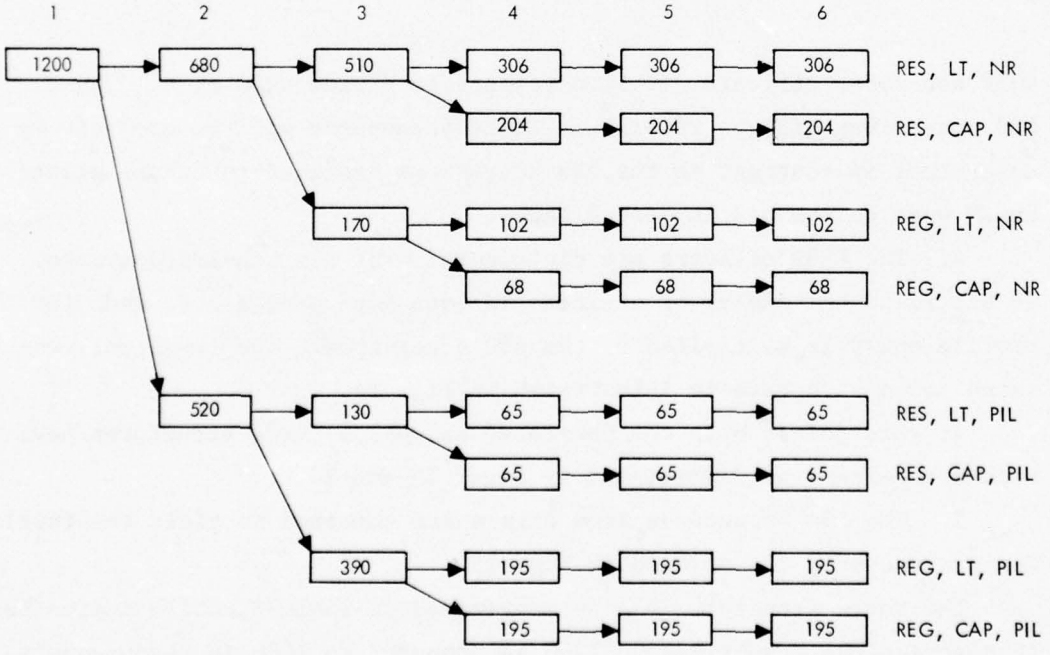


Fig. 15 — Officer force distribution with 7200 officers and 2600 pilots

Table 3

OFFICER FORCE SUMMARY: 7200 OFFICERS, 2600 PILOTS

Officer State	Number of Officers in Grade: Lieutenant	Captain	Total
Non-rated			
Reserve	3308	612	3920
Regular	476	204	680
Total	3784	816	4600
Pilot			
Reserve	845	195	1040
Regular	975	585	1560
Total	1820	780	2600
Non-rated and pilot			
Reserve	4153	807	4960
Regular	1451	789	2240
Total	5604	1596	7200

progression model example,* and the rating transfer rate has decreased from 60 percent to just over 43 percent. In addition, while the force size has increased by 20 percent (from 6000 to 7200), the number of regular officers has increased by less than 2 percent (from 2200 to 2240). This increase is slight because of the decreased number of pilots, whose augmentation rate is 75 percent, and the increased number of non-rated officers, whose augmentation rate is only 25 percent.

Example 2: Regular Force Size and Career Reserve Requirement

This example focuses on the effects of constraining the regular force and imposing a career reserve requirement on the reserve force.

*Note that the accessions have increased by 20 percent, the same percentage increase as with the officer force. In a realistic situation, where losses take place in all years of service, and where the number of rated officers decrease and non-rateds increase, accessions will probably increase at a greater rate than force size because non-rated loss rates historically have been higher than rated loss rates.

A 2000 officer constraint is placed on the regular force, and at the same time a 60 percent career reserve opportunity is imposed on non-rated reserve officers with four years of service. The career reserve constraint essentially limits the number of non-rated reserve officers that are in the force after the fourth year--only 60 percent of the non-rated reserve officers with four years of service are permitted to remain in the force. Stated differently, 40 percent of the non-rated reserve officers with four years of service are forced out.

Table 3 shows that the regular officer constraint will not impact the pilot force structure, since there are only 1560 regular pilots, and the model completely processes pilots before turning to non-rated officers. Thus, 440 regular non-rated officers are still needed in order to satisfy the regular force requirement. In addition, to satisfy the total force requirement, a total of 4080 non-rated officers is still needed.

We begin by constructing an exclusively non-rated force profile, as illustrated in Fig. 16. Note the 40 percent non-rated reserve loss rates in year 4. Note also that one out of every 5.4 non-rated officers is regular. Thus, in order to satisfy the 440 remaining regular force requirement, we need to distribute 2376 non-rated officers (440·5.4). Figure 17 illustrates the force distribution.

To satisfy the total force requirement, 1704 non-rated officers are still needed. These officers must be exclusively reserve non-rated, since the regular force requirement was just satisfied. An exclusively reserve non-rated force profile (Fig. 18) is constructed and the remaining 1704 officers distributed (Fig. 19). Finally, the various pieces of the officer force are collected (Figs. 12, 17, and 19), generating the complete force structure illustrated in Fig. 20 and summarized in Table 4.

Table 5 compares all three examples. The non-rated augmentation rate has fallen from 25 percent to 14 percent for two reasons. First, and most important, the size of the regular force has been reduced by 240 officers. Second, imposing a 60 percent non-rated career reserve opportunity in year 4 has in effect forced the non-rated reserve officers to be younger, thus increasing the number of non-rated reserve

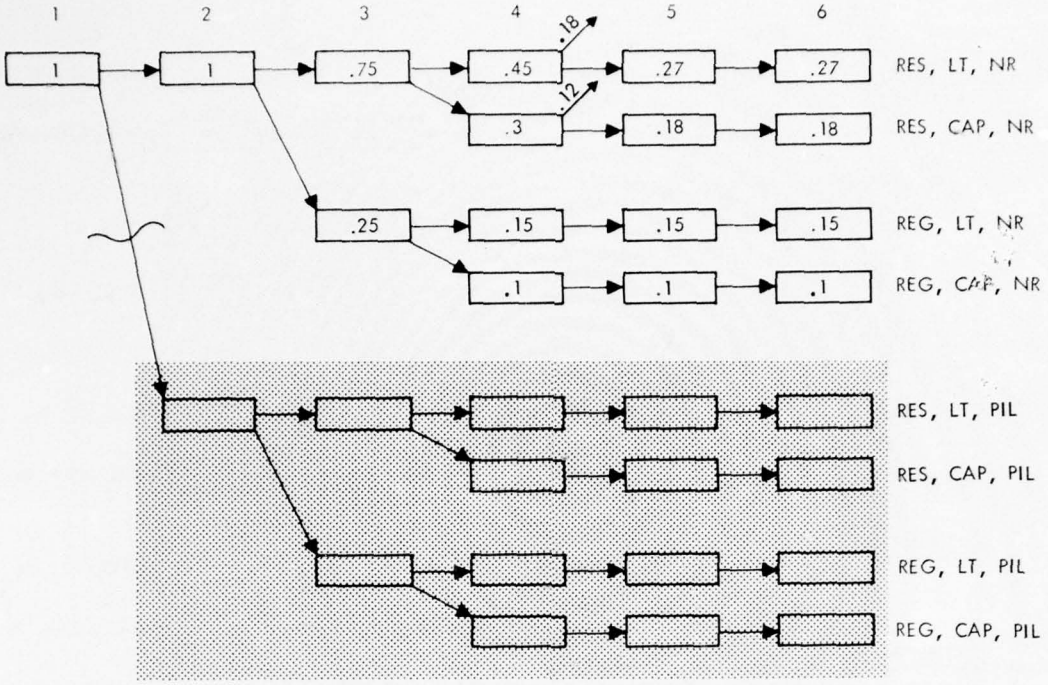


Fig. 16 — Exclusively non-rated force profile with 60 percent career reserve opportunity in year 4

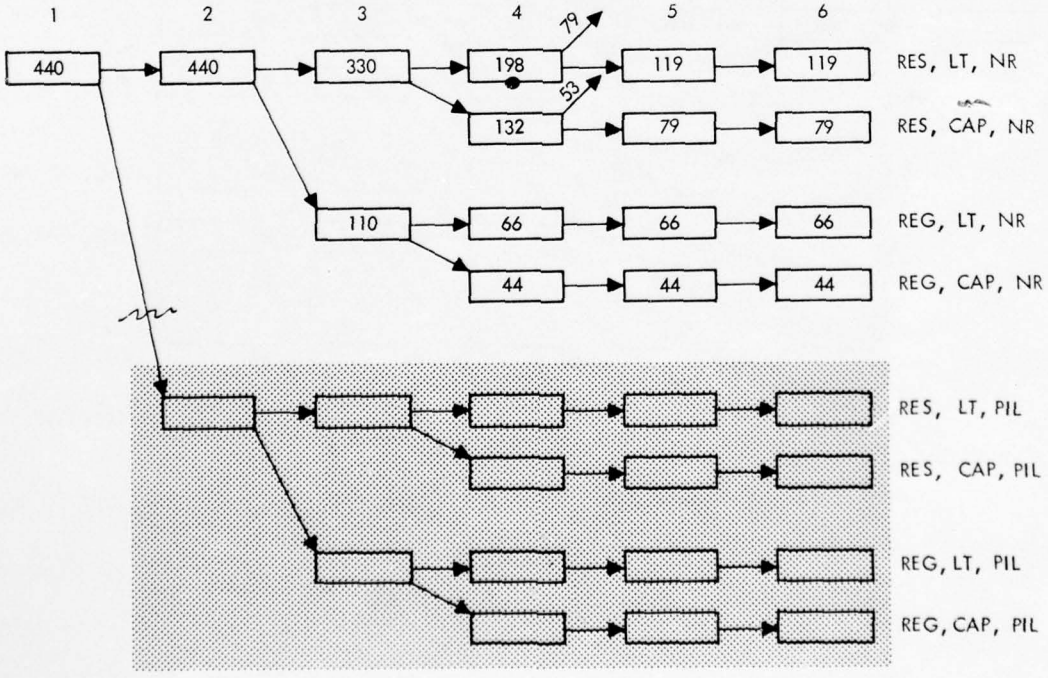


Fig. 17 — Distribution of 440 regular non-rated officers plus the total reserve force implied by the regular non-rateds (total = 2376 non-rated officers)

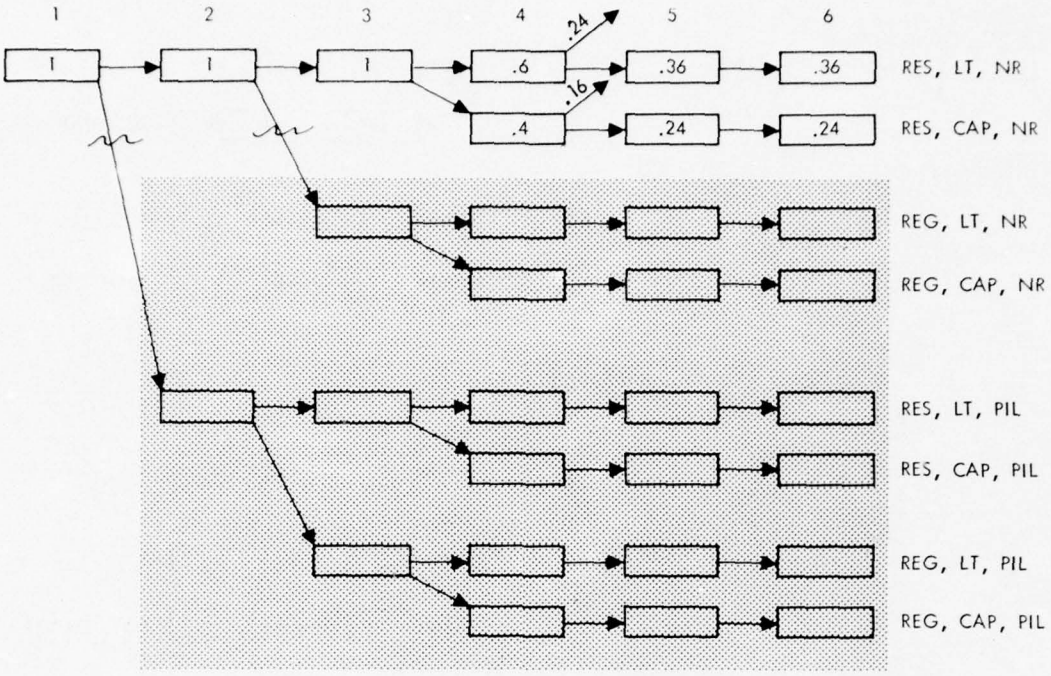


Fig. 18 — Exclusively reserve non-rated force profile

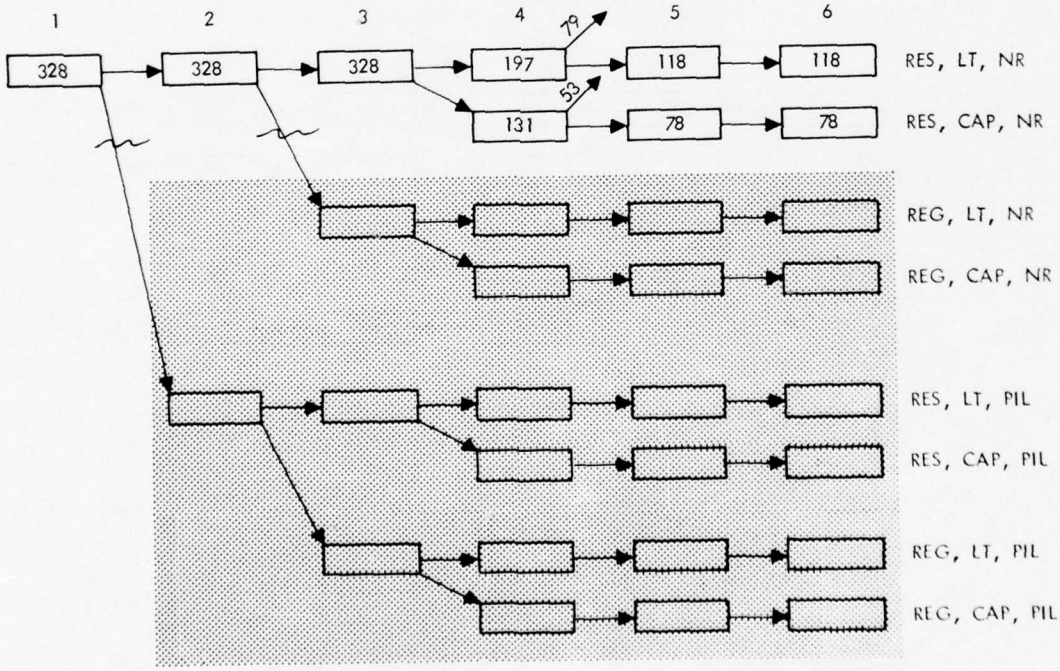


Fig. 19 — Distribution of 1704 exclusively reserve non-rated officers

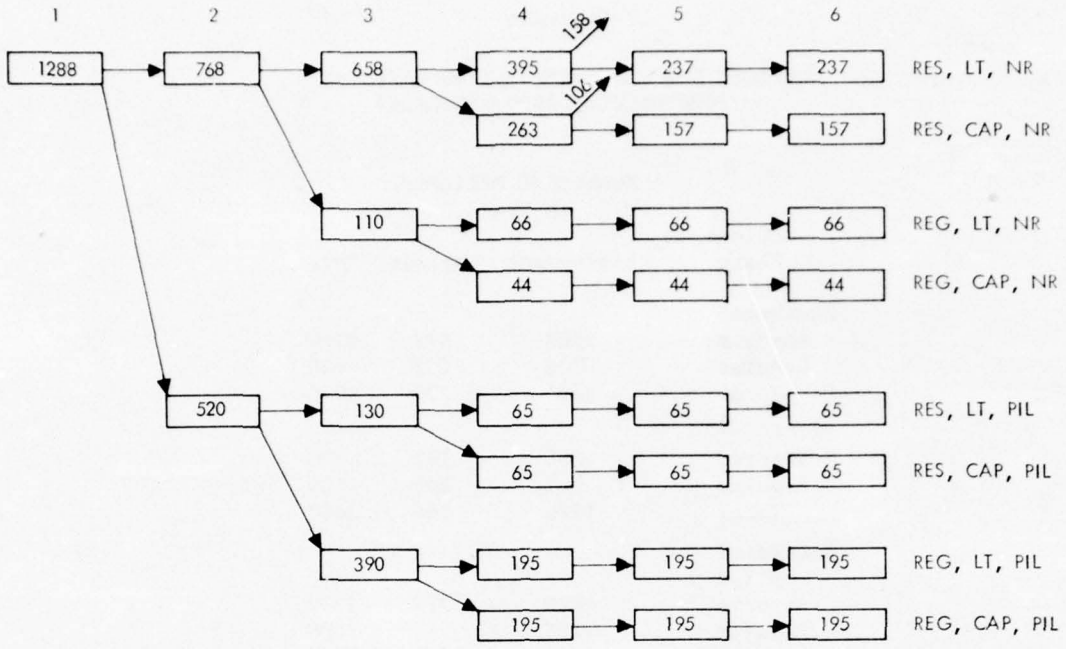


Fig. 20 — Officer force distribution with 7200 officers, 2600 pilots, 2000 regulars and a 60 percent non-rated career reserve opportunity in year 4

officers in year 2. If the size of the regular force had not been reduced but the career reserve opportunity had still been imposed, the non-rated augmentation rate would have been just over 22 percent.

Note that the accessions have increased from 1200 to 1288, solely because the career reserve opportunity causes attrition in year 4. Since accessions increase with no change in the pilot force structure, the rating transfer rate drops.

Implied Force Size and Augmentation Rate Adjustment

One final point should be mentioned here because of its importance in Sec. V. In the last example, when determining how to satisfy the regular force requirement, an exclusively non-rated force profile was constructed and it was determined that one out of every 5.4 non-rated officers distributed in accordance with the profile would be regular. Therefore, satisfaction of the remaining 440 regular officer requirement

Table 4

OFFICER FORCE SUMMARY: 7200 OFFICERS, 2600 PILOTS, 2000 REGULARS[a]

Officer State	Number of Officers in Grade: Lieutenant	Captain	Total
Non-rated			
Reserve	3583	577	4160
Regular	308	132	440
Total	3891	709	4600
Pilot			
Reserve	845	195	1040
Regular	975	585	1560
Total	1820	780	2600
Non-rated and pilot			
Reserve	4428	772	5200
Regular	1283	717	2000
Total	5711	1489	7200

[a]60 percent non-rated career reserve opportunity in year 4.

Table 5

SUMMARY OF NUMERICAL EXAMPLES

Item	Unconstrained Progression Model Example	Constraints Model Examples: 1	2
Force size	6000	7200	7200[a]
Number of pilots	3000	2600[a]	2600[a]
Number of regulars	2200	2240	2000[a]
Career reserve opportunity	100%	100%	50%
Annual accessions	1000	1200	1288
Augmentation rates			
Non-rated	25.0%	25.0%	14.3%
Pilot	75.0%	75.0%	75.0%
Rating transfer rate	60.0%	43.3%	40.4%
Percentage regulars			
Non-rated	13.3%	14.8%	9.6%
Pilot	60.0%	60.0%	60.0%
Total	36.7%	31.1%	27.8%

[a]Constrained.

implied a need for 1936 additional reserve non-rated officers (4.4·440). Had a total force requirement not had sufficient slack to accommodate the additional 1936 non-rated reservists, the model would have opted not to satisfy the regular force requirement. Stated differently, the model would not have permitted the augmentation rate to rise above 25 percent, the augmentation rate specified in the model's inputs.

III. INPUT DATA

This section discusses each of the constraints model inputs and input preparation in detail. Finally, several special or extreme situations are addressed that can arise when extreme manpower or career reserve constraints are placed on the officer force.

INPUT DATA: GENERAL DESCRIPTION

Seven types of input data are required by the constraints model, the first five of which are almost identical to the progression model's inputs.

1. *Academy and ROTC annual accessions.* The constraints model determines the number of OTS annual accessions required to satisfy the manpower and career reserve requirements. This input simply indicates the number of newly commissioned officers entering the force each year from the Academy and ROTC commissioning sources.

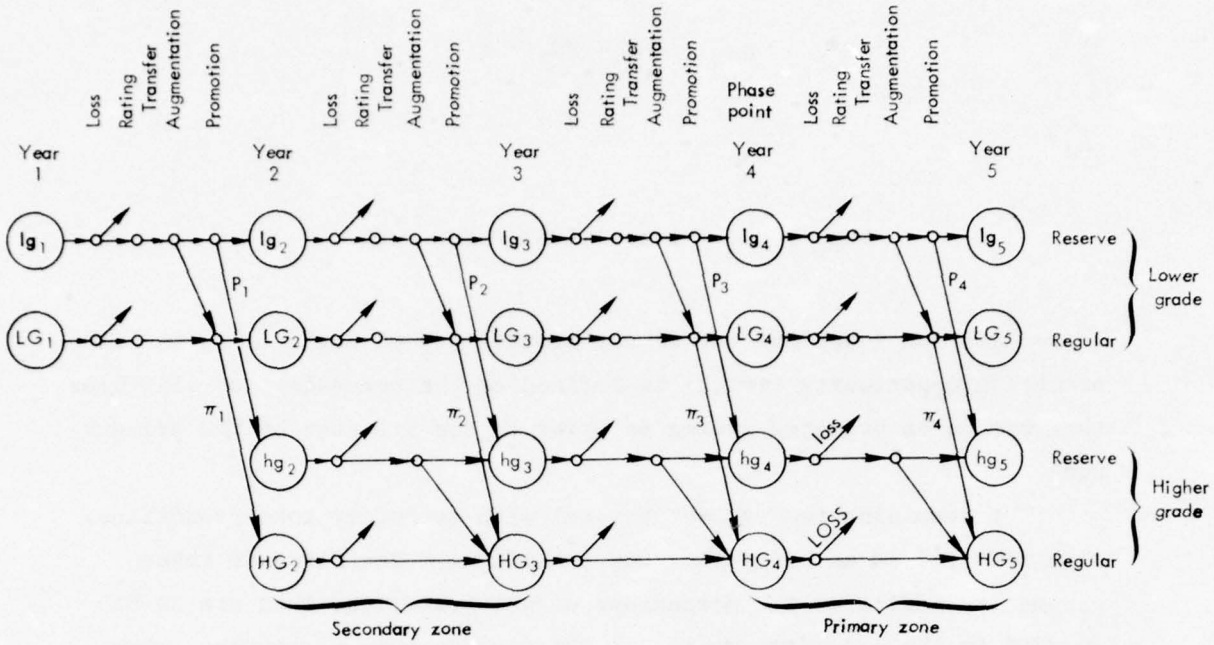
2. *Promotion inputs.* Five promotion parameters must be provided for each grade, rating, and source of commission. These parameters are sufficient to define the promotion zone and the distribution of promotions over the years of service within the promotion zone.

In the constraints model, the promotion zone for a grade, rating, and source of commission is defined to be four years in length, with the first two years referred to as the secondary zone and the last two referred to as the primary zone. The phase point is *defined* to be the first year of the primary zone, i.e., the third year of the promotion zone.* Figure 21 illustrates the promotion zone. Note that *five* years are needed to define the four-year promotion zone--promotions flow into four years (and out of four years).

The first of the five promotion parameters that must be specified is the phase point. Two promotion opportunities must also be specified.

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*In Air Force terminology the phase point is defined as the year of service in which the most promotions take place. However, in the constraints model it is possible to specify promotion inputs that place the bulk of promotions in a year other than the third year of the promotion zone.



NOTE:
Lower case state labels identify reserve states; upper case labels refer to regular states.
"lg" and "LG" identify the lower grade's states; "hg" and "HG" refer to higher grade states.

Fig. 21 — Promotion zone

The first promotion opportunity indicates the percentage of officers *eligible for promotion* that have been promoted during or prior to the first year of the primary zone. The second promotion opportunity indicates the percentage of officers *eligible for promotion* that have been promoted during or prior to the second year of the primary zone. The number of *eligibles* is defined as the number of officers in the phase point year that hold at least the grade from which promotions will be made. Thus, if E denotes the number of eligibles, then (referring to Fig. 21)

$$E = lg_4 + LG_4 + hg_4 + HG_4.$$

Further, if PO_i represents the first (i=1) or second (i=2) promotion opportunity, then

$$hg_4 + HG_4 = PO_1 \cdot E,$$

and

$$hg_5 + HG_5 + loss + LOSS = PO_2 \cdot E.$$

These last two equations are simply another way of saying that the ith promotion opportunity (i=1,2) is defined as the percentage of eligibles that are to be promoted during or prior to the ith year of the primary zone.

The remaining two parameters deal with secondary zone promotions, also referred to as below-the-zone promotions. The first of these parameters indicates the percentage of all promotions that are to be awarded in the secondary zone. If BTZ denotes this percentage, then (referring to Fig. 21)

$$P_1 + P_2 + \pi_1 + \pi_2 = BTZ \cdot (P_1 + P_2 + P_3 + P_4 + \pi_1 + \pi_2 + \pi_3 + \pi_4).$$

The second of the remaining parameters indicates the percentage of secondary zone promotions that are to occur in the first year of the secondary zone. If FYBTZ denotes this percentage, then

$$P_1 + \pi_1 = FYBTZ \cdot (P_1 + P_2 + \pi_1 + \pi_2).$$

In both the progression model and the constraints model, the determination of officer flows in the promotion zone is the most complicated computation performed. This stems from the fact that (1) the promotion parameters affect more than one officer state, and (2) at the beginning of promotion zone computations, the models know only the number of officers in the states prior to the promotion zone--states lg_1 and LG_1 in Fig. 21. To determine the number of officers in each of the sixteen states in the promotion zone and the promotion flows between those states, the progression and constraints models must solve a system of eight simultaneous linear equations in the eight promotion flows P_1 - P_4 and π_1 - π_4 (see Sec. V, p. 88).

3. *Loss data.* A loss rate may be specified for each state, indicating the fraction of officers leaving the force from that state.

4. *Rating transfer data* (also referred to as rating category data). A rating transfer rate, which indicates the fraction of annual accessions that become pilots (or navigators), may be specified for each non-rated lieutenant state prior to the promotion zone for promotion to captain. The model converts these input rates into rates more readily usable by the computation algorithms, namely, the fraction of officers in the state after losses are removed that become pilots (or navigators) as opposed to the fraction of annual accessions. In so doing, the model checks that sufficient officers remain in the non-rated state after losses to support the rating transfer flows to pilot and navigator.

5. *Augmentation data.* For each reserve state an augmentation rate may be provided that indicates the fraction of officers in the state that are to be augmented, i.e., whose component is changed from reserve to regular. This rate applies to officers remaining in the state after the effects of losses (and rating transfers if lieutenant states) have been considered. For lieutenants receiving rating transfers, the rated augmentation rate is applied (see Sec. V, p. 86).

The five types of input data just described--accessions, promotion parameters, loss, rating transfer, and augmentation rates--are identical to the data required by the progression model, except that OTS annual accessions are not needed by the constraints model and are needed by the progression model. Two additional types of input data are required by the constraints model:

6. *Manpower data.* The manpower requirements that can be imposed on the officer force must be included: the total size of the officer force; the wartime pilot and navigator requirements--the number of pilots and navigators with grade *lower than colonel* and with 28 or fewer years of service;* and the desired size of the regular force.

---

*Both the maximum grade and maximum year of service applied to the wartime rated officer requirements can be easily changed. See App. E for details.

7. *Career reserve requirement data.* For each rating and reserve source of commission, an end of initial obligation (EOB) and career reserve requirement must be specified. The EOB is the year of service during which a reserve officer has satisfied his initial service obligation. All reserve officers remaining in the force after the end of initial obligation are defined to be career reservists.

The career reserve requirement provides a mechanism for limiting the number of career reservists. Three types of career reserve requirements are permitted, but only one type may be employed for a given source of commission and rating.

The first type is the career reserve opportunity, i.e., the percentage of reservists in the EOB year (after losses are removed) that are permitted to remain in the force. Figure 22 illustrates some of the flows out of the EOB year. Suppose there are 100 reservists in the EOB year ($s_i = 100$), that the normal input loss rate is 20 percent, and that the career reserve opportunity is 70 percent. Then the number of officers that "get past" the EOB year is

$$100 \cdot (1. - .2) \cdot .7 = 56.$$

That is, the 70 percent career reserve opportunity is applied after *normal* losses are removed.* In effect, the career reserve requirement acts as an additional or supplemental loss rate. Thus in our example 20 officers leave the force due to *normal* losses, and 24 additional officers leave the force because they have not been awarded career reserve status.

The second type of career reserve requirement allows specification of the actual number of career reserve selectees. In the example, 56 officers were selected for career reserve status as a result of the 70 percent career reserve opportunity. The user can specify this number directly by employing the selectee career reserve requirement. If in the example 90 career reserve selectees had been requested, the model

*Normal losses are losses that occur as a result of the input loss rates.

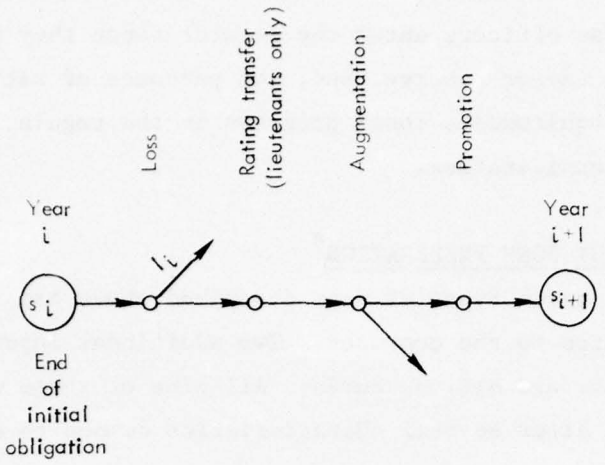


Fig. 22 — End of initial obligation — career reserve requirements

would have provided only 80 (normal losses are accounted for before the career reserve requirement).

The third type of requirement permits specification of the desired total career reservists, i.e., the total number of officers in the career reserve states. Note that in Fig. 22, s_i is not a career reserve state. Also, if the desired number of career reservists is larger than the number that can be supported by flows out of the EOB year after normal losses are accounted for,* then the model will opt to fall short of the requirement.

Several points should be made about career reserve requirements. First, the constraints model imposes these requirements at the point in the flow computation cycle just after normal loss takes place, i.e., before rating transfer (if lieutenant) and augmentation. In other words, the model controls the number of reserve officers permitted to pass beyond the EOB year's loss phase.

Second, the constraints model considers only the number of officers in the career reserve states when specifying the desired total career reservists. The user may, by providing augmentation rates for the

*In the example, if 80 selectees are insufficient to support the requested total career reservists.

career reserve states, augment some career reservists into the regular force. Once these officers enter the regular force they are no longer considered to be career reserve, and, for purposes of satisfying the career reserve requirement, their progress in the regular component is not taken into consideration.

INPUT DATA: INPUT FORM PREPARATION*

Each of the seven types of data described above has its own input form for submission to the computer. Two additional inputs are also needed: the title and options cards. All nine of these will be discussed in detail after several characteristics common to each are pointed out.

Common Characteristics

Unless otherwise indicated, columns 1-20 of each input card should contain the information shown in Table 6.

In addition, each type of input data should be preceded by a card containing the type of input data in columns 1-4, and the last card in the input deck should be blank. Columns 73-80 of each input card may be used for sequencing of the input deck.

The aggregation descriptors (e.g., ALL, RAT) are provided to facilitate input preparation. The constraints model provides a great deal of flexibility during input preparation, permitting the user to specify inputs in a highly detailed manner; e.g., promotion inputs may be specified for different ratings and sources of commission within each grade. Thus, if desired, the promotion parameters for Academy pilots may be different than those for Academy navigators, or ROTC pilots. However, if such detail is not desired, the aggregate descriptors can be employed to indicate that the inputs apply to more than one group of officers.

---

*Readers who are not concerned with the details of input data preparation need not read this subsection.

Table 6

INPUT CARD INFORMATION, COLUMNS 1-20

Column	Information
1-4:	Type of data
	ACSS - accessions data
	PROM - promotion data
	LOSS - loss data
	AUG - augmentation data
	RCAT - rating transfer data
	MPWR - manpower requirements data
	CRES - career reserve requirement data
5-8:	Component
	REG - regular
	RES - reserve
	ALL - RES and REG
9-12:	Grade
	LT - lieutenant
	CAP - captain
	MAJ - major
	LTC - lieutenant colonel
	COL - colonel
13-16:	Rating
	PIL - pilot
	NAV - navigator
	NR, SUP - non-rated or support
	RAT - PIL and NAV
	ALL - PIL, NAV, and NR
17-20:	Source of Commission
	AFA - Air Force Academy
	ROTC - Reserve Officers Training Corps
	SMSO[a], OTS - Officer Training School
	RES - ROTC and OTS
	ALL - Academy, ROTC, and OTS

[a]School of Military Science-Officer (SMS-O) is the past designation for OTS.

Title and Options Cards

The first card of the input deck must be the *title card*. Its contents are printed at the top of each page of output produced by the constraints model.

The second card must be the *options card*, which is used to request more detail in the output reports (see Sec. IV). Since the full complement of outputs, aggregated and unaggregated, may run to hundreds of pages, the user may specify that he wishes only aggregated outputs or only some of the unaggregated outputs. The format of this card is shown in Fig. 23. Blanks indicate that the option is *not* desired, e.g., if columns 1 and 2 are left blank, officer flow reports for each component will not be produced. If anything other than a blank is shown in an option field, then the indicated detailed output will be generated. The fields and detailed reports they select are shown in Table 7.

Accessions Data (ACSS)

These data indicate the number of annual graduates from the Academy and ROTC sources of commission. Figure 24 illustrates the input deck's format.* OTS accessions are not required and, if provided, will be ignored by the constraints model.

Promotion Data (PROM)

These data describe by grade, rating, and source of commission the cumulative promotion opportunities, below-the-zone promotion constraints, and promotion phase points for promotion *into* the indicated grade. Figure 25 illustrates the format of the input deck.

Promotions to the indicated grade may take place in any of four promotion years. In the first two years, below-the-zone promotions take place. In the last two years, primary-zone promotions take place.

The *phase point* is the first year of the primary zone, i.e., the first year into which primary-zone promotions can be made. For example, in Fig. 25, the phase point for promotion to major is the tenth year.

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*Input examples in this subsection are hypothetical and are provided for illustrative purposes only.

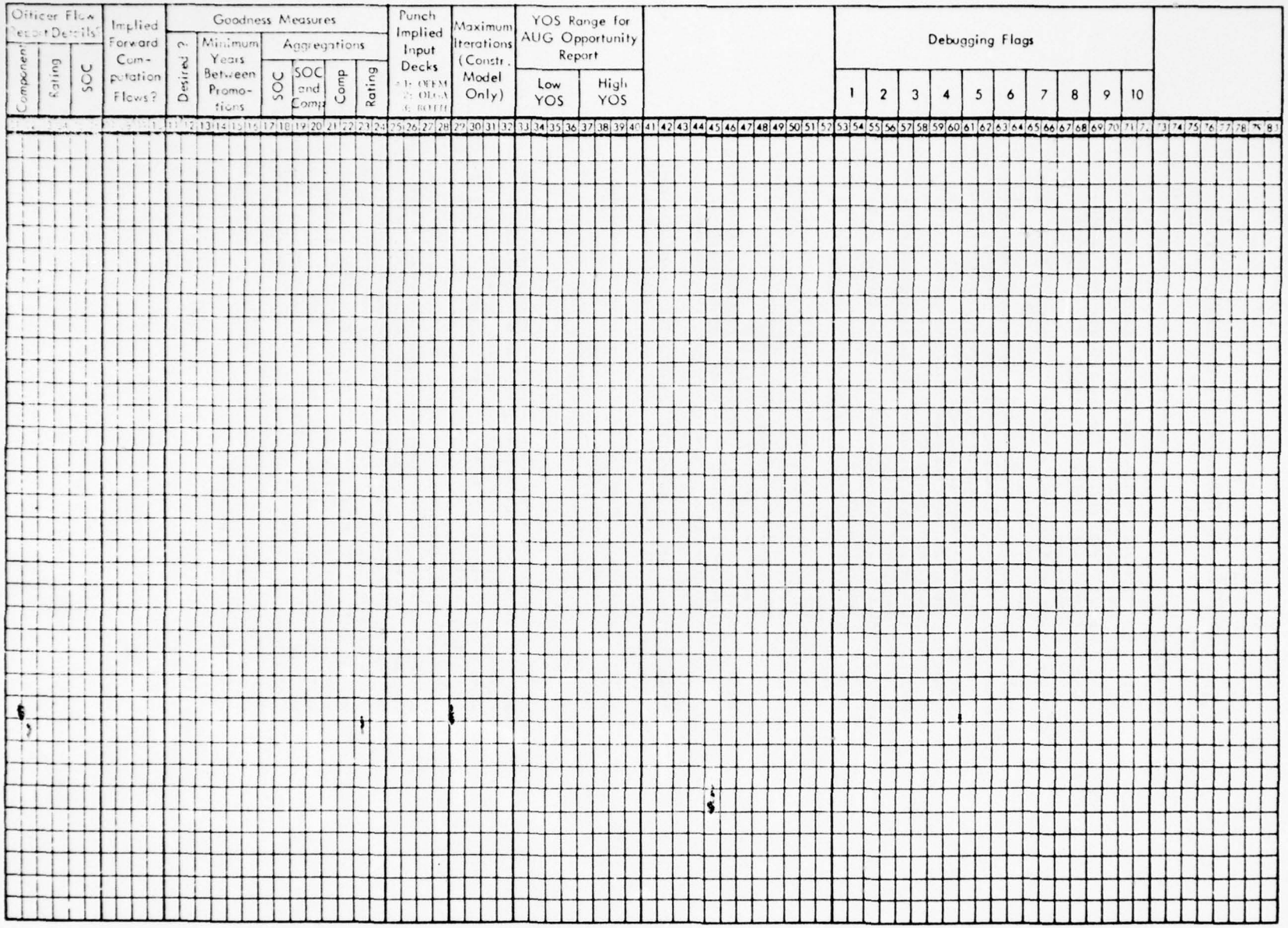


Fig. 23 — Options card format

Table 7

OPTION CARD SELECTIONS, COLUMNS 1-72

Column	Selection
1-2:	If not blank, officer flow reports for each component (see Sec. IV, p. 59).
3-4:	If not blank, officer flow reports for each rating.
5-6:	If not blank, officer flow reports for each source of commission.
7-10:	Leave blank if implied forward computation input reports not wanted (see Sec. IV, p. 66).
11-12:	Blank if goodness measures outputs are not wanted.[a]
13-16:	The minimum waiting period (in years) between promotions. This must be a 1 or more and defaults to 2 (goodness measure package[a] only).
17-18:	Blank if goodness measures[a] not to be aggregated by source of commission.
19-20:	Blank if goodness measures[a] not to be aggregated by source *and* component.
21-22:	Blank if goodness measures[a] not to be aggregated by component only.
23-24:	Blank if goodness measures[a] not to be aggregated by rating.
25-28:	This contains: 1 if the user wants to have an input deck for the *progression* model punched out; 2 if he wants an input deck for the grade limitations model; 3 if he wants both.[b]
28-32:	Maximum iterations permitted for convergence to career reserve requirements--if blank, ten iterations are permitted (see Sec. V, pp. 93, 96, 104, and App. D, pp. 161, 165).
33-40:	Year of service range for augmentation opportunity report. If blank, years 3 and 7 are used (see Sec. IV, p. 70).
53-72:	Leave blank. Used for debugging purposes. A special iteration report can be requested by punching '1' in column 60, the fourth debugging flag (see Sec. IV, p. 75).

[a]The goodness measures package is not currently available in the constraints model, but a description of how to select it is included for completeness. This package will be added at a later date; a description of it is included in the report on the grade limitations model.

[b]After the constraints model computes the officer structure and the associated officer flows within the officer structure, it then determines what the *progression* model inputs would have to be in order to generate the officer structure and associated flows. The model does this *without referring back* to the original inputs used to generate the officer structure. In addition, the model also determines what the grade limitations model inputs would have to be in order to generate an identical officer structure and associated officer flows. The ability of the model to generate grade limitations model inputs is extremely useful when the constraints model and grade limitations model are used together. The computation of the progression model's inputs is useful for model verification and debugging purposes.

Type of Data: ACSS		Annual Accessions				
		Air Force Academy	ROTC	OTS/other		
01 02 03 04	05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20	21 22 23 24 25 26 27 28	29 30 31 32 33 34 35 36	37 38 39 40 41 42 43 44	45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72	73 74 75 76 77 78 79 80
ACSS						
ACSS		960	4500			

Fig. 24 — Accession data

Type of Data: PROM		Grade: CAP, MAJ, LTC, COL (promote to grade)	Rating: PIL, NAV, NR SUP=NR RAT=PIL & NAV	Soc: AFA ROTC SMSO OTS=SMSO RES=ROTC & SMSO	Cumulative promotion opportunities (percent)		Below-the-zone Promotions		Phase Point		
					First year of primary promotion zone	Second year of primary promotion zone	Percent of total promotions that occur BTZ	% of BTZ promotions that occur first BTZ yr	First year of promotions to grade in the primary zone		
01 02 03 04	05 06 07 08	09 10 11 12	13 14 15 16	17 18 19 20	21 22 23 24 25 26 27 28	29 30 31 32 33 34 35 36	37 38 39 40 41 42 43 44	45 46 47 48 49 50 51 52	53 54 55 56 57 58 59 60	61 62 63 64 65 66 67 68 69 70 71 72	73 74 75 76 77 78 79 80
PROM											
PROM		CAP	ALL	ALL	95	95	1.39		5		
PROM		MAJ	ALL	ALL	75	80	5	50	10		
PROM		LTC	ALL	ALL	60	70	10	60	16		
PROM		COL	ALL	ALL	45	50	14	45	22		

Fig. 25 — Promotion data

The *cumulative promotion opportunities* for the first and second years of the primary zone indicate the percentage of those officers eligible for promotion to the grade that are promoted by the indicated year. Thus, as illustrated, if the cumulative promotion opportunities to the grade of major were 75 percent in the first primary-zone year and 80 percent in the second primary-zone year, then 75 percent of those eligible for promotion would be promoted not later than the end of the first primary-zone year, and an additional 5 percent of those eligible would be promoted not later than the end of the second primary-zone year.

The *below-the-zone promotion percentage* indicates the fraction of promotions that can take place below the zone. The *first year below-the-zone* percentage indicates the fraction of below-the-zone promotions that can take place in the first below-the-zone promotion year. Thus, as illustrated for promotion to major, if the below-the-zone percentage were 5 percent, 5 percent of all promotions to the indicated grade would occur in the two below-the-zone promotion years, and 50 percent of those below-the-zone promotions (or 2.5 percent of all promotions) would take place in the first below-the-zone promotion year.

Although not illustrated in the example, separate promotion parameters may be provided for each source of commission and rating within a grade. Thus, for example, ROTC pilots may have different promotion parameters than Academy pilots. Note also that, since we are describing promotions *into* a grade, the lieutenant grade (LT) should not be used when preparing this input form.

The promotion opportunity for captains in both the first and second years of the primary zone is 95 percent. This, in effect, causes all primary-zone promotions to take place in the first primary-zone year. Also, no promotions are scheduled to take place in the first year of the secondary zone. Thus, in this example, lieutenants can be promoted to captain *out of* YOS 3 and 4, and into YOS 4 and 5. Columns 61-72 may be used for descriptive information.

Loss Data (LOSS)

These data indicate the loss rates (due to death, disability, retirement, separation, etc.) by component, grade, rating, source of commission, and year of service. Figure 26 illustrates the input deck's format.

Each input data entry indicates the fraction of officers with the indicated component, grade, rating, source of commission, and year of service who leave the officer force during or at the conclusion of the year of service. For example, in Fig. 26 the sample entry indicates that of all pilot lieutenants with Air Force Academy commissions who hold regular commissions in the third year of service, 1.3 percent will leave the force during or at the conclusion of the third year of service. Columns 69-72 of the input cards may be used for description information.

The constraints model, in attempting to satisfy the career reserve requirements, has the freedom to increase reserve component EOB loss rates.*

Augmentation Data (AUG)

These data indicate, by grade, rating, source of commission, and year of service, the fraction of officers augmented into the regular force from the reserve force. Figure 27 illustrates the format of the input deck.

In the example, of all lieutenant pilots (after losses are removed) with three years of service holding reserve commissions from ROTC or from OTS/other, 25 percent will be augmented into the regular force. Note that these officers are considered as reserve in the third year of service and regular in the fourth. Note also that the *rate of flow out* is applied only to those officers remaining after losses and rating transfer changes are taken into consideration. Finally, note that in our example all reserve majors are augmented.

---

*This increase in EOB loss rates is the vehicle by which the career reserve requirement is imposed. See Sec. V, pp. 93, 95, 96, and App. D, pp. 161, 163, 165, for details.

Type of Data: LOSS	Component REG, RES	Grade: LT, CAP MAJ, LTC, COL	Rating: PIL, NAV, NR SUP=NR RAT= PIL&NAV	Soc: AFA ROTC SMSO OTS= SMSO RES= ROTC & SMSO	Attrition Year of service	Attrition Attrition i.e. Loss rate	Attrition Year of service	Attrition Attrition i.e. Loss rate	Attrition Year of service	Attrition Attrition i.e. Loss rate	Attrition Year of service	Attrition Attrition i.e. Loss rate	Attrition Year of service	Attrition Attrition i.e. Loss rate	Attrition Year of service	Attrition Attrition i.e. Loss rate
LOSS																
LOSS	REG	LT	PIL	AFA	2	0.0	3	.013	4	.014	5	.035	6	1.0		
LOSS	REG	LT	PIL	ROTC	4	.01	5	.01	6	1.0						
LOSS	REG	LT	PIL	SMSO	4	.015	5	.015	6	1.0						

Fig. 26 — Loss data

Type of Data: AUG	(Reserve only)	Grade: LT, CAP MAJ, LTC, COL	Rating: PIL, NAV, NR SUP, NR RAT= PIL&NAV	Soc: AFA ROTC SMSO OTS= SMSO RES= ROTC & SMSO	Augmentation Year of service	Augmentation Rate of Flow out	Augmentation Year of service	Augmentation Rate of Flow out	Augmentation Year of service	Augmentation Rate of Flow out	Augmentation Year of service	Augmentation Rate of Flow out	Augmentation Year of service	Augmentation Rate of Flow out	Augmentation Year of service	Augmentation Rate of Flow out
AUG																
AUG		LT	PIL	RES	3	.25	4	.267	5	.126						
AUG		CAP	PIL	RES	3	.25	4	.267	5	.126						
AUG		LT	NAV	RES	3	.23	4	.218	5	.139						
AUG		CAP	NAV	RES	3	.23	4	.218	5	.135	6	.039				
AUG		LT	NR	RES	2	.072	3	.149			5	.147				
AUG		CAP	NR	RES			3	.149			5	.147				
AUG		MAJ	ALL	RES	8	1.0	9	1.0	10	1.0						

Fig. 27 — Augmentation data (Reserve to Regular)

Since augmentation takes place from reserve into regular, columns 5-8 (the component field) should be left blank. Also, since only ROTC and OTS award reserve commissions to graduates (Academy graduates are awarded regular commissions), the Academy source of commission is not permitted in columns 17-20 (the source of commission field). Columns 69-72 of the input cards may be used for descriptive information.

The constraints model, when attempting to satisfy the regular force requirement, is free to lower non-rated OTS augmentation rates. The non-rated OTS augmentation rates provided in the inputs are thus the maximums permitted.

Rating Transfer Data (RCAT)

These data indicate by source of commission and years of service the number of non-rated lieutenants who become pilots and navigators. The data are presented as a fraction of annual accessions from the indicated source of commission.

Figure 28 illustrates the format of the input deck, and the example entry illustrates the use of the input form, showing how non-rated officers become rated. In YOS 1, 63.3 percent of the Academy graduates enter UPT and become pilots in YOS 2; 9.79 percent of the Academy graduates enter UNT in YOS 1 and become navigators in YOS 2. The remaining Academy graduates remain non-rated officers or are lost to the Air Force.

The constraints model, when attempting to meet the war-time rated officer requirements, is free to alter the OTS pilot and navigator rating transfer rates, which can be either decreased or increased.

Manpower Requirements Data (MPWR)

These data indicate the four types of manpower constraints that can be imposed on the officer force. Figure 29 illustrates the input format.

The *required size of the officer force* specified in the figure is 97,850 officers; the *wartime pilot* and *navigator requirements* are 28,000 and 13,500 officers, respectively. The wartime rated officer requirements apply to rated officers whose grade is lower than colonel with

Type of Data: RCAT		(Lieut. only)	Rating: PIL, NAV, NR SUP=NR RAT= PIL&NAV	Soc: AFA ROTC SMSO OTS= SMSO RES= ROTC & SMSO	Rating Category		Rating Category		Rating Category		Rating Category		Rating Category		Rating Category			
					Year of service	Fraction of annual accessions	Year of service	Fraction of annual accessions	Year of service	Fraction of annual accessions	Year of service	Fraction of annual accessions	Year of service	Fraction of annual accessions	Year of service	Fraction of annual accessions		
01 02 03 04	05 06 07 08	09 10 11 12	13 14 15 16	17 18 19 20	21 22 23	24 25 26 27 28	29 30 31	32 33 34 35 36	37 38 39	40 41 42 43 44	45 46 47	48 49 50 51 52	53 54 55	56 57 58 59 60	61 62 63	64 65 66 67 68	69 70 71 72	73 74 75 76 77 78 79 80
RCAT																		
RCAT			PIL	AFA	1	.633												
RCAT			NAV	AFA	1	.0979												
RCAT			PIL	ROTC	1	.322												
RCAT			NAV	ROTC	1	.146												
RCAT			PIL	SMSQ	1	.138												
RCAT			NAV	SMSQ	1	.132												

Fig. 28 — Rating category data (UPT and UNT graduation rates)

Type of Data: MPWR				Required Officer Force Size	Wartime Rated Officer Requirements		Required Number of Regular Officers		Optional Sequencing Field
					Required Number of Pilots	Required Number of Navigators			
01 02 03 04	05 06 07 08	09 10 11 12	13 14 15 16	17 18 19 20	21 22 23 24 25 26 27 28	29 30 31 32 33 34 35 36	37 38 39 40 41 42 43 44	45 46 47 48 49 50 51 52	53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72	73 74 75 76 77 78 79 80
MPWR									
MPWR					97850	28000	13500	50000	

Fig. 29 — Manpower requirements data

28 or fewer years of service.* The *regular force size requirement*, which is specified in Fig. 29 as 50,000 regular officers, applies to all officers in the regular component, irrespective of the original commissioning source.

Career Reserve Requirement Data (CRES)

These data, whose format is illustrated in Fig. 30, provide the mechanism for selecting career reservists. A different career reserve requirement can be specified for each reserve source of commission and rating. The *end of initial obligation*, the year of service during which the initial service obligation is satisfied, must be provided, and it must be less than the force out year† for reserve lieutenants with the given rating and source of commission. In the examples in Fig. 30, rated ROTC officers end their initial obligation in year 5, and all other reserve officers end their initial obligation in year 4. We emphasize that the EOB is not the force out year.

One of three types of career reserve requirement must be specified for each rating and reserve source of commission. The first, the *career reserve opportunity*, indicates the percentage of reserve officers (after normal losses are removed) in the EOB year who are permitted to become career reservists. In the example in Fig. 30, only 80 percent of rated ROTC officers are allowed to become career reservists, while 100 percent of all OTS reserve officers are awarded career reserve status.

The second type of career reserve requirement, the number of *career reserve selectees*, indicates the number of reserve officers in the EOB year allowed to pass *beyond the EOB year's loss phase*. If this number turns out to be larger than the number passing through the loss phase when *normal* losses are accounted, the model will permit only the normal loss number of officers to pass beyond the EOB year's loss phase. These officers could, if the user provides EOB year augmentation rates, move to the regular component immediately after receiving career reserve status.

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*The maximum grade and year of service can be changed. See App. E.

†That is, the year in which lieutenants who have not been promoted to captain are required to leave the service.

Type of Data:			Rating: PIL, NAV NR SUP = NR RAT = PIL & NAV	Source of Comm. ROTC, SMSO RES = ROTC & SMSO	End of initial obligation	Career Reserve Requirement (Use only one)				Optional Sequencing Field
						Career Reserve Opportunity (percent)	Career Reserve Selectees	Total Career Reservists		
01 02 03 04	05 06 07 08	09 10 11 12	13 14 15 16	17 18 19 20	21 22 23 24	25 26 27 28 29 30 31 32	33 34 35 36 37 38 39 40	41 42 43 44 45 46 47 48	49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72	73 74 75 76 77 78 79 80
CRES										
CRES			RAT	RQTC	5	80				
CRES			NR	RQTC	4		150			
CRES			ALL	QTS	4	100				

Fig. 30 — Career reserve requirement data

The third and final type of career reserve requirement, the *total number of career reservists*, indicates for the given rating and source of commission, the number of officers allowed to reside in the career reserve officer states, i.e., those reserve states whose year of service is greater than the EOB year. Again, if the user desires, augmentation into the regular component can take place from career reserve states. Further, normal losses in the EOB year are accounted for.

EXTREME OFFICER FORCE CONSTRAINTS

The constraints model is not an optimization model, i.e., it does not search for an optimal officer force distribution in terms of some measure of effectiveness. As a result, certain combinations of extreme manpower and career reserve constraints may drastically affect the officer force. Some effects are desirable; others are not. In the remainder of this section some of these extreme cases are discussed.

Elimination of Career Reserve Requirement

If the user does not want to impose a career reserve requirement, he need only to specify a 100 percent career reserve opportunity--see Fig. 30, ALL OTS. When this is done, the constraints model applies normal losses in the EOB year.

Maximizing the Number of Regular Officers

As will be discussed in detail in Sec. V, the constraints model processes Academy graduates first, then the ROTC source of commission imposing the ROTC career reserve requirements. In processing these two sources of commission, the constraints model does not attempt to satisfy the manpower requirements; it is assumed that slack still exists in the manpower requirements when the model begins its processing of the OTS source of commission. The model then turns to the OTS, trying first to satisfy the remaining wartime rated officer requirements, and finally, using the non-rated OTS officers as the final processing group, to satisfy the remaining total force and regular force requirements.

Suppose that, at the beginning of non-rated OTS processing, the remaining regular requirement is greater than the remaining total force requirement. (Both requirements cannot be satisfied simultaneously.) Two possibilities exist, depending on the type of non-rated OTS career reserve requirement.

If the career reserve requirement is an opportunity, then the constraints model will increase the non-rated OTS loss rates in the EOB year sufficiently to impose the career reserve opportunity. The model will then distribute over the non-rated OTS force structure enough officers to satisfy the remaining total force requirement, i.e., will fall short of the regular force requirement. This is done using the non-rated OTS augmentation rates provided in the inputs, which are the maximum rates the model permits.

If, on the other hand, the career reserve requirement is not an opportunity but rather the number of selectees or total career reservists, then different model logic applies. In this case, the model turns the EOB year into a force out year for reserve non-rated OTS officers (i.e., the EOB reserve loss rates are set to 1.0), and then distributes sufficient non-rated OTS officers to satisfy the remaining total force requirement, applying the input augmentation rates. Again, we fall short of the regular force requirement. (A detailed description of non-rated OTS logic will be found in Sec. V and App. D.)

Maximizing the Number of Rated Officers

Suppose we're at the point in processing where we're ready to consider OTS pilots, and that the remaining total force requirement is less than the remaining pilot requirement. The constraints model will in this case distribute sufficient officers over the OTS pilot force structure to satisfy the remaining total force requirement. The model will next determine the number of non-rated OTS officers needed to support the rating transfer flows into pilot, and will distribute these officers over the appropriate non-rated states. Thus, the total force requirement will be *exceeded* by precisely the number of non-rated officers needed to support the rating transfer flows into pilot. For further details, see Sec. V, p. 104.

IV. MODEL OUTPUTS

The constraints model produces several types of output reports that present the officer structure and flows between officer states from both a very detailed and highly aggregated perspective. In addition, if requested by the user, the model prints the results of each iteration whenever iterative model logic is involved, as well as a record of adjusted loss, rating transfer, and augmentation rates. This section examines each output report in detail.

MODEL INPUTS

The constraints model prints and thoroughly checks for errors all input cards read. If a catastrophic error is encountered, the input deck is still completely processed, but none of the officer force computations are performed.

OFFICER FORCE GRADE DISTRIBUTION REPORT

The officer force grade distribution output report presents, for each rating and source of commission the detailed officer inventory by component, grade and year of service. Figures 31-35 illustrate the report for ROTC pilot, navigator, and non-rated officers, as well as aggregations of rated ROTC officers and all ROTC officers. In Fig. 31, for example, there are eight reserve captains with ten years of service and 22 reserve majors, thus yielding 29 reserve ROTC pilots with ten years of service.*

Note the summaries at the bottom of the report. They indicate the column totals as well as the average years of service of all officers in a column. For example, in Fig. 35 there are 46,616 ROTC officers, 25,629 of which are regular. Further, the average years of service of all ROTC officers is 8.8 years, while the regular ROTC officer averages 13.4 years.

---

*Eight captains plus 22 majors, of course, adds to 30 reserve ROTC pilots with ten years of service. The model reports 29 officers because it is using the *internal* state quantities, rounding these numbers off to integer values as each output line is printed.

OFFICER FORCE GRADE DISTRIBUTION
RATING PIL SOURCE OF COMMISSION ROTC

	RESERVE COMPONENT						REGULAR COMPONENT						BOTH RESERVE AND REGULAR COMPONENTS					
YEAR	LIEUT	CAPT	MAJOR	LTCOL	CL/GN	TOTAL	LIEUT	CAPT	MAJOR	LTCOL	CL/GN	TOTAL	LIEUT	CAPT	MAJOR	LTCOL	CL/GN	TOTAL
2	1449					1449							1449					1449
3	1427					1427							1427					1427
4	1040	15				1054	347	5				351	1386	20				1406
5	38	723				761	31	592				624	69	1316				1385
6	0	623				623	0	673				674	1	1296				1296
7		280				280		663				663		943				943
8		37	0			38		642	7			650		680	8			688
9		32	1			34		607	30			637		640	31			671
10		8	22			29		156	470			626		164	491			655
11		5	2			7		122	511			632		127	512			639
12									500			500			500			500
13									490			490			490			490
14									456	24		481			456	24		481
15									423	48		471			423	48		471
16									162	300		462			162	300		462
17									135	317		452			135	317		452
18									133	311		443			133	311		443
19									130	305		434			130	305		434
20									127	265	34	426			127	265	34	426
21										240	40	281				240	40	281
22										151	124	275				151	124	275
23										134	135	269				134	135	269
24										126	127	253				126	127	253
25										105	118	223				105	118	223
26										85	101	186				85	101	186
27											93	93					93	93
28											86	86					86	86
29											77	77					77	77
30											70	70					70	70
TOTAL	3954.	1724.	25.	0.	0.	5703.	378.	3461.	3574.	2412.	1005.	10831.	4332.	5185.	3599.	2412.	1005.	16533.
							AVERAGE YEAR OF SERVICE											
	2.92	5.86	9.98	0.0	0.0	3.84	4.08	7.27	13.44	19.59	25.11	13.60	3.02	6.80	13.42	19.59	25.11	10.23

Fig. 31 — Officer force grade distribution for ROTC pilots

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OFFICER FORCE GRADE DISTRIBUTION
RATING NAV SOURCE OF COMMISSION ROTC

	RESERVE COMPONENT						REGULAR COMPONENT						BOTH RESERVE AND REGULAR COMPONENTS					
YEAR	LIEUT	CAPT	MAJOR	LTCOL	CL/GN	TOTAL	LIEUT	CAPT	MAJOR	LTCOL	CL/GN	TOTAL	LIEUT	CAPT	MAJOR	LTCOL	CL/GN	TOTAL
2	657					657							657					657
3	647					647							647					647
4	484	7				491	145	2				147	628	9				637
5	19	358				377	13	239				251	31	596				628
6	0	307				307	0	281				281	0	588				588
7		133				133		282				282		415				415
8		18	0			18		273	3			276		291	3			294
9		15	1			16		258	13			271		273	13			287
10		4	10			14		66	200			266		70	210			280
11		3	1			3		52	218			270		54	219			273
12									214			214			214			214
13									209			209			209			209
14									195	10		205			195	10		205
15									180	21		201			180	21		201
16									69	128		197			69	128		197
17									58	135		193			58	135		193
18									57	133		189			57	133		189
19									55	130		185			55	130		185
20									54	113	14	182			54	113	14	182
21										101	17	117				101	17	117
22										63	52	115				63	52	115
23										56	56	113				56	56	113
24										52	52	104				52	52	104
25										42	47	89				42	47	89
26										33	40	73				33	40	73
27											36	36					36	36
28											32	32					32	32
29											29	29					29	29
30											25	25					25	25
TOTAL	1807.	844.	12.	0.	0.	2663.	157.	1452.	1524.	1016.	399.	4549.	1964.	2296.	1536.	1016.	399.	7212.
							AVERAGE YEAR OF SERVICE											
	2.93	5.85	9.99	0.0	0.0	3.88	4.08	7.30	13.44	19.54	24.98	13.53	3.02	6.76	13.42	19.54	24.98	9.97

Fig. 32 — Officer force grade distribution for ROTC navigators

OFFICER FORCE GRADE DISTRIBUTION
RATING NR SOURCE OF COMMISSION ROTC

	RESERVE COMPONENT						REGULAR COMPONENT						BOTH RESERVE AND REGULAR COMPONENTS					
YEAR	LIEUT	CAPT	MAJOR	LTCOL	CL/GN	TOTAL	LIEUT	CAPT	MAJOR	LTCOL	CL/GN	TOTAL	LIEUT	CAPT	MAJOR	LTCOL	CL/GN	TOTAL
1	4500					4500							4500					4500
2	2282					2282							2282					2282
3	2018					2018	229					229	2247					2247
4	1668	14				1682	527	4				532	2195	18				2214
5	37	696				733	27	521				548	64	1217				1281
6	0	587				587	0	606				606	1	1192				1193
7		569				569		588				588		1157				1157
8		88	1			89		564	6			570		652	7			659
9		76	3			79		527	26			554		603	29			632
10		18	50			68		135	410			545		153	460			613
11		13	4			16		105	474			579		118	478			596
12									464			464			464			464
13									455			455			455			455
14									423	23		446			423	23		446
15									392	45		437			392	45		437
16									150	278		428			150	278		428
17									126	294		420			126	294		420
18									123	288		411			123	288		411
19									121	283		403			121	283		403
20									118	246	31	395			118	246	31	395
21										221	37	258				221	37	258
22										139	114	252				139	114	252
23										123	124	247				123	124	247
24										115	115	230				115	115	230
25										94	106	200				94	106	200
26										75	90	165				75	90	165
27											82	82					82	82
28											75	75					75	75
29											67	67					67	67
30											60	60					60	60
TOTAL	10504.	2060.	58.	0.	0.	12622.	784.	3050.	3289.	2225.	901.	10249.	11289.	5111.	3347.	2225.	901.	22871.
AVERAGE YEAR OF SERVICE																		
	2.09	6.19	9.98	0.0	0.0	2.80	3.74	7.26	13.47	19.57	25.05	13.22	2.21	6.83	13.41	19.57	25.05	7.47

Fig. 33 — Officer force grade distribution for ROTC non-rated officers

OFFICER FORCE GRADE DISTRIBUTION
RATING RAT SOURCE OF COMMISSION ROTC

	RESERVE COMPONENT						REGULAR COMPONENT						BOTH RESERVE AND REGULAR COMPONENTS					
YEAR	LIEUT	CAPT	MAJOR	LTCOL	CL/GN	TOTAL	LIEUT	CAPT	MAJOR	LTCOL	CL/GN	TOTAL	LIEUT	CAPT	MAJOR	LTCOL	CL/GN	TOTAL
2	2106					2106							2106					2106
3	2074					2074							2074					2074
4	1524	22				1545	491	7				498	2015	29				2043
5	57	1081				1138	44	831				875	101	1912				2013
6	1	929				930	0	954				955	1	1883				1884
7		413				413		945				945		1358				1358
8		55	1			56		915	11			926		971	11			982
9		48	2			50		865	43			908		913	45			958
10		11	32			43		222	669			891		234	701			935
11		8	3			11		173	729			902		181	731			912
12									714			714			714			714
13									700			700			700			700
14									651	35		686			651	35		686
15									603	69		672			603	69		672
16									230	428		659			230	428		659
17									193	452		645			193	452		645
18									189	443		632			189	443		632
19									185	434		620			185	434		620
20									182	378	48	607			182	378	48	607
21										341	57	398				341	57	398
22										214	175	390				214	175	390
23										191	191	382				191	191	382
24										178	179	357				178	179	357
25										147	165	312				147	165	312
26										118	141	259				118	141	259
27											129	129					129	129
28											118	118					118	118
29											106	106					106	106
30											95	95					95	95
TOTAL	5761.	2567.	37.	0.	0.	8365.	535.	4913.	5098.	3429.	1404.	15379.	6297.	7480.	5135.	3429.	1404.	23745.
AVERAGE YEAR OF SERVICE																		
	2.92	5.86	9.99	0.0	0.0	3.85	4.08	7.28	13.44	19.58	25.07	13.58	3.02	6.79	13.42	19.58	25.07	10.15

Fig. 34 — Officer force grade distribution for ROTC rated officers (pilots and navigators)

OFFICER FORCE GRADE DISTRIBUTION
RATING ALL SOURCE OF COMMISSION ROTC

	RESERVE COMPONENT						REGULAR COMPONENT						BOTH RESERVE AND REGULAR COMPONENTS					
YEAR	LIEUT	CAPT	MAJOR	LTCOL	CL/GN	TOTAL	LIEUT	CAPT	MAJOR	LTCOL	CL/GN	TOTAL	LIEUT	CAPT	MAJOR	LTCOL	CL/GN	TOTAL
1	4500					4500							4500					4500
2	4388					4388							4388					4388
3	4092					4092	229					229	4322					4322
4	3191	36				3227	1019	11				1030	4210	47				4257
5	94	1777				1870	71	1352				1423	165	3129				3293
6	1	1516				1517	1	1560				1561	2	3076				3077
7		982				982		1532				1532		2515				2515
8		143	2			145		1479	17			1496		1622	19			1641
9		124	5			128		1392	69			1462		1516	74			1590
10		29	82			111		358	1079			1437		387	1161			1548
11		21	6			27		279	1202			1481		300	1208			1508
12									1178			1178			1178			1178
13									1155			1155			1155			1155
14									1074	57		1132			1074	57		1132
15									996	113		1109			996	113		1109
16									380	706		1087			380	706		1087
17									318	747		1065			318	747		1065
18									312	732		1044			312	732		1044
19									306	717		1023			306	717		1023
20									300	624	79	1002			300	624	79	1002
21										562	93	655				562	93	655
22										353	289	642				353	289	642
23										314	315	629				314	315	629
24										293	294	587				293	294	587
25										241	271	512				241	271	512
26										193	231	425				193	231	425
27											211	211					211	211
28											193	193					193	193
29											173	173					173	173
30											155	155					155	155
TOTAL	16266.	4627.	95.	0.	0.	20987.	1320.	7964.	8387.	5653.	2305.	25629.	17585.	12591.	8482.	5653.	2305.	46616.
AVERAGE YEAR OF SERVICE																		
	2.38	0.00	9.98	0.0	0.0	3.22	3.88	7.27	13.45	19.57	25.06	13.43	2.50	6.80	13.41	19.57	25.06	8.83

Fig. 35 — Officer force grade distribution for all ROTC officers

Several zeroes appear as officer state values, e.g., in Fig. 31, reserve and regular lieutenants with six years of service. These zeroes result when state quantities that lie between zero and 0.5 are rounded. The model's output package doesn't print officer states or flows that are exactly zero, but it does print as zero those states or flows that round to zero. This holds true for all reports, not just the officer force grade distribution.

One more point should be noted before leaving this report. Both detailed and aggregated officer force grade distributions are automatically produced. Five sets of five reports are produced: one for each source of commission, one for the reserve sources of commission aggregated, and one for all sources of commission aggregated. Thus, 25 officer force grade distributions are generated during a model run.

OFFICER FORCE RATING DISTRIBUTION REPORTS

Two officer force rating distributions are automatically produced for each source of commission, the reserve sources aggregated, and all sources aggregated. The first report shows the distribution of officers by component, year of service, and rating for those officers holding the grade of lieutenant colonel and below. The second report shows the officer distribution for colonels and above. Figures 36 and 37 show the ROTC officer force rating distributions.

Note in Fig. 36 that all ROTC officers are reserve non-rated in their first year of service, and that there are 4500 of them. This is precisely the number of ROTC annual accessions, and is consistent with Figs. 33 and 35, the officer force grade distributions that include non-rated ROTC officers.

OFFICER FLOW REPORT

The officer flow report presents detailed flows into and out of the officer states. Figures 38-40 show officer flows for all ROTC officers, one report for each grade, with aggregations over all components and ratings.

In the upper report in Fig. 38, the report of ROTC lieutenants, the center column is labeled *current officer state*. Thus, in year 1

OFFICER FORCE RATING DISTRIBUTION
LIEUTENANT COLONEL AND BELOW
SOURCE OF COMMISSION ROTC

YEAR OF SERVICE	PILOT			NAVIGATOR			NONRATED			TOTAL OVER ALL RATINGS		
	RESERVE	REGULAR	TOTAL	RESERVE	REGULAR	TOTAL	RESERVE	REGULAR	TOTAL	RESERVE	REGULAR	TOTAL
1							4500		4500	4500		4500
2	1449		1449	657		657	2282		2282	4388		4388
3	1427		1427	647		647	2018	229	2247	4092	229	4322
4	1054	351	1406	491	147	637	1682	532	2214	3227	1030	4257
5	761	624	1385	377	251	628	733	548	1281	1870	1423	3293
6	623	674	1296	307	281	588	587	606	1193	1517	1561	3077
7	280	663	943	133	282	415	569	588	1157	982	1532	2515
8	38	650	688	18	276	294	89	570	659	145	1496	1641
9	34	637	671	16	271	287	79	554	632	128	1462	1590
10	29	626	655	14	266	280	68	545	613	111	1437	1548
11	7	632	639	3	270	273	16	579	596	27	1481	1508
12		500	500		214	214		464	464		1178	1178
13		490	490		209	209		455	455		1155	1155
14		481	481		205	205		446	446		1132	1132
15		471	471		201	201		437	437		1109	1109
16		462	462		197	197		428	428		1087	1087
17		452	452		193	193		420	420		1065	1065
18		443	443		189	189		411	411		1044	1044
19		434	434		185	185		403	403		1023	1023
20		392	392		168	168		364	364		924	924
21		240	240		101	101		221	221		562	562
22		151	151		63	63		139	139		353	353
23		134	134		56	56		123	123		314	314
24		126	126		52	52		115	115		293	293
25		105	105		42	42		94	94		241	241
26		85	85		33	33		75	75		193	193
TOTAL	5703.	9826.	15528.	2663.	4150.	6812.	12622.	9348.	21970.	20987.	23324.	44311.
	AVERAGE YEAR OF SERVICE											
	3.84	12.42	9.27	3.88	12.43	9.09	2.80	12.08	6.75	3.22	12.28	7.99

Fig. 36 — Officer force rating distribution for ROTC lieutenant colonels and below

OFFICER FORCE RATING DISTRIBUTION
COLONEL/GENERALS
SOURCE OF COMMISSION ROTC

YEAR OF SERVICE	PILOT			NAVIGATOR			NONRATED			TOTAL OVER ALL RATINGS		
	RESERVE	REGULAR	TOTAL	RESERVE	REGULAR	TOTAL	RESERVE	REGULAR	TOTAL	RESERVE	REGULAR	TOTAL
21		40	40		17	17		37	37		93	93
22		124	124		52	52		114	114		289	289
23		135	135		56	56		124	124		315	315
24		127	127		52	52		115	115		294	294
25		118	118		47	47		106	106		271	271
26		101	101		40	40		90	90		231	231
27		93	93		36	36		82	82		211	211
28		86	86		32	32		75	75		193	193
29		77	77		29	29		67	67		173	173
30		70	70		25	25		60	60		155	155
TOTAL	0.	971.	971.	0.	385.	385.	0.	870.	870.	0.	2226.	2226.
AVERAGE YEAR OF SERVICE												
	0.0	25.28	25.28	0.0	25.16	25.16	0.0	25.23	25.23	0.0	25.24	25.24

Fig. 37 — ROTC officer force rating distribution for ROTC colonels and above

OFFICER FLOWS

COMPONENT ALL GRADE LT RATING ALL SOURCE OF COMMISSION ROTC

YOS	FLOWS INTO THE CURRENT OFFICER STATE						CURRENT OFFICER STATE	FLOWS OUT OF THE CURRENT OFFICER STATE						
	LATERAL FLOW	RATING TRANSFERS		AUGMENTATIONS		PROMOS ONLY		ATTRITION	RATING TRANSFERS		AUGMENTATIONS		PROMOS ONLY	LATERAL FLOW
		ONLY	WITH AUG	ONLY	WITH PRO				ONLY	WITH AUG	ONLY	WITH PRO		
1	4500						4500	112	2106					2282
2	2282	2106					4388	66			229			4092
3	4092			229			4322	65			795	10	38	3415
4	3415			795			4210	555			20	382	2707	144
5	144			20			165	163					0	2
6	2						2	2						
TOT	14435.	2106.	0.	1044.	0.	0.	17585.	1363.	2106.	0.	1044.	392.	2745.	9935.

TOTAL RATING TRANSFERS 2106 IN 2106 OUT TOTAL AUGMENTATIONS 1044 IN 1436 OUT TOTAL PROMOTIONS 0 IN 3137 OUT

COMPONENT ALL GRADE CAP RATING ALL SOURCE OF COMMISSION ROTC

YOS	FLOWS INTO THE CURRENT OFFICER STATE						CURRENT OFFICER STATE	FLOWS OUT OF THE CURRENT OFFICER STATE						
	LATERAL FLOW	RATING TRANSFERS		AUGMENTATIONS		PROMOS ONLY		ATTRITION	RATING TRANSFERS		AUGMENTATIONS		PROMOS ONLY	LATERAL FLOW
		ONLY	WITH AUG	ONLY	WITH PRO				ONLY	WITH AUG	ONLY	WITH PRO		
4					10	38	47	8			6			33
5	33			6	382	2707	3125	53			231			2845
6	2845			231		0	3076	561			5			2510
7	2510			5			2515	873					19	1622
8	1622						1622	50					56	1516
9	1516						1516	40					1089	387
10	387						387	10					77	300
11	300						300	300						
TOT	9212.	0.	0.	242.	392.	2745.	12591.	1896.	0.	0.	242.	0.	1241.	9212.

TOTAL RATING TRANSFERS 0 IN 0 OUT TOTAL AUGMENTATIONS 634 IN 242 OUT TOTAL PROMOTIONS 3137 IN 1241 OUT

Fig. 38 — Officer flows for ROTC lieutenants and captains

OFFICER FLOWS

COMPONENT ALL GRADE MAJ RATING ALL SOURCE OF COMMISSION ROTC

YOS	FLOWS INTO THE CURRENT OFFICER STATE						CURRENT OFFICER STATE	FLOWS OUT OF THE CURRENT OFFICER STATE					
	LATERAL FLOW	RATING TRANSFERS		AUGMENTATIONS		PROMOS ONLY		ATTRITION	RATING TRANSFERS		AUGMENTATIONS		PROMOS ONLY	LATERAL FLOW
		ONLY	WITH AUG	ONLY	WITH PRO				ONLY	WITH AUG	ONLY	WITH PRO		
8						19	19	1			1			17
9	17			1		56	74	2			4			68
10	68			4		1089	1161	30			73			1058
11	1058			73		77	1209	30						1178
12	1178						1178	24						1155
13	1155						1155	23						1074
14	1074						1074	21					57	996
15	996						996	20					57	380
16	380						380	8					595	318
17	318						318	6					54	312
18	312						312	6						306
19	306						306	6						300
20	300						300	300						
TOT	7162.	0.	0.	79.	0.	1241.	8482.	477.	0.	0.	79.	0.	764.	7162.

TOTAL RATING TRANSFERS 0 IN 0 OUT TOTAL AUGMENTATIONS 79 IN 79 OUT TOTAL PROMOTIONS 1241 IN 764 OUT

COMPONENT ALL GRADE LTC RATING ALL SOURCE OF COMMISSION ROTC

YOS	FLOWS INTO THE CURRENT OFFICER STATE						CURRENT OFFICER STATE	FLOWS OUT OF THE CURRENT OFFICER STATE					
	LATERAL FLO	RATING TRANSFERS		AUGMENTATIONS		PROMOS ONLY		ATTRITION	RATING TRANSFERS		AUGMENTATIONS		PROMOS ONLY	LATERAL FLOW
		ONLY	WITH AUG	ONLY	WITH PRO				ONLY	WITH AUG	ONLY	WITH PRO		
14						57	57	1						56
15	56					57	113	2						111
16	111					595	706	14						692
17	692					54	747	15						732
18	732						732	15						717
19	717						717	14						624
20	624						624	42					79	562
21	562						562	11					20	353
22	353						353	7					198	314
23	314						314	21					32	293
24	293						293	52						241
25	241						241	48						193
26	193						193	193						
TOT	4889.	0.	0.	0.	0.	764.	5653.	436.	0.	0.	0.	0.	328.	4889.

TOTAL RATING TRANSFERS 0 IN 0 OUT TOTAL AUGMENTATIONS 0 IN 0 OUT TOTAL PROMOTIONS 764 IN 328 OUT

Fig. 39— Officer flows for ROTC majors and lieutenant colonels

OFFICER FLOWS

COMPONENT ALL GRADE COL RATING ALL SOURCE OF COMMISSION ROTC

YOS	FLOWS INTO THE CURRENT OFFICER STATE						CURRENT OFFICER STATE	FLOWS OUT OF THE CURRENT OFFICER STATE						
	LATERAL FLOW	RATING TRANSFERS		AUGMENTATIONS		PROMOS ONLY		ATTRITION	RATING TRANSFERS		AUGMENTATIONS		PROMOS ONLY	LATERAL FLOW
		ONLY	WITH AUG	ONLY	WITH PRO				ONLY	WITH AUG	ONLY	WITH PRO		
20						79	79	5						73
21	73					20	93	2						91
22	91					198	289	6						283
23	283					32	315	21						294
24	294						294	23						271
25	271						271	40						231
26	231						231	20						211
27	211						211	18						193
28	193						193	20						173
29	173						173	18						155
30	155						155	155						
TOT	1977.	0.	0.	0.	0.	328.	2305.	328.	0.	0.	0.	0.	0.	1977.

TOTAL RATING TRANSFERS 0 IN 0 OUT TOTAL AUGMENTATIONS 0 IN 0 OUT TOTAL PROMOTIONS 328 IN 0 OUT

COMPONENT ALL GRADE LT RATING PIL SOURCE OF COMMISSION SMSO

YOS	FLOWS INTO THE CURRENT OFFICER STATE						CURRENT OFFICER STATE	FLOWS OUT OF THE CURRENT OFFICER STATE						
	LATERAL FLOW	RATING TRANSFERS		AUGMENTATIONS		PROMOS ONLY		ATTRITION	RATING TRANSFERS		AUGMENTATIONS		PROMOS ONLY	LATERAL FLOW
		ONLY	WITH AUG	ONLY	WITH PRO				ONLY	WITH AUG	ONLY	WITH PRO		
2		418					418	6						412
3	412						412	6			100	1	4	300
4	300			100			400	6			4	75	299	16
5	16			4			20	20					0	0
6	0						0	0						
TOT	728.	418.	0.	104.	0.	0.	1250.	38.	0.	0.	104.	77.	303.	728.

TOTAL RATING TRANSFERS 418 IN 0 OUT TOTAL AUGMENTATIONS 104 IN 181 OUT TOTAL PROMOTIONS 0 IN 380 OUT

Fig. 40 — Officer flows for ROTC colonels

there are 4500 ROTC lieutenants (the annual ROTC accessions); in year 2 there are 4388; and in year 6 there are 2. These compare exactly with the right-hand portion of Fig. 35.

The entries to the left of the current officer state indicate the officer flows into the state, and the entries on the right of the current state show the flows out of the state. Thus, for flows associated with year 1 (the underlined row in the upper report of Fig. 38), 4500 officers flow into the current state as lateral flows, i.e., from the ROTC commissioning source. Of the 4500 ROTC lieutenants, 112 are lost to the force, 2106 receive rating transfers, and the remaining 2282 officers flow laterally. In year 2, the row just below the underline, note the 2282 lateral flows into year 2 plus the 2106 rating transfers (aggregating over all ratings). These flows into year 2 equal the number in the current state in year 2, namely 4388, which is 112 less than the 4500 in current state in year 1. If we were not aggregating over rating, but rather presenting only non-rated ROTC lieutenants, then the year 2 current state would be 2282.

The entries in circles in the upper report in Fig. 38 show those officers receiving augmentations only. The contents of both circles represent the same flows, the right-hand circle referring to augmentations out of the reserve component in years 2-4 and the left-hand circle referring to augmentations into the regular component in years 3-5; the officers are in the reserve component in years 2-4 and the regular component in years 3-5.

The oval-enclosed entries are also identical, the right-hand (lieutenant) oval referring to promotion-augmentations and promotions out of the lieutenant states, while the left-hand (captain) oval refers to promotion-augmentations and promotions into the captain states.

The summary lines at the bottom of each report are self-explanatory. Note the consistency between the total number of promotions out of lieutenant (3137) and the total promotions into captain.

Unless detailed officer flow reports are requested on the options card (see Sec. III, p. 42), only highly aggregated reports will be produced: (1) one set of five reports, aggregated over all components, all ratings, and the reserve sources of commission and (2) one set of

five reports, aggregated over all components, all ratings, and all sources of commission. The reports in Figs. 38-40 are themselves aggregated over all components and all ratings. Thus, each current officer state entry in these examples is effectively the sum of six officer states--reserve pilot, regular pilot, reserve navigator, regular navigator, reserve non-rated, and regular non-rated.

Note that, from the definition of a steady-state model (Sec. I, p. 6), the sum of the flows into each current state entry must equal the sum of the flows out of the entry. The model's output package, when producing the officer flow reports, checks to insure that the flows in equal the number in state, and that the flows out equal the number in state. If the flows in do not equal the number in state, an asterisk is printed just to the left of the current state entry. If the flows out do not equal the numbers in state, then an asterisk is printed just to the right of the current state entry.

OFFICER FLOWS AND IMPLIED FORWARD COMPUTATION RATES

Figure 41 illustrates an optional report that presents officer flows in terms of the progression model's four-step computation process, i.e., loss,* rating transfer, augmentation, and promotion. The report must be selected on the options card, either directly or by requesting that the constraints model punch a progression or grade limitations model input deck (see Sec. III, p. 42).

The report in Fig. 41 presents all of the reserve non-rated ROTC officers, since in this run reserve officers are not permitted subsequent to the eleventh year of service. As shown in the upper report, in the first year of service there are 4500 officers in the initial officer state--the number of ROTC annual accessions. During the loss phase, 112 officers are lost to the force, *implying* a loss rate of 2.5 percent. This is an important point. The model's output package, when producing this report, *does not refer to any input parameters*. Only the number of officers in each state and the flows between the states are considered. Thus the loss rates--and all the other rates printed

*In Fig. 41 the loss phase is called the attrition phase.

OFFICER FLOWS AND IMPLIED FORWARD COMPUTATION RATES

COMPONENT RES GRADE LT RATING NR SOURCE OF COMMISSION ROTC

YEAR	INITIAL OFFICER STATE	ATTRITION PHASE			RATING TRANSFER PHASE			AUGMENTATION PHASE			PROMOTION PHASE		
		LOSSES	LOSS RATE	RESIDUE	TRNSFRS OUT	TRNSFR RATE	RESIDUE	AUGMNTS OUT	AUGMENT RATE	RESIDUE	PROMOS	PROMO RATE	RESIDUE
1	4500	112	0.0250	4388	2106	0.4800	2282			2282			2282
2	2282	34	0.0150	2247			2247	229	0.1020	2018			2018
3	2018	30	0.0150	1988			1988	306	0.1540	1682	14 CUT	0.0083	1668
4	1668	917	0.5500	750			750	24	0.0320	726	658 OUT	0.9496	37
5	37	36	0.9900	0			0			0	0 CUT	0.0004	0
6	0	0	1.0000										

COMPONENT RES GRADE CAP RATING NR SOURCE OF COMMISSION ROTC

YEAR	INITIAL OFFICER STATE	ATTRITION PHASE			AUGMENTATION PHASE			PROMOTION PHASE		
		LOSSES	LOSS RATE	RESIDUE	AUGMNTS OUT	AUGMENT RATE	RESIDUE	PROMOS	PROMO RATE	RESIDUE
3								14 IN		14
4	14	8	0.5500	6	0	0.0320	6	658 IN		696
5	696	14	0.0200	682	95	0.1400	587	0 IN		587
6	587	18	0.0300	569			569			569
7	569	480	0.8430	89			89	1 CUT	0.0112	88
8	88	10	0.1100	79			79	3 CUT	0.0354	76
9	76	8	0.1000	68			68	50 CUT	0.7379	18
10	18	2	0.1000	16			16	3 CUT	0.2060	13
11	13	13	1.0000							

COMPONENT RES GRADE MAJ RATING NR SOURCE OF COMMISSION ROTC

YEAR	INITIAL OFFICER STATE	ATTRITION PHASE			AUGMENTATION PHASE			PROMOTION PHASE		
		LOSSES	LOSS RATE	RESIDUE	AUGMNTS OUT	AUGMENT RATE	RESIDUE	PROMOS	PROMO RATE	RESIDUE
8	1	0	0.1100	1	1	1.0000		3 IN		3
9	3	0	0.1000	3	2	0.9940	0	50 IN		50
10	50	5	0.1000	45	45	0.9930	0	3 IN		4
11	4	4	1.0000							

Fig. 41 — Officer flows and implied forward computation rates for ROTC reserve non-rated officers

in the report shown--are *implied* rates, i.e., rates that would have to be in effect to permit the state values and flows between the states.

After losses have been accounted for, there remain 4388 officers in their first year of service. Rating transfers to pilot or navigator are awarded to 2106 of them, thus implying a rating transfer rate of 48 percent (of the 4388 remaining officers). The 2282 non-rated officers remaining after rating transfers flow laterally into the second year of service.

The rates printed in the report are computed by dividing the flows out by the immediately preceding residue. Thus the augmentation rates are computed by dividing the number of augmentations by the rating transfer residue. If pilots were being considered instead of non-rated lieutenants, the rating transfer residue would include any pilot rating transfer flows in. Note also that the promotion flows out of lieutenant are identical to those into captain (the two sets of enclosed entries).

No aggregations are produced in this report--its original intent was to facilitate debugging of the progression model. The report checks to insure that no flow imbalances exist. If any are detected, an asterisk is printed to the right of the appropriate output line.

RATING TRANSFERS AS FRACTIONS OF ANNUAL ACCESSIONS

This report, not illustrated, shows the progression model rating transfer and annual accession inputs necessary to support the officer force structure.

IMPLIED FORWARD COMPUTATION PROMOTION PARAMETERS

The promotion parameter report, illustrated in Fig. 42, shows the progression model promotion parameters necessary to support the officer structure's promotion flows. The number of officers eligible for promotion and the total number of promotions awarded are also presented.

It should be noted that this report is produced with no reference made to the input promotion parameters. Also the phase point, for those promotion zones that are *not* four years in length, is chosen by the output package to be the year of the promotion zone with the most promotions--in conformance with the standard Air Force definition of

IMPLIED FORWARD COMPUTATION PROMOTION PARAMETERS

GRADE	RATING	SOURCE OF COMMISSION	CUMULATIVE PROMOTION OPPORTUNITY		BELOW-THE-ZONE PROMOTIONS		PROMOTION PHASE POINT	ELIGIBLES	PROMOTIONS
			FIRST YEAR OF PRIMARY ZONE	SECOND YEAR OF PRIMARY ZONE	BELOW-THE-ZONE PROMOTION PCT.	FIRST YEAR BELOW THE-ZONE PERCENT			
CAP	PIL	AFA	95.00	95.00	1.50	0.0	5	581	552
CAP	PIL	ROTC	95.00	95.00	1.50	0.0	5	1385	1316
CAP	PIL	SMSC	95.00	95.00	1.50	0.0	5	400	380
CAP	PIL	ALL	95.00	95.00	1.50	0.0	5	2365	2247
CAP	NAV	AFA	95.00	95.00	1.50	0.0	5	90	85
CAP	NAV	ROTC	95.00	95.00	1.50	0.0	5	628	597
CAP	NAV	SMSC	95.00	95.00	1.50	0.0	5	456	434
CAP	NAV	ALL	95.00	95.00	1.50	0.0	5	1174	1116
CAP	NR	AFA	95.00	95.00	1.50	0.0	5	224	213
CAP	NR	ROTC	95.00	95.00	1.50	0.0	5	1281	1224
CAP	NR	SMSC	95.00	95.00	1.50	0.0	5	1340	1283
CAP	NR	ALL	95.00	95.00	1.50	0.0	5	2844	2720
CAP	ALL	AFA	95.00	95.00	1.50	0.0	5	895	850
CAP	ALL	ROTC	95.00	95.00	1.50	0.0	5	3293	3137
CAP	ALL	SMSC	95.00	95.00	1.50	0.0	5	2196	2096
CAP	ALL	ALL	95.00	95.00	1.50	0.0	5	6384	6083
MAJ	PIL	AFA	75.00	80.00	6.00	25.00	10	397	318
MAJ	PIL	ROTC	75.00	80.00	6.00	25.00	10	655	525
MAJ	PIL	SMSC	75.00	80.00	6.00	25.00	10	189	152
MAJ	PIL	ALL	75.00	80.00	6.00	25.00	10	1241	994
MAJ	NAV	AFA	75.00	80.00	6.00	25.00	10	61	49
MAJ	NAV	ROTC	75.00	80.00	6.00	25.00	10	280	224
MAJ	NAV	SMSC	75.00	80.00	6.00	25.00	10	203	163
MAJ	NAV	ALL	75.00	80.00	6.00	25.00	10	545	436
MAJ	NR	AFA	75.00	80.00	6.00	25.00	10	154	124
MAJ	NR	ROTC	75.00	80.00	6.00	25.00	10	613	492
MAJ	NR	SMSC	75.00	80.00	6.00	25.00	10	692	555
MAJ	NR	ALL	75.00	80.00	6.00	25.00	10	1460	1171
MAJ	ALL	AFA	75.00	80.00	6.00	25.00	10	612	491
MAJ	ALL	ROTC	75.00	80.00	6.00	25.00	10	1548	1241
MAJ	ALL	SMSC	75.00	80.00	6.00	25.00	10	1085	870
MAJ	ALL	ALL	75.00	80.00	6.00	25.00	10	3245	2601

Fig. 42— Promotion opportunities, captains and majors

phase point. For those promotion zones that are four years in length, the phase point is picked to be the third year of the promotion zone.

AUGMENTATION OPPORTUNITY REPORT

The augmentation opportunity report, illustrated in Fig. 43, indicates the percentage of officers with the given rating, source of commission, and year of service who are regular force officers. The year-of-service range, unless specified to the contrary on the options card,* is 3 through 7 years of service.

Note in Fig. 43 that 25 percent of all ROTC pilots with four years of service are regular--351 out of 1406. Note also that 23 percent of all ROTC navigators with four years of service are regular--147 out of 637. These percentages are cumulative augmentation opportunities and are most meaningful in the years during which augmentations take place. In the model run that produced the example outputs, augmentation for non-rated officers takes place in years 3-6, and rated augmentation takes place in years 4-7.

IMPLIED BACKWARD COMPUTATION INPUTS

The constraints model output package produces a set of reports indicating the grade limitations model inputs necessary to produce the given officer structure and flows within that structure. Figure 44 illustrates one of those reports, the one dealing with ROTC augmentation distributions. For example, for non-rated lieutenants, just under 43 percent of the augmentations occur in year 3. These are augmentations exclusively, and include neither rating transfer-augmentations nor promotion-augmentations. Just under 57 percent of the augmentations from reserve to regular lieutenant take place in year 4, and less than a quarter of one percent take place in year 5. Note that this distribution does not indicate the *number* of augmentations that will take place, but only *when*, i.e., in what year of service, they will take place.

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*See Sec. III, p. 42.

AUGMENTATION OPPORTUNITIES

SOURCE OF COMMISSION ROTC

YEAR OF SERVICE	PILOT				NAVIGATOR				NONRATED			
	RESERVE	REGULAR	TOTAL	OPPORTUNITY	RESERVE	REGULAR	TOTAL	OPPORTUNITY	RESERVE	REGULAR	TOTAL	OPPORTUNITY
3	1427	0	1427	0	647	0	647	0	2018	229	2247	10
4	1054	351	1405	25	491	147	637	23	1682	532	2214	24
5	761	624	1385	45	377	251	628	40	733	548	1281	43
6	623	674	1296	52	307	281	588	48	587	606	1193	51
7	280	663	943	70	133	282	415	68	569	588	1157	51

SOURCE OF COMMISSION SMSO

YEAR OF SERVICE	PILOT				NAVIGATOR				NONRATED			
	RESERVE	REGULAR	TOTAL	OPPORTUNITY	RESERVE	REGULAR	TOTAL	OPPORTUNITY	RESERVE	REGULAR	TOTAL	OPPORTUNITY
3	412	0	412	0	470	0	470	0	3011	278	3289	8
4	306	101	406	25	357	107	463	23	2596	643	3239	20
5	219	180	400	45	273	183	456	40	684	656	1340	49
6	179	195	374	52	223	205	427	48	549	700	1248	56
7	81	192	272	70	97	205	301	68	532	678	1210	56

SOURCE OF COMMISSION RES

YEAR OF SERVICE	PILOT				NAVIGATOR				NONRATED			
	RESERVE	REGULAR	TOTAL	OPPORTUNITY	RESERVE	REGULAR	TOTAL	OPPORTUNITY	RESERVE	REGULAR	TOTAL	OPPORTUNITY
3	1839	0	1839	0	1117	0	1117	0	5029	507	5536	9
4	1358	453	1812	25	848	253	1101	23	4278	1175	5453	22
5	980	804	1784	45	650	434	1084	40	1416	1204	2621	46
6	802	868	1671	52	529	486	1015	48	1135	1306	2441	53
7	361	855	1216	70	230	487	716	68	1101	1266	2367	53

Fig. 43 — Augmentation opportunities

IMPLIED BACKWARD COMPUTATION INPUTS

AUGMENTATION DISTRIBUTIONS

SOURCE OF COMMISSION ROTC

PILOT

LIEUTENANT		CAPTAIN		MAJOR		LIEUT. COL.		COL/GEN	
YOS	FRACT.	YOS	FRACT.	YOS	FRACT.	YOS	FRACT.	YOS	FRACT.
4	0.9615	5	0.0428	9	0.0187				
5	0.0385	6	0.9572	10	0.0517				
				11	0.9296				

NAVIGATOR

LIEUTENANT		CAPTAIN		MAJOR		LIEUT. COL.		COL/GEN	
YOS	FRACT.	YOS	FRACT.	YOS	FRACT.	YOS	FRACT.	YOS	FRACT.
4	0.9644	5	0.0287	9	0.0187				
5	0.0356	6	0.8763	10	0.0517				
		7	0.0950	11	0.9297				

NONRATED

LIEUTENANT		CAPTAIN		MAJOR		LIEUT. COL.		COL/GEN	
YOS	FRACT.	YOS	FRACT.	YOS	FRACT.	YOS	FRACT.	YOS	FRACT.
3	0.4292	5	0.0021	9	0.0184				
4	0.5685	6	0.9979	10	0.0514				
5	0.0023			11	0.9302				

Fig. 44 — ROTC augmentation-only distributions

ERROR AND WARNING MESSAGE SUMMARY

At the end of each run, a summary of all error and warning messages produced during the run is printed, indicating the page number and the type of error or warning message printed. Included in this summary are all input deck errors and warnings, any flow imbalances detected by the output package, and any *negative states or flows.*[*]

Since the summary presents in one place a list of all the errors or warnings produced, it should be the first thing the user looks at, to insure that the model run is reasonable.

CONSTRAINTS MODEL REPORTS

The reports thus far described are produced by an output package used by the progression and grade limitations models as well as the constraints model. There are, however, several output reports produced by only the constraints model. These reports indicate the constraints model's degree of success in satisfying the manpower and career reserve requirements.

Manpower Requirement Summaries

Figure 45 contains three *manpower requirement summaries*, one for each source of commission, as well as a printout of the career reserve requirement (CRES) inputs. Note that, with the exception of non-rated OTS officers, no career reserve constraints are being placed on the officer force: the career reserve opportunity for all but non-rated OTS officers is 100 percent. However, non-rated OTS career reservists are being limited to 2000 officers.

Each manpower summary shows, for each manpower requirement, the number of officers just added toward meeting the requirement, the number of officers still needed to completely satisfy the requirement, and the manpower requirement itself. Thus, looking at the Academy (AFA) manpower requirement summary, we see that 14,175 officers in the force structure graduated from the Academy, all of which are regular

[*]Negative states or flows are usually encountered in the grade limitations model, but extreme constraints model inputs can also result in negative states or flows.

CAREER RESERVE REQUIREMENTS DATA

	RATING	SOURCE OF COMMISSION	END OF INITIAL OBLIGATION	CAREER RESERVE REQUIREMENTS: CAREER RESERVE OPPORTUNITY	CAREER RESERVISTS SELECTED	TOTAL NUMBER OF CAREER RESERVISTS	
CRES	ALL	ROTC	4	100.00	0	0	CNST1610
CRES	RAT	OTS	4	100.00	0	0	CNST1620
CRES	NR	OTS	4	0.0	0	2000	CNST1630
			0	0.0	0	0	CNST1640

**** MANPOWER REQUIREMENT SUMMARY FOR RATING 'ALL' AND SOURCE OF COMMISSION 'AFA '

	JUST CONSUMED	REMAINING	TOTAL REQUIREMENT
TOTAL MANPOWER REQUIREMENT:	14175.	83675	97850
WARTIME PILOT REQUIREMENT:	7988.	20012	28000
WARTIME NAVIGATOR REQUIREMENT:	1234.	11766	13000
TOTAL REGULAR FORCE REQUIREMENT:	14175.	43825	58000

**** MANPOWER REQUIREMENT SUMMARY FOR RATING 'ALL' AND SOURCE OF COMMISSION 'ROTC'

	JUST CONSUMED	REMAINING	TOTAL REQUIREMENT
TOTAL MANPOWER REQUIREMENT:	40616.	37059	97850
WARTIME PILOT REQUIREMENT:	15523.	4484	28000
WARTIME NAVIGATOR REQUIREMENT:	6812.	4954	13000
TOTAL REGULAR FORCE REQUIREMENT:	25629.	18198	58000

**** MANPOWER REQUIREMENT SUMMARY FOR RATING 'ALL' AND SOURCE OF COMMISSION 'SMSO'

	JUST CONSUMED	REMAINING	TOTAL REQUIREMENT
TOTAL MANPOWER REQUIREMENT:	37066.	-7	97850
WARTIME PILOT REQUIREMENT:	4484.	0	28000
WARTIME NAVIGATOR REQUIREMENT:	4955.	-1	13000
TOTAL REGULAR FORCE REQUIREMENT:	18198.	-2	58000

Fig. 45 — Manpower requirement summaries

officers; 7988 of them are pilots, and 1234 are navigators, all in the grade of lieutenant colonel and below, and with 28 years of service and below.

The second manpower requirement summary, for ROTC, shows that 46,616 of the officers are ROTC graduates, 25,629 of which are regular. Turning to the REMAINING column we see that after all ROTC processing is completed, we still need 37,059 more officers, 18,196 of which should be regular; 4484 of which should be pilots, and 4954 of which should be navigators, all in the grade of lieutenant colonel and below, and with 28 years of service and below.

Turning to the final manpower requirement summary, for OTS (labeled SMSO in the summary, which is synonymous with OTS in the constraints model), we see that the model has exceeded the manpower requirement by seven officers, has satisfied the pilot requirement exactly, is one over on the navigator requirement and two over on the regular force requirement. These are well within the constraints model's limits of acceptability (.1 percent for manpower and regular force requirements, and 1 officer for wartime requirements). If the model's limits of acceptability were exceeded, then an INFEASIBLE message would be printed to the right of the last manpower requirement summary. Exceeding a manpower requirement, not falling short of it, will cause the printing of the INFEASIBLE message.

Note that the absence of messages to the contrary indicates that the career reserve requirements have been satisfied. If they were not satisfied, then messages so indicating would have appeared.

Optional Reports

The manpower requirement summary reports illustrated in Fig. 45 are always printed. Several optional reports that provide much more detail can also be requested.* These reports, originally provided to facilitate program debugging, present a picture of the model's logic.† They are illustrated in Figs. 46-48.

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*See Sec. III, p. 42.

†The reader not interested in these details may skip the remainder of this section.

CAREER RESERVE REQUIREMENT ITERATION RESULTS

RATING	SOURCE OF COMMISSION	END OF INITIAL OBLIGATION	CAREER RESERVE REQUIREMENT: OPPORTUNITY DESIRED	OPPORTUNITY ACTUAL	NUMBER SELECTED DESIRED	NUMBER SELECTED ACTUAL	CAREER RESERVES DESIRED	CAREER RESERVES ACTUAL	LOSS RATES IN EOR YEAR: LIEUTENANT RESERVE	LIEUTENANT REGULAR	CAPTAIN RESERVE	CAPTAIN REGULAR
NR	ROTC	4	100.000	100.000		757		2141	0.5500	0.0150	0.5500	0.0150
**** CAREER RESERVE REQUIREMENT WAS SATISFIED AFTER 1 ITERATIONS												
PIL	ROTC	4	100.000	100.000		1039		1772	0.0150	0.0150	0.0150	0.0150
**** CAREER RESERVE REQUIREMENT WAS SATISFIED AFTER 1 ITERATIONS												
NAV	ROTC	4	100.000	100.000		483		868	0.0150	0.0150	0.0150	0.0150
**** CAREER RESERVE REQUIREMENT WAS SATISFIED AFTER 1 ITERATIONS												

**** MANPOWER REQUIREMENT SUMMARY FOR RATING 'ALL' AND SOURCE OF COMMISSION 'ROTC'

	JUST CONSUMED	REMAINING	TOTAL REQUIREMENT	
TOTAL MANPOWER REQUIREMENT:	46616.	37059	57850	
WARTIME PILOT REQUIREMENT:	15528.	4484	28000	
WARTIME NAVIGATOR REQUIREMENT:	6812.	4954	13000	
TOTAL REGULAR FORCE REQUIREMENT:	25629.	18196	58000	

**** MANPOWER REQUIREMENT SUMMARY FOR RATING 'PIL' AND SOURCE OF COMMISSION 'SMSC'

	JUST CONSUMED	REMAINING	TOTAL REQUIREMENT	
TOTAL MANPOWER REQUIREMENT:	4774.	32285	57850	
WARTIME PILOT REQUIREMENT:	4484.	0	28000	
WARTIME NAVIGATOR REQUIREMENT:	0.	4954	13000	
TOTAL REGULAR FORCE REQUIREMENT:	3129.	15067	58000	PRELIMINARY DISTRIBUTION

**** MANPOWER REQUIREMENT SUMMARY FOR RATING 'NAV' AND SOURCE OF COMMISSION 'SMSC'

	JUST CONSUMED	REMAINING	TOTAL REQUIREMENT	
TOTAL MANPOWER REQUIREMENT:	5245.	27040	57850	
WARTIME PILOT REQUIREMENT:	0.	0	28000	
WARTIME NAVIGATOR REQUIREMENT:	4954.	0	13000	
TOTAL REGULAR FORCE REQUIREMENT:	3311.	11756	58000	PRELIMINARY DISTRIBUTION

Fig. 46 — ROTC and rated OTS details

BEGINNING PRILIMINARY DISTRIBUTION OF NONRATED SMS-O OFFICERS -- BACKING RATED SMS-O OFFICERS INTO NONRATED STATES

TOTAL BACKED UP NONRATEDS:		918.
PILOTS	ACCESSIONS NEEDED:	429.
	NONRATED RESERVES:	429.
	NONRATED REGULARS:	0.
NAVIGS	ACCESSIONS NEEDED:	490.
	NONRATED RESERVES:	490.
	NONRATED REGULARS:	0.
TOTAL ANNUAL ACCESSIONS:		919.

Fig. 47 — Non-rated implications of rated OTS officers

NONRATED SMS-O PRELIMINARY DISTRIBUTION ITERATION RECORD - CAREER RESERVE REQUIREMENT IS TOTAL CAREER RESERVISTS DESIRED
TAKING INTO CONSIDERATION SMS-O NONRATED'S THAT ARE IMPLIED BY SMS-O RATED'S, TOTAL MANPOWER AND REGULARS NOT YET SATISFIED
MANPOWER STILL NEEDED: 26121 REGULARS STILL NEEDED: 11756

**** IMPLIED MANPOWER TOO LOW, CAREER RESERVISTS TOO HIGH -- INCREASE ECB LOSS RATES TO REDUCE CAREER RESERVISTS
CAREER RESERVISTS - ACTUAL: 2470 DESIRED: 2000 LOSS RATES (OLD/NEW) LT: (0.55000C.63563) CAP: (0.55000C.63563)

**** IMPLIED MANPOWER TOO LOW, CAREER RESERVISTS TOO HIGH -- INCREASE ECB LOSS RATES TO REDUCE CAREER RESERVISTS
CAREER RESERVISTS - ACTUAL: 2088 DESIRED: 2000 LOSS RATES (OLD/NEW) LT: (0.63563C.65098) CAP: (0.63563C.65098)

**** IMPLIED MANPOWER TOO LOW, CAREER RESERVISTS TOO HIGH -- INCREASE ECB LOSS RATES TO REDUCE CAREER RESERVISTS
CAREER RESERVISTS - ACTUAL: 2016 DESIRED: 2000 LOSS RATES (OLD/NEW) LT: (0.65098C.65375) CAP: (0.65098C.65375)

**** IMPLIED MANPOWER TOO LOW, CAREER RESERVISTS TOO HIGH -- INCREASE ECB LOSS RATES TO REDUCE CAREER RESERVISTS
CAREER RESERVISTS - ACTUAL: 2003 DESIRED: 2000 LOSS RATES (OLD/NEW) LT: (0.65375C.65427) CAP: (0.65375C.65427)

**** IMPLIED MANPOWER TOO LOW, CAREER RESERVISTS OKAY -- DISTRIBUTE OFFICERS AND TERMINATE PROCESSING
OFFICERS DISTRIBUTED OVER REGULAR AND RESERVE: 23852 NONCAREER RESERVE ONLY: 2265 CAREER RESERVISTS: 2000 ACTL, 2000 DES

**** NONRATED SMS-O PRELIMINARY DISTRIBUTION
ACTUAL MANPOWER LT DESIRED, ACTUAL REGULARS LT DESIRED
CAREER RESERVE REQUIREMENT: TOTAL CAREER RESERVISTS.
SUCCESSFUL COMPLETION OF PRELIMINARY DISTRIBUTION

**** RATE ADJUSTMENT FOR RES , LT , PIL , SMSC, AND YOS 3 AUGMENTATION NEW = 0.25000, OLD = 0.00000

**** RATE ADJUSTMENT FOR RES , LT , PIL , SMSC, AND YOS 4 AUGMENTATION NEW = 0.26800, OLD = 0.00000

**** RATE ADJUSTMENT FOR RES , LT , NAV , SMSC, AND YOS 3 AUGMENTATION NEW = 0.23000, OLD = 0.00000

**** RATE ADJUSTMENT FOR RES , LT , NAV , SMSC, AND YOS 4 AUGMENTATION NEW = 0.22200, OLD = 0.00000

**** RATE ADJUSTMENT FOR RES , LT , NR , SMSC, AND YOS 1 RATING TRANSFER NEW = 0.09874, OLD = 0.0 PIL

**** RATE ADJUSTMENT FOR RES , LT , NR , SMSC, AND YOS 1 RATING TRANSFER NEW = 0.11275, OLD = 0.0 NAV

**** RATE ADJUSTMENT FOR RES , LT , NR , SMSC, AND YOS 2 AUGMENTATION NEW = 0.08458, OLD = 0.00000

**** RATE ADJUSTMENT FOR RES , LT , NR , SMSC, AND YOS 3 AUGMENTATION NEW = 0.12446, OLD = 0.00000

**** RATE ADJUSTMENT FOR RES , LT , NR , SMSC, AND YOS 4 ATTRITION NEW = 0.72835, OLD = 1.00000

**** RATE ADJUSTMENT FOR RES , LT , NR , SMSC, AND YOS 4 AUGMENTATION NEW = 0.03200, OLD = 0.00000

**** MANPOWER REQUIREMENT SUMMARY FOR RATING 'ALL' AND SOURCE OF COMMISSION 'SMSC'

	JUST CONSUMED	REMAINING	TOTAL REQUIREMENT
TOTAL MANPOWER REQUIREMENT:	37066.	-7	57850
WARTIME PILOT REQUIREMENT:	4484.	0	28000
WARTIME NAVIGATOR REQUIREMENT:	4955.	-1	13000
TOTAL REGULAR FORCE REQUIREMENT:	18198.	-2	58000

Fig. 48—Non-rated OTS details

The details of the iterative ROTC processing and rated OTS (called SMSO in Fig. 45) processing are presented in Fig. 46. Since we requested that ROTC and rated OTS career reserve opportunities be 100 percent, the model had no trouble in meeting those requirements. The ROTC requirements were satisfied after one iteration.

Note that the first PRELIMINARY DISTRIBUTION manpower requirement summary refers to OTS pilots and the second refers to OTS navigators. The constraints model first tries to satisfy the remaining wartime pilot requirement, and then the remaining wartime navigator requirement. Thus the OTS pilot preliminary manpower requirement summary shows no wartime pilot requirement remaining. Note that the 4484 OTS pilots that went toward satisfying the remaining wartime pilot requirement resulted in 4774 total officers. The additional 290 officers are OTS pilots above the maximum wartime requirement grade and year of service limits. The same is true for OTS navigators. No non-rated officers are reflected in the two OTS manpower requirement summaries. Further, upon completion of the OTS navigator processing, we see that 27,040 additional non-rated OTS officers are still needed, 11,756 of which should be regular.

Figure 47 illustrates the next step in the OTS modeling process. Specifically, at this point the rated OTS officer states have been determined, but no non-rated officers have been provided to support the rating transfer flows into the rated OTS states. Figure 47 shows the non-rated officers necessary to support the rating transfer flows into the rated OTS states. Note that in the model run that produced these results, all rating transfers take place in the first year of service, i.e., the officers are non-rated in the first year and rated in the second.

The report indicates that 429 accessions are needed to satisfy the rating transfers into OTS pilot. Furthermore, these 429 accessions generate 429 non-rated OTS officers with one year of service. Since in this model run all rating transfers take place in the first year, these 429 officers can go in one of two directions. They can be lost to the force, or they can receive rating transfers to pilot. Thus, none of the 429 accessions end up as non-rated in the second year of service.

This is why, in the figure, the non-rated reserves equal the accessions needed. If rating transfers to pilot took place in the second year, then the non-rated reserves would be greater than the accessions needed. Further, if augmentations took place in years prior to rating transfers, then non-rated regular officers would also be reported.*

The same discussion applies to the non-rated officers required to satisfy OTS navigator rating transfers. We see that 490 accessions are needed. Therefore, a total of 919 OTS accessions are needed to completely support all OTS rating transfer flows.

Figure 48 shows the remaining details of the non-rated OTS logic.† Recall that the non-rated OTS career reserve requirement is 2000 career reservists. The top half of the figure presents the iteration record, indicating the iterations used by the model to converge on 2000 non-rated career reservists.

The iteration process focuses on increasing the EOB year loss rates sufficiently to cause satisfaction of the career reserve requirement. The iteration record shows how close the model comes to meeting the 2000 career reservist target with each successive adjustment of EOB loss rates. Excerpts from the iteration record are given below.‡

Career Reservists	EOB Loss Rate	
2470	.5500	Normal loss rate
2088	.6356	
2016	.6510	
2003	.6538	
2000	.6543	

*See Sec. V, p. 104, and App. D, p. 157, for more details.

†We apologize for the cluttered nature of the report, emphasizing that the report's intent was to aid in debugging.

‡A complete description of the model logic reflected in this iteration record will be found in Sec. V, p. 104, and App. D, p. 165.

Preliminary OTS Distribution

In Figs. 46-48, reference is made to *preliminary* OTS officer distributions. In fact, all of the OTS processing thus far described is preliminary processing. It is called preliminary because the model's next step is to determine what the progression model inputs must be to generate the OTS officer structure. Once these inputs are determined, the model distributes the just-determined OTS accessions over the force structure in *traditional progression model* fashion, and it is this officer structure that is used as the OTS segment of the officer force.

The middle section of Fig. 48 shows the results of some of the input parameter adjustments based on the completed preliminary OTS officer distribution. The OLD rates are not necessarily the rates provided in the inputs. They may be the result of adjustments made during preliminary OTS processing.

The lower segment of Fig. 48 is the manpower requirement summary after the final OTS officer structure has been determined. Note that the final OTS structure contains 4955 navigators, while the preliminary structure reported in Fig. 46 showed 4954 navigators.* The difference of one navigator stems from the model's rounding of the required number of annual OTS accessions.

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*With grade below colonel and 28 or fewer years of service.

V. MODEL LOGIC

In Sec. II several numerical examples illustrated the techniques employed by the constraints model to determine the distribution of the officer force. The examples were highly simplified, our intention being to provide an intuitive flavor of how the model works. This section will take a more rigorous look at the model's logic. The unconstrained progression model is reviewed first, and then the constraints model, including a description of the logic employed to distribute Academy accessions. ROTC logic and OTS logic, the most complicated logic of the constraints model, are discussed.

UNCONSTRAINED OFFICER FORCE PROGRESSION MODEL

The unconstrained progression model is reviewed here because it is used as a building block of the constraints model.*

Table 8 shows the order of computation in the unconstrained progression model. One source of commission is processed at a time, and within each source, one rating is processed at a time. Within each rating the model processes one grade at a time, and each grade is broken down into three year zones: the prepromotion, promotion, and postpromotion year zones. Stated differently, year zone processing is the fundamental processing unit of the unconstrained model, with year zone processing being applied for appropriate combinations of grade, rating, and source of commission.

Prepromotion Year Zone Processing

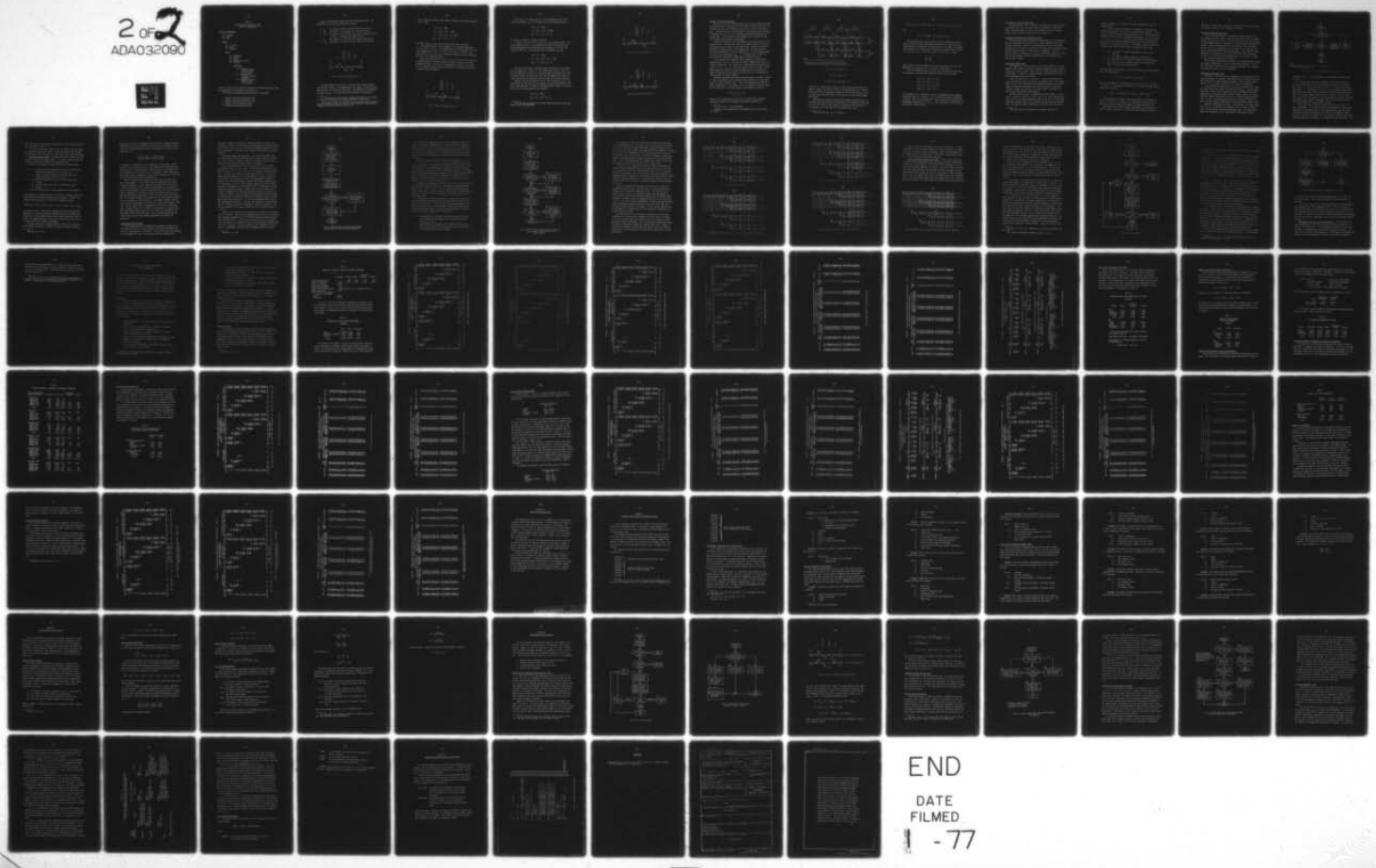
The prepromotion zone for a grade includes all the years of service for which the grade is defined that lie between the promotion zone for promotions into the grade and the promotion zone for promotions out of the grade. Thus, if the last year for promotion to lieutenant colonel

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*This model is described in detail in S. H. Miller, L. C. Sammis, and H. J. Shukiar, *The Officer Force Progression Model: A Steady-State Mathematical Model of the U.S. Air Force Structure*, The Rand Corporation, R-1607-PR, November 1974.

AD-A032 090 RAND CORP SANTA MONICA CALIF F/G 5/1
THE CONSTRAINED OFFICER FORCE PROGRESSION MODEL: A STEADY-STATE--ETC(U)
SEP 76 H J SHUKIAR, S H MILLER, L C SAMMIS F44620-73-C-0011
UNCLASSIFIED R-1982-PR NL

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Table 8

UNCONSTRAINED PROGRESSION MODEL
ORDER OF COMPUTATION

Source of Commission

(1) Academy
(2) ROTC
(3) OTS

Rating

(1) Non-rated
(2) Pilot
(3) Navigator

Grade

(1) Lieutenant
(2) Captain
(3) Major
(4) Lieutenant colonel
(5) Colonel

Year Zones

(1) Prepromotion zone
reserve first,
then regular
(2) Promotion zone
reserve & regular
combined
(3) Postpromotion zone
reserve first,
then regular

is year 17, and the first year for promotion to colonel is year 20, then the prepromotion zone includes years 18 and 19.

Four types of prepromotion processing will be described:

- Reserve non-rated prepromotion flow.
- Regular non-rated prepromotion flow.
- Reserve rated prepromotion flow.
- Regular rated prepromotion flow.

Figure 49 illustrates reserve non-rated prepromotion flow. The variables* in the figure are defined as follows:

- o s_i the number of reserve non-rated officers in year i,
- o ls_i the number of s_i officers that leave the force,
- o r_i the number of s_i officers that receive rating transfers to pilot or navigator (lieutenant only),
- o a_i the number of s_i officers that receive agumentation,
- o s_{i+1} the number of reserve non-rated officers in year i+1.

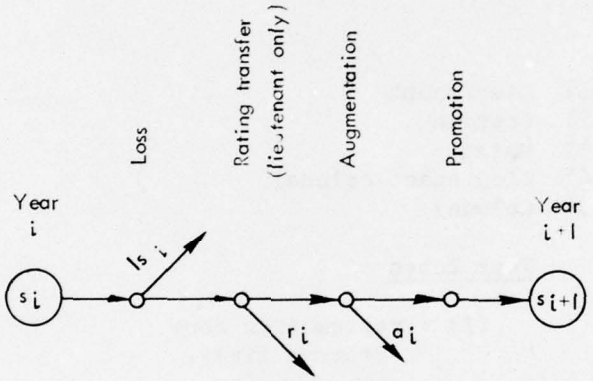


Fig. 49 — Reserve non-rated prepromotion flow

The model knows the value of s_1, the loss rate ($loss_i$), rating transfer rate ($rtran_i$),† and augmentation rate (aug_i), the rates having been specified in the model's input deck. The problem is to determine the value of s_{i+1}. To do this the model proceeds in three phases.

---

*In the discussion that follows, reserve variables will be defined in lower case characters, and regular variables in upper case.

†The rating transfer rate at this point has already been converted from the fraction of annual accessions to the fraction of non-attrited officers in the state (see Sec. III, p. 35).

First, losses are removed, then rating transfers, and finally augmentations. Thus,

$$ls_i = s_i \cdot loss_i,$$
$$r_i = (s_i - ls_i) \cdot rtran_i,$$
$$a_i = (s_i - ls_i - r_i) \cdot aug_i,$$
$$s_{i+1} = s_i - ls_i - r_i - a_i.$$

Note that $rtran_i$ is zero for all grades other than lieutenant.

The rating transfer rate is applied to the officers remaining *after losses are removed*. The augmentation rate is applied to the officers remaining *after losses and rating transfers are removed*. The model saves ls_i, r_i, and a_i for subsequent officer structure processing as well as for output generation.

Figure 50 illustrates *regular non-rated prepromotion flow* with the variables defined in a manner similar to those for reserve non-rated prepromotion flow. Note that the augmentation flow (a_i) is the same as that computed above for reserve non-rated: the officers flowed out of reserve and into regular.

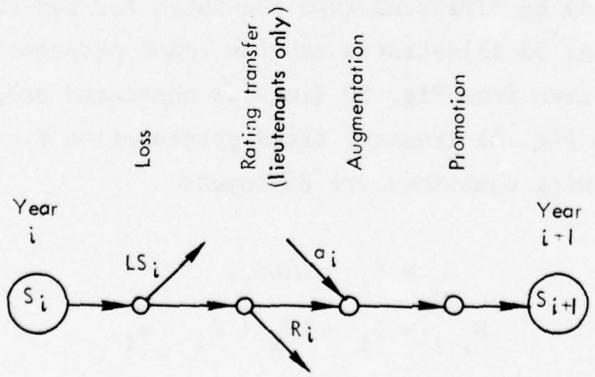


Fig. 50 — Regular non-rated prepromotion flow

Given that S_i is known, as well as the appropriate input rates ($LOSS_i$ and $RTRAN_i$), S_{i+1} is determined by the following equations:

$$LS_i = S_i \cdot LOSS_i,$$
$$R_i = (S_i - LS_i) \cdot RTRAN_i,$$
$$S_{i+1} = S_i - LS_i - R_i + a_i.$$

R_i and LS_i are saved for future processing.

In Fig. 51, *reserve rated** *prepromotion flow* is illustrated. The rating transfer flow, r_i, was computed and saved during reserve non-rated prepromotion flow processing, and is shown as a flow into the reserve rated force. The equations used to determine s_{i+1} are:

$$ls_i = s_i \cdot loss_i,$$
$$a_i = (s_i - ls_i + r_i) \cdot aug_i,$$
$$s_{i+1} = s_i - ls_i + r_i - a_i.$$

Note that the officers receiving rating transfers (r_i) are eligible for augmentation (using the *rated* augmentation rates). Thus, during the same year of service an officer can move from reserve non-rated to regular rated. Note also that the loss and augmentation rates for rated officers may be different than the rates for non-rated officers.

Finally, Fig. 52 illustrates *regular rated prepromotion flow*. In this figure, R_i came from Fig. 50 (regular non-rated prepromotion flow), and a_i came from Fig. 51 (reserve rated prepromotion flow). To age the force, the following equations are employed:

$$LS_i = S_i \cdot LOSS_i,$$
$$S_{i+1} = S_i - LS_i + R_i + a_i.$$

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*For the sake of simplicity, in these discussions pilots and navigators are not distinguished.

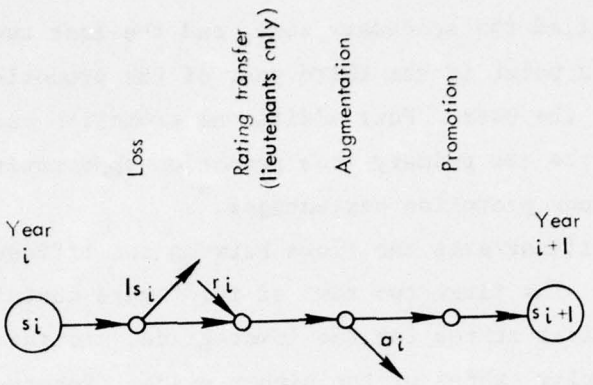


Fig. 51 — Reserve rated prepromotion flow

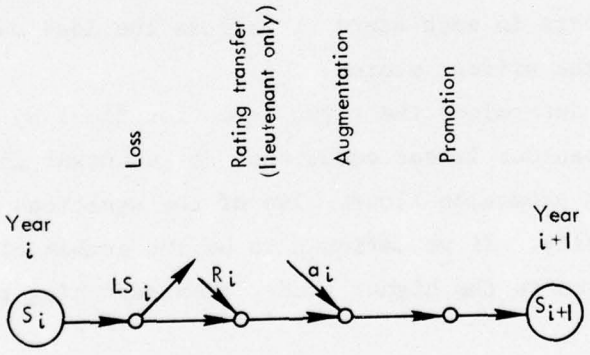


Fig. 52 — Regular rated prepromotion flow

Promotion Year Zone Processing

Recall that in both the progression model and the constraints model the promotion zone is defined to be four years in length, the first two of which are called the secondary zone, and the last two the primary zone. The phase point is the third year of the promotion zone and must be specified by the user. Four additional promotion parameters must be specified: the two primary zone promotion opportunities and the two secondary zone promotion percentages.*

Figure 53 illustrates the flows between the officer states in the promotion zone. The first two rows of the figure contain the reserve and regular officer states for the lower grade, and the last two the reserve and regular states of the higher grade. Reserve promotion flows are represented by the four variables $P_1 - P_4$, and regular promotion flows are represented by $\pi_1 - \pi_4$. The phase point is year 4,† the third year during which higher grade officers can exist.

At the beginning of promotion zone processing, the only known quantities are s_1 and S_1, plus the loss rates, augmentation rates, and promotion parameters. The problem is to determine the eight promotion flows, P_1 to P_4, π_1 to π_4. Once the promotion flows are known, we can employ equations similar to those described above to determine the number of officers in each state as well as the loss and augmentation flows between the officer states.

The model determines the eight promotion flows by solving a system of eight simultaneous linear equations, the unknowns in the equations being the eight promotion flows. Two of the equations deal with promotion opportunity. If we define E to be the number of officers eligible for promotion to the higher grade, then referring to Fig. 53,

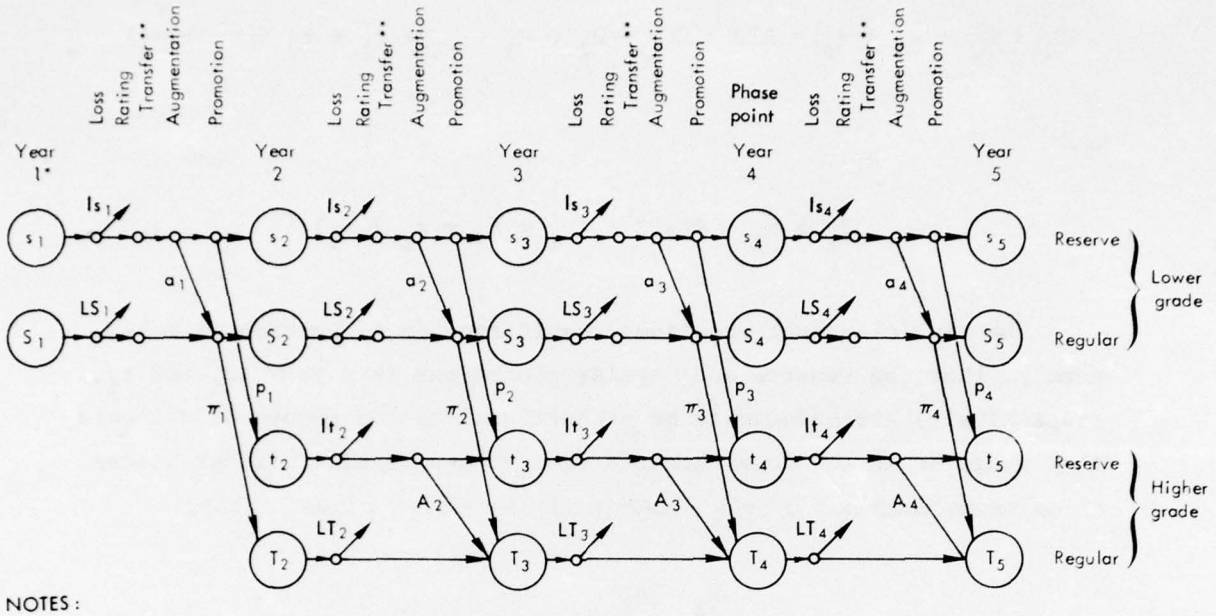
$$E = s_4 + S_4 + t_4 + T_4.$$

Further, if PO_i denotes the first (i=1) or second (i=2) promotion opportunity, then the two promotion opportunity equations are

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*See Sec. III, p. 32, for details.

†Relative to the beginning of the promotion zone, and not year of service.



NOTES:

*This is the first year of the promotion cycle, not the first year of service.

** Rating transfer flows are for lieutenants only. Furthermore, rating transfers should not take place during the promotion zone (see R-1607-PR for details).

Fig. 53 — Flows within promotion zone

$$t_4 + T_4 = PO_1 \cdot E,$$

$$t_5 + T_5 + lt_4 + LT_4 = PO_2 \cdot E.$$

Note that E is specified in terms of officer states whose values are unknown, namely, the officer states in the phase point year. However, those states can be expressed in terms of the two known states, s_1 and S_1, known loss rates (provided in the inputs), and the unknown promotion flows.*

The second two equations deal with secondary zone promotions. If we denote BTZ as the fraction of promotions to be awarded in the secondary zone, and FYBTZ as the fraction of secondary zone promotions to be awarded in the first year of the secondary zone, then,

*See R-1607-PR, op. cit., for details.

$$P_1 + P_2 + \pi_1 + \pi_2 = BTZ \cdot (P_1 + P_2 + P_3 + P_4 + \pi_1 + \pi_2 + \pi_3 + \pi_4),$$

and

$$P_1 + \pi_1 = FYBTZ \cdot (P_1 + P_2 + \pi_1 + \pi_2).$$

The remaining four equations result from an assumption we make, namely, that the reserve and regular promotions in a year (P_i and π_i, respectively) are assumed to be proportional to the number of officers that would be in the lower grade's reserve and regular officer states *if no promotions out of the lower grade had taken place*. Thus,

$$\frac{P_i}{\pi_i} = \frac{s_i'}{S_i'},$$

where s_i' and S_i' are the number of officers that would be in the lower grade were no promotions out of the grade to take place.

Once the promotion flows are known, the following four equations are employed to determine the number of officers in each state:

$$s_{i+1} = s_i - ls_i - a_i - P_i,$$
$$S_{i+1} = S_i - LS_i + a_i - \pi_i,$$
$$t_{i+1} = t_i - lt_i - A_i + P_i,$$
$$T_{i+1} = T_i - LT_i + A_i + \pi_i.$$

It is possible for an officer to receive an augmentation and promotion during the same year of service, e.g., to move from reserve lieutenant to regular captain in the same year. Upon completion of promotion zone processing, the values of s_5, S_5, t_5, and T_5 are known--as are the previous years' officer states.

Postpromotion Year Zone Processing

The postpromotion zone is defined to include those states containing officers that have been passed over for promotion to the higher grade. The processing in this zone is similar to that for the pre-promotion zone and will therefore not be discussed.

CONSTRAINED OFFICER FORCE PROGRESSION MODEL

The constraints model enhances the capabilities of the progression model by permitting the specification of several manpower and career reserve constraints. Where in the progression model the processing performed on each source of commission is similar, the constraints model employs different logic for each source of commission. After the model's inputs are reviewed, each source is discussed separately, starting with the Academy, the most straightforward, and finishing with OTS, the most complex.

Constraints Model Inputs

The constraints model requires all the inputs needed by the progression model (annual accessions, promotion parameters, loss, augmentation, and training rates), except that OTS annual accessions need not be specified. In addition, several manpower constraints and career reserve requirements must be provided.

There are four *manpower constraints*. The first specifies the size of the officer force; the second, the desired size of the regular officer force. The third and fourth constraints specify the desired number of pilots and navigators that hold the grade of lieutenant colonel or below, and that have 28 or fewer years of service, i.e., the wartime rated officer requirements.*

For each reserve source of commission and each rating, a *career reserve requirement* and *end of initial obligation* must also be specified. The end of initial obligation (EOB) is the year of service during which a reserve officer has satisfied his initial service obligation. All reserve officers remaining in the force after the end of

*The grade and year maximums can be changed (see App. E).

initial obligation are defined to be career reservists in the constraints model.

The career reserve requirement is provided as a mechanism for limiting the number of officers that become career reservists. There are three types of career reserve requirements, but only one may be employed for a given source of commission and rating. The first is the *career reserve opportunity*, that is, the percentage of those reserve lieutenants and captains eligible for selection to career reserve status, that actually get selected. For example, suppose we have the following for a given reserve source of commission and rating:

- o l_i the number of reserve lieutenants in year i, the EOB year,
- o c_i the number of reserve captains in the EOB year,
- o bl_i the loss rate for reserve lieutenants in the EOB year,
- o bc_i the loss rate for reserve captains in the EOB year,
- o CRO the career reserve opportunity.

Then the number of reservists *eligible* for selection to career reserve status (E) is given by:

$$E = l_i\ (1.0 - bl_i) + c_i\ (1.0 - bc_i),$$

that is, the number of reservists left *after normal losses have been accounted for*. The number of officers *selected* to enter career reserve status (S) is given by

$$S = CRO \cdot E = CRO\ [l_i\ (1.0 - bl_i) + c_i\ (1.0 - bc_i)].$$

The second type of career reserve requirement is the number of *career reserve selectees* desired. In other words, the model allows the user to specify directly the number of selectees desired (S).

The third type of career reserve requirement is the desired *total number of career reservists*. In this case, the model user directly

specifies the total number of reserve officers (with the given source and rating) having more than EOB years of service.

Constraints Model Academy Logic

In the constraints model, the Academy is treated exactly as in the progression model--annual accessions are moved through the grades, ratings, and years of service. Since no reservists exist in the model for the Academy source of commission, no career reserve requirement is applied. Rating transfer rates are taken directly from the inputs, and the model is not permitted to alter them, even if this means exceeding the wartime rated officer requirements. Also, annual accessions may not be altered, even if the total force size is exceeded. In short, the constraints model assumes that the Academy isn't going to cause manpower constraint difficulties.

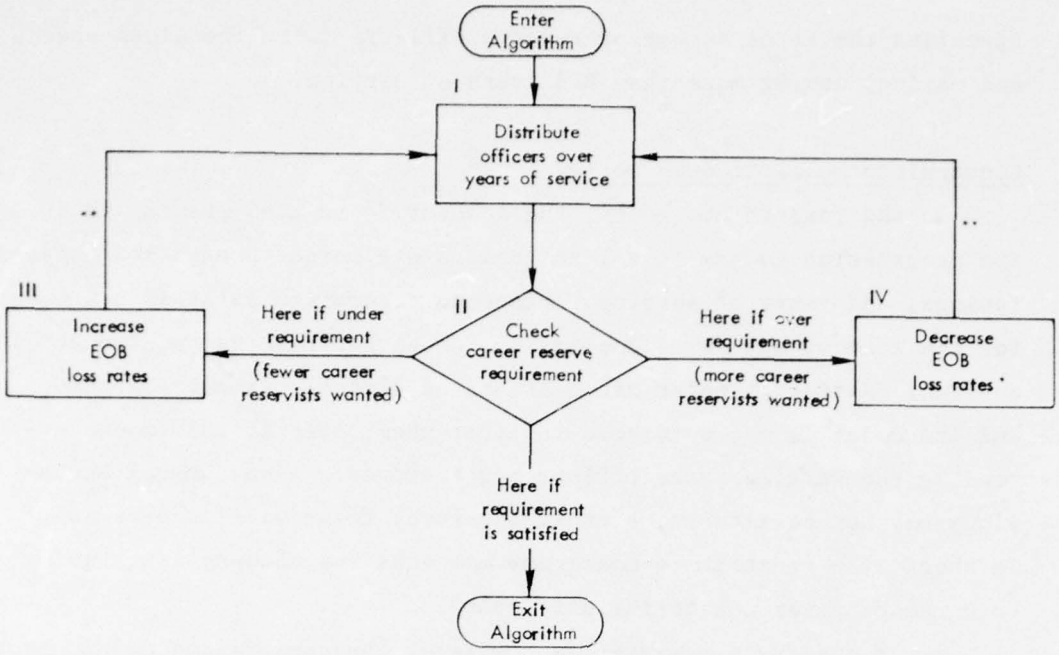
After Academy processing is complete, the constraints model checks the manpower requirements to see if any have been exceeded. If any have, the model notes that the run has gone infeasible, but continues processing the other sources of commission.

Constraints Model ROTC Logic

The ROTC is the next source of commission to be processed, and as with the Academy, the manpower requirements are not checked until after ROTC officers have been completely processed. ROTC processing does, however, try to satisfy the ROTC's career reserve requirements.

In performing ROTC processing, one rating is processed at a time: non-rated first, then pilots, and finally navigators. The processing is similar to that of the progression model, the primary distinction being that the constraints model is given limited ability to increase the input reserve loss rates in the end of initial obligation (EOB) year. In fact, by modifying EOB loss rates, the model is able to impose the career reserve requirement on the reserve ROTC officer force.

Figure 54 illustrates the model's logic applied to an ROTC rating. First, the model distributes the officers over the years of service (box I in the figure) using the progression model. The constraints model next determines if the career reserve requirement has been



NOTES:
*EOB loss rate may not fall below the input loss rates for the EOB year.
** Number of iterations is limited by user.

Fig. 54 — ROTC career reserve requirement logic schematic for a rating

satisfied (box II). If the requirement is satisfied, the model exits the logic.

If, on the other hand, the requirement has not been satisfied, then two possibilities exist, both requiring adjustments of the EOB loss rates. In one case, the officer force is over the career reserve requirement, i.e., depending on the type of career reserve requirement used, there are either too many selectees, too many total career reservists, or the career reserve opportunity is too high. The model will then increase EOB loss rates to try to bring the force more in line with the desired career reserve requirements (box III), and go through the force distribution process again (back to box I).

In the other case, the officer force falls below the career reserve requirement, i.e., there are not enough selectees or total career reservists, or the opportunity is lower than desired. Then the model will lower the EOB loss rates so as to increase the number of career reservists (box IV). The model will not, however, lower the loss rates below the input EOB loss rates, i.e., normal loss will take place. The

model then goes back through the process again, this time with the new loss rates (back to box I).

It should be noted here that the user has control over the number of iterations through the process. Unless specified to the contrary on the options card,* the model will allow no more than ten iterations.

Adjusting EOB Loss Rates. The algorithms used to adjust EOB loss rates are presented in detail in App. C. A career reserve opportunity example is given here to demonstrate those techniques.

Consider the following variables defined for a given rating:

- o l_i number of reserve lieutenants in year i, the EOB year (from officer structure, box I in Fig. 54).
- o c_i number of reserve captains in the EOB year (from officer structure, box I in Fig. 54),
- o bl_i reserve lieutenant loss rate in the EOB year (from inputs),
- o bc_i reserve captain loss rate in the EOB year (from inputs),
- o CRO the desired career reserve opportunity (from inputs).

The problem is to determine two new loss rates, bl_i' and bc_i', that would cause the career reserve opportunity to be satisfied. That is, the new loss rates would have to satisfy the following equation:

$$CRO\ [l_i(1.0 - bl_i) + c_i(1.0 - bc_i)] = l_i(1.0 - bl_i') + c_i(1.0 - bc_i').$$

The left-hand side of the equation simply applies the career reserve opportunity to those reservists in the EOB year who are eligible for selection to career reserve status--after normal losses have been removed. The right-hand side *defines* the loss rates bl_i' and bc_i' so as to satisfy the career reserve requirement.

Clearly, there are an infinite number of values for bl_i' and bc_i' that satisfy the equation. However, in order to uniquely determine

*See Sec. III, p. 42.

bl_i' and bc_i', we make the assumption that the career reserve lieutenant and captain selectees are directly proportional to the number of lieutenant and captain reservists prior to the selection of career reservists, that is:

$$\frac{l_i\ (1.0 - bl_i)}{c_i\ (1.0 - bc_i)} = \frac{l_i\ (1.0 - bl_i')}{c_i\ (1.0 - bc_i')} .$$

For example, if 30 percent of the eligibles are lieutenants, then 30 percent of the selectees will be. This equation and the preceding one form a system of two simultaneous linear equations, the unknowns being the adjusted loss rates bl_i' and bc_i'. The process is more complicated when career reserve selectees or total career reservists are considered, and those details are deferred until App. 3.

Before concluding the discussion of ROTC logic, one additional point needs mention. If the career reserve requirement for an ROTC rating is specified to be the number of selectees or the total number of career reservists, and if after ROTC processing of the rating we have too few officers to satisfy the requirement, and if the OTS career reserve requirement for the same rating is the same as that for the ROTC rating (both use selectees, or both use total career reservists), then the constraints model will increase the OTS career reserve requirement by the number of ROTC shortfalls. For example, suppose that the career reserve requirement for ROTC pilots is 1000 career reserve selectees, and the career reserve requirement for OTS pilots is 500 selectees. Suppose further that the ROTC force structure can support only 800 career reserve pilot selectees, i.e., there is a shortage of 200 ROTC pilot career reserve selectees. The constraints model will increase the OTS pilot career reserve requirement from 500 to 700 selectees.

Constraints Model OTS Logic

The previous sources of commission--the Academy and ROTC--have distributed officers by moving accessions through the non-rated, and then the rated, segments of the force. OTS, on the other hand, operates in the opposite direction. First pilots and then navigators are

processed in order to satisfy the remaining wartime rated officer requirements. After the rated officers are processed, the model processes the non-rated officers so as to satisfy the remaining regular and total force requirements. Different logic is applied to rated and non-rated officers.

Constraints Model Rated OTS Logic. The constraints model first processes pilots and then navigators, but the logic employed is identical. The following discussion, therefore, considers a given rating and does not distinguish between pilots or navigators.

The rated logic depends in part on the type of career reserve requirement employed for the rating. Figure 55 illustrates the logic employed when *career reserve opportunity* is the career reserve requirement. The model first adjusts the EOB loss rates (box I) to take the career reserve opportunity into consideration.* It next constructs a force profile for the rating (box II), and determines the number of officers with the rating needed to satisfy the rating's remaining wartime requirement (box III). For example, suppose the rating's remaining wartime requirement is 1800 officers (i.e., 1800 officers that are lieutenant colonels or below). Suppose also that the rating's force profile is comprised of 90 percent lieutenant colonels and below, and 10 percent colonels. Then to satisfy the remaining wartime requirement of 1800 officers, we need 2000 officers with the given rating. Stated differently, the rated force *implied* by the remaining wartime requirement contains 2000 officers. The model then compares the implied force with the remaining total force requirement, taking the smaller of the two as the number of officers to distribute over the rating (boxes IV, V, and VI).

Note that the regular force constraint is not taken into consideration by the logic. Note also what happens when the total force requirement precludes satisfaction of the rating's remaining wartime requirement (boxes IV and V). In this case, the model will set the implied force size equal to the remaining total force requirement, distributing this over the rating. Thus the rating's wartime requirement will not be met. In addition, the total force requirement will be *exceeded*.

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*See App. D, p. 168.

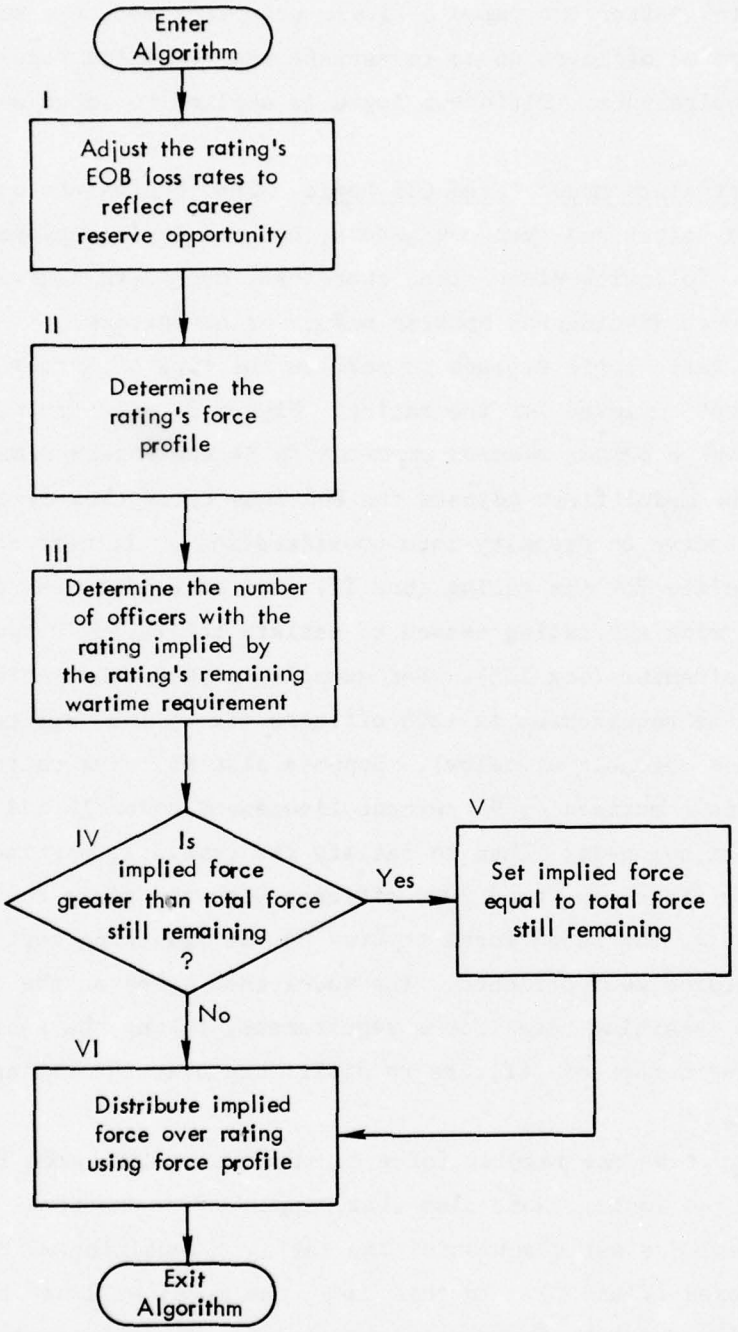


Fig. 55 — Rated OTS logic for a given rating with career reserve opportunity as the career reserve requirement

The total force requirement is exceeded in this case because we still must take into consideration the non-rated officers needed to support the flows into the rated force. This case is an extreme one and does not occur unless severe constraints are placed on the force. The total force requirement will be exceeded in this case by exactly the number of non-rated officers needed to satisfy the flows into the rated force.

Figure 56 illustrates the logic employed when either *career reserve selectees* or *total career reservists* are specified as the career reserve requirement. The model first prepares a force profile for the rating (box I), and next determines the number of officers with the rating implied by the career reserve requirement (box II). For example, suppose that the career reserve requirement is 60 career reserve selectees, and that the force profile indicates that selectees make up 8 percent of the force profile. Then the number of officers with the rating *implied* by the 60 selectees is 750.

The model next determines if enough slack exists in the total force and the rating's wartime requirement constraints to accommodate the implied force (boxes III, IV, V, and VI), appropriately lowering the implied force size if such slack doesn't exist. Then, using the force profile as a guide, the model distributes the implied force over the rating (box VII).

At this point two possibilities exist. In one case, the rating's wartime requirement is satisfied, and the model exits the logic (the NO path out of box VIII). If the rating's wartime requirement has not yet been satisfied and if sufficient slack exists in the total force constraint, the model moves to satisfy the requirement (or as much of it as the total force constraint will permit) by

1. constructing an exclusingly non-career reserve and regular force profile for the rating (i.e., set reserve EOB loss rates to 1.0), and
2. distributing the remainder of the rating's wartime requirement over the rating's non-career reserve and regular force in accordance with the force profile.

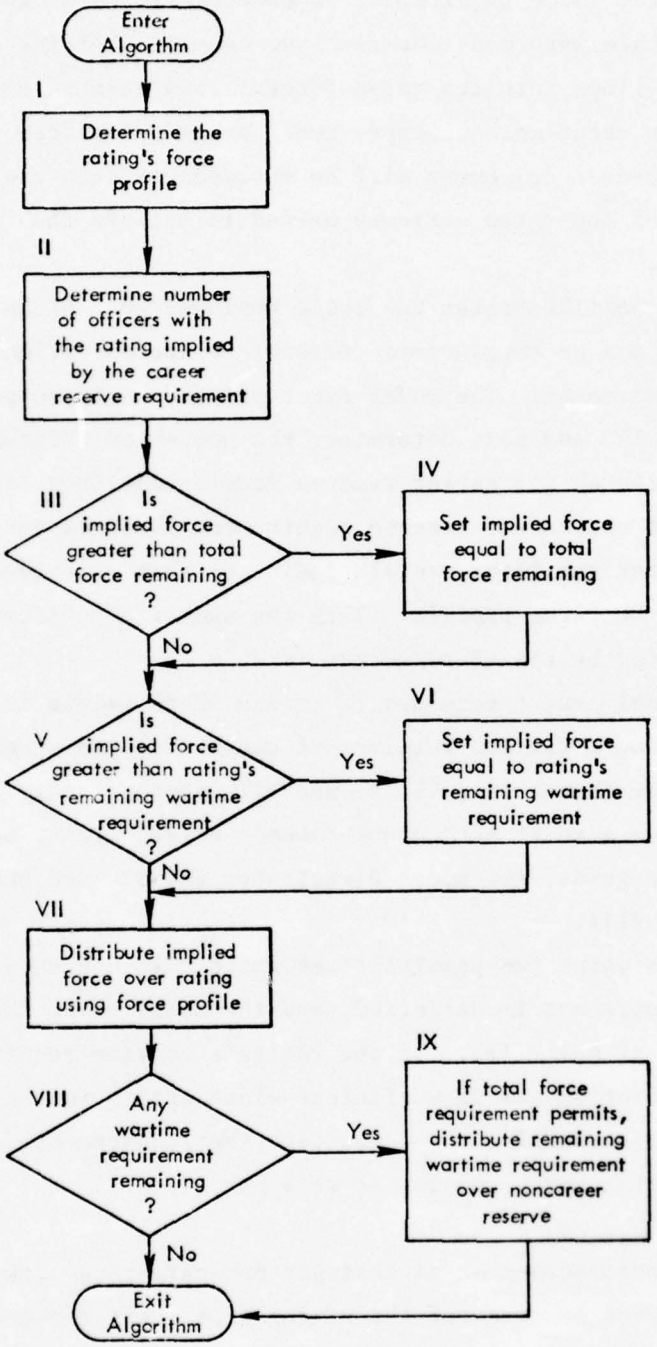


Fig. 56 — Rated OTS logic for a given rating with career reserve selectees or total career reservists as the career reserve requirement

Once again, note that the regular force constraint is not taken into consideration here. Note also, that if insufficient slack exists in the total force or wartime requirement constraints (boxes III, IV, V, and VI), the career reserve requirement cannot be satisfied. Further, if the total force requirement is the limiting constraint (boxes III, IV, and IX), then the total force size will be exceeded by exactly the number of officers needed to support the flows into the rated officer force. All of these situations are extreme cases, and will occur only when severe restrictions are placed on the officer force.

Finally, if after satisfying the career reserve requirement the rating's wartime requirement has not yet been satisfied (the YES path out of box VIII and box IX), then the model logic *implies* an increase in the EOB loss rates. This occurs because the model distributes the remaining wartime requirement over the non-career reserve officer states (regular states are included). To illustrate this point, as well as the rated OTS logic, we consider an example similar to those presented in Sec. II.

Figure 57 contains an exclusively pilot OTS force profile for a hypothetical officer force. The force has a 50 percent promotion opportunity and a 60 percent augmentation rate. The EOB year is the fourth year of service, the remaining wartime pilot requirement is 1170 officers, and the career reserve requirement is 60 career reserve selectees. The first step is to determine the size of the pilot force *implied* by the career reserve requirement. The force profile indicates that the selectees comprise 8 percent of the pilot force ($\frac{.4}{5}$), thus yielding an implied force of 750 pilots. In Fig. 58 the implied force is distributed in accordance with the force profile, yielding the 60 career reserve selectees.

Now 750 pilots of the 1170 needed to satisfy the wartime pilot requirement are accounted for; therefore, 420 more pilots are needed. We want to distribute these 420 officers so as to continue to satisfy the career reserve requirement, i.e., the 420 pilots should be distributed over the non-career reserve and regular pilot force. Figure 59 contains the necessary force profile, and Fig. 60 the actual officer distribution. Note the absence of reserve pilots after year 4 in this distribution.

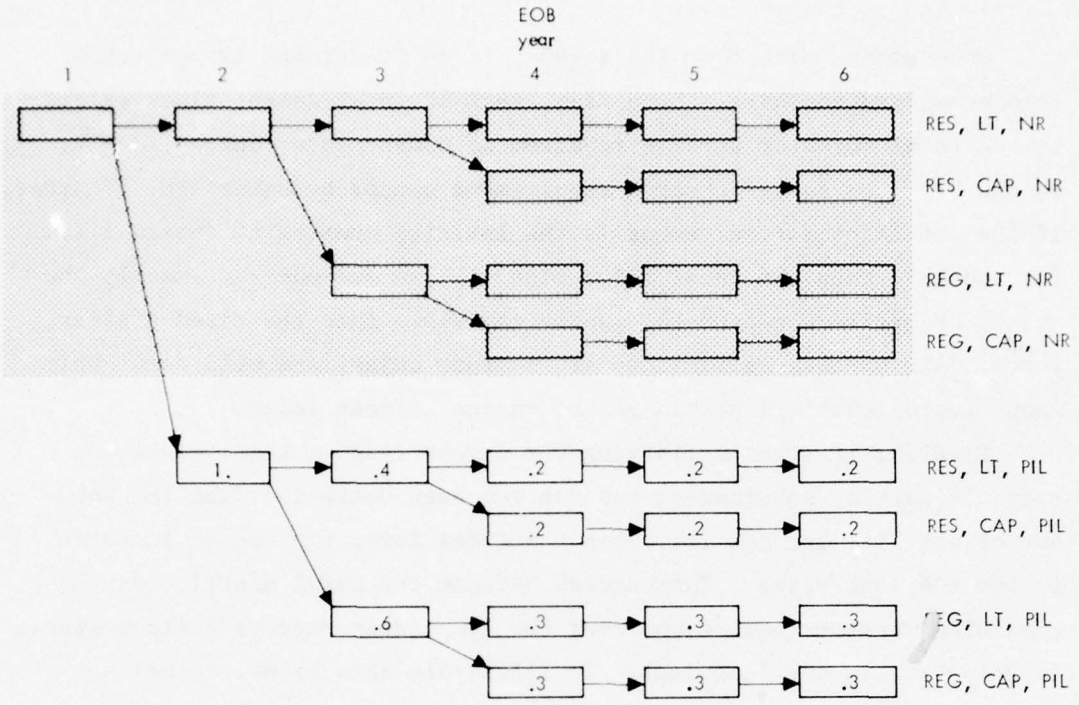


Fig. 57 — Exclusively pilot force profile

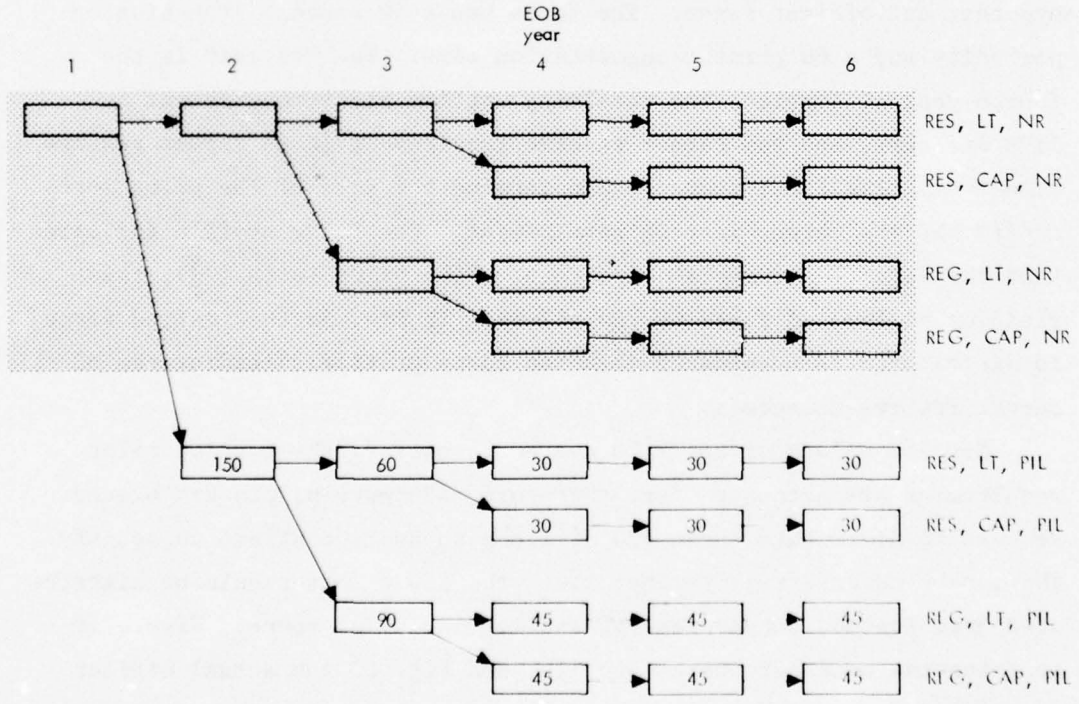


Fig. 58 — Distribution of 750 pilots, the force size implied by a 60 selectee career reserve requirement

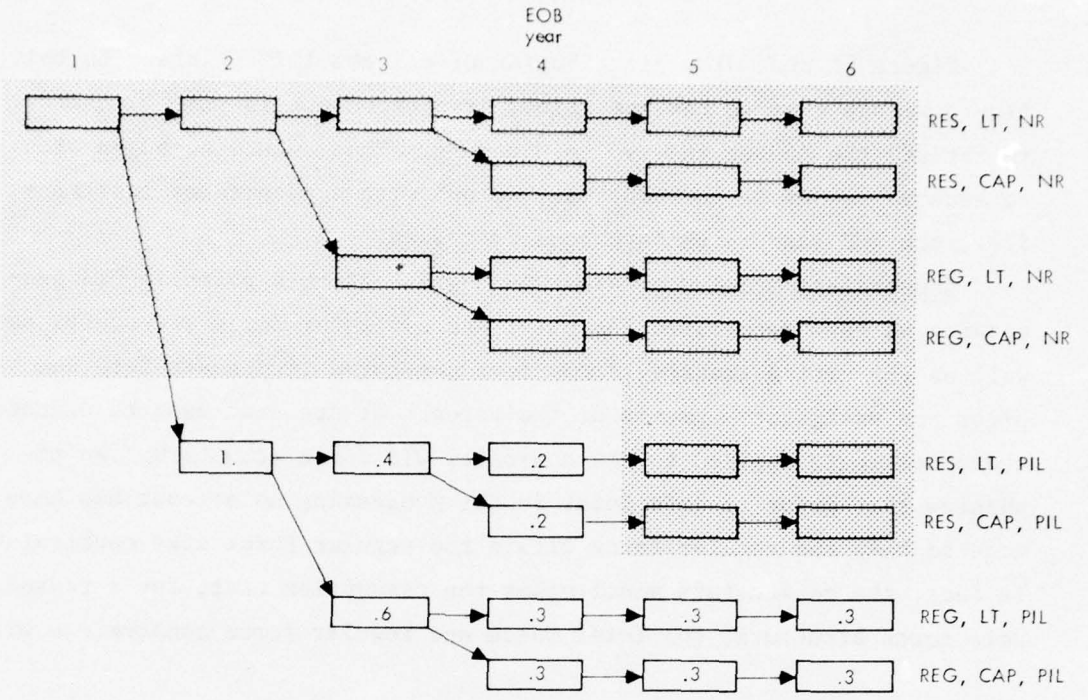


Fig. 59— Exclusively noncareer reserve and regular pilot force profile

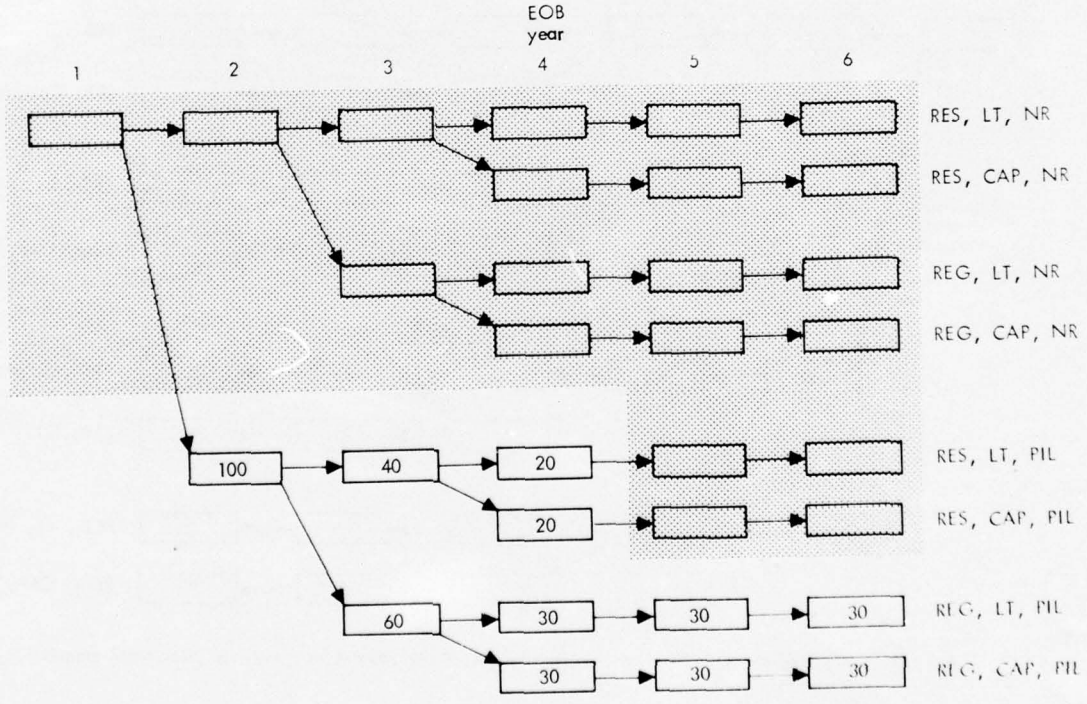


Fig. 60— Distribution of 420 pilots, the remaining wartime pilot requirement

Figure 61 shows the distribution of all the 1170 pilots. In this figure we see that 40 reserve pilots are forced out in year 4 in order to satisfy the career reserve requirement. Thus, where we began with no reserve losses in the EOB year, we end with a 40 percent loss rate, i.e., the EOB loss rates have been increased.

Constraints Model Non-Rated OTS Logic. At this point in OTS processing we have determined the pilot and navigator force structures as well as the rating transfer *flows* from non-rated lieutenant into the pilot and navigator segments of the force. We are now ready to discuss the model logic applied to the non-rated OTS force structure. We emphasize that prior to this point in the processing no attempt has been made to keep the regular force within the regular force size constraint. In fact, the constraints model makes the assumption that, for a reasonable force structure, the total force and regular force constraints will

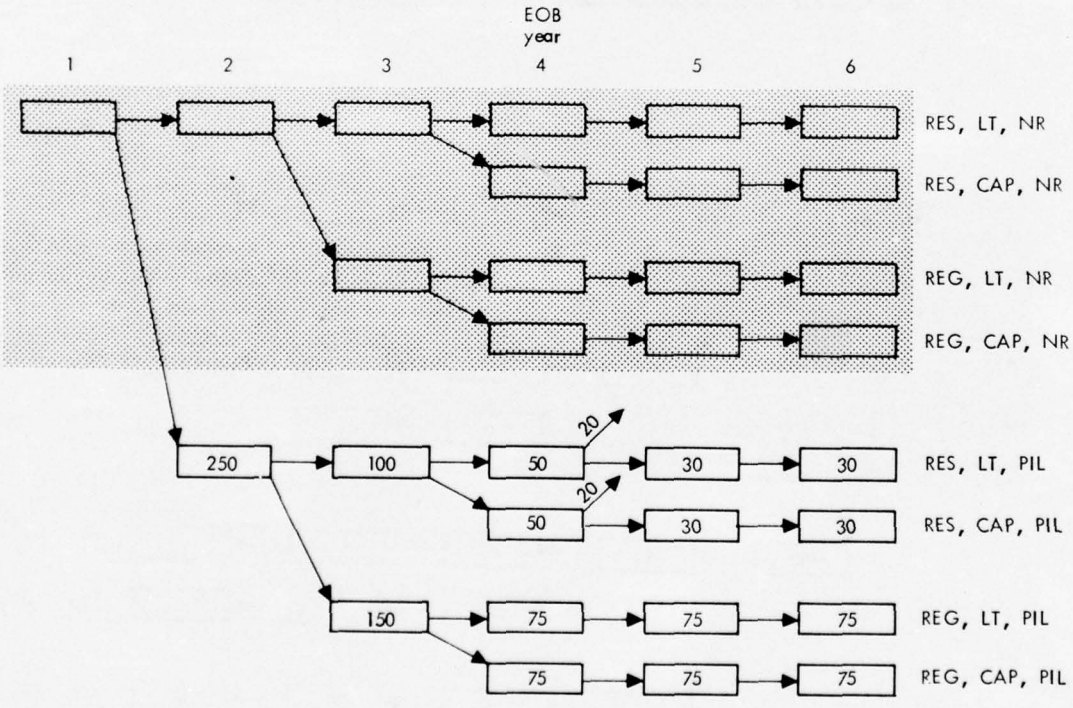


Fig. 61 — Distribution of 1170 pilots, satisfying the career reserve and wartime pilot requirements

not be exceeded prior to non-rated OTS processing. Therefore, most of the non-rated OTS logic applies only if slack exists in these two manpower constraints, and most of the logic is designed to come as close to satisfying these constraints as possible. The non-rated OTS logic is the most complicated for precisely this reason, namely, that all the special cases that might arise need to be handled.

Figure 62 shows a schematic of the non-rated OTS logic. In box I, the non-rated implications of the rated force are determined. We know the rating transfer *flows* into the rated force.* We now track these flows back into the non-rated states and ultimately the accessions that would be needed to support the rating transfer flows. These accessions and non-rated officers are destined to ultimately become rated.

At this point, after the non-rated implications of the rated force have been determined, two questions are asked (boxes II and III): (1) Has the total force requirement been met or exceeded? If yes, we exit the algorithm. (2) Has the total regular force requirement been met or exceeded? If the answer to this second question is yes, the model employs some special logic designed to handle the situation (box IV.)†

If the model gets to box V in Fig. 62, i.e., if the answers to both questions are NO, then there is slack in both the total force and regular force constraints. The model's next step is to construct an exclusively non-rated force profile, making adjustments to reserve EOB loss rates if the career reserve requirement is an opportunity. The model next uses the force profile to determine the total number of non-rated officers implied by each *regular* non-rated officer, and thereby the model determines the size of the non-rated force implied by the satisfaction of the remaining regular force requirement (box VI). For example, suppose three out of five non-rated officers are regular (as indicated by the force profile). Suppose too, that the remaining regular force requirement is 6000 officers. Then the non-rated force

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*See App. B, p. 145, for a discussion of how rating transfer flows are saved.

†This logic is described in detail in App. D, p. 161.

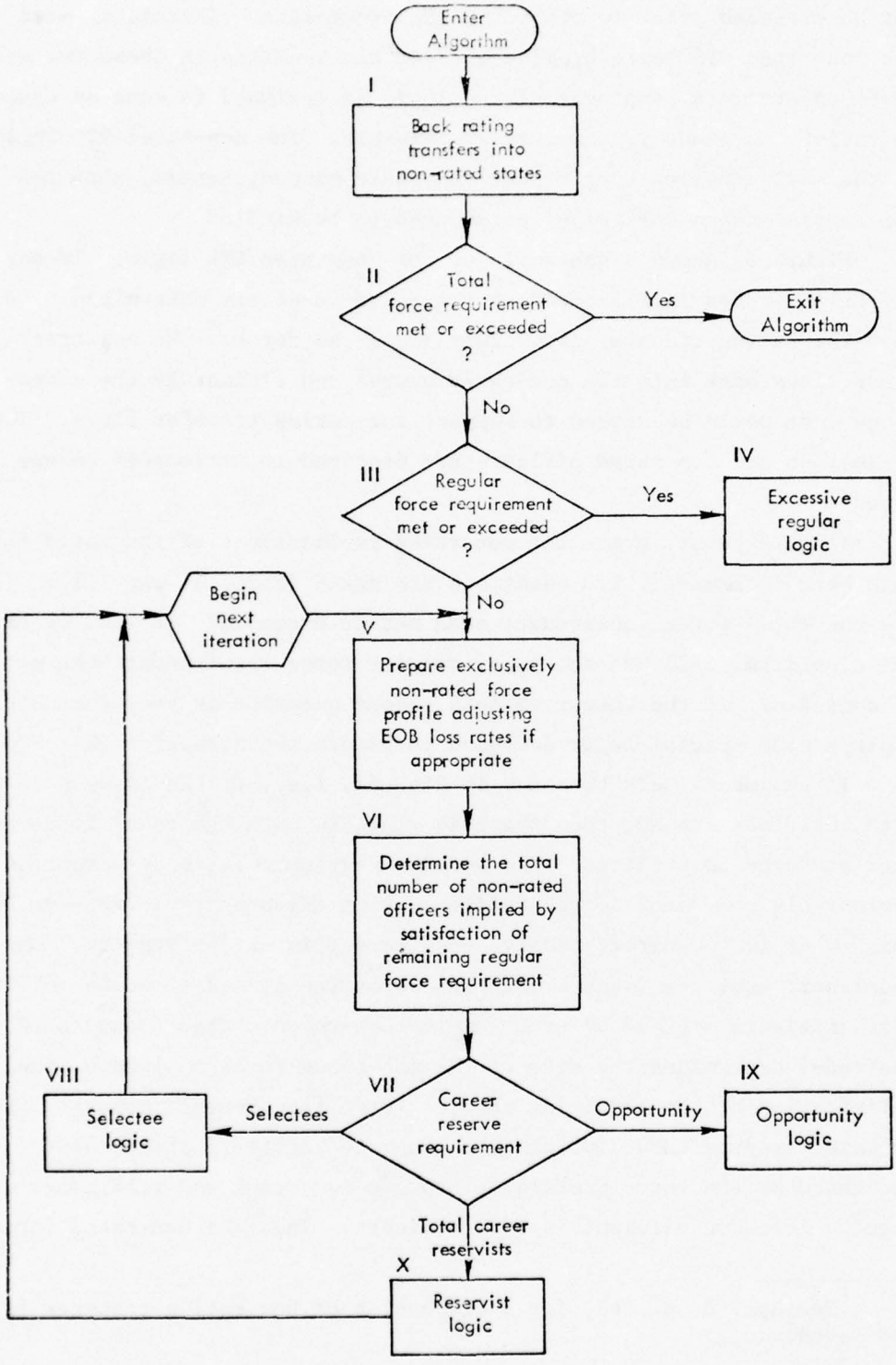


Fig. 62 — Non-rated OTS logic

size implied by satisfaction of the remaining regular force requirement is 10,000 officers.

The next step in the logic depends on the type of career reserve requirement. If the career reserve requirement is either the number of selectees or the total number of career reservists (boxes VIII and X), then an iterative process is employed that tries simultaneously to satisfy the manpower constraints and career reserve requirement. Between each iteration the EOB loss rates are adjusted. Since the EOB loss rates are adjusted, the model must construct a new exclusively non-rated force profile to begin the next iteration (the paths leading back to box V). The number of iterations is under the control of the user.*

What if, on the other hand, the career reserve requirement is an opportunity (box IX in Fig. 62). Then the model employs the logic illustrated in Fig. 63. Remember that at this point we have not as yet satisfied either the total force or the regular force requirement, and we have computed the size of the non-rated force implied by the satisfaction of the remaining regular force requirement (box VI of Fig. 62). There are three possibilities: (1) the implied force is smaller than the remaining total force requirement; (2) the implied force equals the remaining total force requirement; and (3) the implied force exceeds the remaining total force requirement.

If the implied force is smaller than the remaining force requirement (the "<" path out of box XI), then the implied force is distributed in accordance with the force profile (box XII), an exclusively reserve non-rated force profile is constructed (box XV), and the balance of the total force requirement is distributed over the reserve non-rated states (box XVI). The career reserve, total force, and regular force requirements are satisfied. The career reserve requirement is satisfied because reserve EOB loss rates have been adjusted to reflect the supplemental losses caused by the career reserve opportunity.

If the implied force equals the remaining total force requirement (the "=" path out of box XI), the model distributes the implied force

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*See Sec. III, p. 42. The selectee and reservist logic is described in detail in App. D, p. 165.

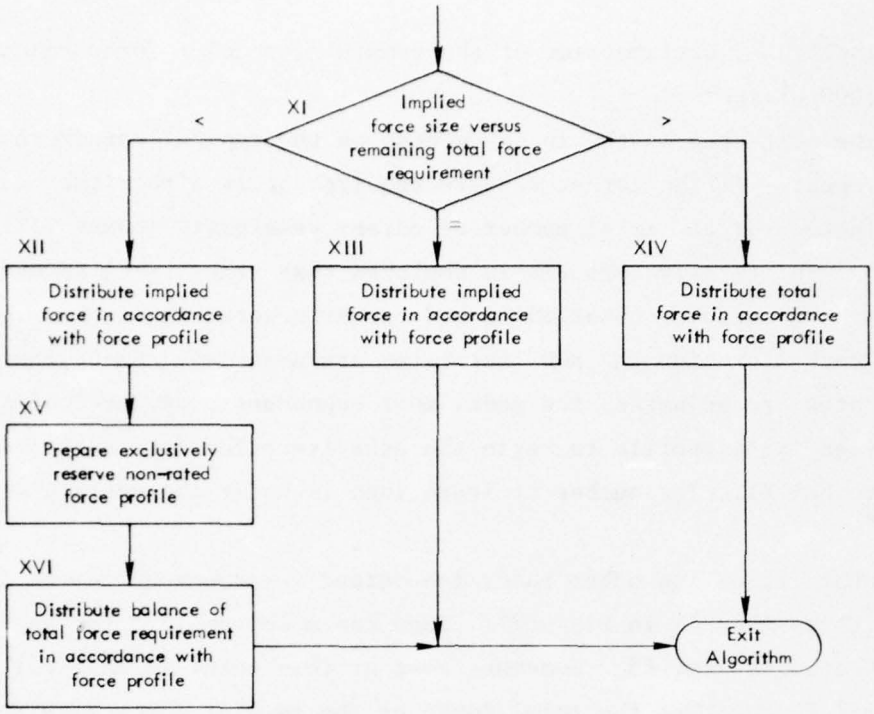


Fig. 63— Career reserve opportunity logic (expansion of Box IX in Fig. 62)

in accordance with the force profile determined in box V of Fig. 62. The career reserve, total force, and regular force requirements are satisfied.

If the force implied by the remaining regular requirement exceeds the remaining total force requirement (the ">" path out of box XI), the model distributes the remaining total force (not the implied force) in accordance with the force profile prepared in box V of Fig. 62. In this case, the total force and career reserve requirements are satisfied, but the regular force requirement is not--we don't have enough regular officers.

Preliminary and Final OTS Force Structure. At this point a complete distribution of OTS officers has been obtained, called the *preliminary* OTS distribution. It is preliminary because it is not based directly on augmentation, rating transfer, and EOB loss rates. The final step in the OTS logic computes all of the rates and opportunities based on the force distribution, as well as the annual accessions.

Then, using the progression model, the constraints model moves those accessions through the grades, ratings, and years of service using the new rates and opportunities. This officer force structure is the *final* OTS force structure.*

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*See App. B, p. 179, for a discussion of how the preliminary distribution officer flows are saved by the constraints model so as to permit the computation of rates and opportunities.

VI. CONSTRAINTS AND GRADE LIMITATIONS MODEL INTERACTION

This section demonstrates how the constraints model and the grade limitations model may be employed in concert. A numerical example where the grade requirements of a steady state officer force are altered is examined to determine the values of personnel policy variables implied by the altered officer force structure, e.g., how the altered force structure affects promotion opportunity, accessions, and rating transfer rates. First the constraints and grade limitations models are reviewed.*

MODEL REVIEW

The constraints model begins with the traditional personnel policy parameters such as promotion and augmentation opportunity as well as annual accessions and loss rates, to determine how the annual accessions are distributed over the officer force structure. The officers are distributed by moving *forward*, from the low to the high grades, and as a by-product, the following implications of the force structure are also determined:

- Grade requirements by component, grade, rating, and source of commission.
- Ratios of promotion-augmentations to regular promotions by grade, rating, and source of commission.
- Ratios of augmentations to regular promotions by grade, rating, and source of commission.
- Ratios of rating transfer-augmentations to augmentations and regular rating transfers to augmentations by rating and source of commission.
- Rating transfer distributions by component, rating, source of commission, and year of service.

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*Readers not charged with responsibility for running the models need not read this section.

- o Rating transfer-augmentation distributions by rating, source of commission, and year of service.
- o Augmentation distributions by grade, rating, source of commission, and year of service.
- o Promotion-augmentation distributions by grade, rating, source of commission, and year of service.
- o Promotion distributions by component, grade, rating, source of commission, and year of service.

The above by-products are precisely the input parameters needed by the grade limitations model; and the constraints model, if requested to do so, can produce an input deck suitable for submission to the grade limitations model.*

The grade limitations model, working in the opposite (or *backward*), direction, takes these inputs and determines the officer force structure implied by those inputs. As a by-product, the grade limitations model determines the progression model inputs implied by the force structure, e.g., promotion and augmentation opportunities, rating transfer rates, and accessions. The inputs required by the grade limitations model are not easily specified, and the progression or constraints models prove to be a great help in that they can provide a starting point for determining the grade limitations model inputs.

NUMERICAL EXAMPLE

In the numerical example considered below, the grade requirements of a previously determined steady-state officer force are altered. The objective is to determine the force structure implied by the altered grade requirements, as well as the changes in the personnel policy parameters implied by the new grade structure. The starting steady-state force structure is summarized in Table 9, and selected output reports from the model run that generated the force structure are shown in Figs. 64-70.

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*See Sec. III, p. 42.

Table 9

SUMMARY OF STARTING STEADY-STATE FORCE STRUCTURES

	Lieutenant	Captain	Major	Lieutenant Colonel	Colonel
Promotion opportunity		95%	80%	70%	50%
Grade requirements	36,743	26,041	18,235	12,154	4,951
Annual accessions	9,335				
Annual UPT graduates	2,475				
Annual UNT graduates	1,228				
Career reserve opportunity	100%	(Maximize size of regular force)			
Total force size	97,850				
Rated officer requirements (lt. col. and below)					
Pilots	28,000				
Navigators	13,000				

We wish to alter the field grade requirements as shown in Table 10, keeping the total force requirement and the rated officer requirements constant. Since we want to keep the total force size constant, this implies a corresponding increase in lieutenant and captain grade requirements.

Table 10

ALTERATION OF FIELD GRADE REQUIREMENTS

(example)

	Old	New	Reduction
Major	18,235	17,500	735
Lieutenant colonel	12,154	9,000	3,154
Colonel	4,951	4,000	951
Total	35,340	30,500	4,840

The question then becomes: How must the field grade's detailed grade requirements be reduced, and the company grade's increased, to reflect the altered total grade requirements, while keeping the rated officer requirements constant at 28,000 pilots and 13,000 navigators?

OFFICER FORCE GRADE DISTRIBUTION
RATING ALL SOURCE OF COMMISSION ALL

	RESERVE COMPONENT						REGULAR COMPONENT						BOTH RESERVE AND REGULAR COMPONENTS					
YEAR	LIEUT	CAPT	MAJOR	LTCOL	CL/GN	TOTAL	LIEUT	CAPT	MAJOR	LTCOL	CL/GN	TOTAL	LIEUT	CAPT	MAJOR	LTCOL	CL/GN	TOTAL
1	8375					8375	960					960	9335					9335
2	8166					8166	936					936	9102					9102
3	7524					7524	1441					1441	8965					8965
4	5952	63				6015	2783	33				2816	8735	95				8831
5	164	3125				3290	169	3202				3371	333	6327				6660
6	2	2660				2662	2	3527				3529	3	6187				6191
7		1880				1880		3338				3338		5218				5218
8		279	3			282		3204	37			3241		3483	40			3523
9		240	9			249		3015	150			3165		3255	159			3414
10		57	160			216		775	2335			3109		831	2494			3326
11		41	12			53		603	2586			3189		644	2598			3242
12									2534			2534			2534			2534
13									2483			2483			2483			2483
14									2310	123		2434			2310	123		2434
15									2141	244		2385			2141	244		2385
16									818	1519		2337			818	1519		2337
17									685	1606		2290			685	1606		2290
18									671	1574		2245			671	1574		2245
19									658	1542		2200			658	1542		2200
20									645	1342	169	2156			645	1342	169	2156
21										1208	200	1409				1208	200	1409
22										759	621	1380				759	621	1380
23										675	678	1353				675	678	1353
24										629	632	1261				629	632	1261
25										517	583	1100				517	583	1100
26										415	497	912				415	497	912
27											453	453					453	453
28											413	413					413	413
29											371	371					371	371
30											334	334					334	334
TOTAL	30184.	8344.	184.	0.	0.	38711.	6290.	17697.	18051.	12154.	4951.	59144.	36473.	26041.	18235.	12154.	4951.	97855.
AVERAGE YEAR OF SERVICE																		
	2.38	6.04	9.98	0.0	0.0	3.21	3.04	7.22	13.45	19.57	25.06	12.71	2.50	6.84	13.41	19.57	25.06	8.95

Fig. 64 — Original steady-state officer force structure

OFFICER FORCE GRADE DISTRIBUTION
RATING PIL SOURCE OF COMMISSION ALL

	RESERVE COMPONENT						REGULAR COMPONENT						BOTH RESERVE AND REGULAR COMPONENTS					
YEAR	LIEUT	CAPT	MAJOR	LTCOL	CL/GN	TOTAL	LIEUT	CAPT	MAJOR	LTCOL	CL/GN	TOTAL	LIEUT	CAPT	MAJOR	LTCOL	CL/GN	TOTAL
2	1007					1007	638					638	2475					2475
3	1039					1039	599					599	2438					2438
4	1340	19				1359	1028	15				1042	2367	34				2401
5	49	931				980	69	1315				1383	116	2247				2365
6	0	802				802	1	1411				1412	1	2213				2214
7		361				361		1290				1290		1650				1650
8		48	1			49		1236	14			1251		1284	15			1299
9		42	2			43		1188	38			1226		1213	59			1270
10		10	28			38		307	903			1208		317	930			1241
11		7	2			9		234	970			1204		241	972			1213
12									931			931			931			931
13									866	46		913			866	46		913
14									803	92		894			803	92		894
15									307	570		876			307	570		876
16									297	562		859			297	562		859
17									252	590		842			252	590		842
18									247	578		825			247	578		825
19									242	503	64	808			242	503	64	808
20										457	76	533				457	76	533
21										287	235	522				287	235	522
22										255	256	512				255	256	512
23										240	241	481				240	241	481
24										199	224	423				199	224	423
25										161	193	354				161	193	354
26											177	177					177	177
27											163	163					163	163
28											147	147					147	147
29											132	132					132	132
TOTAL	5095.	2220.	32.	0.	0.	7347.	2304.	6970.	6799.	4560.	1930.	22561.	7399.	9190.	6831.	4560.	1930.	29908.
AVERAGE YEAR OF SERVICE																		
	2.92	5.86	6.98	.	.	3.84	3.24	7.17	13.43	17.59	23.11	12.70	3.02	6.47	13.42	17.59	23.11	10.52

Fig. 65 — Original steady-state pilot force structure

OFFICER FORCE GRADE DISTRIBUTION
RATING NAV SOURCE OF COMMISSION ALL

	RESERVE COMPONENT						REGULAR COMPONENT						BOTH RESERVE AND REGULAR COMPONENTS					
YEAR	LIEUT	CAPT	MAJOR	LTCOL	CL/GN	TOTAL	LIEUT	CAPT	MAJOR	LTCOL	CL/GN	TOTAL	LIEUT	CAPT	MAJOR	LTCOL	CL/GN	TOTAL
2	1134					1134	94					94	1228					1228
3	1117					1117	93					93	1210					1210
4	836	12				847	340	5				344	1175	17				1192
5	32	617				650	26	498				524	59	1115				1174
6	0	529				529	0	569				570	1	1099				1099
7		230				230		554				554		783				783
8		31	0			31		535	6			541		565	7			572
9		27	1			28		505	25			530		532	26			558
10		6	18			24		130	391			521		136	408			545
11		4	1			6		101	425			526		106	426			532
12									416			416			416			416
13									408			408			408			408
14									379	20		400			379	20		400
15									352	40		392			352	40		392
16									134	250		384			134	250		384
17									112	264		376			112	264		376
18									110	258		369			110	258		369
19									108	253		361			108	253		361
20									106	221	28	354			106	221	28	354
21										196	32	228				196	32	228
22										123	101	224				123	101	224
23										109	110	219				109	110	219
24										101	101	202				101	101	202
25										82	92	174				82	92	174
26										64	77	142				64	77	142
27											70	70					70	70
28											63	63					63	63
29											56	56					56	56
30											50	50					50	50
TOTAL	3120.	1456.	20.	0.	0.	4596.	553.	2897.	2973.	1981.	778.	9182.	3673.	4353.	2993.	1981.	778.	13779.
AVERAGE YEAR OF SERVICE																		
	2.93	5.85	9.98	0.0	0.0	3.88	3.54	7.26	13.44	19.54	24.98	13.19	3.02	6.79	13.42	19.54	24.98	10.08

Fig. 66— Original steady-state navigator force structure

OFFICER FORCE GRADE DISTRIBUTION
RATING NR SOURCE OF COMMISSION ALL

	RESERVE COMPONENT						REGULAR COMPONENT						BOTH RESERVE AND REGULAR COMPONENTS					
YEAR	LIEUT	CAPT	MAJOR	LTCOL	CL/GN	TOTAL	LIEUT	CAPT	MAJOR	LTCOL	CL/GN	TOTAL	LIEUT	CAPT	MAJOR	LTCOL	CL/GN	TOTAL
1	8375					8375	960					960	9335					9335
2	5164					5164	234					234	5398					5398
3	4568					4568	750					750	5317					5317
4	3777	32				3809	1416	13				1429	5193	45				5238
5	83	1576				1659	73	1389				1462	156	2965				3121
6	1	1329				1330	1	1546				1547	2	2876				2877
7		1289				1289		1494				1494		2784				2784
8		200	2			202		1433	16			1450		1634	19			1652
9		172	6			178		1341	67			1408		1513	73			1586
10		41	114			155		345	1041			1386		385	1155			1540
11		29	9			38		268	1191			1460		297	1200			1497
12									1168			1168			1168			1168
13									1144			1144			1144			1144
14									1064	57		1121			1064	57		1121
15									986	112		1099			986	112		1099
16									377	700		1077			377	700		1077
17									316	740		1057			316	740		1055
18									309	725		1034			309	725		1034
19									303	711		1014			303	711		1014
20									297	618	78	993			297	618	78	993
21										556	92	648				556	92	648
22										349	286	635				349	286	635
23										310	312	622				310	312	622
24										289	290	578				289	290	578
25										237	267	503				237	267	503
26										189	227	416				189	227	416
27											206	206					206	206
28											188	188					188	188
29											169	169					169	169
30											152	152					152	152
TOTAL	21968.	4868.	131.	0.	0.	26768.	3433.	7830.	8260.	5593.	2265.	27401.	25401.	12498.	8411.	5593.	2265.	54168.
AVERAGE YEAR OF SERVICE																		
	2.18	6.19	9.98	0.0	0.0	2.92	2.83	7.24	13.47	19.57	25.05	12.56	2.27	6.85	13.41	19.57	25.05	7.79

Fig. 67 — Original steady-state non-rated force structure

IMPLIED FORWARD COMPUTATION PROMOTION PARAMETERS

GRADE	RATING	SOURCE OF COMMISSION	CUMULATIVE PROMOTION OPPORTUNITY		BELOW-THE-ZONE PROMOTIONS		PROMOTION PHASE POINT	ELIGIBLES	PROMOTIONS
			FIRST YEAR OF PRIMARY ZONE	SECOND YEAR OF PRIMARY ZONE	BELOW-THE-ZONE PROMOTION PCT.	FIRST YEAR BELOW THE-ZONE PERCENT			
CAP	PIL	AFA	95.00	95.00	1.50	0.0	5	581	552
CAP	PIL	ROTC	95.00	95.00	1.50	0.0	5	1385	1316
CAP	PIL	SMSO	95.00	95.00	1.50	0.0	5	400	380
CAP	PIL	ALL	95.00	95.00	1.50	0.0	5	2365	2247
CAP	NAV	AFA	95.00	95.00	1.50	0.0	5	90	85
CAP	NAV	ROTC	95.00	95.00	1.50	0.0	5	628	597
CAP	NAV	SMSO	95.00	95.00	1.50	0.0	5	456	434
CAP	NAV	ALL	95.00	95.00	1.50	0.0	5	1174	1116
CAP	NR	AFA	95.00	95.00	1.50	0.0	5	224	213
CAP	NR	ROTC	95.00	95.00	1.50	0.0	5	1281	1224
CAP	NR	SMSO	95.00	95.00	1.50	0.0	5	1617	1546
CAP	NR	ALL	95.00	95.00	1.50	0.0	5	3121	2983
CAP	ALL	AFA	95.00	95.00	1.50	0.0	5	895	850
CAP	ALL	ROTC	95.00	95.00	1.50	0.0	5	3293	3137
CAP	ALL	SMSO	95.00	95.00	1.50	0.0	5	2473	2359
CAP	ALL	ALL	95.00	95.00	1.50	0.0	5	6660	6346
MAJ	PIL	AFA	75.00	80.00	6.00	25.00	10	397	318
MAJ	PIL	ROTC	75.00	80.00	6.00	25.00	10	655	525
MAJ	PIL	SMSO	75.00	80.00	6.00	25.00	10	189	152
MAJ	PIL	ALL	75.00	80.00	6.00	25.00	10	1241	994
MAJ	NAV	AFA	75.00	80.00	6.00	25.00	10	61	49
MAJ	NAV	ROTC	75.00	80.00	6.00	25.00	10	280	224
MAJ	NAV	SMSO	75.00	80.00	6.00	25.00	10	203	163
MAJ	NAV	ALL	75.00	80.00	6.00	25.00	10	545	436
MAJ	NR	AFA	75.00	80.00	6.00	25.00	10	154	124
MAJ	NR	ROTC	75.00	80.00	6.00	25.00	10	613	492
MAJ	NR	SMSO	75.00	80.00	6.00	25.00	10	773	619
MAJ	NR	ALL	75.00	80.00	6.00	25.00	10	1540	1235
MAJ	ALL	AFA	75.00	80.00	6.00	25.00	10	612	491
MAJ	ALL	ROTC	75.00	80.00	6.00	25.00	10	1548	1241
MAJ	ALL	SMSO	75.00	80.00	6.00	25.00	10	1165	934
MAJ	ALL	ALL	75.00	80.00	6.00	25.00	10	3326	2666

Fig. 68 — Original captain and major promotion parameters

IMPLIED FORWARD COMPUTATION PROMOTION PARAMETERS

GRADE	RATING	SOURCE OF COMMISSION	CUMULATIVE PROMOTION OPPORTUNITY		BELOW-THE-ZONE PROMOTIONS		PROMOTION PHASE POINT	ELIGIBLES	PROMOTIONS
			FIRST YEAR OF PRIMARY ZONE	SECOND YEAR OF PRIMARY ZONE	BELOW-THE-ZONE PROMOTION PCT.	FIRST YEAR BELOW THE-ZONE PERCENT			
LTC	PIL	AFA	65.00	70.00	15.00	50.00	16	281	198
LTC	PIL	ROTC	65.00	70.00	15.00	50.00	16	462	325
LTC	PIL	SMSO	65.00	70.00	15.00	50.00	16	133	94
LTC	**PIL**	**ALL**	**65.00**	**70.00**	**15.00**	**50.00**	**16**	**876**	**616**
LTC	**NAV**	**AFA**	**65.00**	**70.00**	**15.00**	**50.00**	**16**	**44**	**31**
LTC	**NAV**	**ROTC**	**65.00**	**70.00**	**15.00**	**50.00**	**16**	**197**	**138**
LTC	NAV	SMSO	65.00	70.00	15.00	50.00	16	143	101
LTC	NAV	ALL	65.00	70.00	15.00	50.00	16	384	270
LTC	NR	AFA	65.00	70.00	15.00	50.00	16	109	77
LTC	**NR**	**ROTC**	**65.00**	**70.00**	**15.00**	**50.00**	**16**	**428**	**301**
LTC	**NR**	**SMSO**	**65.00**	**70.00**	**15.00**	**50.00**	**16**	**539**	**379**
LTC	**NR**	**ALL**	**65.00**	**70.00**	**15.00**	**50.00**	**16**	**1077**	**757**
LTC	ALL	AFA	65.00	70.00	15.00	50.00	16	435	306
LTC	ALL	ROTC	65.00	70.00	15.00	50.00	16	1087	764
LTC	ALL	SMSO	65.00	70.00	15.00	50.00	16	816	574
LTC	**ALL**	**ALL**	**65.00**	**70.00**	**15.00**	**50.00**	**16**	**2337**	**1643**
COL	**PIL**	**AFA**	**45.00**	**50.00**	**30.00**	**80.00**	**22**	**168**	**86**
COL	PIL	ROTC	45.00	50.00	30.00	80.00	22	275	140
COL	PIL	SMSO	45.00	50.00	30.00	80.00	22	79	41
COL	PIL	ALL	45.00	50.00	30.00	80.00	22	522	266
COL	**NAV**	**AFA**	**45.00**	**50.00**	**30.00**	**80.00**	**22**	**25**	**13**
COL	**NAV**	**ROTC**	**45.00**	**50.00**	**30.00**	**80.00**	**22**	**115**	**59**
COL	**NAV**	**SMSO**	**45.00**	**50.00**	**30.00**	**80.00**	**22**	**84**	**43**
COL	NAV	ALL	45.00	50.00	30.00	80.00	22	224	115
COL	NR	AFA	45.00	50.00	30.00	80.00	22	65	33
COL	NR	ROTC	45.00	50.00	30.00	80.00	22	252	129
COL	**NR**	**SMSO**	**45.00**	**50.00**	**30.00**	**80.00**	**22**	**318**	**162**
COL	**NR**	**ALL**	**45.00**	**50.00**	**30.00**	**80.00**	**22**	**635**	**325**
COL	**ALL**	**AFA**	**45.00**	**50.00**	**30.00**	**80.00**	**22**	**258**	**132**
COL	ALL	ROTC	45.00	50.00	30.00	80.00	22	642	328
COL	ALL	SMSO	45.00	50.00	30.00	80.00	22	481	246
COL	ALL	ALL	45.00	50.00	30.00	80.00	22	1380	706

Fig. 69 — Original lieutenant colonel and colonel promotion parameters

IMPLIED BACKWARD COMPUTATION INPUTS

SUMMARY OF OFFICER STATE

COMPONENT	SOURCE OF COMMISSION	PILOT					NAVIGATOR					NONRATED				
		LIEUT.	CAPT.	MAJOR	LT COL	CL/GEN	LIEUT.	CAPT.	MAJOR	LT COL	CL/GEN	LIEUT.	CAPT.	MAJOR	LT COL	CL/GEN
RES	ROTC	3954	1724	25	0	0	1807	844	12	0	0	10504	2060	58	0	0
RES	SMSO	1141	497	7	0	0	1313	612	8	0	0	11464	2608	74	0	0
REG	AFA	1817	2509	2191	1471	613	281	388	339	225	88	1660	940	852	569	230
REG	ROTC	378	3461	3574	2412	1005	157	1452	1524	1016	399	784	3050	3289	2225	901
REG	SMSO	109	1000	1033	697	290	114	1057	1110	740	291	988	3839	4139	2799	1134

RATIO OF PROMOTION-AUGMENTATIONS TO REGULAR PROMOTIONS

COMPONENT	SOURCE OF COMMISSION	PILOT					NAVIGATOR					NONRATED				
		LIEUT.	CAPT.	MAJOR	LT COL	CL/GEN	LIEUT.	CAPT.	MAJOR	LT COL	CL/GEN	LIEUT.	CAPT.	MAJOR	LT COL	CL/GEN
	ROTC		0.8162	0.0	0.0	0.0		0.7551	0.0	0.0	0.0		0.0512	0.0	0.0	0.0
	SMSO		0.8192	0.0	0.0	0.0		0.7584	0.0	0.0	0.0		0.0514	0.0	0.0	0.0

RATIO OF AUGMENTATIONS IN GRADE TO REGULAR PROMOTIONS TO GRADE

COMPONENT	SOURCE OF COMMISSION	PILOT					NAVIGATOR					NONRATED				
		LIEUT.	CAPT.	MAJOR	LT COL	CL/GEN	LIEUT.	CAPT.	MAJOR	LT COL	CL/GEN	LIEUT.	CAPT.	MAJOR	LT COL	CL/GEN
	ROTC		0.2893	0.0412	0.0	0.0		0.3868	0.0457	0.0	0.0		0.1932	0.1114	0.0	0.0
	SMSO		0.2890	0.0416	0.0	0.0		0.3863	0.0465	0.0	0.0		0.1928	0.1112	0.0	0.0

RATING TRANSFER RATIOS

RESERVE OFFICER TRAINING CORPS				SCHOOL OF MILITARY SCIENCE - OFFICERS			
RATING TRANSFER-AUGMENTATIONS TO AUGMENTATIONS ONLY		REGULAR RATING TRANSFERS TO AUGMENTATIONS ONLY		RATING TRANSFER-AUGMENTATIONS TO AUGMENTATIONS ONLY		REGULAR RATING TRANSFERS TO AUGMENTATIONS ONLY	
PILOT	NAVIGATOR	PILOT	NAVIGATOR	PILOT	NAVIGATOR	PILOT	NAVIGATOR
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Fig. 70 — Original officer force detailed grade requirements

Field Grade Requirements by Rating

First, we add more detail to the new field grade requirements by distributing them over the ratings. From Figs. 65-67 we obtain the distribution over the ratings of pilots, navigators, and non-rated officers, respectively, that applied to the original officer force distribution. If we assume that, for a given field grade, the new pilot, navigator, and non-rated grade requirements are proportional to the old, then we can determine each grade's new pilot, navigator, and non-rated requirements, as illustrated in Table 11.

Table 11

DETERMINING NEW REQUIREMENTS FOR EACH GRADE

(example)

Rating	Major	Lieutenant Colonel	Colonel
Old			
Pilot	6,831	4,580	1,908
Navigator	2,993	1,981	778
Non-rated	8,411	5,593	2,265
Total	18,235	12,154	4,951
New			
Total	17,500	9,000	4,000
Pilot	*6,556*[a]	*3,391*	*1,541*
Navigator	*2,872*	*1,467*	*629*
Non-rated	*8,072*	*4,142*	*1,830*

[a]The italicized numbers are being computed. The algorithm used is

(NEW TOTAL/OLD TOTAL) · OLD ENTRY = NEW ENTRY.

For example, for colonel navigators, the following applies

(4,000/4,951) · 778 = *629*

Company Grade Rated Officer Requirements

Since the rated officer requirements must be preserved, the next step is to determine the new pilot and navigator grade requirements for lieutenants and captains. The remaining pilot requirement is determined by subtracting from 28,000 the new grade requirements for major and lieutenant colonel pilots:

$$18{,}053 = 28{,}000 - 6{,}556 - 3{,}391.$$

Similarly, we can compute the remaining navigator requirement:

$$8{,}661 = 13{,}000 - 2{,}872 - 1{,}467.$$

We compute the rated company grade requirements assuming that a rating's old lieutenant and captain grade requirements are proportional to the rating's new lieutenant and captain grade requirements, as illustrated in Table 12.

Table 12

COMPUTING RATED COMPANY GRADE REQUIREMENTS

(example)

Grade	Pilot	Navigator
Old		
Lieutenant	7,399	3,673
Captain	9,190	4,353
Total	16,589	8,026
New		
Total	18,053	8,661
Lieutenant	*8,052*	*3,964*
Captain	*10,001*	*4,697*

Company Grade Non-Rated Officer Requirements

The next step is to determine the non-rated company grade requirements. The total number of non-rated company grade officers needed are

first determined, and then distributed proportionally to the old non-rated company grade requirements. The number of non-rated company grade officers is determined in the following manner:

40,636 =	97,850	(total force requirement)
	-(28,000 + 13,000)	(rated force requirement)
	-(1,541 + 629)	(rated colonels)
	-(8,072 + 4,142 + 1,830)	(non-rated field grade)

Their distribution over the company grades is determined as follows:

	Total	Non-rated Lieutenant	Non-rated Captain
Old	37,899	25,401	12,498
New	40,636	*27,235*	*13,401*

At this point, we have completely determined the new grade requirements by rating. They are shown in Table 13.

Table 13

NEW GRADE REQUIREMENTS BY RATING

Rating	Lieutenant	Captain	Major	Lieutenant Colonel	Colonel
Pilot	8,052	10,001	6,556	3,391	1,541
Navigator	3,964	4,697	2,872	1,467	629
Non-rated	27,235	13,401	8,072	4,142	1,830
Total	39,251	28,099	17,500	9,000	4,000

Grade Requirements by Component and Source of Commission

The final step in the process distributes each rating's grade requirements by component and source of commission. To do this we assume that, for a given grade and rating, the new grade requirements are proportional to the old--the old grade requirements are obtained from the upper report in Fig. 70. The computations are given in Table 14.

Table 14

GRADE REQUIREMENTS BY COMPONENT AND SOURCE OF COMMISSION

Rating/Component and Source of Commission	Lieutenant	Captain	Major	Lieutenant Colonel	Colonel
Pilot (Old):					
Reserve ROTC	3,954	1,724	25		
Reserve OTS	1,141	497	7		
Regular AFA	1,817	2,509	2,191	1,471	613
Regular ROTC	378	3,461	3,574	2,412	1,005
Regular OTS	109	1,000	1,033	697	290
Total	7,399	9,191	6,830	4,580	1,908
Pilot (new):					
Total	8,052	10,001	6,556	3,391	1,541
Reserve ROTC	*4,303*	*1,876*	*24*		
Reserve OTS	*1,242*	*541*	*7*		
Regular AFA	*1,977*	*2,730*	*2,103*	*1,089*	*495*
Regular ROTC	*411*	*3,766*	*3,430*	*1,786*	*812*
Regular OTS	*119*	*1,088*	*992*	*516*	*234*
Navigator (old):					
Reserve ROTC	1,807	844	12		
Reserve OTS	1,313	612	8		
Regular AFA	281	388	339	225	88
Regular ROTC	157	1,452	1,524	1,016	399
Regular OTS	114	1,057	1,110	740	291
Total	3,672	4,353	2,993	1,981	778
Navigator (new):					
Total	3,964	4,697	2,872	1,467	629
Reserve ROTC	*1,951*	*911*	*12*		
Reserve OTS	*1,417*	*660*	*8*		
Reserve AFA	*303*	*419*	*325*	*167*	*71*
Regular ROTC	*169*	*1,566*	*1,462*	*752*	*323*
Regular OTS	*124*	*1,141*	*1,065*	*548*	*235*
Non-rated (old):					
Reserve ROTC	10,504	2,060	58		
Reserve OTS	11,464	2,608	74		
Regular AFA	1,660	940	852	569	230
Regular ROTC	784	3,050	3,289	2,225	901
Regular OTS	988	3,839	4,139	2,799	1,134
Total	25,400	12,497	8,412	5,593	2,265
Non-rated (new):					
Total	27,235	13,401	8,072	4,142	1,830
Reserve ROTC	*11,263*	*2,209*	*56*		
Reserve OTS	*12,292*	*2,797*	*71*		
Regular AFA	*1,780*	*1,008*	*818*	*421*	*186*
Regular ROTC	*841*	*3,270*	*3,155*	*1,648*	*728*
Regular OTS	*1,059*	*4,117*	*3,972*	*2,073*	*916*

Grade Limitations Model Run

These new grade requirements, coupled with grade limitations model inputs produced by the original force structure's constraints model run, can now be submitted to the grade limitations model. Selected outputs from the model run are shown in Figs. 71-73, and comparisons with the original steady-state force structure are presented in Table 15. It is interesting to note that in spite of a 19 percent cut in the grade requirement for colonels, the colonel promotion opportunity increased from 50 to 54 percent. This occurred because the number of lieutenant colonels was reduced by 26 percent, thereby decreasing the number of lieutenant colonels eligible for promotion to colonel, and hence increasing the promotion opportunity to colonel, i.e., the decrease in lieutenant colonel eligibles more than offset the decrease in promotions to colonel.

Table 15

COMPARISON OF ORIGINAL STEADY-STATE AND ALTERED STEADY-STATE FORCES

	Original Force	Altered Force
Promotion opportunity %		
Captain	95.0	93.4
Major	80.0	69.0
Lieutenant colonel	70.0	59.0
Colonel	50.0	53.5
Annual accessions		
Academy	960	1,031
Non-Academy	8,375	8,985
Total	9,335	10,016

OFFICER FORCE GRADE DISTRIBUTION
RATING ALL SOURCE OF COMMISSION ALL

	RESERVE COMPONENT						REGULAR COMPONENT						BOTH RESERVE AND REGULAR COMPONENTS					
YEAR	LIEUT	CAPT	MAJOR	LTCOL	CL/GN	TOTAL	LIEUT	CAPT	MAJOR	LTCOL	CL/GN	TOTAL	LIEUT	CAPT	MAJOR	LTCOL	CL/GN	TOTAL
1	8985					8985	1031					1031	10016					10016
2	8760					8760	1005					1005	9765					9765
3	8081					8081	1538					1538	9619					9619
4	6411	67				6478	2962	34				2996	9373	101				9474
5	229	3344				3573	244	3330				3574	472	6674				7146
6	2	2860				2862	2	3667				3670	5	6527				6532
7		2015				2015		3470				3470		5485				5485
8		299	3			302		3336	33			3369		3635	36			3671
9		259	8			267		3154	135			3289		3413	143			3557
10		84	149			234		1139	2092			3230		1223	2241			3464
11		66	17			83		976	2317			3293		1042	2334			3376
12									2270			2270			2270			2270
13									2225			2225			2225			2225
14									2087	93		2180			2087	93		2180
15									1953	184		2137			1953	184		2137
16									947	1147		2094			947	1147		2094
17									840	1212		2052			840	1212		2052
18									824	1187		2011			824	1187		2011
19									807	1164		1971			807	1164		1971
20									791	1004	137	1931			791	1004	137	1931
21										901	162	1063				901	162	1063
22										540	502	1042				540	502	1042
23										473	548	1021				473	548	1021
24										441	510	952				441	510	952
25										363	471	834				363	471	834
26										291	401	692				291	401	692
27											366	366					366	366
28											334	334					334	334
29											300	300					300	300
30											270	270					270	270
TOTAL	32468.	8995.	178.	0.	0.	41641.	6782.	19106.	17322.	9000.	4000.	56210.	39250.	28101.	17500.	9000.	4000.	97850.
	AVERAGE YEAR OF SERVICE																	
	2.39	6.06	10.02	0.0	0.0	3.22	3.06	7.34	13.74	19.50	25.06	12.00	2.50	6.93	13.70	19.50	25.06	8.26

Fig. 71 — Revised steady-state officer force structure

IMPLIED FORWARD COMPUTATION PROMOTION PARAMETERS

GRADE	RATING	SOURCE OF COMMISSION	CUMULATIVE PROMOTION OPPORTUNITY		BELOW-THE-ZONE PROMOTIONS		PROMOTION PHASE POINT	ELIGIBLES	PROMOTIONS
			FIRST YEAR OF PRIMARY ZONE	SECOND YEAR OF PRIMARY ZONE	BELOW-THE-ZONE PROMOTION PCT.	FIRST YEAR BELOW THE-ZONE PERCENT			
CAP	PIL	AFA	92.41	92.41	1.50	0.0	5	627	579
CAP	PIL	ROTC	93.46	93.46	1.50	0.0	5	1499	1402
CAP	PIL	OTS	93.46	93.46	1.50	0.0	5	433	405
CAP	PIL	ALL	93.21	93.21	1.50	0.0	5	2559	2385
CAP	NAV	AFA	92.61	92.61	1.50	0.0	5	96	89
CAP	NAV	ROTC	93.63	93.63	1.50	0.0	5	675	632
CAP	NAV	OTS	93.61	93.61	1.49	0.0	5	490	459
CAP	NAV	ALL	93.54	93.54	1.50	0.0	5	1261	1180
CAP	NR	AFA	92.66	92.66	1.50	0.0	5	238	220
CAP	NR	ROTC	93.57	93.57	1.53	0.0	5	1365	1285
CAP	NR	OTS	93.53	93.53	1.52	0.0	5	1724	1623
CAP	NR	ALL	93.48	93.48	1.52	0.0	5	3327	3129
CAP	ALL	AFA	92.49	92.49	1.50	0.0	5	960	889
CAP	ALL	ROTC	93.53	93.53	1.51	0.0	5	3539	3319
CAP	ALL	OTS	93.53	93.53	1.51	0.0	5	2647	2487
CAP	ALL	ALL	93.39	93.39	1.51	0.0	5	7186	6590
MAJ	PIL	AFA	64.08	68.32	6.00	25.00	10	416	295
MAJ	PIL	ROTC	64.29	68.60	6.03	25.10	10	686	471
MAJ	PIL	OTS	64.34	68.65	6.03	25.10	10	198	136
MAJ	PIL	ALL	64.23	68.52	6.02	25.07	10	1300	892
MAJ	NAV	AFA	64.48	68.75	6.00	25.00	10	64	44
MAJ	NAV	ROTC	64.84	69.17	6.03	25.12	10	291	201
MAJ	NAV	OTS	64.56	68.89	6.03	25.11	10	212	146
MAJ	NAV	ALL	64.69	69.02	6.03	25.10	10	566	392
MAJ	NR	AFA	64.95	69.25	6.00	25.00	10	160	111
MAJ	NR	ROTC	65.11	69.46	6.06	25.15	10	636	443
MAJ	NR	OTS	65.08	69.42	6.06	25.15	10	802	558
MAJ	NR	ALL	65.08	69.42	6.05	25.14	10	1598	1111
MAJ	ALL	AFA	64.34	68.59	6.00	25.00	10	640	440
MAJ	ALL	ROTC	64.72	69.04	6.04	25.12	10	1613	1116
MAJ	ALL	OTS	64.87	69.20	6.05	25.14	10	1211	840
MAJ	ALL	ALL	64.70	69.01	6.04	25.10	10	3464	2395

Fig. 72 — Revised captain and major promotion parameters

IMPLIED FORWARD COMPUTATION PROMOTION PARAMETERS

GRADE	RATING	SOURCE OF COMMISSION	CUMULATIVE PROMOTION OPPORTUNITY		BELOW-THE-ZONE PROMOTIONS		PROMOTION PHASE POINT	ELIGIBLES	PROMOTIONS
			FIRST YEAR OF PRIMARY ZONE	SECOND YEAR OF PRIMARY ZONE	BELOW-THE-ZONE PROMOTION PCT.	FIRST YEAR BELOW THE-ZONE PERCENT			
LTC	PIL	AFA	54.73	58.93	15.00	50.00	16	252	149
LTC	PIL	ROTC	54.75	58.95	15.00	50.00	16	414	245
LTC	PIL	OTS	54.68	58.88	15.00	50.00	16	120	71
LTC	PIL	ALL	54.73	58.94	15.00	50.00	16	786	465
LTC	NAV	AFA	54.83	59.05	15.00	50.00	16	39	23
LTC	NAV	ROTC	54.73	58.94	15.00	50.00	16	176	104
LTC	NAV	OTS	54.81	59.02	15.00	50.00	16	128	76
LTC	NAV	ALL	54.77	58.98	15.00	50.00	16	344	204
LTC	NR	AFA	54.73	58.93	15.00	50.00	16	98	58
LTC	NR	ROTC	54.79	59.00	15.00	50.00	16	384	227
LTC	NR	OTS	54.76	58.96	15.00	50.00	16	483	286
LTC	NR	ALL	54.77	58.97	15.00	50.00	16	965	572
LTC	ALL	AFA	54.74	58.94	15.00	50.00	16	389	231
LTC	ALL	ROTC	54.76	58.97	15.00	50.00	16	974	577
LTC	ALL	OTS	54.75	58.96	15.00	50.00	16	731	433
LTC	ALL	ALL	54.76	58.96	15.00	50.00	16	2094	1240
COL	PIL	AFA	48.16	53.52	30.00	80.00	22	127	59
COL	PIL	ROTC	48.17	53.52	30.00	80.00	22	208	113
COL	PIL	OTS	48.08	53.42	30.00	80.00	22	60	33
COL	PIL	ALL	48.15	53.51	30.00	80.00	22	394	215
COL	NAV	AFA	47.87	53.22	30.00	80.00	22	19	10
COL	NAV	ROTC	48.26	53.65	30.00	80.00	22	87	48
COL	NAV	OTS	48.19	53.58	30.00	80.00	22	63	35
COL	NAV	ALL	48.19	53.57	30.00	80.00	22	169	93
COL	NR	AFA	48.16	53.53	30.00	80.00	22	49	27
COL	NR	ROTC	48.16	53.52	30.00	80.00	22	191	104
COL	NR	OTS	48.17	53.54	30.00	80.00	22	240	131
COL	NR	ALL	48.16	53.53	30.00	80.00	22	479	262
COL	ALL	AFA	48.13	53.49	30.00	80.00	22	194	106
COL	ALL	ROTC	48.18	53.55	30.00	80.00	22	485	265
COL	ALL	OTS	48.16	53.52	30.00	80.00	22	363	199
COL	ALL	ALL	48.16	53.53	30.00	80.00	22	1042	570

Fig. 73 — Revised lieutenant colonel and colonel promotion parameters

Equal Promotion Opportunities

As shown in Figs. 72 and 73, a slight difference exists between the various promotion opportunities associated with a grade, as illustrated below:

	Promotion Opportunity Spread (%)
Captain	92.4 - 93.6
Major	68.3 - 69.5
Lieutenant colonel	58.9 - 59.1
Colonel	53.2 - 53.7

If any of these variations in promotion opportunity is unacceptable, the constraints and grade limitations models may be employed again to reduce the variation. Beginning with the *progression model* input deck generated by the grade limitations model run, we change the promotion inputs to conform to the average promotion parameters--the ALL ALL promotion parameters for each grade in Figs. 72 and 73. Next we add the appropriate manpower and career reserve constraints--the MPWR and CRES inputs. We then run the constraints model. Selected outputs from the run appear in Figs. 74-77.

Note from Fig. 74 that the major, lieutenant colonel, and colonel grade requirements are not precisely satisfied. Using an arithmetic technique similar to the one just described for the first grade limitations model run, we alter the grade requirements and then make a second grade limitations model run. Selected output reports from this run are shown in Figs. 78-80, and this run is compared with the previous runs in Table 16. As Table 16 indicates, virtually no change in aggregate promotion opportunity takes place, with only insignificant change in accessions.

The promotion opportunity spread has been reduced, as follows:

	Promotion Opportunity Spread (%)
Captain	93.3 - 93.4
Major	68.9 - 69.1
Lieutenant colonel	58.9 - 59.0
Colonel	53.4 - 53.9

OFFICER FORCE GRADE DISTRIBUTION
RATING ALL SOURCE OF COMMISSION ALL

	RESERVE COMPONENT						REGULAR COMPONENT						BOTH RESERVE AND REGULAR COMPONENTS					
YEAR	LIEUT	CAPT	MAJOR	LTCOL	CL/GN	TOTAL	LIEUT	CAPT	MAJOR	LTCOL	CL/GN	TOTAL	LIEUT	CAPT	MAJOR	LTCOL	CL/GN	TOTAL
1	8981					8981	1031					1031	10012					10012
2	8756					8756	1005					1005	9762					9762
3	8076					8076	1540					1540	9615					9615
4	6407	67				6474	2963	34				2997	9370	101				9471
5	236	3332				3568	236	3337				3573	472	6670				7142
6	2	2850				2852	2	3672				3675	5	6522				6527
7		2008				2008		3473				3473		5481				5481
8		298	3			301		3339	33			3372		3637	36			3674
9		258	8			266		3157	135			3292		3415	144			3559
10		85	147			233		1138	2095			3234		1224	2243			3466
11		67	17			84		976	2318			3294		1043	2335			3378
12									2272			2272			2272			2272
13									2227			2227			2227			2227
14									2089	93		2182			2089	93		2182
15									1954	184		2138			1954	184		2138
16									948	1148		2096			948	1148		2096
17									841	1213		2054			841	1213		2054
18									824	1188		2013			824	1188		2013
19									808	1165		1972			808	1165		1972
20									792	1004	137	1933			792	1004	137	1933
21										902	162	1064				902	162	1064
22										540	502	1043				540	502	1043
23										474	548	1022				474	548	1022
24										442	511	952				442	511	952
25										363	471	834				363	471	834
26										291	402	693				291	402	693
27											366	366					366	366
28											334	334					334	334
29											300	300					300	300
30											270	270					270	270
TOTAL	32459.	8965.	176.	0.	0.	41600.	6777.	19127.	17337.	9007.	4003.	56251.	39236.	28092.	17512.	9007.	4003.	97850.
AVERAGE YEAR OF SERVICE																		
	2.39	6.07	10.02	0.0	0.0	3.21	3.06	7.34	13.74	19.50	25.06	12.00	2.50	6.93	13.70	19.50	25.06	8.27

Fig. 74 — Steady-state force structure — constraints model equal promotion opportunity step

IMPLIED FORWARD COMPUTATION PROMOTION PARAMETERS

GRADE	RATING	SOURCE OF COMMISSION	CUMULATIVE PROMOTION OPPORTUNITY		BELOW-THE-ZONE PROMOTIONS		PROMOTION PHASE POINT	ELIGIBLES	PROMOTIONS
			FIRST YEAR OF PRIMARY ZONE	SECOND YEAR OF PRIMARY ZONE	BELOW-THE-ZONE PROMOTION PCT.	FIRST YEAR BELOW THE-ZONE PERCENT			
CAP	PIL	AFA	93.39	93.39	1.51	0.0	5	627	585
CAP	PIL	ROTC	93.39	93.39	1.51	0.0	5	1501	1402
CAP	PIL	SMSO	93.39	93.39	1.51	0.0	5	422	394
CAP	PIL	ALL	93.39	93.39	1.51	0.0	5	2550	2382
CAP	NAV	AFA	93.39	93.39	1.51	0.0	5	97	90
CAP	NAV	ROTC	93.39	93.39	1.51	0.0	5	674	630
CAP	NAV	SMSO	93.39	93.39	1.51	0.0	5	491	459
CAP	NAV	ALL	93.39	93.39	1.51	0.0	5	1262	1179
CAP	NR	AFA	93.39	93.39	1.51	0.0	5	237	222
CAP	NR	ROTC	93.39	93.39	1.51	0.0	5	1364	1282
CAP	NR	SMSO	93.39	93.39	1.51	0.0	5	1728	1624
CAP	NR	ALL	93.39	93.39	1.51	0.0	5	3329	3128
CAP	ALL	AFA	93.39	93.39	1.51	0.0	5	961	897
CAP	ALL	ROTC	93.39	93.39	1.51	0.0	5	3539	3314
CAP	ALL	SMSO	93.39	93.39	1.51	0.0	5	2642	2477
CAP	ALL	ALL	93.39	93.39	1.51	0.0	5	7142	6689
MAJ	PIL	AFA	64.70	69.01	6.04	25.10	10	421	291
MAJ	PIL	ROTC	64.70	69.01	6.04	25.10	10	685	473
MAJ	PIL	SMSO	64.70	69.01	6.04	25.10	10	193	133
MAJ	PIL	ALL	64.70	69.01	6.04	25.10	10	1299	898
MAJ	NAV	AFA	64.70	69.01	6.04	25.10	10	65	45
MAJ	NAV	ROTC	64.70	69.01	6.04	25.10	10	290	200
MAJ	NAV	SMSO	64.70	69.01	6.04	25.10	10	212	146
MAJ	NAV	ALL	64.70	69.01	6.04	25.10	10	566	391
MAJ	NR	AFA	64.70	69.01	6.04	25.10	10	161	111
MAJ	NR	ROTC	64.70	69.01	6.04	25.10	10	637	440
MAJ	NR	SMSO	64.70	69.01	6.04	25.10	10	804	556
MAJ	NR	ALL	64.70	69.01	6.04	25.10	10	1602	1108
MAJ	ALL	AFA	64.70	69.01	6.04	25.10	10	646	447
MAJ	ALL	ROTC	64.70	69.01	6.04	25.10	10	1611	1114
MAJ	ALL	SMSO	64.70	69.01	6.04	25.10	10	1209	836
MAJ	ALL	ALL	64.70	69.01	6.04	25.10	10	3466	2397

Fig. 75 — Captain and major promotion parameters — constraints model equal promotion opportunity step

IMPLIED FORWARD COMPUTATION PROMOTION PARAMETERS

GRADE	RATING	SOURCE OF COMMISSION	CUMULATIVE PROMOTION OPPORTUNITY		BELOW-THE-ZONE PROMOTIONS		PROMOTION PHASE POINT	ELIGIBLES	PROMOTIONS
			FIRST YEAR OF PRIMARY ZONE	SECOND YEAR OF PRIMARY ZONE	BELOW-THE-ZONE PROMOTION PCT.	FIRST YEAR BELOW THE-ZONE PERCENT			
LTC	PIL	AFA	54.76	58.96	15.00	50.00	16	258	153
LTC	PIL	ROTC	54.76	58.96	15.00	50.00	16	416	246
LTC	PIL	SMSO	54.76	58.96	15.00	50.00	16	117	69
LTC	PIL	ALL	54.76	58.96	15.00	50.00	16	790	468
LTC	NAV	AFA	54.76	58.96	15.00	50.00	16	40	24
LTC	NAV	ROTC	54.76	58.96	15.00	50.00	16	175	104
LTC	NAV	SMSO	54.76	58.96	15.00	50.00	16	129	76
LTC	NAV	ALL	54.76	58.96	15.00	50.00	16	344	203
LTC	NR	AFA	54.76	58.96	15.00	50.00	16	98	58
LTC	NR	ROTC	54.76	58.96	15.00	50.00	16	382	226
LTC	NR	SMSO	54.76	58.96	15.00	50.00	16	482	285
LTC	NR	ALL	54.76	58.96	15.00	50.00	16	962	570
LTC	ALL	AFA	54.76	58.96	15.00	50.00	16	396	234
LTC	ALL	ROTC	54.76	58.96	15.00	50.00	16	973	576
LTC	ALL	SMSO	54.76	58.96	15.00	50.00	16	727	431
LTC	ALL	ALL	54.76	58.96	15.00	50.00	16	2096	1241
COL	PIL	AFA	48.16	53.53	30.00	80.00	22	129	71
COL	PIL	ROTC	48.16	53.53	30.00	80.00	22	209	114
COL	PIL	SMSO	48.16	53.53	30.00	80.00	22	59	32
COL	PIL	ALL	48.16	53.53	30.00	80.00	22	396	217
COL	NAV	AFA	48.16	53.53	30.00	80.00	22	19	11
COL	NAV	ROTC	48.16	53.53	30.00	80.00	22	86	47
COL	NAV	SMSO	48.16	53.53	30.00	80.00	22	63	35
COL	NAV	ALL	48.16	53.53	30.00	80.00	22	169	93
COL	NR	AFA	48.16	53.53	30.00	80.00	22	49	27
COL	NR	ROTC	48.16	53.53	30.00	80.00	22	189	104
COL	NR	SMSO	48.16	53.53	30.00	80.00	22	239	131
COL	NR	ALL	48.16	53.53	30.00	80.00	22	477	261
COL	ALL	AFA	48.16	53.53	30.00	80.00	22	198	108
COL	ALL	ROTC	48.16	53.53	30.00	80.00	22	484	265
COL	ALL	SMSO	48.16	53.53	30.00	80.00	22	361	198
COL	ALL	ALL	48.16	53.53	30.00	80.00	22	1043	571

Fig. 76 — Lieutenant colonel and colonel promotion parameters — constraints model equal promotion opportunity step

IMPLIED BACKWARD COMPUTATION INPUTS

SUMMARY OF OFFICER STATE

COMPONENT	SOURCE OF COMMISSION	PILOT					NAVIGATOR					NONRATED				
		LIEUT.	CAPT.	MAJOR	LT COL	CL/GEN	LIEUT.	CAPT.	MAJOR	LT COL	CL/GEN	LIEUT.	CAPT.	MAJOR	LT COL	CL/GEN
RES	ROTC	4306	1881	24	0	0	1951	910	12	0	0	11265	2195	55	0	0
RES	SMSO	1211	528	7	0	0	1420	661	8	0	0	12306	2791	70	0	0
REG	AFA	1971	2753	2146	1112	506	304	424	331	169	73	1778	1016	821	423	187
REG	ROTC	415	3755	3446	1795	816	170	1559	1453	748	320	838	3281	3140	1638	724
REG	SMSO	117	1057	971	506	230	125	1142	1065	548	235	1060	4140	3963	2068	913

RATIO OF PROMOTION-AUGMENTATIONS TO REGULAR PROMOTIONS

COMPONENT	SOURCE OF COMMISSION	PILOT					NAVIGATOR					NONRATED				
		LIEUT.	CAPT.	MAJOR	LT COL	CL/GEN	LIEUT.	CAPT.	MAJOR	LT COL	CL/GEN	LIEUT.	CAPT.	MAJOR	LT COL	CL/GEN
	ROTC		0.7988	0.0	0.0	0.0		0.7448	0.0	0.0	0.0		0.0504	0.0	0.0	0.0
	SMSO		0.8019	0.0	0.0	0.0		0.7399	0.0	0.0	0.0		0.0491	0.0	0.0	0.0

RATIO OF AUGMENTATIONS IN GRADE TO REGULAR PROMOTIONS TO GRADE

COMPONENT	SOURCE OF COMMISSION	PILOT					NAVIGATOR					NONRATED				
		LIEUT.	CAPT.	MAJOR	LT COL	CL/GEN	LIEUT.	CAPT.	MAJOR	LT COL	CL/GEN	LIEUT.	CAPT.	MAJOR	LT COL	CL/GEN
	ROTC		0.2887	0.0412	0.0	0.0		0.3879	0.0449	0.0	0.0		0.1906	0.1090	0.0	0.0
	SMSO		0.2884	0.0414	0.0	0.0		0.3830	0.0466	0.0	0.0		0.1903	0.1095	0.0	0.0

RATING TRANSFER RATIOS

RESERVE OFFICER TRAINING CORPS				SCHOOL OF MILITARY SCIENCE - OFFICERS			
RATING TRANSFER-AUGMENTATIONS TO AUGMENTATIONS ONLY		REGULAR RATING TRANSFERS TO AUGMENTATIONS ONLY		RATING TRANSFER-AUGMENTATIONS TO AUGMENTATIONS ONLY		REGULAR RATING TRANSFERS TO AUGMENTATIONS ONLY	
PILOT	NAVIGATOR	PILOT	NAVIGATOR	PILOT	NAVIGATOR	PILOT	NAVIGATOR
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Fig. 77 — Grade requirements — constraints model equal promotion opportunity step

OFFICER FORCE GRADE DISTRIBUTION
RATING ALL SOURCE OF COMMISSION ALL

	RESERVE COMPONENT						REGULAR COMPONENT						BOTH RESERVE AND REGULAR COMPONENTS					
YEAR	LIEUT	CAPT	MAJOR	LTCOL	CL/GN	TOTAL	LIEUT	CAPT	MAJOR	LTCOL	CL/GN	TOTAL	LIEUT	CAPT	MAJOR	LTCOL	CL/GN	TOTAL
1	8984					8984	1031					1031	10015					10015
2	8759					8759	1006					1006	9765					9765
3	8078					8078	1540					1540	9619					9619
4	6410	67				6476	2964	34				2998	9373	101				9474
5	236	3334				3570	237	3337				3574	473	6671				7144
6	2	2851				2854	2	3672				3675	5	6523				6528
7		2009				2009		3473				3473		5482				5482
8		298	3			301		3339	33			3372		3637	36			3674
9		258	8			266		3157	135			3293		3415	144			3559
10		85	147			233		1140	2093			3234		1226	2241			3466
11		67	17			84		978	2317			3294		1045	2334			3379
12									2270			2270			2270			2270
13									2225			2225			2225			2225
14									2087	93		2180			2087	93		2180
15									1953	184		2137			1953	184		2137
16									947	1147		2094			947	1147		2094
17									840	1212		2052			840	1212		2052
18									824	1187		2011			824	1187		2011
19									807	1164		1971			807	1164		1971
20									791	1004	137	1931			791	1004	137	1931
21										901	162	1063				901	162	1063
22										540	502	1042				540	502	1042
23										473	548	1021				473	548	1021
24										441	510	952				441	510	952
25										363	471	834				363	471	834
26										291	401	692				291	401	692
27											366	366					366	366
28											334	334					334	334
29											300	300					300	300
30											270	270					270	270
TOTAL	32470.	8969.	176.	0.	0.	41615.	6780.	19131.	17324.	9000.	4000.	56235.	39250.	28100.	17500.	9000.	4000.	97849.
AVERAGE YEAR OF SERVICE																		
	2.39	6.07	10.02	0.0	0.0	3.21	3.06	7.34	13.74	19.50	25.06	12.00	2.50	6.93	13.70	19.50	25.06	8.26

Fig. 78 — Steady-state officer force grade — grade limitations model equal promotion opportunity step

IMPLIED FORWARD COMPUTATION PROMOTION PARAMETERS

GRADE	RATING	SOURCE OF COMMISSION	CUMULATIVE PROMOTION OPPORTUNITY		BELOW-THE-ZONE PROMOTIONS		PROMOTION PHASE POINT	ELIGIBLES	PROMOTIONS
			FIRST YEAR OF PRIMARY ZONE	SECOND YEAR OF PRIMARY ZONE	BELOW-THE-ZONE PROMOTION PCT.	FIRST YEAR BELOW THE-ZONE PERCENT			
CAP	PIL	AFA	93.38	93.38	1.50	0.0	5	627	585
CAP	PIL	ROTC	93.41	93.41	1.49	0.0	5	1501	1402
CAP	PIL	OTS	93.37	93.37	1.49	0.0	5	422	394
CAP	PIL	ALL	93.40	93.40	1.50	0.0	5	2550	2382
CAP	NAV	AFA	93.29	93.29	1.50	0.0	5	97	90
CAP	NAV	ROTC	93.34	93.34	1.51	0.0	5	675	630
CAP	NAV	OTS	93.43	93.43	1.51	0.0	5	491	459
CAP	NAV	ALL	93.37	93.37	1.51	0.0	5	1263	1179
CAP	NR	AFA	93.37	93.37	1.50	0.0	5	238	222
CAP	NR	ROTC	93.38	93.38	1.52	0.0	5	1365	1282
CAP	NR	OTS	93.36	93.36	1.52	0.0	5	1729	1625
CAP	NR	ALL	93.37	93.37	1.52	0.0	5	3331	3129
CAP	ALL	AFA	93.37	93.37	1.50	0.0	5	961	897
CAP	ALL	ROTC	93.39	93.39	1.51	0.0	5	3540	3315
CAP	ALL	OTS	93.38	93.38	1.52	0.0	5	2643	2478
CAP	ALL	ALL	93.38	93.38	1.51	0.0	5	7144	6690
MAJ	PIL	AFA	64.72	69.01	6.01	25.00	10	421	291
MAJ	PIL	ROTC	64.66	68.99	6.03	25.10	10	685	473
MAJ	PIL	OTS	64.79	69.13	6.03	25.10	10	193	134
MAJ	PIL	ALL	64.70	69.02	6.02	25.07	10	1298	898
MAJ	NAV	AFA	64.78	69.07	6.01	25.00	10	65	45
MAJ	NAV	ROTC	64.72	69.05	6.04	25.11	10	289	200
MAJ	NAV	OTS	64.62	68.95	6.04	25.11	10	212	146
MAJ	NAV	ALL	64.69	69.02	6.03	25.10	10	566	391
MAJ	NR	AFA	64.61	68.89	6.01	25.00	10	161	111
MAJ	NR	ROTC	64.58	68.89	6.08	25.25	10	637	440
MAJ	NR	OTS	64.59	68.89	6.08	25.25	10	804	555
MAJ	NR	ALL	64.59	68.89	6.08	25.22	10	1602	1106
MAJ	ALL	AFA	64.70	68.98	6.01	25.00	10	647	447
MAJ	ALL	ROTC	64.64	68.96	6.05	25.16	10	1611	1113
MAJ	ALL	OTS	64.62	68.94	6.07	25.20	10	1209	835
MAJ	ALL	ALL	64.64	68.96	6.05	25.14	10	3466	2395

Fig. 79 — Captain and major promotion parameters — grade limitations model equal promotion opportunity step

IMPLIED FORWARD COMPUTATION PROMOTION PARAMETERS

GRADE	RATING	SOURCE OF COMMISSION	CUMULATIVE PROMOTION OPPORTUNITY		BELOW-THE-ZONE PROMOTIONS		PROMOTION PHASE POINT	ELIGIBLES	PROMOTIONS
			FIRST YEAR OF PRIMARY ZONE	SECOND YEAR OF PRIMARY ZONE	BELOW-THE-ZONE PROMOTION PCT.	FIRST YEAR BELOW THE-ZONE PERCENT			
LTC	PIL	AFA	54.77	58.97	15.00	50.00	16	258	153
LTC	PIL	ROTC	54.76	58.97	15.00	50.00	16	416	246
LTC	PIL	OTS	54.78	58.98	15.00	50.00	16	117	69
LTC	PIL	ALL	54.77	58.97	15.00	50.00	16	790	468
LTC	NAV	AFA	54.72	58.92	15.00	50.00	16	40	23
LTC	NAV	ROTC	54.76	58.97	15.00	50.00	16	175	104
LTC	NAV	OTS	54.73	58.93	15.00	50.00	16	129	76
LTC	NAV	ALL	54.75	58.95	15.00	50.00	16	343	203
LTC	NR	AFA	54.75	58.96	15.00	50.00	16	98	58
LTC	NR	ROTC	54.76	58.96	15.00	50.00	16	381	226
LTC	NR	OTS	54.74	58.94	15.00	50.00	16	481	285
LTC	NR	ALL	54.75	58.95	15.00	50.00	16	960	569
LTC	ALL	AFA	54.76	58.96	15.00	50.00	16	396	234
LTC	ALL	ROTC	54.76	58.97	15.00	50.00	16	972	576
LTC	ALL	OTS	54.74	58.95	15.00	50.00	16	727	430
LTC	ALL	ALL	54.75	58.96	15.00	50.00	16	2094	1240
COL	PIL	AFA	48.20	53.56	30.00	80.00	22	120	71
COL	PIL	ROTC	48.17	53.52	30.00	80.00	22	209	114
COL	PIL	OTS	48.16	53.52	30.00	80.00	22	59	32
COL	PIL	ALL	48.18	53.53	30.00	80.00	22	397	217
COL	NAV	AFA	48.47	53.88	30.00	80.00	22	19	11
COL	NAV	ROTC	48.11	53.48	30.00	80.00	22	86	47
COL	NAV	OTS	48.19	53.58	30.00	80.00	22	63	35
COL	NAV	ALL	48.18	53.56	30.00	80.00	22	169	93
COL	NR	AFA	48.28	53.65	30.00	80.00	22	49	27
COL	NR	ROTC	48.20	53.57	30.00	80.00	22	189	104
COL	NR	OTS	48.07	53.42	30.00	80.00	22	239	130
COL	NR	ALL	48.14	53.50	30.00	80.00	22	477	261
COL	ALL	AFA	48.25	53.62	30.00	80.00	22	198	108
COL	ALL	ROTC	48.17	53.53	30.00	80.00	22	484	265
COL	ALL	OTS	48.11	53.47	30.00	80.00	22	361	197
COL	ALL	ALL	48.16	53.52	30.00	80.00	22	1042	570

Fig. 80 — Lieutenant colonel and colonel promotion parameters — grade limitations model equal promotion opportunity step

Table 16

STEADY-STATE FORCE COMPARISONS

	Original Force	First Alteration	Second Alteration
Promotion opportunity (%)			
Captain	95.0	93.4	93.4
Major	80.0	69.0	69.0
Lieutenant colonel	70.0	59.0	59.0
Colonel	50.0	53.5	53.5
Annual accessions			
Academy	960	1,031	1,031
Non-Academy	8,375	8,985	8,984
Total	9,335	10,016	10,015

Impact of Alterations

In Table 16 promotion opportunity and annual accessions have been employed to illustrate the impact of the altered grade requirements on the force structure. Other measures could have been used--for example, annual pilot and navigator production, or the ratio of reserve to regular officers. These measures were chosen simply for illustrative purposes.

In essence, the alteration of the grade requirements transfers about 5,000 officers from the field grades to the company grades. Company grade retention is generally lower than field grade retention, thereby resulting in an increase in officer attrition. (Keep in mind that we are dealing with a hypothetical, steady-state officer force.) In order to maintain a constant force size, accessions must be increased, i.e., more officers are leaving the force, thereby requiring more officers to enter the force. As shown in Table 16, accessions have increased by just under 700 officers, or just over 7 percent.

One important impact on the force structure that has not been considered is the effect of altered grade requirements on officer retention, and thereby on the force structure. We would expect a shift of officers from the field to the company grades to reduce company grade retention, since the shift effectively lowers a company grade

officer's chances of making it to the field grades. The behavioral model of officer retention* will permit estimation of the impact of policy changes on retention, and their combined impact on the officer force.

OTHER ARITHMETIC TECHNIQUES

One numerical technique that might be employed to use the constraints and grade limitations models in concert has been described here merely to suggest how the models may be used together--not to present a cast-in-concrete arithmetic procedure.

The technique employed here causes an increase in Acedemy accessions which may not be desirable. One way to keep Academy accessions constant is, during the second constraints model run, to set Academy accessions back to 960. Figure 81 shows the resultant constraints model steady state force structure. A slight redistribution of grade requirements is needed to achieve the target field grade requirements. That is easily accomplished with a second grade limitations model run, using an arithmetic procedure that alters only non-Academy non-rated officers. Figures 82-84 show selected outputs from the grade limitations model run.

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*Described briefly in Sec. I, p. 14.

OFFICER FORCE GRADE DISTRIBUTION
RATING ALL SOURCE OF COMMISSION ALL

	RESERVE COMPONENT						REGULAR COMPONENT						BOTH RESERVE AND REGULAR COMPONENTS					
YEAR	LIEUT	CAPT	MAJOR	LTCOL	CL/GN	TOTAL	LIEUT	CAPT	MAJOR	LTCOL	CL/GN	TOTAL	LIEUT	CAPT	MAJOR	LTCOL	CL/GN	TOTAL
1	9074					9074	960					960	10034					10034
2	8847					8847	936					936	9783					9783
3	8162					8162	1474					1474	9636					9636
4	6473	67				6541	2917	34				2951	9391	101				9492
5	239	3373				3611	234	3306				3540	473	6679				7151
6	2	2885				2887	2	3649				3651	5	6533				6538
7		2027				2027		3459				3459		5486				5486
8		301	3			304		3327	33			3360		3627	36			3664
9		260	8			269		3145	135			3280		3406	143			3549
10		86	149			235		1134	2088			3222		1220	2236			3456
11		68	17			85		972	2311			3283		1040	2329			3369
12									2265			2265			2265			2265
13									2220			2220			2220			2220
14									2083	93		2175			2083	93		2175
15									1948	184		2132			1948	184		2132
16									945	1144		2089			945	1144		2089
17									839	1209		2048			839	1209		2048
18									822	1185		2007			822	1185		2007
19									805	1161		1966			805	1161		1966
20									789	1001	137	1927			789	1001	137	1927
21										899	161	1061				899	161	1061
22										539	501	1039				539	501	1039
23										472	546	1019				472	546	1019
24										440	509	950				440	509	950
25										362	470	832				362	470	832
26										290	400	691				290	400	691
27											365	365					365	365
28											333	333					333	333
29											299	299					299	299
30											269	269					269	269
TOTAL	32798.	9067.	177.	0.	0.	42042.	6524.	19026.	17283.	8980.	3991.	55804.	39322.	28092.	17461.	8980.	3991.	97845.
	AVERAGE YEAR OF SERVICE																	
	2.39	6.06	10.02	0.0	0.0	3.21	3.08	7.34	13.74	19.50	25.06	12.05	2.50	6.93	13.70	19.50	25.06	8.25

Fig. 81 — Steady state force structure (960 Academy accessions) — constraints model equal promotion opportunity step

OFFICER FORCE GRADE DISTRIBUTION
RATING ALL SOURCE OF COMMISSION ALL

	RESERVE COMPONENT						REGULAR COMPONENT						BOTH RESERVE AND REGULAR COMPONENTS					
YEAR	LIEUT	CAPT	MAJOR	LTCOL	CL/GN	TOTAL	LIEUT	CAPT	MAJOR	LTCOL	CL/GN	TOTAL	LIEUT	CAPT	MAJOR	LTCOL	CL/GN	TOTAL
1	9065					9065	960					960	10025					10025
2	8838					8838	936					936	9774					9774
3	8154					8154	1474					1474	9627					9627
4	6466	67				6533	2916	34				2950	9382	101				9483
5	238	3370				3608	233	3305				3538	472	6675				7147
6	2	2882				2885	2	3648				3650	5	6530				6535
7		2024				2024		3458				3458		5482				5482
8		300	3			303		3325	33			3359		3626	36			3662
9		260	8			268		3144	135			3279		3404	144			3548
10		85	149			234		1129	2092			3221		1214	2241			3455
11		67	17			84		967	2317			3283		1034	2334			3367
12									2270			2270			2270			2270
13									2225			2225			2225			2225
14									2087	93		2180			2087	93		2180
15									1953	184		2137			1953	184		2137
16									947	1147		2094			947	1147		2094
17									840	1212		2052			840	1212		2052
18									824	1187		2011			824	1187		2011
19									807	1164		1971			807	1164		1971
20									791	1004	137	1931			791	1004	137	1931
21										901	162	1063				901	162	1063
22										540	502	1042				540	502	1042
23										473	548	1021				473	548	1021
24										441	510	952				441	510	952
25										363	471	834				363	471	834
26										291	401	692				291	401	692
27											366	366					366	366
28											334	334					334	334
29											300	300					300	300
30											270	270					270	270
TOTAL	32763.	9056.	178.	0.	0.	41997.	6521.	19010.	17322.	9000.	4000.	55853.	39284.	28066.	17500.	9000.	4000.	97849.
AVERAGE YEAR OF SERVICE																		
	2.39	6.06	10.01	0.0	0.0	3.21	3.08	7.34	13.74	19.50	25.06	12.06	2.50	6.93	13.70	19.50	25.06	8.26

Fig. 82 — Steady-state officer force (960 Academy accessions) — grade limitations model equal promotion opportunity step

IMPLIED FORWARD COMPUTATION PROMOTION PARAMETERS

GRADE	RATING	SOURCE OF COMMISSION	CUMULATIVE PROMOTION OPPORTUNITY		BELOW-THE-ZONE PROMOTIONS		PROMOTION PHASE POINT	ELIGIBLES	PROMOTIONS
			FIRST YEAR OF PRIMARY ZONE	SECOND YEAR OF PRIMARY ZONE	BELOW-THE-ZONE PROMOTION PCT.	FIRST YEAR BELOW THE-ZONE PERCENT			
CAP	PIL	AFA	93.41	93.41	1.50	0.0	5	583	545
CAP	PIL	ROTC	93.40	93.40	1.49	0.0	5	1501	1402
CAP	PIL	OTS	93.45	93.45	1.49	0.0	5	475	444
CAP	PIL	ALL	93.41	93.41	1.50	0.0	5	2559	2391
CAP	NAV	AFA	93.34	93.34	1.50	0.0	5	90	84
CAP	NAV	ROTC	93.38	93.38	1.51	0.0	5	674	630
CAP	NAV	OTS	93.41	93.41	1.51	0.0	5	500	467
CAP	NAV	ALL	93.39	93.39	1.51	0.0	5	1264	1181
CAP	NR	AFA	93.44	93.44	1.50	0.0	5	221	207
CAP	NR	ROTC	93.41	93.41	1.52	0.0	5	1362	1280
CAP	NR	OTS	93.39	93.39	1.52	0.0	5	1741	1636
CAP	NR	ALL	93.40	93.40	1.52	0.0	5	3323	3123
CAP	ALL	AFA	93.41	93.41	1.50	0.0	5	894	836
CAP	ALL	ROTC	93.40	93.40	1.51	0.0	5	3537	3312
CAP	ALL	OTS	93.40	93.40	1.52	0.0	5	2715	2547
CAP	ALL	ALL	93.40	93.40	1.51	0.0	5	7147	6695
MAJ	PIL	AFA	64.73	69.02	6.01	25.00	10	392	271
MAJ	PIL	ROTC	64.65	68.98	6.03	25.10	10	685	473
MAJ	PIL	OTS	64.76	69.11	6.03	25.10	10	217	150
MAJ	PIL	ALL	64.69	69.01	6.03	25.07	10	1294	894
MAJ	NAV	AFA	64.77	69.06	6.01	25.00	10	60	42
MAJ	NAV	ROTC	64.74	69.08	6.04	25.11	10	289	200
MAJ	NAV	OTS	64.62	68.94	6.04	25.11	10	215	149
MAJ	NAV	ALL	64.70	69.03	6.03	25.10	10	565	391
MAJ	NR	AFA	64.71	69.00	6.01	25.00	10	150	104
MAJ	NR	ROTC	65.08	69.42	6.08	25.24	10	636	443
MAJ	NR	OTS	65.09	69.44	6.08	25.25	10	810	564
MAJ	NR	ALL	65.05	69.39	6.08	25.22	10	1596	1110
MAJ	ALL	AFA	64.73	69.02	6.01	25.00	10	602	416
MAJ	ALL	ROTC	64.83	69.17	6.05	25.16	10	1611	1116
MAJ	ALL	OTS	64.95	69.29	6.07	25.20	10	1243	863
MAJ	ALL	ALL	64.86	69.19	6.05	25.15	10	3455	2395

Fig. 83 — Captain and major promotion parameters (960 Academy accessions) — grade limitations model equal promotion opportunity step

IMPLIED FORWARD COMPUTATION PROMOTION PARAMETERS

GRADE	RATING	SOURCE OF COMMISSION	CUMULATIVE PROMOTION OPPORTUNITY		BELOW-THE-ZONE PROMOTIONS		PROMOTION PHASE POINT	ELIGIBLES	PROMOTIONS
			FIRST YEAR OF PRIMARY ZONE	SECOND YEAR OF PRIMARY ZONE	BELOW-THE-ZONE PROMOTION PCT.	FIRST YEAR BELOW THE-ZONE PERCENT			
LTC	PIL	AFA	54.77	58.97	15.00	50.00	16	240	142
LTC	PIL	ROTC	54.73	58.93	15.00	50.00	16	416	246
LTC	PIL	OTS	54.79	58.99	15.00	50.00	16	132	78
LTC	PIL	ALL	54.75	58.95	15.00	50.00	16	787	466
LTC	NAV	AFA	54.88	59.09	15.00	50.00	16	37	22
LTC	NAV	ROTC	54.74	58.94	15.00	50.00	16	175	104
LTC	NAV	OTS	54.77	58.98	15.00	50.00	16	131	77
LTC	NAV	ALL	54.77	58.97	15.00	50.00	16	343	203
LTC	NR	AFA	54.80	59.01	15.00	50.00	16	92	54
LTC	NR	ROTC	54.77	58.97	15.00	50.00	16	384	227
LTC	NR	OTS	54.74	58.94	15.00	50.00	16	489	289
LTC	NR	ALL	54.75	58.96	15.00	50.00	16	964	571
LTC	ALL	AFA	54.79	58.99	15.00	50.00	16	369	218
LTC	ALL	ROTC	54.74	58.95	15.00	50.00	16	975	577
LTC	ALL	OTS	54.75	58.96	15.00	50.00	16	751	445
LTC	ALL	ALL	54.75	58.96	15.00	50.00	16	2094	1240
COL	PIL	AFA	48.17	53.52	30.00	80.00	22	120	66
COL	PIL	ROTC	48.21	53.57	30.00	80.00	22	208	114
COL	PIL	OTS	48.22	53.57	30.00	80.00	22	66	36
COL	PIL	ALL	48.20	53.55	30.00	80.00	22	395	216
COL	NAV	AFA	48.33	53.73	30.00	80.00	22	18	10
COL	NAV	ROTC	48.11	53.48	30.00	80.00	22	86	47
COL	NAV	OTS	48.15	53.53	30.00	80.00	22	64	35
COL	NAV	ALL	48.15	53.53	30.00	80.00	22	168	92
COL	NR	AFA	48.15	53.51	30.00	80.00	22	46	25
COL	NR	ROTC	48.18	53.55	30.00	80.00	22	190	104
COL	NR	OTS	48.10	53.46	30.00	80.00	22	242	133
COL	NR	ALL	48.14	53.50	30.00	80.00	22	478	262
COL	ALL	AFA	48.18	53.54	30.00	80.00	22	184	101
COL	ALL	ROTC	48.18	53.54	30.00	80.00	22	485	265
COL	ALL	OTS	48.13	53.49	30.00	80.00	22	373	204
COL	ALL	ALL	48.16	53.53	30.00	80.00	22	1042	570

Fig. 84 — Lieutenant colonel and colonel promotion parameters (960 Academy accessions) — grade limitations model equal promotion opportunity step

Appendix A
COMPUTER CHARACTERISTICS

The constraints model is written in FORTRAN IV and is operational on Rand's IBM 370/158 computer system. On this computer, the model requires less than 150K bytes (about 38K words) or core storage, and executes in from 12 to 60 CPU seconds depending on the output options requested. If no optional or detailed output reports are requested, a model run will generate about 70 pages of output. With full details and all optional output reports requested, a model run will generate about 250-300 pages.

We should point out that the constraints model requires less than 150 K bytes because it is highly segmented, with different program modules sharing the same core storage at different points during the model's execution. If the model were unsegmented, about 280K bytes (70K words) of core storage would be required.

Authorized users may obtain the constraints model as well as the other officer force models upon written request to Rand--a magnetic tape should be included. A program distribution package will be returned that provides detailed instructions on how to install the models. Every attempt has been made to avoid the use of non-standard FORTRAN or IBM 370-dependent features in the officer force models. Included in the program distribution package are suggestions for the removal of such features.

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Appendix B
DATASETS (FILES) USED BY CONSTRAINTS MODEL

In this appendix we describe the contents of the disk datasets used by the constraints model. All but one of these datasets are *temporary*, i.e., they are used as intermediate storage during a run of the constraints model.

The permanent dataset contains the executable load module of the constraints model from which the program is loaded into the computer at the beginning of a model run on the IBM 370 computer system. This dataset is neither read from nor written on by the program itself, and is used only by the 370 operating system to load the program into core storage.

The temporary datasets used directly by the constraints model are listed below:

FT02F001*	preliminary distribution OTS officer flows
FT035001	
FT11F001	implied progression model inputs computed by output package
FT12F001	
FT13F001	
FT14F001	
FT15F001	
FT16F001	

*FTxxF001 is the IBM 370 data definition name (DDNAME) that is associated with FORTRAN unit xx, e.g., FT02F001 refers to FORTRAN unit 2.

FT21F001
FT22F001
FT23F001
FT24F001
FT25F001
FT26F001
FT27F001
FT28F001
FT29F001
FT30F001
FT31F001

} implied grade limitations model inputs computed by output package

PRELIMINARY DISTRIBUTION OTS OFFICER FLOWS

After completing the preliminary distribution of OTS officers, the constraints model next determines the various rates and opportunities, e.g., rating transfer and loss rates and promotion opportunities, implied by the preliminary OTS force structure. These rates and opportunities are then fed into the progression model to determine the final OTS force structure.* Additionally, when the non-rated implications of the rated OTS force structure are being determined, at the inception of non-rated OTS processing, the rating transfer flows into the rated OTS force are needed.†

In both of the above cases, the constraints model needs the flows between the OTS officer states. But due to the nature of OTS processing and the manner in which OTS officers are distributed over the OTS officer states, it becomes inconvenient and costly to retain the officer flows in core storage. Two datasets, FORTRAN units 2 and 3, are employed to save these flows. Setting the seventh debugging flag to 30 results in a printout of these datasets.‡

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*See Sec. V. p. 108, for discussion of the preliminary and final OTS force structures.

†See Sec. V, p. 104, and App. D, p. 157.

‡See Sec. III, p. 42.

FT02F001 Each record on this dataset contains the following:

Word 1) record type
- 1, promotion flow (including augmentations)
- 2, loss flow
- 3, augmentation flow (including rating transfers and promotions)

2) component

3) grade

4) rating

5) source of commission

6) YOS out of which flow takes place

7) flow

FT03F001 Each record is similar to those for unit 2 except for the following:

Word 1) record type
- 4, rating transfer flow (including augmentation)

IMPLIED PROGRESSION MODEL INPUTS

The output package produces several reports that include implied progression model inputs, i.e., input parameters that, when provided to the progression model, would produce an identical force structure.* On request the output package will also generate an implied progression model input deck and write out onto disk the appropriate input parameters being computed for the printed report. FORTRAN units 11-16 are used.

FT11F001 One record is written onto this dataset, containing the following:

Word 1) 3HAFA (the character string 'AFA')

2) Academy accessions

3) 4HROTC

*See Sec. IV, p. 66, for details.

4) ROTC accessions
5) 4HSMSO
6) OTS accessions

FT12F001 Promotion parameters are saved on this dataset, and each record contains the following:

Word 1) grade name (alphanumeric name, CAP,..., COL)
2) rating name
3) source of commission name
4) first primary zone year promotion opportunity
5) second primary zone promotion opportunity
6) below-the-zone promotion percentage
7) first year below-the-zone promotion percentage
8) phase point

FT13F001 On this dataset loss rates are saved, and each record contains the following:

Word 1) component name
2) grade name
3) rating name
4) source of commission name
5) loss rate
6) year of service

FT14F001 Augmentation rates are saved on this dataset, and each record contains the following:

Word 1) grade name
2) rating name
3) source of commission name
4) augmentation rate
5) year of service from which augmentation takes place

FT15F001 and FT16F001 These datasets are used to save pilot and navigator rating transfer rates respectively, and each record contains the following:

Word 1) 3HPIL if unit 15
3HNAV if unit 16
2) source of commission name
3) rating transfer rate expressed as a fraction of annual accessions
4) year of service out of which rating transfer takes place

IMPLIED GRADE LIMITATIONS MODEL INPUTS

Just as the implied progression model inputs are saved on disk when an implied progression model input deck is r quested, the implied grade limitations model inputs are saved on disk when an implied grade limitations model input deck is requested. Units 21-31 are used for this purpose.

FT21F001 The detailed grade requirements are saved on this dataset, and each record contains the following (there are a total of 5 records):

Word 1) component
2) source of commission
3-7) pilot grade requirements, lieutenant through colonel
8-12) navigator grade requirements, lieutenant through colonel
13-17) non-rated grade requirements, lieutenant through colonel

FT22F001 This dataset is used to hold the ratios of promotion-augmentations into a grade to regular promotions into the grade. Each record contains the following (three records are generated):

Word 1) source of commission
2-5) pilot ratios, captain through colonel
6-9) navigator ratios, captain through colonel
10-13) non-rated ratios, captain through colonel

FT23F001 This dataset contains the ratios of augmentations in a grade to regular promotions into the grade. Three records are written, each containing the following:

Word 1) source of commission
2-5) pilot ratios, captain through colonel
6-9) navigator ratios, captain through colonel
10-13) non-rated ratios, captain through colonel

FT24F001 This dataset holds the ratios of regular rating transfers to augmentations only. One record, containing the following, is written:

Word 1) ROTC pilot ratio
2) ROTC navigator ratio
3) OTS pilot ratio
4) OTS navigator ratio

FT25F001 This dataset contains the ratio of rating transfer-augmentations to augmentations only. One record is written, containing the following:

Word 1) ROTC pilot ratio
2) ROTC navigator ratio
3) OTS pilot ratio
4) OTS navigator ratio

FT26F001 This dataset contains the rating transfer distributions. Each record contains the following:

Word 1) component
2) rating
3) source of commission
4) year of service
5) fraction of flows into year of service

FT27F001 This dataset is used to save the rating transfer-augmentation distributions, and each record contains the following:

Word 1) rating
2) source of commission
3) year of service
4) fraction of flows into year of service

FT28F001 The augmentation distributions are saved in this dataset, and each record contains the following:

Word 1) grade
2) rating
3) source of commission
4) year of service
5) fraction of flows into year of service

FT29F001 This dataset holds the promotion-augmentation distributions, and each record contains the following:

Word 1) grade (captain through colonel)
2) rating
3) source of commission
4) year of service
5) fraction of flows into year of service

FT30F001 On this dataset are saved the promotion distributions, and each record contains the following:

Word 1) component
2) grade (captain through colonel)
3) rating
4) source of commission
5) year of service
6) fraction of flows into year of service

FT31F001 This dataset holds the current officer states (the S array in the computer program), so that the subroutine that generates the grade limitations model input deck can use the S array for other purposes. The following two FORTRAN statements write and read the S array, whose dimensions are (3, 5, 3, 3, 17):

```
WRITE (31) S
READ  (31) S
```

Appendix C
ADJUSTING ROTC EOB LOSS RATES

Section V reviewed the constraints model logic applied to the ROTC commissioning source and discussed how the reserve lieutenant and captain loss rates in the EOB year are used to impose the career reserve requirement. Three types of career reserve requirements are available: the career reserve opportunity, number of career reserve selectees, and total career reservists.* This appendix presents the mathematical details of EOB loss rate adjustment for each of the types of career reserve input.

CAREER RESERVE ELIGIBLES

The career reserve requirement is provided as a mechanism for limiting the number of officers that become career reservists, where a career reservist is an officer holding a reserve commission whose year of service is greater than the EOB year. The EOB year is the first year of service during which an officer can voluntarily separate from the force. We define the number of officers *eligible* for career reserve status (with a given rating and reserve source of commission) to be those officers in their EOB year that remain after normal losses are removed. Thus, if we have the following for a given source of commission and rating:

l_i = the number of reserve lieutenants in year i, the EOB year.
c_i = the number of reserve captains in the EOB year.
bl_i = the loss rate for reserve lieutenants in the EOB year.
bc_i = the loss rate for reserve captains in the EOB year.

Then the number of reservists *eligible* for selection to career reserve status (E) is

*See Sec. III, p. 35.

$$E = l_i\ (1.0 - bl_i) + c_i\ (1.0 - bc_i),$$

that is, the number of reservists left after normal loss has taken place.

CAREER RESERVE OPPORTUNITY

When the career reserve requirement is specified as an opportunity, say CRO, then the number of career reservists selected (S) is given by:

$$\begin{aligned} S &= CRO \cdot E \\ &= CRO \cdot [l_i(1.0 - bl_i) + c_i(1.0 - bc_i)]. \end{aligned}$$

Since the constraints model utilizes the progression model to determine the officer structure, it is necessary to transform the career reserve opportunity into something that easily fits into the progression model framework. We do this by increasing EOB loss rates to bl_i' and bc_i' such that the following is satisfied:

$$CRO\ [l_i(1.0 - bl_i) + c_i(1.0 - bc_i)] = l_i(1.0 - bl_i') + c_i(1.0 - bc_i').$$

With the adjusted loss rates, bl_i' and bc_i', the progression model can be readily employed.

The above equation is really one equation in the two unknown adjusted loss rates. To completely determine the adjusted loss rates, another equation is needed. To obtain this second equation, we assume that the career reserve lieutenant and captain selectees are directly proportional to the career reserve lieutenant and captain eligibles, i.e.,

$$\frac{l_i(1.0 - bl_i)}{c_i(1.0 - bc_i)} = \frac{l_i(1.0 - bl_i')}{c_i(1.0 - bc_i')}.$$

Solving these two equations yields

$$bl_i' = 1.0 - CRO \cdot (1.0 - bl_i),$$

$$bc_i' = 1.0 - CRO \cdot (1.0 - bc_i).$$

CAREER RESERVE SELECTEES

If the career reserve requirement is specified to be the number of selectees N′, then we first estimate the career reserve opportunity implied by N′ selectees, and then utilize the algorithm just described. The career reserve opportunity is estimated by

$$CRO = \frac{N'}{l_i(1.0 - bl_i) + c_i(1.0 - bc_i)} .$$

TOTAL CAREER RESERVISTS

If the career reserve requirement is specified as the total number of career reservists (T′), then we first estimate the number of selectees, and utilize the above algorithms to adjust EOB loss rates. Consider the following variables:

T = the number of career reservists under normal losses.

T' = the desired number of career reservists.

l_{i+1} = the number of reserve lieutenants in the year after EOB under normal losses.

c_{i+1} = the number of reserve captains in the year after EOB under normal losses.

l'_{i+1} = the number of reserve lieutenants in the year after EOB if there were T′ career reservists.

c'_{i+1} = the number of reserve captains in the year after EOB if there were T′ career reservists.

The first step in the process is to determine l'_{i+1} and c'_{i+1}. We do this by solving the following two equations:

$$\frac{l_{i+1} + c_{i+1}}{l'_{i+1} + c'_{i+1}} = \frac{T}{T'},$$

$$\frac{l_{i+1}}{c_{i+1}} = \frac{l'_{i+1}}{c'_{i+1}},$$

whose solution is

$$l'_{i+1} = \frac{T'}{T} \cdot l_{i+1},$$

$$c'_{l+1} = \frac{T'}{T} \cdot c_{i+1}.$$

The next step in the procedure is to track l'_{i+1} and c'_{l+1} back to the point in the EOB year just after losses are removed, i.e., to the point where career reserve selection takes place. Consider the following variables:

sl'_i = the number of reserve *lieutenants in the EOB year* selected for career reserve status when there are T' career reservists.

sc'_i = the number of reserve captains in the EOB year selected for career reserve status when there are T' career reservists.

al_i = the input augmentation rate for lieutenants in the EOB year.

ac_i = the input augmentation rate for captains in the EOB year.

Then we can compute sl'_i and sc'_i in the following way:*

*The algorithm in the computer program also takes rating transfers and promotions into consideration.

$$sl'_i = \frac{l'_{i+1}}{(1.0 - al_i)} \quad ,$$

$$sc'_i = \frac{c'_{i+1}}{(1.0 - ac_i)} \quad .$$

We are now ready to employ the previous two algorithms by setting

$$N' = sl'_i + sc'_i \quad .$$

Appendix D
NON-RATED OTS LOGIC DETAILS

Section V described non-rated OTS logic but, for purposes of exposition, glossed over several details. This appendix treats those details. Figure D.1, which is identical to Fig. 62 of Sec. V, illustrates non-rated OTS logic, and Fig. D.2, identical to Fig. 63 of Sec. V, is a detailed schematic of the opportunity logic (box IX of Fig. D.1). The following detailed logic will be discussed in this appendix:

- Backing rating transfers into non-rated states (box I).
- Excessive regular officer logic (box IV).
- Selectee/Reservist logic (boxes VIII and X).
- EOB loss rate adjustment.

BACKING RATING TRANSFERS INTO NON-RATED STATES

At this point we are just beginning to process non-rated OTS officers, and we've just completed the processing of rated OTS officers. We know the rating transfer flows into the rated OTS force structure but do not know the non-rated implications of the rating transfer flows. This segment of logic determines those implications by determining the accessions and non-rated officer states for all non-rated lieutenants destined to ultimately become rated. The model first determines the highest year of service out of which rating transfer flows take place, and then works its way back, one year of service at a time until the first year of service is reached.

Figure D.3 illustrates the flows associated with movement from year i-1 to year i. We know s_i and S_i, the number of lieutenants in the reserve and regular non-rated states in year i.* Since we are dealing with non-rated officers whose ultimate destiny is to become rated, s_i and S_i will be zero in the first year under consideration, namely

*In this discussion lower case variables refer to reserve officers, and upper case variables refer to regular officers.

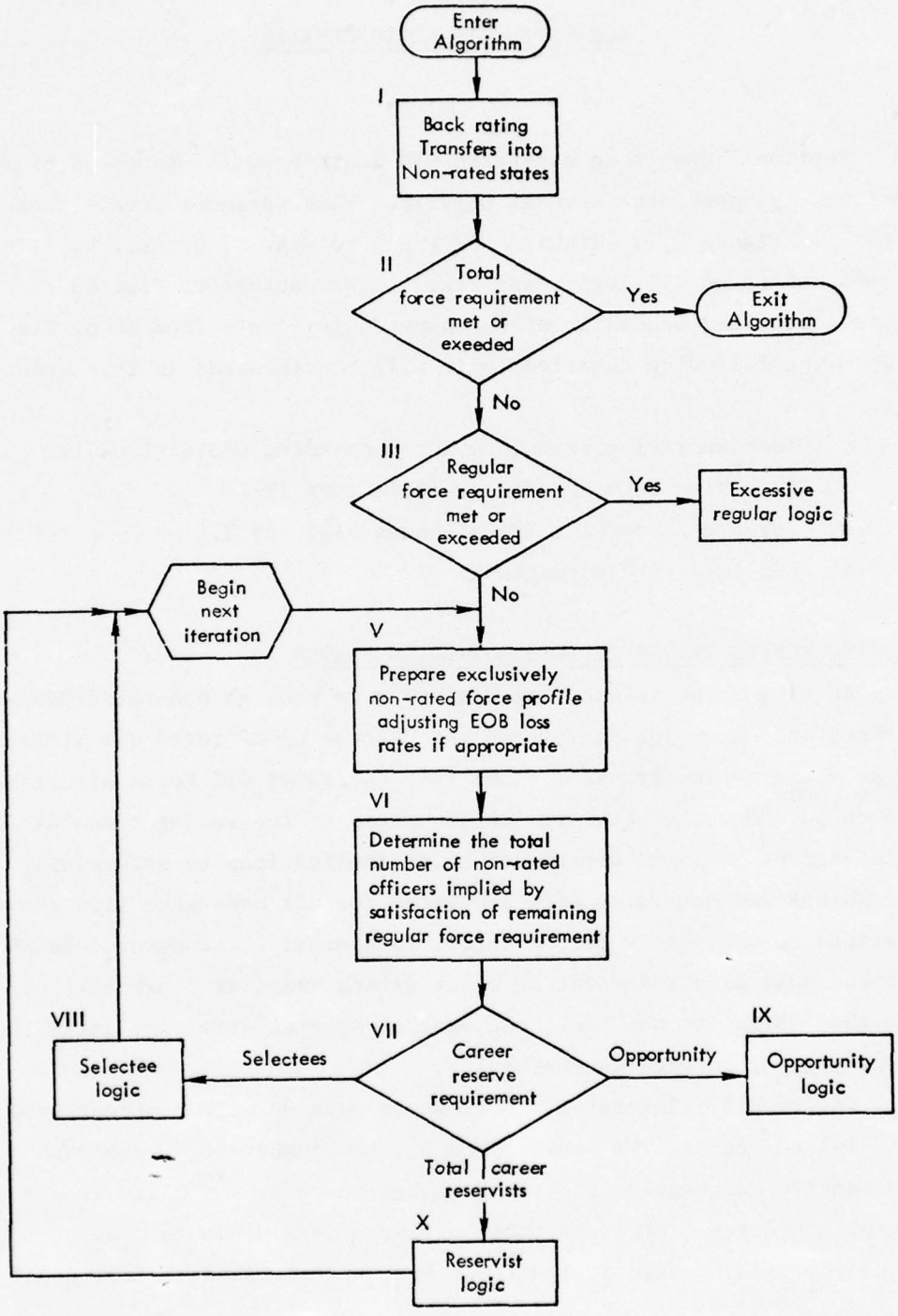


Fig. D.1 — Non-rated OTS logic

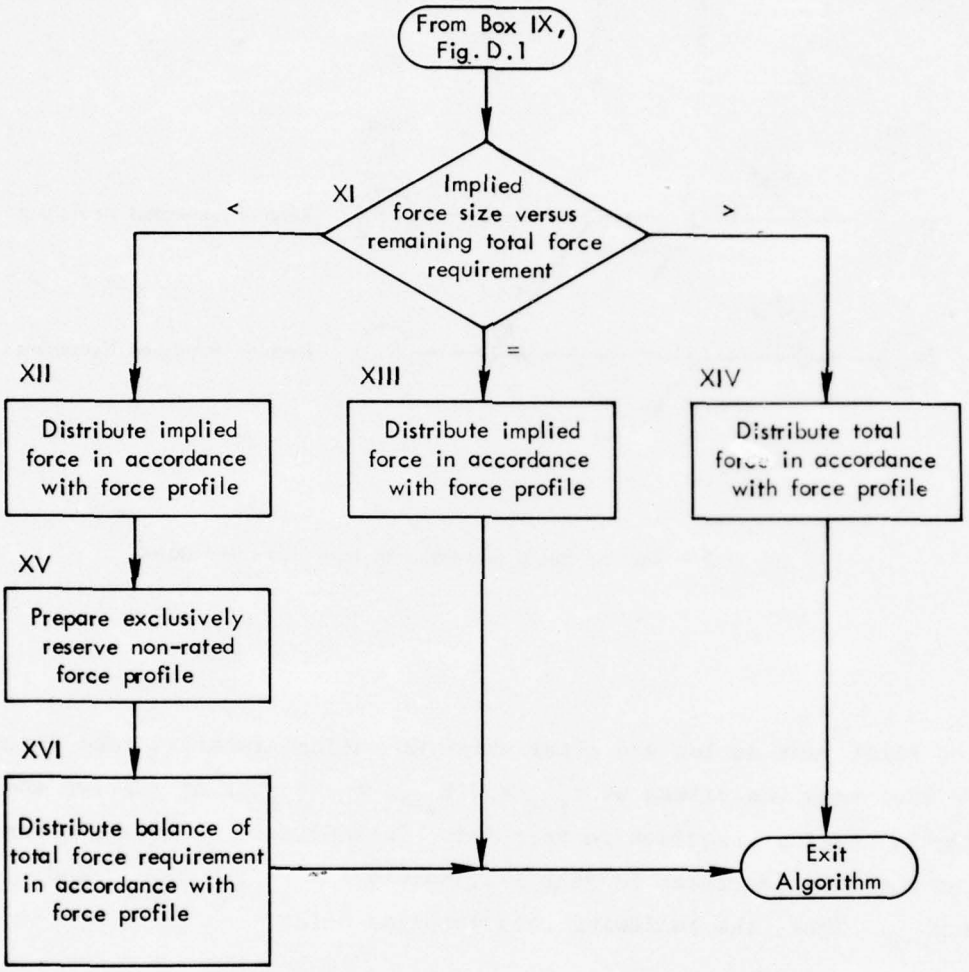


Fig. D.2 — Career reserve opportunity logic
(expansion of Box IX in Fig. D.1)

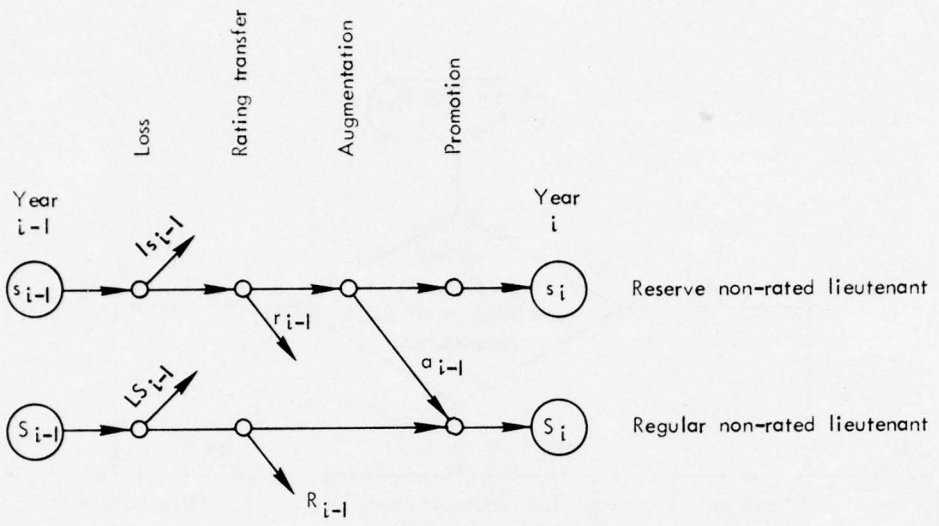


Fig. D.3 — Backing rating transfers into their non-rated states

the first year during and after which no rating transfers take place. We also know the values of r_{i-1} and R_{i-1}, the number of reserve and regular rating transfers in year i-1. In addition, we know the loss and augmentation rates in year i-1, namely $loss_{i-1}$, $LOSS_{i-1}$, and aug_{i-1}. Thus, the following relationships hold:

$$s_i = [s_{i-1} (1.0 - loss_{i-1}) - r_{i-1}] (1.0 - aug_{i-1}),$$

$$S_i = [S_{i-1} (1.0 - LOSS_{i-1}) - R_{i-1}]$$

$$+ [s_{i-1} (1.0 - loss_{i-1}) - r_{i-1}] aug_{i-1},$$

where s_{i-1} and S_{i-1} are the state values to be determined. Solving these equations yields:

$$s_{i-1} = \frac{1.0}{(1.0 - loss_{i-1})} \left[\frac{s_i}{(1.0 - aug_{i-1})} + r_{i-1} \right],$$

$$S_{i-1} = \frac{1.0}{(1.0 - LOSS_{i-1})}$$

$$\cdot \left[S_i + R_{i-1} - aug_{i-1} \left[s_{i-1} (1.0 - loss_{i-1}) - r_{i-1} \right] \right].$$

Thus we have determined the number of reserve and regular non-rated lieutenants in year i-1.

The model goes through the above process twice, once for pilot rating transfers and once for navigator rating transfers. In this manner, the annual accessions and non-rated states are determined for each rating (see Fig. 47 of Sec. IV).

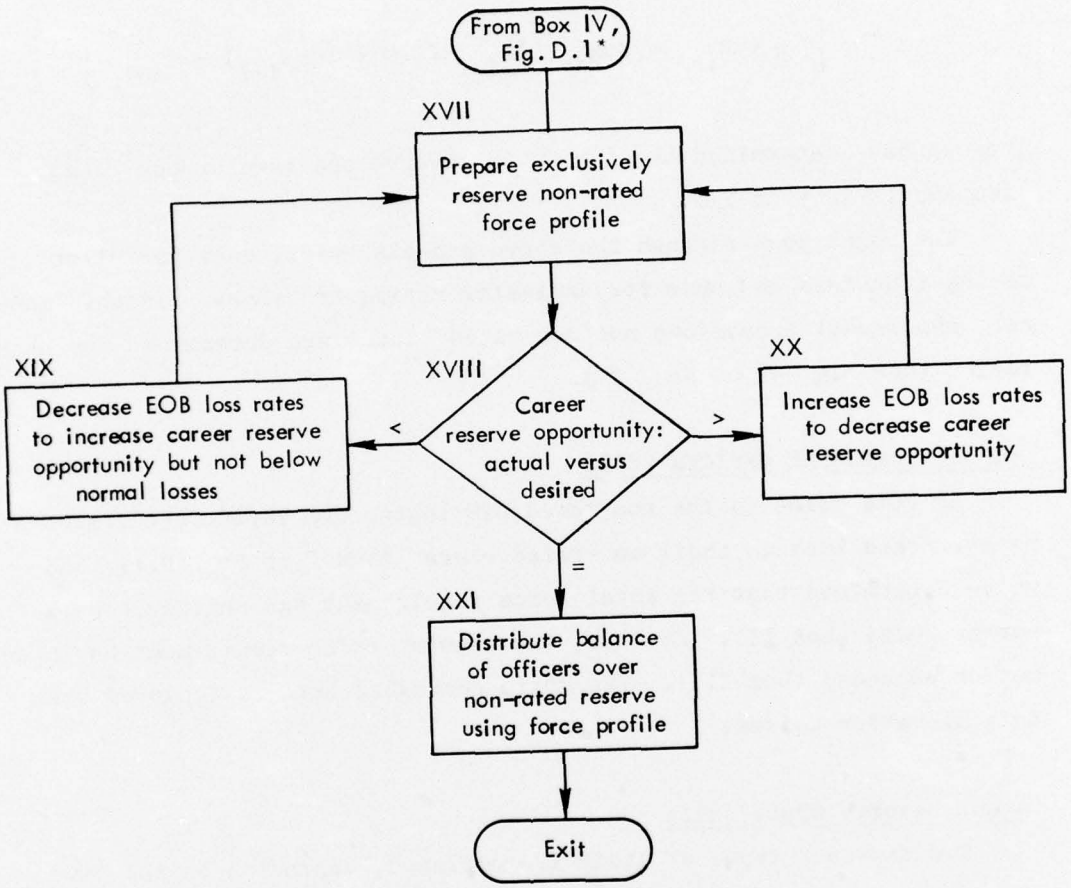
EXCESSIVE REGULAR OFFICER LOGIC

At this point in the non-rated OTS logic, the rated officers have been tracked back to their non-rated states (box I of Fig. D.1), and we've determined that the total force requirement has neither been met nor exceeded (box II). However, the regular force requirement has been met or exceeded (box III). The logic described here is employed when this situation arises.

Career Reserve Opportunity

Two distinct types of logic are employed, depending on the type of career reserve requirement.* Figure D.4 illustrates the logic employed when the career reserve requirement is an *opportunity*. Since we've already met or exceeded the regular force requirement, the logic focuses on non-rated reservists. An iterative technique is employed in an attempt to determine adjusted EOB loss rates that would satisfy the career reserve opportunity. As with other iterative processes in the

*See Sec. III, p. 35, to reveiw the three types of career reserve requirement and their impacts on officers in the EOB year.



*This logic is employed via Box IV of Fig. D.1 when the career requirement is an opportunity

Fig. D.4 — Excessive regular logic if career reserve requirement is an opportunity

constraints model, the user has control over the maximum number of iterations that can be employed (see Sec. III, p. 42).

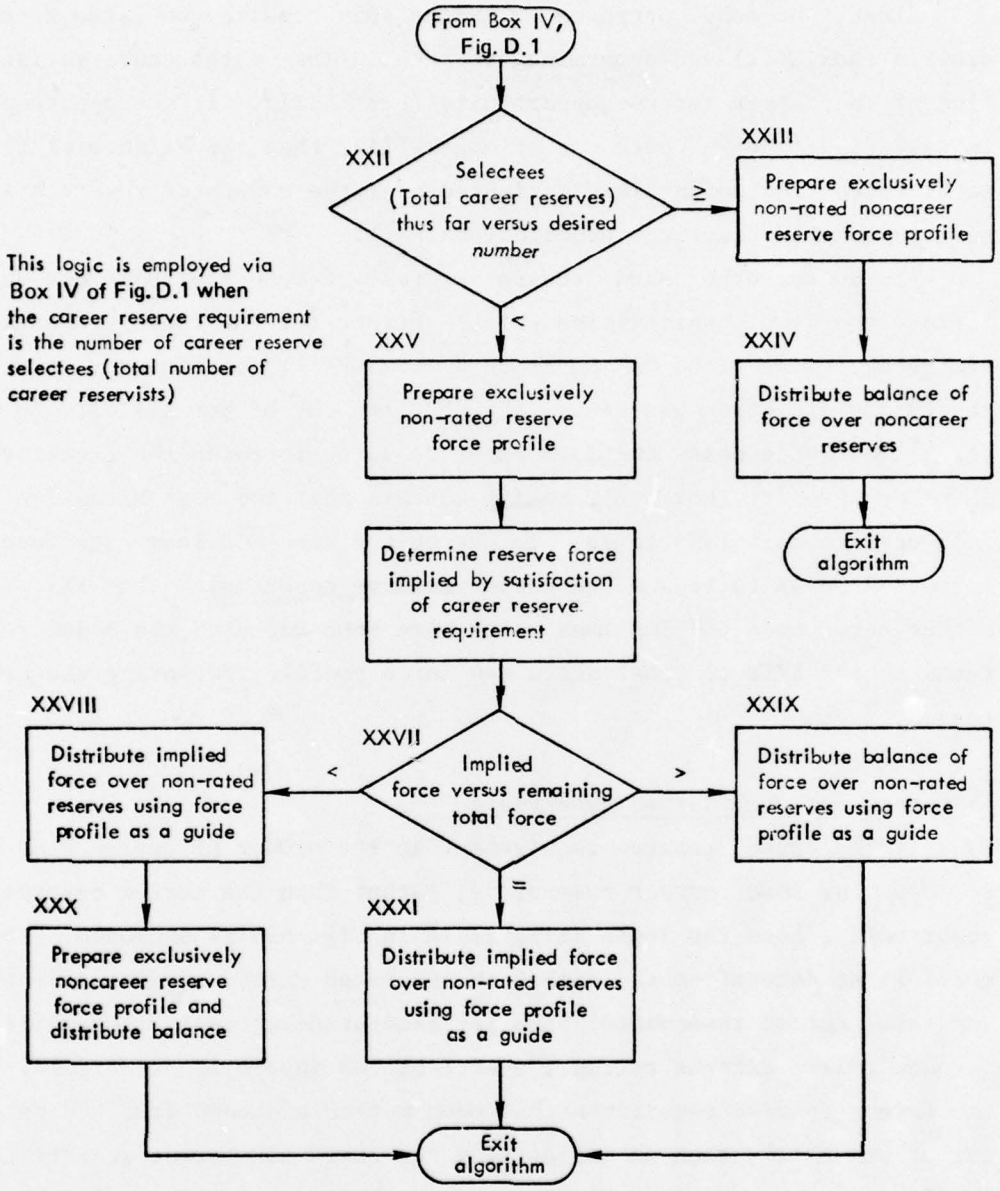
First, the model prepares an exclusively reserve non-rated force profile (box XVII) and determines if the EOB loss rates cause satisfaction of the career reserve opportunity (box XVIII). If the opportunity is satisfied (the "=" path out of box XVIII), then the balance of the total force requirement is distributed over the non-rated reserves in accordance with the force profile (box XXI).

If, on the other hand, the career reserve opportunity is not satisfied, then two possibilities exist: either too few career reservists are being created (the "<" path out of box XVIII), or too many career reservists are being generated (the ">" path out of box XVIII). In the first case we decrease EOB loss rates so as to increase the career reserve opportunity (box XIX), making certain that the loss rates don't fall below normal loss rates. In the second case EOB loss rates are increased so as to reduce the career reserve opportunity (box XX). In either case, once the EOB loss rates have been adjusted the model returns to box XVII to construct a new force profile, repeating the process.

Selectees or Total Career Reservists

If the career reserve requirement is the number of *career reserve selectees* or *total career reservists*, rather than the career reserve opportunity, then the logic illustrated in Fig. D.5 is employed. The model first determines the number of non-rated career reserve selectees (or total career reservists) thus far generated--normally there will be none unless extreme rating transfer or EOB inputs are specified. If the career reserve requirement has been met or exceeded (the ">" path out of box XXII), then an exclusively non-rated non-career reserve force profile is generated (box XXIII), and the balance of the total force requirement is distributed over the non-rated non-career reserves (box XXIV) is accordance with the force profile.

If the career reserve requirement has not been satisfied--we need either more career reserve selectees or total career reservists--the model takes the "<" path out of box XXII, generates an exclusively



This logic is employed via Box IV of Fig. D.1 when the career reserve requirement is the number of career reserve selectees (total number of career reservists)

Fig. D.5 — Excessive regular logic if career reserve requirement is number of selectees (total career reserves)

reserve non-rated force profile (box XXV), and determines the size of the force implied by satisfaction of the career reserve requirement (box XXVI). At this point three possibilities exist: (1) the implied force equals the remaining total force; (2) the implied force is less than the remaining total force; or (3) the implied force is greater than the remaining total force. If the implied force equals or exceeds the remaining total force (the "=" and ">" paths out of box XXVII), the model distributes the remaining total force in accordance with the force profile, and exits the algorithm. In this case, the career reserve requirement cannot be satisfied without exceeding the total force requirement, and the model opts to satisfy the total force requirement.

If the implied force is less than the remaining total force (the "<" path out of box XXVII), the model distributes the implied force in accordance with the force profile (box XXVIII), constructs an exclusively non-rated non-career reserve force profile, and distributes the balance of the total force requirement over the non-rated non-career reserve in accordance with the new force profile (box XXX). Both the career reserve and total force requirements are satisfied.

SELECTEE/RESERVIST LOGIC

This subsection discusses the logic employed when both the total force and regular force requirement have been neither met nor exceeded after the rated OTS officers have been backed into their non-rated states, and where the career reserve requirement is either career reserve selectees or total career reservists. Referring back to Fig. D.1, we are interested in boxes V, VI, VII, VIII, and X. The logic is iterative, the output from boxes VIII and X being adjusted EOB loss rates.

The model enters box V of Fig. D.1 knowing that slack still exists in both the regular force and total force requirements. An exclusively non-rated force profile is prepared, and the total number of non-rated officers implied by satisfaction of the regular requirement is determined. If the implied force were distributed in accordance with the force profile, then the regular force requirement would be satisfied. But there are two additional requirements to consider: the total force

requirement and the career reserve requirement. The force implied by satisfaction of the regular force requirement will either fall short of, satisfy, or exceed each of the two remaining requirements. Thus, there are nine distinct cases that must be handled.

Table D.1 defines the nine cases and describes the logic employed for each case. In *case 1*, both the total force requirement and career reserve requirement would be exceeded if the implied force were distributed over the non-rated force structure. The model increases the EOB loss rates in an attempt to satisfy the career reserve requirement, and goes back to try another iteration.

In *cases 2 and 3*, the implied force would either fall short of or meet the career reserve requirement, but the total force requirement would be exceeded. The model in these cases increases EOB loss rates in an attempt to reduce to total force size, and tries again. The next iteration will probably lead to *case 6* where the total force requirement is satisfied but the career reserve requirement is undersatisfied.

Cases 4 and 7 are similar to *case 1* in that the implied force would exceed the career reserve requirement, and they are processed just as *case 1*, with the EOB loss rates being increased in order to reduce the number of career reserve selectees or total career reservists. For these two cases the next iteration would probably lead to *case 8*, where the implied force would satisfy the career reserve requirement but would fall short of the total force requirement.

In *case 5*, the implied force satisfies both the career reserve requirement and the total force requirement. In this case the model distributes the implied force in accordance with the exclusively non-rated force profile prepared in box V of Fig. D.1. The algorithm is then exited.

In *case 6*, we find that the implied force satisfies the total force requirement but falls short of the career reserve requirement. When this occurs there is no way that the model can simultaneously satisfy the regular force, total force, and career reserve requirements. In order to get closer to the career reserve requirement, the model would have to reduce EOB loss rates; but such a reduction would cause the resulting implied force to exceed the total force requirement. Therefore,

Table D.1

NON-RATED OTS SELECTEES/RESERVIST LOGIC WHEN SLACK EXISTS IN THE TOTAL FORCE AND REGULAR FORCE REQUIREMENTS[a]

Career Reserve Requirement	Total Force Requirement: Exceeded	Satisfied	Below
Exceeded	Case 1 Increase EOB loss rates to reduce number of selectees or total career reservists	Case 4 Same as Case 1	Case 7 Same as Case 1
Satisfied	Case 2 Increase EOB loss rates to reduce size of force	Case 5 ** Successful ** distribute implied officer force	Case 8 ** Successful ** distribute implied force over non-rated reserve and balance over non-career reserve
Below	Case 3 Same as Case 2	Case 6 ** Partial success ** distribute implied officer force. Career reserve requirement under-satisfied	Case 9 Decrease EOB loss rates to increase selectees or total career reservist if they cannot be reduced, process as Case 8

[a]Boxes VIII and X of Fig. D.1.

when *case 6* occurs, the model opts to provide fewer career reserve officers than would be needed to satisfy the career reserve requirement. The total force and regular force requirements are satisfied. The implied force is distributed in accordance with the force profile generated in box V of Fig. D.1, and the algorithm is exited.

In *case 8*, the career reserve requirement is satisfied, but the implied force falls short of the total force requirement. Thus, the implied force satisfies the career reserve and regular force requirements, but falls short of the total force requirement. In this case, the model first distributes the implied force (thereby satisfying the career reserve and regular force requirements), creates an exclusively non-rated non-career reserve force profile (augmentations and career reservists are prohibited), and distributes the balance of the total force requirement in accordance with the new force profile. Note that this has the effect of reducing the non-rated OTS augmentation rates. At the conclusion of *case 8* processing, all three requirements are met, and the algorithm is exited.

The final case, *case 9*, finds that the implied force falls short of both the total force and career reserve requirements. There are two possibilities in this case. If the EOB loss rates can be reduced, they are reduced in an attempt to permit satisfaction of the career reserve requirement, and the algorithm goes back for another try. If, however, the EOB loss rates cannot be further reduced, then the model proceeds as in *case 8*.

EOB LOSS RATE ADJUSTMENT

In the above cases, the EOB loss rates are adjusted using the following formula:

$$EOBNEW = EOBOLD \cdot REQDES/REQIMP,$$

where

EOBNEW is the newly adjusted EOB loss rate (one for lieutenant and one for captain),

EOBOLD	is the old EOB loss rate (one for lieutenant and one for captain),
REQDES	is the desired requirement value,
REQIMP	is the requirement value implied by either the force profile or implied force size.

EOBNEW is not permited to fall below the *normal* loss rate provided in the input parameters, nor is it permitted to exceed unity.

Appendix E
WARTIME REQUIREMENT GRADE AND YEAR LIMITS

The constraints model contains a BLOCK DATA subprogram in which several arrays are initialized to default values. The default values can be easily altered by simply recompiling the subprogram. Figure E.1 is a listing of the subprogram.

The three program statements with sequence numbers 0520, 0530, 0540 set upper limits on both the grades and years of service that apply to the satisfaction of the wartime rated officer requirements. The two variables and their meanings are

HIRTYR(IR) - the highest year of service an officer with rating IR can have in order to be included in the satisfaction of the rating's wartime requirement.

HIRTGD(IR) - the highest grade an officer with rating IR can have in order to be included in the satisfaction of the rating's wartime requirement.

The default values currently in effect are 28 years of service and grade 4, lieutenant colonel. By changing the data statement (#0540), these defaults can be changed. Pilot (IR=1) grade and year limits can be different than those for navigators (IR=2).

```
      BLOCK DATA                                                                BLCK   -
C                                                                               BLCK0060
      COMMON / TITLE  / TITLE(20),  IPAGE                                       BLCK0070
      DATA                          IPAGE / 0 /                                 BLCK0080
C                                                                               BLCK0090
C                                                                               BLCK0100
      COMMON / ABORT  / IABORT                                                  BLCK0110
      DATA              IABORT / 0 /                                            BLCK0120
C                                                                               BLCK0130
C                                                                               BLCK0140
      COMMON / NAMES  / CNAMES(3),  GNAMES(5),  RNAMES(6),  SNAMES(6),          BLCK0150
     1                  CMPIDS(3,2),GRDIDS(5,1),RATIDS(6,3),SRCIDS(6,3)        BLCK0160
      INTEGER           CMPIDS,     GRDIDS,     RATIDS,     SRCIDS              BLCK0170
C                                                                               BLCK0180
      DATA  CNAMES / 3HRES, 3HREG, 3HALL /                                      BLCK0190
      DATA  CMPIDS(1,1), CMPIDS(1,2) / 1, 0 /,                                  BLCK0200
     1      CMPIDS(2,1), CMPIDS(2,2) / 2, 0 /,                                  BLCK0210
     2      CMPIDS(3,1), CMPIDS(3,2) / 1, 2 /                                   BLCK0220
C                                                                               BLCK0230
      DATA  GNAMES / 2HLT, 3HCAP, 3HMAJ, 3HLTC, 3HCOL /                         BLCK0240
      DATA  GRDIDS(1,1) / 1 /,                                                  BLCK0250
     1      GRDIDS(2,1) / 2 /,                                                  BLCK0260
     2      GRDIDS(3,1) / 3 /,                                                  BLCK0270
     3      GRDIDS(4,1) / 4 /,                                                  BLCK0280
     4      GRDIDS(5,1) / 5 /                                                   BLCK0290
C                                                                               BLCK0300
      DATA  RNAMES / 3HPIL, 3HNAV, 2HNR, 3HSUP, 3HRAT, 3HALL /                  BLCK0310
      DATA  RATIDS(1,1), RATIDS(1,2), RATIDS(1,3) / 1, 0, 0 /,                  BLCK0320
     1      RATIDS(2,1), RATIDS(2,2), RATIDS(2,3) / 2, 0, 0 /,                  BLCK0330
     2      RATIDS(3,1), RATIDS(3,2), RATIDS(3,3) / 3, 0, 0 /,                  BLCK0340
     3      RATIDS(4,1), RATIDS(4,2), RATIDS(4,3) / 3, 0, 0 /,                  BLCK0350
     4      RATIDS(5,1), RATIDS(5,2), RATIDS(5,3) / 1, 2, 0 /,                  BLCK0360
     5      RATIDS(6,1), RATIDS(6,2), RATIDS(6,3) / 1, 2, 3 /                   BLCK0370
C                                                                               BLCK0380
      DATA  SNAMES / 3HAFA, 4HROTC, 4HSMSG, 3HCTS, 3HRES, 3HALL /               BLCK0390
      DATA  SRCIDS(1,1), SRCIDS(1,2), SRCIDS(1,3) / 1, 0, 0 /,                  BLCK0400
     1      SRCIDS(2,1), SRCIDS(2,2), SRCIDS(2,3) / 2, 0, 0 /,                  BLCK0410
     2      SRCIDS(3,1), SRCIDS(3,2), SRCIDS(3,3) / 3, 0, 0 /,                  BLCK0420
     3      SRCIDS(4,1), SRCIDS(4,2), SRCIDS(4,3) / 3, 0, 0 /,                  BLCK0430
     4      SRCIDS(5,1), SRCIDS(5,2), SRCIDS(5,3) / 2, 3, 0 /,                  BLCK0440
     5      SRCIDS(6,1), SRCIDS(6,2), SRCIDS(6,3) / 1, 2, 3 /                   BLCK0450
C                                                                               BLCK0460
      COMMON / ITERAT / MAXITR                                                  BLCK0470
      DATA              MAXITR / 10 /                                           BLCK0500
      COMMON / SVRATE / SAVE                                                    BLCK0505
*     LOGICAL           SAVE                                                    BLCK0506
      DATA              SAVE   / .FALSE. /                                      BLCK0507
C                                                                               BLCK0510
      COMMON / HIRATE / HIRTYR(2),  HIRTGD(2)                                   BLKC0520 }
      INTEGER           HIRTYR,     HIRTGD                                      BLKC0530 } Wartime rated officer
      DATA              HIRTYR,     HIRTGD / 28, 28, 4, 4 /                     BLKC0540 } requirement limits
C                                                                               BLKC0550
      END                                                                       BLKC0560
```

Fig. E.1— Constraints model block data subprogram

REFERENCE

Department of the Air Force, *The USAF Personnel Plan*, Volumes I through VIII, Washington, D.C., 1 April 1971.

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The model described is one of a set of computer-based models designed to provide personnel planners with broadly based aggregated data and detailed officer inventories and flows reflecting the effects of policies and conditions under investigation. Air Force personnel planners often face policy alternatives that lead to changes in the size of the officer force, the rated officer force, accessions, training rates, loss rates, promotion policies, or augmentation opportunities. When the planner inputs these alternatives into the constraints model, the model then estimates the effects of these changes on the number of officers who are lost, promoted, augmented, or who are otherwise changing from one state to another. The report presents several highly simplified numerical examples and compares this model with other models in the set. (BG)