AD-A243 092

NAVAL POSTGRADUATE SCHOOL

Monterey, California

DTIC
ELECTE
DEC 09 1991
S B D

THESIS

A MANPOWER PLANNING MODEL FOR
THE COMPOSITION OF OFFICERS OF
THE INDONESIAN ARMY PERSONNEL SYSTEM

by

Suryadi

December, 1990

Thesis Advisor: Kneale T. Marshall

Approved for public release; distribution is unlimited

91-17294

Unclassified

security classification of this page

REPORT DOCUMENTATION PAGE

1a Report Security Classification Unclassified	1b Restrictive Markings
2a Security Classification Authority	3 Distribution Availability of Report Approved for public release; distribution is unlimited.
2b Declassification Downgrading Schedule	
4 Performing Organization Report Number(s)	5 Monitoring Organization Report Number(s)
6a Name of Performing Organization Naval Postgraduate School — 6b Office Symbol *(if applicable)* 30	7a Name of Monitoring Organization Naval Postgraduate School
6c Address *(city, state, and ZIP code)* Monterey, CA 93943-5000	7b Address *(city, state, and ZIP code)* Monterey, CA 93943-5000
8a Name of Funding Sponsoring Organization — 8b Office Symbol *(if applicable)*	9 Procurement Instrument Identification Number
8c Address *(city, state, and ZIP code)*	10 Source of Funding Numbers Program Element No — Project No — Task No — Work Unit Accession No

11 Title *(include security classification)* A MANPOWER PLANNING MODEL FOR THE COMPOSITION OF OFFICERS OF THE INDONESIAN ARMY PERSONNEL SYSTEMS

12 Personal Author(s) Suryadi

13a Type of Report	13b Time Covered	14 Date of Report *(year, month, day)*	15 Page Count
Master's Thesis	From To	December 1990	91

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

17 Cosati Codes			18 Subject Terms *(continue on reverse if necessary and identify by block number)*
Field	Group	Subgroup	The Grade/Time-in-Grade model, APL programs, and application.

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

This thesis documents the methodology and parameters used in designing a manpower planning model using the Grade / Time-in-Grade model for controlling the composition of Indonesian Army officers. This model of a manpower system consists of a two-dimensional state space Markov Model with special structure. The model provides manpower planners with the capability of testing alternative policies and adjusting model parameters to improve the use of personnel resources that are from three sources (Military Academy, Officer Military School, Officer Candidate School). Use of the model is illustrated in a detailed analysis of its application to Indonesian Army officers in steady-state. The calculations of stocks, time in grade or time in military, and promotion rate for every rank are included as the model's output. The thesis is presented with the user in mind, emphasizing the importance of a thorough understanding of the factors that influence planning in manpower system.

20 Distribution Availability of Abstract ☒ unclassified unlimited ☐ same as report ☐ DTIC users	21 Abstract Security Classification Unclassified	
22a Name of Responsible Individual Kneale T. Marshall	22b Telephone *(include Area code)*	22c Office Symbol OR Mt

DD FORM 1473,84 MAR — 83 APR edition may be used until exhausted. All other editions are obsolete — security classification of this page

Unclassified

Approved for public release; distribution is unlimited.

A Manpower Planning Model For The Composition Of Officers Of The Indonesian Army Personnel Systems

by

Suryadi
Major , Indonesian Army
B.S., Indonesian Armed Forces Academy, 1974 Magelang

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN OPERATIONS RESEARCH

from the

NAVAL POSTGRADUATE SCHOOL
December 1990

Author: ______________________
Suryadi

Approved by: ______________________
Kneale T. Marshall, Thesis Advisor

____
Lyn R. Whitaker, Second Reader

____
Peter Purdue, Chairman,
Department of Operations Research

ABSTRACT

This thesis documents the methodology and parameters used in designing a manpower planning model using the Grade / Time-in-Grade model for controlling the composition of Indonesian Army officers. This model of a manpower system consists of a two-dimensional state space Markov Model with special structure. The model provides manpower planners with the capability of testing alternative policies and adjusting model parameters to improve the use of personnel resources that are from three sources (Military Academy, Officer Military School, Officer Candidate School). Use of the model is illustrated in a detailed analysis of its application to Indonesian Army officers in steady-state. The calculations of stocks, time in grade or time in military, and promotion rate for every rank are included as the model's output. The thesis is presented with the user in mind, emphasizing the importance of a thorough understanding of the factors that influence planning in manpower system.

Accession For
NTIS GRA&I ☑
DTIC TAB ☐
Unannounced ☐
Justification
By
Distribution/
Availability Codes
Dist | Avail and/or Special
A-1

QUALITY INSPECTED 4

TABLE OF CONTENTS

LIST OF TABLES

ACKNOWLEDGEMENTS

I would like to express my gratefulness to the people who has provided assistance in preparation of this thesis. Special thank to my lovely wife (Purwanawati) and my children (Noval Fath S., and Annisa Shabrina S.) for their patience and support. My particular gratitude to Prof. Kneale T. Marshall PhD and Prof. Lyn R. Whitaker PhD for their patience and guidance during the completion of this thesis.

I. INTRODUCTION

A. PROBLEM

The Defense Manpower System is essentially a closed hierarchical structure that is subject to the constant changes in the economy and in government policies. A dynamic environment such as this routinely dictates that a manpower manager possess the capability of rendering not only timely, accurate, and decisive solutions to immediate personnel problems, but also of preparing to predict and analyze long-range effects of available alternatives.

The Manpower planners of the Indonesian Army currently want to have a small organization that is effective. The officer personnel part of the organization in accordance with the organization's need have to control the total number of officers in the organization, the number of personnel for every grade, and time in grade for every rank. The officer personnel composition control can not be detached from the factors of uncertainty which create difficulties in the planning process.

In composition control of the Indonesian Army, three main problems encompass the appointment of officers. They are:

1. Recruitment.
   Officers are usually recruited from three different sources, namely (1) the Military Academy (MA) whose graduates are directed for long range goals, (2) the Military School (OMS), and (3) the Officer Candidate School (OCS). Officers from these last two are directed for short-range purposes. The age difference from these three sources at the time of their appointment as officers, can be seen from the entry of the type of officers.

2. Promotions.
   Promotion are given to those who have achieved outstanding performance in the military as well as in civic mission.

3. Separation from the Indonesian Army organization.
   Separation from the Indonesian Army usually due to termination of office includes discharge with honor as well as unhonorable discharges.

B. BACKGROUND

The Indonesian National Army, known as the Tentara Nasional Indonesia Angkatan Darat with the acronym of TNI-AD, is an integral part of the ABRI (the Armed Forces of the Republic of Indonesia) that is directly under the command of the commander of the Armed Forces. TNI-AD's main functions are:

1. To uphold the sovereignty of the state on land. To defend the entity of the national region together with the whole of the defence forces components of the state.
2. As a social force, to participate, actively in matters of social politics in the framework of securing and bring to success the struggle of the people towards the independence as well as in raising the welfare of the entire population of Indonesia based on the Pancasila (Five Principles) and the UUD 1945 (the 1945 Constitutions).
3. To guarantee the safety security of enterprise and activities and the execution of the main duty of the TNI-AD.

The TNI-AD is organized in 2 levels namely, the HQ (Head Quarters) level of TNI-AD with the acronym of (MABESAD) and the Komando Utama TNI-AD (Main Command of the Indonesian Army) with the acronym (KOTAMA TNI-AD). The MABESAD level consists of a Leadership Echelon, a Staff Echelon, a Maintenance Echelon, and the Execution Staff Echelon.

The Main Command level of the TNI-AD is composed of the Strategic Reserve Command of TNI-AD (KOSTRAD), the Special Force Command (KOPASUS) and the Military Area Command (KODAM). The organization structure of the Units that comprise of the Operation Units, the Supporting and Maintenance Units, the Territorial Units, the Intelligence Units organized based on the Organization Table and Personnel (TOP, "Tabel Organisasi dan Personil") along with the Personnel Organization List and Equipment (DSPP, "Daftar Susunan Personil dan Peralatan").

The organization of the units are based on TOP (for Operation Units and Intelligence Units) and DSPP (for Territorial Units and Supporting and Maintenance Units). This organization is designed for the allocation of personnel needed by the organization for executing their main duty as well as for controlling composition of the personnel. The rank composition of the units will determine the rank composition within the organizational circle of TNI-AD.

Officers are the leader elements within the TNI-AD organization, and start their career from the time they are commissioned as 2nd Lieutenant. During active duty, an officer is provided with various kinds of knowledge through formal as well as informal education, along with experience from assignments in various positions. Going through the various assignments an officer is evaluated and thereby receives a promotion as an appreciation for their achievement(s).

Transitions occur during an officer's career within the scope of the TNI-AD organization. These transitions include promotion as an appreciation for their achievement during the execution of their duties, and separation from TNI-AD. The promotion transitions constitute the functions of input and the output that occur to and from all ranks. Recruitment results in input to the rank of 2nd Lt. The separation from TNI-AD encompass officers who are pensioned, or leave the TNI-AD organization.

To uphold the main duty of TNI-AD, control of the composition of officers is needed, including a plan for the filling-in of officer personnel in accordance with the need of the organization.

C. OBJECTIVE

The purpose of this thesis is to apply the Grade / Time-in-Grade manpower model found in Ref. 3 to analyze the officer composition of the Indonesian Army (TNI-AD). This model is a Markov model with a 2-dimensional state space. As the name implies, each state in the Markov chain consists of a grade and the length of time an officer has been in that grade. Time periods are years, and the grades are the six ranks from 2nd Lt through Colonel.

The planning of the appointment/commissioning of officers from the Military Academy (MA), the Officer Military School (OMS), and the Officer Candidate School (OCS) sources, is important for the control of the officers rank composition within the TNI-AD organization.

This model provides the following results: the time-in-military as well as time-in-grade for each source (MA, OMS, OCS), and the number of personnel and total years in each grade. The model is designed to provide the manpower manager with a method of measuring the effects in planning of future policy changes on the rank structure of TNI-AD. Examples are used to illustrate this.

D. ORGANIZATION OF THE THESIS

The concepts involved in the Grade / Time-in-Grade Model are covered in the second chapter. In Chapter III the APL programs for calculation in the Grade / Time-in-Grade model is provided. Chapter IV presents the application of this model to the Indonesian Army (TNI-AD). Chapter V gives conclusions and recommendations.

II. THE GRADE / TIME-IN-GRADE MODEL

A. INTRODUCTION

The development and use of manpower planning models within the TNI-AD would provide policy makers with the capability of early detection and selection of appropriate responses to potential manpower problems. In addition, adoption of these models to existing computer technology could significantly enhance the policy-making process, offering considerable saving in time and accuracy. There is, however, an inherent human shortfall associated with the acceptance of any computer-driven model. All too frequently, after the model has become a part of an established system, the policy maker blindly accepts the computer's results without understanding what the model does and why.

In an attempt to overcome this shortfall, Chapter II discusses in some detail the methods used in designing the Grade / Time-In-Grade model [Ref. 1: p. xx].

B. MODEL DESCRIPTION

A mathematical model is the structuring of a set of pertinent parameters arising from a given problem into a mathematical equation. In its mathematical form the model can then be used to assist in solving that problem. The Grade / Time-in-Grade Model is chosen to structure the TNI-AD officer manpower system. Each officer is counted at discrete time points (yearly), and at each of these times the officer is given a two-dimensional state, (i,j). The first index represents the officers first characteristic (FC) or grade of an individual in a system where no demotions can occur and where a person cannot advance more than one grade per year, and the second index or second characteristic (SC) represents the time spent in the particular grade [Ref. 3: p. 238].

Manpower input requirements for all grades of officers from 2nd Lt. until Col. can be filled from any of sources: MA, OMS, and OCS. The following personnel flows are studied in the model: the number of new recruits, the number of personnel that stay in each grade, the number of promotions, and the number of personnel that leave the system during the given time period.

In a organization such as the TNI-AD where the manpower flow is continuous and dynamic, it becomes extremely difficult to determine the impact of policy changes. Experts have found that an effective method of studying a system such as this is to assume a state of equilibrium (in steady-state) [Ref. 1: pp. 9-11].

1. Structure and Mathematical Notation

The material in this section is contained in [Ref. 3: pp. 235-251]. It is reproduced here for convenience. The structure and mathematical notation used in the Grade/Time-in-Grade (TIG) model as follows:

a. We assume that for planning purposes an organization considers time in discrete periods, and that people are counted at the end of each period. When counted, a person is assumed to possess two characteristics i and j, and is said to be in state (i,j), where i represents the first characteristic (FC), $1 \leq i \leq n$, and j represents the second characteristic (SC), $l(i) \leq j \leq u(i)$. Here $l(i)$ and $u(i)$ are the lower and upper limits respectively for the SC when i is the FC. Also let $J(i) = [j | l(i) \leq j \leq u(i)]$, the set of SC's for FC i, and let w_i be the number of elements in $J(i)$. When the SC is TIG, $l(i) = 1$ for every i.

b. Let $q_i(j,m)$, where $j,m \in J(i)$ be the fraction of people in state (i,j) in a time period who move to state (i,m) in the next time period, and let Q_i be the $w_i \times w_i$ matrix $[q_i(j,m)]$. For the TIG model only movement from (i,j) to $(i,j+1)$ is possible in one time period for a given FC i when no promotion occurs. Let $q_i(j,j+1) = q_{ij}$ for $j = 1,2,\ldots\ldots\ldots,u(i) - 1$. Then each Q_i has the structure as follows:

$$Q_i = \begin{bmatrix} 0 & q_{i,1} & 0 & - & 0 \\ 0 & 0 & q_{i,2} & - & 0 \\ 0 & 0 & 0 & - & 0 \\ - & - & - & - & - \\ 0 & 0 & 0 & - & q_{i,u(i)-1} \\ 0 & 0 & 0 & - & 0 \end{bmatrix}, \tag{1}$$

where transition matrix Q_i has non-zero elements only immediately above the main diagonal, and dimensions $u(i) \times u(i)$.

c. Let $p_i(j,m), j \in J(i), m \in J(i+1)$ be the fraction of people in state (i,j) in a time period who move to state $(i+1,m)$ in the next time period, and let P_i be the $w_i \times w_{i+1}$ matrix $[p_i(j,m)]$. For the TIG model, only movement from (i,j) to $(i+1,1)$ is possible for a given i when promotion occurs. Let $p_i(j,1) = p_{ij}$. Then each matrix P_i has a single column of non-zeros, with the following structure:

$$P_i = \begin{bmatrix} p_{i1} & 0 & - & 0 \\ - & - & - & - \\ p_{i,u(i)} & 0 & - & 0 \end{bmatrix}. \tag{2}$$

Thus P_i has dimensions $u(i) \times u(i+1)$.

d. Let Q be the fractional flow matrix for all active states in the system. Then Q has the following structure:

$$Q = \begin{bmatrix} Q_1 & P_1 & 0 & - & 0 & 0 \\ 0 & Q_2 & P_2 & - & 0 & 0 \\ 0 & 0 & Q_3 & - & 0 & 0 \\ - & - & - & - & - & - \\ 0 & 0 & 0 & - & Q_{n-1} & P_{n-1} \\ 0 & 0 & 0 & - & 0 & Q_n \end{bmatrix}, \tag{3}$$

where the zeros, represent that matrices have all elements equal to 0.

e. Define $N = (I - Q)^{-1}$, where I is the identity matrix. Each element of N is the expected number of visits to the column state starting from the row state. N is usually called the fundamental matrix. Then N has the structure as follows:

$$N = \begin{bmatrix} N_1 & N_1P_1N_2 & N_1P_1N_2P_2N_3 & - & \prod_{i=1}^{n-1}(N_iP_i)N_n \\ 0 & N_2 & N_2P_2N_3 & - & \prod_{i=2}^{n-1}(N_iP_i)N_n \\ 0 & 0 & N_3 & - & \prod_{i=3}^{n-1}(N_iP_i)N_n \\ - & - & - & - & - \\ 0 & 0 & 0 & - & N_n \end{bmatrix}, \tag{4}$$

where $N_i = (I - Q_i)^{-1}$, $i = 1,......,n$ the fundamental matrix for FC i.

2. Definitions and Equations

Let T_i be the set of states associated with FC i; thus

$$T_i = [(i,j)|j \in J(i)],\ i = 1,2,.....,n.$$

Also let $w_i = u(i) - l(i) + 1$, the number of state in T_i (and $J(i)$). Finally let T_0 be the single state "out of the system". Note that for the TIG model $w_i = u(i)$, since $l(i) = 1$

Recall that we assume system matrix Q has a fundamental matrix $N = (I - Q)^{-1}$, and each element of N is the expected number of visits to the column state starting from the row state. Note that the large matrix N is completely determined by the matrices N_i and P_i, as shown in equation (4). Thus the only matrix inversions required are those of $(I - Q_i)$, $i = 1,....,n$. This is of considerable computational significance when Q is a large matrix.

Each matrix N_i has a probabilistic interpretation. We pursue this interpretation and show that these matrices can be used to determine other probabilistic properties of interest.

In this section we make numerous definitions and denote the k^{th} one by Dk. Let us consider first the properties associated with a single set of states T_i and define:

D1. $v_i(j,m)$ = expected number of visit to state (i,m) given that FC_i is entered in state (i,j),

V_i = a $w_i \times w_i$ matrix having $v_i(j,m)$ as the element in row $j - l(i) + 1$ and column $m - l(i) + 1$.

From (4) the element of N_i in row $j - l(i) + 1$ and column $m - l(i) + 1$ equals the expected number of visit to state (i,m) given that FC_i is entered in state (i,j). So, from definition D1, we have:

$$V_i = N_i. \tag{5}$$

Note that the rows and columns of N_i and V_i correspond to states in T_i in the same order as the rows and columns of Q_i.

Now define:

D2. $\tau_i(j)$ = expected time in FC_i given that FC_i is entered in state (i,j),

$\tau_i = [\tau_i(l(i)),....,\tau_i(u(i))]$, a $w_i \times 1$ vector. The expected time spent in FC i equals the sum of the expected number of visits to the various states in FC i. From (5) and D2,

$$\tau_i(j) = \text{ component } (j - l(i) + 1) \text{ of } N_i\bar{1},$$

$$\tau_i = N_i\bar{1}, \quad \text{a } w_i \times 1 \text{ vector ,} \tag{6}$$

where $\bar{1}$ is a vector with all components equal to one.

We next turn our attention to where the process goes when it leaves FC i . The process upon leaving T_i must enter either T_{i+1} (if $i < n$) or T_0. Next define,

D3. $b_i(j,m)$ = probability of entering FC $i + 1$ in state $(i + 1,m)$ given that FC i is entered in state (i,j),

B_i = a $w_i \times w_{i+1}$ matrix having $b_i(j,m)$ as the element in row $j - l(i) + 1$, and column $m - l(i) + 1$. Note that for the TIG model, only the first column is positive.

D4. $b_i(j)$ = probability of ever entering T_{i+1} given that FC i is entered in state (i,j),

$b_i = [b_i(l(i)),....,b_i(u(i))]$, a $w_i \times 1$ vector,

D5. $b_{i0}(j)$ = probability of never entering T_{i+1} given that FC i is entered in state (i,j),

$b_{i0} = [b_{i0}(l(i)),....,b_{i0}(u(i))]$, a $w_i \times 1$ vector.

From these definitions it follows that

$$B_i = N_i P_{i,} \text{ a } w_i \times w_i \text{ matrix,} \tag{7}$$

$$b_i = B_i\bar{1}, \text{ a } w_i \times 1 \text{ vector, and} \tag{8}$$

$$b_{i0} = \bar{1} - b_i.$$

The matrix B_i is particularly useful in manpower policy analysis. For example let f_i be a $1 \times w_i$ vector of the number of people entering T_i. Then f_iB_i is a $1 \times w_{i+1}$ vector of the number of these people who will evetually enter T_{i+1}. Thus B_i can be used to reveal the promotion structure in the Grade/TIG model.

Next we consider the first-order properties related to FC i and k where $i \leq k$.

Define :

D6. $b((i,j),(k,m))$ = probability of entering FC k in state (k,m) given that FC i is entered in state (i,j),

B_{ik} = a $w_i \times w_k$ matrix having b((i,j),(k,m)) as the element in row $j - l(i) + 1$ and column $m - l(k) + 1$. From definitions D3 and D6 and a simple conditioning argument we have,

$$b((i,j),(i+2,m)) = \sum_{r=l(i+1)}^{u(i+1)} b_i(j,r)b_{i+1}(r,m), \text{ and} \tag{9}$$

$$B_{i,i+2} = B_iB_{i+1}. \tag{10}$$

Notice from D6 that B_{ii} is an identity matrix and from D3 that $B_{i,i+1} = B_i$. More generally it can be shown that for $i \leq k$,

$$B_{ik} = \prod_{r=1}^{k-1} B_{r,} \text{ a } w_i \times w_k \text{ matrix .} \tag{11}$$

Define:

D7. $v((i,j),(k,m))$ = expected number of visits to state (k,m) given that FC i is entered in state (i,j),

$V_{ik} = a\ w_i \times w_k$ matrix having $v((i,j),(k,m))$ as the element in row $j - l(i) + 1$ and column $m - l(k) + 1$,

D8. $b_{ik}(j)$ = probability of ever entering FC k, given that FC i is entered in state (i,j),

$b_{ik} = [b_{ik}(l(i)),....,b_{ik}(u(i))]$, a $w_i \times 1$ vector. Considering each row of B_{ik} as the part of an initial probability vector that applies to T_k, we then have,

$$V_{ik} = B_{ik}N_{k,} \text{ a } w_i \times w_k \text{ matrix, and} \tag{12}$$

$$b_{ik} = B_{ik}\bar{1}, \text{ a } w_i \times 1 \text{ vector.} \tag{13}$$

Define:

D9. $\tau_{ik}(j)$ = expected time in FC k given that FC i was entered in state (i,j),

$\tau_{ik} = [\tau_{ik}(l(i)),..., \tau_{ik}(u(i))]$, a $w_i \times 1$ vector. The expected time in an FC is the sum of the expected number of visits to states in that FC, so

$$\tau_{ik} = V_{ik}\bar{1}, \text{ a } w_i \times 1 \text{ vector.} \tag{14}$$

So far we have discussed measures related to "stocks" and "flows" in steady-state (equilibrium). The rationale underlying the use of such models is that one should determine the organization structure that results from long-term application of policies. We now turn to the transient structure of the manpower system.

Let, $s_{ij}(t)$ = expected stocks in state (i,j) at time t, $s_i(t) = (s_{i,l(i)}(t),...,s_{i,u(i)}(t))$, a $1 \times w_i$ vector of expected stocks in T_i, $s(t) = (s_1(t),.......,s_n(t))$, a $1 \times \sum_{i=1}^{n} w_i$ vector of expected stocks in the system. Let $f_{ij}(t)$ = expected external flow into state (i,j) during period t, a scalar, and let $f_i(t) = (f_{i,l(i)}(t),...f_{i,u(i)}(t))$, a $1 \times w_i$ vector.

Assume that external flows are the same in all periods, so that

$$f_i(t) = f_{i,} \quad t = 1,2......., \quad i = 1.......,n. \tag{15}$$

Then using the basic stock equation,

$$s_i(t) = s_i(t-1)Q_i + f_i + s_{i-1}(t-1)P_{i-1,} \quad i = 1,....,n. \tag{16}$$

It is easy to show that,

$$s_1(t) \to f_1 N_1, \text{ as } t \to \infty \tag{17}$$

Now recursively define,

$$\tilde{s}_1 = f_1 N_1,$$

$$\tilde{s}_i = (f_i + \tilde{s}_{i-1} P_{i-1}) N_i, \quad i = 1,\dots,n. \tag{18}$$

Then it can be shown that $s_i(t) \to \tilde{s}_i$ as $t \to \infty$, and

$$\tilde{s}_i = \sum_{k=1}^{i} f_k B_{ki} N_i, \quad i = 1,\dots,n. \tag{19}$$

Note that,

$$\sum_{k=i}^{i} f_k B_{ki}$$

is a non-negative $1 \times w_i$ vector, so the limiting vector of stocks in grade i must be a non-negative combination of the rows of N_i. Thus, in general, not all non-negative $1 \times w_i$ vector are possible limiting stock vectors under constant external flows.

The next chapter contains some computer programs to calculate these measures of interest. They are written in the APL language for fast interactive use and simple modification.

III. THE PROGRAM FOR CALCULATIONS

A. INTRODUCTION

This chapter contains computer programs to calculate measures of interest to answer problems of manpower. The program language utilized is APL executed on the IBM 3033 system 370 mainframe computer. First, the program interactively solicits input to create the Q_i matrics, P_i matrics and the Q matrix, Second, the program solves for the fundamental matrix. Finally, a set of programs are written to evaluate stocks, and calculate B_i, b_i and V_{ik}.

B. THE APL PROGRAMS

1. Q_i Matrix

The purpose of this program is to organize the Q_i matrix in accordance with its structure [see (1), Chapter II], with this program we will be able to organize Q_i matrix on every grade (Q_1,Q_2,Q_3,Q_4,Q_5,Q_6), and for each source (MA, OMS, OCS). The program Q_i are as follows:

```
       - Q-QMATRIX I
[1]    J←I
[2]    Q←(I,J)ρ0
[3]    L←0
-4-    'ENTER NON ZERO VALUES OF Q-MATRIX'
[5]    QQ←⎕
[6]   LOOP:L←L
[7]    →(L=J-1)ρOK
[8]    Q[L+1;L+2]←QQ[L+1]
[9]    L←L+1
[10]   →(L≠J)ρLOOP
[11]   →0
[12] OK: ⍝YOU HAVE DONE
       ∇
```

2. P_i Matrix

The use of this program is to organize the P_i matrix in accordance with its structure [see (2), Chapter II], with this program we will be able to organize P_i matrix on every grade (P_1,P_2,P_3,P_4,P_5,P_6), and for each source (MA, OMS, OCS). The program P_i are as follows:

```
      - P-PMATRIX I
[1]     J←I
[2]     P←(I,J)ρ0
[3]     'INPUT THE VALUES FROM COLUMN ONE OF P-MATRIC'
[4]     PP←⎕
[5]     P[;1]←PP
        ∇
```

3. Q Matrix

The purpose of this program is to organize the Q matrix in accordance with its structure [see (3), Chapter II], with this program we will be able to organize Q matrix for each source (MA, OMS, OCS). The program Q are as follows:

```
        ∇ QBIGMAT
-1-     'ENTER THE NUMBER OF ROWS OR COLUMNS OF SUBMATRIC Q1'
[2]     A←⎕
-3-     'ENTER THE NUMBER OF ROWS OR COLUMNS OF SUBMATRIC Q2'
[4]     B←⎕
-5-     'ENTER THE NUMBER OF ROWS OR COLUMNS OF SUBMATRIC Q3'
[6]     C←⎕
-7-     'ENTER THE NUMBER OF ROWS OR COLUMNS OF SUBMATRIC Q4'
[8]     D←⎕
-9-     'ENTER THE NUMBER OF ROWS OR COLUMNS OF SUBMATRIC Q5'
[10]    E←⎕
-11-    'ENTER THE NUMBER OF ROWS OR COLUMNS OF SUBMATRIC Q6'
[12]    F←⎕
[13]    J←I←A+B+C+D+E+E
[14]    K←(I-E)+F
[15]    QB←(I,J)ρ0
[16]    QB[ιA;ιA]←Q1←QMATRIC A
[17]    QB[ιA;A↓ι(A+A)]←P1←PMATRIC A
```

```
[18]   QB[A↓⍳(A+B);A↓⍳(A+B)]←Q2←QMATRIC B
[19]   QB[A↓⍳(A+B);(A+B)↓⍳(A+B+B)]←P2←PMATRIC B
[20]   QB[(A+B)↓⍳(A+B+C);(A+B)↓⍳(A+B+C)]←Q3←QMATRIC C
[21]   QB[(A+B)↓⍳(A+B+C);(A+B+C)↓⍳(A+B+C+C)]←P3←PMATRIC C
[22]   QB[(A+B+C)↓⍳(A+B+C+D);(A+B+C)↓⍳(A+B+C+D)]←Q4←QMATRIC D
[23]   QB[(A+B+C)↓⍳(A+B+C+D);(A+B+C+D)↓⍳(A+B+C+D+D)]←P4←PMATRIC D
[24]   QB[(A+B+C+D)↓⍳(A+B+C+D+E);(A+B+C+D)↓⍳(A+B+C+D+E)]←Q5←QMATRIC E
[25]   QB[(A+B+C+D)↓⍳(A+B+C+D+E);(A+B+C+D+E)↓⍳(A+B+C+D+E+E)]←P5←PMATRIC E
[26]   QB[(A+B+C+D+E)↓⍳(A+B+C+D+E+F);(A+B+C+D+E)↓⍳(A+B+C+D+E+F)]←Q6←QMATRIC F
[27]   QBIG←QB[⍳K;⍳K]
       ∇
```

4. Fundamental Matrix

System matrix Q has a fundamental matrix, $N = (I - Q)^{-1}$; matrix Q_i also has fundamental matrix $N_i = (I - Q_i)^{-1}$. This program can be used to calculate the fundamental matrix mentioned above, where I is an identity matrix that is made in identity matrix program are as follows:

```
       ∇ R←IDEN N
[1]    R←(⍳N)∘.=⍳N
       ∇
```

Furthermore program fundamental matrix are as follows:

```
       ∇ R←FUNDMAT QBIG;DIM;IM
[1]    DIM←1↑⍴QBIG
[2]    IM←IDEN DIM
[3]    R←⌹(IM-QBIG)
       ∇
```

5. Stocks

This program stocks (number of personnel) for every grade and for every period, where the above mentioned stocks are in steady-state. It requires input the total number of recruitment from each source (MA, OMS, OCS). From the evaluation with the use of this program, the following can be obtained, that is the number of years within the military. The stocks program are as follows:

```
∇ SS←SSSTOCK QBIG;DIM
'INPUT THE NUMBER OF RECRUITMENT'
RECV←⎕
N←FUNDMAT QBIG
V←+/N
TIM-1 ROUND V
DIM←1↑⍴QBIG
RECV←RECV,(DIM-1)⍴0
SS←RECV+.×FUNDMAT QBIG
SS←0 ROUND SS
TSS←+/SS
'IF YOU WANT TO KNOW TIME-IN-MILITARY, TYPE TIM'
'THIS IS THE OUTPUT OF STOCK IN STEADY STATE :'
∇
```

6. Promotion Rate

Recall B_i and b_i from Chapter II [see (7), (8)]. To calculate B_i and b_i, the following program is used:

```
∇ QI PROM PI
NI←FUNDMAT QI
BI←NI+.×PI
BS←BI+.×((1↑⍴BI)⍴1)
VIK←BI+.×NI
TIG←VIK+.×((1↑⍴VIK)⍴1)
BI←3 ROUND BI
BS←3 ROUND BS
VIK←3 ROUND VIK
TIG-1 ROUND TIG
'IF YOU WANT TO KNOW PROMOTION RATE, TYPE BI OR BS'
'IF YOU WANT TO KNOW TIME-IN-GRADE, TYPE TIG'
∇
```

7. The Expected Time in Grade

Recall V_{ik} and τ_{ik} from Chapter II [see (12), (14)]. Then to calculate V_{ik} and τ_{ik} , the following program is used:

```
      ∇ QI PROM PI
[1]     NI←FUNDMAT QI
[2]     BI←NI+.×PI
[3]     BS←BI+.×((1↑ρBI)ρ1)
[4]     VIK←BI+.×NI
[5]     TIG←VIK+.×((1↑ρVIK)ρ1)
[6]     BI←3 ROUND BI
[7]     BS←3 ROUND BS
[8]     VIK←3 ROUND VIK
-9-     TIG-1 ROUND TIG
[10]    'IF YOU WANT TO KNOW PROMOTION RATE, TYPE BI OR BS'
[11]    'IF YOU WANT TO KNOW TIME-IN-GRADE, TYPE TIG'
      ∇
```

Note; The rounding of the number of results from the calculation result mentioned, the following program is being used:

```
      ∇ RD←ZZ ROUND XX
[1]     RD←(⌊0.5+XX×10*ZZ)÷10*ZZ
      ∇
```

IV. APPLICATION TO THE INDONESIAN ARMY (TNI-AD)

A. INTRODUCTION

In this chapter the Grade / Time-in-Grade model is used to model the composition of the the officers of the TNI-AD. Emphasis is on the steady state results.

In this analysis, we first discuss the data compilation, then we perform "model fitting", so that it can be applied in the TNI-AD, and finally we carry out the calculations for the model.

B. GENERAL INFORMATION

The TNI-AD is organized based on TOP (for Operational Units and Intelligence Units), and DSPP (for Territorial Units and Supporting and Maintainance Units), with the intention to determine the allocation of the number of personnel needed by the organization to carry out their main duty and to control the personnel rank composition within the organization. In ideal conditions, the organization can execute its main duty most effectively if the total number of personnel in hand is in accordance with TOP / DSPP.

In the framework of personnel development, during his or her active term of duty, an officer can be given various types of assignment within the different offices that differ both within as well as outside the TNI-AD organization. Officer(s) can be assigned outside the TNI-AD organization, both within as well as outside the sphere of the Indonesian Department of Defence & Security / the Indonesian Armed Forces (HANKAM / ABRI), results in higher requirements that would be needed just for officers of the TNI-AD.

The officer(s) promotion period in every grade is determined with the minimum and maximum officer's term of office, as follows:

1. From 2nd Lt to 1st LT, minimum in the military 3 years, and maximum in the military 8 years.
2. From 1st LT to Capt, minimum in the military 6 years, and maximum in the military 11 years.
3. From Capt to Maj, minimum in the military 11 years, and maximum in the military 15 years.
4. From Maj to LCol, minimum in the military 15 years, and maximum in the military 19 years.

5. From LCol to Col, minimum in the military 19 years, and maximum in the military 25 years, and the minimal age of 40.
6. From Col to Brig Gen, after minimum time in grade of Col level for 2 years.
7. From Brig Gen to Maj Gen etc. Based on need of the organization and assignment.

The minimum term of office can only be obtained by officers with excellent records and potential. When an officer reaches the maximum term in rank, the person concerned will be given the option to terminate their contract. Promotion from Col to the Flag Officer, is not considered in this thesis.

C. DATA

Data connected with recruitment, promotion, and officer personnel separation of the TNI-AD has been obtained from the Indonesian Army Computer Center (DISPULLAHTAD), as well as the Staff Personnel TNI-AD.

The above mentioned data are grouped in accordance with the officer source (MA, OMS, and OCS) and can be seen in Appendix A.

D. MODEL FITTING

The Grade / Time-in-Grade model discussed in Chapter II, is now applied to TNI-AD officers who come from different sources (MA, OMS, OCS). Therefore this model was applied separately to each of the three sources of the above mentioned TNI-AD officers.

For each officer source (MA, OMS, OCS), we need to determine the structure of Q_i matrix, P_i matrix, and Q matrix as follows:

1. Q_i Matrix Derivation

To obtain Q_i matrix for every grade, q_{ij} [from (1) Chapter II] can be derived from:

$$q_{ij} = \frac{\begin{array}{c}\text{the number of personnel in state } (i,j) \\ \text{who stay in rank } i \text{ during time period}\end{array}}{\begin{array}{c}\text{the total number of personnel} \\ \text{who start the time period in state } (i,j)\end{array}}$$

Furthermore, from the q_{ij} mentioned above the Q_i matrix can be organized by the use of "program QMATRIC", in order to obtain Q_i matrix that is in accordance with its structure [from (1) Chapter II].

Example;

By the use of data 2nd LT from MA (Appendix A, Table 6) the q_{ij} is derived,

- $q_{11} = \frac{717}{717} = 1$
- $q_{12} = \frac{717}{717} = 1$
- $q_{13} = \frac{711}{717} = 0.992$
- $q_{14} = \frac{246}{711} = 0.346$
- $q_{15} = \frac{53}{246} = 0.215$
- $q_{16} = \frac{20}{53} = 0.377$
- $q_{17} = \frac{5}{20} = 0.250$
- $q_{18} = 0$

Then with the use of "program QMATRIC" [from Chapter III] the Q_1 matrix can be organized as follows:

$$Q_1 = \begin{bmatrix} 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0.992 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0.346 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0.215 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0.377 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.250 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}.$$

For other Q_i matrix of each grade and for each source (MA, OMS, OCS) the following can be shown at the Appendix B.

2. P_l Matrix Derivation

From the above mentioned data, p_{ij} can be calculated as the fraction promoted every period.

$$p_{ij} = \frac{\text{the number promoted from } (i,j) \text{to } (i+1,1) \text{during time period}}{\text{the total number who start the time period in } (i,j)}$$

Then, from p_{ij} the P_l matrix can be obtained by the use of "program PMATRIC" [from Chapter III].

Example;

We use again the data 2nd Lt from MA (Appendix A, Table 6) that was derived from p_{ij} ,

- $p_{11} = \frac{0}{717} = 0$
- $p_{12} = \frac{0}{717} = 0$
- $p_{13} = \frac{0}{717} = 0$
- $p_{14} = \frac{453}{711} = 0.637$
- $p_{15} = \frac{177}{246} = 0.720$
- $p_{16} = \frac{24}{53} = 0.453$
- $p_{17} = \frac{8}{20} = 0.400$
- $p_{18} = 0$

From the p_{ij} , and with the use of "program PMATRIC" the P_1 matrix's:

$$P_1 = \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0.637 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0.720 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0.453 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0.400 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}.$$

P_i matrices at every grade and for every source (MA, OMS, OCS) are shown in Appendix C.

3. Q Matrix Derivation

After obtaining the Q_i matrix and P_i matrix for every grade, the Q matrix [from (3) Chapter II] can be constructed using the "program QBIGMAT" [from Chapter III].

Note;

- Q matrix for MA : 68×68
- Q matrix for OMS : 62×62
- Q matrix for OCS : 71×71

For matrices of this size, it was not found necessary to use the result in equation (4) of Chapter II.

E. CALCULATIONS

Having obtained the Q_i , P_i , and Q matrices for every source (MA, OMS, OCS), using the formulas [see Chapter II], and the computer programs [see Chapter III], we are ready to apply the model to calculate measures of interest and/or test the effects of various policy changes.

1. Time in Military Computation

Time in military is the time an individual is commissioned 2nd Lt until they leave the system. To calculate time in military:

- Calculate the fundamental matrix $N = (I - Q)^{-1}$, with the use of "program IDEN and program FUNDMAT" [from Chapter III].
- From the N, with the use of "program SSSTOCK" [from Chapter III]. Expected time in military (ETIM) can be derived.

The results of ETIM calculations can be seen from the Table 1.

Table 1. EXPECTED TIME IN MILITARY FOR EVERY SOURCE.

SOURCE	TIME IN MILITARY
MA	25.3 years
OMS	22.9 years
OCS	19.4 years

2. Time in Grade Computation

The calculation of time in grade (TIG) is to see how long one stays in a rank, in order to fulfill the requirement for promotion to next higher rank. With the use of formula from D8, D9, and (14) [Chapter II], and the program "PROM" for every grade, Time in grade is compiled for every grade. Results of the computations are shown in Table 2.

Table 2. EXPECTED TIME IN GRADE FOR EVERY SOURCE.

RANK	TIME IN GRADE (YEARS)		
	MA	OMS	OCS
2nd Lt	4.1	4.2	4.7
1st LT	5.6	4.9	4.6
Capt	6.0	6.4	4.9
Maj	4.7	5.2	5.6
LCol	3.4	2.8	1.8
Col	2.6	1.3	1.2

Note, we can see from Table 2 that for 2nd LT's from MA the stay in grade is 4.1 years, from OMS is 4.2 years, and from OCS is 4.7 years, and so on. The officers from MA stay in grade longer than those officers from OMS and OCS, becauce officers from MA are prepared for a long range in military career, and because the officers from MA are younger, when they enter TNI-AD as 2nd LT.

3. Promotion Rate Computation

With the use of formula from D3, D4, D5, and (7) [Chapter II], promotion rate is calculated with the use of "program PROM" for every grade. The results of promotion rate (B_i) computations can be seen from Appendix D.

The results of this promotion rate (the matrix B_i) are very essential in manpower policy analysis, because we can calculate the flow of officers from grade i to $(i + 1)$.

For example;

- Let f_1 = [300 0 0 0 0 0 0 0], that is, we recruit 300 people as 2nd Lt's from MA.
- B_1 = promotion rate from 2nd LT to 1st LT for officers from MA.

Now we calculate $f_1 \times B_1$:

$$[300\ 0\ 0\ 0\ 0\ 0\ 0\ 0]\begin{bmatrix} .924 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ .924 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ .924 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ .931 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ .850 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ .604 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ .400 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix} = [277.2\ 0\ 0\ 0\ 0\ 0\ 0\ 0].$$

Thus, we can see 277 of the 300 entering officers from the MA eventually become 1st LT's. From this result, we can calculate from 1st Lt to Capt using B_2, and the calculation is as mentioned above. So, we can see that of the 300 entering officers from the MA become Capt is 252. The calculation can continue until the grade of Col.

4. Stock Computations

We now calculate the steady state stocks that result from a given recruiting policy. The stocks ($s(t)$) for every grade depend on the total number of recruitment for each year, that will be comissioned as 2nd Lt from all three sources (MA, OMS, OCS).

With the use of formula (19) Chapter II, and the program "SSSTOCK" with the total number of recruitment input from all officer sources (MA, OMS, OCS), that are assumed to stay constant every year, we calculate the steady state stocks.

Two examples of stocks computation are as follows:

a. Example 1;

Assuming each year there is recruitment from each officer source (MA, OMS, OCS), as follows:

Table 3. THE RECRUITMENT FROM EVERY SOURCE (MA, OMS, OCS).

SOURCE	The Number of Officers	%
MA	335	23.4
OMS	534	37.3
OCS	564	39.3
Total	1433	100

The result in the steady state stocks are shown in Table 4.

Table 4. THE NUMBER OF STOCKS AND PRECENTAGE FOR EVERY GRADE.

SOURCE	RANK						Total	%
	2nd Lt	1st Lt	Capt	Maj	LCol	Col		
MA	1488	1910	2188	1718	888	270	8462	26.7
OMS	2555	2860	2967	2476	1223	158	12239	38.7
OCS	3435	2544	2407	1821	678	61	10946	34.6
Total	7478	7314	7562	6015	2789	489	31647	100
%	23.6	23.1	23.9	19.0	8.8	1.6	100	-

Note that although the recruits from MA is 23.4%, the total officer corps from MA is 26.7%. By rank one can see that the precentage of 2nd LT's from MA is 19.9%, whereas for Col the precentage from MA is 55.2%. This reflects the greater retention and promotion of MA trained officers over those from OMS and OCS. The results of stocks computation for every grade and for every sources are shown in Appendix E (Table 26, 27, 28), which can be used for more detailed analysis.

b. Example 2;

Assume there are changes in policy, where the number of recruits from MA is decreased, and the number of recruits from OMS and OCS increased. The inputs of recruitment are as follows:

Table 5. THE RECRUITMENT FROM EVERY SOURCE (MA, OMS, OCS).

SOURCE	The Number of Officers	%
MA	200	13.9
OMS	600	41.9
OCS	633	44.2
Total	1433	100

From the use of program "SSSTOCK", the results are shown in Table 6.

Table 6. THE NUMBER OF STOCKS AND PRECENTAGE FOR EVERY GRADE.

SOURCE	RANK						Total	%
	2nd Lt	1st Lt	Capt	Maj	LCol	Col		
MA	889	1142	1304	1026	530	163	5054	16.3
OMS	2871	3210	3227	2782	1372	179	13641	44.0
OCS	3856	2856	2701	2044	760	69	12286	39.7
Total	7616	7208	7232	5852	2662	411	30981	100
%	24.6	23.3	23.3	18.9	8.6	1.3	100	-

Note, we can see that the precentage of recruits from OCS is 44.2%, but the total officer corps from OCS is 39.7%. By rank one can see that the 2nd Lt's from OCS is 50.6%, whereas for Col the precentage from OCS is 16.8%. This reflects, the fact that the retention and promotion of OCS trained officers is less than from MA and OMS.

V. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

This thesis applies the Grade / Time-in-Grade model to the Indonesian Army (TNI-AD). One use of the model is to predict the composition of officers of the TNI-AD produced by a given recruitment policy. The model provides manpower planners with the capability of alternatives policy changes and adjusting model parameters to improve the use of different personnel resources (MA, OMS, OCS).

The calculations of the composition of the TNI-AD use the Grade / Time-in-Grade model that can provide the output to solve the problem of manpower planning of the TNI-AD's officer who come from three different sources (MA, OMS, OCS). By using this model, we can see the results of the Expected Time in Military (ETIM), the Expected Time in Grade (TIG), the promotion rate for every grade, and the steady state stocks for every grade.

The results of the calculations can be used as suggestion to the manpower planner in order to control the TNI-AD officers composition in the long range, and also for the alternatives due to policy changes.

B. RECOMMENDATIONS

In order to control the TNI-AD officers composition in accordance with TOP/DSPP and to have the number of officers ready at all time in accordance with the organization need, the balance between average term of duty within the rank and the number of officers needed from each source (MA, OMS, OCS) must be examined.

The model gives expected time-in-military, time-in-grade, and the promotion rate for every grade as follows:

1. Promotion rate.
   Promotion rate for each period from every source (MA, OMS, OCS) and ranking are as seen from Appendix D.
2. Expected time in military (ETIM).
   Minimum expected time in military of officers until the time of pension for officers from every source (MA, OMS, OCS) are as follows:
   a. For officers from MA = 25.3 years.
   b. For officers from CMOS = 22.9 years.
   c. For officers from OCS = 19.4 years.

3. Expected time in grade (TIG).

Time in grade for each grade from every source (MA, OMS, OCS) in order to fulfill the requirement for promotion are as follows:

Table 7. MIN AND MAX TIME IN GRADE.

RANK	TIME IN GRADE	
	MIN	MAX
2nd LT	4.1	4.7
1st LT	4.6	5.6
Capt	4.9	6.4
Maj	4.7	5.6
LCol	1.8	3.4
Col	1.2	2.6

The manpower model is becoming an integral part of the increasingly complex and dynamic environment of the manpower planner. The ultimate acceptance and use of any model depends largely on understanding its design. This thesis is presented with the user in mind, emphasizing the importance of a detailed understanding of the factors that influence planning in a manpower system using the Grade / Time-in-Grade model.

APPENDIX A. THE DATA OF THE INDONESIAN ARMY (TNI-AD) OFFICERS

1. Officer Personnel Data from MA

Table 8. 2ND LT (FROM MILITARY ACADEMY)

YEAR 1	YEAR 2			
	Stay in Rank	Promoted	Leave	Total
2nd Lt (0-1)	717	0	0	717
2nd Lt (1-2)	717	0	0	717
2nd Lt (2-3)	711	0	6	717
2nd Lt (3-4)	246	453	12	711
2nd Lt (4-5)	53	177	16	246
2nd Lt (5-6)	20	24	9	53
2nd Lt (6-7)	5	8	7	20
Total	2468	662	50	3180

Table 9. 1ST LT (FROM MILITARY ACADEMY)

YEAR 1	YEAR 2			
	Stay in Rank	Promoted	Leave	Total
1st Lt (0-1)	662	0	0	662
1st Lt (1-2)	662	0	0	662
1st Lt (2-3)	662	0	0	662
1st Lt (3-4)	610	45	7	662
1st Lt (4-5)	448	152	10	610
1st Lt (5-6)	242	193	13	448
1st Lt (6-7)	98	133	11	242
1st Lt (7-8)	43	47	8	98
1st Lt (8-9)	3	34	6	43
Total	3430	604	55	4089

Table 10. CAPT (FROM MILITARY ACADEMY)

YEAR 1	YEAR 2			
	Stay in Rank	Promoted	Leave	Total
Capt (0-1)	604	0	0	604
Capt (1-2)	604	0	0	604
Capt (2-3)	604	0	0	604
Capt (3-4)	604	0	0	604
Capt (4-5)	604	0	0	604
Capt (5-6)	490	101	13	604
Capt (6-7)	317	151	22	490
Capt (7-8)	153	134	30	317
Capt (8-9)	61	61	31	153
Capt (9-10)	30	8	23	61
Capt (10-11)	8	7	15	30
Capt (11-12)	2	4	2	8
Total	4081	466	136	4683

Table 11. MAJ (FROM MILITARY ACADEMY)

YEAR 1	YEAR 2			
	Stay in Rank	Promoted	Leave	Total
Maj (0-1)	466	0	0	466
Maj (1-2)	466	0	0	466
Maj (2-3)	466	0	0	466
Maj (3-4)	447	0	19	466
Maj (4-5)	420	0	27	447
Maj (5-6)	382	0	38	420
Maj (6-7)	281	53	48	382
Maj (7-8)	167	62	52	281
Maj (8-9)	84	47	36	167
Maj (9-10)	27	36	21	84
Maj (10-11)	2	14	11	27
Total	3208	212	252	3672

Table 12. LCOL (FROM MILITARY ACADEMY)

YEAR 1	YEAR 2			
	Stay in Rank	Promoted	Leave	Total
LCol (0-1)	212	0	0	212
LCol (1-2)	212	0	0	212
LCol (2-3)	212	0	0	212
LCol (3-4)	212	0	0	212
LCol (4-5)	196	16	0	212
LCol (5-6)	178	18	0	196
LCol (6-7)	156	14	8	178
LCol (7-8)	127	12	17	156
LCol (8-9)	90	12	25	127
LCol (9-10)	55	6	29	90
LCol (10-11)	26	3	26	55
LCol (11-12)	11	0	15	26
LCol (12-13)	2	0	9	11
Total	1689	81	129	1899

Table 13. COL (FROM MILITARY ACADEMY)

YEAR 1	YEAR 2			
	Stay in Rank	Promoted	Leave	Total
Col (0-1)	81	0	0	81
Col (1-2)	81	0	0	81
Col (2-3)	77	4	0	81
Col (3-4)	71	6	0	77
Col (4-5)	63	8	0	71
Col (5-6)	50	5	8	63
Col (6-7)	37	2	11	50
Col (7-8)	23	2	12	37
Col (8-9)	12	2	9	23
Col (9-10)	3	1	8	12
Total	498	30	48	576

2. Officer Personnel Data from OMS

Table 14. 2ND LT (FROM OFFICER MILITARY SCHOOL)

YEAR 1	YEAR 2			
	Stay in Rank	Promoted	Leave	Total
2nd Lt (0-1)	339	0	0	339
2nd Lt (1-2)	339	0	0	339
2nd Lt (2-3)	339	0	0	339
2nd Lt (3-4)	161	170	8	339
2nd Lt (4-5)	70	86	5	161
2nd Lt (5-6)	26	33	11	70
2nd Lt (6-7)	9	8	9	26
Total	1283	297	33	1613

Table 15. 1ST LT (FROM OFFICER MILITARY SCHOOL)

YEAR 1	YEAR 2			
	Stay in Rank	Promoted	Leave	Total
1st Lt (0-1)	297	0	0	297
1st Lt (1-2)	297	0	0	297
1st Lt (2-3)	297	0	0	297
1st Lt (3-4)	266	24	7	297
1st Lt (4-5)	163	93	10	266
1st Lt (5-6)	99	53	11	163
1st Lt (6-7)	57	30	12	99
1st Lt (7-8)	30	21	6	57
1st Lt (8-9)	12	18	0	30
Total	1518	239	46	1803

Table 16. CAPT (FROM OFFICER MILITARY SCHOOL)

YEAR 1	YEAR 2			
	Stay in Rank	Promoted	Leave	Total
Capt (0-1)	239	0	0	239
Capt (1-2)	239	0	0	239
Capt (2-3)	239	0	0	239
Capt (3-4)	239	0	0	239
Capt (4-5)	239	0	0	239
Capt (5-6)	201	38	0	239
Capt (6-7)	116	79	6	201
Capt (7-8)	62	46	8	116
Capt (8-9)	36	14	12	62
Capt (9-10)	20	7	9	36
Capt (10-11)	8	6	6	20
Capt (11-12)	3	4	1	8
Total	1641	194	42	1877

Table 17. MAJ (FROM OFFICER MILITARY SCHOOL)

YEAR 1	YEAR 2			
	Stay in Rank	Promoted	Leave	Total
Maj (0-1)	194	0	0	194
Maj (1-2)	194	0	0	194
Maj (2-3)	194	0	0	194
Maj (3-4)	194	0	0	194
Maj (4-5)	185	0	9	194
Maj (5-6)	174	0	11	185
Maj (6-7)	125	35	14	174
Maj (7-8)	64	47	14	125
Maj (8-9)	33	19	12	64
Maj (9-10)	15	8	10	33
Maj (10-11)	4	3	8	15
Total	1376	112	78	1566

Table 18. LCOL (FROM OFFICER MILITARY SCHOOL)

YEAR 1	YEAR 2			
	Stay in Rank	Promoted	Leave	Total
LCol (0-1)	112	0	0	112
LCol (1-2)	112	0	0	112
LCol (2-3)	112	0	0	112
LCol (3-4)	103	0	9	112
LCol (4-5)	88	4	11	103
LCol (5-6)	63	6	19	88
LCol (6-7)	39	6	18	63
LCol (7-8)	19	5	15	39
LCol (8-9)	7	3	9	19
LCol (9-10)	5	2	0	7
LCol (10-11)	3	2	0	5
Total	663	28	81	772

Table 19. COL (FROM OFFICER MILITARY SCHOOL)

YEAR 1	YEAR 2			
	Stay in Rank	Promoted	Leave	Total
Col (0-1)	28	0	0	28
Col (1-2)	21	0	7	28
Col (2-3)	11	0	10	21
Col (3-4)	7	2	2	11
Col (4-5)	4	1	2	7
Col (5-6)	2	1	1	4
Total	73	4	22	99

3. Officer Personnel Data from OCS

Table 20. 2ND LT (FROM OFFICER CANDIDATE SCHOOL)

YEAR 1	YEAR 2			
	Stay in Rank	Promoted	Leave	Total
2nd Lt (0-1)	976	0	0	976
2nd Lt (1-2)	976	0	0	976
2nd Lt (2-3)	966	0	10	976
2nd Lt (3-4)	638	313	15	966
2nd Lt (4-5)	478	133	27	638
2nd Lt (5-6)	338	111	29	478
2nd Lt (6-7)	236	76	26	338
2nd Lt (7-8)	155	58	23	236
2nd Lt (8-9)	97	36	22	155
2nd Lt (9-10)	66	12	19	97
2nd Lt (10-11)	43	9	14	66
Total	4969	748	185	5902

Table 21. 1ST LT (FROM OFFICER CANDIDATE SCHOOL)

YEAR 1	YEAR 2			
	Stay in Rank	Promoted	Leave	Total
1st Lt (0-1)	748	0	0	748
1st Lt (1-2)	748	0	0	748
1st Lt (2-3)	738	0	10	748
1st Lt (3-4)	562	153	23	738
1st Lt (4-5)	402	136	24	562
1st Lt (5-6)	239	125	38	402
1st Lt (6-7)	119	91	29	239
1st Lt (7-8)	60	43	16	119
1st Lt (8-9)	23	26	11	60
1st Lt (9-10)	15	0	8	23
Total	3654	574	159	4387

Table 22. CAPT (FROM OFFICER CANDIDATE SCHOOL)

YEAR 1	YEAR 2			
	Stay in Rank	Promoted	Leave	Total
Capt (0-1)	574	0	0	574
Capt (1-2)	574	0	0	574
Capt (2-3)	561	0	13	574
Capt (3-4)	544	0	17	561
Capt (4-5)	525	0	19	544
Capt (5-6)	334	168	23	525
Capt (6-7)	192	116	26	334
Capt (7-8)	113	51	28	192
Capt (8-9)	65	18	30	113
Capt (9-10)	43	6	16	65
Capt (10-11)	29	4	10	43
Capt (11-12)	18	4	7	29
Capt (12-13)	11	3	4	18
Capt (13-14)	6	0	5	11
Total	3589	370	198	4157

Table 23. MAJ (FROM OFFICER CANDIDATE SCHOOL)

YEAR 1	YEAR 2			
	Stay in Rank	Promoted	Leave	Total
Maj (0-1)	370	0	0	370
Maj (1-2)	368	0	2	370
Maj (2-3)	361	0	7	368
Maj (3-4)	351	0	10	361
Maj (4-5)	340	0	11	351
Maj (5-6)	323	0	17	340
Maj (6-7)	257	37	29	323
Maj (7-8)	154	88	15	257
Maj (8-9)	99	41	14	154
Maj (9-10)	64	26	9	99
Maj (10-11)	42	9	13	64
Maj (11-12)	28	6	8	42
Maj (12-13)	21	0	7	28
Total	2778	207	142	3127

Table 24. LCOL (FROM OFFICER CANDIDATE SCHOOL)

YEAR 1	YEAR 2			
	Stay in Rank	Promoted	Leave	Total
LCol (0-1)	198	0	9	207
LCol (1-2)	181	0	17	198
LCol (2-3)	162	0	19	181
LCol (3-4)	141	0	21	162
LCol (4-5)	109	3	29	141
LCol (5-6)	77	4	28	109
LCol (6-7)	46	8	23	77
LCol (7-8)	25	6	15	46
LCol (8-9)	14	4	7	25
LCol (9-10)	7	4	3	14
LCol (10-11)	2	0	5	7
Total	962	29	176	1167

Table 25. COL (FROM OFFICER CANDIDATE SCHOOL)

YEAR 1	YEAR 2			
	Stay in Rank	Promoted	Leave	Total
Col (0-1)	25	0	4	29
Col (1-2)	18	0	7	25
Col (2-3)	15	0	3	18
Col (3-4)	10	2	3	15
Col (4-5)	6	2	2	10
Col (5-6)	3	1	2	6
Total	77	5	21	103

APPENDIX B. THE RESULTS OF Q_I MATRIX

1. Q_i Matrix for MA

Q1

0	1	0	0	0	0	0	0
0	0	1	0	0	0	0	0
0	0	0	0.992	0	0	0	0
0	0	0	0	0.346	0	0	0
0	0	0	0	0	0.215	0	0
0	0	0	0	0	0	0.377	0
0	0	0	0	0	0	0	0.25
0	0	0	0	0	0	0	0

Q2

0	1	0	0	0	0	0	0	0	0
0	0	1	0	0	0	0	0	0	0
0	0	0	1	0	0	0	0	0	0
0	0	0	0	0.921	0	0	0	0	0
0	0	0	0	0	0.734	0	0	0	0
0	0	0	0	0	0	0.54	0	0	0
0	0	0	0	0	0	0	0.405	0	0
0	0	0	0	0	0	0	0	0.439	0
0	0	0	0	0	0	0	0	0	0.07
0	0	0	0	0	0	0	0	0	0

Q3

0	1	0	0	0	0	0	0	0	0	0	0	0
0	0	1	0	0	0	0	0	0	0	0	0	0
0	0	0	1	0	0	0	0	0	0	0	0	0
0	0	0	0	1	0	0	0	0	0	0	0	0
0	0	0	0	0	1	0	0	0	0	0	0	0
0	0	0	0	0	0	0.811	0	0	0	0	0	0
0	0	0	0	0	0	0	0.647	0	0	0	0	0
0	0	0	0	0	0	0	0	0.483	0	0	0	0
0	0	0	0	0	0	0	0	0	0.399	0	0	0
0	0	0	0	0	0	0	0	0	0	0.492	0	0
0	0	0	0	0	0	0	0	0	0	0	0.267	0
0	0	0	0	0	0	0	0	0	0	0	0	0.25
0	0	0	0	0	0	0	0	0	0	0	0	0

Q4

0	1	0	0	0	0	0	0	0	0	0	0
0	0	1	0	0	0	0	0	0	0	0	0
0	0	0	1	0	0	0	0	0	0	0	0
0	0	0	0	0.959	0	0	0	0	0	0	0
0	0	0	0	0	0.94	0	0	0	0	0	0
0	0	0	0	0	0	0.91	0	0	0	0	0
0	0	0	0	0	0	0	0.736	0	0	0	0
0	0	0	0	0	0	0	0	0.594	0	0	0
0	0	0	0	0	0	0	0	0	0.503	0	0
0	0	0	0	0	0	0	0	0	0	0.321	0
0	0	0	0	0	0	0	0	0	0	0	0.074
0	0	0	0	0	0	0	0	0	0	0	0

Q5

0	1	0	0	0	0	0	0	0	0	0	0	0
	0											
0	0	1	0	0	0	0	0	0	0	0	0	0
	0											
0	0	0	1	0	0	0	0	0	0	0	0	0
	0											
0	0	0	0	1	0	0	0	0	0	0	0	0
	0											
0	0	0	0	0	0.925	0	0	0	0	0	0	0
	0											
0	0	0	0	0	0	0.908	0	0	0	0	0	0
	0											
0	0	0	0	0	0	0	0.876	0	0	0	0	0
	0											
0	0	0	0	0	0	0	0	0.814	0	0	0	0
	0											
0	0	0	0	0	0	0	0	0	0.709	0	0	0
	0											
0	0	0	0	0	0	0	0	0	0	0.611	0	0
	0											
0	0	0	0	0	0	0	0	0	0	0	0.473	0
	0											
0	0	0	0	0	0	0	0	0	0	0	0	0.423
	0											
0	0	0	0	0	0	0	0	0	0	0	0	0
	0.182											
0	0	0	0	0	0	0	0	0	0	0	0	0
	0											

	Q6									
0	1	0	0	0	0	0	0	0	0	0
0	0	1	0	0	0	0	0	0	0	0
0	0	0	0.951	0	0	0	0	0	0	0
0	0	0	0	0.922	0	0	0	0	0	0
0	0	0	0	0	0.887	0	0	0	0	0
0	0	0	0	0	0	0.794	0	0	0	0
0	0	0	0	0	0	0	0.74	0	0	0
0	0	0	0	0	0	0	0	0.622	0	0
0	0	0	0	0	0	0	0	0	0.522	0
0	0	0	0	0	0	0	0	0	0	0.25
0	0	0	0	0	0	0	0	0	0	0

2. Q_i Matrix for OMS

Q1

0	1	0	0	0	0	0	0
0	0	1	0	0	0	0	0
0	0	0	1	0	0	0	0
0	0	0	0	0.475	0	0	0
0	0	0	0	0	0.435	0	0
0	0	0	0	0	0	0.372	0
0	0	0	0	0	0	0	0.346
0	0	0	0	0	0	0	0

Q2

0	1	0	0	0	0	0	0	0	0
0	0	1	0	0	0	0	0	0	0
0	0	0	1	0	0	0	0	0	0
0	0	0	0	0.896	0	0	0	0	0
0	0	0	0	0	0.613	0	0	0	0
0	0	0	0	0	0	0.607	0	0	0
0	0	0	0	0	0	0	0.576	0	0
0	0	0	0	0	0	0	0	0.526	0
0	0	0	0	0	0	0	0	0	0.4
0	0	0	0	0	0	0	0	0	0

Q3

0	1	0	0	0	0	0	0	0	0	0	0	0
0	0	1	0	0	0	0	0	0	0	0	0	0
0	0	0	1	0	0	0	0	0	0	0	0	0
0	0	0	0	1	0	0	0	0	0	0	0	0
0	0	0	0	0	1	0	0	0	0	0	0	0
0	0	0	0	0	0	0.841	0	0	0	0	0	0
0	0	0	0	0	0	0	0.577	0	0	0	0	0
0	0	0	0	0	0	0	0	0.534	0	0	0	0
0	0	0	0	0	0	0	0	0	0.581	0	0	0
0	0	0	0	0	0	0	0	0	0	0.556	0	0
0	0	0	0	0	0	0	0	0	0	0	0.4	0
0	0	0	0	0	0	0	0	0	0	0	0	0.375
0	0	0	0	0	0	0	0	0	0	0	0	0

Q4

0	1	0	0	0	0	0	0	0	0	0	0
0	0	1	0	0	0	0	0	0	0	0	0
0	0	0	1	0	0	0	0	0	0	0	0
0	0	0	0	1	0	0	0	0	0	0	0
0	0	0	0	0	0.954	0	0	0	0	0	0
0	0	0	0	0	0	0.941	0	0	0	0	0
0	0	0	0	0	0	0	0.718	0	0	0	0
0	0	0	0	0	0	0	0	0.512	0	0	0
0	0	0	0	0	0	0	0	0	0.516	0	0
0	0	0	0	0	0	0	0	0	0	0.455	0
0	0	0	0	0	0	0	0	0	0	0	0.267
0	0	0	0	0	0	0	0	0	0	0	0

Q5

0	1	0	0	0	0	0	0	0	0	0	0
0	0	1	0	0	0	0	0	0	0	0	0
0	0	0	1	0	0	0	0	0	0	0	0
0	0	0	0	0.92	0	0	0	0	0	0	0
0	0	0	0	0	0.854	0	0	0	0	0	0
0	0	0	0	0	0	0.716	0	0	0	0	0
0	0	0	0	0	0	0	0.619	0	0	0	0
0	0	0	0	0	0	0	0	0.487	0	0	0
0	0	0	0	0	0	0	0	0	0.368	0	0
0	0	0	0	0	0	0	0	0	0	0.714	0
0	0	0	0	0	0	0	0	0	0	0	0.6
0	0	0	0	0	0	0	0	0	0	0	0

Q6

0	1	0	0	0	0	0
0	0	0.75	0	0	0	0
0	0	0	0.524	0	0	0
0	0	0	0	0.636	0	0
0	0	0	0	0	0.571	0
0	0	0	0	0	0	0.5
0	0	0	0	0	0	0

3. Q_i Matrix for OCS

$Q1$

0	1	0	0	0	0	0	0	0	0	0	0
0	0	1	0	0	0	0	0	0	0	0	0
0	0	0	0.99	0	0	0	0	0	0	0	0
0	0	0	0	0.66	0	0	0	0	0	0	0
0	0	0	0	0	0.749	0	0	0	0	0	0
0	0	0	0	0	0	0.707	0	0	0	0	0
0	0	0	0	0	0	0	0.698	0	0	0	0
0	0	0	0	0	0	0	0	0.657	0	0	0
0	0	0	0	0	0	0	0	0	0.626	0	0
0	0	0	0	0	0	0	0	0	0	0.68	0
0	0	0	0	0	0	0	0	0	0	0	0.652
0	0	0	0	0	0	0	0	0	0	0	0

$Q2$

0	1	0	0	0	0	0	0	0	0	0
0	0	1	0	0	0	0	0	0	0	0
0	0	0	0.987	0	0	0	0	0	0	0
0	0	0	0	0.762	0	0	0	0	0	0
0	0	0	0	0	0.715	0	0	0	0	0
0	0	0	0	0	0	0.595	0	0	0	0
0	0	0	0	0	0	0	0.498	0	0	0
0	0	0	0	0	0	0	0	0.504	0	0
0	0	0	0	0	0	0	0	0	0.383	0
0	0	0	0	0	0	0	0	0	0	0.652
0	0	0	0	0	0	0	0	0	0	0

	Q3													
0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0.977	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0.97	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0.965	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0.636	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0.575	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0.589	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0.575	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0.662	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0.674	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0.621	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0.611	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.545
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Q4

0	1	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0.995	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0.981	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0.972	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0.969	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0.95	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0.796	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0.599	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0.643	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0.646	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0.656	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0.667	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0.75
0	0	0	0	0	0	0	0	0	0	0	0	0	0

$Q5$

0	0.957	0	0	0	0	0	0	0	0	0	0
0	0	0.914	0	0	0	0	0	0	0	0	0
0	0	0	0.895	0	0	0	0	0	0	0	0
0	0	0	0	0.87	0	0	0	0	0	0	0
0	0	0	0	0	0.773	0	0	0	0	0	0
0	0	0	0	0	0	0.706	0	0	0	0	0
0	0	0	0	0	0	0	0.597	0	0	0	0
0	0	0	0	0	0	0	0	0.544	0	0	0
0	0	0	0	0	0	0	0	0	0.56	0	0
0	0	0	0	0	0	0	0	0	0	0.5	0
0	0	0	0	0	0	0	0	0	0	0	0.286
0	0	0	0	0	0	0	0	0	0	0	0

$Q6$

0	0.862	0	0	0	0	0
0	0	0.72	0	0	0	0
0	0	0	0.833	0	0	0
0	0	0	0	0.667	0	0
0	0	0	0	0	0.6	0
0	0	0	0	0	0	0.5
0	0	0	0	0	0	0

APPENDIX C. THE RESULTS OF P_l MATRIX

1. P_i Matrix for MA

$P1$

0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0.637	0	0	0	0	0	0	0
0.72	0	0	0	0	0	0	0
0.453	0	0	0	0	0	0	0
0.4	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0

$P2$

0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0.068	0	0	0	0	0	0	0	0	0
0.249	0	0	0	0	0	0	0	0	0
0.431	0	0	0	0	0	0	0	0	0
0.55	0	0	0	0	0	0	0	0	0
0.48	0	0	0	0	0	0	0	0	0
0.791	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0

P3

0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0.167	0	0	0	0	0	0	0	0	0	0	0	0
0.308	0	0	0	0	0	0	0	0	0	0	0	0
0.423	0	0	0	0	0	0	0	0	0	0	0	0
0.399	0	0	0	0	0	0	0	0	0	0	0	0
0.131	0	0	0	0	0	0	0	0	0	0	0	0
0.233	0	0	0	0	0	0	0	0	0	0	0	0
0.5	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0

P4

0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0.139	0	0	0	0	0	0	0	0	0	0	0
0.221	0	0	0	0	0	0	0	0	0	0	0
0.281	0	0	0	0	0	0	0	0	0	0	0
0.429	0	0	0	0	0	0	0	0	0	0	0
0.519	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0

$P5$

0	0	0	0	0	0	0	0	0	0	0	0	0
	0											
0	0	0	0	0	0	0	0	0	0	0	0	0
	0											
0	0	0	0	0	0	0	0	0	0	0	0	0
	0											
0	0	0	0	0	0	0	0	0	0	0	0	0
	0											
0.075	0	0	0	0	0	0	0	0	0	0	0	0
	0											
0.092	0	0	0	0	0	0	0	0	0	0	0	0
	0											
0.079	0	0	0	0	0	0	0	0	0	0	0	0
	0											
0.077	0	0	0	0	0	0	0	0	0	0	0	0
	0											
0.094	0	0	0	0	0	0	0	0	0	0	0	0
	0											
0.067	0	0	0	0	0	0	0	0	0	0	0	0
	0											
0.055	0	0	0	0	0	0	0	0	0	0	0	0
	0											
0	0	0	0	0	0	0	0	0	0	0	0	0
	0											
0	0	0	0	0	0	0	0	0	0	0	0	0
	0											
0	0	0	0	0	0	0	0	0	0	0	0	0
	0											

P6

0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0.049	0	0	0	0	0	0	0	0	0	0
0.078	0	0	0	0	0	0	0	0	0	0
0.113	0	0	0	0	0	0	0	0	0	0
0.079	0	0	0	0	0	0	0	0	0	0
0.04	0	0	0	0	0	0	0	0	0	0
0.054	0	0	0	0	0	0	0	0	0	0
0.087	0	0	0	0	0	0	0	0	0	0
0.083	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0

2. P_i Matrix for OMS

P1

0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0.501	0	0	0	0	0	0	0
0.534	0	0	0	0	0	0	0
0.471	0	0	0	0	0	0	0
0.308	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0

P2

0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0.081	0	0	0	0	0	0	0	0	0
0.35	0	0	0	0	0	0	0	0	0
0.325	0	0	0	0	0	0	0	0	0
0.303	0	0	0	0	0	0	0	0	0
0.368	0	0	0	0	0	0	0	0	0
0.6	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0

*P*3

0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0
0.159	0	0	0	0	0	0	0	0	0	0	0	0
0.393	0	0	0	0	0	0	0	0	0	0	0	0
0.397	0	0	0	0	0	0	0	0	0	0	0	0
0.226	0	0	0	0	0	0	0	0	0	0	0	0
0.194	0	0	0	0	0	0	0	0	0	0	0	0
0.3	0	0	0	0	0	0	0	0	0	0	0	0
0.5	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0

*P*4

0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0.201	0	0	0	0	0	0	0	0	0	0	0
0.376	0	0	0	0	0	0	0	0	0	0	0
0.297	0	0	0	0	0	0	0	0	0	0	0
0.242	0	0	0	0	0	0	0	0	0	0	0
0.2	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0

*P*5

0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0.039	0	0	0	0	0	0	0	0	0	0	0
0.068	0	0	0	0	0	0	0	0	0	0	0
0.095	0	0	0	0	0	0	0	0	0	0	0
0.128	0	0	0	0	0	0	0	0	0	0	0
0.158	0	0	0	0	0	0	0	0	0	0	0
0.286	0	0	0	0	0	0	0	0	0	0	0
0.4	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0

*P*6

0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0.182	0	0	0	0	0	0
0.143	0	0	0	0	0	0
0.25	0	0	0	0	0	0
0	0	0	0	0	0	0

3. P_i Matrix for OCS

$P1$

0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0.324	0	0	0	0	0	0	0	0	0	0	0
0.209	0	0	0	0	0	0	0	0	0	0	0
0.232	0	0	0	0	0	0	0	0	0	0	0
0.225	0	0	0	0	0	0	0	0	0	0	0
0.246	0	0	0	0	0	0	0	0	0	0	0
0.232	0	0	0	0	0	0	0	0	0	0	0
0.124	0	0	0	0	0	0	0	0	0	0	0
0.136	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0

$P2$

0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0.207	0	0	0	0	0	0	0	0	0	0
0.242	0	0	0	0	0	0	0	0	0	0
0.311	0	0	0	0	0	0	0	0	0	0
0.381	0	0	0	0	0	0	0	0	0	0
0.361	0	0	0	0	0	0	0	0	0	0
0.433	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0

*P*3

0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0										
0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0										
0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0										
0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0										
0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0										
0.32	0	0	0	0	0	0	0	0	0	0	0	0
	0	0										
0.347	0	0	0	0	0	0	0	0	0	0	0	0
	0	0										
0.266	0	0	0	0	0	0	0	0	0	0	0	0
	0	0										
0.159	0	0	0	0	0	0	0	0	0	0	0	0
	0	0										
0.092	0	0	0	0	0	0	0	0	0	0	0	0
	0	0										
0.093	0	0	0	0	0	0	0	0	0	0	0	0
	0	0										
0.138	0	0	0	0	0	0	0	0	0	0	0	0
	0	0										
0.167	0	0	0	0	0	0	0	0	0	0	0	0
	0	0										
0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0										
0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0										

	P4											
0	0	0	0	0	0	0	0	0	0	0	0	0
	0											
0	0	0	0	0	0	0	0	0	0	0	0	0
	0											
0	0	0	0	0	0	0	0	0	0	0	0	0
	0											
0	0	0	0	0	0	0	0	0	0	0	0	0
	0											
0	0	0	0	0	0	0	0	0	0	0	0	0
	0											
0	0	0	0	0	0	0	0	0	0	0	0	0
	0											
0.115	0	0	0	0	0	0	0	0	0	0	0	0
	0											
0.342	0	0	0	0	0	0	0	0	0	0	0	0
	0											
0.266	0	0	0	0	0	0	0	0	0	0	0	0
	0											
0.263	0	0	0	0	0	0	0	0	0	0	0	0
	0											
0.141	0	0	0	0	0	0	0	0	0	0	0	0
	0											
0.143	0	0	0	0	0	0	0	0	0	0	0	0
	0											
0	0	0	0	0	0	0	0	0	0	0	0	0
	0											
0	0	0	0	0	0	0	0	0	0	0	0	0
	0											

*P*5

0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0.021	0	0	0	0	0	0	0	0	0	0	0
0.037	0	0	0	0	0	0	0	0	0	0	0
0.104	0	0	0	0	0	0	0	0	0	0	0
0.13	0	0	0	0	0	0	0	0	0	0	0
0.16	0	0	0	0	0	0	0	0	0	0	0
0.286	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0

*P*6

0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0.133	0	0	0	0	0	0
0.2	0	0	0	0	0	0
0.167	0	0	0	0	0	0
0	0	0	0	0	0	0

APPENDIX D. PROMOTION RATE (B_I)

1. Promotion Rate (B_i) for MA

*B*1

0.924	0	0	0	0	0	0	0
0.924	0	0	0	0	0	0	0
0.924	0	0	0	0	0	0	0
0.931	0	0	0	0	0	0	0
0.85	0	0	0	0	0	0	0
0.604	0	0	0	0	0	0	0
0.4	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0

*B*2

0.912	0	0	0	0	0	0	0	0	0
0.912	0	0	0	0	0	0	0	0	0
0.912	0	0	0	0	0	0	0	0	0
0.912	0	0	0	0	0	0	0	0	0
0.916	0	0	0	0	0	0	0	0	0
0.909	0	0	0	0	0	0	0	0	0
0.885	0	0	0	0	0	0	0	0	0
0.827	0	0	0	0	0	0	0	0	0
0.791	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0

B3

0.771	0	0	0	0	0	0	0	0	0	0	0	0
0.771	0	0	0	0	0	0	0	0	0	0	0	0
0.771	0	0	0	0	0	0	0	0	0	0	0	0
0.771	0	0	0	0	0	0	0	0	0	0	0	0
0.771	0	0	0	0	0	0	0	0	0	0	0	0
0.771	0	0	0	0	0	0	0	0	0	0	0	0
0.745	0	0	0	0	0	0	0	0	0	0	0	0
0.676	0	0	0	0	0	0	0	0	0	0	0	0
0.523	0	0	0	0	0	0	0	0	0	0	0	0
0.311	0	0	0	0	0	0	0	0	0	0	0	0
0.367	0	0	0	0	0	0	0	0	0	0	0	0
0.5	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0

B4

0.456	0	0	0	0	0	0	0	0	0	0	0
0.456	0	0	0	0	0	0	0	0	0	0	0
0.456	0	0	0	0	0	0	0	0	0	0	0
0.456	0	0	0	0	0	0	0	0	0	0	0
0.475	0	0	0	0	0	0	0	0	0	0	0
0.505	0	0	0	0	0	0	0	0	0	0	0
0.555	0	0	0	0	0	0	0	0	0	0	0
0.566	0	0	0	0	0	0	0	0	0	0	0
0.581	0	0	0	0	0	0	0	0	0	0	0
0.596	0	0	0	0	0	0	0	0	0	0	0
0.519	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0

	B5												
0.382	0	0	0	0	0	0	0	0	0	0	0	0	0
0.382	0	0	0	0	0	0	0	0	0	0	0	0	0
0.382	0	0	0	0	0	0	0	0	0	0	0	0	0
0.382	0	0	0	0	0	0	0	0	0	0	0	0	0
0.382	0	0	0	0	0	0	0	0	0	0	0	0	0
0.332	0	0	0	0	0	0	0	0	0	0	0	0	0
0.264	0	0	0	0	0	0	0	0	0	0	0	0	0
0.212	0	0	0	0	0	0	0	0	0	0	0	0	0
0.165	0	0	0	0	0	0	0	0	0	0	0	0	0
0.101	0	0	0	0	0	0	0	0	0	0	0	0	0
0.055	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0

B6

0.37	0	0	0	0	0	0	0	0	0	0
0.37	0	0	0	0	0	0	0	0	0	0
0.37	0	0	0	0	0	0	0	0	0	0
0.338	0	0	0	0	0	0	0	0	0	0
0.282	0	0	0	0	0	0	0	0	0	0
0.19	0	0	0	0	0	0	0	0	0	0
0.14	0	0	0	0	0	0	0	0	0	0
0.135	0	0	0	0	0	0	0	0	0	0
0.13	0	0	0	0	0	0	0	0	0	0
0.083	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0

2. Promotion Rate (B_i) for OMS

$B1$

0.876	0	0	0	0	0	0	0
0.876	0	0	0	0	0	0	0
0.876	0	0	0	0	0	0	0
0.876	0	0	0	0	0	0	0
0.789	0	0	0	0	0	0	0
0.586	0	0	0	0	0	0	0
0.308	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0

$B2$

0.805	0	0	0	0	0	0	0	0	0
0.805	0	0	0	0	0	0	0	0	0
0.805	0	0	0	0	0	0	0	0	0
0.805	0	0	0	0	0	0	0	0	0
0.808	0	0	0	0	0	0	0	0	0
0.748	0	0	0	0	0	0	0	0	0
0.697	0	0	0	0	0	0	0	0	0
0.684	0	0	0	0	0	0	0	0	0
0.6	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0

B3

0.812	0	0	0	0	0	0	0	0	0	0	0	0
0.812	0	0	0	0	0	0	0	0	0	0	0	0
0.812	0	0	0	0	0	0	0	0	0	0	0	0
0.812	0	0	0	0	0	0	0	0	0	0	0	0
0.812	0	0	0	0	0	0	0	0	0	0	0	0
0.812	0	0	0	0	0	0	0	0	0	0	0	0
0.776	0	0	0	0	0	0	0	0	0	0	0	0
0.664	0	0	0	0	0	0	0	0	0	0	0	0
0.5	0	0	0	0	0	0	0	0	0	0	0	0
0.472	0	0	0	0	0	0	0	0	0	0	0	0
0.5	0	0	0	0	0	0	0	0	0	0	0	0
0.5	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0

B4

0.578	0	0	0	0	0	0	0	0	0	0	0
0.578	0	0	0	0	0	0	0	0	0	0	0
0.578	0	0	0	0	0	0	0	0	0	0	0
0.578	0	0	0	0	0	0	0	0	0	0	0
0.578	0	0	0	0	0	0	0	0	0	0	0
0.605	0	0	0	0	0	0	0	0	0	0	0
0.643	0	0	0	0	0	0	0	0	0	0	0
0.616	0	0	0	0	0	0	0	0	0	0	0
0.469	0	0	0	0	0	0	0	0	0	0	0
0.333	0	0	0	0	0	0	0	0	0	0	0
0.2	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0

*B*5

0.25	0	0	0	0	0	0	0	0	0	0	0
0.25	0	0	0	0	0	0	0	0	0	0	0
0.25	0	0	0	0	0	0	0	0	0	0	0
0.25	0	0	0	0	0	0	0	0	0	0	0
0.272	0	0	0	0	0	0	0	0	0	0	0
0.272	0	0	0	0	0	0	0	0	0	0	0
0.285	0	0	0	0	0	0	0	0	0	0	0
0.307	0	0	0	0	0	0	0	0	0	0	0
0.368	0	0	0	0	0	0	0	0	0	0	0
0.572	0	0	0	0	0	0	0	0	0	0	0
0.4	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0

*B*6

0.143	0	0	0	0	0	0
0.143	0	0	0	0	0	0
0.191	0	0	0	0	0	0
0.364	0	0	0	0	0	0
0.286	0	0	0	0	0	0
0.25	0	0	0	0	0	0
0	0	0	0	0	0	0

3. Promotion Rate (B_i) for OCS

*B*1

0.766	0	0	0	0	0	0	0	0	0	0	0
0.766	0	0	0	0	0	0	0	0	0	0	0
0.766	0	0	0	0	0	0	0	0	0	0	0
0.774	0	0	0	0	0	0	0	0	0	0	0
0.682	0	0	0	0	0	0	0	0	0	0	0
0.632	0	0	0	0	0	0	0	0	0	0	0
0.565	0	0	0	0	0	0	0	0	0	0	0
0.487	0	0	0	0	0	0	0	0	0	0	0
0.368	0	0	0	0	0	0	0	0	0	0	0
0.216	0	0	0	0	0	0	0	0	0	0	0
0.136	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0

*B*2

0.768	0	0	0	0	0	0	0	0	0	0
0.768	0	0	0	0	0	0	0	0	0	0
0.768	0	0	0	0	0	0	0	0	0	0
0.778	0	0	0	0	0	0	0	0	0	0
0.749	0	0	0	0	0	0	0	0	0	0
0.709	0	0	0	0	0	0	0	0	0	0
0.669	0	0	0	0	0	0	0	0	0	0
0.579	0	0	0	0	0	0	0	0	0	0
0.433	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0

*B*3

0.644	0	0	0	0	0	0	0	0	0	0	0	0
	0	0										
0.644	0	0	0	0	0	0	0	0	0	0	0	0
	0	0										
0.644	0	0	0	0	0	0	0	0	0	0	0	0
	0	0										
0.66	0	0	0	0	0	0	0	0	0	0	0	0
	0	0										
0.68	0	0	0	0	0	0	0	0	0	0	0	0
	0	0										
0.705	0	0	0	0	0	0	0	0	0	0	0	0
	0	0										
0.605	0	0	0	0	0	0	0	0	0	0	0	0
	0	0										
0.448	0	0	0	0	0	0	0	0	0	0	0	0
	0	0										
0.309	0	0	0	0	0	0	0	0	0	0	0	0
	0	0										
0.261	0	0	0	0	0	0	0	0	0	0	0	0
	0	0										
0.256	0	0	0	0	0	0	0	0	0	0	0	0
	0	0										
0.242	0	0	0	0	0	0	0	0	0	0	0	0
	0	0										
0.167	0	0	0	0	0	0	0	0	0	0	0	0
	0	0										
0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0										
0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0										

B4

0.56 0 0 0 0 0 0 0 0 0 0 0 0
0
0.56 0 0 0 0 0 0 0 0 0 0 0 0
0
0.563 0 0 0 0 0 0 0 0 0 0 0 0
0
0.574 0 0 0 0 0 0 0 0 0 0 0 0
0
0.59 0 0 0 0 0 0 0 0 0 0 0 0
0
0.609 0 0 0 0 0 0 0 0 0 0 0 0
0
0.641 0 0 0 0 0 0 0 0 0 0 0 0
0
0.661 0 0 0 0 0 0 0 0 0 0 0 0
0
0.533 0 0 0 0 0 0 0 0 0 0 0 0
0
0.415 0 0 0 0 0 0 0 0 0 0 0 0
0
0.235 0 0 0 0 0 0 0 0 0 0 0 0
0
0.143 0 0 0 0 0 0 0 0 0 0 0 0
0
0 0 0 0 0 0 0 0 0 0 0 0 0
0
0 0 0 0 0 0 0 0 0 0 0 0 0
0

*B*5

0.14	0	0	0	0	0	0	0	0	0	0	0
0.146	0	0	0	0	0	0	0	0	0	0	0
0.16	0	0	0	0	0	0	0	0	0	0	0
0.179	0	0	0	0	0	0	0	0	0	0	0
0.205	0	0	0	0	0	0	0	0	0	0	0
0.239	0	0	0	0	0	0	0	0	0	0	0
0.286	0	0	0	0	0	0	0	0	0	0	0
0.304	0	0	0	0	0	0	0	0	0	0	0
0.32	0	0	0	0	0	0	0	0	0	0	0
0.286	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0

*B*6

0.172	0	0	0	0	0	0
0.2	0	0	0	0	0	0
0.278	0	0	0	0	0	0
0.333	0	0	0	0	0	0
0.3	0	0	0	0	0	0
0.167	0	0	0	0	0	0
0	0	0	0	0	0	0

APPENDIX E. THE RESULTS OF STOCK COMPUTATIONS

1. The Results of Stocks for MA

Table 26. THE NUMBER OF STOCKS FOR MA

YEARS	RANK					
	2nd Lt	1st Lt	Capt	Maj	LCol	Col
0 - 1	335	309	282	218	99	38
1 - 2	335	309	282	218	99	38
2 - 3	335	309	282	218	99	38
3 - 4	332	309	282	218	99	36
4 - 5	115	285	282	209	99	33
5 - 6	25	209	282	196	92	29
6 - 7	9	113	229	179	83	23
7 - 8	2	46	148	131	73	17
8 - 9	0	20	71	78	59	11
9 - 10	0	1	29	39	42	6
10 - 11	0	0	14	13	26	1
11 - 12	0	0	4	1	12	0
12 - 13	0	0	1	0	5	0
13 - 14	0	0	0	0	1	0
Total	1488	1910	2188	1718	888	270

2. The Results of Stocks for OMS

Table 27. THE NUMBER OF STOCKS FOR OMS

YEARS	RANK					
	2nd Lt	1st Lt	Capt	Maj	LCol	Col
0 - 1	534	468	377	306	177	44
1 - 2	534	468	377	306	177	44
2 - 3	534	468	377	306	177	33
3 - 4	534	468	377	306	177	17
4 - 5	254	419	377	306	162	11
5 - 6	110	257	377	292	139	6
6 - 7	41	156	317	274	99	3
7 - 8	14	90	183	197	61	0
8 - 9	0	47	98	101	30	0
9 - 10	0	19	57	52	11	0
10 - 11	0	0	32	24	8	0
11 - 12	0	0	13	6	5	0
12 - 13	0	0	5	0	0	0
Total	2555	2860	2967	2476	1223	158

3. The Results of Stocks for OCS

Table 28. THE NUMBER OF STOCKS FOR OCS

YEARS	RANK					
	2nd Lt	1st Lt	Capt	Maj	LCol	Col
0 - 1	564	432	332	214	120	17
1 - 2	564	432	332	214	115	14
2 - 3	564	432	332	213	105	10
3 - 4	558	427	324	209	94	9
4 - 5	369	325	315	203	82	6
5 - 6	276	232	304	197	63	3
6 - 7	196	138	193	187	45	2
7 - 8	136	69	111	149	27	0
8 - 9	89	35	65	89	14	0
9 - 10	56	13	38	57	8	0
10 - 11	38	9	25	37	4	0
11 - 12	0	0	17	24	1	0
12 - 13	0	0	10	16	0	0
13 - 14	0	0	6	12	0	0
14 - 15	0	0	3	0	0	0
Total	3435	2544	2407	1821	678	61

LIST OF REFERENCES

1. Richard C. Grinold and Kneale T. Marshall, *Manpower Planning Models*, Publications in Operations Research Series, North-Holland, Inc., 1977.

2. David J. Bartholomew and Andrew F. Forbes, " Statistical Techniques for Manpower Planning ", John Wiley & Sons Ltd., 1979.

3. W. J. Hayne and K. T. Marshall, *Two-Characteristic Markov-Type Manpower Flow Models*, Naval Research Logistics Quarterly, Vol. 24, No. 2, June 1977.

4. Kneale T. Marshall, *Efficient Computation and Long Range Optimization Application Using a Two-Characterisric Markov-Type Manpower Flow Model*, Naval Postgraduate School, Monterey, California, May 1977.

5. Jerry R. Turner, *APL is Easy*, STSC, Inc., John Wiley & Sons, Inc., 1987.

6. Leonard Gilman and Allen J. Rose, *APL an Interactive Approach*, Third Edition, John Wiley & Sons, Inc., 1984.

7. R. C. Grinold and K. T. Marshall, *Manpower Planning Models - V Optimization Models*, Naval Postgraduate School, Monterey, California, October 1975.

8. Sheldon M. Ross, *Introduction to Probability Models*, Third Edition, Academic Press, Inc., 1985.

9. U. Narayan Bhat, *Elements of Applied Stochastic Processes*, Second Edition, John Wiley & Sons, Inc., 1984.

INITIAL DISTRIBUTION LIST

		No. Copies
1.	Defense Technical Information Center Cameron Station Alexandria, VA 22304-6145	2
2.	Library, Code 52 Naval Postgraduate School Monterey, CA 93943-5002	2
3.	Chairman, Code OR Department of Operations Research Naval Postgraduate School Monterey, CA 93943-5000	1
4.	Professor Kneale T. Marshall Naval Postgraduate School, Code OR/Mt Monterey, CA 93943-5000	1
5.	Professor Lyn R. Whitaker Naval Postgraduate School, Code OR/Wh Monterey, CA 93943-5000	1
6.	Major Suryadi Jl. Gelatik No. 11, Panca Arga Magelang, Jawa Tengah, Indonesia	2
7.	R. Ismairin Sukardi 1120 Lincoln Ave Pacific Grove, CA 93950	1
8.	Chief of the Defense Attache Embassy of the Republic of Indonesia 2020 Massachusetts Avenue N.W. Washington, D.C. 20036	1
9.	KAPUSDIKLAT Departemen HANKAM Jl. Pangkalan Jati No. 1 Jakarta-Selatan, Indonesia	1
10.	DIRZI TNI-AD Ditzi Mabes TNI-AD Jl. Kesatrian V Jakarta-Timur, Indonesia	1

11. Gubernur AKMIL TNI-AD 1
Akademi Militer TNI-AD
Jl. Gatot Subroto
Magelang, Jawa-Tengah, Indonesia

12. DANPUSDIKZI TNI-AD 1
Pusdikzi TNI-AD
Jl. Sudirman 35
Bogor, Jawa-Barat, Indonesia