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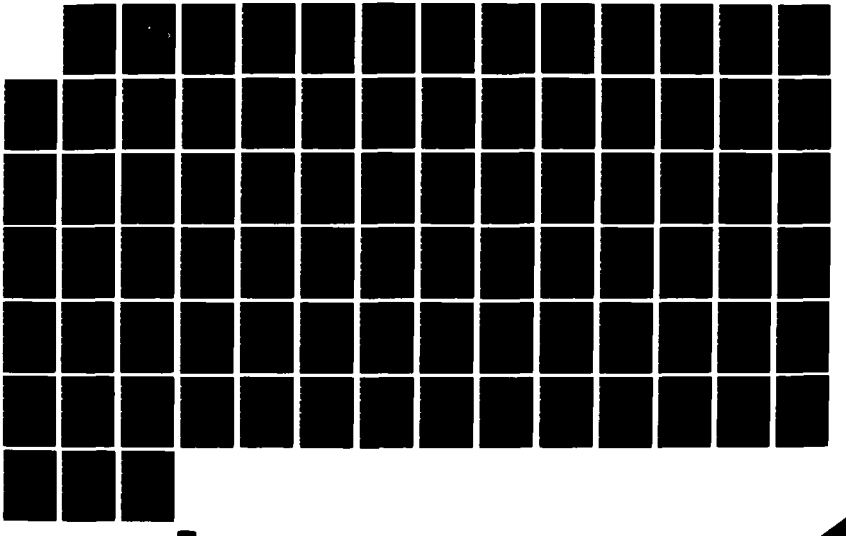

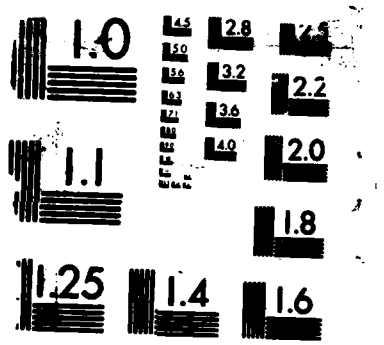

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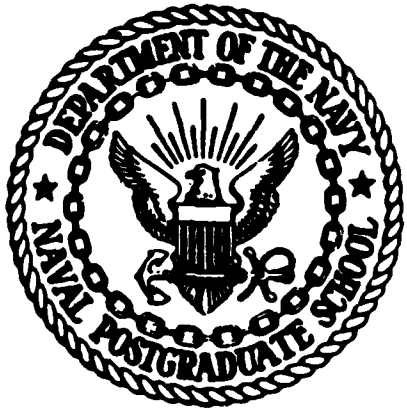

THESIS

DETERMINING THE MOST APPROPRIATE CRITERIA FOR SELECTION TO BRIGADIER GENERAL

by

James Craig Naudain

September 1987

Thesis Advisors: F. Russell Richards
David R. Whipple

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The United States Army Military Personnel Center is currently implementing the Selection Board Support System (SBSS), which is an executive decision support system designed to assist selection board members with difficult selection decisions. Previous study groups have determined the criteria by which board members will evaluate candidates, through the grade of O-6, under SBSS. This thesis determines the most appropriate criteria for the selection to Brigadier General.

The criteria were determined by analyzing the expert opinion data of 327 Brigadier and Major Generals. Univariate and multivariate statistical techniques were used to analyze questionnaire data and to suggest selection criteria. The final selection criteria determination was based on results from principle component analysis, variable cluster analysis, and a subjective analysis of the General Officers' comments. Keywords:

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DETERMINING THE MOST APPROPRIATE CRITERIA FOR SELECTION TO BRIGADIER GENERAL

by

James Craig Naudain
Captain (P), United States Army
B.S., United States Military Academy, 1977

Submitted in partial fulfillment of the
requirements for the degree of

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Author: _____
James Craig Naudain

Approved by: _____
F. Russell Richards, Co-Advisor

_____
David R. Whipple, Co-Advisor

_____
Peter Purdue, Chairman,
Department of Operations Research

_____
Kneale T. Marshall,
Dean of Information and Policy Sciences

ABSTRACT

The United States Army Military Personnel Center is currently implementing the Selection Board Support System (SBSS), which is an executive decision support system designed to assist selection board members with difficult selection decisions. Previous study groups have determined the criteria by which board members will evaluate candidates, through the grade of O-6, under SBSS. This thesis determines the most appropriate criteria for the selection to Brigadier General.

The criteria were determined by analyzing the expert opinion data of 327 Brigadier and Major Generals. Univariate and multivariate statistical techniques were used to analyze questionnaire data and to suggest selection criteria. The final selection criteria determination was based on results from principle component analysis, variable cluster analysis, and a subjective analysis of the General Officers' comments.

TABLE OF CONTENTS

I. INTRODUCTION 9
A. PROBLEM STATEMENT 9
B. BACKGROUND 9
C. OVERVIEW OF THE SELECTION BOARD SUPPORT SYSTEM (SBSS) 10
D. THESIS OBJECTIVES, METHODOLOGY, AND OUTLINE 11

II. DATA COLLECTION INSTRUMENT DEVELOPMENT 13
A. GENERAL 13
B. BACKGROUND INTERVIEWS 13
C. POPULATION SELECTION 15
D. QUESTION DEVELOPMENT AND SURVEY CONSTRUCTION 16
E. SURVEY APPROVAL PROCESS 18
F. TEST OF SURVEY 19
G. SURVEY SUPPORT 19

III. ANALYSIS PLAN 20

IV. ANALYSIS OF DATA 21
A. GENERAL 21
B. DATA COLLECTION 21
C. QUESTIONNAIRE DATA 22
D. DATA PREPARATION 22
1. Demographic and Background Variables 23
2. Selection Criteria Variables 25
3. Job Performance Variables 25
E. UNIVARIATE ANALYSIS OF SUMMARY STATISTICS 25
1. Background Variable Summary Statistics 25

2. Selection Variable Summary Statistics 27
3. Job Performance Variable Summary Statistics 27
F. UNIVARIATE FREQUENCY DISTRIBUTION ANALYSIS 28
1. Demographic and Background Variables 28
2. Selection Variable Distributions 34
G. ANALYSIS OF VARIANCE 34
1. Introduction 34
2. Analysis Discussion 39
H. BIVARIATE ANALYSIS 41
1. Demographic Influences 42
2. Correlation Analysis 45
I. PRINCIPLE COMPONENT ANALYSIS 46
1. Introduction 46
2. Analysis 47
J. VARIABLE CLUSTER ANALYSIS 51
1. Methodology 51
2. Analysis 52
K. SUBJECTIVE ANALYSIS 53
1. Analysis of Annotated Criteria 54
2. Additional Comments 55

V. CONCLUSIONS AND RECOMMENDATIONS 57
A. SUMMARIZED RESULTS 57
1. Exploratory Analysis 57
2. Analysis of Variance and Kruskal-Wallis Tests 57
3. Bivariate Analysis 57
4. Principle Component Analysis 58
5. Variable Cluster Analysis 58
6. Subjective Analysis 58
B. CONCLUSIONS 58
1. The Most Appropriate Selection Criteria 59
2. Supplemental Conclusions 60
C. RECOMMENDATIONS 62

1. Implementation of Selection Criteria 62
2. Further Study And Research 63

APPENDIX A: BRIGADIER GENERAL SURVEY 65

APPENDIX B: MAJOR GENERAL SURVEY 69

APPENDIX C: SURVEY COVER LETTER 73

APPENDIX D: ANALYSIS FLOW CHART 74

APPENDIX E: SELECTION VARIABLE FREQUENCY DISTRIBUTIONS 75

APPENDIX F: PEARSON PRODUCT-MOMENT CORRELATION MATRIX 80

APPENDIX G: PRINCIPLE COMPONENT EIGENVECTORS 82

LIST OF REFERENCES 84

INITIAL DISTRIBUTION LIST 85

LIST OF TABLES

1. SUMMARY OF DEMOGRAPHIC AND BACKGROUND VARIABLE DEFINITIONS 24
2. SELECTION AND JOB PERFORMANCE VARIABLE DEFINITIONS 26
3. BACKGROUND VARIABLE SUMMARY STATISTICS 27
4. SELECTION VARIABLE SUMMARY STATISTICS 28
5. JOB PERFORMANCE VARIABLE SUMMARY STATISTICS 29
6. DISTRIBUTION BY SPECIALTY CODE 33
7. ANOVA SIGNIFICANCE OUTCOMES USING THE SUM VARIABLE 40
8. ANOVA SIGNIFICANCE OUTCOMES USING FIRST PRINCIPLE COMPONENT 41
9. SIGNIFICANCE OUTCOMES USING INDIVIDUAL SELECTION VARIABLES 42
10. EFFECT OF CIVIL EDUCATION LEVEL ON CIVIL EDUCATION IMPORTANCE (MEANS) 43
11. EFFECTS OF CAREER SPECIALTIES ON CRITERIA IMPORTANCE (EXAMPLES) 44
12. PRINCIPLE COMPONENT EIGENVALUES AND VARIANCE PROPORTIONS 49
13. PRINCIPLE COMPONENT ANALYSIS EIGENVECTORS (EXTRACT) 50
14. CLUSTER VARIATION SUMMARY 52
15. CLUSTER FORMATION SUMMARY 54
16. FREQUENCY OF ANNOTATED CRITERIA 56
17. BRIGADIER GENERAL SELECTION CRITERIA 61

LIST OF FIGURES

4.1 Treatment Distribution 30
4.2 RANK Distribution 30
4.3 CIVED Distribution 31
4.4 OFFBD Distribution 32
4.5 BGBD Distribution 32
4.6 Distributions of Background Variables 35
4.7 Selection Variable Box Plot 36
4.8 Effects of BGBD on PERSKNOW 45
4.9 Scree Plot of Eigenvalues 48

University in the late 1970's for multiple attribute decision making (MADM). It is a rank ordering method where N number of criteria are used to evaluate M number of alternatives (candidates for selection). The concept states that the most desirable alternative should be closest to the ideal solution and furthest from the worst-case negative ideal solution. Euclidean distance is calculated to measure the distance between each alternative and the ideal or negative ideal solution. The relative closeness to the ideal solution determines the preference order of the alternatives / candidates. [Ref. 1: p. M10]

The board members' individual rank orders are then combined into a single order of merit list (OML) using a Borda scoring technique. This technique is scale invariant and is not affected by board members having different scoring means or variances. A candidate's Borda score is calculated by a simple sum of his order of merit sequence numbers from each board members' OML. The overall Order of Merit List is preference ordered by lowest Borda score. [Ref. 1: p. M2]

The capabilities of SBSS provide the opportunity to utilize the support system for a varying number of criteria. The number of criteria for evaluation can range from two, considered as 'low power', to ten, which provides the greatest resolution. For initial screening and evaluation, the low power mode is sufficient to identify significant differences among candidates. The high power mode is implemented for the difficult decisions such as those candidates near a OML cut line or, in the case of BG selection, those Colonels whose files are selected for the short-stack.

In November 1985, The Army Vice Chief of Staff directed that SBSS be implemented, especially for the *tough* selection decisions. Since Brigadier General selection is one of the most difficult selection decisions, SBSS will be used to assist in this process. The question arises as to the appropriateness of the above mentioned criteria when applied to the Brigadier General candidates. For example, most General Officer candidates will have attended a senior service school, so the military education criteria may not be an appropriate criteria/discriminater. ***There may be more appropriate criteria and attributes by which to evaluate the Colonels eligible for Brigadier General.***

D. THESIS OBJECTIVES, METHODOLOGY, AND OUTLINE

The first major objective of this thesis was to determine whether a set of more appropriate criteria for Brigadier General selection, different from those utilized for grades thru O-6, could be obtained to use with SBSS. Assuming that a set of criteria

could be developed, the second objective was to determine the most appropriate criteria. Inherent in this determination was the analysis of selection attributes as well as those required for particular job positions. No preconceptions existed regarding the results which this study should provide.

The steps used in formulating conclusions were as follows:

1) Define the problem
2) Determine the method by which to solve the problem
3) Develop an analysis plan to support the solution methodology
4) Develop a data collection instrument which would support and obtain data for the analysis plan
5) Analyze the data
6) Draw conclusions and suggest recommendations

The thesis format follows from the methodology outline. In Chapter II, the development of the data collection instrument is explained. Chapter III presents the analysis plan, followed by Chapter IV which discusses the data analysis and explains the results. Chapter V includes the the conclusions and recommendations.

II. DATA COLLECTION INSTRUMENT DEVELOPMENT

This chapter presents the development of the data collection instrument. First, the background research interviews are discussed. Second, the choice of the sampling population is justified. Next, the development of the questions and construction of the questionnaire are addressed. This is followed by an explanation of the survey approval process and the test of the data collection instrument. Finally, the support agencies are noted.

A. GENERAL

Initial research on the topic of General Officer selection criteria and position requirements revealed several related current studies addressing similar subject matter. The Hay Group, in their study of General Officers and Senior Executive Service addressed General Officer position requirements versus SES position requirements [Ref. 2.] The Army Research Institute has completed several studies on senior leadership, which discuss leadership characteristics and requirements for grades O-9 and O-10 [Ref. 3.] None of these studies specifically addressed selection criteria nor did they address Selection Board Support System utilization of the criteria. Existing data bases did not provide the necessary information for meeting the objectives. of this thesis. For this study, data indicating the attribute required for selection to Brigadier General needed to be gathered. It was decided that the best method to insure data accuracy and proper data application was to develop a specific questionnaire for selection criteria data collection.

B. BACKGROUND INTERVIEWS

Prior to designing the survey questionnaire, interviews were conducted with representatives of several agencies in order to develop a better understanding of the selection process and to determine the most effective method of acquiring the necessary information.

The Secretariat for Department of the Army Selection Boards is responsible for conducting most centralized selection boards for the Army. Interviews with the Secretariat's representatives yielded insight to the selection procedure. Selection "procedure" is the term connoting the *method* used during a particular selection board.

This is in contrast to the term, selection "process", which connotes the entire *system* of selecting an individual for promotion. The Secretariat representatives assisted in providing an understanding of the present selection procedure, prior to the implementation of SBSS. Currently, each selection board member evaluates the file of every eligible officer. He or she assigns a single value, 1 thru 6, including a plus or minus, to each file. This score represents the total evaluation of a candidate by a board member. The members then prioritize the candidates for selection by developing an order of merit list from these evaluations. The Selection Board Support System greatly enhances these current procedures.

The Force Plans Branch of the Office of the Deputy Chief of Staff for Plans, MILPERCEN, provided information on the design, development, and implementation of SBSS, as well as the SBSS selection procedures discussed in chapter one. In addition, they established a base of knowledge and recommended numerous agencies to contact in order to expand that base.

The Colonel's Division, MILPERCEN, is responsible for maintaining all colonels' files. A representative described the preparation of the approximately 2000 colonels' files for review by the selection board. The content of a typical file which the selection board picks for the 200 file short-stack was discussed. Typically, a colonel whose file is in the short-stack has held a brigade level command, has attended a senior service school, and has held a key O-6 staff position. (This does not mean that someone without those specific qualifications could not be selected for the short-stack.) Evaluation reports are exemplary and all files in the short-stack would appear flawless.

Representatives of the General Officer Management Office (GOMO) provided great insight into the ways and means by which General Officers are managed. General Officer selection boards are held through the grade of O-8. Lieutenant General and O-10's are not selected through a board process. During General Officer selection, a "floor" is placed on the board for the selection of particular specialties. In other words, provided an individual is fully qualified to become a General Officer, a board *may* select a colonel who has a lower order of merit listing to insure meeting a specialty requirement. The impact, influence, and importance of a board member possessing personal knowledge of a candidate was discussed with the GOMO. The general conclusion was that personal knowledge does impact on selection boards and that a degree of personal knowledge is appropriate when selecting a General Officer. An officer's reputation and belief that a person will represent the Army well, are

important General Officer selection considerations. The assignment process of an individual selected for General Officer was also conveyed, to include the notification time of billet vacancies and a description of the new management support system. Brigadier General job descriptions and the requirements for every BG billet were also obtained thru this office. In addition, the GOMO provided contact with the consulting firm, Hay Associates. That firm has surveyed all General Officers and Senior Executive Service personnel to determine proper SES/General Officer billet allocation. The firm provided insight into the General Officer population and a detailed review of current job requirements.

The final agency contacted was the Army Research Institute for the Behavioral Sciences and Social Sciences (ARI). Although many of their studies are mainly in the area of behavioral science, their research reports, "Senior Leadership: Requisite Skills and Developmental Processes For Three- and Four-Star Assignments" and "Senior Leadership Performance Requirements at the Executive Level", provided good research material for the development of questionnaire materials.

C. POPULATION SELECTION

The first step in developing the questionnaire was to determine the information required to be extracted from the gathered data. Information concerning General Officer attributes, position requirements, and relative importance of selection criteria was necessary to properly complete this study. The next issue was who should provide the required information. The decision was made that the persons best qualified to access the attributes required of a General Officer, as well as those requirements of General Officer positions, are the General Officers themselves.

The population selected for survey was the collection of all Brigadier and Major Generals. This group has the most recent, first-hand knowledge of the demands placed upon Brigadier Generals and could therefore be a good judge of the necessary attributes. Inclusion of both the Brigadier and Major Generals provided two "treatments" for the questionnaire. The Brigadier Generals provided feedback on their own current positions and the current demands placed upon them. It provided for an introspective analysis of the Brigadier Generals as a group. In addition, surveying *all* of the Brigadier Generals would allow the development of a data base which included all current BG billets. A survey of the Major Generals would provide for a supervisory, top-down, view of the required BG attributes. Their responses would provide an external assessment of the Brigadier General criteria. Combining both viewpoints

would give a more complete data base for analysis. Furthermore, a comparation of the two would show if there was a substantial difference of opinion between those currently serving as Brigadier Generals and those who oversee them. The General Officer Management Office approved the administration of the survey to this population of General Officers.

One major goal of the survey was to insure the questionnaire was geared for the sample population. The Brigadier and Major General populations were relatively small, and each position unique. Therefore, we needed to insure the maximum possible response to the survey. Realizing this limitation and recognizing the time constraints placed upon General Officers, the survey length was kept to a minimum. Questions were written in an executive style; developed to extract the maximum information in the least amount of words. The questions were moderately spaced on each page and the total survey packet restricted to five pages to encourage a higher likelihood of response. In addition, the time required to complete the survey was tested. The fifteen minute completion time requirement was clearly indicated on the cover page. The survey was designed for the population; developed to minimize the time requirement placed on the General Officers, and insure the maximum response rate.

D. QUESTION DEVELOPMENT AND SURVEY CONSTRUCTION

The survey questions had to insure that proper, adequate, and useful information was obtained for analysis. Questions were developed from mainly three sources: General Officer billet / job descriptions, current SBSS criteria, and background interviews.

The General Officer Management Office maintains approximately twenty binders containing the descriptions, requirements, and characteristics of all General Officer billets, including 205 Brigadier General positions. To develop the criteria to be evaluated on the questionnaire, the position requirements for each BG billet were analyzed. Each description contained a position summary and position analysis consisting of prioritized criteria and their applications. The listed criteria were of a general nature and standardized across the positions. Therefore, a more inclusive list of criteria was developed from analyzing the applications. A record of the criteria for each billet was maintained and multiple occurances of the same or similar criteria were summed across all of the descriptions. Criteria which were similar in nature were then grouped together. For example, some positions required medical, legal, specialized engineering, scientific expertise, or branch specific expertise. These criteria were

grouped into one criteria category, "technical expertise". The final criteria to be evaluated on the survey were selected by determining those criteria or categories with the highest density across the Brigadier General billets. Subjectively, the criteria were selected to maximize the coverage of all General Officer responsibilities.

Additional criteria were developed by reviewing the SBSS documentation. Since an earlier study group had determined five criteria for use on the selection boards through O-6, those criteria were selected to be evaluated by the General Officer population. This provided data to determine whether the existing criteria were appropriate for General Officer selection.

Two survey questions listed the criteria to be evaluated. The General Officers were requested to evaluate the criteria for the relative importance for selection and then again requested to evaluate the identical criteria for importance for job performance. Evaluation of the identical criteria for these two questions would provide data for comparison of selection criteria and job performance criteria. These questions were worded to elicit responses on a scale of 1 thru 7, with 1 labeled as "slightly important", 4 labeled as "moderately important", and 7 labeled as "extremely important". This coding was used to attempt to create a spread across the range of numerical values. The scale purposely did not include a "not important" label since all the criteria were developed from General Officer requirements. The survey was developed insuring that all criteria were rated on the same scale. Rating all criteria on the same scale would provide ease of comparison between and among criteria during the data analysis.

In addition to the criteria developed from the billet descriptions and the SBSS documentation, several criteria were listed to insure the validity of the responses. Several criteria, which when evaluated, should have a high correlation with another criterion were embedded into the two questions. For example, although "tactics" and "strategy" are not the same, there should be a relatively high correlation between the two. Strategy was added to the criteria list to check for consistency in a response. This was also done by adding the criterion, "Plans, Program Budgeting System (PPBS)", to check for correlation with "program management" and "acquisition".

A total of twenty-six separate criteria were listed for General Officer evaluation. The first Criterion listed on the two questions was "time in service". The purpose of placing this criterion *up-front* was to cause the population to think of using the low end of the rating scale and avoid inflated responses. (We believed that "time in service" was

of slight importance for selection and job performance, however, responses indicated differently.) An additional criterion named "other" was included at the end of the list to allow the General Officers to submit a broader response if they felt an important attribute was omitted from the questions.

The remaining survey questions attempted to gain insight into the survey population itself. Demographic questions included: time in grade, civilian education level, former branch or specialty, and current position. Additional questions queried the General Officer's selection board experience. They were asked to indicate the number of officer selection boards on which they have served. Another question asked if the General Officers have previously served on a Brigadier General selection board. The background interviews resulted in a question concerning the importance of personal board member knowledge of a candidate.

Finally a set of questions regarding the Brigadier Generals' preparedness for their assigned positions rounded out the questionnaire. Brigadier Generals were asked to evaluate how well prepared they were for their first General Officer position and subsequent position. They also evaluated the appropriateness of their first position to their individual career backgrounds. Major Generals were asked to comment on the preparedness of a Brigadier General which he or she supervised.

All survey questions were designed to obtain the maximum information requiring the minimum effort by the survey population. Each question supported the proposed analysis plan. Appendices A and B respectively contain copies of the Brigadier General and Major General surveys.

E. SURVEY APPROVAL PROCESS

All surveys which address Army issues and personnel are required to receive approval from the Survey Branch of the U. S. Army Soldier Support Center (National Capital Region). In addition, since this survey was being administered to General Officers, it also needed the approval of the General Officer Management Office. To insure a high response rate and convey the importance of the survey, the signature of the Deputy Chief of Staff for Personnel was sought for the accompanying cover letter.

An initial analysis plan, along with a draft survey was submitted to the Survey Branch for approval in December 1986. Survey Branch personnel reviewed the documents, insured that the survey supported the analysis plan, and made minor changes to the questionnaire. Their tendency was to lengthen the explanation of the survey questions to insure that each question would be understood. Reinforcing the

idea that we were surveying a specialized population, allowed the survey to be approved in its existing brief, executive style form. The survey received final approval in January 1987 and survey control number, ATNC-AO-87-05, was assigned. A copy of the survey was submitted to the GOMO. Approval was received with no additional changes.

The final step of the approval process was to obtain the signature of the DCSPER, LTG Elton. A survey cover letter was drafted (appendix C) and the project was briefed to LTG Elton by the chief of the GOMO. It received auto-pen approval on 5 February 1987.

F. TEST OF SURVEY

Prior to the final survey approval, the collection instrument was tested. Due to the small survey population, the test population was limited to seven General Officers. The Generals selected for the test represented a variety of General Officer billets and consisted of both Brigadier and Major Generals.

The responses from the test cases were encouraging. Comments by the Generals were interesting and helpful. Only a minor wording change was required on one question; the remaining questions appeared to be understood by all participants.

The test data were compiled and found to be useable when analyzed according to the analysis plan.

G. SURVEY SUPPORT

Publication and distribution of the survey questionnaire required the support of several offices. The GOMO was instrumental in obtaining approval and signatures on the cover letter. In addition, they printed the cover letter, provided General Officer mailing labels, and performed a mail-merge of the letters and labels. The Naval Post Graduate School print shop printed and collated the surveys. Survey responses were routed through the Force Plans Branch, MILPERCEN, for immediate forwarding to the Naval Postgraduate School for analysis.

III. ANALYSIS PLAN

The purpose of the analysis plan was to insure the objectives of the thesis were met. It was designed concurrently with the survey and provided a systematic method for data analysis.

To obtain an understanding of the data set, an exploratory analysis was scheduled as the first step of the analysis plan. The exploratory plan commenced with univariate descriptive procedures and progressed to multivariate analysis. Both graphical and non-graphical analysis of the means, frequencies, distributions, and correlations were to be included in this step.

Next, Analysis of Variance (ANOVA) techniques were planned in order to test the hypotheses that the means between the demographical treatments were equal. Tests were included to determine whether the respondents' civilian education level, rank, selection board experience, or career background had significant influence on the population's evaluations.

The plan then required a more advanced statistical technique to actually extract the most appropriate selection criteria. For the selection criteria data, a principle component analysis (PCA) was planned in order to reduce the dimensionality of the problem as well as determine the number and strength of the principle components actually present for selection. Using principle components the study would determine if there exists a set of underlying, meaningful, composite variables which would explain aggregated characteristics of the original selection variables.

A subjective analysis of General Officer comments concluded the analysis plan.

IV. ANALYSIS OF DATA

This chapter discusses the input of the response variables and the analysis of the collected data. First, the survey administration and data preparation are discussed. Exploratory data analysis, to include analysis of means, standard deviations, and frequencies is next developed. The exploratory analysis is followed by discussion of analysis of variance procedures and bivariate analysis. Several variable reduction methods to include principle component analysis and variable cluster analysis are developed. A brief comparison analysis of selection criteria and job performance criteria concludes the numerical analysis. Finally, a subjective analysis, based on the General Officers' written comments, closes the chapter.

A. GENERAL

The analysis documented in this chapter follows the analysis plan developed in chapter three. Additionally, subsequent to the analysis plan development, it was decided that the variable reduction technique, variable cluster analysis, was required. Computational hardware resources used for the analysis included an IBM 3033 System 370 mainframe computer. The MVS batch system was used to process analysis requirements. The choice of software was based upon current assets and capabilities of the U. S. Army Military Personnel Center, as well as the power required of the statistical tool. All analysis was performed using the SAS, version 5, statistical package. Complementing graphics were developed using the APL based, unreleased IBM mainframe graphics and statistical package, Grafstat.

B. DATA COLLECTION

The survey was administered to 349 General Officers via mail on 15 February 1987. Throughout February and March, responses were received from 145 Major Generals and 186 Brigadier Generals, for a total of 331 responses. This resulted in a 94.8% response rate. The goal of developing a survey that would insure a high response rate was realized.

Of the 331 responses, only four were not used in the analysis, creating a 98.8% utilization rate. The inability to use those responses was due to incompleteness or obvious misunderstanding of questions which would cause inaccuracies in the analysis.

In addition to replying to the specific survey questions, many General Officers included comments which displayed great interest in the study.

C. QUESTIONNAIRE DATA

Strictly speaking, the subjective responses to the General Officer questionnaire yield only ordinal scale data (except for the demographic question responses which yield nominal scale data). Consequently, only statistical procedures that require counting and ranking of the data are justified theoretically. However, we believe that the nonparametric techniques available for analyzing ordinal data are not rich enough to support the kinds of analyses that are necessary for anyalyzing this data. Parametric techniques should be performed on the data.

Interval data is required to justify much of the parametric analysis which is proposed. Interval data have an equality of unit over different parts of the scale in addition to an ordering. We believe that the subjective scales used for the General Officer questionnaires have some degree of numerical information. To consider only the rank order characteristic of the data would ignore this important information. Thus, the data statistically represent an ill-defined middle ground. We believe that the parametric techniques can and should be performed on the questionnaire data. In addition, each technique is a well established statistical procedure and each is generally robust with respect to departures from the strict assumptions under which they were originally derived.

D. DATA PREPARATION

The data variables developed from the survey responses fall into three categories:

- Background and demographic variables
- Selection criteria variables
- Job performance variables

Based on this intuitive division of the response variables, a SAS formated input file was created and the variables were divided into three formatted records. Each data point was manually input to the SAS data file and then verified to insure the quality of the data entry. Several surveys included individual, unanswered questions, thus creating missing data values. SAS identifies these missing values by use of a period "." . Unless otherwise specified, missing values were omitted from all statistical computations, thus maintaining accuracy.

1. **Demographic and Background Variables**

In order to perform a quantitative evaluation, several demographic response variables were recoded from the questionnaire.

The General Officers' ranks were input in two different manners. The first variable divided the responses into two treatments. The variable, "TREAT", recoded the responses as nominal values, 1 or 2, corresponding to Brigadier Generals and Major Generals respectively. The variable, "RANK", further categorized the rank information to include promotable status. The responses were recoded as a nominal variable with values, 1, 2, 3, 4, respectively representing BG, BG(P), MG, and MG(P).

The variable, "TIG", represents the time-in-grade for a General Officer. These values were transcribed directly from the responses and did not require recoding. Likewise, the General Officers' former specialty codes and functional areas / secondary specialties were input directly from the survey responses and the representative variables are named "SC" and "FUNCAREA" respectively.

The variable, "CIVED", represents the General Officers' level of civilian education. Again the responses were recoded as nominal values. A BS/BA level degree is represented by the value "1". A MS/MA level degree (to include MBA) is recoded as the value "2". A PhD degree is assigned a value "3", and the "other" category is assigned the value "4". The "other" category includes medical degrees (MD, DDS, etc.) and law degrees (LLB, JD).

The next two variables represent a respondents experience with selection boards. The variable, "OFFBD", represents the number of officer selection boards served on by a respondent. Service on nine or more boards were aggregated into a single category; therefore, values range from 0 to 9. The variable, "BGBD", is a binary variable indicating whether or not a General Officer had previously served on a Brigadier General selection board. The values 0 or 1 were used to represent the responses "no" or "yes", respectively.

The remaining background questions were evaluated on a scale of one thru seven (with seven indicating a strong score). The values were transcribed directly to the data set. The variable, "PERSKNOW", represents the importance of a board member's personal knowledge of a General Officer candidate. The variable, "FIRSTPSN", results from a question asked of Brigadier Generals. It queried how well prepared they were for their first General Officer assignment. The variable also includes data from a similar question asked of Major Generals, asking them to evaluate the

preparedness of a new Brigadier General subordinately assigned. The variables, "SUBSQPSN" and "APPROPSN" were developed from questions asked only of Brigadier Generals. SUBSQPSN represents how well a BG was prepared for a subsequent General Officer assignment. For those Brigadier Generals currently serving in their first General Officer position, the SUBSQPSN variable was entered as a missing data value. The variable, "APPROPSN", represents the appropriateness of a Brigadier General's first position as compared to his or her career background.

All record one variables are summarized in Table 1.

TABLE 1

SUMMARY OF DEMOGRAPHIC AND BACKGROUND VARIABLE DEFINITIONS

VARIABLE	DESCRIPTION	POSSIBLE VALUES
TREAT	Rank Treatment for BG or MG	1, 2
RANK	Ranks to include promotable status BG, BG(P), MG, MG(P)	1, 2, 3, 4
TIG	Time in Grade	Actual time (in months)
SC	Former specialty code	Code Number
FUNCAREA	Former functional area or secondary specialty	Code Number
CIVED	Civilian education level (Bachelors, Masters, Phd, Other)	1, 2, 3, 4
OFFBD	Officer selection board experience (Number of selection boards)	0 thru 9
BGBD	Brigadier General selection board experience (No or Yes)	0, 1
PERSKNOW	Importance of personal board member knowledge of a candidate	1 thru 7
FIRSTPSN	Preparedness for first General Officer position	1 thru 7
SUBSQPSN	Preparedness for subsequent General Officer positions	1 thru 7
APPROPSN	Appropriateness of first position to career background	1 thru7

2. **Selection Criteria Variables**

Record two variables are summarized in Table 2. Each variable represents a single selection criterion and is valued on a discrete scale of one thru seven. The data values were transcribed directly from the questionnaire with the value of 7 indicating a criterion to be extremely important and a value of 1 describing a selection criterion to be slightly important.

3. **Job Performance Variables**

Record three variables represent the job performance criteria and are also summarized in Table 2. Values and variable meanings are identical to those for the selection variables. A "1" has been placed as a suffix to the variable name to distinguish the job performance variables.

E. UNIVARIATE ANALYSIS OF SUMMARY STATISTICS

The analysis begins by concentrating on the basic summary statistics. This section explores the means, standard deviations, and numerical ranges of individual variable responses.

1. **Background Variable Summary Statistics**

The summary statistics for the record 1 variables are given at Table 3. Summary statistics for the nominal variables are omitted. The first column of the table lists the variable name. The column labeled "N" shows the number of observations (responses) for the particular variable. The next two columns provide means and standard deviations respectively and the last two columns indicate the range of values assigned to the variable.

There are two interesting points concerning these variables. Although PERSKNOW has a mean of 5.598, it also has a relatively large standard deviation and the assigned values encompass the full range of possible values. This indicates a wide range of opinion concerning the importance of a board members personal knowledge of a candidate.

The second interesting point shows that there is a marked difference between a Brigadier General's preparedness for his first and subsequent positions. The mean of SUBSQPSN is greater than that of FIRSTPSN. Additionally, the range and standard deviation of SUBSQPSN is smaller, illustrating a stronger consensus of opinion that the Brigadier Generals were better prepared for their subsequent positions. What this

TABLE 2

SELECTION AND JOB PERFORMANCE VARIABLE DEFINITIONS

SELECTION VARIABLES	JOB PERFORMANCE VARIABLES	DEFINITIONS
TIS	TIS1	Time in Service
PHYSFIT	PHYSFIT1	Physical Fitness and Military Bearing
MEL	MEL1	Military Education Level
ASSIGN	ASSIGN1	Assignment History
PERFORM	PERFORM1	Past Performance
CIVILED	CIVILED1	Civilian Education
RESMGT	RESMGT1	Resource Management Ability
DECISN	DECISN1	Decision Making Ability
FORNREL	FORNREL1	Foreign Relations Skills
PUBREL	PUBREL1	Public Relations Skills
GOVTREL	GOVTREL1	Government Interaction Skills
VERBCOM	VERBCOM1	Verbal Communication Skills
WRITCOM	WRITCOM1	Written Communication Skills
TECHEXP	TECHEXP1	Technical Expertise
INDUS	INDUS1	Industrial Interaction Ability
CONCEPT	CONCEPT1	Ability to Conceptualize
LEADER	LEADER1	Leadership
COMBAT	COMBAT1	Combat Experience
CMDPRES	CMDPRES1	Command Presence
PPBS	PPBS1	PPBS Knowledge
PROGMGT	PROGMGT1	Program Management Ability
TIMEMGT	TIMEMGT1	Time Management Skills
TACTICS	TACTICS1	Tactics Skills
ACQUIS	ACQUIS1	Acquisition Skills
JOINT	JOINT1	Joint Service Skills
STRAT	STRAT1	Strategy Skills

Note: All variables are evaluated on a scale of importance: 1 thru 7

analysis does not tell us is whether the subsequent position improvement is due to better assignment-experience correlation, or, due to adaptation to overall requirements placed on a General Officer.

TABLE 3
BACKGROUND VARIABLE SUMMARY STATISTICS

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
PERSKNOW	326	5.59815951	1.24079242	1.00000000	7.00000000
FIRSTPSN	305	5.67868852	1.00412222	2.00000000	7.00000000
SUBSQPSN	102	6.00000000	0.91196665	3.00000000	7.00000000
APPROPSN	177	6.22598870	1.07914226	2.00000000	7.00000000

2. Selection Variable Summary Statistics

The summary statistics for the selection variables are given at Table 4. The statistics depict the average importance of a particular criterion for selection. The means indicate that leadership, past performance, and decision making ability are considered extremely important. The corresponding variables have mean values greater than 6.7 and maintain relatively small standard deviations and ranges.

An interesting observation is that at the time of the survey, General Officers evaluated the joint service criterion relatively low in comparison to other criteria. This appears not to be in concert with the Title IV joint service requirement for General Officer selection.

3. Job Performance Variable Summary Statistics

The summary statistics of the job performance variables are given in Table 5. Implementation of a management support system which aids in the assignment process (discussed in Chapter 1) reduced the need to explore these data deeply. Moreover, a high correlation between job assignment and career experience was observed in the variable, APPROPSN, thus indicating appropriate assignment once a candidate is selected for BG. Therefore, the analysis concentrated on the selection variables.

TABLE 4

SELECTION VARIABLE SUMMARY STATISTICS

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
TIS	325	4.70153846	1.14940837	1.00000000	7.00000000
PHYSFIT	326	5.92331288	0.90652816	3.00000000	7.00000000
MEL	326	5.88343558	0.89712456	3.00000000	7.00000000
ASSIGN	326	6.21472393	0.83935749	2.00000000	7.00000000
PERFORM	326	6.78527607	0.48028621	4.00000000	7.00000000
CIVILED	326	4.66871166	1.15588243	1.00000000	7.00000000
RESMGT	326	5.52147239	0.95651562	2.00000000	7.00000000
DECISN	325	6.77538462	0.46680910	5.00000000	7.00000000
FORNREL	326	4.37116564	1.22799268	1.00000000	7.00000000
PUBREL	325	5.18153846	1.06905004	2.00000000	7.00000000
GOVTREL	326	4.54294479	1.21389237	1.00000000	7.00000000
VERBCOM	326	6.44478528	0.66217854	4.00000000	7.00000000
WRITCOM	326	6.20858896	0.78410351	3.00000000	7.00000000
TECHEXP	326	6.17177914	0.88470833	2.00000000	7.00000000
INDUS	325	4.20307692	1.25289409	1.00000000	7.00000000
CONCEPT	325	6.13230769	0.88071024	3.00000000	7.00000000
LEADER	325	6.87076923	0.35386886	5.00000000	7.00000000
COMBAT	326	5.17177914	1.16932639	1.00000000	7.00000000
CMDPRES	326	6.05828221	0.90450605	2.00000000	7.00000000
PPBS	324	4.94444444	1.05425571	1.00000000	7.00000000
PROGMGT	326	4.89570552	1.16150299	2.00000000	7.00000000
TIMEMGT	326	5.89877301	1.01019345	2.00000000	7.00000000
TACTICS	324	5.39506173	1.16373491	1.00000000	7.00000000
ACQUIS	324	4.46604938	1.18899305	1.00000000	7.00000000
JOINT	326	4.96625767	1.05046339	1.00000000	7.00000000
STRAT	326	5.56748466	1.07276112	1.00000000	7.00000000

F. UNIVARIATE FREQUENCY DISTRIBUTION ANALYSIS

This section continues the exploratory analysis thru analysis of the frequency distributions. Analysis of the frequency distributions adds to our understanding of the variables and provides a basis for the assumptions to be made in the more advanced analysis techniques. It provides a summary of the responses to the nominal scale variables.

1. Demographic and Background Variables

The histograms of the demographic variables depict the make-up of the surveyed population. Figures 4.1 thru 4.5 and Table 6 include the demographic frequency data. The first column of the accompanying tables lists the variable name and the nominal variable values (categories), as discussed in Section D of this chapter. The second column indicates the frequency, or number of respondents, who are members of the respective categories. Column three shows the cumulative frequency; column four states the percent of the population in a specific category. The final column lists the cumulative percentages.

TABLE 5

JOB PERFORMANCE VARIABLE SUMMARY STATISTICS

VARIABLE	N	MEAN	STANDARD DEVIATION	MINIMUM VALUE	MAXIMUM VALUE
TIS1	284	4.60915493	1.17935150	1.00000000	7.00000000
PHYSFIT1	284	5.67253521	1.13496591	2.00000000	7.00000000
MEL1	284	5.55985915	1.08634700	1.00000000	7.00000000
ASSIGN1	285	6.18947368	0.78221521	4.00000000	7.00000000
PERFORM1	285	6.28421053	0.93443315	2.00000000	7.00000000
CIVILED1	285	4.84912281	1.43952296	1.00000000	7.00000000
RESMGT1	285	5.75789474	1.19608330	1.00000000	7.00000000
DECISN1	285	6.68070175	0.54366991	5.00000000	7.00000000
FORNREL1	285	4.26315789	1.74144100	1.00000000	7.00000000
PUBREL1	286	5.39860140	1.36954268	1.00000000	7.00000000
GOVTREL1	284	4.66901408	1.62237810	1.00000000	7.00000000
VERBCOM1	285	6.58947368	0.59032225	4.00000000	7.00000000
WRITCOM1	285	6.28070175	0.83822385	3.00000000	7.00000000
TECHEXP1	284	6.11267606	1.10315059	2.00000000	7.00000000
INDUS1	285	4.22807018	1.75446650	1.00000000	7.00000000
CONCEPT1	285	6.26315789	0.90238955	2.00000000	7.00000000
LEADER1	285	6.65263158	0.67294425	3.00000000	7.00000000
COMBAT1	285	4.53684211	1.58654461	1.00000000	7.00000000
CMDPRES1	283	5.92579505	1.15997325	1.00000000	7.00000000
PPBS1	284	5.11619718	1.48152998	1.00000000	7.00000000
PROGMGT1	284	5.07394366	1.66808240	1.00000000	7.00000000
TIMEMGT1	285	6.22807018	0.89634516	3.00000000	7.00000000
TACTICS1	285	4.76491228	1.77149686	1.00000000	7.00000000
ACQUIS1	284	4.54225352	1.70064731	1.00000000	7.00000000
JOINT1	284	5.03169014	1.47621279	1.00000000	7.00000000
STRAT1	284	4.98591549	1.67916316	1.00000000	7.00000000

a. Treatment Distribution

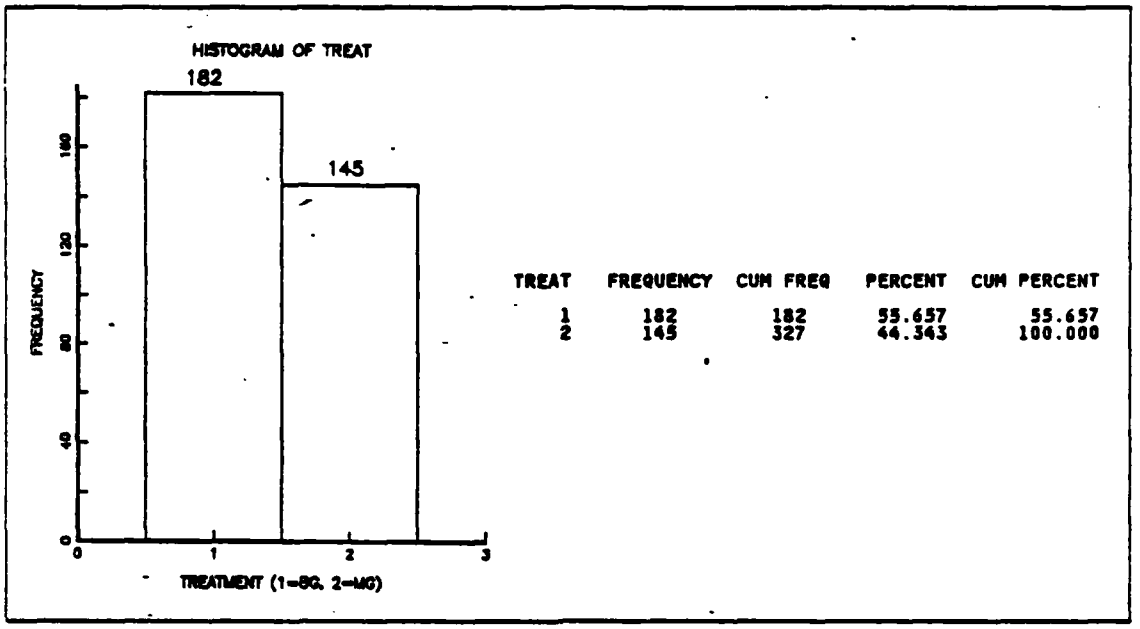
Figure 4.1 displays the breakdown of the population by rank treatment. The table shows that approximately 56% of the data is based on BG responses and 44% is based on those of Major Generals.

b. Rank Distribution

The variable, RANK, further divides the population's rank structure to include promotable status. The categories of BG, BG(P), MG, and MG(P) are represented by the values 1, 2, 3, and 4 respectively. The RANK distribution is given in Figure 4.2.

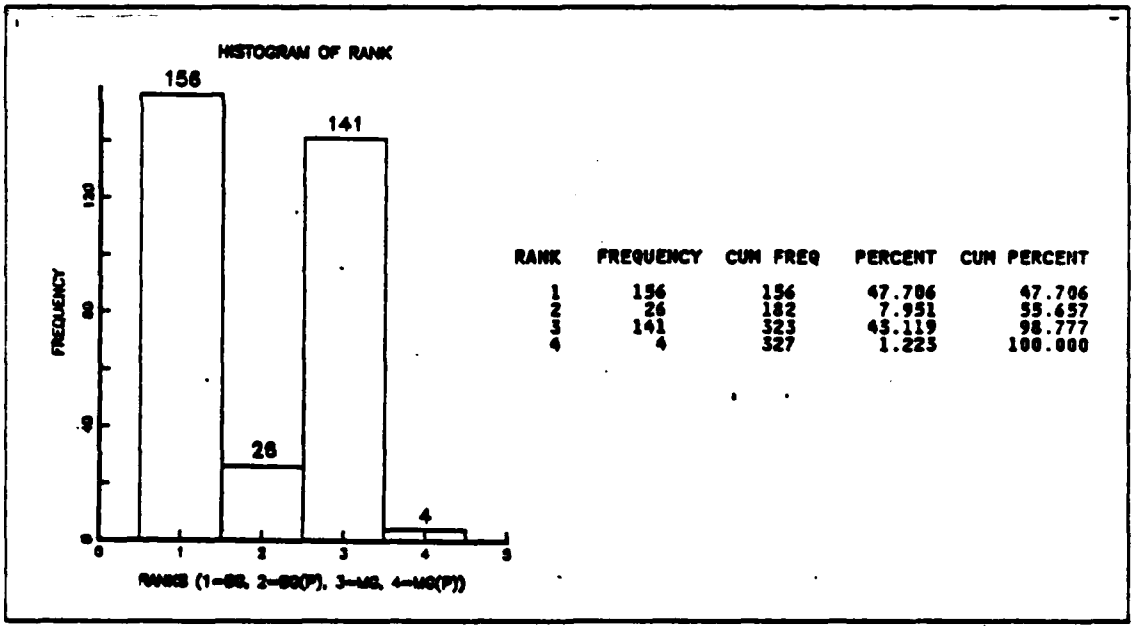
c. Distribution of Civilian Education Levels

Figure 4.3 identifies the civilian education level of the General Officer population. Overwhelmingly, the majority (277 of 327) of Brigadier and Major Generals hold a masters degree. Eighteen Generals, or 5.5% of the responding



TREAT	FREQUENCY	CUM FREQ	PERCENT	CUM PERCENT
1	182	182	55.657	55.657
2	145	327	44.343	100.000

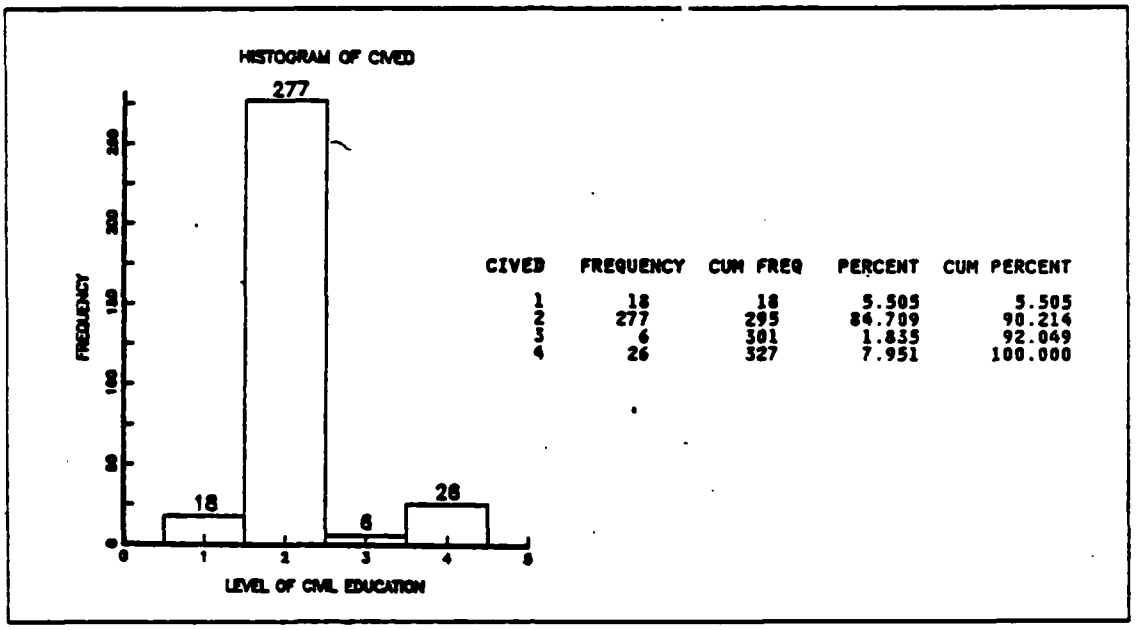
Figure 4.1 Treatment Distribution.



RANK	FREQUENCY	CUM FREQ	PERCENT	CUM PERCENT
1	156	156	47.706	47.706
2	26	182	7.951	55.657
3	141	323	43.119	98.777
4	4	327	1.223	100.000

Figure 4.2 RANK Distribution.

population, maintain a bachelors degree and only 1.8% have obtained a PhD. Twenty-six General Officers hold specialty degrees in law medicine or dentistry.



CIVED	FREQUENCY	CUM FREQ	PERCENT	CUM PERCENT
1	18	18	5.505	5.505
2	277	295	84.709	90.214
3	6	301	1.835	92.049
4	26	327	7.951	100.000

Figure 4.3 CIVED Distribution.

d. Officer Selection Board Experience Distribution

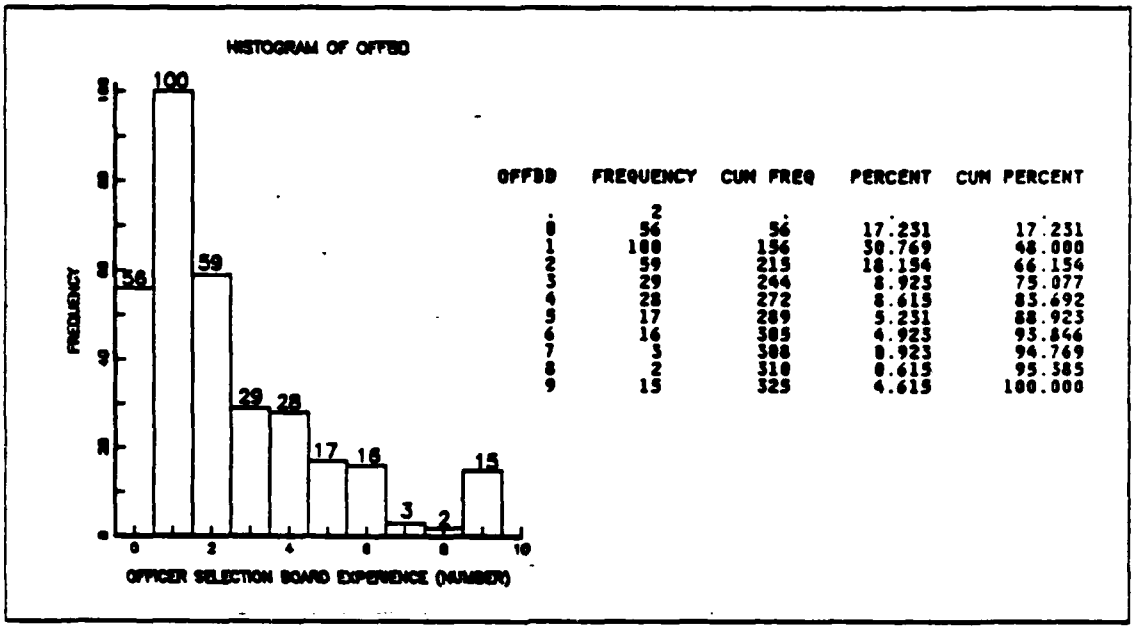
Figure 4.4 identifies the number of officer selection boards served on by General Officers. The X axis gives the number of selection boards and the frequency indicates how many Generals have had that level of experience. The category, "9", is aggregated to reflect nine or more selection boards. The data shows that 82% of the respondents has had some previous officer selection board experience.

e. Distribution of Brigadier General Board Experience

The distribution of Brigadier General selection board experience indicates that the majority of the respondents had not previously served on a BG selection board. Only 54 of the 327 General Officers have had this experience. Figure 4.5 displays the distribution.

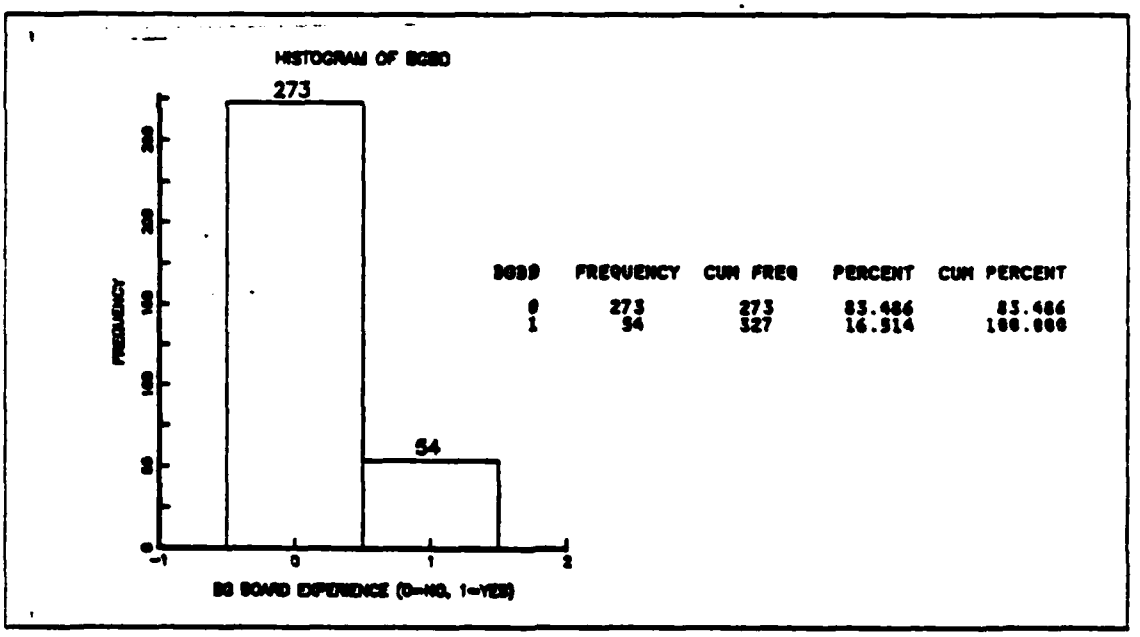
f. Career Background Distributions

Table 6 depicts the career backgrounds of the General Officers. It identifies the number of General Officers responding by their former specialty codes (SC).



OFFBD	FREQUENCY	CUM FREQ	PERCENT	CUM PERCENT
.	2			
0	56	56	17.231	17.231
1	100	156	30.769	48.000
2	59	215	18.154	66.154
3	29	244	8.923	75.077
4	28	272	8.615	83.692
5	17	289	5.231	88.923
6	16	305	4.923	93.846
7	3	308	0.923	94.769
8	2	310	0.615	95.385
9	15	325	4.615	100.000

Figure 4.4 OFFBD Distribution.



BGBD	FREQUENCY	CUM FREQ	PERCENT	CUM PERCENT
0	273	273	83.486	83.486
1	54	327	16.514	100.000

Figure 4.5 BGBD Distribution.

TABLE 6

DISTRIBUTION BY SPECIALTY CODE

SC	FREQUENCY	CUM FREQ	PERCENT	CUM PERCENT
.	19	.	.	.
11	70	70	22.727	22.727
12	29	99	9.416	32.143
13	47	146	15.260	47.403
14	12	158	3.896	51.299
15	15	173	4.870	56.169
16	1	174	0.325	56.494
21	25	199	8.117	64.610
24	1	200	0.325	64.935
25	14	214	4.545	69.481
27	1	215	0.325	69.805
31	6	221	1.948	71.753
35	6	227	1.948	73.701
36	2	229	0.649	74.351
37	1	230	0.325	74.675
41	7	237	2.273	76.948
44	3	240	0.974	77.922
47	1	241	0.325	78.247
51	5	246	1.623	79.870
55	3	249	0.974	80.844
56	1	250	0.325	81.169
60	1	251	0.325	81.494
61	4	255	1.299	82.792
63	1	256	0.325	83.117
64	1	257	0.325	83.442
67	1	258	0.325	83.766
70	3	261	0.974	84.740
71	4	265	1.299	86.039
73	1	266	0.325	86.364
74	4	270	1.299	87.662
75	4	274	1.299	88.961
81	1	275	0.325	89.286
82	1	276	0.325	89.610
91	15	291	4.870	94.481
92	10	301	3.247	97.727
95	7	308	2.273	100.000

Frequency distributions for the remaining variables (each with the discrete values 1-7) were examined primarily with an eye towards normality. The distributions of the variables, PERSKNOW, FIRSTPSN, and SUBSQPSN were slightly non-normal being skewed toward the higher values.

A comparison of the FIRSTPSN and SUBSQPSN distributions, indicates that Brigadier Generals are more prepared for subsequent positions than their first assignments. Both distributions are skewed toward the larger values, however. It is logical that individuals feel better prepared for subsequent assignments. The important point is that there are several Brigadier Generals who believe they were not as well prepared for their first assignments as they could have been.

Over 92% of the Brigadier Generals judged the appropriateness of their first assignment, as compared to their career backgrounds to be in the top three values. The distribution indicates that, once selected for General Officer rank, Brigadier Generals feel they are appropriately assigned. This finding allows the study to concentrate on determining the most appropriate selection criteria and to limit the job performance criteria analysis.

The distribution of PERSKNOW shows that a board members personal knowledge of a candidate does play an important role in Brigadier General selection. Over 84% of the respondents evaluated the importance to be 5 or greater. The distribution analysis improves the interpretation of the summary statistic analysis. Further analysis to determine the effect of BG board experience on this distribution is discussed in Section H.

Figure 4.6 displays the histograms of the variables, FIRSTPSN, SUBSQPSN, APPROPSN, and PERSKNOW.

2. Selection Variable Distributions

The majority of the selection variable distributions tend to be normally distributed, however they are slightly skewed toward the greater values. Six of the twenty-six selection variables, ASSIGN, PERFORM, DECISN, VERBCOM, WRITCOM, TECHEXP, and LEADER are highly skewed toward the greater values The strongest criterion, based on distribution analysis, is leadership. Over 87% of the General Officers assessed this criterion with the highest possible value, 7. Past performance is the next highest evaluated criterion with 81% of the respondents assigning the highest rating.

Figure 4.7 comparatively displays the selection variables in a box plot. The histograms for each individual selection variable are found at Appendix E.

G. ANALYSIS OF VARIANCE

1. Introduction

This section concentrates on the use of analysis of variance (ANOVA) as an investigative tool to detect differences in means among the levels of demographic variables. An attempt is made to explain the variation in the response as being due to the level classification.

For example, using CIVED as the independent variable and one of the selection variables as the dependent variable, ANOVA compares the equality of the means of the selection variable across the levels of four education levels of CIVED.

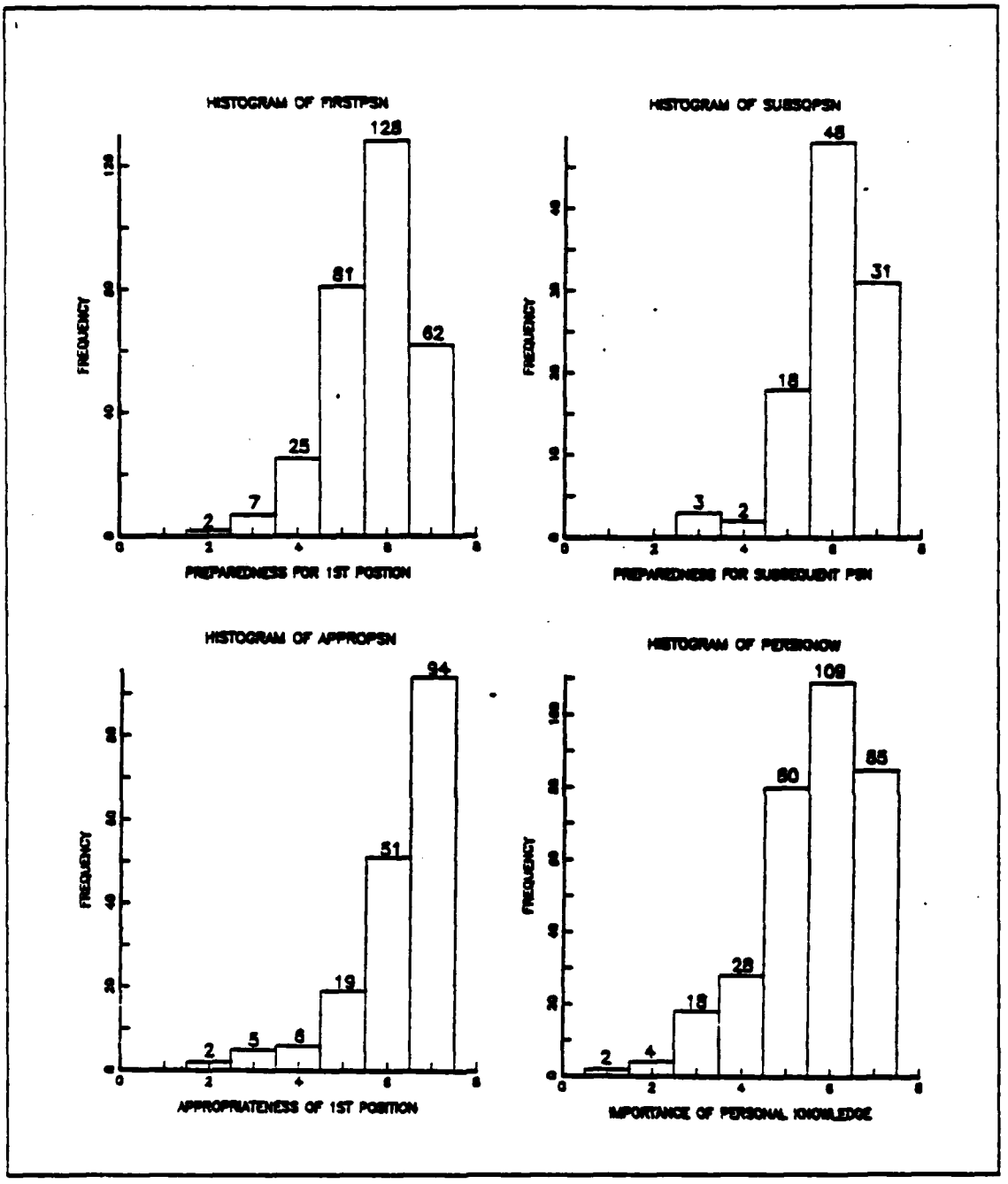


Figure 4.6 Distributions of Background Variables.

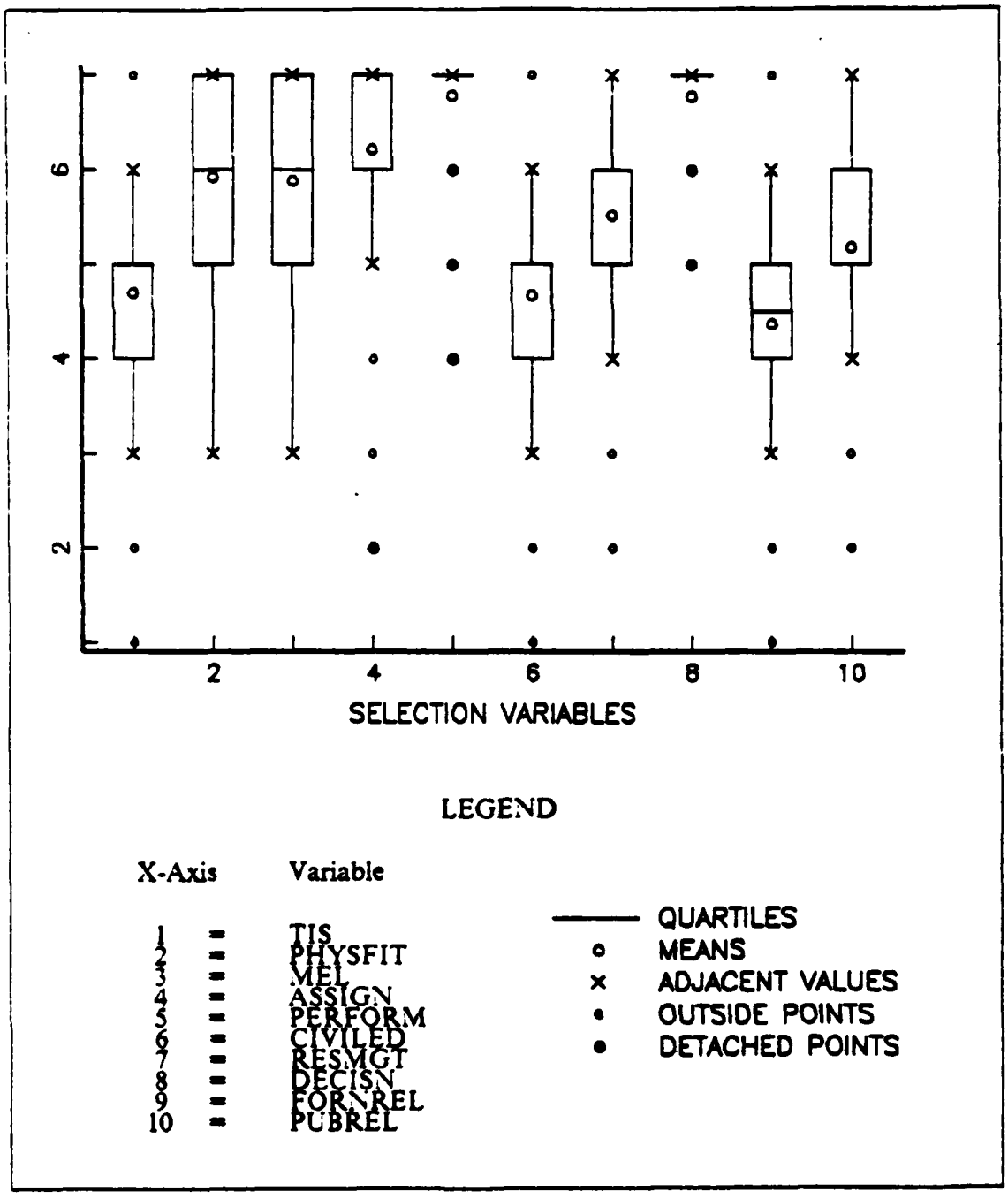


Figure 4.7 Selection Variable Box Plot.

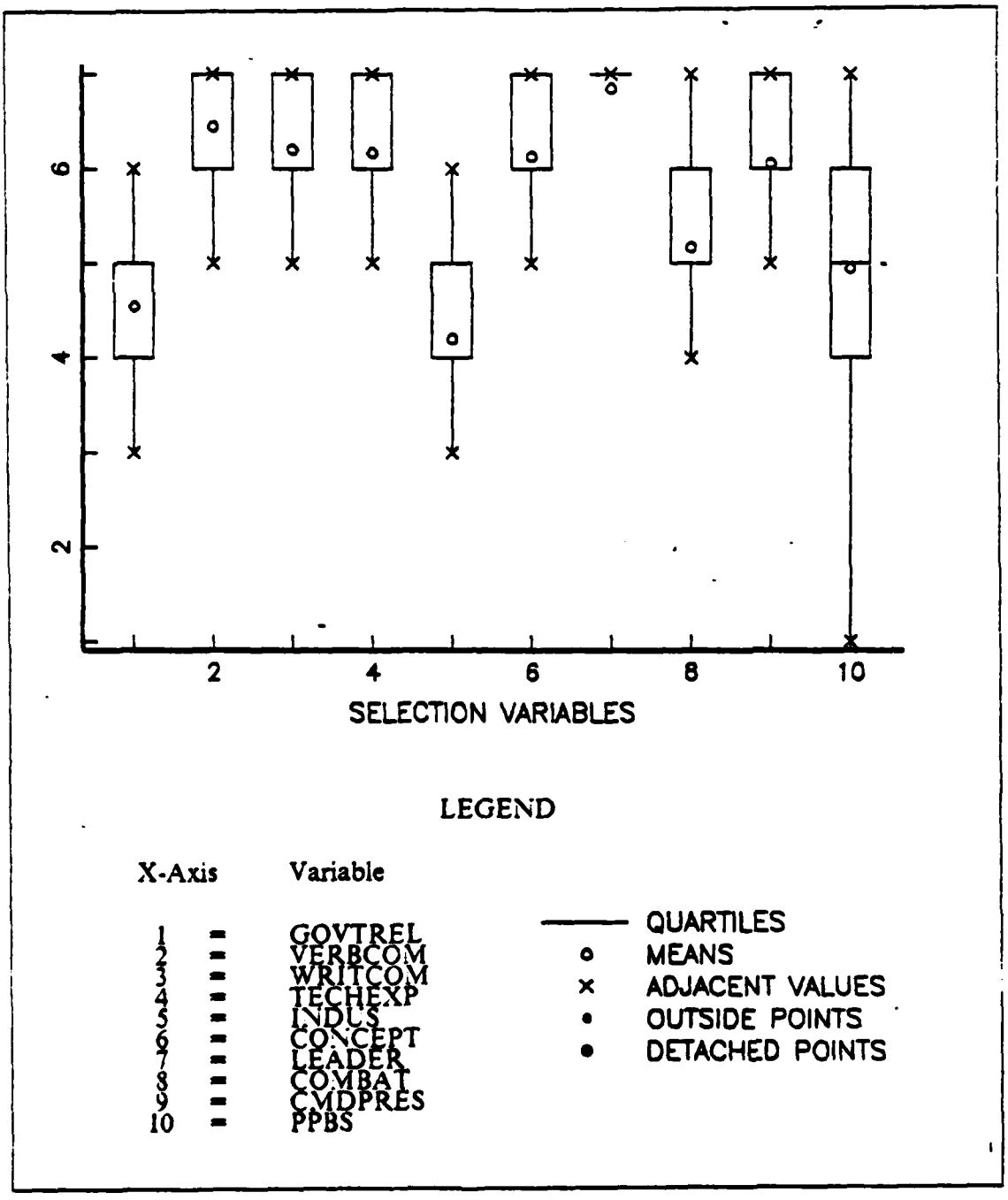


Figure 4.7 Selection Variable Box Plot. (cont'd.)

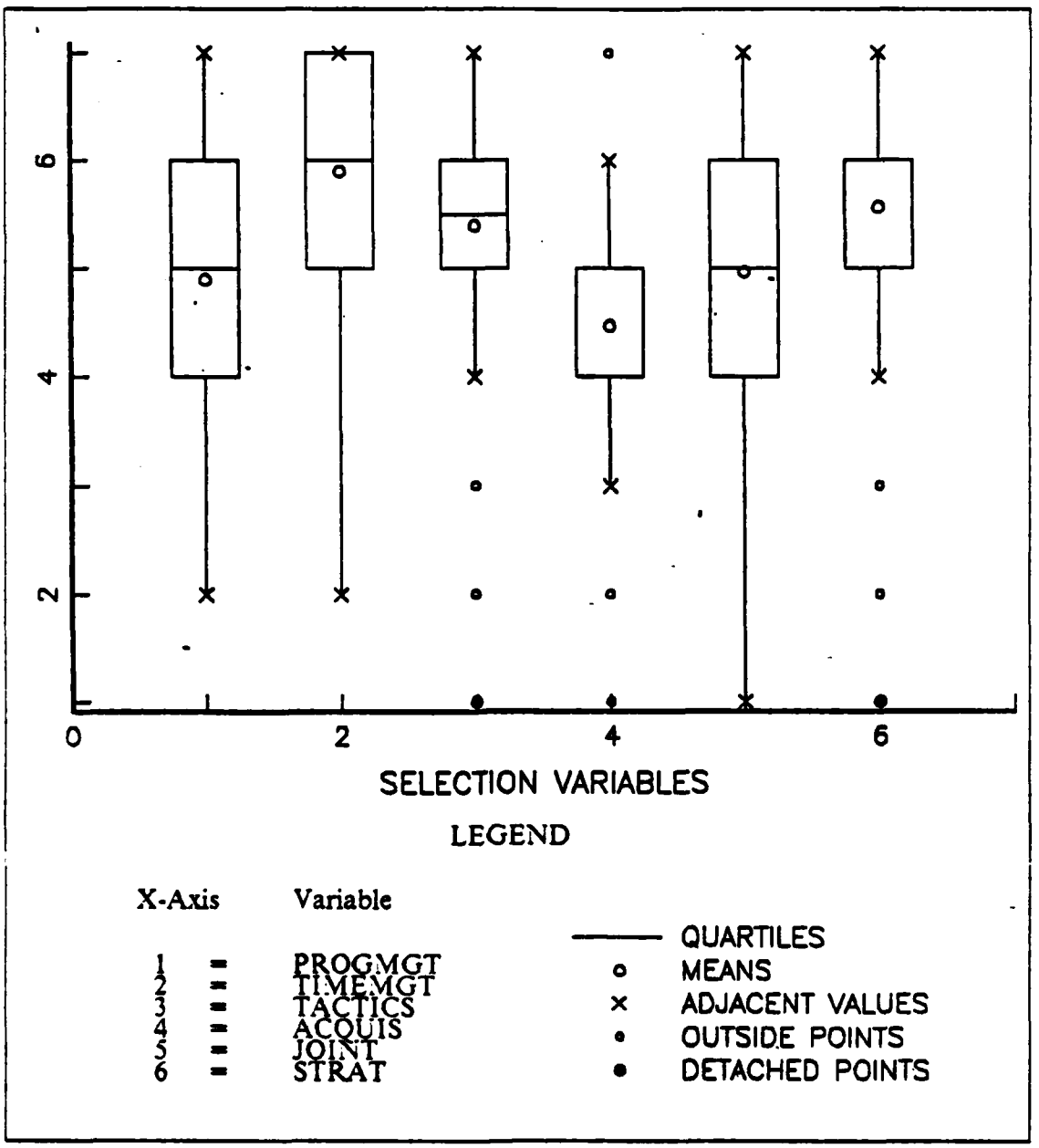


Figure 4.7 Selection Variable Box Plot. (cont'd.)

For the test, the null hypothesis states that the means of the selection variable for all four CIVED levels are equal, while the alternate hypothesis states that they are not. This test was performed using the variables, TREAT, CIVED, OFFBD, BGBD, SC, and FUNCAREA as the independent variables. Several forms of the twenty-six selection variables were used as the dependent variables:

1) An ANOVA was performed using each selection variable as the dependent variable individually. This determines significant differences in General Officer responses for each selection variable.

2) An "overall" measure was generated by adding the values of all the selection variables. This derived variable was used as the dependent variable in ANOVA studies to test for differences in means as a function of the demographic variables. Table 7 tabulates the results for the five, one-way ANOVAs using this dependent variable.

3) Subsequent to the principle component analysis of the selection variables (Section I), an ANOVA was performed using the first principle component as the dependent variable. This approach was done to investigate significant differences in *overall* General Officer responses. The first principle component was used because it accounts for the greatest variance in all of the original selection variables. Table 8 gives the results for the five, one-way ANOVAs using the first principle component dependent variable.

The test statistic used to reject or not reject the null hypothesis for ANOVA is the F statistic. An observed F value, larger than the selected .05 significance level F value, would be cause for rejection of the null hypothesis. It would indicate that there exists a significant difference between the means.

The analysis of variance fixed effects model assumes that the underlying variable distributions are normal [Ref. 4: p.524]. The majority of the variable distributions are slightly non-normal and skewed toward the larger values; however, the ANOVA procedure is robust. To insure and check the robustness of the ANOVA model, all ANOVA tests were duplicated using the nonparametric, Kruskal-Wallis test.

The Kruskal-Wallis test does not assume normality and tests the null hypothesis that the classification (level) distributions are identical. The alternate hypothesis states that at least one of the classifications tends to yield larger observations than at least one of the other variable classifications. [Ref. 5: p.230]

Both the ANOVA and the Kruskal-Wallis test determine whether the differences between the classification (level) means are significant. The agreement between the two statistical tools supports the robustness of the ANOVA model in this study.

2. Analysis Discussion

Table 7 summarizes the Analysis of Variance results, as well as the Kruskal-Wallis results using the summed selection variable, as the dependent variable. The table's first column lists the independent classification variables. The second column lists the number of classifications or levels within the corresponding independent variable. For

both ANOVA and Kruskal-Wallis, the .05 α level test statistics are listed and the computed/observed F and T values are indicated. The "SIG" columns indicate whether a significant difference between the level means exists. As shown in Table 7, there are no significant differences in the level means for any of the classification variables. Additionally, the Kruskal-Wallis test and the ANOVA model produced identical significance outcomes. This analysis indicates that overall General Officer responses are not affected by their demographic backgrounds and allows us to neglect demographics in future analysis when considering this "overall" measure.

TABLE 7

ANOVA SIGNIFICANCE OUTCOMES USING THE SUM VARIABLE

Dependent Variable: Summed Transformation Variable

Classification Variables	Levels	ANOVA			KRUSKAL-WALLIS		
		F_{05}	F_{obs}	SIG	T_{05}	T_{obs}	SIG.
TREAT	2	3.84	2.26	NO	3.84	1.73	NO
RANK	4	2.60	1.04	NO	7.82	2.64	NO
CIVED	4	2.60	0.35	NO	7.82	1.60	NO
OFFBD	10	1.88	1.39	NO	16.92	13.54	NO
BGBD	2	3.84	0.02	NO	3.84	0.01	NO
SC	34	1.45	1.12	NO	47.37	39.51	NO
FUNCAREA	35	1.44	1.35	NO	48.57	46.10	NO

Table 8 summarizes the ANOVA and Kruskal-Wallis test results using the selection variables' first principle component as the dependent variable. Differences in classification means appear to be slightly significant at the .05 α level, only when using FUNCAREA as the independent variable. The operational significance of these differences are inspected during the variable cluster analysis (Section J). Generally, demographics do not seem to have a significant effect on overall responses.

TABLE 8

ANOVA SIGNIFICANCE OUTCOMES USING FIRST PRINCIPLE COMPONENT

Dependent Variable: First Principle Component

Classification Variables	Levels	ANOVA			KRUSKAL-WALLIS		
		F_{05}	F_{obs}	SIG	T_{05}	T_{obs}	SIG.
TREAT	2	3.84	3.37	NO	3.84	2.82	NO
RANK	4	2.60	1.58	NO	7.82	4.18	NO
CIVED	4	2.60	0.33	NO	7.82	1.19	NO
OFFBD	10	1.88	1.52	NO	16.92	14.50	NO
BGBD	2	3.84	0.10	NO	3.84	0.08	NO
SC	34	1.45	1.29	NO	47.37	44.69	NO
FUNCAREA	35	1.44	1.51	YES	48.57	51.23	YES

The third method of exploring for differences involved the use of ANOVA and the Kruskal-Wallis test on each selection variable taken separately. These tests show no significant differences in any of the selection variable responses due to officer selection board experience or Brigadier General selection board experience. Table 9 lists all tests (independent classification variable and the associated dependent selection variable) which were found to be significant. Except for under the classification variable, CIVED, all the dependent variables fall into two categories: military acquisition management (PPBS, ACQUIS, INDUS, PROGMGT) and warfare skills (TACTICS, STRAT). These groupings show that there is a diversity of opinion on the importance of these criteria. The significant variables and groupings are further analyzed in the bivariate and variable cluster analysis sections of the thesis.

H. BIVARIATE ANALYSIS

This section concentrates on identifying relationships between pairs of variables. The section is divided into two subsections; the first identifies possible trends within the

TABLE 9

SIGNIFICANCE OUTCOMES USING INDIVIDUAL SELECTION VARIABLES

INDEPENDENT VARIABLE	SIGNIFICANT DEPENDENT VARIABLES
TREAT	PPBS ACQUIS
RANK	PPBS TACTICS STRAT
CIVED	CIVILED GOVTREL CMDPRES TACTICS STRAT
SC	INDUS PPBS TACTICS STRAT
FUNCAREA	RESMGT INDUS PPBS PROGMGT TACTICS ACQUIS STRAT

levels of a variable, and the second identifies relationships among the selection variables using correlation analysis.

1. **Demographic Influences**

The analysis of variance suggested a further inspection of several variables to determine whether demographic trends exist within the responses for an individual criterion.

a. Effects of Civilian Education Level

An interesting trend is displayed by the effect of civil education level on the importance of the civilian education criterion. There is a definite trend in the means of

the education levels. The means increase monotonically from those General Officers maintaining a BS/BA degree, to those with a MS/MA degree, followed by those with specialty degrees, and finally to those holding a PhD. The General Officers with higher degrees believe civilian education to be more important for selection. Table 10 displays the level means.

TABLE 10
EFFECT OF CIVIL EDUCATION LEVEL ON
CIVIL EDUCATION IMPORTANCE (MEANS)

LEVEL	MEAN
Bachelors Degree	4.000
Masters Degree	4.667
Specialized Degree	5.000
PhD	5.333

The ANOVA also identified the variables, TACTICS and STRAT, to have significant differences of means under the CIVED classifications. The trend in these two variables is opposite from that of education importance. The importance of tactics and strategy for selection appears to be negatively correlated with education level. Overall, General Officers holding higher degrees tend to believe tactics and strategy to be less important.

b. Effects of Career Backgrounds on Selection

The ANOVA process determined several variables to have significant differences under the specialty code and functional area classifications. Table 11 displays the means for several of the variables partitioned by G.O. specialties or functional areas.The trends suggested to this author are indicated. General Officers with career backgrounds in combat arms tend to hold tactics and strategy to be more important for selection than do those with former specialties in combat service support. Similarly, an individual with an Operations and Plans secondary specialty considers

tactics and strategy to be relatively more important than does a respondent with an Automation Systems background. A General Officer with a former specialty in Contracting and Industrial Management believed industrial interaction to be more important than a person with the Operations or Foreign Area expertise. The results show that selection board members view certain criteria to be important based on their own career backgrounds.

TABLE 11

EFFECTS OF CAREER SPECIALTIES ON CRITERIA IMPORTANCE (EXAMPLES)

CRITERION VARIABLE	SPECIALTY or FUNCTIONAL AREA	MEAN	TREND
TACTICS	Infantry Armor F.A. Opns/Plans Automation Medical	5.886 6.103 5.609 5.892 3.400 3.000	High for combat arms and opns/plans. Low for non-combat arms and service specialties.
INDUS	Contracting Officers Opns/Plans Foreign Area Opns Medical	5.571 3.630 3.000 3.750	High for acquisition and industrial management. Low for those specialties without industrial interaction.
STRAT	Infantry Armor F.A.	6.143 6.138 5.830	High for Combat arms.

c. Effects of BGBD on PERSKNOW

It is plausible that a person who has had the experience serving on a Brigadier General selection board may have a different opinion about the importance of a member's personal knowledge of a candidate. The effect of BGBD was tested on the variable, PERSKNOW. The classification distributions shown in Figure 4.8 indicate a small amount of influence on the selection process, due to previous board

experience. Persons who have had previous experience believe that personal knowledge plays a slightly greater role. Those individuals evaluated the importance to range from moderately important (value 3) to extremely important (value 7), with 70% judging it to be in the top two values. General Officers without previous service on a Brigadier General selection board, evaluated the importance across the full range of values. Fifty-seven percent judged the importance to be in the top two categories.

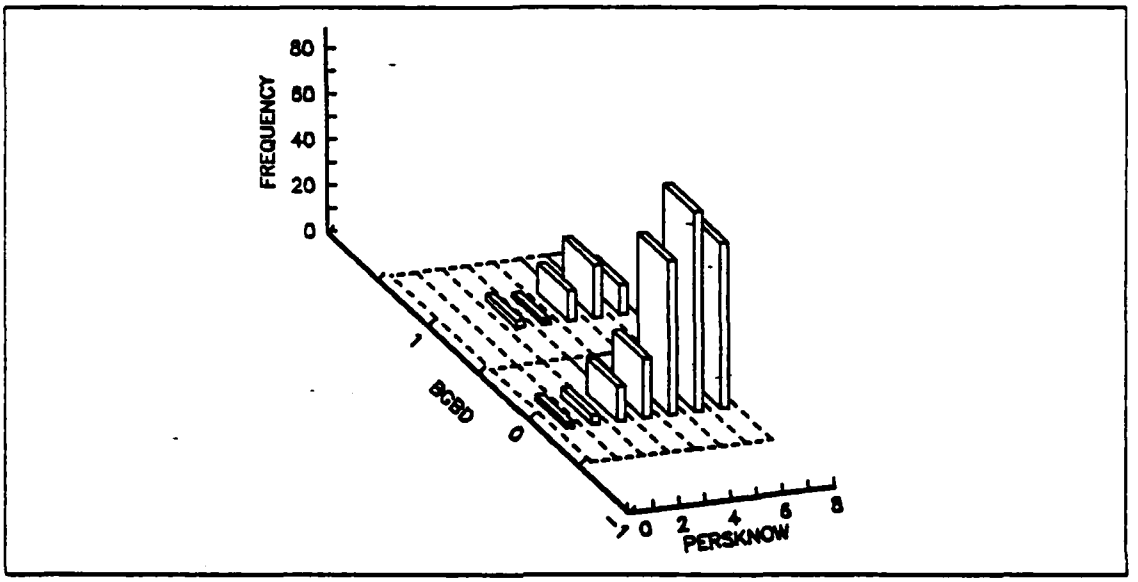


Figure 4.8 Effects of BGBD on PERSKNOW.

2. Correlation Analysis

This subsection concentrates on identifying relationships between pairs of variables using the Pearson product-moment correlation matrix. The twenty-six selection variables are analyzed in this section. The correlation analysis forms a basis for the subsequent principle component analysis discussed in the next section. The purpose of correlation analysis is to identify those variables which have strong association. It does not show a cause and effect relationship between the variables. The correlation coefficient, ρ, has a range from -1 to +1. A value of +1 indicates an exact linear relationship between the variables. In other words, the high values of a variable occur with the high values or the other variable. A ρ value of -1 shows an exact inverse linear relationship where the high values of one variable occur with the low values of the other. A ρ value of 0.0 indicates that there is no linear relationship

between the two variables. The complete correlation matrix is given in Appendix F. The most significant observations are discussed below.

The highest ρ value is 0.79 and the next largest absolute value is 0.65. The general absence of large correlations (in absolute value) indicate that the original criteria included in the survey tend to be uncorrelated and represent a wide scope of General Officer responsibilities. This also suggests that a principle component analysis to reduce dimensions may not be successful.

Although the correlations generally are not strong, some of the variables have moderately high correlations which are believed to be due to imbeded test variables. As expected, there are relatively high correlations between the variables which were specificly included in the analysis to check for consistent responses (see Chapter 2, Section D). The correlation between TACTICS and STRAT is 0.79, indicating a response consistency. The set of variables PPBS, ACQUIS, PROGMGT, INDUS, and RESMGT) have pairwise correlations in the neighborhood of 0.50. Since the five variables do have common traits for military acquisition management or resource allocation, these correlations were expected.

Other variables which display moderately large correlations are VERBCOM with WRITCOM (0.64), and the pairwise correlations of PUBREL, GOVTREL, and FORNREL.

Although the above specified correlations are statistically significant, the majority of the Pearson product-moment correlations are low and significant variable relationships can not be extracted from the matrix.

I. PRINCIPLE COMPONENT ANALYSIS

1. Introduction

This section discusses the multivariate technique, principle component analysis (PCA), which was performed on the selection variables. There are three objectives to performing a PCA:

1) Reduce the dimensionality of the data set
2) Identify new, meaningful, underlying variables
3) Eliminate original variables which contribute little extra information. [Ref. 6: p.106]

Principle component analysis finds an orthogonal transformation of the original selection variables to a new set of uncorrelated composite variables, called principle components. Each principle component is a linear combination of the original

variables, representing some aggregate characteristic of the those variables. The combinations are constructed in such a way that the first principle component accounts for the largest proportion of variance and each successive composite variable accounts for a smaller proportion of the variance [Ref. 7: p.424]. In principle component analysis, a number of principle components equal to the number of original variables are required to account for 100% of the variance. Hopefully, most of the variance can be accounted for in the first few components, thereby allowing for dimension reduction. In line with the thesis objective, the reduced set of composite variables may be used as a basis for SBSS selection criteria.

Principle component analysis operates on either a correlation or covariance matrix. For this study, the Pearson correlation matrix was used. The PCA computes a set of composite variables called eigenvectors, of the form:

$$Y_{(j)} = a_{1j} X_1 + a_{2j} X_2 + \ldots + a_{pj} X_p \qquad \text{(eqn 4.1)}$$

These composite variables represent a set of orthogonal components in 26 space (the space of the original variables). The corresponding eigenvalues represent the variance accounted for by the respective principle component. The new composite variable, or jth principle component, is represented in the notation by Y_j . The sign and magnitude of the loading coefficient a_{ij} shows the direction and magnitude of the relationship between the composite variable Y_j and the original variable X_i. The principle component is frequently interpreted in the terms of those variables having strong loading coefficients. Those selection variables with high loadings for a principle component can often be interpreted as displaying similar characteristics. [Ref. 7: p.425]

There are several "rules-of-thumb" for determining how many principle components to retain. The most popular selects a number of components which accounts for a specific cumulative fraction of the total variance (eg. 90%). Another rule-of-thumb selects those components with eigenvalues greater than or equal to one. The third method is based on a subjective interpretation of a scree plot. The final decision on the number of components to retain, is not based on a statistical requirement. Rather it is determined by good judgement and operational significance.

2. **Analysis**

The principle component analysis was performed on the twenty-six selection variables. Determination of the number of components to retain was difficult. Seven

components would be selected using the criterion "eigenvalue ≥ 1." The scree plot shown as-Figure 4.9 shows a definite break at six principle components.

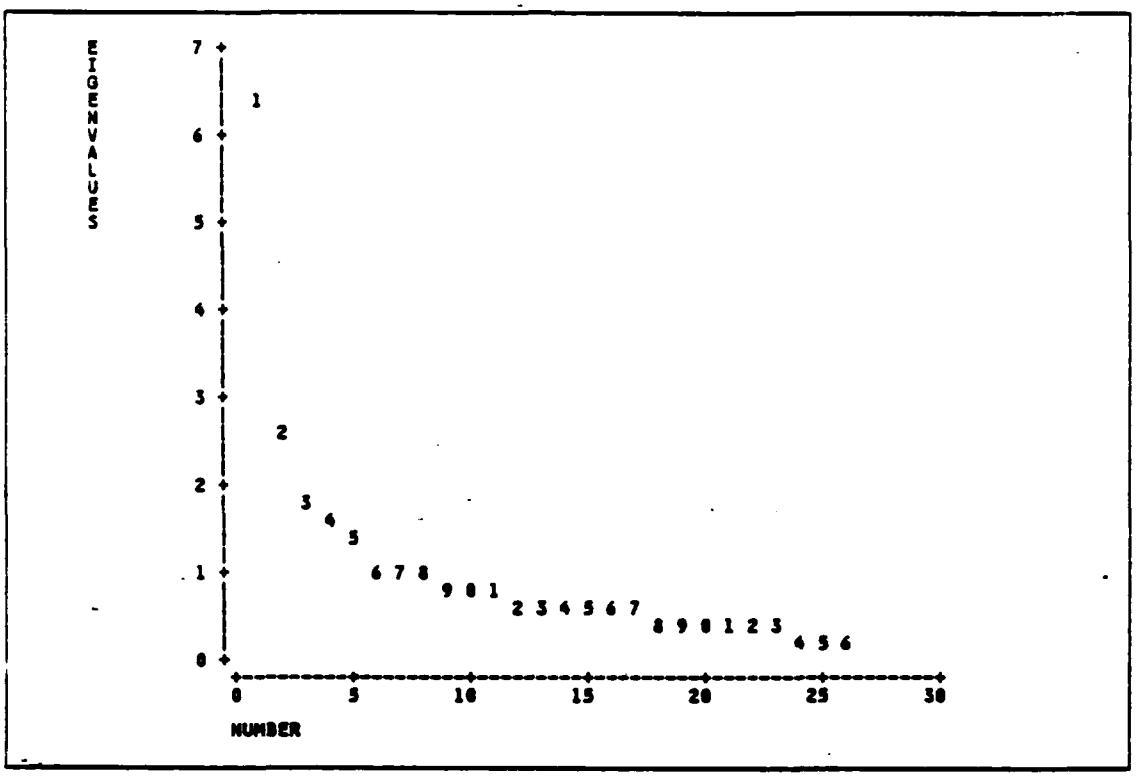


Figure 4.9 Scree Plot of Eigenvalues.

However, six or seven principle components do not explain an adequate amount of the variance. Only 56% of the variance is explained with six components and seven components accounts for only 60%. As indicated in Table 12, twenty-one components are required to account for 90% of the total variance and twelve principle components are needed to explain 75% of the variance. Table 12 displays the eigenvalues for all twenty-six principle components. Column two shows the difference between the eigenvalues of successive components. The third column indicates the proportion of variance accounted for by each component and the last column displays the cumulative proportion of variance explained by the principle components.

Consistent with the expectations based on the correlation analysis, the PCA did not yield operationally useful results. The principle component analysis takes a group of correlated variables and transforms them into uncorrelated composites. The

TABLE 12

PRINCIPLE COMPONENT EIGENVALUES AND VARIANCE PROPORTIONS

	EIGENVALUE	DIFFERENCE	PROPORTION	CUMULATIVE
PRIN1	6.35086	3.81298	0.244264	0.24426
PRIN2	2.53789	0.70411	0.097611	0.34188
PRIN3	1.83378	0.28328	0.070530	0.41241
PRIN4	1.55051	0.16101	0.059635	0.47204
PRIN5	1.38950	0.29274	0.053442	0.52548
PRIN6	1.09675	0.03673	0.042183	0.56767
PRIN7	1.06002	0.08213	0.040770	0.60844
PRIN8	0.97789	0.08720	0.037611	0.64605
PRIN9	0.89070	0.06893	0.034258	0.68030
PRIN10	0.82177	0.02325	0.031606	0.71191
PRIN11	0.79852	0.10705	0.030712	0.74262
PRIN12	0.69147	0.00440	0.026595	0.76922
PRIN13	0.68707	0.04405	0.026426	0.79564
PRIN14	0.64302	0.02390	0.024732	0.82038
PRIN15	0.61912	0.03839	0.023812	0.84419
PRIN16	0.58073	0.05525	0.022336	0.86652
PRIN17	0.52548	0.08326	0.020211	0.88673
PRIN18	0.44222	0.04020	0.017009	0.90374
PRIN19	0.40202	0.00899	0.015462	0.91921
PRIN20	0.39302	0.02144	0.015116	0.93432
PRIN21	0.37158	0.04774	0.014292	0.94861
PRIN22	0.32383	0.01707	0.012455	0.96107
PRIN23	0.30676	0.01912	0.011799	0.97287
PRIN24	0.28764	0.03970	0.011063	0.98393
PRIN25	0.24794	0.07807	0.009536	0.99347
PRIN26	0.16988	.	0.006534	1.00000

interpretation of the components is difficult. Table 13 displays an extract of the eigenvectors for the first seven principle components. The complete set of eigenvectors may be found at Appendix G. Most of the loading coefficients have values less than 0.50 . Only five of the loadings exceeded 0.5 in all of the components. The linear combinations do not suggest new, meaningful composite variables with the possible exception of the first component. Although the first component loadings have small magnitudes, they are all positive. No one coefficient or small subset of coefficients "stand out" from the complete set. This suggests that the first principle component represents an *"all around"* or *"whole person"* criterion. The first component accounts for 24.4% of the total variance.

The third objective of principle component analysis is to eliminate original variables which contribute relatively little extra information. Performing this analysis led to the elimination of four of the original variables, thereby slightly reducing the dimension. The method used the eliminate the variables consists of two steps:

TABLE 13

PRINCIPLE COMPONENT ANALYSIS EIGENVECTORS (EXTRACT)

EIGENVECTORS

	PRIN1	PRIN2	PRIN3	PRIN4	PRIN5	PRIN6	PRIN7
TIS	0.128215	0.075610	0.203039	0.380570	-.016454	-.212939	-.269676
PHYSFIT	0.158309	0.171314	-.119287	0.354514	-.021787	-.262829	-.294937
MEL	0.178980	0.089034	-.049265	0.479524	0.082934	-.123272	0.144802
ASSIGN	0.136811	0.068633	0.100553	0.195233	0.276809	-.006473	0.407794
PERFORM	0.071552	0.067023	-.192161	0.184915	0.143507	0.455070	0.435239
CIVILED	0.227202	-.174175	-.032577	0.184283	-.033962	0.185293	0.115964
RESMGT	0.250761	-.129078	0.045271	-.024059	0.163599	-.028304	-.035089
DECISN	0.159153	0.075268	-.262080	-.209805	0.032999	0.091271	-.215971
FORNREL	0.245653	-.035936	0.241775	0.007555	-.397139	0.035478	0.074965
PUBREL	0.238911	-.137734	-.008343	0.008351	-.356465	-.064523	-.017579
GOVTREL	0.231997	-.133030	0.091849	-.121685	-.417582	-.062946	0.047271
VERBCOM	0.217141	0.048591	-.414140	-.114580	-.049618	-.297818	0.130065
WRITCOM	0.233836	0.099130	-.257327	-.006084	-.047447	-.273317	0.177363
TECHEXP	0.063671	0.185208	0.166460	-.114408	0.396451	-.347051	0.098727
INDUS	0.270224	-.211141	0.184872	-.054870	0.114517	0.057534	-.041691
CONCEPT	0.168323	-.006135	-.262556	-.293283	-.017839	0.013471	0.180368
LEADER	0.112758	0.180906	-.266890	0.021185	0.030454	0.368036	-.305354
COMBAT	0.136752	0.323191	0.079037	0.107846	-.195065	0.330552	0.010291
CMDPRES	0.207086	0.315931	-.142391	0.106756	-.020372	0.114006	-.206778
PPBS	0.280242	-.107343	0.070735	-.001862	0.217054	0.141145	-.077999
PROGMGT	0.261139	-.197225	0.111916	-.138063	0.230735	0.105806	-.224610
TIMEMGT	0.220918	0.013053	-.200403	-.230153	0.133311	-.137204	-.026947
TACTICS	0.086183	0.469654	0.276980	-.212465	0.034998	0.017095	-.026012
ACQUIS	0.256595	-.209139	0.215854	-.066462	0.221947	0.101951	-.123069
JOINT	0.190939	0.043405	0.221618	-.047331	-.151684	-.065107	0.298078
STRAT	0.068948	0.460754	-0.244757	-.266743	-.025757	0.022516	0.060620

1) Variables which maintain low loading coefficients in the eigenvectors but have high correlations with another variable are reviewed.

2) Variables which have significant loadings only on the latter principle components are eliminated. A high loading in a component that explains a small amount of variance does not yield much information.

The variables which were eliminated using these rules are: ACQUIS, VERBCOM, INDUS, and STRAT. Note that three of the variables (ACQUIS, INDUS, STRAT) have corresponding variables designed to test survey response consistency and therefore have high correlations (see Chapter 2, Section D). VERBCOM is highly correlated with WRITCOM and is therefore somewhat redundant. Elimination of variables reduced the number of selection variables from twenty-six to twenty-two.

The principle component analysis did not yield the sought after reduction in dimensionality. Therefore, additional multivariate techniques, not included in the original analysis plan were utilized in order to develop the Brigadier General selection criteria.

J. VARIABLE CLUSTER ANALYSIS

This section concentrates on a dimension reduction technique called variable cluster analysis. Because the principle component analysis did not yield a reduced number of composite variables which could be meaningfully interpreted, the original analysis plan was extended to include this statistical technique. Variable clustering uses the correlation or covariance matrix to divide the variables into non-overlapping clusters. Consistent with the PCA, the correlation is used. Analyzing the correlation matrix causes all variables to be treated as equally important. Using the covariance matrix results in the variables with larger variances given more importance in the analysis [Ref. 8: p.802]. The effect of variable clustering is to produce clusters which can be interpreted as a new composite variable with a meaningful aggregated characteristic. This is similar to the purpose of a principle component analysis, however the variable cluster components are easier to interpret.

1. Methodology

Variable clustering commences with all variables in one group or cluster. The first two principle components are computed and an orthoblique rotation is performed on the eigenvectors. The variables are assigned to the rotated component with which they have the highest squared correlation. The following steps are then repeated:

1) The first two principle components are found for each cluster of variables.
2) The group which has the second highest eigenvector or explains the smallest amount of variation is chosen for splitting.
3) An orthoblique rotation is performed.
4) A variable is assigned to the rotated component with which it has the highest squared correlation.
5) The variables are iteratively reassigned to clusters to maximize the variance accounted for by the group components.

The steps are repeated until each variable forms its own cluster, thereby accounting for 100% of the variance. [Ref. 8: p.802]

The earlier ANOVA analysis performed on the first principle component with FUNCAREA as the independent variable (Section G), suggested looking at the effects of functional areas on the variable clustering. A variable clustering was performed for each functional area independently. Most cluster differences occured for functional areas which contained a single observation. These variable clusters are not representative of the General Officer population and thus were not considered for further analysis or implementation. Moreover, the clusters were not statistically or operationally significant.

2. **Analysis**

The variable cluster analysis was performed on the 22 selection variables, which were reduced from 26 variables by the principle component analysis. The twenty-two variables were clustered using the principle components as the cluster components. Since the Selection Board Support System can be adapted to allow as few as two selection criteria, or as many as ten; the maximum number of clusters generated was ten.

Table 14 gives the summary for ten clusters. In the column labeled "members" is the number of original variables assigned to each cluster. The column labeled "variation explained", indicates the variation explained by the cluster component. It includes only contributions from the variables within that cluster. The proportion of variance explained is computed by dividing the amount of variance explained by the cluster by the total variance of the variables in the cluster. As indicated at the bottom of Table 14, the total proportion to the variance explained in the 10 clusters is approximately 67%. The key as to whether this amount is sufficient to adequately explain the information in the original variables, is determined by the operational significance of the clusters.

TABLE 14

CLUSTER VARIATION SUMMARY

OBLIQUE PRINCIPAL COMPONENT CLUSTER ANALYSIS

CLUSTER SUMMARY FOR 10 CLUSTERS

CLUSTER	MEMBERS	CLUSTER VARIATION	VARIATION EXPLAINED	PROPORTION EXPLAINED	SECOND EIGENVALUE
1	3	3.00000	2.06530	0.6884	0.53714
2	3	3.00000	1.66866	0.5562	0.72296
3	4	4.00000	2.36450	0.5911	0.76566
4	2	2.00000	1.36684	0.6834	0.63316
5	2	2.00000	1.36278	0.6814	0.63722
6	4	4.00000	1.87924	0.4698	0.81825
7	1	1.00000	1.00000	1.0000	
8	1	1.00000	1.00000	1.0000	
9	1	1.00000	1.00000	1.0000	
10	1	1.00000	1.00000	1.0000	
TOTAL VARIATION EXPLAINED =			14.7073	PROPORTION =	0.668515

Table 15 indicates the names of the original variables assigned to each cluster. The clusters do appear to represent underlying meaningful variables which display operationally interpretable characteristics. The first cluster, containing the variables RESMGT, PPBS, and PROGMGT represents skills required in *Resource Allocation Management.* The variables, TIS, PHYSFIT, and MEL are grouped in the second cluster. This cluster suggests *Overall Military Qualification.* The third cluster represents *Relational Skills* and consists of the variables, FORNREL, PUBREL, GOVTREL, and CIVILED. Civilian education retains a weak correlation with the cluster as indicated in column 2 of Table 15. The inclusion of civilian education in this cluster is consistent with the Army Research Institute finding that graduate education in the field of international relations is valuable at the three and four star General Officer levels [Ref. 9: p.49]. The aggregated characteristic suggested by the variables, COMBAT and TACTICS, in the fourth cluster is *War-Fighting Skills. Organizational Management Skills* is established as the next cluster. The variables aggregated in this characteristic are: DECISN, CONCEPT, WRITCOM, and TIMEMGT. The sixth cluster represents *Leadership* by containing the variables, CMDPRES and LEADER. Clusters seven thru ten are univariate with each variable explaining its own cluster. Those clusters represent *Technical Expertise, Assignment History, Duty Performance,* and *Joint Service Qualification.*

Columns two and three of Table 15 indicate the squared correlations of the original variables with their cluster and the next closest cluster component. A small value in the column labeled "1-R**2" indicates a good fit. [Ref. 8: p. 810] As mentioned earlier, CIVILED does not have a good correlation with either its own cluster or with the next closest cluster. It appears to be a good candidate for a separate cluster.

The clusters account for 67% of the variance. More importantly, they are operationally significant and represent logical groupings of the variables. They do represent aggregate characteristics of the original variables and provide a good basis for the final set of recommended criteria to be used with SBSS.

K. SUBJECTIVE ANALYSIS

The General Officers were given the opportunity to annotate additional criteria which they deemed important for selection. This section discusses the General Officers' written comments

TABLE 15

CLUSTER FORMATION SUMMARY

	VARIABLE	R-SQUARED WITH OWN CLUSTER	R-SQUARED WITH NEXT CLOSEST	1-R**2 RATIO
CLUSTER 1				
	RESMGT	0.6294	0.1855	0.4550
	PPBS	0.7335	0.1916	0.3296
	PROGMGT	0.7024	0.1862	0.3657
CLUSTER 2				
	TIS	0.4910	0.0482	0.5347
	PHYSFIT	0.6004	0.1402	0.4648
	MEL	0.5772	0.0798	0.4594
CLUSTER 3				
	CIVILED	0.3779	0.2077	0.7852
	FORNREL	0.7026	0.1672	0.3571
	PUBREL	0.6539	0.1669	0.4154
	GOVTREL	0.6301	0.1331	0.4267
CLUSTER 4				
	COMBAT	0.6834	0.1618	0.3777
	TACTICS	0.6834	0.0848	0.3459
CLUSTER 5				
	LEADER	0.6814	0.0897	0.3500
	CMDPRES	0.6814	0.2414	0.4200
CLUSTER 6				
	DECISN	0.3837	0.1005	0.6851
	WRITCOM	0.4460	0.1269	0.6346
	CONCEPT	0.5152	0.0760	0.5247
	TIMEMGT	0.5344	0.1890	0.5741
CLUSTER 7				
	TECHEXP	1.0000	0.0571	0.0000
CLUSTER 8				
	ASSIGN	1.0000	0.0589	0.0000
CLUSTER 9				
	PERFORM	1.0000	0.0416	0.0000
CLUSTER 10				
	JOINT	1.0000	0.1445	0.0000

1. **Analysis of Annotated Criteria**

Over 50 different additional criteria were annotated on the questionnaires by the respondents. Many of these represented response by only a few respondents. There were, however, several recurring themes resulting from the additional criteria. The need for the selection board to consider *interpersonal skills* was the strongest of these. Several lengthy comments were written on interpersonal skills and the need for General Officers to possess the attribute. Strong feelings were expressed that General

Officers should have a *genuine concern for subordinate soldiers and their families*, possess a high level of *integrity*, and utilize a high degree of *common sense* were also expressed.

General Officers holding positions in medical related specialties (dentistry, veterinary medicine, etc) urged that Brigadier General selectees possess a national board certification in their field.

Those criteria which were annotated on the original survey in multiplicity are found in Table 16 with the frequency of their occurrences. Many of the criteria possess the aggregated characteristics determined in the Variable Clustering section and can be expressed as members of the clusters.

2. **Additional Comments**

In addition to providing input for specific selection criteria, several General Officers commented on special selection considerations. There were several comments concerning the need for a small number of Brigadier Generals to be selected on the basis of expertise in a specific specialty. One General stated, ".... I urge that both the selection boards and the GOMO in concert take care to select officers, hopefully a very small number, by virtue of their high performance in particular specialties /functions for related vacancies, and that officers selected for general performance be assigned to center-stream positions that better foster general development and progression." In concert with this theme, several General Officers expressed the opinion that several positions maintain a vertical learning curve for newly assigned Brigadier Generals.

In addition, strong comments on the requirement for General Officers to possess interpersonal skills were reiterated. It was suggested that the selection system should weed-out people-eaters, those with egos that get in the way of performance, as well as those which do not have a genuine concern for soldiers. These are criteria which are difficult to measure by an individual's file. For determining these attributes, personal knowledge of the candidate is necessary. An interesting comment on the idea of personal knowledge was submitted by one General Officer. Paraphrasing, he said that personal knowledge is a "two-edged sword" and should not be considered a problem. It is an issue which can not be changed since senior officers develop reputations, good or bad, and some member of the board is bound to have knowledge of one or more of the candidates. Furthermore, he believed that it is impossible for a person to be selected for General Officer whose file does not support the selection.

TABLE 16
FREQUENCY OF ANNOTATED CRITERIA

CRITERION	FREQUENCY
Interpersonal Skills	15
Concern for Soldiers	10
Common Sense	8
Integrity	8
Selflessness	7
Reputation	5
High Level Staff Relationships	5
Trainer Ability	5
Instalation Management	5
Logistics	5
Moral Courage	4
Language Skills	3
Health Condition	3
Team Building Ability	3
Analytical Thought Process	3
National Board Certification (Medical Specialties)	3
Reserve Component Knowledge	2
Spousal Support	2

The comments prove to be strong concerns of the survey population. The comments are considered heavily in the final conclusions and recommendations.

V. CONCLUSIONS AND RECOMMENDATIONS

This chapter focuses on the study's conclusions. A summary of the significant results from the analysis is presented. This is followed by a discussion of the conclusions drawn from the analysis. The most appropriate selection criteria are discussed, as well as several supplemental conclusions determined from the data. The basis upon which each conclusion is developed is explained. Next, recommendations are presented for approval and implementation. Concluding the thesis are recommendations for further study and research in related topics.

A. SUMMARIZED RESULTS

1. Exploratory Analysis

The exploratory analysis provided an overview of the population demographics as well as an initial examination of the General Officers' evaluations. The means and distribution analyses revealed that leadership, technical expertise, past performance, assignment history, decision making ability, and verbal and written communication skills are considered extremely important for selection to the rank of Brigadier General.

These analyses also indicated that the vast majority of General Officers believe that they are appropriately assigned to a position congruent with their career background experience. They also believe they were better prepared for subsequent assignments versus their first assignment as a General Officer.

2. Analysis of Variance and Kruskal-Wallis Tests

The analysis of variance and Kruskal-Wallis test indicated there is no significant differences in the overall selection criteria evaluations due to the General Officers' demographics. A statistically significant difference due to secondary specialties is indicated when the first principle component was used as the dependent variable. However, these differences are operationally insignificant. Several selection variables were identified as being individually significant due to specific demographical distinctions. These variables were examined for possible trends in the bivariate analysis.

3. Bivariate Analysis

The bivariate analysis exhibited several trends in the General Officers evaluations. First, the importance of the civilian education criterion monotonically

increases with the level of degree possessed by the General Officers. Secondly, the General Officer career backgrounds affect the relative importance of several criteria. The Generals tend to evaluate higher those criteria which reflect their own career requirements. Finally, General Officers which have had previous experience serving on a Brigadier General selection board (versus those who have not) believe personal knowledge of a candidate is more important in the selection process.

Correlation analysis of the selection variables indicated that overall there are low correlations among the variables. The original selection variables tend to be uncorrelated and thus provide a wide diversity of requirements placed on General Officers. Variables which represent criteria included in the survey to check for consistent responses possess relatively high correlations, indicating consistency.

4. **Principle Component Analysis**

Due to the low correlations between the original variables, the principle component analysis did not reduce the dimensionality of the data set through the transformed linear combinations. Generally, the principle components were difficult to interpret; however, the first principle component does suggest a criterion exhibiting a "whole-person" or "overall" aggregated characteristic.

By examining the eigenvectors, four of the original selection variables were eliminated. These variables possessed low loading coefficients on the principle components.

5. **Variable Cluster Analysis**

The variable cluster analysis resulted in ten interpretable clusters of the twenty-two original selection variables. These clusters account for 67% of the variance and represent meaningful, aggregated characteristics. The clusters are operationally significant and form a basis for the final set of recommended selection criteria.

6. **Subjective Analysis**

The General Officers' additional comments and annotated criteria presented several recurring themes which they believed important for selection to BG. Interpersonal skills, concern for soldiers, common sense, integrity, and selflessness were the most frequently mentioned.

B. CONCLUSIONS

The study's initial conclusion is that the five criteria, presently utilized for selection boards through the grade of O-6, are not appropriate for Brigadier General selection. These criteria: qualification, performance, physical fitness and military

bearing, military education level, and civilian education level, do not convey the full scope of required General Officer attributes. Moreover, some provide little discriminatory power for the General Officer grades.

The study also concludes that an appropriate set of Brigadier General selection criteria does exist.

1. **The Most Appropriate Selection Criteria**

The results of the variable cluster analysis form the basis for the set of Brigadier General selection criteria. The results of the cluster analysis can contribute directly to development of a classification scheme [Ref. 10: p.4].

There are ten criteria which can be considered most appropriate for selection to Brigadier General. Within several criteria, there are aspects or traits which should be considered during the evaluation of those criteria.

The first criterion is *overall qualification.* This criterion is developed based upon three sources of analysis: variable cluster analysis, principle component analysis, and subjective analysis. The PCA establishes that the overall qualification criterion is statistically significant and is necessary for selection. Paralleling the PCA, the variable cluster analysis provides the criterion classification and exhibits several aspects which should be considered in the evaluation of this criterion. Those aspects are: time in service, physical fitness and military bearing, and military education level. In addition, several General Officer traits to be considered when evaluating this criterion are identified by the subjective analysis. They include: reputation, integrity, common sense, selflessness, and the candidate's health.

Relational skills is the next criterion. There are several categories of relational skills to recognize during evaluation. As established by the variable clustering; public, inter-governmental, and foreign (international) relational skills should be considered. The candidate's civilian education in those skills should also be reviewed. Moreover, the General Officers additional comments direct that interpersonal skills and high level staff relational skills also be considered in the evaluation.

The next criterion identified is *Warfare Skills.* Combat experience as well as tactics and strategy skills should be included within this criterion.

Resource Allocation Management is also established as a selection criterion. Aspects to be acknowledged under this criterion consist of: budgeting ability, PPBS knowledge, system acquisition skills, resource management ability, logistics skills, and program management ability.

Based upon both the variable clustering as well as the Title IV requirement, *Joint Service Qualification* is introduced as a selection criterion. Evaluation of this criteria should be based on the candidate's experience gained through joint service assignments as well as non-army military education.

Technical Expertise is the next criterion to be evaluated during the BG selection process. The candidates expertise in specialized areas and civilian education degrees should be considered during this evaluation. As suggested by the subjective analysis, language skills can be acknowledged during this portion of the evaluation also. Furthermore, board members should recognize national board certifications for those in the medical and related fields.

Another criterion is *Organizational Management Skills.* This classification is composed of decision making ability, written and verbal communication skills, time management ability, and the ability to conceptualize an organization's future requirements should be considered.

The last three clusters were comprised of a single criterion. Each is considered extremely important for selection. They are: *Leadership Ability*, *Assignment History*, and *Duty Performance.*

These ten selection criterion are congruous with the requirements for implementation with the Selection Board Support System. Table 17 summarizes the ten selection criteria. The second column of the table indicates those aspects of the respective criteria which should be considered during their evaluation.

2. **Supplemental Conclusions**

Several findings were made during the course of the study which, although do not impact directly on determining the selection criteria, do present some interesting conclusions.

Based on the bivariate analysis results, the conclusion can be drawn that selection board members tend to promote in their own image. The analysis revealed that career backgrounds affect the relative importance of selection criteria. In addition, those individuals with higher civilian education degrees generally considered civilian education more important.

The means and frequency analysis showed that General Officers considered joint service skills to be *relatively* less important than many of the other criteria. These data were collected when the Title IV joint service requirement was relatively new and its impact not fully noted. A survey administered at the present time may receive a different response.

TABLE 17

BRIGADIER GENERAL SELECTION CRITERIA

SELECTION CRITERIA	ASPECTS or TRAITS CONSIDERED DURING CRITERIA EVALUATION
Overall Military Qualification	Time in Service Physical Fitness Military Education Level Reputation Common Sense Integrity Selflessness Health Condition
Relational Skills	Public Relations Inter-governmental Relations Foreign Relations Civilian Education (for above) Interpersonal Skills High Level Staff Relations
Resource Allocation Management	Budgeting Ability PPBS Knowledge System Acquisition Ability Logistical Skills Program Management Ability
Technical Expertise	Expertise in a Specialty Civilian Education Degree
Organizational Management Skills	Decision Making Ability Written Communication Skills Verbal Communication Skills Time Management Ability Ability to Conceptualize
War-Fighting Skills	Combat Experience Tactics Skills Strategy Skills
Joint Service Qualification	
Leadership	
Assignment History	
Duty Performance	

A conclusion drawn from background variable exploratory analysis indicates that, in general, Brigadier Generals believe that they are appropriately assigned to billets correlating to their career experiences. With the full implementation of the Executive Track decision support system, the assignment-experience correlation will be greatly enhanced.

The analysis of job preparedness showed that there are several positions which require specialized expertise. In addition, many General Officers feel better prepared for G.O. positions subsequent to their first G.O. assignment.

Although there were diverse opinions on the subject, the study's final conclusion indicates that personal knowledge of a candidate by a board member is relatively important. It allows for the evaluation of those attributes which are difficult to measure, and provides an opportunity to judge whether an individual will represent the army well.

C. RECOMMENDATIONS

1. Implementation of Selection Criteria

We recommend that the ten selection criteria determined by this study be implemented with the Selection Board Support System for the Brigadier General selection process. At the commencement of the selection board, the criteria should be identified to the board members. Consistent with SBSS, the each board member will determine the relative weights to be applied to each criterion. Weight determination will be based upon guidance from the Chief of Staff and personal perception of criterion importance. It is recommended that D.A. Secretariat staff personnel provide written instructions describing each criteria, as specified in Table 17, to be considered during the evaluation. This provides structure and consistency to evaluation process.

It is further recommended that these criteria be utilized only to evaluate the candidates whose files are in the 'short-stack'. Employing ten criteria, SBSS detects subtle differences in evaluations and aids the board member with the final selection decision. This careful scrutiny of the files is not necessary for the initial screening and evaluation. For the initial screening and evaluation, it is recommended the current SBSS criteria, performance and qualification, be utilized.

Evaluation of the short-stack files with ten criteria will require time. It is therefore recommended the board members be alloted more time per file for this very important evaluation and decision.

The analysis indicated the existence of several General Officer positions which require specialized expertise. If possible, it is recommended that the GOMO identify annual impending vacancies for these specialized positions prior to the selection board convening. Selection of Brigadier Generals to fill these vacancies or meet specialty "floors" can be accomplished through the *technical expertise* criterion evaluation. Once all candidates have been evaluated, the order of merit list can be re-ordered by specialty and the technical expertise score. Individuals which meet the overall General Officer qualifications, and possess the greatest expertise in a specialty, can be identified to fill those specialized positions.

Due to the finding that career backgrounds can influence criteria importance, it is recommended that selection boards be comprised of General Officers with varying career backgrounds and experience.

2. **Further Study And Research**

a. Immediate

A committee should be established, in the short-term, to determine the sources from which board members can obtain relevant information for criteria evaluation. Several such sources are: Officer Record Brief, official photo, Officer Evaluation Reports, and personal knowledge of the candidate. The committee should determine if additional sources exist and how they can be included for the board members' review. When selecting the army's top leaders, it is important every available information source be utilized to insure the best decision.

Prior to full scale implementation, the criteria should be tested by the next convening Brigadier General selection board in order to obtain constructive feedback. Upon completion of selection under the current system, it is recommended the board replicate the final selection from the short-stack using the ten selection criteria.

b. Long Term

The raw data and comments provided by the survey are useful for further analysis and study. It is recommended that the comments be reviewed to aid in the determination of which positions have specialized requirements. In concert with this, the responses can be used by the GOMO as a second validating source for the data base values assigned to the billet competencies of their management support system.

Finally, further research is recommended to determine the feasibility of implementing an executive training program for newly selected Brigadier Generals. The responses to the questions addressing preparedness indicated that some Brigadier

Generals believe they could have been better prepared for their first G.O. position. The questionnaire data can be used as a basis to establish an appropriate professional development course.

APPENDIX A
BRIGADIER GENERAL SURVEY

****

MARK ALL ANSWERS DIRECTLY ON THE SURVEY QUESTIONAIRE
BY CIRCLING APPROPRIATE ANSWER OR FILLING IN THE BLANKS

****

1. Circle your present rank. MG(P) MG BG(P) BG

2. What is your time in grade? _____(months)

3. What is your current position and organization?

_____

_____

4. What was your former primary specialty? _____

5. What was your former functional area or secondary specialty ?

_____

6. Circle highest civilian education.

BS/BA MS/MA PhD Other _____

Major subject area? _____

7. On how many officer selection boards have you served? ____

8. Have you ever been a member of a Brigadier General selection board?

Yes No

9. In your opinion, how important to the selection process, is PERSONAL board member knowledge of the selectees' potential as a General Officer?

Extremely Important			Moderately Important			Slightly Important
7	6	5	4	3	2	1

10. How well were you prepared for your first BG position?

Extremely prepared			Moderately prepared			Slightly prepared
7	6	5	4	3	2	1

11. How well were you prepared for subsequent General Officer positions?

_____ Not applicable (currently serving in first BG position)

Extremely prepared			Moderately prepared			Slightly prepared
7	6	5	4	3	2	1

12. Was your first job, as a BG, appropriate to your backround and experience.

Extremely appropriate			Moderately appropriate			Slightly appropriate
7	6	5	4	3	2	1

13. To best perform in your current position, please describe the subject areas in which you should possess expertise.

_____

_____

_____

14. For SELECTION to BG, rate the following criteria. (circle one value for each criteria).

	Extremely Important			Moderately Important			Slightly Important
1. Total Time in Service	7	6	5	4	3	2	1
2. Physical Fitness / Military Bearing	7	6	5	4	3	2	1
3. Military Education Level	7	6	5	4	3	2	1
4. Types of Assignments Held	7	6	5	4	3	2	1
5. Past Overall Performance	7	6	5	4	3	2	1
6. Advanced Civilian Education	7	6	5	4	3	2	1
7. Resource Management Ability	7	6	5	4	3	2	1
8. Decision Making Ability	7	6	5	4	3	2	1
9. Foreign Relation Skills	7	6	5	4	3	2	1
10. Public Relations/Media Skills	7	6	5	4	3	2	1
11. Inter-government skill (national, state, or local)	7	6	5	4	3	2	1
12. Verbal Communication Skills	7	6	5	4	3	2	1
13. Written Communication Skills	7	6	5	4	3	2	1
14. Technical / Field Expertise	7	6	5	4	3	2	1
15. Industry Interaction Ability	7	6	5	4	3	2	1
16. Ability to Conceptualize	7	6	5	4	3	2	1
17. Leadership Ability	7	6	5	4	3	2	1
18. Combat Experience	7	6	5	4	3	2	1
19. Command Presence	7	6	5	4	3	2	1
20. PPBS Knowledge	7	6	5	4	3	2	1
21. Program Management Ability	7	6	5	4	3	2	1
22. Time Management Ability	7	6	5	4	3	2	1
23. Knowledge of Tactics	7	6	5	4	3	2	1
24. Acquisition/Procurement Skill	7	6	5	4	3	2	1
25. Joint Service Knowledge	7	6	5	4	3	2	1
26. Tactics/Strategy Skills	7	6	5	4	3	2	1
27. Other _____ (please specify)	7	6	5	4	3	2	1

15. For your current 3G position, rate each of the criteria which are required to BEST PERFORM in that position. (circle one value for each criteria)

	Extremely Important			Moderately Important			Slightly Important
1. Total Time in Service	7	6	5	4	3	2	1
2. Physical Fitness / Military Bearing	7	6	5	4	3	2	1
3. Military Education Level	7	6	5	4	3	2	1
4. Types of Assignments Held	7	6	5	4	3	2	1
5. Past Overall Performance	7	6	5	4	3	2	1
6. Advanced Civilian Education	7	6	5	4	3	2	1
7. Resource Management Ability	7	6	5	4	3	2	1
8. Decision Making Ability	7	6	5	4	3	2	1
9. Foreign Relations Knowledge	7	6	5	4	3	2	1
10. Public Relations/Media Skills	7	6	5	4	3	2	1
11. Inter-government skill (national, state, local)	7	6	5	4	3	2	1
12. Verbal Communication Skills	7	6	5	4	3	2	1
13. Written Communication Skills	7	6	5	4	3	2	1
14. Technical / Field Expertise	7	6	5	4	3	2	1
15. Industry Interaction Ability	7	6	5	4	3	2	1
16. Ability to Conceptualize	7	6	5	4	3	2	1
17. Leadership Ability	7	6	5	4	3	2	1
18. Combat Experience	7	6	5	4	3	2	1
19. Command Presence	7	6	5	4	3	2	1
20. PPBS Knowledge	7	6	5	4	3	2	1
21. Program Management Ability	7	6	5	4	3	2	1
22. Time Management Ability	7	6	5	4	3	2	1
23. Knowledge of Tactics	7	6	5	4	3	2	1
24. Acquisition/Procurement Skill	7	6	5	4	3	2	1
25. Joint Service Knowledge	7	6	5	4	3	2	1
26. Tactics/Strategy Skills	7	6	5	4	3	2	1
27. Other _____ (please specify)	7	6	5	4	3	2	1

APPENDIX B
MAJOR GENERAL SURVEY

****

MARK ALL ANSWERS DIRECTLY ON THE SURVEY QUESTIONAIRE
BY CIRCLING THE APPROPRIATE ANSWER OR FILLING IN THE BLANKS

****

1. Circle your present rank. MG(P) MG BG(P) BG

2. What is your time in grade? _____(months)

3. What is your current position and organization?

_____

_____

4. What was your former primary specialty? _____

5. What was your former functional area or secondary specialty ?

_____

6. Circle highest civilian education.

BS/BA MS/MA PhD Other _____

Major subject area? _____

7. On how many officer selection boards have you served? _____

8. Have you ever been a member of a Brigadier General selection board?

Yes No

9. In your opinion, how important to the selection process is PERSONAL board member knowledge of the selectees' potential as a General Officer?

Extremely important			Moderately important			Slightly important
7	6	5	4	3	2	1

10. On the average, how well were the BGs that you supervise prepared for their first BG positions?

Extremely prepared			Moderately prepared			Slightly prepared
7	6	5	4	3	2	1

11. To best perform in their current positions, please describe the subject area, in which the BGs that you supervise, should posses expertise?

Subject area: _____

_____

Associated BG position: _____

Subject area: _____

_____

Associated BG position: _____

12. For SELECTION to BG, rate the following criteria. (circle one value for each criteria).

	Extremely Important					Moderately Important	Slightly Important
1. Total Time in Service	7	6	5	4	3	2	1
2. Physical Fitness / Military Bearing	7	6	5	4	3	2	1
3. Military Education Level	7	6	5	4	3	2	1
4. Types of Assignments Held	7	6	5	4	3	2	1
5. Past Overall Performance	7	6	5	4	3	2	1
6. Advanced Civilian Education	7	6	5	4	3	2	1
7. Resource Management Ability	7	6	5	4	3	2	1
8. Decision Making Ability	7	6	5	4	3	2	1
9. Foreign Relation Skills	7	6	5	4	3	2	1
10. Public Relations/Media Skills	7	6	5	4	3	2	1
11. Inter-government skill (national, state, or local)	7	6	5	4	3	2	1
12. Verbal Communication Skills	7	6	5	4	3	2	1
13. Written Communication Skills	7	6	5	4	3	2	1
14. Technical / Field Expertise	7	6	5	4	3	2	1
15. Industry Interaction Ability	7	6	5	4	3	2	1
16. Ability to Conceptualize	7	6	5	4	3	2	1
17. Leadership Ability	7	6	5	4	3	2	1
18. Combat Experience	7	6	5	4	3	2	1
19. Command Presence	7	6	5	4	3	2	1
20. PPBS Knowledge	7	6	5	4	3	2	1
21. Program Management Ability	7	6	5	4	3	2	1
22. Time Management Ability	7	6	5	4	3	2	1
23. Knowledge of Tactics	7	6	5	4	3	2	1
24. Acquisition/Procurement Skill	7	6	5	4	3	2	1
25. Joint Service Knowledge	7	6	5	4	3	2	1
26. Tactics/Strategy Skills	7	6	5	4	3	2	1
27. Other _____ (please specify)	7	6	5	4	3	2	1

13. For one BG position which YOU SUPERVISE, rate each of the criteria which are required to BEST PERFORM in that position. (circle one value for each criteria) (If you wish to rate the criteria for additional positions which you supervise, feel free to reproduce this page, complete rating, and attach to questionaire.)

Position Title: _____

Organization: _____

	Extremely Important					Moderately Important		Slightly Important
1. Total Years of Service	7	6	5	4	3	2	1	
2. Physical Fitness / Military Bearing	7	6	5	4	3	2	1	
3. Military Education Level	7	6	5	4	3	2	1	
4. Types of Assignments Held	7	6	5	4	3	2	1	
5. Past Overall Performance	7	6	5	4	3	2	1	
6. Advanced Civilian Education	7	6	5	4	3	2	1	
7. Resource Management Ability	7	6	5	4	3	2	1	
8. Decision Making Ability	7	6	5	4	3	2	1	
9. Foreign Relations Knowledge	7	6	5	4	3	2	1	
10. Public Relations Skills	7	6	5	4	3	2	1	
11. Inter-government skills (national, state, or local)	7	6	5	4	3	2	1	
12. Verbal Communication Skills	7	6	5	4	3	2	1	
13. Written Communication Skills	7	6	5	4	3	2	1	
14. Technical / Field Expertise	7	6	5	4	3	2	1	
15 Industry Interaction Ability	7	6	5	4	3	2	1	
16. Ability to Conceptualize	7	6	5	4	3	2	1	
17. Leadership Ability	7	6	5	4	3	2	1	
18. Combat Experience	7	6	5	4	3	2	1	
19. Command Presence	7	6	5	4	3	2	1	
20. PPBS Knowledge	7	6	5	4	3	2	1	
21. Program Management Ability	7	6	5	4	3	2	1	
22. Time Management Ability	7	6	5	4	3	2	1	
23. Knowledge of Tactics	7	6	5	4	3	2	1	
24. Acquisition/Procurement Skill	7	6	5	4	3	2	1	
25. Joint Service Knowledge	7	6	5	4	3	2	1	
26. Tactics/Strategy Skill	7	6	5	4	3	2	1	
27. Other _____ (please specify)	7	6	5	4	3	2	1	

APPENDIX C
SURVEY COVER LETTER

DEPARTMENT OF THE ARMY
OFFICE OF THE DEPUTY CHIEF OF STAFF FOR PERSONNEL
WASHINGTON, DC 20310-0300

REPLY TO ATTENTION OF

DAPC-MS

S: 10 March 1987

SUBJECT: Brigadier General Selection Process

(ADDRESS)

1. Each year the Army's leadership addresses the difficult process of selection to Brigadier General. As you know, there are many more well qualified Colonels than Army requirements for Brigadier General. Therefore, the selection process must provide our Army the best from the best qualified group of senior Colonels. Essentially, you are being asked to provide the criteria you consider essential in this selection process.

2. The attached survey was developed from existing Brigadier General position descriptions. What is now needed is your valued assessment as to the appropriateness of each criteria, which once satisfied, will provide the best Brigadier General. When all surveys are completed, the data will be analyzed to determine consensus and ordered priority of selection criteria. Appropriate recommendations will then be made to the Chief of Staff. Approved recommendations will be incorporated into the selection process and may also be employed as integral elements of a newly developed executive decision support system for board member use.

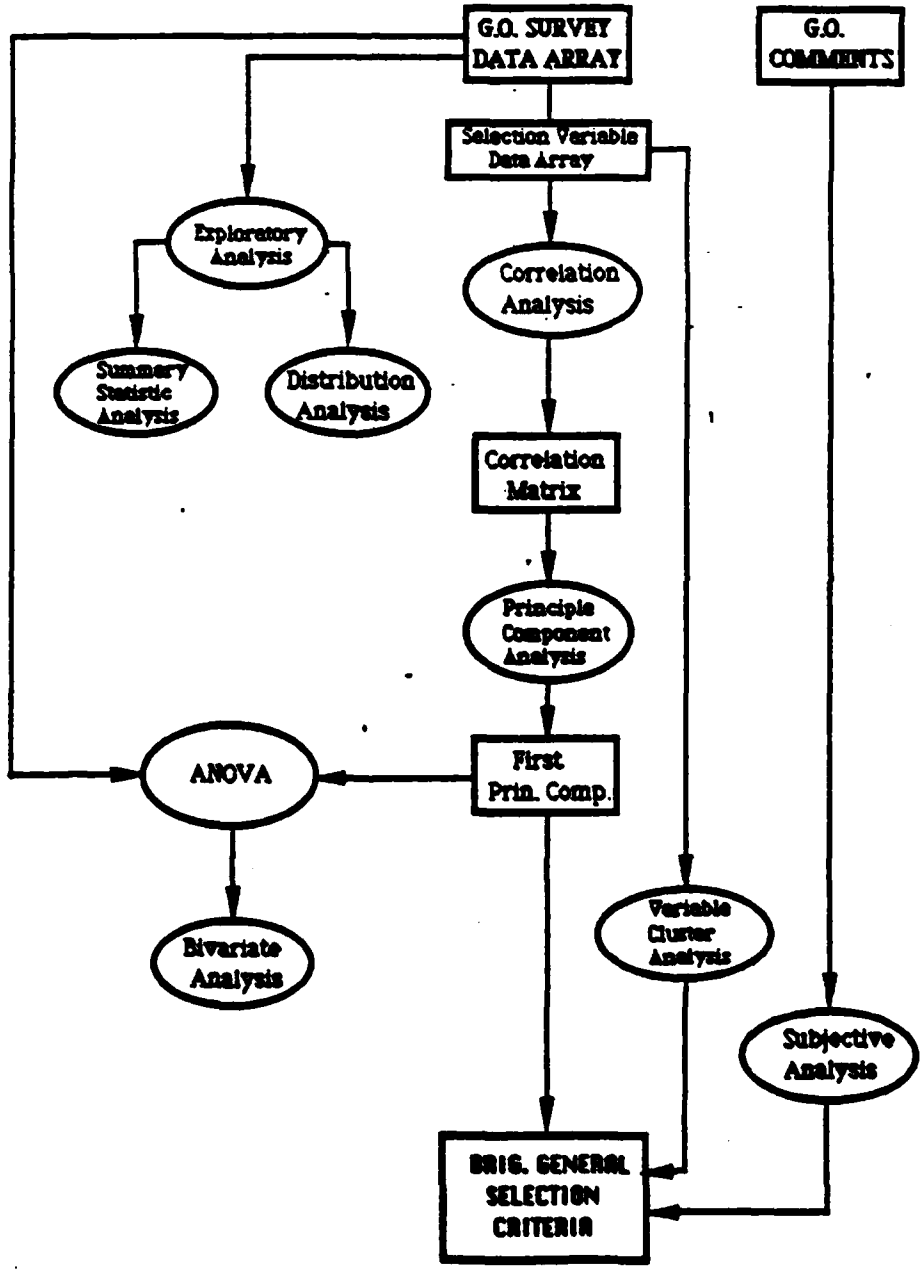
3. Your individual comments are welcome. To insure the most candid response possible, only the summarized data will be permitted for FOUO release. Your responses are without attribution.

4. Should you have questions concerning the survey, call either COL Jack Ferry, DAPC-MS, (A)221-9060, (COM)202-325-9060 or MAJ Braddy, DAPC-PLF, (A)221-0380, (COM)202-325-0380.

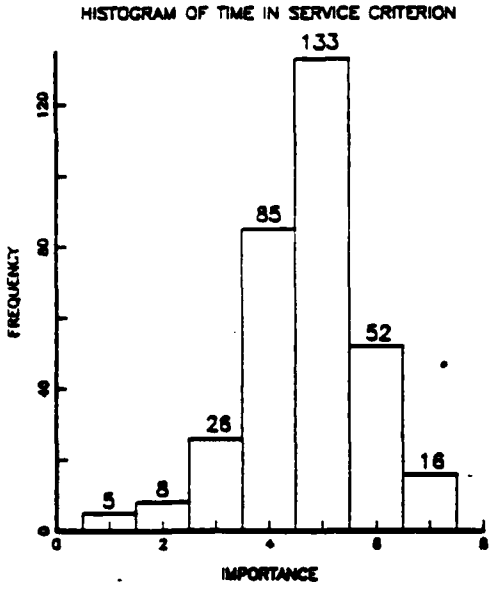
5. Your cooperation in timely completion of this survey is greatly appreciated. You will help to make a very good selection process even better.

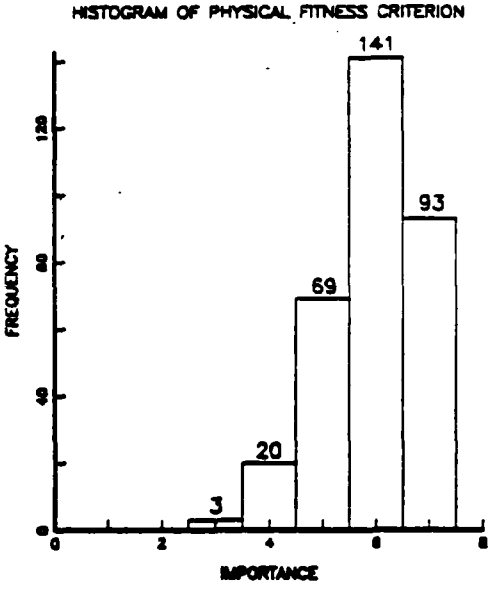
ROBERT M. ELTON
Lieutenant General, USA
Deputy Chief of Staff
for Personnel

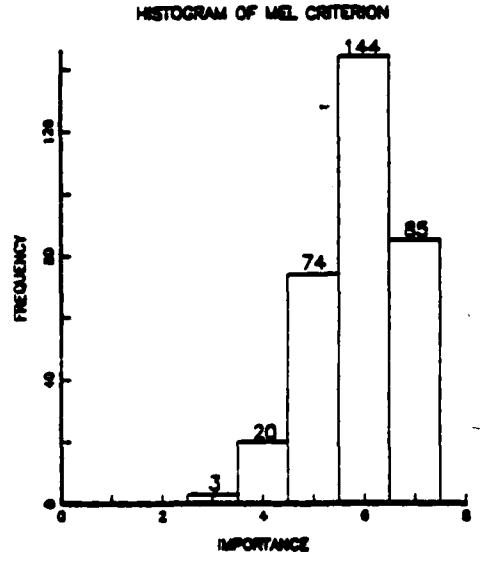
APPENDIX D
ANALYSIS FLOW CHART

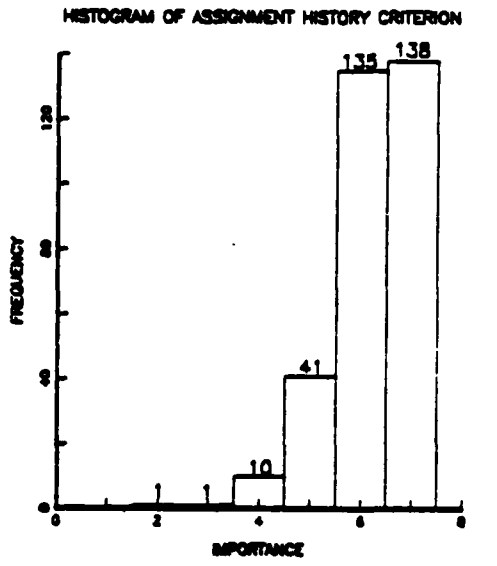


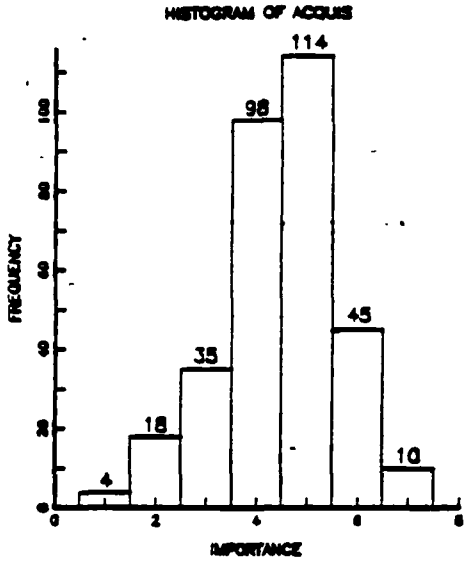
APPENDIX E
SELECTION VARIABLE FREQUENCY DISTRIBUTIONS







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FREQUENCY
IMPORTANCE
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45
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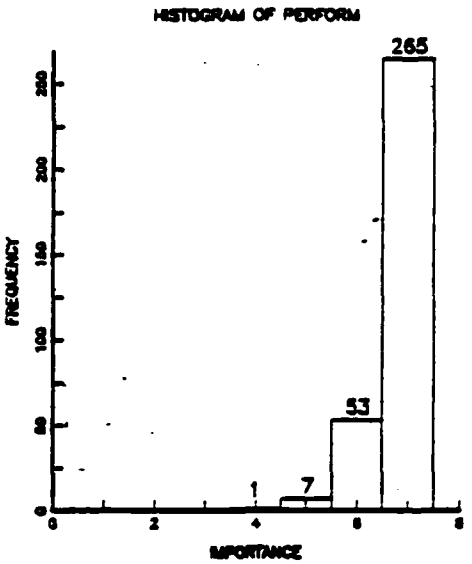
HISTOGRAM OF PERFORM
FREQUENCY
IMPORTANCE
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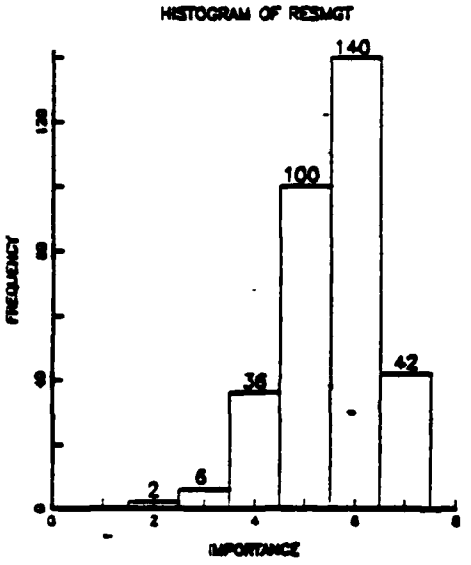
HISTOGRAM OF RESMGT
FREQUENCY
IMPORTANCE
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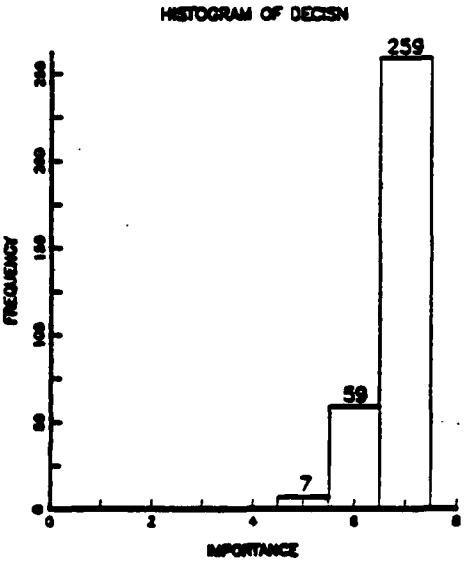
HISTOGRAM OF DECISN
FREQUENCY
IMPORTANCE
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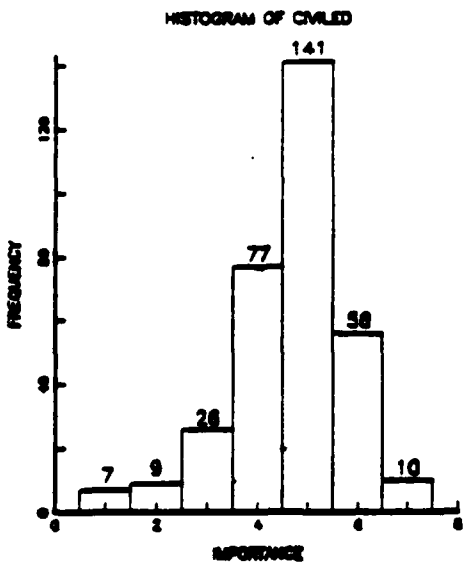
HISTOGRAM OF CIVILED
FREQUENCY
IMPORTANCE
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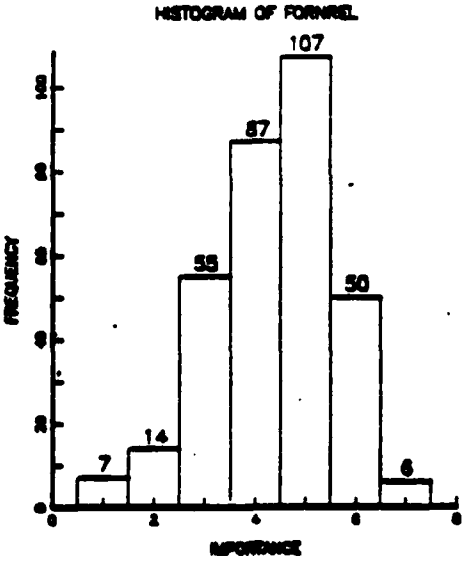
HISTOGRAM OF FORNREL
FREQUENCY
IMPORTANCE
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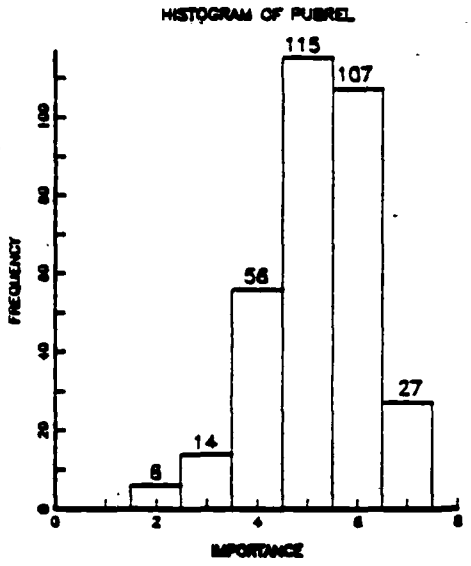
HISTOGRAM OF PUBREL
FREQUENCY
IMPORTANCE
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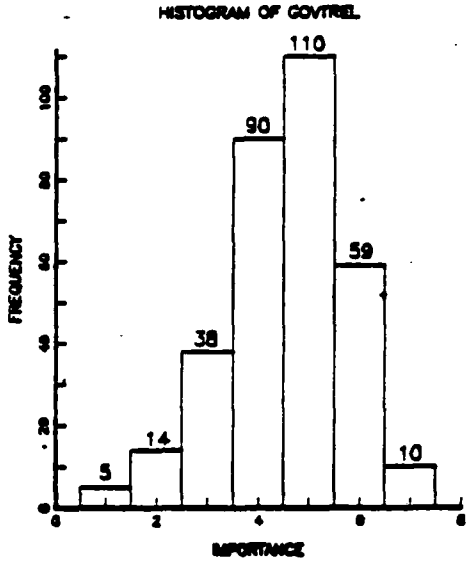
107
27


HISTOGRAM OF GOVTREL
FREQUENCY
IMPORTANCE
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59
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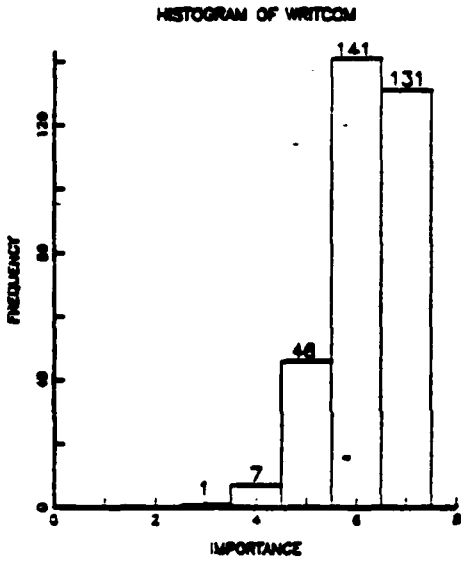
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FREQUENCY
IMPORTANCE
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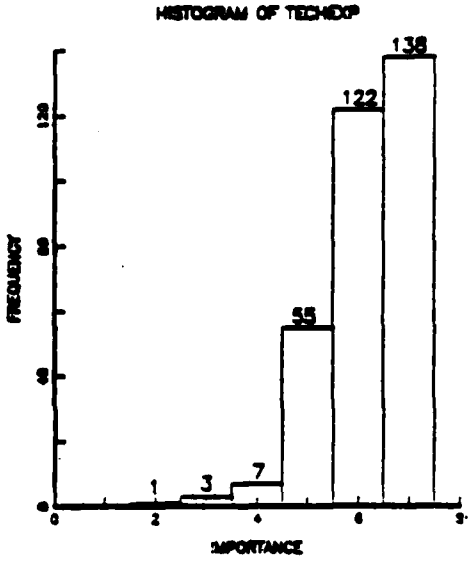
HISTOGRAM OF TECHEXP
FREQUENCY
IMPORTANCE
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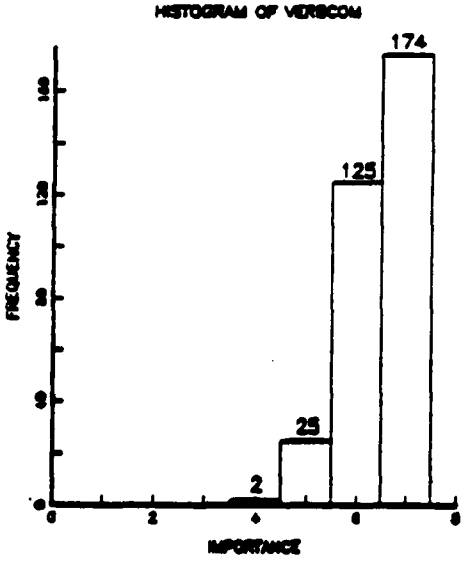
HISTOGRAM OF VERBCOM
FREQUENCY
IMPORTANCE
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125
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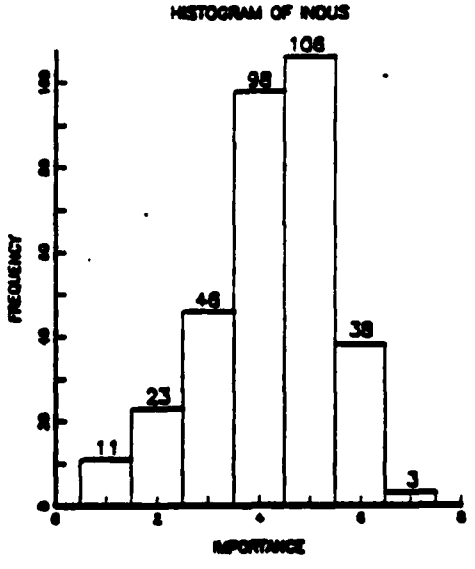
HISTOGRAM OF INDUS
FREQUENCY
IMPORTANCE
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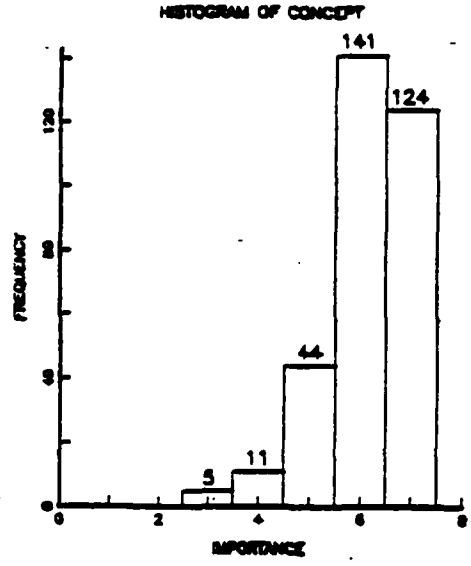
98
108
38
3


HISTOGRAM OF CONCEPT
FREQUENCY
IMPORTANCE
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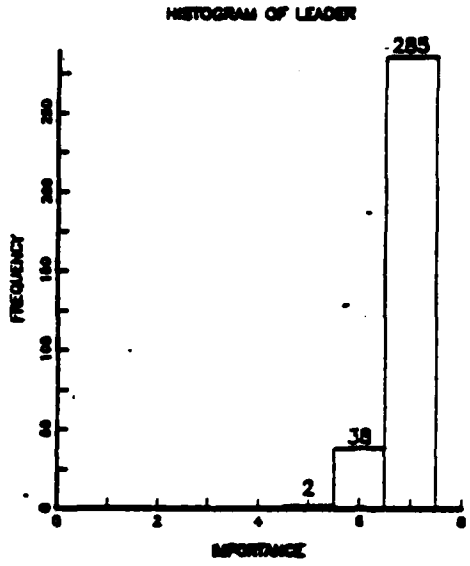
HISTOGRAM OF LEADER
FREQUENCY
IMPORTANCE
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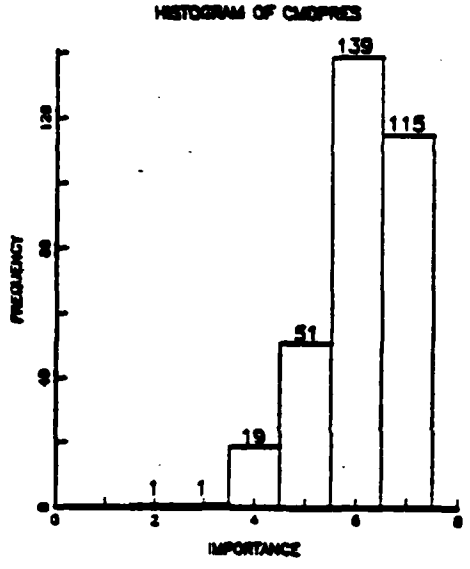
HISTOGRAM OF CMDPRES
FREQUENCY
IMPORTANCE
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139
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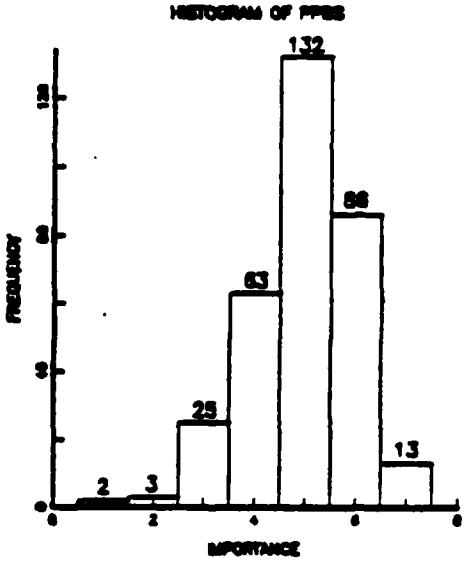
HISTOGRAM OF PPBS
FREQUENCY
IMPORTANCE
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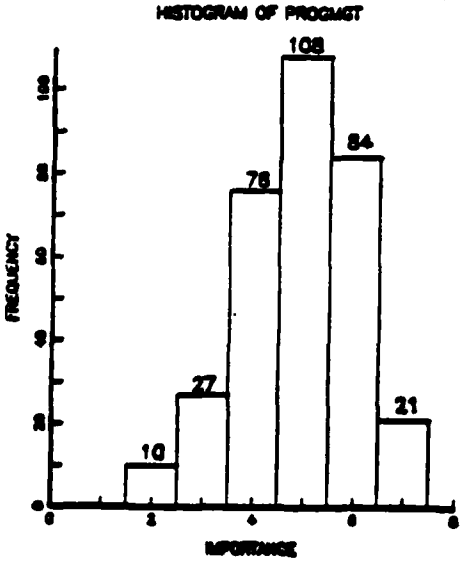
HISTOGRAM OF PROGMGT
FREQUENCY
IMPORTANCE
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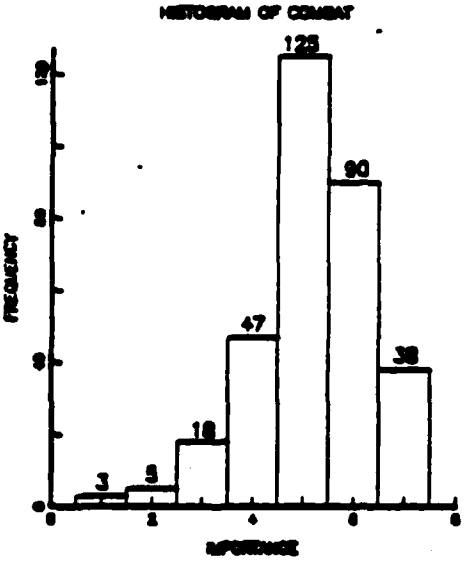
76
108
84
21


HISTOGRAM OF COMBAT
FREQUENCY
IMPORTANCE
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125
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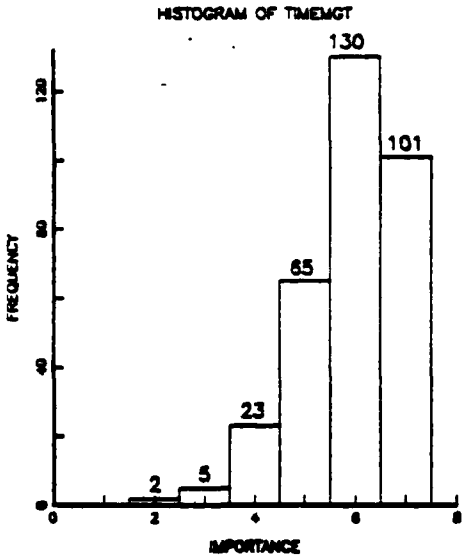
HISTOGRAM OF TIMEMGT
FREQUENCY
IMPORTANCE
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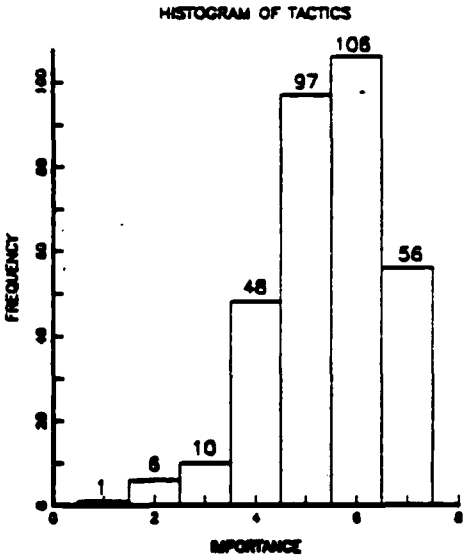
101


HISTOGRAM OF TACTICS
FREQUENCY
IMPORTANCE
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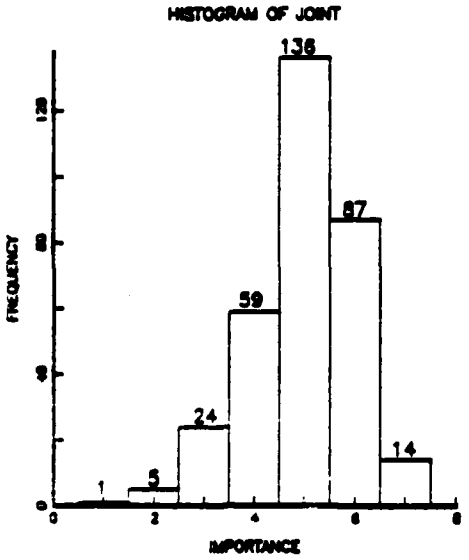
97
108
56


HISTOGRAM OF JOINT
FREQUENCY
IMPORTANCE
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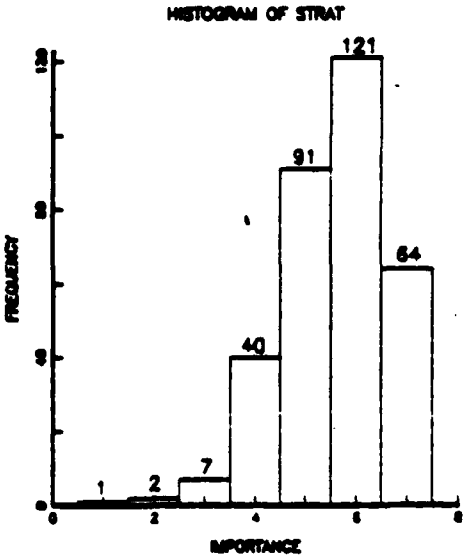
87
14


HISTOGRAM OF STRAT
FREQUENCY
IMPORTANCE
1
2
7
40
91
121
64

APPENDIX F

PEARSON PRODUCT-MOMENT CORRELATION MATRIX

CORRELATIONS

	TIS	PHYSFIT	MEL	ASSIGN	PERFORM	CIVILED	RESMGT
TIS	1.0000	0.3137	0.2940	0.1372	-0.0248	0.1814	0.1350
PHYSFIT	0.3137	1.0000	0.3904	0.1287	0.1049	0.1263	0.1910
MEL	0.2940	0.3904	1.0000	0.2696	0.1811	0.3499	0.2661
ASSIGN	0.1372	0.1287	0.2696	1.0000	0.1396	0.1918	0.1712
PERFORM	-0.0248	0.1049	0.1811	0.1396	1.0000	0.1362	0.1271
CIVILED	0.1814	0.1263	0.3499	0.1918	0.1362	1.0000	0.3090
RESMGT	0.1350	0.1910	0.2661	0.1712	0.1271	0.3090	1.0000
DECISN	-0.0051	0.1795	0.0829	0.0956	0.0384	0.2022	0.2531
FORNREL	0.2408	0.1758	0.2053	0.1723	0.0151	0.4031	0.3031
PUBREL	0.1073	0.2249	0.1837	0.1382	0.0380	0.3584	0.4005
GOVTREL	0.1544	0.1274	0.1054	0.0794	0.0037	0.2679	0.3186
VERBCOM	0.0184	0.2281	0.2529	0.0926	0.1029	0.2422	0.2745
WRITCOM	0.1361	0.2368	0.3305	0.1568	0.1063	0.2806	0.2786
TECHEXP	0.0834	0.0829	0.0622	0.2398	-0.0233	-0.0492	0.1154
INDUS	0.1786	0.1456	0.2101	0.2264	0.0646	0.3800	0.4495
CONCEPT	-0.0088	0.0823	0.0478	0.0979	0.1299	0.2080	0.1569
LEADER	0.0642	0.1747	0.1144	0.0717	0.1466	0.1173	0.0578
COMBAT	0.1614	0.1511	0.2163	0.1425	0.1094	0.1450	0.0850
CMDPRES	0.1887	0.4439	0.2623	0.1792	0.1898	0.1429	0.1943
PPBS	0.2398	0.1391	0.2980	0.2255	0.0938	0.4279	0.5179
PROGMGT	0.1243	0.1347	0.1397	0.1330	0.0113	0.3931	0.4793
TIMEMGT	0.0617	0.1991	0.1145	0.1044	0.1166	0.2462	0.3520
TACTICS	0.1290	0.1218	0.0700	0.1189	0.0049	-0.1060	0.0396
ACQUIS	0.2074	0.0984	0.1749	0.2225	0.0541	0.3834	0.4585
JOINT	0.1747	0.1346	0.1726	0.1782	0.0506	0.2301	0.2703
STRAT	0.0675	0.0728	0.0473	0.0525	0.0081	-0.1182	0.0068

	DECISN	FORNREL	PUBREL	GOVTREL	VERBCOM	WRITCOM	TECHEXP
TIS	-0.0051	0.2408	0.1073	0.1544	0.0184	0.1361	0.0834
PHYSFIT	0.1795	0.1758	0.2249	0.1274	0.2281	0.2368	0.0829
MEL	0.0829	0.2053	0.1837	0.1054	0.2529	0.3305	0.0622
ASSIGN	0.0956	0.1723	0.1382	0.0794	0.0926	0.1568	0.2398
PERFORM	0.0384	0.0151	0.0380	0.0037	0.1029	0.1063	-0.0233
CIVILED	0.2022	0.4031	0.3584	0.2679	0.2422	0.2806	-0.0492
RESMGT	0.2531	0.3031	0.4005	0.3186	0.2745	0.2786	0.1154
DECISN	1.0000	0.1582	0.1714	0.1800	0.3525	0.2042	0.0514
FORNREL	0.1582	1.0000	0.5438	0.5756	0.1451	0.2660	0.0476
PUBREL	0.1714	0.5438	1.0000	0.5421	0.3315	0.2781	-0.0468
GOVTREL	0.1800	0.5756	0.5421	1.0000	0.2627	0.2801	-0.0108
VERBCOM	0.3525	0.1451	0.3315	0.2627	1.0000	0.6398	0.0521
WRITCOM	0.2042	0.2660	0.2781	0.2801	0.6398	1.0000	0.0993
TECHEXP	0.0514	0.0476	-0.0468	-0.0108	0.0521	0.0993	1.0000
INDUS	0.1421	0.4369	0.3709	0.4815	0.1907	0.2540	0.1236
CONCEPT	0.3048	0.1669	0.1809	0.2997	0.3821	0.2879	0.0520
LEADER	0.2738	0.0927	0.0909	0.0551	0.1878	0.2268	0.0402
COMBAT	0.1114	0.2640	0.1265	0.1529	0.1306	0.2096	0.0360
CMDPRES	0.2494	0.2002	0.2523	0.1722	0.3491	0.3414	0.1229
PPBS	0.2478	0.3127	0.3036	0.2931	0.2755	0.3461	0.0623
PROGMGT	0.1994	0.3382	0.3217	0.2973	0.2500	0.2640	0.0731
TIMEMGT	0.2615	0.1710	0.3014	0.2305	0.4508	0.3579	0.0977
TACTICS	0.0912	0.1660	-0.0125	0.0272	-0.0009	0.1223	0.2917
ACQUIS	0.1478	0.3502	0.3540	0.3618	0.1607	0.1902	0.1209
JOINT	0.0701	0.4089	0.2076	0.3114	0.1910	0.2376	0.0495
STRAT	0.1263	0.1637	-0.0512	0.0088	0.0372	0.1188	0.2223

	INDUS	CONCEPT	LEADER	COMBAT	CMDPRES	PPBS	PROGMGT
TIS	0.1786	-0.0088	0.0642	0.1614	0.1887	0.2398	0.1243
PHYSFIT	0.1456	0.0823	0.1747	0.1511	0.4439	0.1391	0.1347
MEL	0.2101	0.0478	0.1144	0.2163	0.2623	0.2980	0.1397
ASSIGN	0.2264	0.0979	0.0717	0.1425	0.1792	0.2255	0.1330
PERFORM	0.0646	0.1299	0.1466	0.1094	0.1898	0.0938	0.0113
CIVILED	0.3800	0.2080	0.1173	0.1450	0.1429	0.4279	0.3931
RESMGT	0.4495	0.1569	0.0578	0.0850	0.1943	0.5179	0.4793
DECISN	0.1421	0.3048	0.2738	0.1114	0.2494	0.2478	0.1994
FORNREL	0.4369	0.1669	0.0927	0.2640	0.2002	0.3127	0.3382
PUBREL	0.3709	0.1809	0.0909	0.1265	0.2523	0.3036	0.3217
GOVTREL	0.4815	0.2997	0.0551	0.1529	0.1722	0.2931	0.2973
VERBCOM	0.1907	0.3821	0.1878	0.1306	0.3491	0.2755	0.2500
WRITCOM	0.2540	0.2879	0.2268	0.2096	0.3414	0.3461	0.2640
TECHEXP	0.1236	0.0520	0.0402	0.0360	0.1229	0.0623	0.0731
INDUS	1.0000	0.2590	0.0750	0.0474	0.1924	0.5431	0.5946
CONCEPT	0.2590	1.0000	0.1840	0.0572	0.1749	0.2420	0.2115
LEADER	0.0750	0.1840	1.0000	0.2048	0.3630	0.1354	0.1322
COMBAT	0.0474	0.0572	0.2048	1.0000	0.4595	0.2133	0.0491
CMDPRES	0.1924	0.1749	0.3630	0.4595	1.0000	0.2656	0.1794
PPBS	0.5431	0.2420	0.1354	0.2133	0.2656	1.0000	0.5985
PROGMGT	0.5946	0.2115	0.1322	0.0491	0.1794	0.5985	1.0000
TIMEMGT	0.2718	0.3438	0.1514	0.0696	0.3057	0.3634	0.3667
TACTICS	0.0112	0.0261	0.1174	0.3673	0.3531	0.0498	0.0529
ACQUIS	0.6488	0.1791	0.0420	0.0740	0.1624	0.5314	0.6560
JOINT	0.3011	0.1460	0.0077	0.1877	0.1626	0.3096	0.2604
STRAT	-0.0291	0.0755	0.0825	0.3441	0.2565	0.0577	-0.0167

	TIMEMGT	TACTICS	ACQUIS	JOINT	STRAT
TIS	0.0617	0.1290	0.2074	0.1747	0.0675
PHYSFIT	0.1991	0.1218	0.0984	0.1346	0.0728
MEL	0.1145	0.0700	0.1749	0.1726	0.0473
ASSIGN	0.1044	0.1189	0.2225	0.1782	0.0525
PERFORM	0.1166	0.0049	0.0541	0.0506	0.0081
CIVILED	0.2462	-0.1060	0.3834	0.2301	-0.1182
RESMGT	0.3520	0.0396	0.4585	0.2703	0.0068
DECISN	0.2615	0.0912	0.1478	0.0701	0.1263
FORNREL	0.1710	0.1660	0.3502	0.4089	0.1637
PUBREL	0.3014	-0.0125	0.3540	0.2076	-0.0512
GOVTREL	0.2305	0.0272	0.3618	0.3114	0.0088
VERBCOM	0.4508	-0.0009	0.1607	0.1910	0.0372
WRITCOM	0.3579	0.1223	0.1902	0.2376	0.1188
TECHEXP	0.0977	0.2917	0.1209	0.0495	0.2223
INDUS	0.2718	0.0112	0.6488	0.3011	-0.0291
CONCEPT	0.3438	0.0261	0.1791	0.1460	0.0755
LEADER	0.1514	0.1174	0.0420	0.0077	0.0825
COMBAT	0.0696	0.3673	0.0740	0.1877	0.3441
CMDPRES	0.3057	0.3531	0.1624	0.1626	0.2565
PPBS	0.3634	0.0498	0.5314	0.3096	0.0577
PROGMGT	0.3667	0.0529	0.6560	0.2604	-0.0167
TIMEMGT	1.0000	0.1377	0.3218	0.2008	0.0996
TACTICS	0.1377	1.0000	0.0478	0.1864	0.7930
ACQUIS	0.3218	0.0478	1.0000	0.2622	-0.0211
JOINT	0.2008	0.1864	0.2622	1.0000	0.2435
STRAT	0.0996	0.7930	-0.0211	0.2435	1.0000

APPENDIX G
PRINCIPLE COMPONENT EIGENVECTORS

EIGENVECTORS

	PRIN1	PRIN2	PRIN3	PRIN4	PRIN5	PRIN6	PRIN7
TIS	0.128215	0.075610	0.203039	0.380570	-.016454	-.212939	-.269676
PHYSFIT	0.158309	0.171314	-.119287	0.354514	-.021787	-.262829	-.294937
MEL	0.178980	0.089034	-.049265	0.479524	0.082934	-.123272	0.144802
ASSIGN	0.136811	0.068633	0.100553	0.195233	0.276809	-.006473	0.407794
PERFORM	0.071552	0.067023	-.192161	0.184915	0.143507	0.455070	0.435239
CIVILED	0.227202	-.174175	-.032577	0.184283	-.033962	0.185293	0.115964
RESMGT	0.250761	-.129078	0.045271	-.024059	0.163599	-.028304	-.035089
DECISN	0.159153	0.075268	-.262080	-.209805	0.032999	0.091271	-.215971
FORNREL	0.245653	-.035936	0.241775	0.007555	-.397139	0.035478	0.074965
PUBREL	0.238911	-.137734	-.008343	0.008351	-.356465	-.064523	-.017579
GOVTREL	0.231997	-.133030	0.091849	-.121685	-.417582	-.062946	0.047271
VERBCOM	0.217141	0.048591	-.414140	-.114580	-.049618	-.297818	0.130065
WRITCOM	0.233836	0.099130	-.257327	-.006084	-.047447	-.273317	0.177363
TECHEXP	0.063671	0.185208	0.166460	-.114408	0.396451	-.347031	0.098727
INDUS	0.270224	-.211141	0.184872	-.054870	0.114517	0.057534	-.041691
CONCEPT	0.168323	-.006135	-.262556	-.293283	-.017839	0.013471	0.180368
LEADER	0.112758	0.180906	-.266890	0.021185	0.030454	0.368036	-.305354
COMBAT	0.136752	0.323191	0.079037	0.107846	-.195063	0.330552	0.010291
CMDPRES	0.207086	0.315931	-.142391	0.106756	-.020372	0.114006	-.206778
PPBS	0.280242	-.107343	0.070735	-.001862	0.217054	0.141145	-.077999
PROGMGT	0.261139	-.197225	0.111916	-.138063	0.230735	0.105806	-.224610
TIMEMGT	0.220918	0.013053	-.200403	-.230153	0.133311	-.137204	-.026947
TACTICS	0.086183	0.469654	0.276980	-.212465	0.034998	0.017095	-.026012
ACQUIS	0.256595	-.209139	0.215854	-.066462	0.221947	0.101931	-.123069
JOINT	0.190939	0.043405	0.221618	-.047331	-.151684	-.065107	0.298078
STRAT	0.068948	0.460754	0.244757	-.266743	-.025757	0.022516	0.060620

	PRIN8	PRIN9	PRIN10	PRIN11	PRIN12	PRIN13	PRIN14
TIS	-.030790	-.178368	0.463631	-.067317	-.160711	0.131684	0.035096
PHYSFIT	0.090133	0.321283	0.181214	0.204165	0.016565	-.163458	-.020710
MEL	-.133497	-.116826	-.083705	0.160834	0.100029	0.259798	-.070920
ASSIGN	0.428741	-.172555	-.163293	0.058707	-.275775	-.443360	0.136714
PERFORM	-.008474	0.487337	0.248786	0.025235	0.128039	0.218311	-.055069
CIVILED	-.062167	-.323933	-.046043	0.130272	-.033391	0.295151	0.447222
RESMGT	-.116182	0.249576	-.230972	0.291051	0.158260	0.053839	-.235693
DECISN	0.224021	-.244182	-.052394	0.656670	0.008935	0.013633	-.172326
FORNREL	0.194320	-.039601	-.016954	0.042536	0.155197	0.115334	0.151869
PUBREL	0.197920	0.273786	-.295165	0.022940	-.064973	0.049596	0.228908
GOVTREL	0.238290	0.106737	0.085350	-.096077	-.021318	0.075310	-.245530
VERBCOM	-.159527	-.070587	-.132216	-.103727	0.009267	-.027301	-.080369
WRITCOM	-.207778	-.179796	-.130472	-.321229	0.194112	0.083577	-.083186
TECHEXP	0.428385	0.018746	-.094535	-.167521	0.207832	0.267309	-.059720
INDUS	0.102601	0.055084	0.108215	-.168743	0.040215	0.005094	-.213672
CONCEPT	0.175724	-.151315	0.528997	-.021253	-.303751	0.122253	-.148375
LEADER	0.275153	-.192929	0.072124	-.264609	0.510809	-.116148	0.196212
COMBAT	-.115811	-.152890	-.262936	-.172915	-.339670	-.022212	-.275145
CMDPRES	0.044804	0.211181	-.095596	-.184446	-.181877	-.219812	-.078198
PPBS	-.242288	-.159621	-.031631	0.006844	-.087673	-.027368	-.176512
PROGMGT	-.151465	-.003346	-.033171	-.099691	0.071575	-.057177	0.062964
TIMEMGT	-.175637	0.241697	0.080584	-.011861	-.256039	-.085262	0.529584
TACTICS	-.071219	0.078847	-.015848	0.046572	-.020773	0.152966	0.155036
ACQUIS	-.010722	0.066773	0.012638	-.118572	-.104738	0.004245	0.000462
JOINT	-.245540	-.076747	0.270985	0.146696	0.374562	-.562786	-.005666
STRAT	-.159100	-.004162	0.053207	0.163166	0.046443	0.157148	0.077460

	PRIN15	PRIN16	PRIN17	PRIN18	PRIN19	PRIN20	PRIN21
TIS	0.507183	-.192782	0.161419	-.063242	0.156004	0.012618	0.004678
PHYSFIT	-.343313	0.173816	0.011569	-.217811	-.302793	0.203059	-.041709
MEL	-.318699	-.128974	-.315260	0.448654	0.139681	0.024526	0.195657
ASSIGN	0.001711	-.330040	0.036568	-.081705	-.091773	0.042855	-.084176
PERFORM	0.169405	-.024151	0.286081	-.033274	-.049085	0.045322	0.119395
CIVILED	-.097535	0.366236	0.075119	-.157600	0.082312	-.188073	-.349062
RESMGT	0.339872	-.116752	-.408596	-.222918	0.038253	0.078874	-.459865
DECISN	0.114969	0.021660	0.348330	0.175560	-.020122	0.003364	0.065791
FORNREL	0.003984	0.057893	0.067042	-.099729	-.306142	0.101247	0.097706
PUBREL	0.063357	-.132059	-.107439	-.217338	0.321650	-.045373	0.401142
GOVTREL	0.051824	-.105768	0.004840	0.352145	-.156137	-.089933	-.165200
VERBCOM	0.027478	-.026148	0.228585	-.005218	0.278862	0.093152	0.114731
WRITCOM	0.006769	-.200962	0.230631	-.177206	-.263299	0.033166	-.202636
TECHEXP	0.183631	0.475396	-.038843	0.016876	0.007362	-.017142	0.157722
INDUS	-.275909	-.052795	0.100724	0.189137	-.059900	-.265485	-.191267
CONCEPT	-.192040	0.037771	-.394531	-.262500	0.135772	0.098534	0.015301
LEADER	0.082770	-.186573	-.258419	0.085969	0.037883	0.080737	-.009996
COMBAT	0.159710	0.314964	-.113817	0.083082	-.104372	0.402417	-.000365
CMDPRES	-.067048	0.199123	0.091279	-.034981	0.260481	-.497280	-.133233
PPBS	0.124506	-.048264	-.147334	-.139900	-.327669	-.414585	0.466942
PROGMGT	-.201536	0.009724	0.123110	-.213895	-.071962	0.292556	0.173440
TIMEMGT	0.222824	0.069998	-.164458	0.433003	-.281165	0.036431	-.029598
TACTICS	-.129357	-.211268	0.036095	-.037443	0.068166	-.032888	-.118164
ACQUIS	-.121636	-.034289	0.231475	0.192759	0.359142	0.350470	-.028647
JOINT	0.082543	0.291140	-.038975	0.068704	0.205211	-.011947	0.062482
STRAT	-.145536	-.208398	0.011085	-.070307	0.020517	-.058492	0.042022

	PRIN22	PRIN23	PRIN24	PRIN25	PRIN26
TIS	-.051743	0.022386	0.119025	0.088080	0.052161
PHYSFIT	0.267797	-.135540	0.010458	-.113561	-.049481
MEL	-.167940	0.141539	-.059479	0.089219	0.027228
ASSIGN	0.043015	0.082781	0.058842	-.039710	0.048361
PERFORM	0.025314	0.031609	0.027201	0.038921	-.011055
CIVILED	0.274135	0.032846	0.050262	-.031308	0.010614
RESMGT	-.096028	0.026020	0.042577	-.091908	0.016668
DECISN	-.076512	-.057482	-.085138	0.198701	-.005453
FORNREL	-.588326	0.018284	-.016684	-.355231	-.095493
PUBREL	0.140901	-.238289	-.012721	0.325746	0.042886
GOVTREL	0.435275	0.417133	-.075426	-.047604	0.066965
VERBCOM	0.054961	0.083616	0.476518	-.415916	-.168590
WRITCOM	-.040232	-.175371	-.395531	0.286041	0.079904
TECHEXP	0.062156	0.019700	-.018157	0.034725	0.043462
INDUS	-.134189	-.444760	0.476728	0.216095	-.027089
CONCEPT	-.119950	-.004958	-.106051	0.050271	-.030410
LEADER	0.117713	-.061291	0.051577	-.088540	-.014046
COMBAT	0.066455	-.151388	0.150364	0.129429	0.007566
CMDPRES	-.305685	0.231330	-.192256	-.048016	0.139184
PPBS	0.215290	-.057816	-.127480	-.238059	-.167786
PROGMGT	-.081980	0.557726	0.179338	0.309572	0.178457
TIMEMGT	-.101294	-.067981	0.019775	0.055598	0.051720
TACTICS	0.080820	0.121915	-.009540	0.154121	-.676289
ACQUIS	0.072228	-.224517	-.458056	-.331092	-.020736
JOINT	0.051532	-.030755	-.064936	0.148303	-.047233
STRAT	0.137456	-.125172	0.112980	-.204253	0.628556

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