NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

THESIS

DEVELOPING A MODEL FOR ASSIGNING SENIOR OFFICERS IN THE BRAZILIAN AIR FORCE

by

Arthur A. Gentil Toneli

March 2015

Thesis Advisor: Chad W. Seagren
Second Reader: Benjamin J. Roberts

THIS PAGE INTENTIONALLY LEFT BLANK

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

1. AGENCY USE ONLY *(Leave blank)*	**2. REPORT DATE** March 2015	**3. REPORT TYPE AND DATES COVERED** Master's Thesis

4. TITLE AND SUBTITLE
DEVELOPING A MODEL FOR ASSIGNING SENIOR OFFICERS IN THE BRAZILIAN AIR FORCE

5. FUNDING NUMBERS

6. AUTHOR(S) Arthur A. Gentil Toneli

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Naval Postgraduate School
Monterey, CA 93943-5000

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING /MONITORING AGENCY NAME(S) AND ADDRESS(ES)
N/A

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government. IRB Protocol number ____N/A____.

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

12b. DISTRIBUTION CODE
A

13. ABSTRACT (maximum 200 words)

The Brazilian Air Force faces a huge challenge in the assignment process. While aviators outnumber any other community, there are few jobs related to aviation available for senior officers. As a consequence, when junior aviators who invested their time improving their skills in air operations are promoted to senior ranks, they must be assigned to managerial positions in areas they don't master. The problem becomes worse in the absence of career paths for senior officers and at the discretion of officers and commands to present their preferences in the assignment process with no regard for previous job experience.

The purpose of this thesis is to develop a model for assigning senior officers without specialization, as it occurs among aviators in the Brazilian Air Force, so that job performance can be maximized. The model uses linear programming and takes individual preferences and organizational needs into consideration. The results of simulation in three different scenarios suggest that it is possible to capitalize on previous job experience and simultaneously satisfy the interests of officers and commands. One expected benefit of the study is the natural specialization of senior officers, without the intervention of career managers.

14. SUBJECT TERMS
assignment process, senior officer, linear programming, job performance, job experience, individual preference

15. NUMBER OF PAGES
81

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	**18. SECURITY CLASSIFICATION OF THIS PAGE**	**19. SECURITY CLASSIFICATION OF ABSTRACT**	**20. LIMITATION OF ABSTRACT**
Unclassified	Unclassified	Unclassified	UU

NSN 7540–01-280-5500

Standard Form 298 (Rev. 2–89)
Prescribed by ANSI Std. 239–18

THIS PAGE INTENTIONALLY LEFT BLANK

Approved for public release; distribution is unlimited

DEVELOPING A MODEL FOR ASSIGNING SENIOR OFFICERS IN THE BRAZILIAN AIR FORCE

Arthur A. Gentil Toneli
Lieutenant Colonel, Brazilian Air Force
B.S., Air Force Academy, 1996

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL
March 2015

Author: Arthur A. Gentil Toneli

Approved by: Chad W. Seagren
Thesis Advisor

Benjamin J. Roberts
Second Reader

William R. Gates
Dean, Graduate School of Business and Public Policy

THIS PAGE INTENTIONALLY LEFT BLANK

ABSTRACT

The Brazilian Air Force faces a huge challenge in the assignment process. While aviators outnumber any other community, there are few jobs related to aviation available for senior officers. As a consequence, when junior aviators who invested their time improving their skills in air operations are promoted to senior ranks, they must be assigned to managerial positions in areas they don't master. The problem becomes worse in the absence of career paths for senior officers and at the discretion of officers and commands to present their preferences in the assignment process with no regard for previous job experience.

The purpose of this thesis is to develop a model for assigning senior officers without specialization, as it occurs among aviators in the Brazilian Air Force, so that job performance can be maximized. The model uses linear programming and takes individual preferences and organizational needs into consideration. The results of simulation in three different scenarios suggest that it is possible to capitalize on previous job experience and simultaneously satisfy the interests of officers and commands. One expected benefit of the study is the natural specialization of senior officers, without the intervention of career managers.

THIS PAGE INTENTIONALLY LEFT BLANK

TABLE OF CONTENTS

I. INTRODUCTION 1
A. BACKGROUND 1
B. PURPOSE 7
C. RESEARCH QUESTIONS 7
D. METHODOLOGY 7
E. SCOPE AND LIMITATION 8
F. EXPECTED BENEFIT OF THE STUDY 9

II. OFFICER DISTRIBUTION PROCESS 11
A. BRAZILIAN AIR FORCE PROCESS 11
B. U.S. NAVY PROCESS 15
C. COMPARISON BETWEEN BRAZILIAN AIR FORCE AND U.S. NAVY PROCESSES 19
D. CHAPTER SUMMARY 20

III. PERFORMANCE DRIVERS 21
A. THEORY OF WORK PERFORMANCE 21
1. Ability 23
2. Effort 24
3. Support 26
B. THE EFFECT OF JOB EXPERIENCE ON JOB PERFORMANCE 27
C. PERFORMANCE DRIVERS FOR THE BRAZILIAN AIR FORCE 30
D. CHAPTER SUMMARY 32

IV. DECISION MODELING 33
A. ASSIGNMENT MODEL 34
B. PREVIOUS STUDIES ON LINEAR PROGRAMMING 35
1. Two-Sided Matching for the U.S. Navy’s Enlisted Detailing Process: A Comparison of Deferred Acceptance and Linear Programming via Simulation 35
2. Assignment of Employee to Workplaces under Consideration of Employee Competences and Preferences 36
3. Optimizing Marine Security Guard Assignments 38
4. Equitably Distributing Quality of Marine Security Guards Using Integer Programming 39
C. LESSONS FOR THE BRAZILIAN AIR FORCE 40

V. PROPOSED MODEL 43
A. NEW ARCHITECTURE FOR THE ASSIGNMENT PROCESS 43
B. MATHEMATICAL MODEL 44
1. Variables 45
2. Coefficient of Performance 45
3. Objective Function 46

4. Constraints 47
C. EVALUATION 47
1. Scenario 1 48
2. Scenario 2 50
3. Scenario 3 51
D. ANALYSIS 53
VI. SUMMARY, CONCLUSION, AND RECOMMENDATIONS 55
A. SUMMARY 55
B. CONCLUSION 56
C. RECOMMENDATIONS 58
LIST OF REFERENCES 59
INITIAL DISTRIBUTION LIST 63

LIST OF FIGURES

Figure 1. Distribution of junior officers by specialty (after Presidente da República Federativa do Brasil 2014) 3
Figure 2. Distribution of senior officers by specialty (after Presidente da República Federativa do Brasil 2014) 4
Figure 3. Simplified layout of the Brazilian Air Force organizational structure (after Centro de Comunicação Social da Aeronáutica [CECOMSAER] 2014) 5
Figure 4. Example of a real matrix for an O-5 aviator 14
Figure 5. Example of officer’s preferences with personal information (from Black 2014, 22) 17
Figure 6. Example of billets available for SWO specialty at rank of O-5 (from Black 2014, 24) 18
Figure 7. Example of application comparison (after BUPERS Business Transformation Office 2012, 19) 19
Figure 8. Interaction of dimensions (after Blumberg and Pringle 1982, 565) 22
Figure 9. Causal model relating job experience and job performance (after Schmidt, Hunter, and Outerbridge 1986, 434) 28
Figure 10. Network model for personnel assignment 34
Figure 11. Level of satisfaction in Scenario 1 49
Figure 12. Assignments in Scenario 1 49
Figure 13. Level of satisfaction in Scenario 2 50
Figure 14. Assignments in Scenario 2 51
Figure 15. Level of satisfaction in Scenario 3 52
Figure 16. Assignments in Scenario 3 52
Figure 17. Analysis of satisfaction across scenarios 53

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF TABLES

Table 1. Specialties and ranks in the Brazilian Air Force (after Presidente da República Federativa do Brasil 2014) 2
Table 2. Dimensions of work performance (after Blumberg and Pringle 1982, 562) 21
Table 3. Managerial implication of expectancy theory (after Schermerhorn 1993, 452) 26

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF ACRONYMS AND ABBREVIATIONS

Most of the acronyms and abbreviations in this thesis come from the Brazilian Air Force. These terms are based on Portuguese words and may not match the initials in English.

CECOMSAER	Air Force Public Affairs Center
CMS/ID	Career Management System/Interactive Detailing
COMGAR	Air Operations Command
COMGEP	Air Force Personnel Command
DA	Deferred Acceptance
EMAER	Air Staff
GP	Goal Programming
ICA	Air Force Instruction
IP	Integer Programming
LP	Linear Programming
MCA	Air Force Manual
MILPERSMAN	Navy Military Personnel Manual
MPEOS	Movement by Selection of Senior Officer
NLP	Nonlinear Programming
NPA	Standard Operating Procedure
ODGSA	Organizations of General and Sectorial Management and Direct Assistance to the Air Force Commander
PCA	Air Force Plan
PLAMOV	Movement Plan
SIGPES	Personnel Management Information System
TEP	Personnel Strategic Table
TLP	Personnel Inventory Table

THIS PAGE INTENTIONALLY LEFT BLANK

ACKNOWLEDGMENTS

This thesis is dedicated to my beloved wife, Andreia, who took over the burden of managing all housework issues alone, letting me free to focus on this study. I could not have succeeded without your support. Thank you for your love and continuous encouragement.

I am grateful to Professor Chad Seagren, who believed in the feasibility of my project and agreed to be my thesis advisor without any constraint. Thank you for reviewing my drafts and providing valuable comments that shaped a brainstorming of ideas into a scientific research.

I also would like to express my appreciation to Professor Benjamin Roberts, who inspired me to choose this topic while he was my instructor in Human Resources Management. My gratitude to you extends from teaching me the basics in this subject to guiding me through the complexity of theories that support this thesis.

Finally, I would like to thank all instructors who indirectly contributed to the maturity of my perspective, especially Professor Bill Hatch, who helped me understand the peculiarities of manpower and personnel management in the U.S. Navy, which came to be the first clue to the feasibility of the proposed model.

THIS PAGE INTENTIONALLY LEFT BLANK

I. INTRODUCTION

A. BACKGROUND

The Brazilian Air Force was created in 1941 during the Second World War by gathering all personnel, equipment, and facilities from the Navy and Army aviation branches. Just after clustering all airpower resources, the new Brazilian service was employed in combat to support the Allied war effort. Patrolling the South Atlantic and providing air liaison to the Brazilian Expeditionary Force, as well as conducting air reconnaissance and interdiction missions in Italy, the importance of pilots became evident among the first Air Force officers.

According to Robbins and Judge (2012, 223), “an organization’s current customs, traditions, and general way of doing things are largely due to what it has done before and how successful it was in doing it.” The founders exert a strong influence on an organization’s culture, because they are not committed to any previous culture, and the small size of a newborn organization makes it easy to impose their vision. The founders start the cycle. First, they select and keep those who share the same beliefs. Second, they reinforce their way of thinking by indoctrination and socialization. Finally, they hand over to the next generation, who will sustain the founders’ beliefs as the only reasonable way of thinking.

The organizational culture of the Brazilian Air Force is not only driven by historical facts but also by specific features that distinguish any air force from other services.

> In the Air Force, the division is between pilots and all others. Whereas there has always been a healthy rivalry among pilots of different types of aircraft (not only among the categories of aircraft flown, but even down to models of the same category), pilots are collectively on a plateau quite far removed from all others, including flight crew members and ballistic missile officers. Pilots are likely to identify themselves as pilots even more than as Air Force officers. (Builder 1989, 26)

The strong culture in favor of pilots puts them in charge of the Brazilian Air Force, not only as a consequence of their perceived importance, but also because their community is the largest one among officers.

The officer community is divided into career officers and temporary officers. Each category starts and ends at different ranks (Table 1).

Table 1. Specialties and ranks in the Brazilian Air Force (after Presidente da República Federativa do Brasil 2014)

	RANK								
	JUNIOR			SENIOR			GENERAL		
	O1	O2	O3	O4	O5	O6	O7	O8	O9
CAREER OFFICER									
Aviator	■	■	■	■	■	■	■	■	■
Engineer		■	■	■	■	■	■	■	
Intendant	■	■	■	■	■	■	■	■	
Physician		■	■	■	■	■	■	■	
Dentist		■	■	■	■	■			
Pharmacist		■	■	■	■	■			
Infantryman	■	■	■	■	■	■	■		
Aircraft Specialist	■	■	■	■	■	■			
Communication Specialist	■	■	■	■	■	■			
Armament Specialist	■	■	■	■	■	■			
Photography Specialist	■	■	■	■	■	■			
Meteorology Specialist	■	■	■	■	■	■			
Air Traffic Control Specialist	■	■	■	■	■	■			
Technical Supply Specialist	■	■	■	■	■	■			
Aeronautics Specialist	■	■	■						
TEMPORARY OFFICER									
Complementary Officer	■	■							

The pilots, or aviators as they are called in Brazil, belong to the only community that can reach the highest rank in the Brazilian Air Force, even though they start at the lowest grade. Since they perform the main activity in the Air Force, the junior officers are allowed to dedicate their time almost exclusively to planning air operations and flying their aircrafts. The burden of clerical activities is delegated to aeronautics specialists and complementary officers, who run the administration at the junior level. At this point, the inventory of officers at junior rank is reasonable (Figure 1). Twenty percent of junior officers can be dedicated to air operation, because 39.5% (21.8% + 17.7%) will be on station to handle administrative issues.

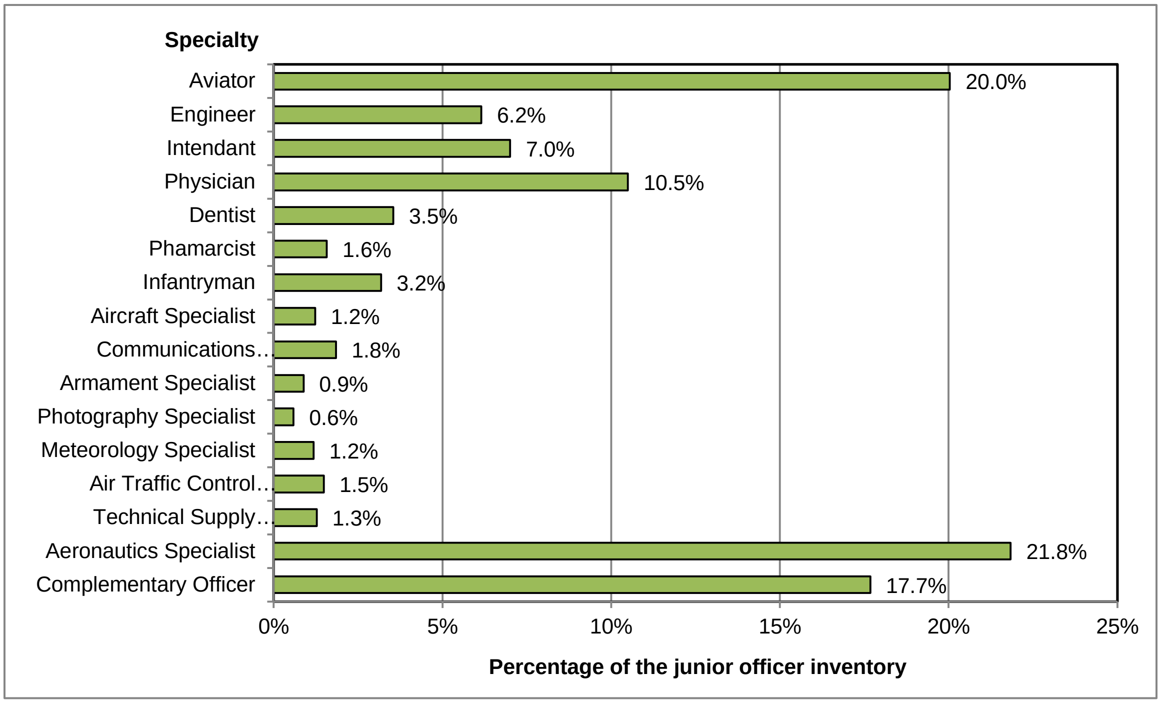

Figure 1. Distribution of junior officers by specialty (after Presidente da República Federativa do Brasil 2014)

The reality at senior rank is very different. Aeronautics specialists and complementary officers do not reach this grade and consequently cannot replace aviators in managerial activities. On the other hand, aviators who capitalized experience in air operations find themselves as chiefs in many different areas. The point is that the absence of aeronautics specialists and complementary officers and the difference in promotion rate among the specialties change the balance in the inventory of senior officers, increasing the aviator rate to 40.2% (Figure 2).

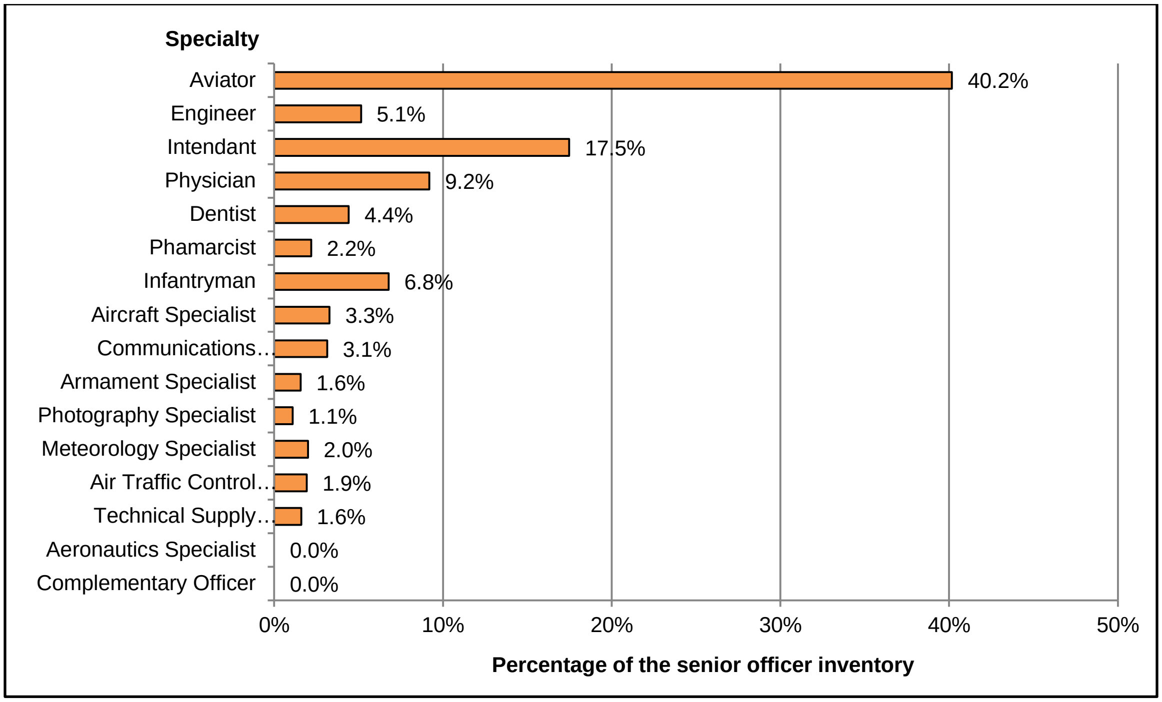

Figure 2. Distribution of senior officers by specialty (after Presidente da República Federativa do Brasil 2014)

This inventory would be understandable if the organizational structure of the Brazilian Air Force had enough operational billets to absorb 40% of the senior officers. Instead, the organizational structure is administrative and not operational, with many areas of specialization demanding managers.

At the highest level of management, the Brazilian Air Force (Figure 3) is organized in one general staff, seven sector departments, and 10 assistance offices. These organizations are collectively known as Organizations of General and Sectorial Management and Direct Assistance to the Air Force Commander (ODGSA), and each one has an area of specialization.

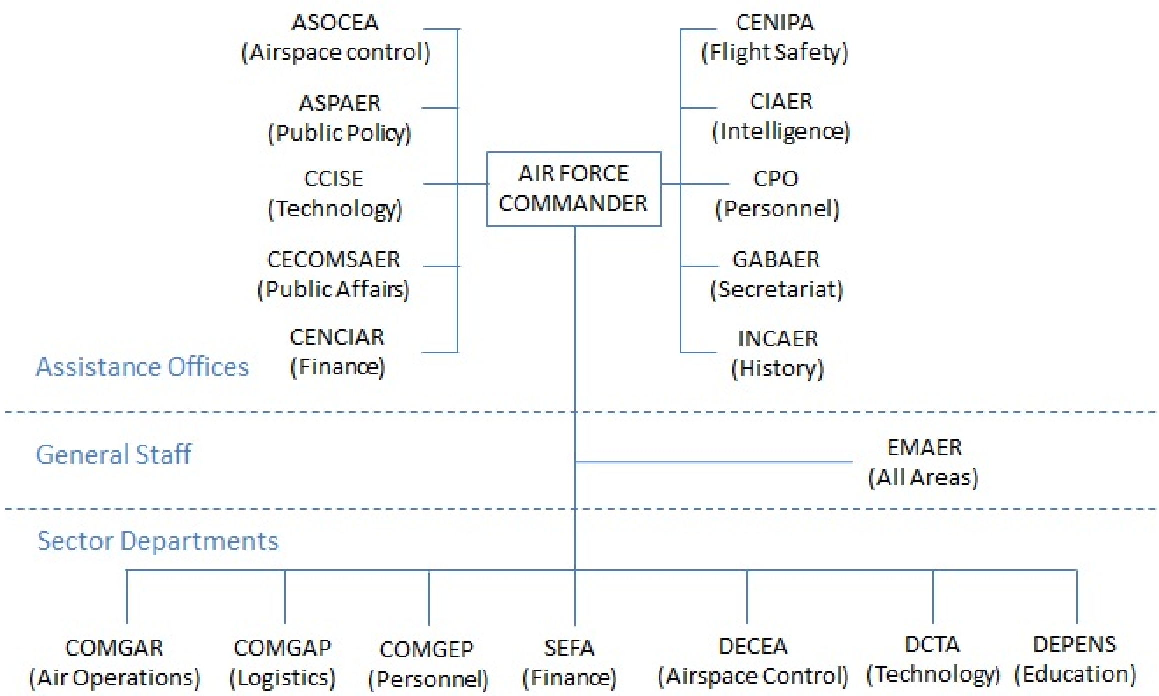

Figure 3. Simplified layout of the Brazilian Air Force organizational structure (after Centro de Comunicação Social da Aeronáutica [CECOMSAER] 2014)

Most of the areas work systemically. This means that an aviator can be assigned to any of these domains regardless of the department or hierarchical level in the organization. For example, an aviator in the Air Operations Command (COMGAR) can be assigned to work in personnel, intelligence, logistics, public affairs, flight safety, or other areas, even though the department is specialized in air operations. The difference is that, if he is a junior, someone will take care of the office for him. But if he is a senior, he will be expected to make decisions about issues that require a level of experience he may not have.

Moreover, these areas of specialization overlap across jobs. Someone working with personnel may need to have knowledge about education. Logistics is associated with finance. Air operation and flight safety are interconnected. Depending on the job, the aviator may be required to have experience in many areas, in different proportions.

The need to specialize the aviators was debated by the Air Staff (EMAER) in 2010 during a workgroup that studied the educational system in eight air forces from North America and Europe. One of the proposals suggested a reduction in the number of aviators in relation to the total inventory of officers, transferring tasks to other specialties. This would decrease the variety of jobs for aviators, increasing specialization and improving performance. Another proposal suggested the implementation of the career manager, as used in many studied countries. The career manager would help officers choose jobs that satisfy individual preferences and organizational needs. Each job would be available in specific career paths, which would reinforce the officers' specializations and improve their performances.

Four years later, neither proposal was implemented. The culture that dictates that aviators must be in charge of the entire service by working in different areas is still in force. Whether it is appropriate or not, the point is that the lack of specialization in the largest community in the Brazilian Air Force imposes a huge challenge on the assignment process.

Since aviators outnumber any other specialty, they are appointed to a great variety of jobs in order to run the operational and administrative tasks. The commands have discretion to lay down the organizational needs and select the officers holistically, regardless of their experience. The officers do not have the support of career managers to narrow down their preferences in career paths. They are free to make any choice, regardless of their own skills, exacerbating the loss of human capital even more.

Once a year, the officers of the Brazilian Air Force who have fulfilled specific requirements are rotated to other stations. Since it generates a fixed cost that cannot be avoided, it is important that the Air Force gets the maximum benefit from this process. But under this background, the Brazilian Air Force cannot assign the right person to the right place.

B. PURPOSE

This purpose of this thesis is to create an algorithm to be used in the assignment process of senior officers without specialization, as it occurs among aviators in the Brazilian Air Force, so that job performance can be maximized.

The assignment process deals with two apparently conflicting forces: the individual preference for specific jobs and the institutional preference for specific officers. If officers are assigned to jobs they don't like, regardless of the reason, motivation decreases, which leads to less effort spent on the job and poorer performance. If they are assigned to jobs they don't fit, due to lack of experience or education, their performance decreases as well.

Since the current assignment process does not capitalize on previous job experience, the proposed algorithm for assigning officers will also incorporate this variable in order to maximize performance.

C. RESEARCH QUESTIONS

Primary Question

- How should individual preferences and organizational needs be balanced during the assignment process in order to maximize senior officers' performance in the Brazilian Air Force?

Secondary Questions

- Which performance drivers are relevant for the assignment process?
- Which decision modeling techniques are applicable in the assignment process?

D. METHODOLOGY

The methodology used in this thesis research consists of searching for relevant variables that affect individual performance, according to theories of work performance, and applying them in an optimization model for the assignment process.

The first literature review summarizes the officer assignment process in the Brazilian Air Force and U.S. Navy. The differences are described in order to provide suggestions for a future implementation of the model.

A second review presents the variables that affect performance, according to theories of work performance. However, the characteristics of the assignment process make only a few of them relevant to be incorporated in the algorithm.

The third review introduces the concept of decision modeling and presents the results of previous studies regarding the application of linear programming in assignment problems. The weakness of each one is analyzed to guide the development of the model.

The last step is to propose an algorithm for the Brazilian Air Force that fits its specific needs based on the conclusions drawn from the previous literature reviews. The algorithm is evaluated by analyzing the results obtained through simulation in different scenarios.

E. SCOPE AND LIMITATION

> One of the most well-documented findings from studies of individual and organizational behavior is that organizations and their members resist change.
>
> –Robbins and Judge 2012, 235

To avoid conflict with the organizational culture, this research looks for a solution that causes the minimum change in the modus operandi of the Brazilian Air Force.

The research could have been a cost-benefit analysis of increasing the number of officers in more specialized communities, so that the aviators could be released to operational jobs. Even if it generated net benefits, this proposal could face cultural barriers for approval, since it decreases the proportion of aviators, changing the balance of power inside the Brazilian Air Force.

Another alternative could have been splitting the aviation community into subspecialties since graduation from the Air Force Academy. In this case, the resistance to change could be driven by the burden of planning many career paths and the unknown constraints imposed on the distribution process.

This research has a different scope. It proposes a mathematical model for the assignment process to solve the problem with minor changes in the modus operandi. The evaluation of the model does not include comparisons with real data. The Brazilian Air Force does not track changes in assignments or experience electronically, which makes this approach unfeasible. Instead, results from the simulation of assigning random cohorts are analyzed statistically. The simulation intends to demonstrate that it is possible to capitalize experience through the assignment process and create specialization among officers, respecting individual preferences.

F. EXPECTED BENEFIT OF THE STUDY

The study is expected to show that both officers and commands can experience mutual benefits using an algorithm that maximizes shared interests instead of divergent preferences.

The algorithm is designed to optimize the use of human capital while matching officers and jobs. The greater the experience accumulated in one type of activity, then the greater is the chance to use it again. If the algorithm works as designed, the officers will have a natural specialization without the intervention of a career manager. This benefit will be visible at higher ranks, because the officers will hold key positions in areas where they have the most experience. In the end, they will consider themselves key players, instead of just figures to fill vacant jobs.

THIS PAGE INTENTIONALLY LEFT BLANK

II. OFFICER DISTRIBUTION PROCESS

A. BRAZILIAN AIR FORCE PROCESS

The Brazilian Air Force executes personnel management under the responsibility of the Air Force Personnel Command (COMGEP) in an annual period cycle composed of two processes.

The first is the Planning process, in which manpower needs proposed by each organization are analyzed, adjusted, and approved. The second is the Distribution process, which is based on two indicators: the personnel inventory table (TLP) and the personnel strategic table (TEP). The TLP is the current inventory of military personnel grouped by rank and specialties, while the TEP is the manpower target level for each organization. Since there is a shortage of military personnel to fill all vacant jobs, the COMGEP uses the distribution process as a tool to achieve the same readiness among all organizations by keeping the TLP/TEP ratio constant.

"The distribution of personnel includes activities that aim to ensure the existence of military personnel in all jobs, in amounts that meet the needs of human resources" (Comando da Aeronáutica 2014, 18). This statement, taken from the main source of manpower policy in the Brazilian Air Force, exemplifies the quantitative approach used in the officer distribution process.

Aviation is the officer community most commonly affected by this policy. The official document that describes the expected qualification for each specialty lists 12 skills for aviators, all of them related to aviation issues (Comando-Geral do Pessoal 2012b, 12). However, since the inventory of aviators outnumbers any other community at senior ranks, the distribution process places them in many different jobs, unrelated to aviation, in order to meet manpower requirements.

The policy that regulates the distribution process introduces the subject by stating how organizational interest and personal preference should be treated.

> Every rotation is performed to meet the interest of the Service. When the military is included in Proposal of Organization, Operational Command or ODGSA, the personal preferences are consultative information to the search of a possible conciliation between the conveniences of the Service and the military. (Comando-Geral do Pessoal 2012a, 13)

This process focuses on a military personnel rotation that has a permanent change of station and uses two types of plans: the Movement Plan (PLAMOV) and the Special Movement Plan. The employment of any one depends on the minimum period of two years on station, the existence of a vacant job in the next destination, and the impact on the TLP/TEP ratio. The most important plans for aviators are the PLAMOV and one category of Special Movement called Movement by Selection of Senior Officer (MPEOS).

(1) PLAMOV

The PLAMOV is the regular rotation plan for junior officers. Since the primary instructions are followed, the ODGSA have discretion to use their own criteria in assigning officers.

The officer who meets the requirements fills out a form stating three locations where he would like to live and forwards it through the chain of command. For aviators, this wide range of possible choices does not affect their career, because junior officers are supposed to follow an operational path. The options are just an opportunity to choose from a few possibilities according to the operational specialization.

After graduating from the Air Force Academy, the aviators attend an advanced operational course, in which they learn how to use the aircraft for military purposes. The aviator spends the junior ranks climbing the operational ladder. This is the regular career path, although some will diverge to administrative jobs sooner. For officers under operational orders, the Operational Command does the placement and assignment, but does not have autonomy to execute the distribution. The command submits the aggregated plan to the sector department, who finishes the assignment and forwards the final plan to the COMGEP for execution.

(2) MPEOS

The MPEOS is the regular rotation plan for senior officers. Every time they hand over a command position assigned by the highest level of the Air Force, or graduate from the Command and Staff College, or return from an appointment abroad, they are automatically included in this plan.

MPEOS is a process by which officers are “chosen by jobs” instead of “choosing the jobs.” The acronym is not completely right, because the officers can express their preference, even though it is not the main criterion. However, different from the junior officers, the senior officers do not have any operational or administrative career path to follow. Therefore, the ODGSA have discretion to choose any officer, and the officer to state any preference.

The preferences are collected electronically through the MPEOS module of the Personnel Management Information System (SIGPES) in sequential order: first, the options of senior officers, and then, the choices of ODGSA representatives. There are no advocates for senior officers during this process. The officer’s choices may either translate their professional or personal preferences.

The officer engaged in MPEOS should choose and rank one to nine combinations of locations and ODGSA from a given matrix (Figure 4), which presents available jobs for his rank and specialty (Comando-Geral do Pessoal 2013, 4). In the case of aviators, there is a broad range of alternatives (blue cells in Figure 4) to choose from. If he is willing to live in Brasília or Rio de Janeiro, he can choose almost any main area of specialization, regardless of his experience.

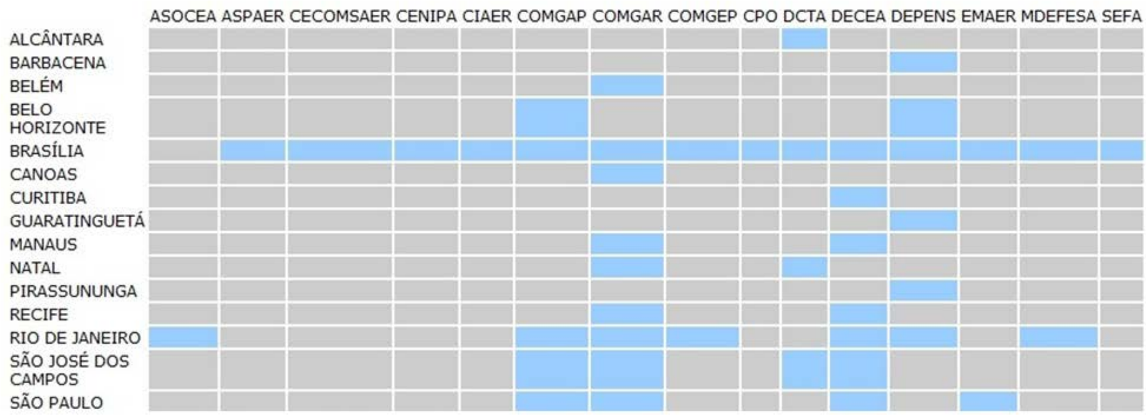

Figure 4. Example of a real matrix for an O-5 aviator[1]

Besides ranking his combined preferences, the officer is expected to provide some additional information in the MPEOS module, using text format. He should express his preference for specific organizations under each ODGSA, since more than one organization may exist in each location. He should also present his preference for areas of specialization, because even though each ODGSA has a central area of activity, the areas of specialization are systemic and most of them are available in many organizations. Finally, he should declare his overall experience and qualification.

This additional information is forwarded to each ODGSA representative in order to assist their selection. However, according to the regulations, they are not compelled to follow the officer's profile. So, the selection may be biased by friendship or hearsay. Using any criteria, they list all officers by rank and specialty in decreasing order of preference.

After all stakeholders have ranked their preferences, a mathematical model will attribute weights to officers and ODGSA preferences, taking into consideration the TLP/TEP ratio. The outcome will be the proposed distribution of officers. A meeting among ODGSA representatives at the COMGEP will be held in order to allow changes in the proposal for final approval.

[1] This figure is a print screen from the author's personal record retrieved on July 3, 2014, from the MPEOS module.

B. U.S. NAVY PROCESS

The U.S. Navy executes manpower and personnel management as two distinct processes that include four sub-processes: Manpower Requirements, Manpower Programming, Personnel Planning, and Personnel Distribution.

The first two sub-processes are focused on “spaces” to be filled. The Manpower Requirements are the translation of national strategic objectives into unconstrained manpower needs. These requirements are expressed as minimum skill, pay grade, and quantity to accomplish 100% of missions in a defined scenario (Hatch 2013, 39). The Manpower Programming is “the matching of available resources to validated requirements” (Butler and Molina 2002, 9). In this process, the requirements are prioritized and narrowed down to a determined quantity of personnel in order to fit the budget constraints.

The following two sub-processes represent the “faces” in the manpower management. The Personnel Planning administers the total inventory by predicting gain and losses and using the community managers to shape each community with changes in manpower policies like recruiting and career development. The Personnel Distribution aims to assign the right person in the right place at the right time with the right skills (Hatch 2013, 144).

The main concepts about the officer distribution process are described in two articles of the Navy Military Personnel Manual (MILPERSMAN): 1301-100 and 1301-102.

(1) MILPERSMAN 1301-100

The Navy Personnel Command is responsible for officer distribution and career development functions, which are merged in one single process.

> The development and optimum employment of a qualified, motivated work force is a universal, many-faceted problem. … Inventories must be kept in line with requirements and, at the same time, the individual officer must be provided with a meaningful, professional development pattern. (Bureau of Naval Personnel 2003a, 2)

The mission of the officer distribution divisions in the Navy Personnel Command is summarized in three topics:

> a. To assign the best qualified officers to meet needs of the Navy as defined by the approved officer billet file.
>
> b. To assign officers to billets which develop their professional expertise so that the officer corps as a whole embodies leadership, technical, and managerial skills necessary to achieve the Navy's mission.
>
> c. To assign officers sensitively and fairly, ensuring their continued professional motivation and dedication to the Navy. (Bureau of Naval Personnel 2003a, 2)

This threefold mission is translated in the "Triad of Detailing," which incorporates needs of the Navy, career needs of the individual, and desires of the individual. All three areas are considered for assigning officers.

At one extreme, the needs of the Navy are deemed as "the most important factor" and override other interests. At another extreme, the desires of the individual are considered "extremely important," since they affect the morale of the officer. In the middle, there are the career needs, whose satisfaction is wished by both the Navy and the officer.

> Operational, technical, and managerial areas of development are key elements in every officer's career progression. … Each officer community has a basic career path that develops its officers to assume positions of increasing responsibility. Within a career path, there is a great deal of room for flexibility among assignments to achieve the desired results. Depending on the community, each officer must obtain certain qualifications during their career. (Bureau of Naval Personnel 2003a, 4)

The Navy Personnel Command has a policy of encouraging direct communication between representatives and individuals in order to ensure that the three components of the Triad of Detailing are balanced. Each officer should submit their preferences and personal information one year before the projection rotation date. The preference information will be composed of a list of five choices for each one of the three available categories (command, billet, and location), which will be ranked according to officer's interest. These data will be inserted in a database to be used by the assignment officer, also called "detailer," as shown in Figure 5.

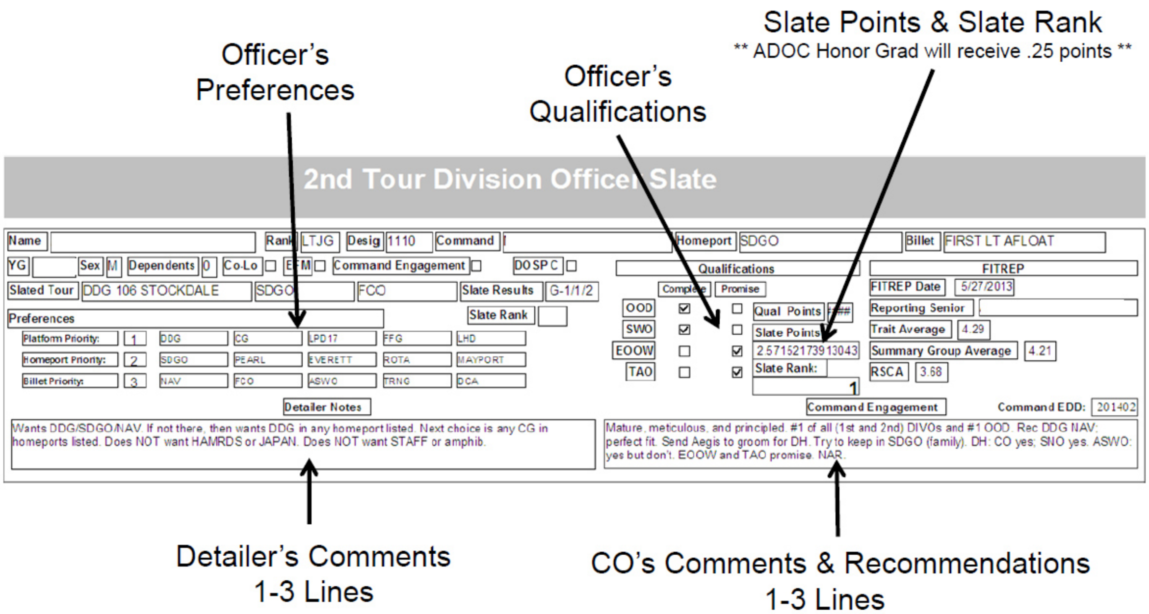

Figure 5. Example of officer's preferences with personal information (from Black 2014, 22)

(2) MILPERSMAN 1301-102

There are two important stakeholders in this process as identified by the Bureau of Naval Personnel (2003b, 1). "The officer distribution process basically consists of identifying and placing a requirement (placement) and assigning an officer to fill the requirement (assignment)." The first is the placement officer, who represents the commands' interest and has the responsibility of ensuring the best match between billet requirements and officer qualifications. The second is the assignment officer, who represents the officers' interests and is responsible for ensuring that career needs and individual interests are taken into consideration.

The process is cyclic. Whenever an officer is assigned to a different billet, the current billet becomes available for reassignment. The common reference in the distribution process is the projected rotation date, which is fixed for each position. Placement officers post billets that are to become vacant in the next year, and assignment officers recognize that some officers are completing their tours of duty and will need to be reassigned, as shown in Figure 6. The distribution is conducted separately for each career community.

SWO LCDR DOWNSTREAM FILL LIST:

**** WAR COLLEGE UPDATE: We are currently taking inputs for SUMMER '09 Senior WC Seats. If you are interested, please look at the hyperlink (hyperlink) on the previous web page, and then submit your preferences to your Detailer.****

GSA BILLETS ARE PRIORITY FILL BILLETS

HOT FILLS ARE COLOR CODED RED IN THE COMMAND LINE

FILL DATE	UIC	BSC	COMMAND	BILLET TITLE	HMPRT	AQD /SCP	NOTES
GSA BILLETS							
200905	42795	00250	ECRC FWD NORFOLK	LNO CENTCOM - N5 - NE18540065	NORVA		TS/SCI CLEAR, PRD 1005. NMPS 11MAY09. AEGIS
	PERFORMS LIAISON DUTIES IN SUPPORT OF USNAVCENT'S MISSION AS ASSIGNED AND DIRECTED BY COMUSNAVCENT. SUPPORTS						
200906	4060A	00242	ECRC FWD SAN DIEGO - IRAQ	JCCS-1 DIVISION OPS - NE22090017	SDGO		SEC CLR: TS/SCI, PRD: 1005, NMPS: 20090622, SUB RULE: AEGIS
	CENTCOM, CTEWCC, CFLCC, JIEDDO, ATEC, AMC, BRIGADE AND BATTALION COMMANDERS, OTHER AGENCIES AND PROGRAM MANAGERS ON ALL MATTERS RELATED TO EW OPERATIONS, CAPABILITIES AND CREW SYSTEM PROCUREMENT, TESTING, INSTALLATION AND SUSTAINMENT. RESPONSIBLE FOR TRAINING THROUGHOUT THE DIVISION.						
NON-GSA BILLETS							
NOW	00948	73010	FLTASWTRACENPAC	INST NAV SCI/302L	SDGO		
NOW	00948	74010	FLTASWTRACENPAC	TRNG/ CS DIV HD	SDGO	ASW	
200902	00011	86335	OPNAV	STF REDI GEN/LCS REQUIREMENTS	ARLING		AP BILLET
200902	00074	81500	CNSWC	EQ PGM SUP/NAVY POM	CORNDO		
200903	00011	42410	OPNAV	LOGISTICS/N424F OPLOG & ASST CLF PGM MGR	ARLING		Potential SS-SCP Billet
200903	00038	35400	USPACOM	PLANS OFFICER	PEARL	JD1	
200904	52739	10010	ESG 3	FLAG SEC	SDGO		NOMINATIVE BILLET
200905	32778	92010	COMFLEACT CHINHA	OPS ASHR	CHINHA		
200906	44040	20200	PEP CANADA-ESQUI	2ND CAN SQDN OPS OFF	VICTCA		
200906	63190	73130	SWOSCOLCOM NPORT	INST TECH/CMBT SYS/DDG WEP-CSO 9545 2544	NEWPORT		

Figure 6. Example of billets available for SWO specialty at rank of O-5 (from Black 2014, 24)

(3) Information Technology Support

The officer distribution process uses a web-based system hosted at the Bureau of Naval Personnel under the Navy Personnel Command which allows easy access to assignment officers and personnel information. The enlisted distribution process, on the other hand, has a more elaborate tool for placing and assigning jobs.

The system, called Career Management System/Interactive Detailing (CMS/ID), allows the enlisted personnel to select jobs that meet professional and personal interests and submit their own application, as if they were in a civilian labor market. Not all jobs are offered, but just those available for their rate and specialty. The jobs are also filtered according to the preferences previously communicated and suggested by the assignment officer, according to each profile. Potential applicants can view job details and apply for up to five jobs. After that, he can use the system to follow the status of the submitted application.

The selection does not occur automatically. The assignment officer should access each job and choose the most qualified candidate manually, which keeps this process subjective and labor intensive, as shown in Figure 7.

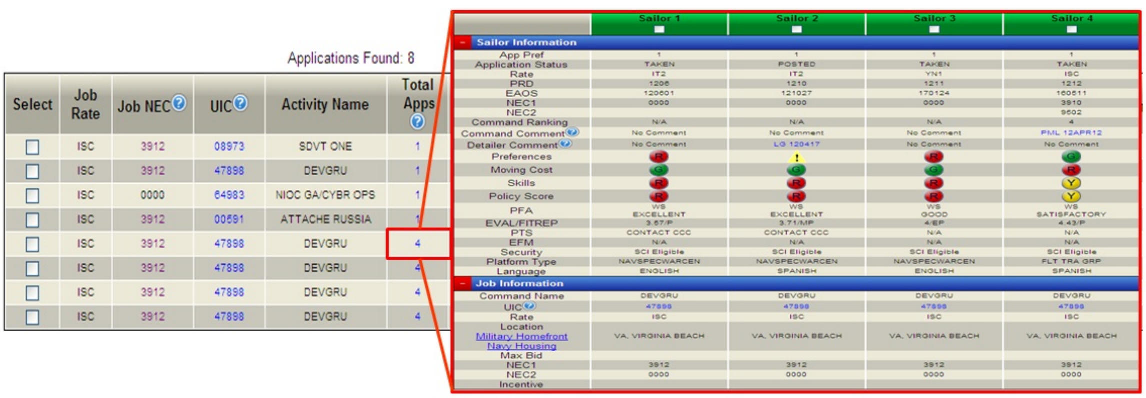

Figure 7. Example of application comparison (after BUPERS Business Transformation Office 2012, 19)

C. COMPARISON BETWEEN BRAZILIAN AIR FORCE AND U.S. NAVY PROCESSES

The Brazilian Air Force uses an algorithm that automates the overall matching of preferences between commands and officers, but not the requirements of human capital. The available qualitative information helps the ODGSA representatives make their choices, but they are not compelled to follow the officer’s experience or preferences for areas of specialization.

The U.S. Navy has not automated the assignment process. Instead, it uses information technology to facilitate the interaction of officers and their representatives. The commands do not choose officers; they choose requirements. The assignment officer matches requirements and officers' preferences considering the career development.

The development of a mathematical model for the Brazilian Air Force to consider all the information manually handled by the U.S. Navy would be very complex. Since the requirements exist to ensure a satisfactory performance in the next job, the model should include only the relevant variables that drive performance.

D. CHAPTER SUMMARY

This chapter explains the assignment process of officers in the Brazilian Air Force and describes the same process in the U.S. Navy for comparison. Since the divergence in the assignment processes between the two services is not correlated with differences in the operational environment, both processes can be compared without restriction. In the Brazilian Air Force, the assignment process matches free preferences between officers and commands. In the U.S. Navy, commands do not choose officers; they choose requirements to be matched with officers' preferences and career needs. It makes the process less subjective in the U.S. Navy and inspires the development of a model for the Brazilian Air Force.

III. PERFORMANCE DRIVERS

A. THEORY OF WORK PERFORMANCE

Between 1930 and 1980, many researchers attempted to find the antecedents of performance. The typical approach consisted of searching for a simple relationship between job performance and one or two variables. Despite the enormous effort, counted in thousands of studies, the researchers “failed to provide strong and consistent predictors of performance” (Blumberg and Pringle 1982, 560).

Inspired by an action-research project designed to increase job satisfaction and performance simultaneously in an American underground coal mine, Blumberg and Pringle (1982, 560–69) propose a model to explain work performance. They identify a broad range of variables from the literature and from 13 months of field observation inside the coal mine and classify them in three dimensions, as shown in Table 2.

Table 2. Dimensions of work performance (after Blumberg and Pringle 1982, 562)

Dimensions	**Variables**
Capacity to perform	Ability, age, health, knowledge, skills, intelligence, level of education, endurance, stamina, energy level, motor skills.
Willingness to perform	Motivation, job satisfaction, job status, anxiety, legitimacy of participation, attitude, perceived task characteristics, job involvement, ego involvement, self-image, norms, values, perceived role, expectations, feeling of equity.
Opportunity to perform	Tools, equipment, materials, and suppliers; working conditions; actions of coworkers; leader behavior; mentorism; organizational policies, rules, and procedures; information; time; pay.

The model explains the interaction of the dimensions (Figure 8) and describes performance (P) as a function of the product of opportunity (O), capacity (C), and willingness (W) in the equation P = O x C x W.

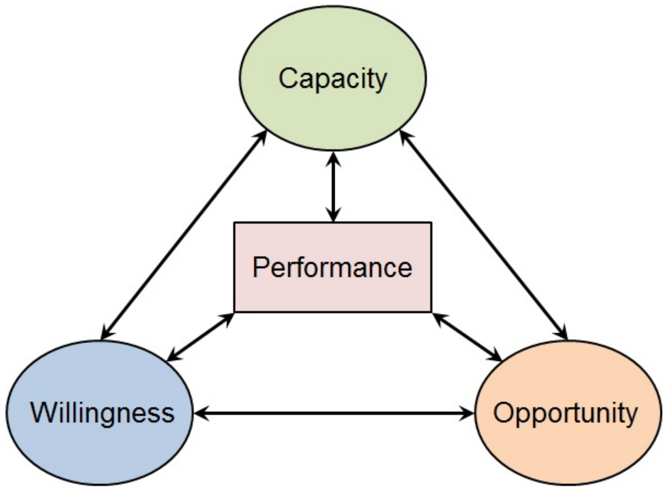

Figure 8. Interaction of dimensions (after Blumberg and Pringle 1982, 565)

The multiplicative model means that performance only occurs if all three elements are present in some degree. In case any element assumes a value equal to zero, the value for performance will be zero. It is an extreme condition. More frequently, an element can have a low value, which will decrease the overall performance without reducing it to zero. Besides the multiplicative equation, Blumberg and Pringle (1982, 565) also comment on the use of a summative model.

> A summative model seems more appropriate for the variables that comprise each of the dimensions. For example, in a particular situation, capacity to perform might consist of a weighted algebraic sum of the effects of ability, age and health. Even if one of the variables, such as age, were not favorably represented, there still would be some capacity remaining for performing because of favorable levels of ability and health. (Blumberg and Pringle 1982, 565)

Blumberg and Pringle (1982, 565) use social learning theory to justify the model. According to this theory, human behavior can be explained in terms of "continuous reciprocal interaction between cognitive, behavioral, and environmental influences" (Bandura 1977, vii). Referencing Bandura's concept of reciprocal interaction, Blumberg and Pringle (1982, 565) explain that external circumstances can change behavior, and behavior can change external circumstances.

> At the individual level, performance is determined by opportunity, willingness, and capacity and, in turn, is a partial determinant of each. The act of performing, for instance, gives one experience on the job, which over time may improve the individual's skills or abilities (elements of capacity). High job performance may increase a worker's job satisfaction and reduce his or her anxiety about performance (elements of willingness). And one individual's superb performance may inspire his or her co-workers (an element of opportunity) to perform better, which in turn may impel the individual to even higher performance (examples of his can be seen most clearly at athletic events). (Blumberg and Pringle 1982, 565)

Schermerhorn, Gardner, and Martin (1990, 48) consider this model "a comprehensive approach to individual performance" and call it the "individual performance equation." Their equation uses different names for the three dimensions: ability, instead of capacity; effort, instead of willingness; and support, instead of opportunity, even though they refer to Blumberg and Pringle (1982, 560–69).

Mathis, Jackson, and Valentine (2014, 149) confirm the statements of Schermerhorn, Gardner, and Martin (1990, 48) and state that "the relationship of those factors is broadly defined in management literature." The equation is the same as described by Schermerhorn, Gardner, and Martin (1990, 48):

Performance (P) = Ability (A) x Effort (E) x Support (S)

1. Ability

Performance begins with ability, considered to be the collection of skills and other personal characteristics needed in a job (Schermerhorn, Gardner, and

Martin 1990, 48). First of all, managers must ensure the employees have the right attributes by using procedures that match individual talents and job requirements (Ibid., 48–49). If the employee does not have the requirements, the manager should use training programs to develop the employee's abilities or reassign him to achieve a better person-job fit (Ibid., 49).

Schermerhorn, Gardner, and Martin (1990, 49) consider the assignment as an alternative for training and a solution for improving performance. Assignment is a matter of choice and usually does not incur extra expenses as it does with training. Moreover, avoiding costs with basic training saves resources to be used in advanced training with employees who already have some experience in the job, which creates a virtuous cycle in the improvement of human capital.

To illustrate the effect of ability on performance, let's consider the case of a hypothetical senior officer. If he is assigned to be a chief of a logistics division without specific knowledge or experience in that area, his performance will be impaired no matter how motivated he is in the job and how much support he has in his new organization. To avoid underperformance, the organization will have to provide basic training for someone who was supposed to have advanced ability in the job. The alternative of reassigning him to achieve a better person-job fit is not usual practice in the Brazilian Air Force, because knowledge and experience are not considered factors in the assignment process.

2. Effort

Performance involves effort, which is the willingness to work hard. Unlike other factors, the decision to put effort into a job is not under managerial control, which explains the reason why theories of motivation are so emphasized in human resources management (Schermerhorn, Gardner, and Martin 1990, 50). Victor Vroom made an important contribution to the management literature by introducing the Expectancy Theory, which has three factors:

- **Expectancy:** A person's belief that working hard will result in a desired level of task performance being achieved (this is sometimes called *effort-performance expectancy*).

- **Instrumentality:** A person's belief that successful performance will be followed by rewards and other potential outcomes (this is sometimes called *performance-outcome expectancy*).

- **Valence:** The value a person assigns to possible rewards and other work-related outcomes. (Schermerhorn 1993, 451)

The effect of effort on performance can also be exemplified in the case of the senior officer. If he is assigned to be the chief of a logistics division but he is not motivated in this job, his performance will suffer regardless of his level of ability and the support provided by the organization. The reason for the lack of motivation may reside in one of those three factors:

- **Expectancy:** He may not believe that he will have good performance in that job because he has never worked with logistics before, even though the organization provides basic training for newcomers.

- **Instrumentality:** He may think that if he demonstrates high performance, he will not be rewarded with the possibility of having priority in choosing his next assignment. Instead, he may become indispensable in a job he does not like.

- **Valence:** He may not care for any kind of reward offered by his next job, because none of them can offset the disadvantage of living in a location that his family does not want to be in.

The Expectancy Theory assumes that all these factors must exist in order to motivate the employee. Schermerhorn (1993, 451) asserts that this theory "can help managers to better understand and respond to different points of view in the workplace" and proposes a list of actions (Table 3) to maximize expectancy, instrumentality, and valence among employees.

Table 3. Managerial implication of expectancy theory (after Schermerhorn 1993, 452)

To Maximize Expectancy	
Make the person feel competent and capable of achieving the desired performance level	• Select workers with ability • Train workers to use ability • Support work efforts • Clarify performance goals
To Maximize Instrumentality	
Make the person confident in understanding which rewards and outcomes will follow performance accomplishments	• Clarify psychological contracts • Communicate performance-outcome possibilities • Demonstrate what rewards are contingent on performance
To Maximize Valence	
Make the person understand the value of various possible rewards and work outcomes	• Identify individual needs • Adjust rewards to match these needs

The first action suggested by Schermerhorn (1993, 452) to increase motivation is to "select workers with ability," which is supported by the interaction model developed by Blumberg and Pringle (1982, 560–69). The mismatch between job requirements and employee's ability is only one source of low motivation. The underlying causes are complex and may be driven by either professional or personal issues. The simplest way to address this problem in the assignment process is to consult the officer about his preferences and take them into consideration.

3. Support

Performance requires support in both physical and social aspects of the work environment. "Even the most hard-working and highly capable individuals will be unable to maximize their performance if they do not have the necessary support" (Schermerhorn, Gardner, and Martin 1990, 49). Blumberg and Pringle (1982, 565) define support (opportunity) as "the particular configuration of the field of forces surrounding a person and his or her task that enables or constrains that person's task performance and that are beyond the person's direct control."

The case of the senior officer can also be used to illustrate the effect of support on performance. He may be motivated with his new assignment and have all the requirements desired for the job. But if the organization does not have an adequate budget for clerical issues and does not provide any kind of information technology device to help manage the logistics division, his performance will be lower than expected. Considering other examples of low support, he may face a lack of autonomy, high workload, and no empathy from his boss and co-workers.

B. THE EFFECT OF JOB EXPERIENCE ON JOB PERFORMANCE

Although experience has been frequently used as a predictor of performance in the selection of employees, little research has been devoted to the effect of job experience on performance (McDaniel, Schmidt, and Hunter 1988, 327). Regardless of the existence of formal training, "new employees must learn the methods and skills required for job performance over a period of time on the job" (Schmidt, Hunter, and Outerbridge 1986, 432). Therefore, the amount of experience is expected to have a positive effect on performance.

Philosophers like John Locke and Aristotle believed that the human being is born with a blank mind and, throughout life, new experiences imprint knowledge on it. These philosophers did not distinguish between experience and knowledge, but there are theoretical and practical reasons to do so (Quiñones, Ford, and Teachout 1995, 889). For example, attending a course in logistics management may increase the descriptive knowledge of a senior officer, but only hands-on experience will give him the procedural knowledge to master the subject.

Besides affecting different dimensions of knowledge, similar experience may not produce the same amount of knowledge (Quiñones, Ford, and Teachout 1995, 890). For example, an officer who worked with logistics in the past and another officer with no previous involvement in this area are likely to extract different amounts of experience from observing a warehouse operation.

Schmidt, Hunter, and Outerbridge (1986, 432–39), using empirical data, study the effect of experience in similar jobs, not on organizational seniority. They develop a causal model (Figure 9) that explains the impact of job experience and general mental ability on job knowledge, job performance (work sample performance), and supervisory rating of job performance. This thesis only analyzes the effect of experience on performance.

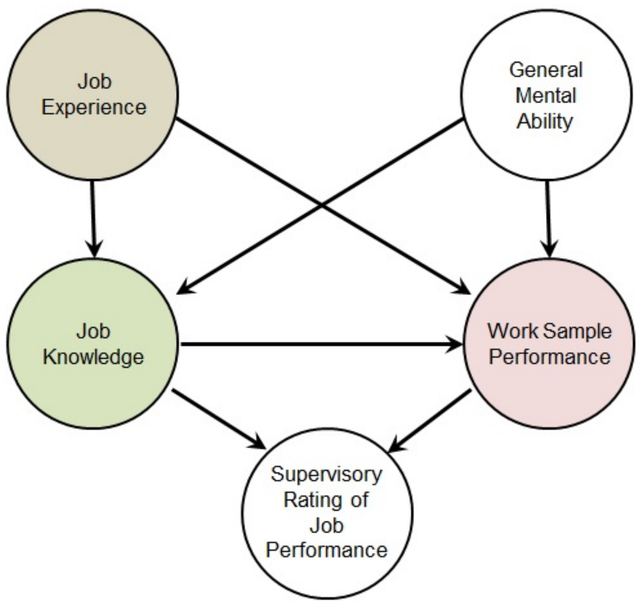

Figure 9. Causal model relating job experience and job performance (after Schmidt, Hunter, and Outerbridge 1986, 434)

Schmidt, Hunter, and Outerbridge (1986, 436) conclude that the primary effect of job experience is on job knowledge, which indirectly increases job performance. However, the findings suggest that "job experience leads to the acquisition of skills, techniques, methods, psychomotor habits, and so forth, that directly produce improvements in performance capabilities independent of increases in job knowledge" (Schmidt, Hunter, and Outerbridge 1986, 436).

Schmidt, Hunter, and Outerbridge (1986, 438) propose that the difference in job performance caused by experience decreases as the average level of experience increases. To clarify, they present an example of the effect of hiring new employees at the beginning of each year. If this routine does not change, at the end of the fourth year, the most experienced cohort (senior) will have four years of experience, while the least experienced (junior), only one. The level of experience in the junior cohort will be only 25% of the senior group. Tracking these two cohorts over time, when the senior group completes 20 years of continuous employment, the junior will have 16 years. At that moment, the level of experience in the junior cohort will be 80% of the senior group.

These findings are confirmed by McDaniel, Schmidt, and Hunter (1988, 329): "Results indicate that for all levels of job experience and for both low- and high-complexity jobs, the correlation between job experience and job performance is positive." Furthermore, "the correlation is highest for samples with low mean levels of job experience" (Ibid.).

One limitation of the research conducted by Schmidt, Hunter, and Outerbridge (1986, 432–39) is that the conclusions are based only on non-managerial employees. McEnrue (1988, 175–84) overcomes this issue by studying the relationship between job experience of managers and their performance.

> This study yielded evidence of a strong, positive relationship between the length of job experience among early-career managers and their performance. Those with longer tenure in the role of restaurant manager achieved higher sales and realized larger profits. … However, the amount of time an individual had managed a particular restaurant or worked with the organization were not significant predictors compared to length of time as a manager. (McEnrue 1988, 181)

Dokko, Wilk, and Rothbard (2009, 51–68), supported by psychological theory, propose that sociocognitive factors interfere in the portability of experience among jobs. They confirm that "prior occupational experience has a positive effect on performance via knowledge and skill," but they find "a negative direct effect that diminishes the overall relationship" (Ibid., 65). According to their research, related work experience can have "a negative effect on performance through institutional mechanisms (i.e., norms) or cognitive mechanisms (i.e., schemas and scripts) that lead to rigidities in behavior or thinking" (Ibid., 54). However, they also find that "those who feel they fit well into the culture of the new firm are less subject to the negative effects of rigidities on performance" (Ibid., 63). This suggests that willingness to work under a culture affects the capacity to use previous experience in benefit of the performance, which is also explained by the interaction model proposed by Blumberg and Pringle (1982, 560–69).

C. PERFORMANCE DRIVERS FOR THE BRAZILIAN AIR FORCE

Previous studies suggest that performance is driven by ability, effort, and support. Experience in the job, not in the organization, also affects performance, either directly or indirectly through knowledge, and is aggregated in the ability dimension. To select the relevant performance drivers for the officer assignment process, some peculiarities related to the officer community in the Brazilian Air Force must be taken into consideration.

The Brazilian Air Force uses the concept of an internal labor market to fill vacant jobs. The officer's career follows a bottom-up path, and there is no lateral transfer among communities. Future aviators join the Air Force with a high school diploma and attend the same undergraduate course at the Air Force Academy. Promotion is based on tenure, and all aviators are supposed to reach the rank of O-6. There are two mandatory career development courses: one at the rank of O-3 and the other at the rank of O-5. It makes the aviator community very homogeneous regarding education. Although some officers may have the opportunity to attend a postgraduate course, either budgeted by the Air Force or by personal resources, the level of education can be considered constant in each rank.

Besides the level of education, ability may also be affected by individual attributes (e.g., general mental ability and personality traits). However, they are not relevant for the assignment process, because all officers must be assigned, which keeps constant the sum of these attributes across jobs. It is expected that any ODGSA wants to receive the “best” officer. But who receives the “best” will leave the “worst” to the other. The use of individual attributes in the assignment process is a win-lose game.

The assignment of senior officers is executed separately for each community and for each rank. Under theses constraints, education is constant, so it does not differentiate officers. Individual attributes are not constant, but they do not differentiate ODGSA preferences. The only performance driver that is relevant in the ability dimension is experience, because each officer acquires different experience along the career, which makes them attractive for specific jobs.

If information about vacant jobs is available, as it happens in the U.S. Navy, the officer can make his own choices by ranking the preferences according to the complex system of variables that drives his motivation. He is the most qualified person to assess his professional and personal interests. As a result, the effort dimension, translated in the officer’s preferences, should be used in the assignment process to improve performance, as exhaustively debated in the literature.

Although the last dimension of performance—support—should be a concern for all organizations because it affects performance, this dimension is irrelevant for the assignment process, because the level of physical support is the same for any officer that occupies the same position. The social support may be different, but it is absorbed by the officer’s preferences that consider the overall “quality of the job” as a criterion of selection and ranking.

Therefore, the performance drivers that are relevant for the assignment process are experience, in the ability dimension (A), and officer’s preferences, in the effort dimension (E). For the Brazilian Air Force, the individual performance equation should be described as follows:

Performance (P) = Experience (A) x Preference (E)

D. CHAPTER SUMMARY

This chapter explains the main theories of work performance and peculiarities of the officer community in the Brazilian Air Force in order to enable the selection of relevant variables for the development of the model. The starting point is the study conducted by Blumberg and Pringle (1982), who propose a model to predict work performance based on the interaction of three dimensions. Their model became known in the literature as the individual performance equation and explains performance as a function of ability, effort, and support. Other studies find that job experience also affects performance via job knowledge, which belongs to the ability dimension. After comparing these studies with the characteristics of the Brazilian Air Force, the three dimensions are narrowed down to only two variables: experience and preference.

IV. DECISION MODELING

The assignment process is a decision-making activity in which the service faces a trade-off between frequent conflicting interests. Commands want to fill their positions with the best officers according to their criteria, and officers want to be assigned to jobs that satisfy their interests. Nobody is willing to be worse off at the end. The purpose of an assignment model is not only to automate the assignment of a large inventory of people, but also to remove the subjectivity of this process and make it transparent and fair, regardless of the quantity of people being assigned.

Balakrishnan, Render, and Stair (2013, 2) define decision modeling as a “scientific approach to managerial decision making” and argue that “the resulting model should typically be such that the decision-making process is not affected by personal bias, whim, emotions and guesswork.” Managerial decisions should be guided by scientific methods instead of personal preferences.

Decision modeling techniques have been used successfully by many organizations to solve complex problems in a wide variety of areas, like business, government, health care, and education. Although they are very efficient, it is “important to be familiar with the limitations, assumptions, and specific applicability of the model” (Balakrishnan, Render, and Stair 2013, 2).

In many organizations, managers allocate scarce resources by identifying the best, or optimal, solution among thousands of alternatives. To facilitate this process, they use mathematical programming. Despite the term, this does not require any advanced mathematical or computer software programming skills. Among the mathematical programming methods, “the most widely used modeling technique designed to help managers in planning and decision-making is linear programming (LP),” which can be efficiently handled by using spreadsheet packages such as Microsoft Excel (Balakrishnan, Render, and Stair 2013, 20).

A. ASSIGNMENT MODEL

Assignment models belong to one class of LP called network flow models. “Networks consist of nodes (or points) and arcs (or lines) that connect the nodes together.” An assignment model uses the network architecture to find the optimal one-to-one assignment of supply to demand, which can be people to project, jobs to machine, and so on (Balakrishnan, Render, and Stair 2013, 162).

The concept of the assignment model is illustrated in a simple example that has three officers and three jobs (Figure 10). The decision variables are represented by nine arcs. Each arc is associated with a particular benefit and can be chosen or not. The objective function is to maximize the total benefit considering all assignments. Some constraints are mandatory to guarantee a one-to-one assignment: each officer must be assigned to only one job, and each job must have only one officer assigned.

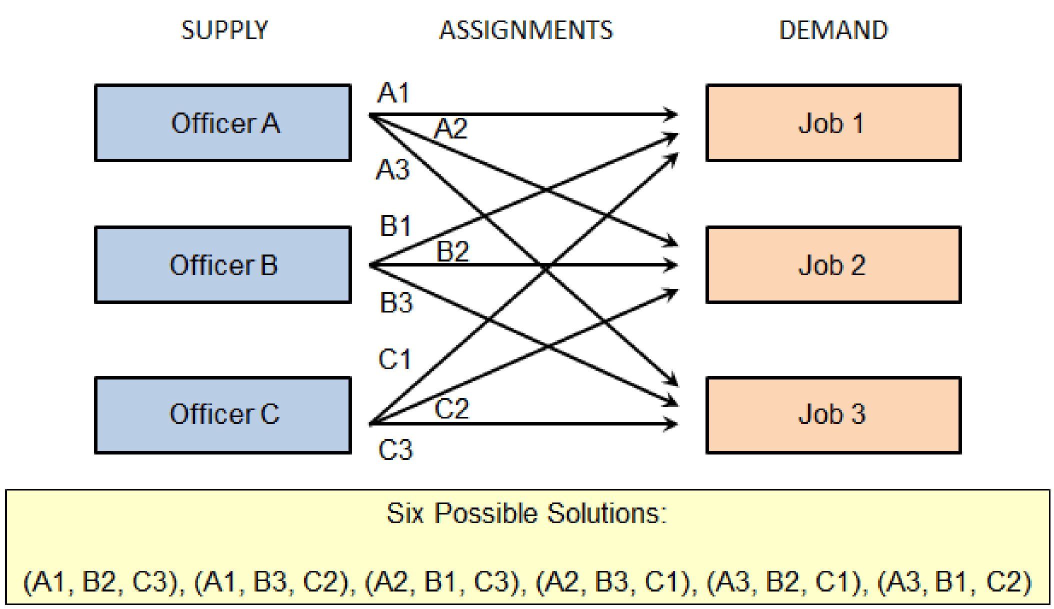

Figure 10. Network model for personnel assignment

All LP share the characteristic of allowing the decision variables to have fractional values and therefore one additional constraint limiting the decisions variable to binary values should be included. For this reason, sometimes studies dealing with assignment problems are classified as integer programming (IP).

The simplicity of the concept behind the assignment model may raise questions among managers about the utility of this technique. Someone may argue that it is easier and faster to solve the problem by hand than to set it up in a spreadsheet. The previous example has only six possible solutions for assigning officers to jobs. But a model that has 10 officers and 10 jobs, which is still a small problem, will result in 10! (= 10 x 9 x 8 x 7 x 6 x 5 x 4 x 3 x 2 x 1), or 3,628,800 possible combinations. It would be unfeasible for anyone to find the best solution manually among all these alternatives.

B. PREVIOUS STUDIES ON LINEAR PROGRAMMING

In addition to the fact that few studies have been conducted to develop LP models for the assignment process, the models are tailored to specific problems, which decreases the degree of portability of algorithms among studies. Unless the models are developed under the same background, it is difficult to make comparisons. Therefore, the following literature review is conducted to present some obstacles faced by LP users, instead of judging the validity of the model for the assignment process.

1. Two-Sided Matching for the U.S. Navy’s Enlisted Detailing Process: A Comparison of Deferred Acceptance and Linear Programming via Simulation

In their master’s thesis, Ho and Low (2002) compare the performance of LP via simulation against a particular two-sided matching algorithm called Deferred Acceptance (DA). Both LP and DA are “the principal methods used in the market for two-sided matching processes” (Ibid., 81). Ho and Low (2002, 17) explain the logic of the DA algorithm through an example with consultants and interns that has been converted in this thesis to officers and ODGSA.

Assume that each officer and ODGSA have ranked each other according to their preferences. Each officer starts the process by showing his interest to the most preferred ODGSA. Each ODGSA temporarily keeps the best officer, who may appear in any position of the preference list, and rejects the others. The rejected officer proposes again to the second highest ranked ODGSA in his list. If the ODGSA considers the new proposal preferable to the first one, the ODGSA keeps the new and discards the first. The process continues until none of the proposals are rejected in a step.

Ho and Low (2002, v) argue that previous studies have found great benefits in favor of DA, “which ensures stable matches, prevents ‘off-the-site’ trades between matching parties and upholds integrity of the matching system.” On the other hand, LP can optimize the entire assignment system and promote a balanced approach among preferences of both parties (Ho and Low, 2002, v).

After performing 100 simulation runs, Ho and Low (2002) compare the outcomes from the DA and the LP algorithms using “quantitative measures (percent matches), qualitative measures (average utility score and stable matches) and composite measures” (Ho and Low 2002, 81). The results suggest that the LP method has better performance than the DA algorithm in percent matches and when the measures are “combined into equally weighted composite scores.” There is no difference in average utility between them. The only advantage of DA over LP is reaching stable matches (Ho and Low 2002, 81–82).

2. Assignment of Employee to Workplaces under Consideration of Employee Competences and Preferences

In their research paper, Peters and Zelewski (2007, 84–99) develop a model for the assignment of employees to workplaces under consideration of employee competences and preferences. Peters and Zelewski (2007, 85) define competence as “the ability of an employee to utilize his or her knowledge to achieve a predefined goal, such as an effective and efficient execution of a task.” This is a broad definition that encompasses all variables under the ability dimension, as explained in the previous chapter. Although their research and this thesis are different in scope, both have the same theoretical background.

> Non-fulfillment of competence requirements as well as assignment contrary to employee preference may easily lead to employee demotivation. Firstly, workplace assignment based upon individual competences enables the employee to select the appropriate activities to perform the tasks. As a result, they are able to complete their tasks more easily. Secondly, the consideration of competence preferences leads to higher motivation since employees are normally more motivated to complete tasks related to their interests and abilities. (Peters and Zelewski 2007, 85)

The model chosen by Peters and Zelewski (2007, 84–99) uses goal programming (GP), which allows the existence of multiple objective functions (Balakrishnan, Render, and Stair 2013, 230). In GP models, the first step is setting a desired target for each objective, which is viewed as a goal. After that, the goals are weighted or ranked according to the level of importance: "With GP we try to minimize deviations between the specified goals and what we can actually achieve for the multiple objective functions within the given constraints" (Ibid., 231).

Peters and Zelewski (2007, 84–99) propose two models using the same set of three different objectives. In one model, the objectives are ranked, and the problem solved according to the sequence of priorities; in the other, they are given the same priority and considered simultaneously in an aggregated objective function. The objective function is set up to minimize the sum of weighted discrepancies.

> These discrepancies are firstly caused by the weighted deviations between competence levels required for a workplace and the actual competence levels of the employees, secondly caused by the deviations between the importance of competences to a workplace and the employees' preferences regarding the competences, as well as thirdly caused by weighted deviations between the actual workplace attributes and the employees' preferred values of the workplace attributes. (Peters and Zelewski 2007, 96–97)

Peters and Zelewski (2007, 97) explain that both models have some deficiency for practical application: they rely on a significant amount of input data; these data may not be updated regularly and some may be fuzzy. Balakrishnan, Render, and Stair (2013, 234) point out two drawbacks for the weighted goals approach: first, all goals must be measured in the same unit; second, "it is not always easy to assign suitable weights for the different deviation variables."

3. Optimizing Marine Security Guard Assignments

In his master's thesis, Enoka (2011) proposes a network flow model to assign Marine security guards to embassy detachments. The model deals with multiple demands between different sources and aims to balance the guards' experiences across all facilities. Experience is classified in four levels according to the number of tours of duty the Marine accomplished as a security guard.

The model handles many attributes, among those, the individual's preference. The Marines express their preferences for duty stations by ranking three detachments and two regions of choice, but their preferences are only taken into consideration after other priorities have been satisfied (Enoka 2011, 10).

To optimize the assignments based on different attributes, the model relies on a multitude of weights, which adds subjectivity to the algorithm. These weights can be changed at the user's discretion. Enoka (2011, 39) states that the model enables the Marine Corps to "adjust attribute weights based on guidance from the Commanding Officer." The algorithm "allows the user to exercise a degree of control over the assignment process by setting weights to emphasize or deemphasize particular attributes." The model even "allows the user to force or forbid assignments" (Ibid., 15).

Besides the arbitrary weight for each attribute, the model assigns equally arbitrary penalties between 0 and 1 for each Marine-billet pair. "If the pair results in a penalty, the penalty is multiplied by the weight of the violated attribute" (Enoka 2011, 39).

After running the model with four different sets of weights and comparing the results with actual assignments, Enoka (2011, 58) concludes that the model provides “solutions that result in a higher overall satisfaction level than manually generated assignments.” Moreover, “these results demonstrate that it is possible to satisfy many [Marines’] preferences without sacrificing solution quality with regard to other [attributes]” (Enoka 2011, 57–58). However, Enoka (2011) does not comment that each set of weights used in his analysis produces a different outcome, nor does he provide any recommendation about how to tackle the subjectivity behind this comprehensive model.

4. Equitably Distributing Quality of Marine Security Guards Using Integer Programming

In his master’s thesis, Sabado (2013) develops a model to equitably distribute the quality of Marine security guards among diplomatic facilities. “The definition of Quality (Q) is flexible in that it is based on a decision-maker’s preference and can be a function of multiple categories or a single one.” In the proposed model, quality is a function of recommendation, rank, experience, and performance rating. “The model uses a value-based hierarchy measurement scale that places weights on specific attributes for individuals to quantify the quality of each Marine” (Sabado 2013, 13).

The objective function is set up to distribute quality uniformly among all nine regions by minimizing the sum of squared differences. Since this function is not linear, the algorithm is a nonlinear programming (NLP) model. Balakrishnan, Render, and Stair (2013, 242) assert that, in practice, NLP models are difficult to solve and become even more difficult as the number of decision variables increases. The optimal solution to an NPL model does not need to be at the corner point of the feasible region. Depending on where the search process starts, it can terminate at either a global or a local optimal solution (Balakrishnan, Render, and Stair 2013, 242).

Sabado (2013, 25) tests four variations of the same model and concludes that “the four models are limited due to the subjectivity involved in quantifying the value of each category and weighted attribute.” The best way to quantify the individual quality is to use cardinal numbers in a value hierarchy scale, as both coefficients and weighted attributes. However, each model uses the preferences of decision-makers as ordinal instead of cardinal numbers (Sabado 2013, 25).

> Ordinal numbers were used because of the difficulty in using an accurate value to place on categories such as Recommendation. For example, in reality, if a decision-maker gives an individual a Recommendation value of 4 and a Rank value of 2, a statement can only be made that the decision-maker places a higher value on the recommendation … than on the rank of the individual. We cannot make the conclusion that the recommendation … should be given twice as much value as rank. However, regardless of the type of mathematical programming software used, all values are treated as cardinal numbers. Therefore, in the previous example, recommendation is treated as having twice as much value as rank. (Sabado 2013, 25)

In his recommendations, Sabado (2013, 45) states that this model does not take into consideration several other possible criteria for assignment, such as individual preference, and finishes by saying that his “model provides results based on a set of established criteria.”

C. LESSONS FOR THE BRAZILIAN AIR FORCE

Linear programming is a technique that solves the assignment problem with an optimal solution. However, the efficacy of the model depends on its setup, as inferred from the review of previous studies.

Ho and Low (2002) compare LP with DA and conclude that the only advantage of DA is reaching stable matches. Even though DA has been used in assignments, this technique does not apply to the Brazilian Air Force, because it just matches free preferences between supply and demand for labor. The use of DA would hide not only the diversity of criteria among ODGSA, but also the waste of human capital in the assignment process.

Peters and Zelewski (2007) argue that the practical utility of models that require a significant amount of weighted input data is doubtful. These data may not be updated regularly and some may be fuzzy. It is not always easy to assign weights for different variables. The goals should also be measured in the same unit.

Enoka (2011) suggests that LP techniques can leverage the assignment process to a higher level of overall satisfaction, and states that it is possible to satisfy individual preferences without sacrificing other attributes. However, no comment is made about the subjectivity of assigning weights and penalties.

The review from Sabado (2013) shows that the use of many weighted variables should be avoided since it increases the subjectivity of the solution. If possible, the model should not be an NLP, because it may reach solutions not optimal for the entire assignment.

Therefore, the development of a mathematical model for the Brazilian Air Force should consider equations with simple formulations that do not require the assignment of arbitrary weights to its variables so that LP techniques can be successfully applied to find the optimal solution.

THIS PAGE INTENTIONALLY LEFT BLANK

V. PROPOSED MODEL

A. NEW ARCHITECTURE FOR THE ASSIGNMENT PROCESS

The proposed model does not encompass all factors addressed in the assignment process. Any attempt to do so might lead to the subjectivity of using many weighted variables. Instead, the model is considered a component of the assignment process architecture, which must be redesigned to absorb the features not included in the individual performance equation. The new assignment process has four sub-processes: officer distribution, job placement, job selection, and officer assignment.

The first sub-process is the officer distribution. Officers who demand a permanent change of station for mandatory or voluntary reasons make a request through the SIGPES. After approval, these officers are considered in transit, which changes the status of their current positions from occupied to vacant. The total inventory of officers in transit is distributed by the COMGEP, considering the new TLP/TEP ratio of each ODGSA after subtracting those officers.

The second is the job placement. With the information of how many officers, discriminated by rank and specialty, each ODGSA is entitled to receive, the ODGSA selects the positions it wants to fill and posts the available jobs in the SIGPES. Each job is described as related to a different mix of desired areas of experience. For example, the chief of logistics in an air base may be expected to have experience in logistics and air operations, while the same position in a headquarter may require experience in logistics and finance. These areas of specialization must be previously standardized by the Brazilian Air Force.

The third sub-process is the job selection. Each officer in transit accesses the SIGPES and selects 10 jobs in decreasing order of preference. Since the assignment process in the Brazilian Air Force is executed separately for each community and for each rank, the only relevant variables not addressed by the process are experience and preference, as explained in Chapter III. Regarding the experience, the SIGPES already stores information about previous jobs, although it does not classify them in areas of specialization. After this new capability has been implemented, the system will be able to convert the time spent in each job into the amount of experience for each area of specialization. In this case, when the officer selects a specific job, the SIGPES adds up the number of years of experience in the areas recommended for that job and divides it by the amount of experience presented by the officer in transit that best fits the job. It generates a relative coefficient of fitness for each officer in each job, which is used as the unit of measure for experience. In relation to the measure of preference, a weight is attributed to each position in the sequence of choices.

The fourth and last sub-process is the officer assignment, which is the result of the application of the mathematical model that uses LP techniques to optimize the person-job fit, taking the individual preferences into consideration.

B. MATHEMATICAL MODEL

The current algorithm used by the Brazilian Air Force is an assignment model by which many officers (employees) are assigned to each ODGSA (employers). The objective is to maximize the sum of weighted preferences between both groups. Besides not capitalizing on the officer's experience, the model does not ensure that the officer will have the desired job. Person-job fit and individual preferences for specific jobs are handled at the discretion of the ODGSA and are not controlled by the model. The only certainty is that the officer has a good possibility of living in the location he wants, because each employer accepts many employees.

On the other hand, the proposed model deals with the assignment of one officer to each available job and aims to maximize job performance, which is used as a proxy for the interaction of person-job fit and individual preferences. It also gives the officer the opportunity to prioritize the location, if he wishes, since he can select all available jobs in the same work station.

1. Variables

The model is based on the individual performance equation and has the following variables:

$i =$ officer

$j =$ assigned job

$k =$ current job

$A_{ij} =$ relative level of experience B_{ij} in comparison to C_j

$B_{ij} =$ years of experience of officer i in areas correlated with job j

$C_j =$ largest amount of years of experience in areas correlated with job j among all officers in transit

$E_{ij} =$ weight attributed to rank R_{ij}

$P_{ij} =$ performance of officer i in job j

$R_{ij} =$ rank of preference of officer i for job j, enumerated from 1 to 10 in decreasing order of priority

$X_{ij} =$ assignment of officer i to job j

$Z =$ objective function to be maximized

2. Coefficient of Performance

The coefficient of performance is the result of the individual performance equation for officer i assigned to job j, calculated as follows:

$$A_{ij} = \frac{B_{ij}}{C_j} \quad (1)$$

$$E_{ij} = \frac{11 - R_{ij}}{10}, \text{ if } R_{ij} \leq 10, \text{ otherwise } E_{ij} = 0.001 \quad (2)$$

$$P_{ij} = A_{ij} \times E_{ij} \quad (3)$$

Equation 1 ensures that A_{ij} will have a maximum value of 1. The same occurs with Equation 2 in respect to E_{ij}. It means that both ability (experience) and effort (preference) have the same importance in estimating officer's performance in Equation 3. This setup is important because it removes any bias from the model that uses P_{ij} as the coefficient to be optimized.

Equation 2 is a linear function and generates values for E_{ij} that are equally spaced across the rank of preferences. It is supposed to represent the level of satisfaction for each job, which may not hold true for every person. However, it makes the algorithm strategy-resistant. Since the model aims to maximize performance, if the officers had the discretion to attribute weights according to their perception of utility, someone could game the algorithm by assigning a low value for all options except for the first. When the algorithm tries to optimize P_{ij}, it will be forced to assign the person to his first choice to avoid low values of performance generated by any other option.

Another remark is that E_{ij} is restricted to the minimum value of 0.001, which is 100 times smaller than the 10th option. This variable is not allowed to reach the value of zero, because jobs situated beyond the 10th option are not necessarily rejected by the officer. It just indicates that these jobs are not ranked in the top 10. Moreover, attributing the value of zero would reduce P_{ij} to zero, which would make the algorithm lose the information about experience and not find the optimal solution.

3. Objective Function

$$Z = \sum_{i=1}^{n} \sum_{i=1}^{n} P_{ij} \times X_{ij} \tag{4}$$

The objective function (Equation 4) is a linear equation that maximizes the sum of the estimated performances for all officers in all jobs.

4. Constraints

$$\sum_{j=1}^{n} X_{ij} = 1, \ \forall i \in \{1,...,n\} \tag{5}$$

$$\sum_{i=1}^{n} X_{ij} = 1, \ \forall j \in \{1,...,n\} \tag{6}$$

$$X_{ij} = 0 \text{ , if } j = k, \ \forall i, j, k \in \{1,...,n\} \tag{7}$$

$$X_{ij} \in \{0,1\} \tag{8}$$

The constraints are defined by four equations. Each officer must be assigned to only one job (Equation 5). Each job must receive only one officer (Equation 6). Assigned and current jobs must be different (Equation 7). Assignments must be integer numbers (binary), assuming the value of 1 if officer i is assigned to job j; 0 otherwise (Equation 8).

C. EVALUATION

The model is evaluated by analyzing the results obtained through simulation in three different scenarios. The simulation uses Microsoft Excel 2010 with OpenSolver, which is an add-in that extends Excel's built-in Solver with a more powerful linear programming tool.

The objective is to assign 100 officers to 100 jobs. The initial setup considers a uniform distribution of officer's experiences across jobs, with each officer occupying a different position at the beginning of each round. Each simulation starts with two independent tables of random numbers, one for ability and the other for effort, which are transformed according to the specificity of the scenario and then multiplied to generate the coefficient P_{ij} used in the objective function.

Although the value for ability is random, the average of the initial level of person-job fit (A_{ij}) is slightly greater than 50%, because A_{ij} is a proportion of a random number in relation to the highest one that is observed in each job.

Consequently, each job will always have a value for A_{ij} equal to 1, which makes its average greater than 50%.

Two indicators are used to compare the change in satisfaction of commands and officers across scenarios. The overall level of person-job fit, measured by the total amount of recommended experience correlated with the assigned jobs, is adopted as a reference for estimating the command's satisfaction. Although the degree of person-job fit may also affect officer's motivation, the assignment of jobs according to officer's preference is a better indicator of their satisfaction, since it includes both professional and personal interests. Therefore, the distribution of officers along the rank of preferences is adopted as the second indicator. Their satisfaction is measured by the weighted average of E_{ij} in relation to the quantity of officers assigned to each rank.

The evaluation of the model is based on data collected from 50 runs performed in each scenario. After validation in the 95% confidence interval, the results are analyzed using descriptive statistics.

1. Scenario 1

In the first scenario, each officer selects and ranks 10 jobs randomly, regardless of his relative level of experience. It simulates the case in which the officer is not driven by professional interests. For example, he may choose only jobs available in one specific location to enhance his quality of life.

The results indicate that, even though the officer may not be concerned with his career, the level of person-job fit increases to 77% in relation to the initial setup, as shown in Figure 11. Contrary to intuition, the officer is not penalized by the increase in person-job fit, since his level of satisfaction is 80.4%, even greater than the commands' satisfaction (77%). As shown in Figure 12, he has an aggregated probability of 52.8% of being assigned to one of the first two options and 1.9% of not being assigned to any of the selected jobs.

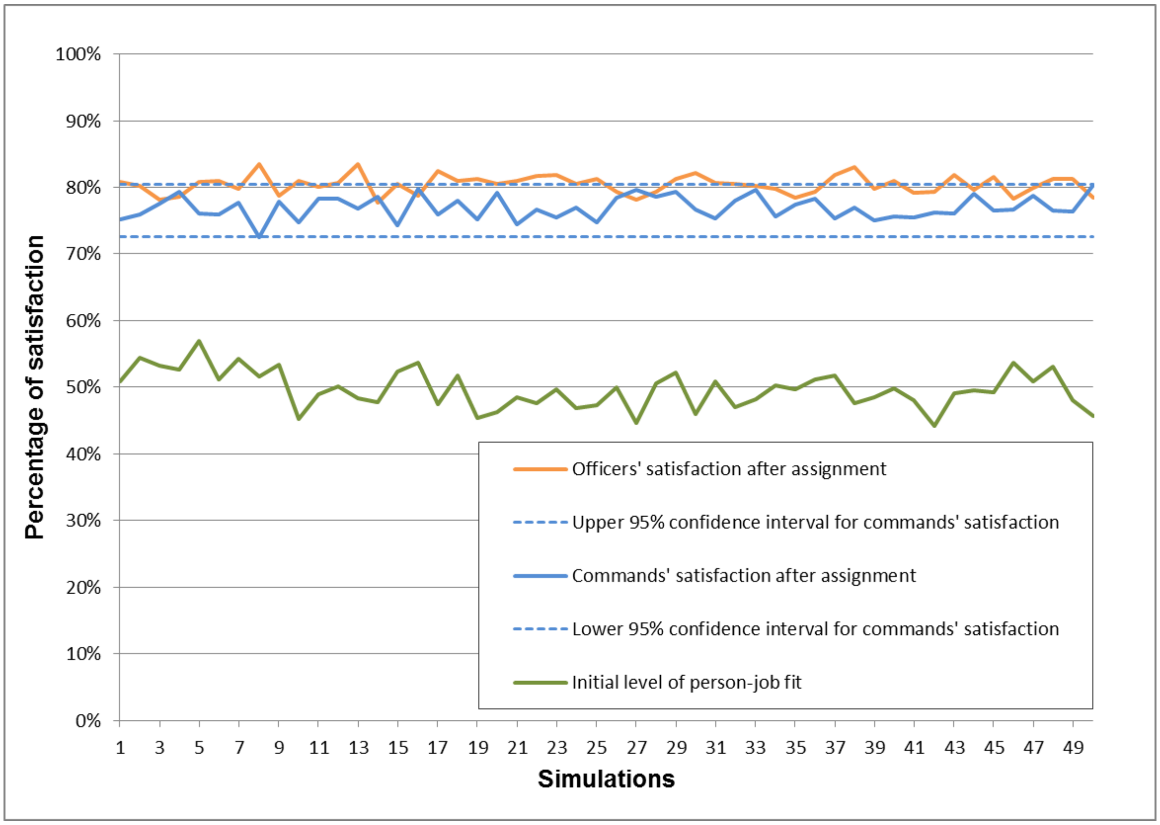

Figure 11. Level of satisfaction in Scenario 1

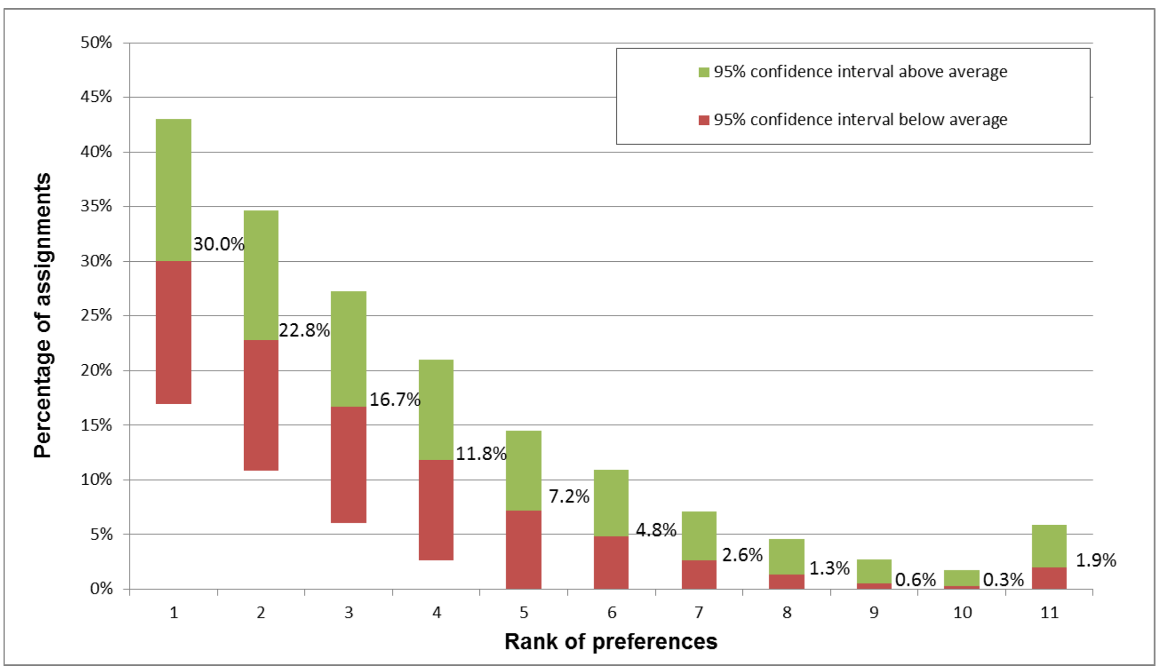

Figure 12. Assignments in Scenario 1

2. Scenario 2

In the second scenario, the officer searches for equilibrium between personal and professional interests. He discards all jobs in which he has a relative level of experience not greater than 50% and then selects and ranks 10 jobs randomly from the remaining options.

The results indicate that the level of person-job fit after assignment increases to 84.2% in relation to the initial setup, as shown in Figure 13. Again, the officer is not penalized by the increase in person-job fit. Instead, his level of satisfaction is 88%, still greater than commands' satisfaction (84.2%). In this scenario, he has an aggregated probability of 68% of being assigned to one of the first two options and only 0.2% of not being assigned to any of the selected jobs, as shown in Figure 14.

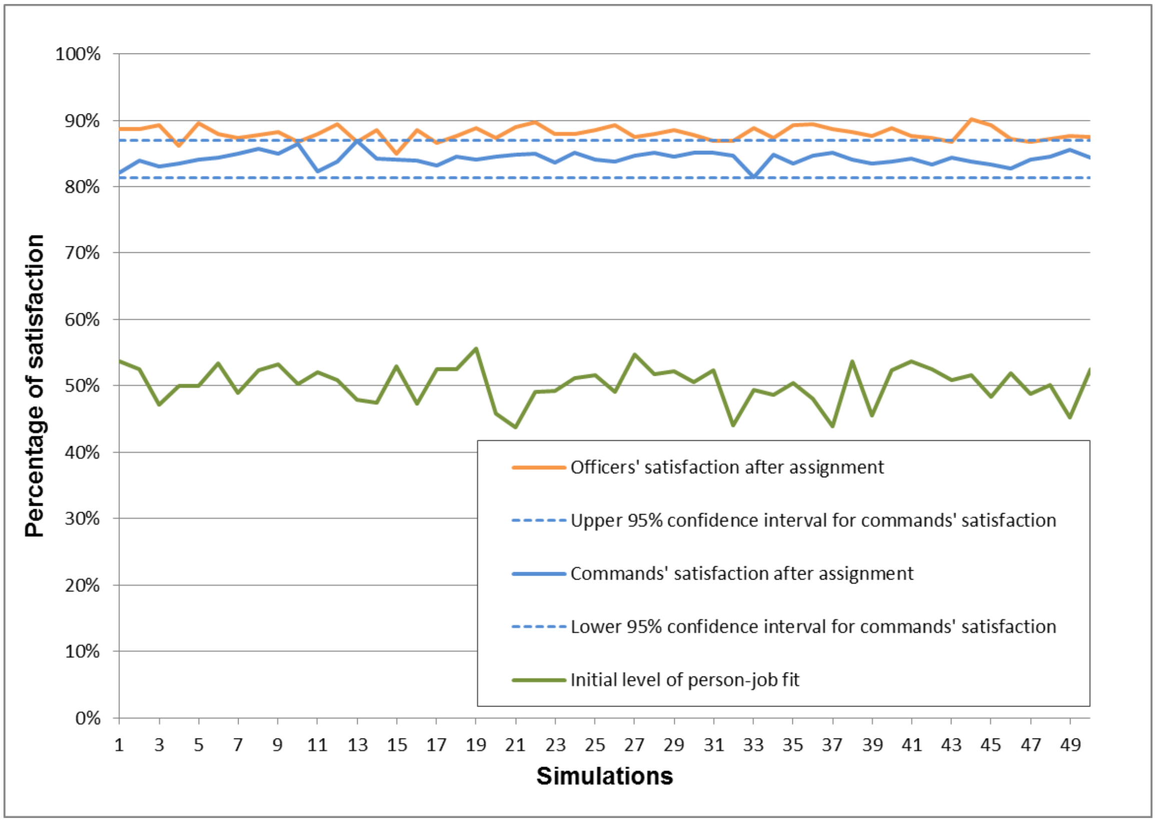

Figure 13. Level of satisfaction in Scenario 2

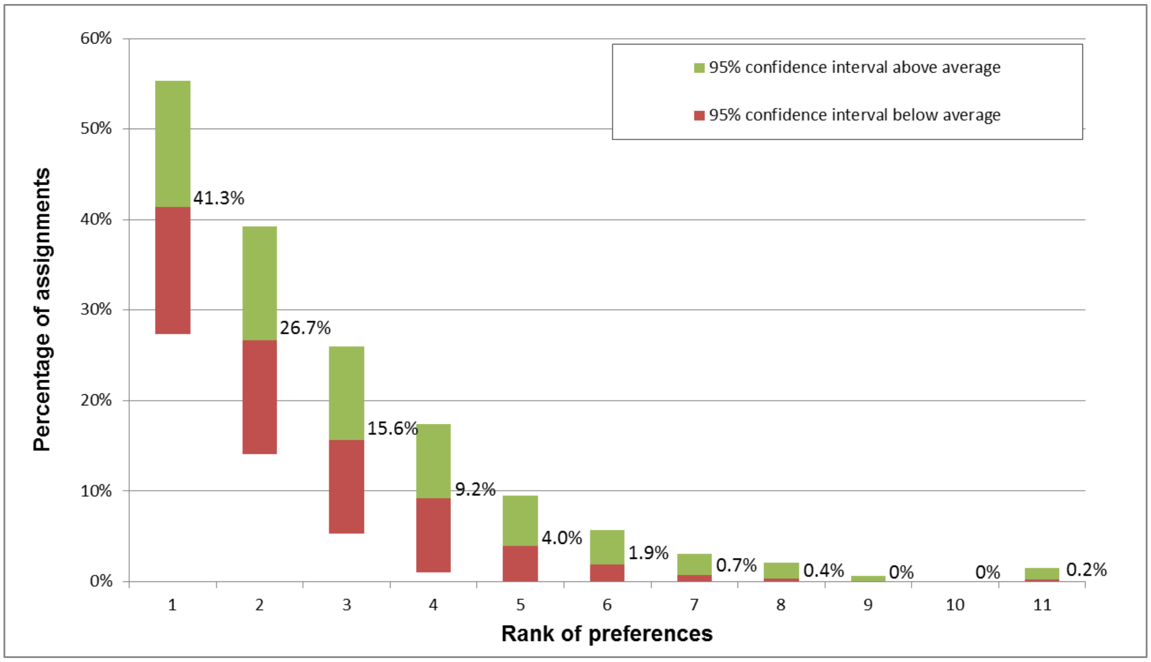

Figure 14. Assignments in Scenario 2

3. Scenario 3

In the third scenario, the officer is driven by professional interests. He selects the 10 jobs in which he has the highest relative level of experience and ranks them randomly according to personal preferences.

The results indicate that the level of person-job fit after assignment increases to 96% in relation to the initial setup, as shown in Figure 15. In this scenario, the overall commands' satisfaction reaches the highest level (96%), greater than the officer's satisfaction, which is 91.9%. The officer has an aggregated probability of 79.2% of being assigned to one of the first two options, as shown in Figure 16, and the chance of being assigned to a job not chosen is reduced to 0%.

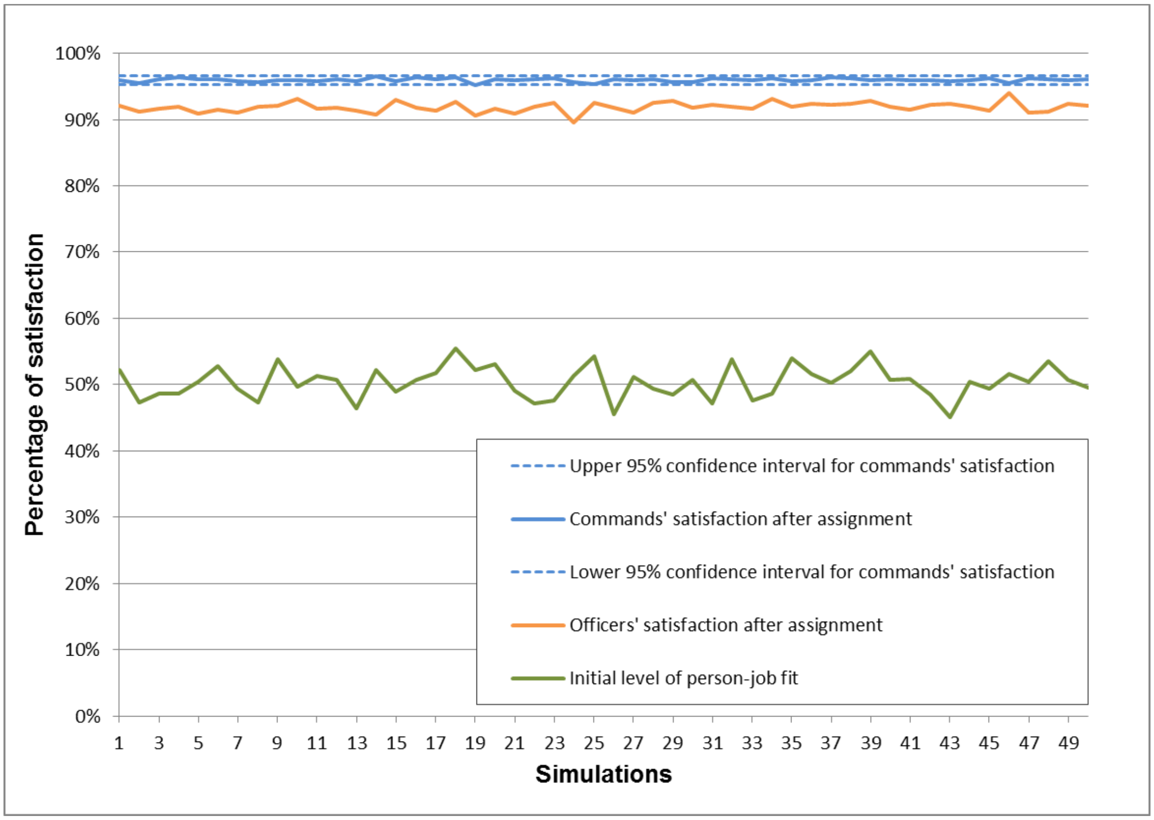

Figure 15. Level of satisfaction in Scenario 3

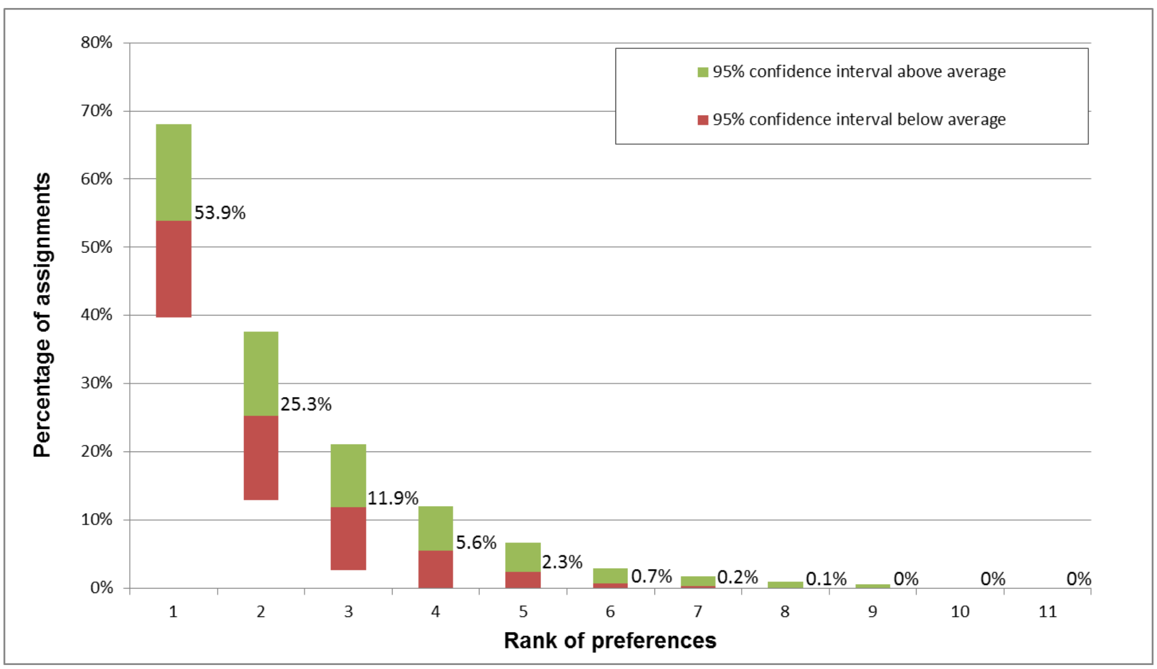

Figure 16. Assignments in Scenario 3

D. ANALYSIS

The analysis of the model shows that the level of satisfaction among commands and officers changes in the same direction (Figure 17), suggesting the feasibility of an assignment process without trade-offs between the parties. In all three scenarios, the overall level of person-job fit increases in relation to the initial setup, which enhances the commands' satisfaction. At the same time, the officers have their preferences taken into consideration, which boosts their motivation.

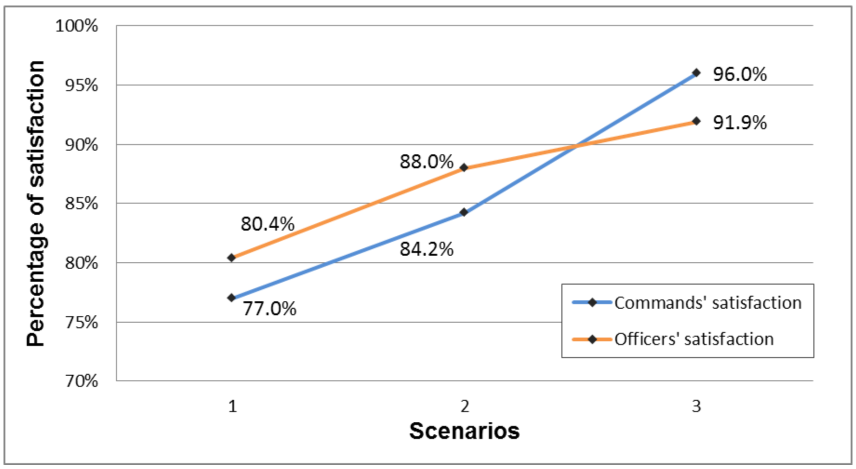

Figure 17. Analysis of satisfaction across scenarios

The model has some resemblance to the labor market dynamic. If the officer selects jobs in which he has relatively low levels of experience, he increases the probability of losing the competition to other officers that may better fit the jobs. This behavior reduces the chance of being assigned to the most preferred jobs, as observed in the first scenario. If he wants to enhance his quality of life, he should select jobs for which he has a significant level of relative experience among those available in the locations where he can satisfy his personal interests, as implied in the second scenario. However, if the officer is more concerned with his career, he should choose jobs in which he has the greatest level of person-job fit among all officers in transit, as presented in the third scenario, so that he can win the competition for the most preferable jobs and take advantage of the previous experience to enhance his job performance. In all three scenarios, the officer is the unique player, which makes him responsible for his own satisfaction. The only trade-off is between personal and professional interests.

The similarity with the labor market makes the model strategy-resistant. If the officer tries to game the algorithm by hiding his previous experience and selecting jobs in which he has relatively low levels of person-job fit, the probability of getting the desired job decreases. The smartest strategy is narrowing down the options with respect to the amount of experience in each area of specialization, which increases not only the probability of getting a more preferable job, but also the quality of officers received by the commands.

As a consequence, the model is self-reinforcing. Each time the officer is assigned to a job, he enlarges his experience in some specific areas, which makes him more competitive to be chosen for jobs related to those areas. After some assignments, the officer will acquire a natural specialization without the intervention of a career manager.

VI. SUMMARY, CONCLUSION, AND RECOMMENDATIONS

A. SUMMARY

The Brazilian Air Force faces a dilemma with aviators at senior ranks. The need to specialize them slows down under the organizational culture, which places the aviators in the position of being the sole community able to lead the Air Force. As a consequence, aviators outnumber any other specialty within the Air Force and occupy a great variety of jobs in different areas, even though they acquire the same body of knowledge from the Air Force Academy.

Instead of suggesting the creation of formal subspecialties or a reduction of the aviator rate in the officer community, this thesis used the assignment process to go around the organizational culture and proposed a model that could increase the performance of those officers with minor changes to the current modus operandi. However, the assignment process has its own dilemma: how should individual preferences and organizational needs be balanced in the assignment process in order to maximize officers' performance in the Brazilian Air Force? Solving it became the primary research question.

The research started with a comprehensive literature review. First, the officer assignment processes in the Brazilian Air Force and U.S. Navy were studied for comparison. The findings indicated that the U.S. Navy has a less subjective process in which job requirements—and not commands' preferences, as used in the Brazilian Air Force—are matched to officer's preferences. However, the number of variables is too large for a single model.

To decrease the number of variables, the second review searched for the performance drivers that are relevant to the assignment process. Based on work performance theories and Brazilian Air Force peculiarities, the variables were reduced to only two: job experience, as a driver for ability, and officer's preferences, as a proxy for effort invested in the job.

The last literature review studied the decision modeling techniques applied to the assignment process. Linear programming seems to be the best choice for the proposed model, because it provides an optimal answer for the problem. However, to decrease the subjectivity of the solution, the equations should be simple enough to not require the assignment of arbitrary weights to its variables.

The simplicity of the model formulation required the redesign of the assignment process, using information technology as applied by the U.S. Navy, so that the process could absorb other features not included in the individual performance equation. The analysis of the results, obtained through simulation, suggested that it is possible to have an assignment process without trade-offs between commands and officers. The model makes the satisfaction of commands and officers change in the same direction. Furthermore, the model is self-reinforcing. Each time the officer is assigned to a job, his experience in some areas of specialization increases, which increases the possibility of getting a similar job in the next assignment. Finally, after some assignments, the officer will acquire a natural specialization and will be considered a key player, instead of just a number in the assignment process.

B. CONCLUSION

This thesis had the purpose of creating an algorithm to be used in the assignment process of senior officers without specialization, as it occurs among aviators in the Brazilian Air Force, so that job performance can be maximized.

(1) Primary Question

How should individual preferences and organizational needs be balanced during the assignment process in order to maximize senior officers' performance in the Brazilian Air Force?

The main point is to reduce the subjectivity of the assignment process by replacing the ODGSA's preferences with recommended experience. Since the assignment process is executed for each rank and specialty, and the aviators share the same background, job experience is the best proxy for person-job fit. On the other hand, officers should continue to state their preferences in this process, because the preferences are indicators of motivation, which translates to commitment to the job. Since both experience and preference are equally important factors that affect performance, these variables should receive the same treatment in the assignment process, without the use of arbitrary weights. The remaining constraints would be absorbed by the assignment process architecture, as proposed in this thesis. The analysis of simulations using the proposed algorithm suggests that it is possible to increase the satisfaction of commands and officers at the same time.

(2) Secondary Questions

Which performance drivers are relevant for the assignment process?

The performance drivers are classified in three dimensions: ability, effort, and support. The latter can be discarded in the assignment process, because physical support is constant for any officer assigned to the same position, and social support is already considered by the officers' preferences. The individual preference summarizes a complex system of factors that drive motivation and is an easy way to predict the effort invested in the job. The ability dimension has some important variables for the assignment process, but the homogeneity of the officer community and the modus operandi in the Brazilian Air Force turn job experience into the only relevant proxy for ability. For the Brazilian Air Force, the performance drivers can be narrowed down to experience and preference.

Which decision modeling techniques are applicable in the assignment process?

Linear programming, especially network flow models, has been used successfully to solve the assignment problem. However, the model setup affects the solution. Trying to build a model with multiple variables, researchers have faced the subjectivity of assigning arbitrary weights to different attributes, which bias the solution toward the user's beliefs. It seems that there is a trade-off between the comprehensiveness of the model and its fidelity to human resources management theories. In the Brazilian Air Force, the introduction of more subjectivity by using a model that embraces many variables may worsen the solution instead of optimizing it. For this reason, the proposed algorithm stands out for its simplicity and leaves the assignment process architecture in charge of the secondary variables.

C. RECOMMENDATIONS

(1) Recommendations for the Brazilian Air Force

The Brazilian Air Force should consider balancing the satisfaction of commands and senior officers by reformulating the assignment process with a new architecture and a new algorithm. Since the validation of the proposed model was conducted without comparison with real data, its implementation requires a pilot test, so that the algorithm can be adjusted beforehand to any unforeseen circumstances.

(2) Recommendations for Further Research

The characteristics of the Brazilian Air Force may reduce the portability of the proposed model to other services around the world. However, the theoretical background of this research seems to be universal, which encourages future studies of the same topic. The individual performance equation can be expanded with other variables, and the analysis of the results compared with those reported in this thesis. If available, real data can be used to measure the strength of the model in relation to the assignment process in any country.

LIST OF REFERENCES

Balakrishnan, Nagraj, Barry Render, and Ralph M. Stair. 2013. *Managerial Decision Modeling*. 3rd ed. Upper Saddle River, NJ: Pearson.

Bandura, Albert. 1977. *Social Learning Theory*. Englewood Cliffs, NJ: Prentice-Hall.

Black, Gene. 2014. "Surface Warfare Officer Community Brief." http://www.public.navy.mil/bupers-npc/officer/Detailing/surfacewarfare/Pages/default.aspx.

Blumberg, Melvin, and Charles D. Pringle. 1982. "The Missing Opportunity in Organizational Research: Some Implications for a Theory of Work Performance." *The Academy of Management Review* 7(4): 560–69.

Builder, Carl H. 1989. *The Masks of War: American Military Styles in Strategy and Analysis*. Baltimore, MD: Johns Hopkins University Press.

BUPERS Business Transformation Office. 2012. "Release Training: Career Management System/ Interactive Detailing." http://www.public.navy.mil/bupers-npc/enlisted/cmsid/Pages/default2.aspx.

Bureau of Naval Personnel. 2003a. *Naval Military Personnel Manual* (MILPERSMAN 1301–100). Millington, TN: Department of the Navy.

———. 2003b. *Naval Military Personnel Manual* (MILPERSMAN 1301-102). Millington, TN: Department of the Navy.

Butler, Virginia L., and Valerie A. Molina. 2002. "Characterizing Sailor and Command Enlisted Placement and Assignment Preferences." Master's thesis, Naval Postgraduate School.

Centro de Comunicação Social da Aeronáutica. 2014. "Organograma da Força Aérea Brasileira." Brasília, DF: Comando da Aeronáutica. http://www.fab.mil.br/organograma.

Comando da Aeronáutica. 2014. "PCA 30–1: Plano de Pessoal da Aeronáutica." Brasília, DF: Comando da Aeronáutica.

Comando-Geral do Pessoal. 2012a. "ICA 30–4: Movimentação de Pessoal Militar." Brasília, DF: Comando da Aeronáutica.

———. 2012b. "MCA 36–7: Perfil Profissional dos Oficiais da Aeronáutica." Brasília, DF: Comando da Aeronáutica.

———. 2013. “NPA 49/DPM: Movimentação por Escolha de Oficiais Superiores.” Brasília, DF: Comando da Aeronáutica.

Dokko, Gina, Steffanie L. Wilk, and Nancy P. Rothbard. 2009. “Unpacking Prior Experience: How Career History Affects Job Performance.” *Organization Science* 20(1): 51–68.

Enoka, Maro D. 2011. “Optimizing Marine Security Guard Assignments.” Master’s thesis, Naval Postgraduate School.

Hatch, William. 2013. “Department of Defense Human Resource Management.” Presentation at the *Seminar in Manpower, Personnel and Training I*, Monterey, California, October 4–December 6.

Ho, Joshua H., and Eng Hwee Low. 2002. “Two-Sided Matching for the U.S. Navy’s Enlisted Detailing Process: A Comparison of Deferred Acceptance and Linear Programming via Simulation.” Master’s thesis, Naval Postgraduate School.

Mathis, Robert L., John H. Jackson, and Sean R. Valentine. 2014. *Human Resourses Management*. 14th ed. Stamford, CT: Cengage Learning.

McDaniel, Michael A., Frank L. Schmidt, and John E. Hunter. 1988. “Job Experience Correlates of Job Performance.” *Journal of Applied Psychology* 73(2): 327–30.

McEnrue, Mary P. 1988. “Length of Experience and the Performance of Managers in the Establishment Phase of Their Careers.” *Academy of Management Journal* 31(1): 175–84.

OPNAV N16 Fleet Introduction Team. 2011. “CMS-ID Essentials.” http://www.public.navy.mil/bupers-npc/enlisted/cmsid/Pages/default2.aspx.

Peters, Malte L., and Stephan Zelewski. 2007. “Assignment of Employees to Workplaces under Consideration of Employee Competences and Preferences.” *Management Research News* 30(2): 84–99.

Presidente da República Federativa do Brasil. 2014. “Decreto No 8.209, de 21 de Março de 2014.” Brasília, DF: Imprensa Nacional.

Quiñones, Miguel A., J. Kevin Ford, and Mark S. Teachout. 1995. “The Relationship between Work Experience and Job Performance: A Conceptual and Meta-Analytic Review.” *Personnel Psychology* 48(4): 887–910.

Robbins, Stephen P., and Timothy A. Judge. 2012. *Essentials of Organizational Behavior*. 11th ed. Upper Saddle River, NJ: Pearson.

Sabado, Jonathan Y. 2013. “Equitably Distributing Quality of Marine Security Guards Using Integer Programming.” Master’s thesis, Naval Postgraduate School.

Schermerhorn, John R. 1993. *Management for Productivity*. 4th ed. Wiley Series in Management. New York, NY: John Wiley & Sons.

Schermerhorn, John R., William L. Gardner, and Thomas N. Martin. 1990. “Management Dialogues: Turning on the Marginal Performer.” *Organizational Dynamics* 18(4): 47–59.

Schmidt, Frank L., John E. Hunter, and Alice N. Outerbridge. 1986. “Impact of Job Experience and Ability on Job Knowlegde, Work Sample Performance, and Supervisory Ratings of Job Performance.” *Journal of Applied Psychology* 71(3): 432–39.

THIS PAGE INTENTIONALLY LEFT BLANK

INITIAL DISTRIBUTION LIST

1. Defense Technical Information Center
   Ft. Belvoir, Virginia

2. Dudley Knox Library
   Naval Postgraduate School
   Monterey, California