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MARINE CORPS MILITARY OCCUPATIONAL SPECIALTY (MOS) ASSIGNMENTS: CAREER IMPACTS OF MATCH QUALITY

by

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As the Marine Corps confronts a battlefield of increasing scale, complexity, and fluidity, it must leverage every opportunity to optimize performance and lethality. To this end, General David H. Berger, Commandant of the Marine Corps, has prioritized the improvement of talent management practices. However, one concept within talent management, match quality, remains largely overlooked and unexplored.

This research explores whether the same economic and social benefits of match quality suggested in the literature also apply in the Marine Corps. As such, this thesis uses regression analysis to determine the statistical relationship between MOS preference received on career outcomes among Marine Corps officers. It also determines factors not currently considered within the Marine Corps' MOS assignment process that may be used to improve Marine Corps officer's occupational specialty match quality.

The results of this study indicate a modest, but statistically significant, relationship between MOS preference received and performance. However, MOS preference is not found to be a positive, statistically significant predictor of length of service. Still, these findings support the establishment of a system that efficiently exchanges information about the individuals and occupations in the market, reveals their true preferences, and improves match quality. This study identifies several realistic and feasible methods to improve match quality within the Marine Corps.

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MARINE CORPS MILITARY OCCUPATIONAL SPECIALTY (MOS) ASSIGNMENTS: CAREER IMPACTS OF MATCH QUALITY

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ABSTRACT

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LIST OF ACRONYMS AND ABBREVIATIONS

AI	artificial intelligence
APA	American Psychological Association
API	application programming interface
ASTB	aviation selection test battery
BRADSO	Branch of Choice Active Duty Service Obligation
CCAT	Criteria Cognitive Aptitude Test
CFT	Combat Fitness Test
COTS	commercial-off-the-shelf
DI	drill instructor
DMP	Diamond Mortensen Pissarides
DOD	Department of Defense
DON	Department of the Navy
EOD	Explosive Ordnance Disposal
FITREP	Fitness Report
GCT	General Classification Test
GMA	general mental ability
GOTS	government off the shelf
GPA	grade point average
IWC	Information Warfare Community
KSAO	knowledge, skills, abilities, other characteristic
M&RA	Manpower and Reserve Affairs
MAB-II	Multidimensional Aptitude Battery-II
MARADMIN	United States Marine Corps Administrative Message
MARSOC	United States Marine Forces, Special Operations Command
MCO	Marine Corps Order
MIDS	Midshipmen Information System
MMPI	Minnesota Multiphasic Personality Inventory
MOS	Military Occupational Specialty
MP	Manpower Plans and Policy
MRO	Marine Reported On

NEO PI-R	Neuroticism, Extraversion, Openness to experience Personality Inventory-Revised
NFIB	National Federation of Independent Business
NSW	Naval Special Warfare
OEMA	Office of Economic Manpower Analysis
OCC	Officer Candidate Course
OCS	Officer Candidate School
PARS	performance-anchored rating scale
PLC	Platoon Leaders Course
PES	Marine Corps Performance Evaluation System
PFT	Physical Fitness Test
P-J	person-job fit
P-O	person-organization fit
PROTRAMID	Professional Training for Midshipmen
P-T	person-team fit
PWS	performance work statement
RCT	randomized control trial
RO	Reviewing Officer
ROTC	Reserve Officer Training Corps
Rpt Avg	report average
RV	relative value
RS	Reporting Senior
SDT	Self-Determination Theory
SPC	Staff Platoon Commander
SWO	Surface Warfare Officer
SWO-N	Surface Warfare Officer-Nuclear
TAB	Talent Assessment Battery
TAIS	The Attentional Interpersonal Style
TBS	The Basic School
TECOM	United States Marine Corps Training and Education Command
TFDW	Total Force Data Warehouse
USMA	United States Military Academy
USNA	United States Naval Academy
VSOT	Visual Spatial Orientation Test

EXECUTIVE SUMMARY

As the Marine Corps confronts a battlefield of increasing scale, complexity, and fluidity, it must leverage every opportunity to optimize performance and lethality. While cutting edge technology and training have traditionally been employed to preserve its operational advantage, Marine Corps Commandant, General David H. Berger, has also prioritized the improvement of talent management practices (Berger, 2019). In his Commandant's Planning Guidance (2019), he explained the value of enhancing talent management practices to improve recruiting efforts, encourage high performers to stay, and to separate low performers at the earliest possible opportunity. This represents significant progress toward modernized talent management practices and will likely generate significant long-term benefits. However, one concept within talent management, match quality, remains largely overlooked and unexplored.

The term match quality is rooted in matching theory, which emerged independently from the fields of psychology and economics. Psychologists first used the term "match" in the 1940s as an indication of placement, likeness or fit, within the context of occupational assignment (Hahn, 1940). Economists began to consider matching principles in the 1960s, with the objective of achieving "optimality" between two matched agents. Match quality eventually emerged as the measure of effectiveness or value associated resulting from this newly formed match.

Despite their independent efforts to develop matching principles, vocational psychologists and economists share the same objective, which is to pair two agents (individual-individual, individual-job, individual-organization) in the most effective and beneficial manner possible. This endeavor is supported by methods of revealing the true characteristics and preferences of the individuals and organizations operating in the market, and by establishing a marketplace structure that is capable of effectively and efficiently forming a match between the two agents.

The existing body of literature validates the social and economic benefit of match quality. Research reviewed for this report indicated that those who are placed in jobs that

best align with their skills have greater job satisfaction and productivity (Spokane et al., 2000), experience less turnover (Greenberg & Greenberg, 1980; Akerlof et al., 1988; Malamud, 2009), and demonstrate higher levels of performance (Barrick and Mount, 2005). Nobel Prizes in Economic Science were awarded to Drs. Dale Mortensen, Christopher Pissarides and Peter Diamond in 2010 (Mortensen, 2011) and to Drs. Alvin Roth and Lloyd Shapley in 2012 (Roth, 2012), in recognition of their work on designing efficient matching marketplaces.

Despite these positive results and increased use of matching processes in private industry, the practice of matching has not been meaningfully implemented, nor carefully studied in the Marine Corps. Following the completion of their commissioning course, Marine Corps officers attend The Basic School in Quantico, Virginia, where they are assigned a military occupational specialty (MOS). TBS still employs an MOS assignment process that is largely based on a directive issued in 1977, is completed in less than 20 weeks, and on average, assigns approximately 50% of the graduating class of officers with their top occupational specialty preference (Everly, 2019). Intuitively, it stands to reason that TBS's current process might benefit from the matching practices presented in the vocational psychology and economic literature.

The purpose of this research was to explore whether the same economic and social benefits of match quality suggested in the literature, also apply in the Marine Corps. The thesis also determined factors, not currently considered within the Marine Corps' MOS assignment process, that may be used to improve Marine Corps officer's occupational specialty match quality.

To explore the relationship between MOS preference received and performance, multiple linear regression was employed. The results of this analysis indicated a modest, but positive, statistically significant relationship between MOS preference and performance. Other variables found to be statistically significant predictors of performance included prior enlisted service, commissioning through an enlisted to officer program, commissioning through a national service academy, gender, education level, and performance at The Basic School.

To examine the relationship between MOS preference received and length of service, multivariate logistic regression analysis was conducted. Contrary to the performance model, this regression analysis did not find MOS preference received to be a consistent, statistically significant predictor of length of service. Interestingly, the model found that an individual who is assigned their first, second, or third MOS preference, is less likely to surpass five and six years of commissioned service, respectively, by comparison to an individual who is assigned their fourth choice. Beyond seven years of commissioned service, MOS preference received did not make a statistical difference. However, given collinearity between the variables representing TBS performance, MOS preference received, and performance in the operating forces, and an inability to control for reason for departure from military service, the results of this model may not truly reveal the impact of match quality on length of service.

Most importantly, although it was a modest effect, this analysis indicated that occupational assignment mattered with regard to performance. This finding supports the establishment of a system that improves match quality by efficiently exchanging information about the individuals and occupations in the market and by revealing their true preferences.

To explore how to improve match quality, several matching and selection processes presently employed within the DOD were compared. Of the organizations reviewed, the U.S. Army's "talent-based branching" model initiated at USMA, demonstrated the most comprehensive and relatable approach. This aspect of the study demonstrated the plausibility of introducing several tools and methods to improve the current MOS assignment process, with little interruption to the existing curriculum.

In the short term, the thesis recommends the careful identification of the knowledge skills, and attributes associated with each occupation and the ability to test for these characteristics in a cost-effective manner. It was also recommended that TBS engage with private industry to identify these traits and to develop a battery of tests which can be administered and reviewed after normal working hours. The precedent to partner with private industry for this purpose has already been established at Marine Corps Recruit Depot and within MARSOC.

For the long term, the thesis recommends implementing these talent-based assessments and the MOS assignment process prior to TBS, creating a two-sided market structure to facilitate MOS community input, and establishing an efficient matching marketplace driven by a "deferred acceptance" algorithm (Roth, 2012).

The Marine Corps should not continue to confront the future operating environment with an industrial era occupational assignment model. The literature reviewed during this research, and the statistical relationship identified between MOS preference received and performance through regression analysis, indicate the potential benefit of applying match quality principles to enhance the MOS assignment practices. Match quality offers the Marine Corps a time and cost-effective method to elevate the performance of its personnel in the short term, and to enhance its human capital from accession through command selection over the long term.

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I. INTRODUCTION

> The wise selection of the business, profession, trade, or occupation to which one's life is to be devoted and the development of full efficiency in the chosen field are matters of the deepest moment to young men and to the public. These vital problems should be solved in a careful, scientific way, with due regard to each person's aptitudes, abilities, ambitions, resources, and limitations, and the relations of these elements to the conditions of success in different industries.
>
> —Frank Parsons, 1909

A. BACKGROUND

As the Marine Corps confronts a battlefield of increasing scale, complexity, and fluidity, it must leverage every opportunity to optimize performance and lethality. While cutting edge technology and training have traditionally been employed to preserve operational advantage, General David H. Berger, Commandant of the Marine Corps, has shifted this myopic approach. His *Commandant's Planning Guidance*, published in 2019, presented several refreshing and innovative concepts organized along five lines of effort: force design, warfighting, education and training, command and leadership, and core values (Berger, 2019, p. 1). Among these lines of effort, General Berger identified force design as his top priority and established meaningful guidance to revamp organizational structure, enhance naval and joint force integration, and to recruit, educate, and take care of Marines—"the centerpiece of the corps" (Berger, 2019, p. 6).

He also placed a significant emphasis on an unexpected line of effort: talent management. In doing so, General Berger called for improved maternity leave policies, a more performance-based promotion system, and to use "money like a focused weapon" to retain the most talented individuals (2019, p. 7). Overall, his planning guidance referenced "talent" 24 times; a benchmark far surpassing any previous Commandant.

General Berger's guidance represents significant progress toward the development of modern and sustainable talent management practices. However, many of the proposed measures are reactionary, focused on addressing human capital once it is in the operating forces or to prevent its departure from service. This highlights a significant gap in the need

for systems, processes, and policies that proactively optimize human capital before it enters the operating forces, rather than reactively, as an officer approaches a new job assignment or departure from service.

A more proactive approach to talent management may be found in the fields of vocational psychology and economics. Matching theory, which addresses the formation of a match between two agents (Roth, 1982), and match quality, the value or degree of fit associated with this match (Mortensen, 1978), have been practiced and researched for several decades to form the most beneficial and effective match between employee and employer. These concepts are supported by methods of revealing the true characteristics and preferences of the individuals and organizations operating in the market, and by establishing a marketplace structure that is capable of effectively and efficiently forming a match between the two agents.

The existing body of literature substantiates the value of these theories. Employees who are appropriately matched have greater job satisfaction and are more productive (Spokane et al., 2000), experience less turnover (Greenberg & Greenberg, 1980; Akerlof et al., 1988; Malamud, 2009), and demonstrate higher levels of performance (Barrick and Mount, 2005). Additionally, Nobel Prizes in Economic Science were awarded to Drs. Dale Mortensen, Christopher Pissarides and Peter Diamond in 2010 (Mortensen, 2011) and to Drs. Alvin Roth and Lloyd Shapley in 2012 (Roth, 2012), in recognition of their work on designing efficient matching marketplaces.

Private industry is also capitalizing on matching principles. A simple internet search reveals an abundance of online platforms designed to harvest and catalog personal data through innovative assessment tools and to match individuals with the optimal occupation. Advancements in machine learning techniques and artificial intelligence have only accelerated the growth of this industry. In light of this innovation, it would appear that identifying the right person for the right job has never been more prevalent, plausible, or accurate.

Despite these positive results and the increased use of matching processes in private industry, the practice of matching has not been meaningfully implemented, nor carefully

studied in the Marine Corps. Following the completion of their commissioning course, Marine Corps officers attend The Basic School (TBS) in Quantico, Virginia, where they are assigned a military occupational specialty (MOS). TBS still employs an MOS assignment process that is largely based on a directive issued in 1977 (Everly, 2019). This model is completed in less than 20 weeks and on average, assigns approximately 50% of the graduating class of officers with their first occupational specialty (Everly, 2019).

Intuitively, it stands to reason that TBS's current MOS assignment process would benefit from the same matching practices presented in the vocational psychology and economic literature. However, first it is necessary to explore whether the same economic and social benefits of match quality apply among Marine Corps Officers.

B. PURPOSE OF STUDY

The purpose of this research is to explore match quality's impact on career outcomes among Marine Corps Officers. As such, this study determines the statistical relationship between MOS preference received, and individual performance and longevity within the Marine Corps. This study also explores which factors and methods may feasibly be applied within the Marine Corps officer MOS assignment process to improve match quality. More specifically, this research addresses the following questions:

1. How does match quality, as measured by MOS preference received, impact a Marine Corps Officer's length of service and performance in the operating forces? By merging individual MOS preference rankings submitted at TBS with their actual MOS assignment and career outcome recorded in total force data warehouse (TFDW) data, multivariate regression analyses are used to study how officer performance (measured by Fitness Report [FITREP] relative value scores) and time-in-service (measured in years) are impacted by MOS preference received.

2. What individual factors, not currently considered within the Marine Corps' MOS assignment process, should be considered to improve Marine Corps officer's occupational specialty match quality? This study assesses how other military services and organizations within the Department of Defense (DOD) confront the challenge of talent assessment and occupational assignment. As a part of this investigation, this study identifies aspects of

these processes that may be feasibly introduced at TBS to enable an officer to make a more well-informed decision regarding choice of occupational specialty.

C. RESULTS

The regression to examine the effect of MOS preference received on performance, as measured by FITREP relative value, revealed a modest but positive, statistically significant relationship. This effect remained consistent even as all available control variables were added. Other variables found to be statistically significant predictors of performance included commissioning through an enlisted to officer program, commissioning through a national service academy, gender, education level, and performance at TBS.

Unlike the performance model, the regression to examine the effects of MOS preference received on length of service, did not reveal a consistent, statistically significant relationship. Contrary to the expectation, the model found that an individual who is assigned their first, second, or third MOS preference, is less likely to surpass five and six years of commissioned service, respectively, by comparison to an individual who is assigned their fourth choice. Beyond seven years of commissioned service, MOS preference did not have a statistically significant impact on length of service. Interestingly, the only variable found to be a consistent, statistically significant predictor of length of service was commissioning through a service academy. However, the impact of this variable was negative across all models.

Although the length of service regression model did not conclude positive results, this does not necessarily represent a case against match quality. Given collinearity between the variables representing TBS performance, MOS preference received, and performance in the operating forces, and an inability to control for reason for departure from military service, the results of this model may not truly reveal the impact of match quality on length of service. It should be noted that similar results of lower continuation rates among service academy graduates, and high performers writ large, prompted further research and the U.S. Army's transition from a performance-based MOS assignment model to a "talent-based" occupational assignment model (Wardynski et al., 2009; Colarusso et al., 2016).

The results of Research Question 1 indicate that improving the existing MOS assignment process's ability to generate match quality may also improve career outcomes, particularly performance. However, additional statistics and further analysis may help reveal match quality's exact impact on increasing length of service among Marine Corps officers. Exploring feasible ways in which the Marine Corps can improve the MOS assignment process, outside of performance, were identified in Research Question 2.

To determine how the Marine Corps may improve match quality in the MOS assignment process, several matching and selection processes presently employed within the DOD were compared. Of the organizations reviewed, the U.S. Army's "talent-based branching" model initiated at USMA, demonstrated the most comprehensive and relatable approach. This aspect of the study demonstrated the plausibility of introducing several tools and methods to improve the current MOS assignment process, with little interruption to the existing curriculum.

In the short term, this included the careful identification of the knowledge skills, and attributes associated with each occupation and the ability to test for these characteristics in a cost-effective manner. It was recommended that TBS engage with private industry to identify these traits and to develop a battery of tests which can be administered and reviewed after normal working hours. The precedent to partner with private industry for this purpose has already been established at Marine Corps Recruit Depot and within U.S. Marine Corps, Special Operations Command (MARSOC).

For the long term, the thesis recommends implementing these talent-based assessments and the MOS assignment process prior to TBS, creating a two-sided market structure to facilitate MOS community input, and establishing an efficient matching marketplace driven by a "deferred acceptance" algorithm (Roth, 2012).

D. OVERVIEW OF CHAPTERS

This thesis is organized into six chapters. Following the introductory chapter, Chapter II provides an overview of matching and match quality, the Marine Corps' MOS assignment process, and the Marine Corps' performance evaluation system. Chapter III reviews published research in fields of vocational psychology and economics regarding the

theory, application, process, and benefits associated with matching and match quality. Chapters IV and V address the data, methodology, and results associated with research questions 1 and 2, respectively. Finally, Chapter VI concludes this thesis and provides recommendations for future research.

II. BACKGROUND

This study determines match quality's impact on performance and length of service among Marine Corps officers. This discussion requires an understanding of match quality, to include its definition, approaches, and associated challenges. Given the use of performance data, this also requires an understanding of the process by which a Marine officer's performance is measured and evaluated.

A secondary objective of this research explores the way in which other military organizations confront the same challenge of MOS assignment. This qualitative analysis is intended to identify successful matching processes that may enhance or improve the Marine Corps' present MOS assignment process. This requires an understanding of the Marine Corps' current approach, the unique method which is utilized for assignment, and the venue which facilitates the process.

This chapter provides a foundational overview of these terms, institutions, processes, and systems. The background begins with an overview of match quality and concludes with an explanation of the Marine Corps Performance Evaluation System (PES).

A. MATCHING AND MATCH QUALITY

This section provides an overview of matching and match quality. This overview includes information regarding its origin, definition, challenges, and application.

1. Matching and Match Quality: Definition

The term *match quality* is rooted in matching theory, which emerged independently from the fields of psychology and economics. Psychologists first used the term "match," as an indication of placement, likeness or fit, within the context of occupational assignment in the 1940s (Hahn, 1940). Economists began to consider matching principles in the 1960s, to achieve "optimality" between two matched pairs. Despite their independent efforts to develop matching principles, they shared the same objective, to pair two unknown agents (individual-individual, individual-job, individual-organization) in the most effective and beneficial manner possible.

Eventually, it became necessary to measure the effectiveness or value resulting from a newly formed match and the term "match quality" emerged. Northwestern University Economist Dr. Dale T. Mortensen was the first to use the term "match quality" and to present a definition. In 1988, he stated that match quality was simply, "the joint benefit to be shared," between a pair (Mortensen, 1988, p. S224). In 2019, David Epstein offered an updated definition in his book *Range,* where he described match quality as the "term economists use to describe the degree of fit between the work someone does and who they are—their abilities and proclivities" (Epstein, 2019, p. 128).

Given the term's application in psychology and economics, match quality can be quantified in many ways, to include the increased wage, performance, satisfaction, or longevity, resulting from a newly formed match. The present study interprets match quality through a combination of Mortensen and Epstein's definitions. Within the context of this research, match quality is intended to describe the increased performance or length of service, resulting from the match formed during the MOS assignment process.

2. Matching and Match Quality: Challenge

Although psychologists and economists developed matching approaches independently, they identified the same two primary challenges. These reinforcing factors are heterogeneity and information asymmetry.

According to Browning and Carro (2007), heterogeneity is, "the dispersion in factors that are relevant and known to individual agents when making a particular decision" (p. 1). Within the context of the labor market, heterogeneity is readily apparent, as there are vast differences among worker characteristics, preferences, abilities, skills, and experiences. Similarly, there are myriad differences in organizational cultures and job characteristics. This heterogeneity presents an opportunity to assign individuals with an occupation that aligns with their unique characteristics. However, these differences also complicate the ability to form a quality match.

Given these differences in employee and employer characteristics, information asymmetry, or uncertainty, further challenges the formation of matches. A firm's true vision, strategy, and operating concept is unknown to the individual, and the individual's

true work habits and preferences are unknown to the organization. Neither the individual nor the firm enjoys perfect information about the other. In turn, as each agent searches for a potential match, neither can determine which match generates the greatest economic or social value.

Further complicating these factors are their potential to compound over time. As time progresses, the characteristics of each individual and organization in the marketplace evolve, increasing both the level of heterogeneity among workers and the potential for information asymmetry. This is particularly the case for workers between the ages of 18 and 30; the age cohort that represents a majority of the subjects included in this study. It is during this time period that an individual experiences the greatest change in personality, values, and preferences (Quoidbach et al., 2013).

In turn, matching processes must adequately discern among individual and occupational characteristics and provide information to each participant in such a way that reveals the value of a prospective match. These processes should not only consider the individual and firm's present characteristics, but also the propensity for each to learn, grow, and evolve over time.

3. Matching and Match Quality: Approaches

Vocational psychologists and economists each developed unique processes and systems to address the challenges identified in the previous section. Given the nature of their work, psychologists focused on the counselor's ability to harvest information from the client. Assessment tools and methods evolved from basic interview questions in the early 20th century to advanced standardized testing in the 21st century. Nevertheless, a vocational psychologists intent remained the same, to collect, analyze, and differentiate personal and vocational data to recommend the best possible occupational match.

The first matching model within the field of vocational psychology, *The Method of the Vocation Counselor,* was introduced by Frank Parsons in 1909. Parsons' matching efforts laid the foundation for Donald Paterson's occupational classification system employed during the Great Depression and in the military during World War II (Erdheim et al., 2007), John Holland's hexagonal model developed during the 1970s (Holland, 1978),

and the "Big Five" personality taxonomy created during the 1980s (Goldberg, 1993). Many of these methods or assessment measures are still in use today.

As psychologists focused on the counselor's ability to gather information, economists focused on the market. To address heterogeneity and information symmetry economists concentrated on marketplace structures that enabled information to flow freely, provided individuals the opportunity to compare alternatives, limited the amount of risk imposed on participants in the market, and allowed the matching marketplace to establish equilibrium on its own, without regulation.

Interestingly, economists also considered the way in which individuals collected their own information to rationalize, decide, and then act within the marketplace. Two important theories emerged to describe this phenomenon. The first, categorized matching as a "search" theory (Mortensen, 1978), wherein individuals and firms gain information by searching for alternatives. The second categorized matching as an "experience" theory (Jovanovic, 1979), wherein individuals and firms gain information through "experience."

Several noteworthy economic matching models emerged from these principles. In the 1990s, Mortensen connected with Christopher Pissarides and Peter Diamond, and the Diamond-Mortensen-Pissarides (DMP) matching model emerged. For their efforts, the three economists were awarded the Nobel Prize for Economics in 2010 (Mortensen, 2011). Drs. Alvin Roth and Lloyd Shapley joined Diamond, Mortensen, and Pissarides, in earning the Nobel Prize for Economics in 2012 for his research and development of successful matching methods across a wide range of vocational disciplines (Roth, 2012).

Today, research and development of matching processes continues to accelerate given the ability to collect and analyze, personal and organizational data, with unprecedented speed and accuracy. One example is California-based Eightfold.AI, a talent intelligence platform powered by artificial intelligence (AI). Eightfold's website advertises the ability to "evaluate internal and external candidates with AI that automatically infers skills, validates skills, and sees potential," to enable, "unbiased, data-driven decisions throughout the entire employee life cycle" (Eightfold, 2021, Why Eightfold). Similarly, Google developed a cloud-based talent solution with a job-search application programming

interface (API) in 2017. Google advertises a similar goal, to increase quality hires and decrease the time to hire, by using machine learning processes to, "better understand job content and jobseeker intent" (Google, 2020, Cloud Talent Solution). In 2017, Forbes estimated the value of this recruitment market are more than $200 billion (Bersin, 2017).

Matching process application does not end with private industry. The U.S. military has also begun to consider match quality's relevance in its talent management and talent assessment practices. Ravaged by the ongoing war effort, manpower build-up, and then subsequent draw-down, the U.S. Army began incorporating match quality into research as early as 2009 (Wardynski et al., 2009). These efforts were spearheaded by the United States Military Academy's (USMA) Office of Economic and Manpower Analysis (OEMA). In 2010, the organization published four reports affirming the need for better talent management, accession, and retention models, each of which referenced the principles of match quality. Among many innovative proposals, the U.S. Army has adopted OEMA's recommendation for "Talent-Based" MOS assignment process, at its national service academy, "West Point."

B. MATCHING AND MATCH QUALITY, THE MARINE CORPS

A significant portion of this research considers the Marine Corps' present ability to meet the matching challenges identified in the previous section. To do so, the study examines matching approaches utilized by several organizations in the DOD, to identify their qualities, and determine which methods may be feasibly introduced within the Marine Corps. This requires an examination and understanding of the Marine Corps current approach to MOS assignment.

1. Marine Corps MOS Assignment: Challenge

The Marine Corps must overcome the same matching process challenges identified in the previous section. Each newly commissioned officer is characterized by a distinct set of attributes including age, gender, race, prior employment experience, education level, commissioning source and possesses a unique set of skills, abilities, and preferences. As they enter initial level training, most enjoy very little knowledge about the Marine Corps, or the requirements of a particular occupational specialty. Yet, the Marine Corps must

overcome this level of uncertainty and assign and individual one of 26 primary MOSs, in approximately 20 weeks. The list of available primary MOSs is provided in Table 1.

Table 1. Background, Marine Corps Occupational Specialties. Adapted from Everly (2019, p. 15).

MOS	Title		MOS	Title
0102	Manpower Officer		3002	Ground Supply Officer
0203	Ground Intelligence Officer		3404	Financial Management Officer
0204	Counterintelligence/Human Source Intelligence Officer		4402	Judge Advocate General
0206	Signals Intelligence Officer		4502	Communication Strategy and Operations Officer
0207	Air Intelligence Officer		5803	Military Police Officer
0302	Infantry Officer		6002	Aircraft Maintenance Officer
0402	Logistics		6602	Aviation Supply Officer
0602	Communications Officer		7204	Low Altitude Air Defense Officer
0802	Field Artillery Officer		7208	Air Support Control Officer
1302	Combat Engineer Officer		7210	Air Defense Control Officer
1702	Cyberspace Officer		7220	Air Traffic Control Officer
1802	Tank Officer		7315	Unmanned Aircraft System MAGTF Electronic Warfare Officer
1803	Assault Amphibious Vehicle Officer		7599	Flight Student

2. Marine Corps MOS Assignment: Venue

After earning a commission, officers are assigned orders to Camp Barrett, Marine Corps Base Quantico, VA, to attend The Basic School. All officers, irrespective of commissioning source or duty status (active duty or reserve), are required to attend TBS. This is a unique opportunity, as the Marine Corps is the only service to require its officers to attend a course of this nature, prior to MOS school.

According to its website, TBS's mission is to:

> Train and educate newly commissioned or appointed officers in the high standards of professional knowledge, esprit-de-corps, and leadership to prepare them for duty as company grade officers in the operating forces, with particular emphasis on the duties, responsibilities, and warfighting skills required of a rifle platoon commander. (USMC, 2020)

It is important to note that TBS serves a larger function than simply MOS assignment. During this 6-month course, all officers, regardless of future MOS assignment,

complete more than 330 hours of classroom instruction and academic study. They also complete more than 600 hours of field training (Spooner, 2020). Included in this training and education is a demanding curriculum of field exercises, day and night land navigation courses, long-range hiking, obstacle and endurance courses, and weapons qualification. In addition to tactics, TBS educates Officers in the art of leadership to include ethics, critical thinking, problem solving, and decision-making. Overall, the curriculum is intended to satisfy the adage that "every Marine is, first and foremost, a rifleman."

Per the mission statement, this rigorous level of instruction is primarily intended to prepare Second Lieutenants for duty in the operating forces. However, it is also intended to grade and evaluate an individual's military, academic, and leadership proficiency. Each event contributes to an individual's grade point average (GPA) in one of these categories, which among other inputs, is then used to establish their class rank. This order of merit system serves many purposes, one of which is to guide the MOS assignment process.

3. Marine Corps MOS assignment: Approach

Though it is not the primary mission, TBS also maintains the responsibility of MOS assignment. The following sections identify the process by which TBS addresses information asymmetry, heterogeneity, and marketplace structure.

a. Marine Corps MOS Assignment Process: Information Asymmetry and Heterogeneity

TBS graduates approximately seven companies each year. These companies are composed of approximately 300 students each and are further subdivided into platoons. Information about each student in the company is gained through training events and evaluations that are organic to the school's standardized, six-month curriculum. Each of these events serves to evaluate the officer's military, physical, and academic proficiency. Additional information is also gained about the individual through daily interaction with their immediate supervisor, the Staff Platoon Commander (SPC). Each SPC is responsible for conducting periodic evaluations, properly documenting these evaluations, and for providing verbal feedback to each student in their platoon. As the curriculum progresses and a student's military, academic, and physical fitness grades are established, SPC

evaluations are completed, and class rank is formed, individuals are inherently discerned from one another. In turn, the amount of uncertainty about the characteristics of the officers requiring occupational assignment decreases.

TBS recognizes that many students are unaware of the characteristics and attributes of each occupational specialty and the process by which MOSs are assigned. To reduce this uncertainty the "MOS Education Continuum" (Everly, 2019) was established. According to the Marine Officer MOS Assignment Handbook, this continuum exposes officers to the broad range of primary MOSs, and informs officers of the "MOS allocation process, MOS prerequisites, MOS classification standards (MSCs), and factors in MOS assignment so they can make realistic, well-informed decisions about their desires" (Everly, 2019, p. 2). This continuum is organized into three phases, which are described below.

(1) Inform Phase

A large portion of the inform phase takes place organically, during classroom instruction and field training exercises. During these events, students are assigned various functional roles and responsibilities. As students prepare and then execute their responsibilities during these training exercises, it inherently reveals the unique characteristics of each occupational specialty. As these events take place, students are also encouraged to interact with the staff, which is comprised of experienced officers and enlisted Marines with various MOS backgrounds.

Students are also required to participate in three educational briefs. These briefs are organized along the through primary MOS groupings: "Combat Arms, Information and Aviation, and Combat Service Support" (Everly, 2019). Each brief is followed by an MOS "mixer" during which students are encouraged to engage experienced officers in that grouping.

(2) Assign Phase

During the assign phase, officers pursuing certain MOSs are provided the opportunity to physically qualify through the Physical Fitness Test (PFT) and the Combat

Fitness Test (CFT) (Everly, 2018). This helps shape an individual's preference by informing them of the MOSs for which they qualify.

Students are also given the opportunity to submit their occupational specialty preferences during weeks 7 and 16. Students only rank the occupational specialties for which they are eligible, as determined by prior physical fitness test screening (Everly, 2019). Officers are then assigned their MOS during week 21. A more detailed overview of the assignment phase is provided in the next section.

(3) Transition Phase

In the transition phase students receive additional information about the MOS they have recently been assigned. They are also given a brief that "covers officer assignment, career designation, promotions" and professional education opportunities within that occupational field (Everly, 2019, p. 3). Following the brief, students are again afforded the opportunity to meet with experienced officers in their assigned occupational field (Everly, 2019).

b. Marine Corps MOS Assignment Process: Market Attributes and Characteristics

TBS's MOS assignment market is shaped by four factors: quality distribution, student suitability, unique or additional considerations, and student preferences. A description of these components is explained in the sections that follow.

(1) Quality distribution

Quality distribution is the most unique aspect of TBS's MOS assignment process. Rather than grant MOS assignment preference to individuals in accordance with their lineal standing, instead, the lineal standing is broken into thirds. MOSs for each company are then allocated equally across each third. This change was implemented in 1977 and is intended to address two important concepts.

First quality distribution ensures all occupational fields are allocated a "fair share of the most competitive lieutenants" (Everly, 2019, p. 1). It protects the less "popular" or less "trendy" MOSs from being assigned a cohort of officers who all graduated in the

bottom third of their TBS company. For example, if a company must graduate 30 infantry officers, TBS will ensure that 10 officers from each third, are assigned the infantry MOS. Figure 1 illustrates this concept.

Quality distribution also serves another purpose. TBS acknowledges that an individual's performance and subsequent standing in their company, may not be indicative of their performance in the operating forces. While an individual may struggle during training and evaluation, their performance may improve when placed in the right occupational specialty or working environment. In this way, the quality distribution serves as a hedge against this potential disparity by providing equal opportunity for MOS assignment to each third.

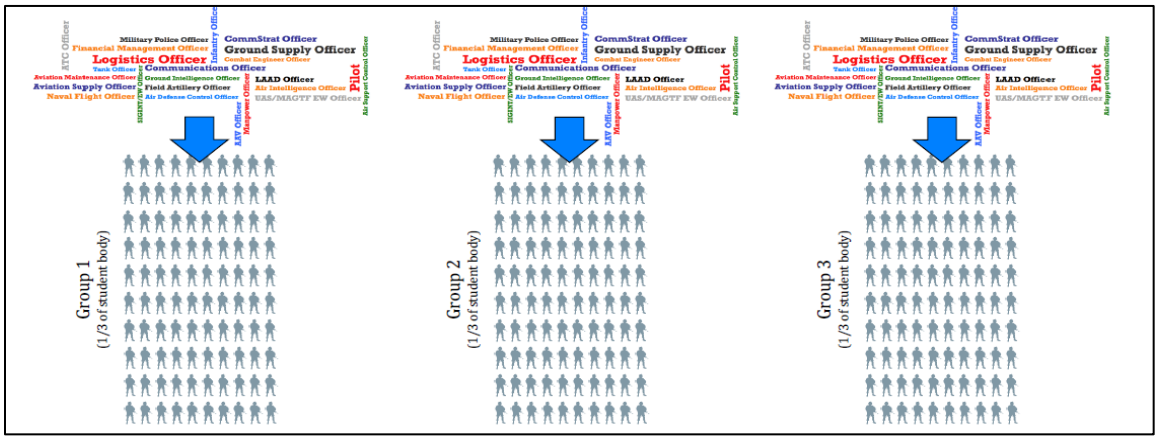


Figure 1. Background, Marine Corps Officer MOS Assignment "Thirds" Distribution. Source: Everly (2018).

Of note, students who were guaranteed an occupational specialty prior to attending TBS and are not in competition for an MOS are removed from this quality distribution. This includes Naval aviators, Naval Flight Officers, and Judge Advocates, and reduces the "assignable" population of officers in each company to approximately 160 officers.

(2) Student suitability

TBS companies are composed of approximately 300 students and are further organized into platoons. Each platoon is led by a Staff Platoon Commander (SPC), an active-duty Marine Corps Captain. Among many other duties, it is the SPC's responsibility

to carefully evaluate an individual's character and performance, and determine their suitability for a particular MOS.

(3) Unique or additional considerations

Officers are given the opportunity to declare any special or unique circumstances which should be considered in the MOS assignment. This may include "prior enlisted or civilian work experience in a specific technical field" (Everly, 2019, p. 1). This experience is only a consideration and does not guarantee an assignment.

(4) Student preferences

A student's preferences also shape the MOS assignment process. During weeks 12 and 19, students are required to consider each of the MOSs for which they qualify and submit their preferences in rank order. (Everly, 2019). In addition to the physical qualifications which must be met, preferences may also be shaped by eligibility for specific security clearance. The MOS handbook states that, "student preferences are considered secondary to the needs of the Marine Corps when assigning MOSs" (Everly, 2018, p. 2).

c. Marine Corps MOS Assignment Process: Execution

Once lineal standing is established, individuals who are not in competition for MOSs are removed, and MOSs are evenly allocated to each third, the actual assignment process begins. The process proceeds by starting in the top third. If an individual's first MOS choice is available, the individual is deemed to be suitable for that particular occupation, and another individual in the same third is not more uniquely qualified, the individual is assigned that MOS. The process then proceeds onto the middle and bottom, working in individual rank order, ensuring each occupational community receives a fair share of quality officers from each third.

Human feedback is present in the assignment model, as each company's staff is authorized to deviate from an individual's assigned occupational specialty at the discretion of the Company Commander (Everly, 2019). The final assignment list must be approved by the Commanding Officer of TBS and the submitted to Manpower and Reserve Affairs (M&RA), for final approval.

4. Marine Corps MOS Assignment: Summary

TBS is intended to train and educate new Marine Corps Second Lieutenants; it is not specifically designed to address MOS assignment. Still, whether or intentionally or unintentionally, it has incorporated many activities and processes which do confront the challenges of match quality discussed in the previous section of this chapter. The military, academic, and leadership scores and lineal standing that is derived from these metrics serves to differentiate officers from one another and provide information about the individual to the organization. The MOS education process, including informational briefings and MOS mixers provides additional information to the individual about the organization and each occupational community. Finally, the broad range of field training and classroom educations, helps build each individual's level of experience to make a better-informed decision within the compressed timeline.

According to TBS's MOS handbook this process achieves the results indicated in Figure 2. As shown, approximately 44% of officers receive their top preference, 77% receive one of their top three preferences, and 94% of officers receive one of their top five preferences.

CHOICE	NUMBER	PERCENTAGE
First	51	44%
Second	22	19%
Third	16	14%
Fourth	8	7%
Fifth	12	10%
6th-10th	7	6%
11th-15th	0	0%
16th-20th	0	0%
21st+	0	0%
TOTAL	116	100%

Figure 1.1. *MOS Assignments for a Notional BOC Company*

Figure 2. Background, Marine Corps MOS Assignment for a Notional TBS Company. Source: Everly (2019).

C. MARINE CORPS PERFORMANCE EVALUATION SYSTEM

As discussed in Section A of this chapter, "match quality" is often measured in terms of performance. In addition to length of service, it is this study's intent to assess match quality in the same manner. While an officer's performance may be assessed in several forms to include promotion, number of awards, or selection to command, an empirical measure is more suitable for regression analysis. In turn, this study relies upon a metric generated by the Marine Corps formal written evaluation known as the Fitness Report (FITREP). The following sections describe the reporting structure, grading criteria, metrics, associated with the FITREPs.

1. Fitness Reports: Reporting Construct, Grading Criteria, Metrics

The FITREP is intended to be a standardized and normalized assessment of a Marine's performance in their assigned duties, regardless of occupational specialty, over a designated time-period. According to the regulation which governs the completion of FITREPs, Marine Corps Order (MCO) P1610.7A:

> The completed fitness report is the most important information component in manpower management…The fitness report is the Commandant's primary tool available for the selection of personnel for promotion, retention, career designation, resident schooling, command, and duty assignments. (Department of the Navy [DON], 2018)

The PES outlines the strict process by which FITREPs are completed and issued to the individual Marine. The following sections describe this process.

a. Fitness Reports, reporting construct

Each of the subjects included in this analysis—ground assignable officers of rank Second Lieutenant through Major—are administered a FITREP. Each of these FITREPs follows the same reporting construct, regardless of rank.

The individual for whom the report is written is the "Marine Reported On" (MRO). The individual completing the preponderance of the evaluation, typically the first commissioned or warrant officer in the MRO's chain of command, is known as the "Reporting Senior." A second, "Reviewing Officer" (RO), typically the first commissioned

or warrant officer in the RSs chain of command, also completes a small portion of the evaluation. According to MCO P1610.7A, the presence of the RO is intended to, "provide the experienced leadership, supervision, and detached point of view necessary to ensure consistent, accurate, and unbiased evaluations" (2018, p. 2-2). Figure 3 illustrates this MRO, RS, RO relationship.

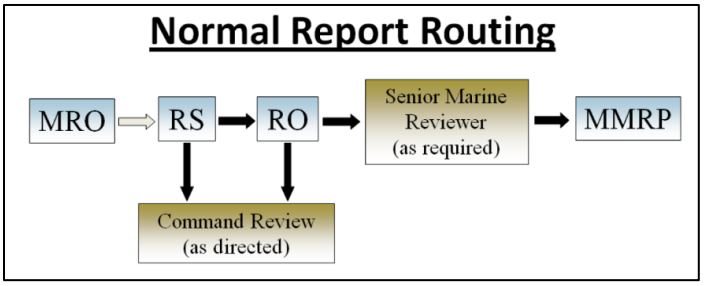


Figure 3. Background, FITREP Routing Process. Source: DON (2018, p I-1).

b. Fitness Reports, grading criteria

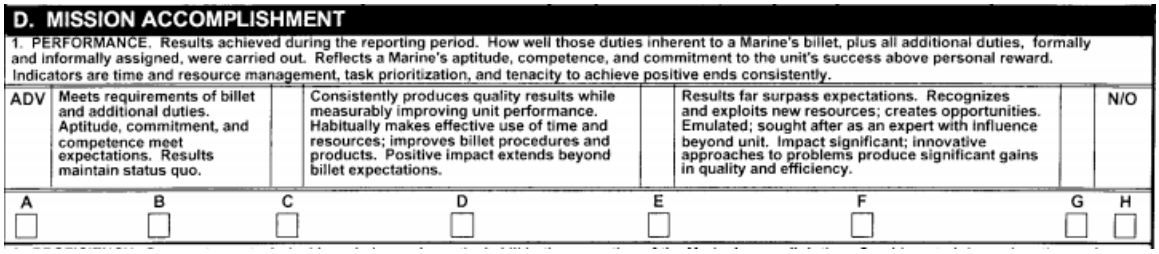
The FITREP provides the opportunity for each MRO to be evaluated according to 14 attributes. These attributes are subdivided into five larger sections including mission accomplishment, individual character, leadership, intellect and wisdom, and fulfillment of evaluation responsibilities (DON, 2018). These attributes and sections are shown in Table 2.

Table 2. Background, Fitness Report Grading Criteria. Fitness Report Grading Criteria. Adapted from DON (2018, 4–22).

Mission Accomplishment	Individual Character	Leadership	Intellect and wisdom	Fulfillment of evaluation responsibilities
1. Performance 2. Proficiency	3. Courage 4. Effectiveness under Stress 5. Initiative	6. Leading subordinates 7. Developing subordinates 8. Setting the example 9. Ensuring well-being of subordinates 10. Communication skills	11. Professional military education 12. Decision making ability 13. Judgment	14. Evaluations

Each of these 14 attributes has a designated grading scale, known as the performance-anchored rating scale (PARS). First, the PARS defines the attribute (Box 1, Figure 4). This ensures RSs grade each MRO in accordance with the same description. Then, a marking gradient is provided (See: A–H, Figure 4). The marking gradient is consistent across all PARS, where "A" represents a poor, or "adverse," level of performance, "G" represents the highest possible score, and "H" indicates the RS was not able to observe the MRO's performance.

It is important to note that the RS is expected to evaluate the MRO in accordance with the attribute and marking gradient provided and in comparison, with all MROs of the same rank for whom the RS has already evaluated. Overall, this provides the RS with a fair, standardized approach for grading each of the 14 attributes. The RS is also required to provide qualitative remarks in a specific section of the report.



D. MISSION ACCOMPLISHMENT

1. PERFORMANCE. Results achieved during the reporting period. How well those duties inherent to a Marine's billet, plus all additional duties, formally and informally assigned, were carried out. Reflects a Marine's aptitude, competence, and commitment to the unit's success above personal reward. Indicators are time and resource management, task prioritization, and tenacity to achieve positive ends consistently.

ADV						N/O
Meets requirements of billet and additional duties. Aptitude, commitment, and competence meet expectations. Results maintain status quo.	Consistently produces quality results while measurably improving unit performance. Habitually makes effective use of time and resources; improves billet procedures and products. Positive impact extends beyond billet expectations.	Results far surpass expectations. Recognizes and exploits new resources; creates opportunities. Emulated; sought after as an expert with influence beyond unit. Impact significant; innovative approaches to problems produce significant gains in quality and efficiency.				

A	B	C	D	E	F	G	H
☐	☐	☐	☐	☐	☐	☐	☐

Figure 4. Background, FITREP Performance-Anchored Rating Scale (PARS) for the "Performance" Attribute. Source: NAVMC 10835A (2020).

The RO also performs a quantifiable evaluation. However, this metric is not used during this analysis.

c. Fitness Reports, metrics

(1) Report Average (Rpt Avg)

The first empirical measure derived from the FITREP is the Report Average (Rpt Avg). The Rpt Avg is determined based on the sum of each attribute, where A=1, B=2, C=3, D=4, E=5, F=6, G=7, divided by the number of attributes graded; which is typically fourteen. In turn, Rpt Avg is measured on a scale between 1 and 7.

(2) Relative Value (RV)

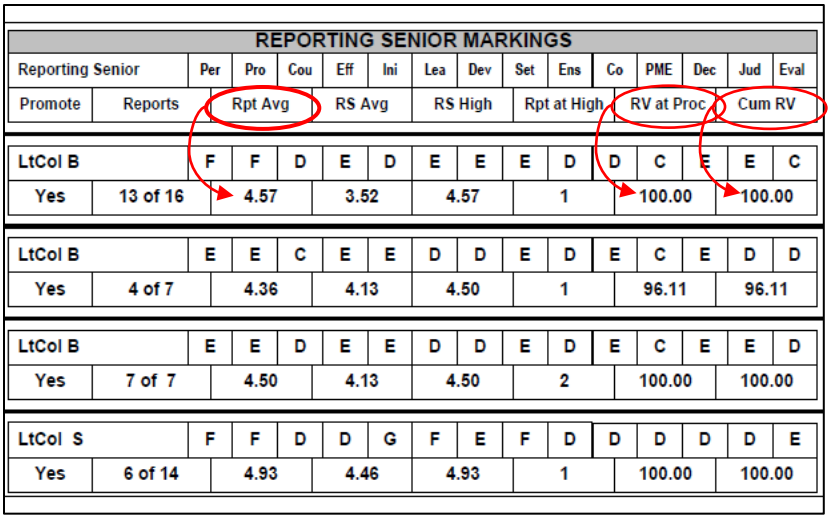
To ensure fairness across officers of the same rank, this Rpt Avg is then converted into a *relative value* (RV). This normalizes Rpt Avg's and insulates MROs from RSs who may generate over or underinflated FITREP scores. According to MCO P1610.7A, the RV is designed, "to give individuals making personnel management decisions the ability to weigh the merit of a single fitness report in relation" to MROs of the same rank (DOD, 2018, p. 8-5). RVs are calculated on a scale from 80 to 100. The MRO will receive an RV at the time of processing and a cumulative RV. The cumulative RV will continue to adjust over time as the RS generates additional FITREPs on Marines of the same rank.

Table 3 illustrates the practical significance of these RV scores. As shown, an RV of 93.34 or higher would place the MRO in the top third among those previously evaluated by the RS.

Table 3. Background, FITREP, Relative value categorizations.
Adapted from DON (2018, p. 8-6).

Relative Value Score	Categorization
93.34–100.00	The report is in the upper third of the RS profile
86.67–93.33	The report is in the middle third of the RS profile
80.00–86.66	The report is in the bottom third of the RS profile

Figure 5 illustrates how each of these metrics is recorded on a Marine's "Master Brief Sheet," the document which serves as a repository of personal data, to include an individual's performance metrics. In this example, the MRO received four separate FITREPs from "LtCol B," his or her RS. The MRO's Rpt Avgs were 4.57, 4.36, 4.50, and 4.93 and RVs at Proc were 100.00, 96.11, 100.00, and 100.00, respectively. This presentation allows members of a promotion or command selection board to easily compare metrics between individuals of the same rank.



REPORTING SENIOR MARKINGS															
Reporting Senior		Per	Pro	Cou	Eff	Ini	Lea	Dev	Set	Ens	Co	PME	Dec	Jud	Eval
Promote	Reports	Rpt Avg			RS Avg		RS High		Rpt at High		RV at Proc			Cum RV	
LtCol B		F	F	D	E	D	E	E	E	D	D	C	E	E	C
Yes	13 of 16	4.57			3.52		4.57		1		100.00			100.00	
LtCol B		E	E	C	E	E	D	D	E	D	E	C	E	D	D
Yes	4 of 7	4.36			4.13		4.50		1		96.11			96.11	
LtCol B		E	E	D	E	E	D	D	E	D	E	C	E	E	D
Yes	7 of 7	4.50			4.13		4.50		2		100.00			100.00	
LtCol S		F	F	D	D	G	F	E	F	D	D	D	D	D	E
Yes	6 of 14	4.93			4.46		4.93		1		100.00			100.00	

Figure 5. Background, FITREP Reporting Senior Markings Example. Source: DON (2018, p. D-1).

2. Marine Corps Performance Evaluation System: Summary

As demonstrated in the previous paragraphs, the Marine Corps PES provides a well-defined methodology to produce a timely and accurate performance evaluation with limited personal bias. The metrics generated by the FITREP provide analysts with an uninterrupted stream of quantifiable performance evaluations throughout the course of a Marine's career. This makes the FITREP RV at processing an ideal metric for performance for the purposes of this study.

D. BACKGROUND SUMMARY

This chapter provided a foundational overview of match quality in the fields of vocational psychology, economics, and the Marine Corps. A definition of match quality was provided, and the challenges associated with generating match quality, to include, addressing heterogeneity, information asymmetry, and the careful development of a marketplace that is capable of effectively and efficiently forming a match between the two agents, were identified. This chapter demonstrated that vocational psychologists and economists have extensively researched methods and developed practices to overcome these challenges. Recent advancements in machine learning and artificial intelligence have

only simplified these processes and accelerated progress. Yet the Marine Corps' MOS assignment progressed far less over the same time period.

III. LITERATURE REVIEW

This study determines match quality's impact on performance and length of service among Marine Corps officers, and identifies feasible ways in which to improve MOS match quality in the Marine Corps. As discussed in the background section of this report, matching is rooted in the fields of vocational psychology and economics. In turn, it is necessary to investigate the theories proposed by each discipline, identify empirically proven methods, and explore their potential applicability in the Marine Corps MOS assignment process. Overall, the purpose of this literature review is to identify relevant aspects of the existing literature that may inform or provide solutions to the present research.

A. VOCATIONAL PSYCHOLOGY LITERATURE

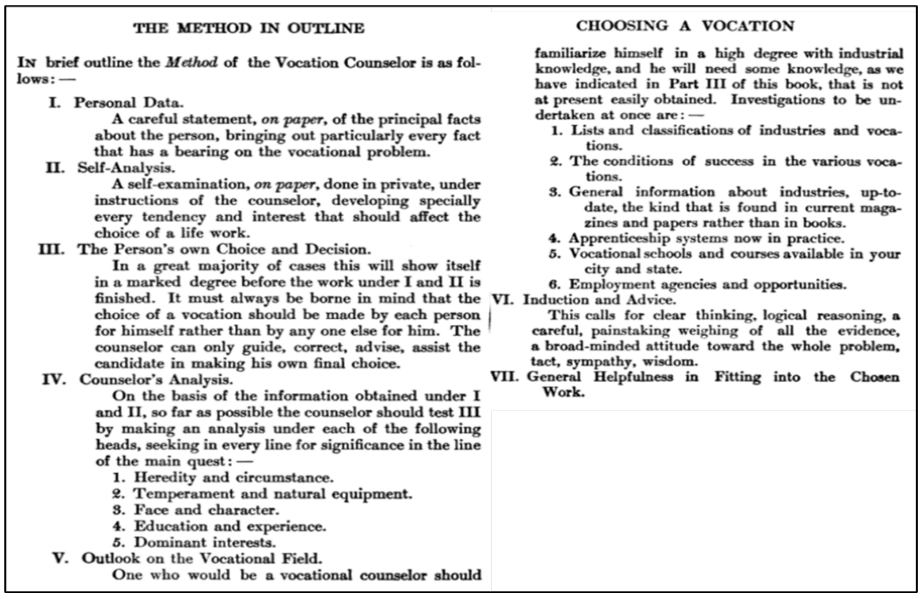
1. Theoretical Research, Vocational Psychology

Frank Parsons is universally recognized as the founder of the vocational psychology movement (Mann, 1950; Gummere, 1988; Erdheim et al., 2007) and for the development of the talent matching approach (Gothard, 2001). Parsons established his theory on occupational assignment and selection in his book, *Choosing a Vocation,* which was published in 1909. In the opening chapter, Parsons stated:

> If a boy takes up a line of work to which he is adapted, he will achieve far greater success than if he drifts into an industry for which he is not fitted. An occupation out of harmony with the worker's aptitudes and capacities means inefficiency, unenthusiastic and perhaps distasteful labor, and low pay; while an occupation in harmony with the nature of the man means enthusiasm, love of work, and high economic values,—superior product, efficient service, and good pay. (1909, p. 1)

To establish proper occupational "fit" and "harmony," Parsons proposed a precise, engineer-like (Gummere, 1988), and scientific approach to determine the occupation for which an individual was best aligned (Parsons, 1909). This process (Figure 6) was to be carried out by a vocational counselor. To assist, Parsons provided more than 116 questions, regarding "ancestry, family, education, reading, experience, interests, aptitudes, abilities, limitations, resources, etc." to be administered by the counselor (Parsons, 1909, p. 7). He

also trained his counselors to study occupational fields and labor markets to enhance their ability to provide accurate recommendations. Parsons also challenged the individual to conduct their own "self-study, self-investigation, and self-revelation," to facilitate the process (p. 5).



THE METHOD IN OUTLINE

In brief outline the *Method* of the Vocation Counselor is as follows: —

I. Personal Data.
A careful statement, *on paper*, of the principal facts about the person, bringing out particularly every fact that has a bearing on the vocational problem.

II. Self-Analysis.
A self-examination, *on paper*, done in private, under instructions of the counselor, developing specially every tendency and interest that should affect the choice of a life work.

III. The Person's own Choice and Decision.
In a great majority of cases this will show itself in a marked degree before the work under I and II is finished. It must always be borne in mind that the choice of a vocation should be made by each person for himself rather than by any one else for him. The counselor can only guide, correct, advise, assist the candidate in making his own final choice.

IV. Counselor's Analysis.
On the basis of the information obtained under I and II, so far as possible the counselor should test III by making an analysis under each of the following heads, seeking in every line for significance in the line of the main quest: —
1. Heredity and circumstance.
2. Temperament and natural equipment.
3. Face and character.
4. Education and experience.
5. Dominant interests.

V. Outlook on the Vocational Field.
One who would be a vocational counselor should

CHOOSING A VOCATION

familiarize himself in a high degree with industrial knowledge, and he will need some knowledge, as we have indicated in Part III of this book, that is not at present easily obtained. Investigations to be undertaken at once are: —
1. Lists and classifications of industries and vocations.
2. The conditions of success in the various vocations.
3. General information about industries, up-to-date, the kind that is found in current magazines and papers rather than in books.
4. Apprenticeship systems now in practice.
5. Vocational schools and courses available in your city and state.
6. Employment agencies and opportunities.

VI. Induction and Advice.
This calls for clear thinking, logical reasoning, a careful, painstaking weighing of all the evidence, a broad-minded attitude toward the whole problem, tact, sympathy, wisdom.

VII. General Helpfulness in Fitting into the Chosen Work.

Figure 6. Literature Review, Frank Parsons' Method for Vocational Assignment. Source: Parsons (1909, pp. 45–46).

Ultimately, Parsons established the premise that an individual should be "matched" with an ideal occupation. He then developed the process and techniques to do so. In 2001, Gothard summarized the three key components of Parsons matching framework:

> [A] clear understanding of the individual's aptitudes, interests, and limitations…a knowledge of the requirements and conditions of different kinds of employment…[and] finally, an ability to match these two. (Gothard, 2001, p. 10)

Donald G. Paterson contributed significantly to the field of vocational psychology throughout the mid-20th century. In 1957, Paterson published an article entitled, *The Conservation of Human Talent.* In this piece, Paterson recapped his efforts to combine psychology and manpower management within the U.S. military during World War I, as follows:

> We were given the opportunity to apply psychological methods to the solution of military manpower problem. In this work, we learned to work with the medical profession [and] with the psychiatrists…Here again we adapted available psychological tests and rating scales, improved existing methods, and devised new methods. The aim, of course, was to aid our armed forces to utilize the talents of our civilian-soldiers with a minimum of waste in time and in manpower. The slogan behind all of this effort became "the right man in the right place. (Paterson, 1957, p. 134)

After World War I, Paterson joined the psychology department at the University of Minnesota where he and fellow colleagues spearheaded efforts in testing and measurement to improve vocational guidance (Erdheim et al., 2007). Their emphasis on personality testing and empirical data led to the development of several standardized tests. These tests were adopted by the U.S. military for personnel selection as early as the 1940s, and the Minnesota Multiphasic Personality Inventory (MMPI) is still in use today (Butcher, 2017).

Paterson and the department's efforts led to the establishment of an occupational classification system. This system helped reduce unemployment during the Great Depression and assign occupational specialties to military personnel during World War II (Chartrand, 1991; Erdheim et al., 2007).

"Holland's Theory," emerged in the late 1970s. It was John L. Holland's belief that personality and work environment were the most significant factors in occupational assignment. Holland developed or adapted tests to precisely classify both personality and job characteristics according to the same six traits: realistic, investigative, artistic, social, enterprising, or conventional (Gothard, 2001). He then developed a hexagonal model (Figure 7), around which he placed the six personality and occupational traits.

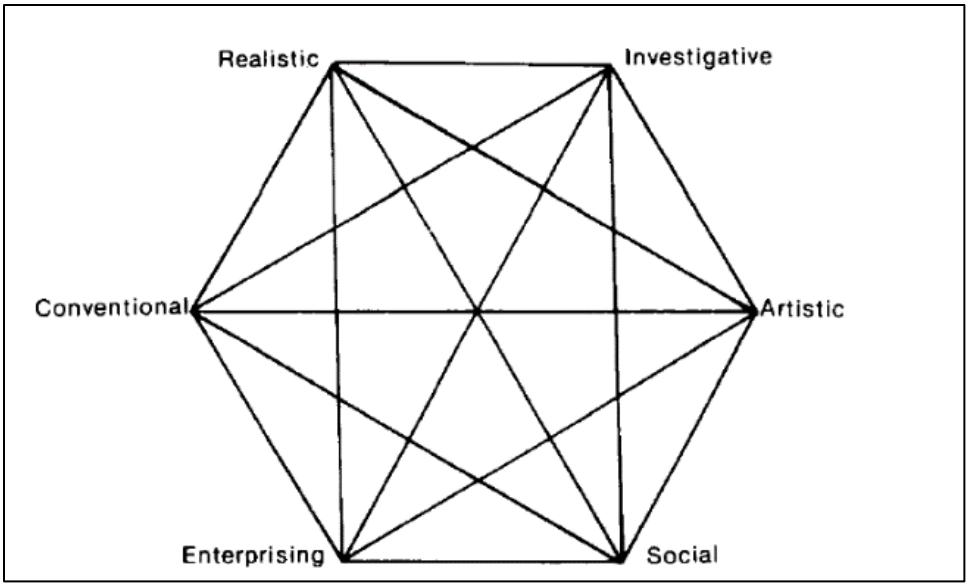


Figure 7. Literature Review, John L. Holland's Hexagonal Career Choice Model. Source: Holland and Gottfredson (1978, p. 177).

Holland and Gottfredson explained "Holland's Theory" in their article, *Using a Typology of Persons and Environment to Explain Career: Some Extensions and Clarifications* (1978).

> According to the hexagonal model, the similarity of the types is inversely related to the distance between them. The hexagonal model is also used to estimate degrees of person / job congruency. For example, a Realistic person in a Realistic job is in a more congruent situation than a Realistic person in an Investigative job; a Realistic person in a Social job is in the most incongruent situation possible; and so on. (Holland & Gottfredson, 1978, p, 148)

Holland's job-matching model was quite simple. The closer the distance between personality and occupational traits on the hexagonal model, the greater the satisfaction and longevity (Holland and Gottfredson, 1978). His theory is still among the most often researched in the field of vocational psychology (Chartrand, 1991; Spokane et al., 2000).

As the emphasis on personality classification in the field of vocational psychology continued, so too did the number of tests and corresponding personality traits. To simplify individual differences for research and analysis purposes, several Psychologists began working in the 1980s to streamline the existing taxonomy (Goldberg, 1993). By the early

1990s, the “Big Five” or “Five-factor” personality structure emerged with the following traits: Factor I, Surgency or Extraversion; Factor II, Agreeableness or Pleasantness; Factor III, Conscientiousness or Dependability; Factor IV, Emotional Stability vs Neuroticism; and Factor V, Intellect or Openness to Experience (Goldberg, 1993). Although slight modifications have since been implemented, the premise and associated classification system remain largely in-tact.

In 2004, Anderson et al. further refined Holland’s original theories on the importance of work environment when forming a match. In their article, *Future Perspectives on Employee Selection: Key Directions for Future Research and Practice* (2004), this team of researchers suggested that *multiple* levels of matching (referred to in their article as multi-level selection) actually occur in the work environment. These include the person-job (P-J) fit, the person-team (P-T) fit, and the person-organization (P-O) fit. Anderson et al. proposed that a proper match is one that optimizes fit across all three levels simultaneously, not just within one level.

Anderson et al. acknowledged the challenges associated with achieving an appropriate fit within this multi-level matching construct. While some personality or cognitive traits may be complementary, others may have contradictory effects (Anderson et al., 2004). As their article states, “high levels of independence of thought and thus propensity to innovate are needed for P–J fit, whereas value conformity and adherence to the company culture is desired at the P–O level of fit” (Anderson et al., 2004, p. 5). To address this complexity, the team developed the table shown in Figure 8.

TABLE 1
Multilevel Selection—Examples of Criterion Constructs, Predictor Methods, and Interaction Effects for a Fictitious Job Role

	Criterion constructs	*Predictor methods*	*Interaction effects: some examples*
Person–Job Fit	1. Cognitive ability	GMA test Tests of specific cognitive abilities	Complementary [3,5], Neutral [2,6,8]
	2. Sociability	Interviews Personality instrument	Complementary [6,7,10], Neutral [5,8,9,11] Contradictory [4]
	3. Innovation potential	Personality instrument Leaderless group discussion at AC Interviews Situational judgment tests (SJTs)	Complementary [1,11], Neutral [5,8,9] Contradictory [4,11]
	4. Detail consciousness in task performance	Work sample test Reference/Testimonials	Complementary [1,5] Neutral [7,8] Contradictory [3,6,7]
Person–Team Fit	5. Expert knowledge relevant to team's present task	Unstructured interview Work sample test	Complementary [7] Neutral [8,9]
	6. Teamworking skills	Led group discussion at AC References/Testimonials	Complementary [2,10], Neutral [1,8,9] Contradictory [4]
	7. Team citizenship behavior	Leaderless group discussion at AC References/Testimonials	Complementary [2,7,9], Neutral [8,11]
Person–Organisation Fit	8. Internalisation of core organisational values	Personal values inventory Unstructured interview Biodata inventory ("soft" items)	Complementary [9,10,11,6], Neutral [4] Contradictory [3]
	9. Loyalty to organisation	Motivation questionnaire	Complementary [8,10,11,7], Neutral [1,5]
	10. Ability to represent an organisation at external events	Presentation exercise at AC	Complementary [8,9,11,2,6],
	11. Commitment to organisational goals as articulated in its mission statement	Unstructured interview at AC	Neutral [2,4] Contradictory [3]

Notes: Interaction effects are suggested both within-level (e.g. cognitive ability and innovation potential interact in a complementary manner *within* P–J fit) and between-level (e.g. sociability in P–J fit and teamworking skills in P–T fit interact in a complementary manner *between* levels of analysis).
Note that this table presents examples of possible interaction effects for a fictitious job role. Depending on how these constructs are defined and operationalised, these effects will vary between organisations and between jobs in the same organisation, it can be argued.

Figure 8. Literature Review, Multilevel Matching Criteria, Predictor Methods, and Interaction Effects. Source: Anderson et al. (2004).

Lastly, Ployhart and Schneider presented a modern model for job matching. Like Holland and Anderson et al., they emphasized the importance of the work environment, in addition to the organization when forming a match. Ployhart and Schneider's approach, published in their article, *The Social and Organizational Context of Personnel Selection* outlines their process (2012), distills the selection process into four steps.

> First, it is necessary to comprehensively define the job and then identify the most critical aspects of performance on the job. Second, it is necessary to comprehensively identify the KSAOs [Knowledge, skills, abilities, or other characteristics] linked to each critical performance dimension…reduce this set to only those KSAOs critical for performing the critical tasks…Finally, measures of those KSAOs need to be developed or acquired so that they can be administered to applicants in an efficient and cost-effective manner. (p. 49)

Ployhart and Schneider's approach is simple. Yet, in many ways, it comprehensively addresses the concepts proposed in the literature previously discussed during this review.

Self-determination theory (SDT) offers strong evidence to support the practice of aligning individuals with their natural talents and tendencies. Psychologists Richard M. Ryan and Edward L. Deci are credited with the theory's founding in the 1980s. In their article, *Self-Determination Theory and the Facilitation of Intrinsic Motivation, Social Development, and Well-Being* (2000), they provide an overview of the theory and its significant in the field of psychology.

SDT's contribution to the body of literature on match quality rests in its understanding of motivation, particularly its discernment between internal and external motivation. Simply stated by Ryan and Deci, "Motivation produces," and is "therefore of preeminent concern to those in roles…that involve mobilizing others to act" (Ryan & Deci, 2000, p. 69).

Still, motivation can be deconstructed into two sources. As Ryan and Deci indicate, individuals can derive motivation intrinsically, through "personal commitment," "value," or "interest," or extrinsically, through "strong external coercion" or "from fear of being surveilled" (Ryan & Deci, 2000, p. 69). However, this distinction is particularly important given the contrast in outcomes generated by each source of motivation. As their article states,

> Comparisons between people whose motivation is authentic (literally, self-authored or endorsed) and those who are merely externally controlled for an action typically reveal that the former, relative to the latter, have more interest excitement, and confidence, which in turn is manifest both as enhanced performance, persistence, and creativity and as heightened vitality, self-esteem, and general well-being … Perhaps no single phenomenon reflects the positive potential of human nature as much as intrinsic motivation, the inherent tendency to seek out novelty and challenges, to extend and exercise one's capacities, to explore, and to learn. (p. 69-70)

Beyond its view on the importance of intrinsic motivation, the article indicates SDT's "arena" also includes the development of "conditions that foster these positive

processes." It is match processes and theories like those discussed in this literature review, that according to Ryan and Deci, "optimize people's development, performance and well-being" (Ryan & Deci, 2000, p. 68).

2. Empirical Research, Vocational Psychology

As demonstrated in the literature reviewed in the previous section, Psychologists have theorized the benefit of pairing an individual's personality and cognitive ability with the appropriate job for more than a century. They have also worked consistently to develop and refine the testing mechanisms to assess and properly classify each of these traits to improve their matching processes.

Unfortunately, it has been difficult to prove the validity of these theories. There are several factors that challenge the ability to validate the utility of these trait-centric, vocational matching approaches:

- The variety of personality assessments, personality characterizations, cognitive measures, and methods of analyses challenge the consistency of empirical studies.
- The propensity for an individual's personality to evolve, impacts the reliability of personality testing, and therefore the ability to measure the utility of a match over time (Quoidbach et al., 2013). Simultaneously, job and work environment characteristics evolve.
- The theory that many individuals may be able to fake, or provide more socially desirable responses, during personality assessments challenges the validity of these tests and the job-matches that are generated by their results (Viswesvaran et al., 2007).
- The complexity of the multi-level matching described by Anderson et al. (P-J, P-T, and P-O matching) challenges the ability to quantify the value of any specific match.

However, several empirical studies emerged in the last 20 years which have substantiated many of the claims theorized throughout the 20th century. In 2000, Spokane et al. conducted a landmark study to quantify the benefits of matching efforts writ large. They consolidated and compared the results of more than, "66 empirical studies of congruence published from 1985 to 1999," with a review of "63 studies published prior to 1985." They recorded the variables that were found to be statistically significant predictors or moderators of congruence in more than one study. The results of their analysis are provided in Figure 9.

TABLE 3
Summary of Variables Associated with Congruence in Studies from 1985–1999 in More than One Study

Significant correlation hypothesized by theory	Nonsignificant correlation	Significant moderator variables
[Perceived congruence][a]	Anxiety	Group importance
Well-being	Gender role	
Job/task satisfaction (overall, intrinsic, and extrinsic)[b]	Satisfaction with income, fringe benefits, job security	
Supervisor's evaluation	Employee conduct (attendance, professional behavior, teamwork)	
[Job persistence stability]	Coping behavior	
Competency utilization	[Self-concept]	
Indecision	Job readiness	
Productivity/work quality/job involvement	Annual income	
Satisfaction with education	Number of job skills	

[a] Overlap with the 1985 review is noted by square brackets.
[b] Evidence is mixed on this variable, but there are a sufficient number of positive correlations to list job satisfaction.

Figure 9. Literature Review, Summary of Variables Associated with Congruence in Studies from 1985–1999 in More Than One Study. Source: Spokane et al. (2000, p. 177).

The result of Spokane et al.'s study indicates a significant correlation between a proper job-match and productivity, well-being, and job satisfaction. Their study acknowledged that, "these relationships vary in strength from small to moderate and may depend upon…the congruence index, sampling, person and environment measures…" (p. 177). Most importantly, they concluded that the, "congruence concept is useful and predictive of the complex transactions and interrelationships that occur in work settings" (p. 181).

In 2005, Barrick and Mount published the results of several meta-analyses in their article entitled *Yes, Personality Mattes: Moving on to More Important Matters*. In addition

to outlining seven empirically backed reasons to substantiate the importance of personality in the workplace, the team further qualified the importance of specific personality traits. Among the Big Five personality traits, the team concluded that emotional stability and conscientiousness were the most "generalizable" and "best predictors" of performance in the workplace (p. 361). They found that "extraversion, agreeableness, and openness to experience [were] also valid predictors of performance but only in specific niches" (p. 360). For example, their research stated, "agreeableness matters only when that interaction involves helping, cooperating, and nurturing others" (p. 360).

In addition to the model shown in Figure 8 of the previous section, Anderson et al. also provided empirical results to substantiate their endorsement of general mental ability (GMA), or cognitive ability, testing. Their study cited "large-scale meta-analyses" which found cognitive ability to be a "highly valid predictor of job performance and training success" in the United States and European Union (2004, p. 490). Furthermore, they concluded that, "GMA has been found to correlate strongly with divergent thinking abilities," which allows individuals to "cope better with a changing work role" (2004, p. 490). This is particularly valuable for this study, as a Marines officer's duties can vary considerably.

In 2007, Viswesvaran, Deller, and Ones (2007) published a report entitled *Personality Measures in Personnel Selection: Some new contributions*. This report is included in the review for two reasons. The first is that their research supported Barrick and Mounts findings by stating "personality variables, particularly conscientiousness measures, have useful levels of criterion-related validity to warrant their continued use in personnel selection" (p. 355). Second, they addressed the concern over faking, or attempting to provide "socially desirable" responses to personality tests. They offered two important considerations:

> Some researchers (Hogan, 2005) have argued that providing desirable responses is a sign of an adjusted individual and as such should not be a concern in personality assessments at work. However, it is important and interesting to note that individual differences in socially desirable responding as capture by social desirability scales are not predictive of performance. (p. 356)

In 2008, a joint study was conducted by economists Lex Borghans, James Heckman, Bas ter Weel, and psychologist Angela Duckworth. In a review of more than nine studies conducted between 1991 and 2006 using the "Big Five" personality taxonomy, the team found "substantial evidence on the importance of personality traits in predicting socioeconomic outcomes including job performance, health, and academic achievement" (Borghans et al., 2008, p. 43).

However, they also find that in several categories, an individual's IQ had more predictive power. The results, shown in Figure 10, indicate that job performance and longevity, the two factors most relevant to the present study, were best predicted by IQ and conscientiousness (personality), respectively.

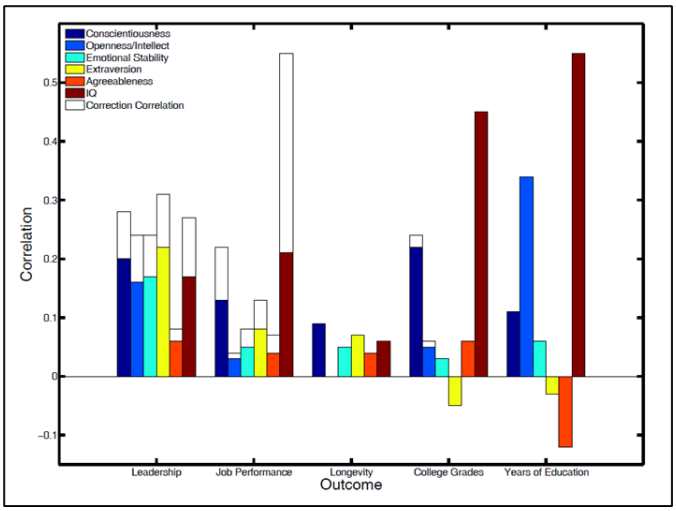


Figure 10. Literature Review, Predictive Validities, IQ and Big Five Dimensions. Source: Borghans et al. (2008, p. 141).

Lastly, in 2009, Bard Kuvaas, of the Department of Leadership and Organisational Management at the Norwegian School of Management, conducted empirical research to study the relationship between intrinsic motivation and work performance. His research, entitled, *A Test of Hypotheses Derived from Self-Determination Theory Among Public Sector Employees,* relied on data from 779 workers across a range of occupational trades in the public sector. Kuvaas' regression analysis included the independent variables, job autonomy and task interdependence; dependent variables, work performance (self-

reported) and intrinsic motivation; and control variables, education, wages, organizational tenure, and occupational sector (Kuvaas, 2009, p. 43).

His results were highly supportive of SDT's hypotheses regarding the relationship between intrinsic motivation and performance. First, Kuvaas found a statistically significant results when regressing intrinsic motivation on job autonomy, supervisor support,[1] and task interdependence at the $p < 0.001$, $p < 0.001$, and $p < 0.01$ level of significance, respectively (Kuvaas, 2009, 44). Second, he also found a statistically significant relationship ($p < 0.001$) between intrinsic motivation and work performance. As Kuvaas concluded, together, these results indicate "support for the SDT position" (Kuvaas, 2009, 46).

3. A Summary of Vocational Psychology Literature

The literature presents several implications for the present study. First, vocational psychologists demonstrated the importance of collecting and analyzing data. In terms of the individual—personality and cognitive ability—were consistently incorporated into matching approaches, from Parsons' work in 1901 to Anderson et al.'s publication in 2004. In terms of the organization or occupation, psychologists emphasized the importance of identifying the specific tasks, responsibilities, knowledge, and skills needed to execute the given position or occupation.

The empirical literature suggested several positive social and economic outcomes as a result of these theories, to include improved job satisfaction, well-being, productivity, and longevity. The literature also found some traits to have more predictive power. The personality trait, conscientiousness, was found to be a strong predictor of job performance outcomes, while the predictive power of other personality traits in the big five personality taxonomy were found to vary by job requirement and work environment (Barrick and Mount, 2000; Borghans et al., 2008). Cognitive ability was also found to be a strong predictor of job performance, and according to Borghans et al. (2008), has more predictive power than personality.

[1] Kuvaas defined supervisory support as, "an employees' perceived support from their immediate supervisor regarding development, competence and autonomy" (2009, p. 43).

This literature highlights many differences between the matching processes established in the field of vocational psychology and the present TBS MOS assignment process. Standardized cognitive and personality assessments, which were used by the U.S. Army to conduct occupational assignment as early as World War II, are not incorporated into the MOS assignment model or conducted at TBS. While the General Classification Test (GCT) was administered at TBS for several decades, it was never a component of the MOS assignment process. TBS does consider academic performance, but this is more indicative of an individual's present intelligence, not their future potential. In May 2019, the Marine Corps announced that it would incorporate the new Criteria Cognitive Aptitude Test (CCAT) into the MOS assignment process, but it has not yet formalized this process (MARADMIN 294/19, 2019).

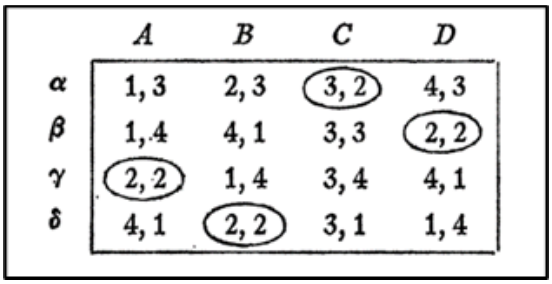
B. ECONOMICS LITERATURE

Like the field of psychology, matching in economics has a rich and extensive collection of literature. The following sections track the development of matching models in the field of economics from their origin in the early 1960s through the present. It also provides a review of empirical studies concerning match quality.

1. Theoretical Research, Economics

According to several economists, the first recognized model for matching procedures or match theory was published by Drs. David Gale and Lloyd Shapley in 1962 (Mortensen, 1988; Roth, 1982). This short article, titled *College Admissions and the Stability of Marriage* (1962), addressed the achievement of "optimality" between prospective college applicants and universities, and between married couples.

Their solution was almost entirely mathematical, one of game theoretic, Nash equilibrium. An example of this Nash Equilibrium model is shown in Figure 11 for the stable marriage scenario outlined in their report published in 1962. Males are represented by [α, β, γ, δ] and females are represented by [A, B, C, D].



	A	B	C	D
α	1, 3	2, 3	(3, 2)	4, 3
β	1, 4	4, 1	3, 3	(2, 2)
γ	(2, 2)	1, 4	3, 4	4, 1
δ	4, 1	(2, 2)	3, 1	1, 4

Figure 11. Literature Review, Gale and Shapley's Marriage Ranking Matrix. Source: Gale and Shapley (1962, p. 12).

Gale and Shapley's utilization of Nash equilibrium in matching scenarios was a significant milestone. However, their most valuable contribution was the identification of several dilemmas for each agent within the matching marketplace. For example, concerning the college application process, they identified the following challenges, from the perspective of the college:

> It may not be known (a) whether a given applicant has also applied elsewhere; if this is known it may not be known (b) how he ranks the colleges to which he has applied; even if this is known it will not be known (c) which of the other colleges will offer to admit him. A result of all of this uncertainty is that colleges can expect only that the entering class will come reasonably close in numbers to the desired quota, and be reasonable close to the attainable optimum in quality (Gale and Shapley, 1962, p. 9).

Gale and Shapley's concern regarding information asymmetry and uncertainty is easily recognizable in the excerpt. Concerning the college applicant, the team identified the following challenges with respect to matching:

> An applicant who is asked to list in his application all other colleges applied for in order of preference may, feel perhaps, not without reason, that by telling a college it is, say, his third choice he will be hurting his chances of being admitted…Suppose an applicant is accepted by one college and placed on the waiting list of another that he prefers. Should he play safe by accepting the first or take the chance that the second will admit him later? Is it ethical to accept the first without informing the second and then withdraw his acceptance if the second later admits him? (p. 9)

Gale and Shapley also recognized several challenges in the marriage scenario. They acknowledged that it may be possible for one of the women to receive more than one proposal. In that case, they suggested that "she [may] not accept him yet, but [keep] him

on a string to allow for the possibility that someone better may come along later." In this case, an iteration of proposal and rejection would be necessary. Gale and Shapley coined this iteration, "deferred-acceptance" (p. 14).

Gale and Shapley's development of the "deferred-acceptance" concept and recognition of the challenges associated with matching problems were highly profound in the field of economics. Despite being unable to resolve many of the challenges they identified, Gale and Shapley's report prompted fellow economists to consider the way in which individuals operating inside the marketplace would confront these challenges, and about the way in which matching markets could be developed to achieve optimality.

As a result of Gale and Shapley's research, two important theories emerged, to address the information asymmetry and uncertainty faced by individuals in the matching marketplace. Dr. Dale T. Mortensen of Northwestern University was among the first to publish research regarding the role of "search theory," in matching. "Search theory" posited that individuals would collect information by searching for alternatives, and then decide which amongst those alternatives was the preferred option. Dr. Boyan Jovanovic of Columbia University established the "experience theory." According to Jovanovic, individuals would collect information by experiencing the match, and then determining whether or not it was the preferred option.

In 1978, Mortensen was the first to publish his research on "matching" in an article entitled, *Specific Capital and Labor Turnover.* In his article, Mortensen asserted that the value of a match, represented more than the capital value of the worker or the firm, individually (1978, p. 574). Instead, he argued matching was a function of "joint wealth maximization," between the individual and the firm (1978, p. 574). Under these circumstances, and as a proponent of search theory, Mortensen claimed that a match would endure between the employee and employer such that the value of the present match was greater than the capital value of a new match revealed through searching. Consequentially, quality matches were those that generated a larger joint-value and therefore disincentivized the search for better alternatives by either the individual or the firm (Mortensen, 1978).

An additional challenge that Mortensen identified of particular relevance to the present study is the element of time. In an article published in 1988, entitled *Matching: Finding a Partner for Life or Otherwise,* he presented the following challenge regarding time:

> Nevertheless, unstable structures can form when matching requires time, is costly, and takes place under conditions of uncertainty both because it is not rational to wait indefinitely for the perfect partner and because experience is required to discover the value of a specific partnership. (Mortensen, 1988, p. S238)

Boyan Jovanovic of Columbia University proposed the alternative theory. In his article, *Job Matching and the Theory of Turnover,* Jovanovic noted that, "the only way to determine the quality of a particular match [was] to form the match and 'experience it'" (1979, p. 973). Jovanovic noted the following important implication about experience in the labor market:

> The third major assumption … is that imperfect information exists on both sides of the market about the exact location of one's optimal assignment. Following an initial assignment, new information becomes available, and reassignment becomes optimal in certain cases. The job-matching model generates turnover as the phenomenon of optimal reassignment caused by the accumulation of better information with passage of time. (Jovanovic, 1979, p. 974)

Importantly, Mortensen continued to focus on matching as a function of searching. In 1994, he was joined by Christopher Pissarides for a landmark publication titled, *Job Creation and Job Destruction*. The matching model proposed in this report and subsequently refined by Peter Diamond, became known as the DMP model (Mortensen, 2011). The DMP model—which accounted for marketplaces frictions including the cost of searching for alternatives, wages, and benefits—is still "widely accepted as the most realistic account of unemployment," according to Stanford University Economist, Robert Hall (2012). The DMP model represented more than 30 years of leading research in the field of match quality and unemployment. For their efforts, Diamond, Mortensen, and Pissarides were awarded the Nobel Prize for Economics in 2010 (Mortensen, 2011).

While Mortensen and Jovanovic focused on the information gathering aspects of Gale and Shapley's research, Alvin E. Roth concentrated on the marketplace writ large. Like Mortensen and Jovanovic, Roth began studying matching procedures in the 1970s and quickly emerged as an industry leader. His success in developing efficient marketplaces to efficiently match medical residents, clinical psychologists, judicial law clerks, and vital organ donors, is well documented (Stanford, 2018).

Roth summarized his research on matching markets in a publication appropriately titled, *What have we learned from market design?* (2007). In this report, Roth concluded that efficient matching markets accomplished the following:

> 1. provide thickness – that is, they need to attract a sufficient propotion of potential market participants to come together ready to transact with one another.
> 2. overcome the congestion that thickness can bring, by providing enough time, or by making transaction fast enough, so that market parparticipants can consider enough alternative possible transactions to arrive at satisfactory ones.
> 3. make it *safe* to participate in the market as simply as possible
>
> a. as opposed to transacting outside of the marketplace, or
> b. as opposed to engaging in strategic behavior that reduces overall welfare (Roth, 2007, p. 2)

Roth's efforts to research and establish a framework for matching market design was highly influential. In 2012, Alvin Roth and Lloyd Shapley (original author of the game theoretic matching model) were awarded the Nobel Prize for Economics.

2. Empirical Research, Economics

In 1980, one of the first empirical studies on job matching from an economic perspective was published in the Harvard Business Review. Greenberg and Greenberg (1980) drew a random sample of 18,000 individuals, from a population of 360,000 workers in the United States, Canada, and Western Europe, across 14 industries. The team tracked two categories of individuals in the work force, those whose personal characteristics were matched, and those whose personal characteristics were *not* matched, with the functional requirements of the job. They tracked these two types of employees in high and low turnover occupations.

The results of their study are shown in Figure 12. The research team found that those who were matched performed at a higher level and experienced less turnover, in both high and low turnover industries, over both the short and long term.

Exhibit VI
Sales performance in low-turnover industries according to job matching

Measurement period after hiring	Performance quartile				Quit or fired
	1st	2nd	3rd	4th	
6 months					
Job-matched	9%	40%	32%	14%	5%
Not job-matched	2%	17%	25%	31%	25%
14 months					
Job-matched	22%	48%	16%	6%	8%
Not job-matched	1%	9%	21%	35%	34%

Note: Sample sizes – 1,980 people who were job-matched and 3,961 who were not job-matched.

Exhibit VII
Sales performance in high-turnover industries according to job matching

Measurement period after hiring	Performance quartile				Quit or fired
	1st	2nd	3rd	4th	
6 months					
Job-matched	11%	28%	23%	14%	24%
Not job-matched	2%	10%	18%	24%	46%
14 months					
Job-matched	19%	42%	7%	4%	28%
Not job-matched	1%	6%	14%	22%	57%

Note: Sample sizes – 4,362 people who were job-matched and 8,740 who were not job-matched.

Figure 12. Literature Review, Greenberg and Greenberg Sales Performance in Low and High Turnover Industries According to Job Matching. Source: Greenberg and Greenberg (1980, p. 12).

The study did not describe the process which was utilized to match employees in this research. However, to improve job match quality, Greenberg and Greenberg recommended that firms consider the requirements of the job and the, "qualities a person must have to perform well and be happy doing the work" (1980, p. 131). The team also added that it was, "more important to assess the personality qualities of a person," by comparison to appearance or experience (1980, p. 133).

In 1988, Akerlof at al., published a landmark report entitled *Job Switching and Job Satisfaction in the U.S. Labor Market.* This study drew a sample from the National Longitudinal Survey of 5,020 males, who were surveyed 12 times, between 1966 and 1983 (p. 541). Akerlof et al.'s research was intended to explore the motive for job switching and the role of nonpecuniary rewards in this decision to switch jobs.

To get a better understanding of job switching, the team calculated the correlation between, "the log of the quit rate and the log of the civilian unemployment rate from January 1948 through December 1981" (p. 530). They determined the simple correlation between the two statistics to be -0.74, the correlation between the growth of the two data points to be -0.34, and found the standard error for both statistics to be 0.05. See Figure 13.

In turn, Akerlof et al. concluded an *inverse* relationship between the unemployment rate and the quit rate. The team offered the following explanation for this phenomenon: "Quits increase as opportunities expand; the opportunities for job switching are significantly greater when unemployment is low than when it is high" (p. 497).

Figure 13. Literature Review, Akerlof et al., Quits and Unemployment. Source: Akerlof et al., p. 531 (1988).

Having concluded job switching was more prevalent during periods of low unemployment, the team shifted focus to determine the underlying cause of this switch. Data was drawn from a representative sample of workers who were specifically queried about their level of job satisfaction, attitude regarding their present work, and reason for switching or exiting the labor force. Akerlof et al.' found statistically significant evidence that

- "Over 80 percent of those who liked their jobs cite a nonpecuniary reason as the primary cause of their satisfaction" (p. 543).
- "Among those who disliked their jobs, in over 80 percent of the cases, the culprit is nonpecuniary" (p. 543).
- 57 percent of those who quit "reported job-related motives for quitting. Approximately 75 percent of this group were primarily motivated by nonpecuniary reasons" (p. 553).

The research then conducted econometric analysis to validate these results. In their "benchmark econometric" model, Akerlof et al. found that pecuniary and NPR were jointly and independently significant determinants of worker satisfaction. More importantly, it found that pecuniary and NPR equally predicted satisfaction in 1966, and that NPR had a larger effect on satisfaction in 1971 (Akerlof et al., 1988).

Akerlof et al.'s conclusion regarding the prevalence of job switching as unemployment decreases has important implications for the present research. This is particularly relevant to the U.S. military as servicemember retention also decreases as the economy expands (DOD, 2020). Assuming servicemember preferences mirror those of the subjects included in Akerlof et al.'s study, NPRs like "congenial coworkers; hours; working conditions; supervision; company policy; good union; [and] meeting interesting people," are of greater importance than wage (p. 543). This is particularly noteworthy as insight, as military officers of the same rank and MOS community earn the same wage.

Lastly, in many ways, Akerlof et al.'s has important implications for Mortensen and Jovanovic's research completed more than a decade earlier. Within the context of Akerlof et al.'s research it is clear individuals gained further information, both as they experienced the match and as they searched for alternatives, particularly regarding pecuniary and nonpecuniary rewards. The consequence of the inability to capture these dynamics in a matching process or marketplace are also evident.

In 1993, Dr. John Bishop of Cornell University conducted empirical research to "examine how government can facilitate better job matching." His report, entitled *Improving Job Matches in the U.S. Labor Market*, analyzed a database of more than 2,500 firms from the National Federation of Independent Business (NFIB). Bishop utilized the dataset's turnover, performance, and worker attribute figures to conduct regression analysis across a range of occupational trades.

Overall, the analysis found that, "better measures of work habits, occupational skills, and the ability to learn new occupational and job skills should reduce the mismatches between workers and jobs and the disappointments and turnover that result" (Bishop, 1993, p. 354). In other words, employers who focused on accurately measuring and predicting

these attributes, were likely to generate the highest quality matches; or at least experience "smaller negative productivity surprises" (p. 353).

In 2009, Ofer Malamud conducted particularly relevant research on career outcomes. His report *Discovering One's Talent: Learning from Academic Specialization,* compared the probability of job switching between individuals with early and late academic specialization. Data for Malamud's research was primarily drawn from the 1980 National Survey of Graduates and Diplomates, a dataset of approximately 8,000 college graduates in the United Kingdom. This dataset was ideally suited for Malamud's research as English and Welsh universities require students to "apply to a specific field of study…while still in secondary school," while Scottish students, "are required to study several different fields during their first two years before specializing in a particular field" (Malamud, 2009, p. 3). This provided the opportunity to compare the difference in career outcomes between those that specialized in an academic field early and those who specialized just two years later.

To carry out this study, Malamud created a dummy variable *SWITCH, "*defined as 1 if the occupational field is different from the field of study at university, and 0 otherwise." He then regressed this variable on several controls including demographic characteristics, socioeconomic status, and field of study (Malamud, 2009). Malamud discovered the following:

- "I find that individuals from Scotland, who specialize relatively late, are less likely to switch to an unrelated occupation than their counterparts from England…In contrast, I find no difference in the probability of switching between England and Wales where the timing of academic specialization is similar" (p. 3).

- "The estimated difference in field switching between England and Scotland from the preferred 2SLS specification is approximately 6 percentage points, which is substantial considering that the rate of field switching in Scotland is about .42" (p. 18).

Like Akerlof et al.'s study, Malamud's research underscored the importance of experience and the search for alternatives when matching. As individuals experienced the match, learned more about their own talents and proclivities, they evolved, and their preferences changed. Then, as they compared their present match against an alternative, they realized a better opportunity may be available.

The important implication for the present study were the negative long term consequence experienced both those who were afforded less time to experience and compare alternatives. An ideal occupational matching model must appropriately account for the human dynamics of experience, learning, and growth, while also considering the restraint of time, to generate an optimal match.

3. A Review of Economics Literature

While the vocational psychology literature focused on the counselor, the individual, and the ability to collect, analyze and classify information, the economic literature addressed matching processes from a marketplace perspective. This started with Gale and Shapley's Nash equilibrium model in 1962 and was later refined and honed by Roth from the 1980s through the present. Accounting for the marketplace attributes proposed by Roth are particularly important to the present study as the demand for certain Marine Officer MOSs generally exceeds the allocated supply.

More importantly, the research also addressed the role of individual and organizational growth and evolution. As time passes, these two agents in the marketplace continuously collect information through experience and by comparing the present match to possible alternatives. This is particularly relevant to the present study, as occupational assignments are typically permanent, or at least long term in nature, with little accommodation offered for switching MOSs.

The empirical analysis appears to substantiate these theories. Individuals who are job-matched experience less turnover by comparison to those who are not job-matched (Greenberg and Greenberg, 1980). Furthermore, it suggested that to generate match quality, firms should consider the requirements of the job (Greenberg and Greenberg, 1980;

Bishop, 1993), personality (Greenberg and Greenberg, 1980), and the ability to learn new skills (Bishop, 1993).

The empirical analysis also substantiates the experience and search theory. As Malamud and Akerlof et al.'s research indicates individuals are not static, they continue to learn, grow, and evolve after the match is formed. An optimized matching approach must consider this dynamic aspect.

C. MILITARY RESEARCH LITERATURE

In 2009, Wardynski, Lyle, and Colarusso were prompted by evidence of critical shortfalls in the U.S. Army officer corps. Even more startling, this team confronted the reality that "continuations on active duty past the commissioning obligation [were] lowest among the junior officers that the U.S. Army invested the most in" (2009, p. v), as shown in Figure 14.

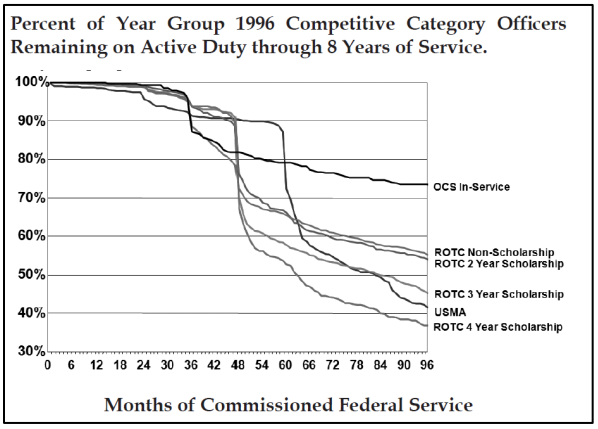


Figure 14. Literature Review, Percent of Army Officers Remaining on Active Duty through 8 Years of Service, by Commissioning Source. Source: Wardynski et al. (2009, p. 5).

Ultimately, the U.S. Army confronted the phenomenon demonstrated in Akerlof et al. and Malamud's research, regarding experience and the search for alternatives. As former Cadets generated experience and considered alternatives, they continued to gain information, learn, and grow. Upon doing so, they discovered career options that provided

equal or better pay and aligned more closely with their skillsets beyond the U.S. Army. Wardynski et al., summarized this realization in the following manner:

> The Army paid for the undergraduate education of these officers due to their demonstrated intelligence, leadership potential, and high aptitudes for learning. Coupled with the education and training provided by the Army, these characteristics are in demand everywhere and are aggressively sought by outside employers. As these officers have the greatest range of employment options, they more often exercise those options when their Army careers fail to meet their expectations. (2009, p. 4)

The authors identified this as a match-quality problem. They proposed a comprehensive and revolutionary solution that recognized "the need for institutional adaptability to foster and benefit from deeper officer competencies…and creates an environment in which talent attributes evolve and grow over time." In summary, the authors set out to develop a talent management strategy that would place "the right talent in the right job at the right time" (p. vi).

In this study conducted in 2009, job-matching addressed the alignment of individuals with the optimal job, for those who were already assigned an occupational specialty and were presently in the operating forces. To do so, the authors proposed an "information-enabled" internal market "in which consumers can demand and suppliers can provide talent" (p. 35) Though the author's reference to match quality is for a separate occasion from that of the present study, it was the first known mention of "matching" in military sponsored research and inspired follow-on study.

However, just 7 years later, the same organization provided a more specific solution to optimize the assignment of individuals to occupational fields. OEMA's goal in developing this process was to gather "detailed information on the unique talents possessed by each new officer, as well as on the unique talent demands of each Army basic branch," and to create a "'talent market' that identifies and liberates the strengths of every officer, placing each into the career field where they are most likely to be engaged, productive, and satisfied leaders" (Colarusso et al., 2016, p. ix).

OEMA's research resulted in a "talent-based" model for branch assignment; appropriately named "Talent-Based Branching." They perceived talent as an individual's skills, knowledge, and behaviors, as shown in Figure 15.

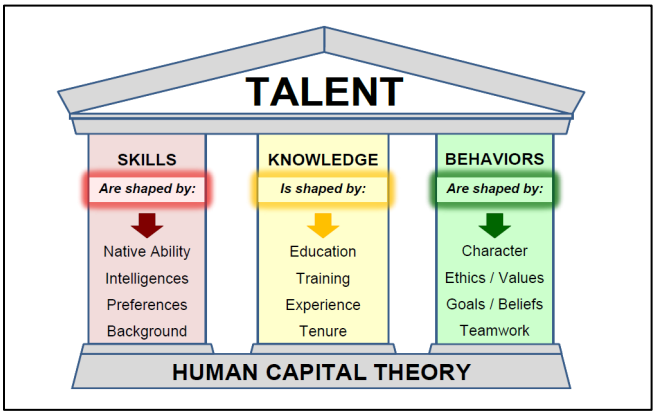


Figure 15. Literature Review, The Dimensions of Individual Talent. Source: Colarusso et al. (2016, p. 15).

Overall, the branching process consisted of three distinct phases: Branch Education and Mentorship, Integrative Talent Assessment and Branch Recommendations, and Branch Assignments. This occupational assignment process captures many important features. To help students gain a better understanding about an ideal future occupation, they are provided information about each branch through various forms of media. They are also administered a 3-hour "Talent Assessment Battery." This informs both the cadet and the U.S. Army of the occupation's which best align with an individual's talents.

After the submission of preferences, each candidate's branch preferences are analyzed by a team of human-resource professionals, who then provide additional feedback to the future officer. In a significant departure from the legacy system, the branch's preferences for the individual are also taken into consideration. They "signal their interest in each cadet…via a five-point Likert-scale recommendation, ranging from 'must select' to 'do not select'" (Colarusso et al., 2016, p. 28). This phase concludes when both the branch and individual's preferences have been submitted. The assignment process then

proceeds utilizing a deferred-acceptance algorithm, originally researched and popularized by Roth (1982).

Although long term data to determine the efficacy of the Talent Based Branching program is not yet available, Colarusso et al., provided results from approximately 3,000 cadets, across three graduating classes from West Point (2016). The team noted that across all three classes

> "Roughly 40 percent of cadets changed their top preference…[and] Nearly 90 percent changed at least one of their top three branch preferences and 97 percent changed at least one of their top five branch preferences" (Colarusso et al., 2016, p. 32).

More interestingly, "80% of cadets received their top branch choice compared to 77% for graduating classes from the last 4 years of the legacy" system (Colarusso et al., 2016, p. 32). This is a significant departure from the estimated 44% of Marine Officers who are assigned their first choice in the present MOS assignment process used at TBS.

The results also increased satisfaction on the supply, or branch side, of the market. The following data demonstrates the attainment of each branch's, "centerpiece talent (mental toughness, physical fitness, problem solving, etc.)" (Colarusso et al., 2016, p. 34). Figure 16 demonstrates that 9 of the 17 branches met or exceeded their goal.

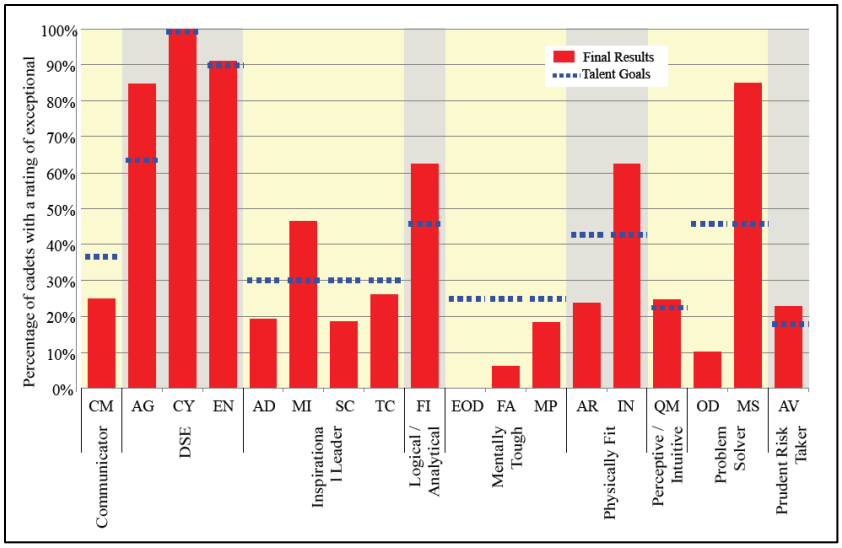


Figure 16. Literature Review, Share of West Point Cadets Possessing Primary Talent Requirement by Branch. Source: Colarusso et al. (2016, p. 35).

Overall, the OEMA's new approach demonstrated benefit for both the individual soldier and the service writ large. It is important to note the unique features of this system, to include the informational materials, cognitive and non-cognitive talent assessment battery, feedback loops, and two-sided market involvement. These components serve to discern one individual's strengths from another and generate information symmetry between the individual and the service. A secondary benefit of the program is the wealth of individual talent data that is collected. If properly harnessed this could also provide long term benefit for both the service and the individual.

D. LITERATURE REVIEW SUMMARY

A review of both economic and psychological literature has several important implications for the development of an optimal matching process. One of the most important findings is that understanding the individual only represents one component of the process. The other component is the marketplace. A review of the literature in both disciplines was vital to uncovering this important concept.

The literature indicates several important concepts to consider when confronting the challenges presented by the level of heterogeneity and degree of uncertainty in

matching problems. In summary, the vocational psychology and economic literature suggests the following:

- Incorporate methods to harvest information about the individual, to include, personality traits, cognitive ability, background experience, and natural ability (Parsons, 1909; Paterson, 1957; Holland, 1979; Barrick & Mount, 2000; Anderson et al., 2004; Viswesvaran, Deller & Ones, 2007; Borghans et al., 2008).

- Develop a framework or structure to efficiently allocate MOSs within a competitive market (Roth, 2007).

- Identify key occupational skills and abilities for each MOS to efficiently match individuals with occupations (Parsons, 1909; Ployhart & Schneider, 2012). This concept is supported by the ability to assess and measure an individual's personality and abilities in a cost-effective manner (Ployhart & Schneider, 2012).

- Individuals are not static, their personality, cognitive ability, preferences, and characteristics will evolve over time. This change is the result of experience and the opportunity to compare alternatives. Organizations must gather sufficient individual data to address this dynamic aspect of matching. (Mortensen, 1978; Jovanovic, 1979, Akerlof et al., 1988; Malamud, 2009; Quoidbach, Glibert, & Wilson, 2013).

TBS's current matching model departs from the existing psychological and economic literature in many ways. While TBS does evaluate young officers through physical fitness tests, academic examinations, and combat-like field exercises, it does not currently test for personality and does not include cognitive ability in its MOS assignment process. Aside from infantry skills, it does not specifically test for any specific occupational skills. It also forces an even allocation of MOSs across each of the "thirds," a potentially inefficient approach by comparison to a market that allows transactions to flow more freely. Given the concepts provided in the literature, especially those presented by

Mortensen, Jovanovic, and Epstein, TBS's present MOS assignment model is better suited to provide a worthwhile short-term match, rather than a sustainable long-term match.

The literature is clear about the risk associated with poor matching methods or match quality. Spokane, Meir, and Catalano's (2000) meta-analysis found that lower job satisfaction, well-being, and productivity were associated with poor matches. Greenberg and Greenberg (1980) found that individuals who were not properly matched experienced higher turnover. Lastly, Akerlof et al. (1988) and Malamud (2009) demonstrated an individual's willingness to switch to generate a higher quality match.

These are important considerations for the Marine Corps. As the smallest branch of service, the Marine Corps must identify methods to maximize retention, productivity, satisfaction, and well-being, without pecuniary rewards. As the literature indicates, match quality provides a solution to this dilemma.

The U.S. Army's talent-matching approach demonstrates a plausible solution for the Marine Corps. OEMA's use of a Talent Assessment Battery to test for personality traits, occupational abilities, and cognition; team of human resources professionals used to analyze personal data and identify appropriate matches; and efficient, two-sided market structures comprehensively addresses the matching concepts identified earlier in this section. Furthermore, early empirical analysis demonstrates their ability to match individuals with their preferred option, far exceeds the present TBS MOS assignment model.

The present study extends this body of literature by completing the first occupational match quality research on Marine Corps officers. This includes an exploration of whether or not the Marine Corps experiences similar negative consequences with regard to longevity and performance as that presented in the literature. It also identifies matching methods that may be realistically applied at TBS to improve match quality.

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IV. RESEARCH QUESTION 1

Research Question 1: How does match quality, as measured by MOS preference received, impact a Marine Corps Officer's length of service and performance in the operating forces?

This chapter provides an overview of the data sources, variables, and methodology associated with Research Question 1. It also provides the results and associated limitations of this analysis.

A. DATA

1. Data Sources

Research question 1 addresses the statistical relationship between MOS preference, and an individual's performance and length of service, through multiple linear and multivariate logistic regression analysis. To conduct these regressions, data is drawn from two sources: Marine Corps Training and Education Command (TECOM) and the Marine Corps Total Force Data Warehouse (TFDW).

TBS, the venue which conducts the MOS assignment process, is an organization within TECOM. To support research efforts, TECOM began collecting, cleaning, and assembling an extensive dataset of more than 70 different student MOS preference, performance, demographic, and commissioning source metrics. In turn, this dataset offered the most relevant and reliable data to support this research. Information for approximately 16,400 students who graduated from TBS between January 1, 2010 and December 31, 2020 was provided.

The TECOM dataset provides the most critical variable to the analysis, the "MOS preference received" variable, which indicates the MOS each student preference received, on a scale between one and 25. It also provided multiple measures of performance, to include academic, military, and leadership grade point averages; and class standing, represented both lineally and by TBS "third." Given that the report's objective is to

measure match quality's impact on Marine Corps officers, the TECOM data serves as the base data set, onto which TFDW data is merged.

TFDW is a central repository of information that collects more than 6,000 data points from approximately 25 different Marine Corps data systems, monthly (Garrick, 2014). For this analysis, TFDW provides approximately 25 career outcome variables to include all available FITREP scores and length of service metrics for each of the 16,402 observations in the TECOM data set. Among these variables, "average relative value" and "years of commissioned service" are identified as key response variables.

2. Data Merging and Cleaning

Although the TECOM data set provides approximately 16,402 observations, it is necessary to exclude 7,186 of these observations. This includes approximately 1,013 officers in the Marine Corps Reserve and 4,561 Naval Aviators, Naval Flight Officers, and Judge Advocates General, as this study focuses on active-duty personnel who are not guaranteed an occupational specialty at TBS. Approximately 1,369 individuals are excluded, as they have not yet received a quantifiable evaluation of their performance (they have not received a measurable FITREP score). Lastly, approximately 266 entries are not incorporated into the final sample, as their MOS preference is listed as "0," their TBS academic GPA is greater than 100, or their data contained other miscellaneous errors. Table 4 summarizes the results of the data cleaning process.

Table 4. Research Question 1, Data Cleaning Results

	Observations	**Percent of Initial Sample**
Initial Sample	16,402	100%
Marine Corps Reservists	1,013	6.18%
Naval Aviators and Flight Officers	4,121	25.12%
Judge Advocate Generals	440	2.68%
No observed FITREP	1,369	8.35%
International Officers	2	0.01%
MOS Preference of "0"	51	0.31%
TBS Academic GPA > 100	190	1.16%
Final Sample	**9,216**	**56.19%**

3. Variable Descriptions

This section provides a description of the variables included in the regression analysis. It begins with a summary statistics table (Table 5) of each of the variables after which a section is provided to describe and summarize each grouping of variables.

Table 5. Research Question 1, Dependent and Independent Variable Table

Variable	Type	Description	Mean	Std. Dev.	Range	Freq
Dependent Variables						
Performance	Cont.	Average relative value	92.305	4.3	80 - 100	N/A
YrsComm5	Binary	Commissioned (Comm.) service ≥ 5 years	0.727	0.446	1, 0	6,700
YrsComm6	Binary	Comm. service ≥ 6 years	0.633	0.482	1, 0	5,837
YrsComm7	Binary	Comm. service ≥ 7 years	0.552	0.497	1, 0	5,085
YrsComm8	Binary	Comm. service ≥ 8 years	0.453	0.498	1, 0	4,179
YrsComm9	Binary	Comm. service ≥ 9 years	0.324	0.468	1, 0	2,983
YrsComm10	Binary	Comm. service ≥ 10 years	0.177	0.382	1, 0	1,631
YrsComm11	Binary	Comm. service ≥ 11 years	0.064	0.245	1, 0	593
Variables of Interest						
MOS_Pref_Rcvd	Cont.	MOS preference (pref.) received	1.95	29.159	1 - 25	
MOS_Pref_Rcvd_1	Binary	Received first MOS pref.	0.506	0.5	1, 0	4,663
MOS_Pref_Rcvd_2	Binary	Received second MOS pref.	0.174	0.379	1, 0	1,603
MOS_Pref_Rcvd_3	Binary	Received third MOS pref.	0.11	0.313	1, 0	1,012
MOS_Pref_Rcvd_ 4orGreater	Binary	Received fourth or greater MOS pref.	0.21	0.408	1, 0	1,938
Control Variables						
Commission_EnlProg	Binary	Enlisted to officer program.	0.127	0.333	0	1,173
Commission_ OCSOCCPLC	Binary	Direct commissioning program (OCS, OCC, PLC)	0.499	0.5	1, 0	4,595
Commission_ OtherReserve	Binary	"Other" program or Marine Corps Reserves	0.047	0.211	1, 0	1,648
Commission_ROTC	Binary	ROTC program	0.179	0.383	1, 0	432
Commission_ SvcAcademy	Binary	Service Academy (USNA, USMA, USAFA)	0.148	0.356	1, 0	1,368
Demo_Age	Cont.	Officer's current age	24.401	2.921	20 - 39	N/A
Demo_EDU_ MoreThanBach	Binary	More than Bachelor's degree	0.017	0.13	1, 0	158
Demo_Gender	Binary	Female, Male	0.103	0.304	1, 0	951
Demo_Race_NonWhite	Binary	Non-White, White	0.253	0.435	1, 0	2,332
PriorEnlisted	Binary	Officer enlisted prior to commissioning	0.146	0.353	1, 0	1346
TBS_Third_Bottom	Binary	Graduated in bottom third	0.331	0.471	1, 0	3,051
TBS_Third_Middle	Binary	Graduated in middle third	0.323	0.467	1, 0	2,973
TBS_Third_Top	Binary	Graduated in top third	0.346	0.476	1, 0	3,192
i.TBSClassYear	Binary	TBS Class Year, 2010 - 2020	2013.84	2.583	2010, …, 2020	N/A

a. Dependent (response) variables

Research Question 1 explores MOS preference's impact on length of service and performance, respectively. Therefore, two key response variables are necessary, length of service and performance. Both variables are taken from the TFDW data set.

To explore length of service, binary variables are generated to account for whether an individual surpasses a given number of years of commissioned service. Variables of this nature provide the opportunity to determine the probability that an individual completes a given number of years of commissioned service, given their MOS preference received, using multivariate logistics regression analysis.

Of note, the length of service variables begin at year five and terminate at year 11. This interval is chosen as years of commissioned service peak at years four and nine, respectively, as shown in Figure 17. Overall, average years of commissioned service in the final sample is 6.74 years.

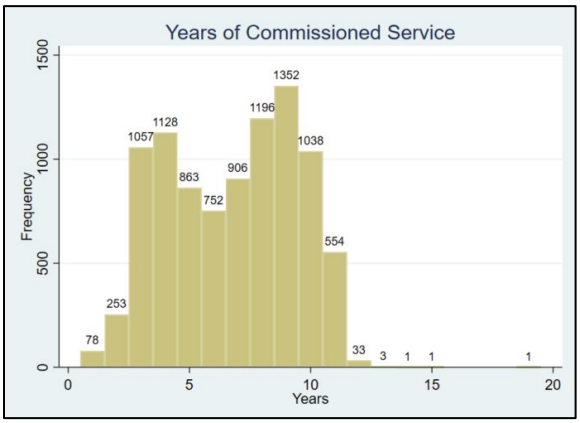

Figure 17. Research Question 1, Statistics: Years of Commissioned Service

To explore performance, a continuous variable from the TFDW data set was selected. This variable reflects an individual's average RV, across all available FITREP scores, as recorded at the time the FITREP was processed. Overall, the average RV in the final sample is 92.305.

b. Variables of interest

The most critical set of independent variables, which indicate MOS preference received, is drawn from the TECOM data set. This set of variables is used to measure the impact of MOS preference on either performance or length of service.

At TBS, students are required to rank each of the MOS for which they qualify. In turn, it is possible to receive an MOS preference between one and 25. However, this variable is not treated as a continuous variable during this analysis for two reasons. First, as shown in Figure 18, nearly 88% of observations are accounted for within the first five MOS preferences. In turn, a linear relationship between MOS preference and performance or length of service, cannot be assumed for the purpose of regression analysis.

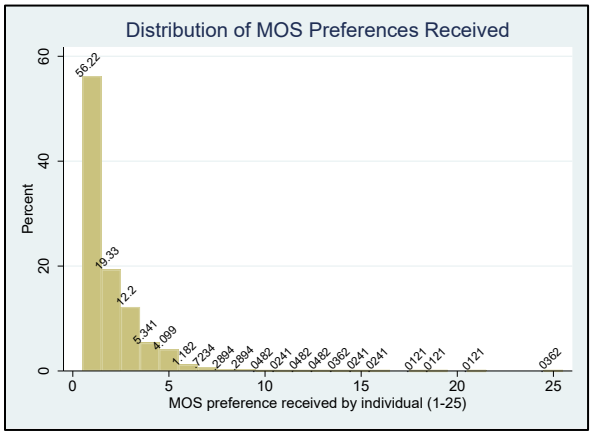

Figure 18. Research Question 1, Statistics: Histogram of MOS Preference Received

Second, TBS did not account for preferences beyond the fifth rank in 2010 and 2011 and did not do so beyond third rank in 2012, as shown in Table 6. Therefore, approximately 10% of the final sample received an MOS preference between four and 25, but their exact MOS preference rankings after the fourth preference is unknown.

Table 6. Research Question 1, Statistics: MOS Preference by TBS Class Year

MOS Preference (1-25) by TBS Class Year (2010-2020)											
	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
1	434	553	505	537	476	512	544	664	364	64	10
2	195	181	171	163	200	185	179	206	100	22	1
3	113	111	126	106	116	97	132	128	68	15	0
4	71	33	0	40	75	56	67	59	31	10	1
5	71	35	0	32	53	55	36	26	19	8	5
6	0	0	0	5	19	30	16	9	17	1	1
7	0	0	0	5	1	25	11	3	12	2	1
8	0	0	0	1	2	11	2	1	2	4	1
9	0	0	0	2	2	10	1	0	8	1	0
10	0	0	0	0	0	3	0	1	0	0	0
11	0	0	0	0	0	1	0	0	0	1	0
12	0	0	0	0	0	2	1	0	1	0	0
13	0	0	0	0	0	2	0	0	1	1	0
14	0	0	0	0	1	2	0	0	0	0	0
15	0	0	0	0	0	0	0	0	1	1	0
16	0	0	0	0	0	0	0	0	2	0	0
18	0	0	0	0	0	1	0	0	0	0	0
19	0	0	0	0	0	1	0	0	0	0	0
21	0	0	0	0	0	0	0	0	1	0	0
25	0	0	0	0	0	0	0	0	3	0	0
Unk	112	338	363	108	0	1	0	0	0	0	0
Total	**996**	**1251**	**1165**	**999**	**945**	**994**	**989**	**1097**	**630**	**130**	**20**

To account for this non-linear relationship, and the 922 observations for which an exact MOS preference is unknown, indicator variables are generated from the generic MOS preference variable (*MOS_Pref_Rcvd*). These account for the assignment of a first, second, third, or fourth or greater MOS preference, respectively. This also provides the opportunity to properly account for the individuals who have been assigned an MOS preference beyond the third rank, but whose actual numerical preference rank is unknown.

c. Control Variables

(1) Commissioning Source Variables

Commissioning source data is drawn from the TECOM data set. Binary variables are generated for each of the categories listed inside TFDW's commissioning source variable. Of note, approximately 52% of the final sample graduated from the Officer Candidate School (OCS), Officer Candidate Course (OCC), or Platoon Leader's Course (PLC). In turn, this cohort represented the largest commissioning source and serves as the baseline commissioning source during regression analysis.

(2) Demographic Variables

Demographic data, to include age, gender, education, and race is drawn from the TECOM dataset. Most demographic variables are binary, except age, which is continuous. The final sample is composed of 8,265 (89.7%) males and 951 (10.3%) females. The average age is approximately 24 years, while the median is 23. Only approximately 158 of the 9,167 individuals (1.7%) earned more than a bachelor's degree. Given that those who identified as "white" accounted for nearly 75% of the population, a binary variable for race has been created to account for those who identified as "white" and "non-white."

(3) Prior Enlisted Variable

A prior enlisted variable is drawn from the TECOM data set. This is a binary variable used to indicate an officer's prior enlisted service. This applies to approximately 15% of the final sample.

(4) TBS Performance Variables

Individual TBS performance data is drawn from the TECOM dataset. As discussed in the background section of this report, an individual's academic, military skill, and leadership GPAs comprise an individual's class standing. This class standing is then used to categorize an individual into either the top, middle, or bottom third. In turn, top, middle, and bottom "third" variables are generated to capture TBS's unique, quality distribution, MOS assignment model.

(5) TBS Class Year

TBS class year, which represents the fiscal year in which the officer attended TBS, is also drawn from the TECOM data set. This variable, *TBSClassYear*, is employed as a categorical variable during regression analysis to account for differences across fiscal years. Table 7 provides the number of observations by year.

Table 7. Research Question 1, Statistics: Count of Individuals by TBS Class Year

i.TBSClassYear	Freq	Percent	Cumulative
2010.TBSClassYear	996	10.81%	10.81%
2011.TBSClassYear	1,251	13.57%	24.38%
2012.TBSClassYear	1,165	12.64%	37.02%
2013.TBSClassYear	999	10.84%	47.86%
2014.TBSClassYear	945	10.25%	58.12%
2015.TBSClassYear	994	10.79%	68.90%
2016.TBSClassYear	989	10.73%	79.63%
2017.TBSClassYear	1,097	11.90%	91.54%
2018.TBSClassYear	630	6.84%	98.37%
2019.TBSClassYear	130	1.41%	99.78%
2020.TBSClassYear	20	0.22%	100.00%
Total	9,216		

d. MOS preference trends (not included in regression analysis)

Although specific MOSs are not included in the regression analysis, it is worth examining the trends among first, second, and third MOS preferences. These are displayed in Table 8. Interestingly, individuals overwhelmingly selected the infantry community as their first MOS choice, however, it is not listed among the top five preferences chosen as a second MOS preference, nor is it listed in the top ten among third MOS preferences. By comparison, combat engineer, artillery and logistics are consistently selected within the top five across all MOS preferences. Recall from Table 5 (Section 3) that approximately 50.5% percent of individuals in the final sample are assigned their first preference.

Table 8. Research Question 1, Statistics: Top 10 First, Second and Third MOS Preferences

First MOS Preference			
	MOS	Freq.	Percent
1	0302	2059	22.41
2	1302	877	9.55
3	0402	848	9.23
4	0204	729	7.94
5	0802	610	6.64
6	1802	486	5.29
7	5803	447	4.87
8	0203	427	4.65
9	0206	349	3.8
10	0602	345	3.76

Second MOS Preference		
MOS	Freq.	Percent
1302	1087	11.9
0402	974	10.67
0802	926	10.14
0203	785	8.6
1802	649	7.11
0204	635	6.95
0302	554	6.07
0206	443	4.85
0207	418	4.58
1803	359	3.93

Third MOS Preference		
MOS	Freq.	Percent
1302	1104	12.09
0802	940	10.29
0402	748	8.19
1802	736	8.06
0204	665	7.28
0203	520	5.69
0207	520	5.69
1803	479	5.24
6602	370	4.05
5803	369	4.04

B. MODEL 1: MOS PREFERENCE AND PERFORMANCE

The first model examines the statistical relationship between performance, as measured by FITREP RV, and MOS preference received using the same control variables. Multiple linear regression is most suitable for this analysis, given the continuous outcome associated with the dependent variable, *Performance.* This method provides the opportunity to explore the increase in RV, given an individual received their first, second, or third MOS preference, while controlling for commissioning source, demographics, race, whether an individual was prior enlisted, and TBS performance. This regression is represented by the following equation.

$$Y = \beta_0 + \beta_1 MOS\_Pref\_Rcvd\_1 + \beta_2 MOS\_Pref\_Rcvd\_2 + \beta_3 MOS\_Pref\_Rcvd\_3 + \beta_4 MOS\_Pref\_Rcvd\_4orGrtr + \delta_x X + \epsilon$$

where:

Y = Performance, as measured by relative value
β = Incremental effect on Y given MOS preference received
δ = Incremental effect on Y given commissioning source, demographic, prior enlisted service, and TBS performance data
ε = Prediction error term

1. Model 1, Hypothesis

A simple bar graph displaying the relationship between *Performance*, as measured by RV, and each of the *MOS_Pref_Rcvd_X* variables is provided in Figure 19. This basic representation indicates a positive relationship between MOS preference received

and performance, as measured by RV. While approximately 22% of individuals who receive their first MOS preference earn an average RV greater than 96 points, only approximately 17% of individuals who receive their fourth or greater MOS preference achieve the same mark.

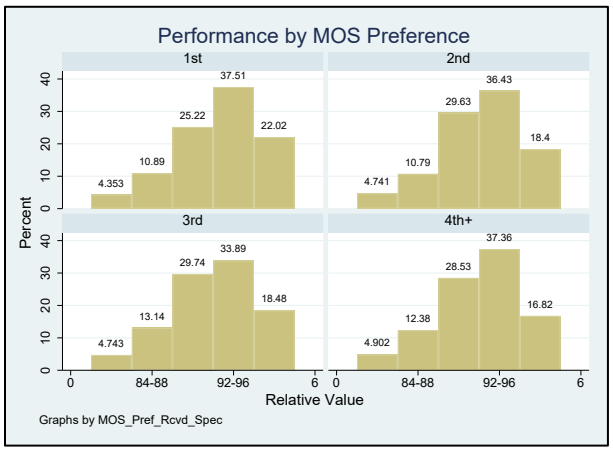

Figure 19. Research Question 1, Performance by MOS Preference Received

When controlling for demographics, commissioning source, and TBS performance, this regression analysis is expected to reveal a positive, statistically significant relationship between *MOS_Pref_Rcvd_1, MOS_Pref_Rcvd_2,* and *MOS_Pref_Rcvd_3* and performance as measured by RV. In other words, the effect of MOS preference on RV is expected to be greater than zero as represented by the alternative hypothesis (H_a).

$$H_o: \beta_1, \beta_2, \beta_3 = 0$$
$$H_a: \beta_1, \beta_2, \beta_3 > 0$$

2. Model 1, Results

This model examines the impact on performance, as measured by FITREP RV, given an individual received their first, second, third MOS preference, by comparison to individuals who received their fourth or greater MOS preference. An abbreviated table of the results is shown in Table 9; the full table of results is shown in the Appendix.

Table 9. Research Question 1, Models: Performance Model Results

Iteration	**1**	**2**	**3**	**4**	**5**
n	9,214	9,214	9,214	9,214	9,214
Variables of Interest					
MOS_Pref_Rcvd_1[1]	0.723***	0.641***	0.601***	0.590***	0.293**
MOS_Pref_Rcvd_2	0.370*	0.342*	0.300*	0.295*	0.236
MOS_Pref_Rcvd_3	0.153	0.168	0.137	0.135	0.158
Controls					
TBS Class Year	X	X	X	X	X
Commissioning Sources[2]		X	X	X	X
Demographics (Age, Gender, Education Level, Race)			X	X	X
Prior Enlisted				X	X
TBS performance[3]					X

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

[1] *MOS_Pref_Rcvd_4orGrtr* is omitted to serve as baseline comparison

[2] *Commission_OCCOCSPLC* is omitted to serve as baseline comparison

[3] *TBS_Third_Bottom* is omitted to serve as baseline comparison

The results of this model reveal a modest, but statistically significant relationship between *MOS_Pref_Rcvd_1* and *performance*. Therefore, the null hypothesis that *MOS_Pref_Rcvd_1, MOS_Pref_Rcvd_2,* and *MOS_Pref_Rcvd_3* does not have a positive, statistically significant impact on *Performance* is rejected in favor of the alternative hypothesis.

According to the baseline model, which only controls for TBS class year, individuals who receive their first MOS preference can expect a 0.723-point increase in their RV, by comparison to individuals who receive their fourth or greater MOS preference. This benefit decreases to 0.293 points, as all controls are added but remains statistically significant at the $p < 0.001$ level of significance across all iterations. It is difficult to place this benefit into finite terms, as RVs are normalized report averages, across reporting seniors. However, it can safely be concluded that in the final model, the impact of being assigned your top preference is equivalent to an increase in less than one letter grade (B to C, or, C to D) for one FITREP PAR.

Aside from MOS preference, the final model also finds *Commission_EnlProg, Commission_SvcAcademy*, *Demo_Gender, Demo_EDU_MoreThanBach, PriorEnlisted,*

TBS_Third_Top, and *TBS_Third_Middle* to be statistically significant factors in increasing performance. In practical terms, these results indicate that an officer who is female, completed prior enlisted service, earned a master's degree, commissioned through an enlisted to officer program, graduated in the top third of her TBS company, and received her first MOS preference, would experience an 8.2-point RV advantage, by comparison to the baseline variables in each category.

It is important to note the positive, statistically significant effect of prior enlisted service. This finding may demonstrate the value of "experience" when generating preferences and forming a match, as suggested in the economic literature. Recall that according to the Jovanovic, individuals with experience – like those with prior enlisted service – benefit from "the accumulation of better information with passage of time" (1979, p. 974). Insight gained through experience may help reduce uncertainty, reveal the value of a prospective match, and more accurately shape an individual's preference for a prospective occupation. In this instance, the benefit of prior enlisted experience is more pronounced as approximately 80% of those who have prior enlisted service also commissioned through an enlisted to officer commission programming which is also found to have a positive and statistically significant impact on performance. In turn, individuals who match both of these criteria would expect, on average, to experience a 2.3-point increase in their RV, while holding other factors constant.

It is also important to note that the most significant change in MOS preference's impact on *Performance* occurs as the control for TBS performance is added. This suggests a statistical relationship between TBS performance and *Performance* in the operating forces. The two graphs shown in Figure 20 also demonstrate this relationship. Although TBS's MOS assignment model is designed to distribute quality evenly across each third, the graph on the left demonstrates that the top third of TBS graduates is assigned a significantly higher proportion of first MOS preferences. Individuals assigned their first preference account for nearly 60% of the top third, compared to just 42% from the bottom third. The graph on the right demonstrates the significant difference in performance, as measured by RV, between individuals who graduated in the top and bottom third respectively. Approximately 30% of top third graduates earned an average RV greater than

96 points, while only 11% of those in the bottom third have achieved the same mark. Together, these graphs signal TBS performance's association with MOS preference received, and performance in the operating forces, as measured by RV.

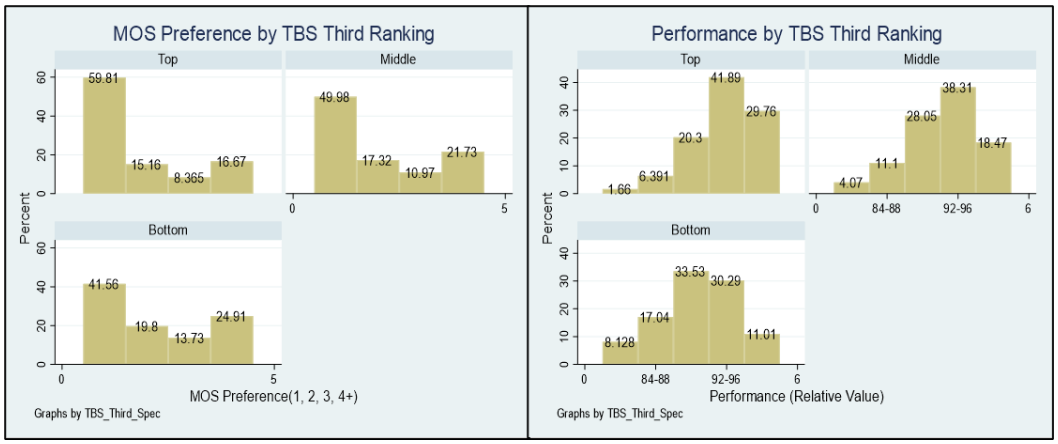

Figure 20. Research Question 1, MOS Preference by TBS performance and TBS performance by performance (RV)

In summary, these findings indicate that match quality, as measured by MOS preference received, is positively associated with performance, as measured by RV. In turn, improving the existing MOS assignment process's ability to generate match quality, may improve the overall level of performance among Marine Corps officers.

C. MODEL 2: MOS PREFERENCE AND LENGTH OF SERVICE

The second model examines the statistical relationship between length of service, represented as a series of binary variables, and MOS preference received, as represented by the four MOS preference indicator variables. To explore this relationship, multivariable logistic regression is most suitable, given the binary outcome associated with the dependent variables, *YrsComm [6-11]*. This method provides the opportunity to explore the probability of surpassing a specified length of service threshold, given an individual is assigned their first, second, or third MOS preference, while controlling for commissioning source, demographics, race, prior enlisted service, and TBS performance. Iterations for

each *YrsComm* variable are performed. This regression is represented by the following equation.

$$Pr\,(Y_t = 1) = \beta_0 + \beta_1 MOS\_Pref\_Rcvd\_1 + \beta_2 MOS\_Pref\_Rcvd\_2 + \beta_3 MOS\_Pref\_Rcvd\_3 + \beta_4 MOS\_Pref\_Rcvd\_4orGrtr + \delta_x X + \epsilon$$

where:

Y = Probability that an officer surpasses *t* years of commissioned service
β = Incremental effect on *Y* given MOS preference received
δ = Incremental effect on *Y* given commissioning source, demographic, prior enlisted service, and TBS performance data
ε = Prediction error term

1. Model 2, Hypothesis

A standard bar chart displaying the relationship between the *YrsComm [X]* variables and the *MOS_Pref_Rcvd_X* variables is provided in Figure 21. This rudimentary examination indicates a negative relationship between MOS preference received and longevity. Among those who received their first MOS preference, approximately 13.7% have six or more years of commissioned service, while approximately 9.4% have 11 or more years of commissioned service. By comparison, among those who received their fourth or greater MOS preference, approximately 12% have six or more years of commissioned service, while approximately 10.1% have 11 or more years of commissioned service. Overall, the proportion of individuals who received their first MOS preference decreases by approximately 4 percentage points, while the proportion of individuals who received their fourth or greater preference only decreases by approximately 2 percentage points, between *YrsComm6* and *YrsComm11.*

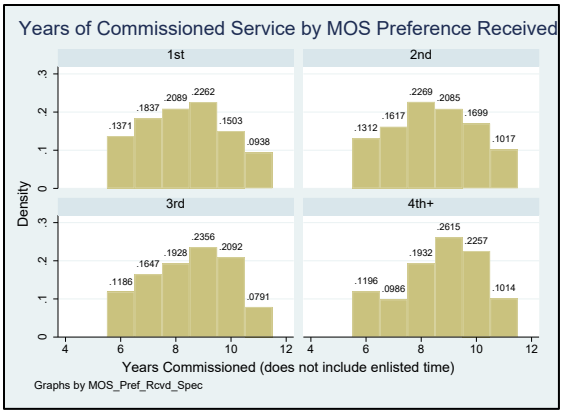

Figure 21. Research Question 1, *YrsComm [x]* by *MOS_Pref_Rcvd_X*

However, when controlling for demographics, commissioning source, and TBS performance, a positive, statistically significant relationship between *MOS_Pref_Rcvd_1, MOS_Pref_Rcvd_2,* and *MOS_Pref_Rcvd_3* and length of service is expected. In other words, β_1, β_2, and β_3 are expected to be greater than zero, as represented by the alternative hypothesis (H_a).

$$H_o: \beta_1, \beta_2, \beta_3 = 0$$
$$H_a: \beta_1, \beta_2, \beta_3 > 0$$

2. Model 2, Results

This model determines the odds of surpassing a specified number of years of commissioned service, given an individual received their first, second, third MOS preference, by comparison to individuals who received their fourth or greater MOS preference. An abbreviated table of the results, presented in terms of odds-ratios, is shown in Table 10; the full table of results is shown in the Appendix. Note that the number of observations decreases for each successive model, as individuals who are not be eligible to surpass the specified length of service, given their current time in service, are excluded. For example, individuals who attended TBS in 2017 are not included in the regression to determine the probability of surpassing five years of commissioned service.

Table 10. Research Question 1, Models: Length of Service Model Results

Dependent Variable: *YrsCommX*	5	6	7	8	9	10	11
Censor: *TBSClassYear* ≤	2016	2015	2014	2013	2012	2011	2010
n	6,952	6,350	5,356	4,411	3,412	2,247	996
Variables of Interest							
MOS_Pref_Rcvd_1 [1]	0.389***	0.516***	0.874	0.477***	1.080	0.917	1.179
MOS_Pref_Rcvd_2	0.472***	0.491***	0.837	0.933	1.224	0.993	1.057
MOS_Pref_Rcvd_3	0.376***	0.577**	0.730	0.747	1.708**	1.624*	0.567
Controls							
TBS Class Year	X	X	X	X	X	X	X
Commissioning Sources [2]	X	X	X	X	X	X	X
Demographics (Age, Gender, Education Level, Race)	X	X	X	X	X	X	X
Prior Enlisted	X	X	X	X	X	X	X
TBS performance [3]	X	X	X	X	X	X	X

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

[1] *MOS_Pref_Rcvd_4orGrtr* is omitted to serve as baseline comparison

[2] *Commission_OCCOCSPLC* is omitted to serve as baseline comparison

[3] *TBS_Third_Bottom* is omitted to serve as baseline comparison

The results of this model do not reveal a consistent, positive, statistically significant relationship between MOS preference and length of service. Therefore, the null hypothesis that the relationship between *MOS_Pref_Rcvd_1, MOS_Pref_Rcvd_2,* and *MOS_Pref_Rcvd_3,* and length of service is zero, across all length of service models, cannot be rejected.

Contrary to the expectation, the model reveals that individuals who receive their first, second, or third MOS preference demonstrate lower odds of surpassing *YrsComm5* and *YrsComm6*, by comparison to those who received their fourth or greater MOS preference. These results are all significant at the $p < 0.001$ level of significance, except for MOS_Pref_Rcvd_3 at *YrsComm6* which is significant at the $p < 0.01$ level of significance. *MOS_Pref_Rcvd_1* is also found to reduce the odds of surpassing eight years of commissioned service at the $p < 0.001$ level of significance.

It should be noted that neither gender, prior enlisted service, nor TBS performance are found to be consistent, positive, or negative, statistically significant predictors of length of service. The model only reveals that commissioning at a service academy is a consistent, negative, statistically significant predictor of length of service. This variable is found to

reduce the likelihood of surpassing 6, 7, 8, 9, 10, and 11 years of commissioned service at the $p < 0.001$ level of significance.

This result resembles Wardynski. et al.'s (2009) study of U.S. Army officers, which also found lower continuation rates in the U.S. Army among service academy graduates. Confronted by this trend, Wardynski et al. acknowledged that the skills necessary to attend and graduate from a service academy correspond with the same skills demanded by private industry. In turn, high performers – like those with the skills and determination to be selected for a service academy – are also most likely to have the broadest range of alternative employment options beyond the military (Wardynski et al., 2009).

Given Model 1's results on performance; Figure 20's depiction of the positive relationships between TBS ranking, MOS preference, and performance; and Wardynski et al.'s observations on length of service, it is prudent to examine the relationship between performance and years of commissioned service among Marine Corps officers. Figure 20 demonstrates that among those who completed at least six years of commissioned service, approximately 22% have an average RV greater than 96 points. By comparison, among those who have completed at least 11 years of commissioned service, only approximately 14% achieve the same average RV marks. Together, the results of Model 1 and the relationships demonstrated in Figures 20 and 22 suggest that while MOS preference is likely a proxy for performance, performance is also negatively associated with length of service.

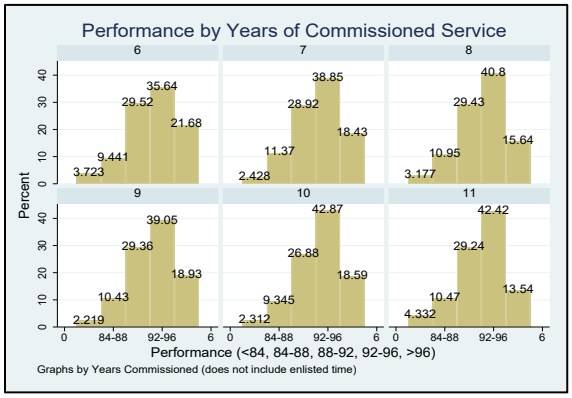

Figure 22. Research Question 1, *Performance* by *YrsComm [X]*

In summary, Model 2 indicates that match quality, as measured by MOS preference, does not appear to have a positive, statistically significant impact on length of service. The model also provides little insight, beyond commissioning through a service academy, into any other factors which may increase longevity. However, given collinearity between TBS performance, MOS preference received, and performance in the operating forces, Model 2 may not truly reveal match quality's impact on length of service.

It should also be noted when interpreting the results of Model 2, they are only indicative of an association between MOS preference received and surpassing the threshold of five and six years of commissioned service, respectively. It cannot be determined that being assigned a first, second, or third MOS preference *causes* departure from military service during any of the specified years.

3. Additional Analysis of Incremental Effects of Gender and Race

Additional analysis was conducted on the specific impact of race and gender on length of service among individuals who received their first MOS preference. To determine the incremental impact on length of service among females who were assigned their top preference, the interaction variable *f_MOS_Pref_Rcvd_1* was generated. This variable accounted for 399 observations in the final sample. Similarly, the variable *nw_MOS_Pref_Rcvd_1* was generated to account for individuals who identified as being non-white and received their first MOS preference. Multivariate logistic regression analysis was then conducted using the same variables included in Model 2.

The full results of this analysis are provided in the Appendix. In summary, among individuals who received their first MOS preference, neither gender nor race were found to make a consistent, statistically significant difference in predicting length of service. The variable *nw_MOS_Pref_Rcvd_1* was only found to be statistically significant in predicting *YrsComm6* at the $p < 0.05$ level of significance, and the variable *f_MOS_Pref_Rcvd_1* was not found to be statistically significant in any year.

D. DISCUSSION

The multiple linear regression model to examine performance reveals a modest, but statistically significant relationship between *MOS_Pref_Rcvd_1* and *performance*, as measured by FITREP RV. This positive association between MOS preference and performance persists as all additional control variables are added. The model also finds commissioning through an enlisted to officer program or service academy, gender, education level, prior enlisted service, and TBS performance to be statistically significant factors in increasing performance. This model indicates that improving the existing MOS assignment process's ability to generate match quality, may also improve the overall level of performance among Marine Corps officers.

The multivariate logistic regression model to explore longevity did not reveal a consistent, positive, statistically significant relationship between MOS preference received and length of service. Contrary to the expectation, the model indicates that individuals who receive their first, second or third MOS preference demonstrated lower odds of reaching *YrsComm5* and *YrsComm6*, by comparison to individuals who received their fourth or greater MOS preference. Additional analysis using the same regression model and control variables found that among those who received their first MOS preference, neither gender nor race made a statistically significant difference in predicting length of service.

Model 2 finds a negative, statistically significant relationship between service academy graduates and each of the length of service variables. Additionally, Figure 22 indicates a negative trend among higher performers, as measured by their average RV, and length of service. It should be noted that the discovery of similar trends among its service academy graduates and top performing officers prompted the U.S. Army's efforts to improve talent management practices (Wardynski et al., 2009). This research, spearheaded by the U.S. Army OEMA, lead to the improvement of several manpower management systems through matching and match quality principles. Most relevant to this report, it resulted in the U.S. Army's transition from a performance-based MOS assignment model to a "talent-based" occupational assignment model (Wardynski et al., 2009; Colarusso et al., 2016). The significance of this research is presented in the Literature Review.

Although Model 2 does not find a consistent, positive relationship between MOS preference and length of service, this does not necessarily represent a case against match quality. In fact, similar findings among U.S. Army officers provided sufficient evidence to further integrate matching and match quality principles into its occupational assignment model.

E. LIMITATIONS

There are several limitations worth nothing. In terms of data, the most significant limitation resulted from the 922 observations (approximately 10% of the final sample) for which a precise MOS preference could not be determined. This limited controls for MOS preference to just four binary variables. A full list of MOS preferences may have enabled the opportunity to consider MOS preference as a continuous variable, or to accurately form additional categories, such as top three, top five, or top ten preferences.

Given existing policy, it was only possible to incorporate a certain degree of individual data. This limited the ability to study performance and service length outcomes, to factors primarily measured before or during TBS. Additional individual factors which could have better informed this study include, number of dependents, number of deployments, total deployment duration, awards, resident professional military education, or completion of a special education program.

While Model 2 does not find MOS preference to have a positive, statistically significant impact on length of service, it is unable to control for reason for departure from military service. Many individuals depart military service for reasons outside of a mismatch in MOS preference. Exit surveys which document the reason for departure would better inform this model. Without them, the results of Model 2 may misrepresent the value of match quality on longevity, among Marine Corps officers.

In general, it is difficult to conduct research of this nature, given the inability to compare and measure the alternative match which was not formed. In the present case, it was only possible to explore match quality form the perspective of the individual and assume that their preferences perfectly reflected their most suitable occupational matches. In turn, the results of this analysis only indicated the relationship between MOS

preference, as desired and/or judged by the individual, and their eventual performance and length of service.

F. CONCLUSION

The results of Research Question 1 indicate that improving the existing MOS assignment process's ability to generate match quality may also improve career outcomes, particularly in terms of performance. However, given collinearity between TBS performance, MOS preference received, and performance in the operating forces, and an inability to control for reason for departure from military service, Model 2 may not truly reveal match quality's impact on length of service. Additional statistics and further analysis may better reveal match quality's true impact on increasing length of service among Marine Corps officers. Exploring feasible ways in which the Marine Corps can improve the MOS assignment process is the subject of research question 2.

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V. RESEARCH QUESTION 2

Research Question 2: What individual factors, not currently considered within the Marine Corps' MOS assignment process, should be considered to improve Marine Corps officer's occupational specialty match quality?

The following chapter explores factors and methods that may be feasibly applied at TBS to improve the MOS assignment process through match quality. An overview of the data and methodology used to conduct this qualitative analysis is provided. The results of this analysis, a discussion, and a list of recommendations which may be applied in the short and long term is also provided.

A. DATA

1. Organizations Considered

In addition to TBS, three organizations were evaluated to address research question 2. These samples were selected based on their similarity, in terms of purpose, size, or scope, to TBS's MOS assignment process.

a. The Basic School

Located in Quantico, Virginia, TBS is the U.S. Marine Corps' unique training requirement for all newly commissioned or appointed Marine Corps officers. Following commissioning, but prior to attending their occupational specialty, officers must attend this six-month training course. TBS graduates approximately seven companies per year. Approximately 50% of each graduating company must be assigned an occupational specialty; the remainder are guaranteed a specific MOS upon commissioning.

b. The United States Naval Academy

Located in Annapolis, Maryland, USNA is the U.S. Navy's undergraduate college. Assigned the rank of Midshipman, students attend the school for four years before graduating with a Bachelor of Science degree. Each year approximately 1,000 midshipmen graduate from USNA and must be assigned a specific occupation or military branch of

service. Approximately 75% of these graduates earn a commission as an Ensign in the U.S. Navy, while approximately 25% are commissioned as Second Lieutenants in the U.S. Marine Corps.

c. The United States Military Academy

Located in West Point, NY, USMA is the U.S. Army's undergraduate college. Assigned the rank of Cadet, students attend the school for four years before graduating with a Bachelor of Science degree. Each year, approximately 1,000 cadets are assigned one of 18 occupational branches before they graduate, and earn a commission as a Second Lieutenant in the U.S. Army.

d. U.S. Marine Forces, Special Operations Command (MARSOC)

Located in Camp Lejeune, NC, MARSOC is the U.S. Marine Corps' component within U.S. Special Operations Command. Each year, MARSOC hosts approximately three assessment and selection classes of approximately 200 Marine Corps officers and enlisted personnel. An undisclosed number of these officers and enlisted personnel are selected to attend follow-on training to become either Special Operations Officers or Critical Skills Operators, respectively.

2. Variable Descriptions

The following section describes the variables selected for this analysis. These variables, or matching process attributes, are included due to their consistent use within the theoretical literature or given their statistically significant value in predicting or improving performance, job satisfaction, or match quality in the empirical literature.

a. General Characteristics

Matching processes are designed to address a unique set of organizational or institutional requirements. This category of variables, to include *process requirement*, *throughput and frequency*, *assignment scope*, and *timeline*, is included to describe, consider, and account for these differences across each sample.

b. Heterogeneity and Information Asymmetry

As described in the Background chapter of this report, matching markets are characterized by heterogeneity and information asymmetry. These differences present the opportunity to develop a match based on the unique qualities of the individual and prospective occupation. However, they also present a challenge, due to the lack of certainty about the individual characteristics of the agents operating in the market. Matching processes can be made more efficient by increasing the availability of information that helps discern between alternatives (both individuals and occupations) presented in the market, reduces the level of uncertainty experienced by the agents, and reveals the potential value of a match between participants. To explore each organization's ability to address heterogeneity and information asymmetry, the following variables were considered.

(1) *Personality*, *Cognitive Ability / Aptitude*

Recall from the literature review that personality and cognitive ability were among the most commonly cited attributes used to discern between individuals and predict future job performance. This category of variables is included to examine the methods utilized to measure these individual traits.

(2) *Occupational Traits: Knowledge, Skills, Abilities, Talents*

Recall from the literature review, the commonly cited recommendation to identify the knowledge, skills, abilities, and talents associated with a particular occupation, and the development of cost-effective methods to test for these characteristics. This variable is included to determine whether each organization identifies these occupational characteristics and to examine how they are conveyed to those in the marketplace.

(3) *Testing for Alignment with Occupational Traits*

This variable explores the testing methods developed to measure an individual's knowledge, skills, abilities, and talents, as identified in the previous section.

c. Marketplace Attributes

Recall that addressing heterogeneity and information asymmetry only represents one of two significant components. A matching process must also design a marketplace to effectively form matches between participants in the market.

The economic literature provided valuable insight into the development of matching marketplaces. According to Nobel prize winning economist, Dr. Alvin Roth (2007), a matching market must overcome congestion (provide sufficient time, allow participants the opportunity to consider possible alternatives) and provide safety (provide an efficient framework that minimizes a participant's risk), among other important attributes.

One of these important attributes is interaction between both sides of the market, or two-sided interaction, as highlighted in Colarusso et al.'s (2016) research on a talent-based matching approach. This attribute ensures the needs of the "demand" side of the market, the occupations, are also taken into consideration.

This category of variables, to include *system, overcoming congestion, safety,* and *two-sided interaction,* evaluates each process's ability to address these factors.

d. Information Management

Though this attribute was not derived from the literature, intuitively, organizations must consider a cost-effective method or platform to store, analyze, and act on information in a timely manner. This component increased is very relevant for organizations keen on reaching data-driven decisions. This is not only an important consideration to facilitate near-term decision-making, such as MOS assignment, but also for long term decisions like special duty assignments, promotion, or command selection. A key cost element associated with information management is the soft (manpower) cost of organizing and analyzing the relevant data.

B. METHODOLOGY

To determine which matching process attributes or factors may improve or enhance MOS match quality in the Marine Corps, a qualitative analysis of four matching processes

is conducted using the attributes listed in the previous section. This evaluation is conducted by reviewing each organization's regulation, instruction, or guidebook, and through personal interviews with individuals who either supervise or execute their organizations matching process.

This comparative analysis identifies the qualities of each organization's matching process, and pinpoints which methods and attributes may be feasibly introduced within the existing set of institutional and organizational constraints at TBS. The results of this analysis are described in Section C and are also compiled and summarized in Table 11.

Note: Physical, academic, and leadership performance attributes are valuable methods to address heterogeneity, information asymmetry, the potential for success in a specific occupation. However, these factors are omitted from this portion of the analysis for two reasons. First, this analysis addresses areas for potential improvement; each organization already acknowledges the importance of these factors and includes them in their matching or selection process. Second, many of the standards for these attributes and their associated testing measures are not transferable from one organization to another. For example, the physical standards for special operations assessment and selection are not appropriate for an occupational matching process conducted during entry-level officer training. Likewise, the academic requirements at USMA or USNA are not relevant to special operations selection.

C. RESULTS

Several of the organizations reviewed during this analysis demonstrated innovative and efficient matching processes. Of the organizations examined, the U.S. Army's "talent-based branching" model initiated at USMA, demonstrated the most comprehensive occupational matching process. It also demonstrated the greatest similarity in terms of purpose and scope with TBS, and offered the most transferable matching processes to TBS. The pilot study conducted on this branching process also indicated early success, in terms of satisfaction. In turn, USMA provides several effective matching methods that may be feasibly applied at TBS to improve the MOS assignment process.

USMA's "talent-based" branch assignment approach was established in 2012. Its strength and functionality reside in its ability to identify, describe, and convey an individual's match to the specific skills, knowledge, behaviors, and talent priorities associated with each occupation. Most notably, individuals are administered a battery of standardized, talent-based assessments. This customized battery of tests was developed by USMA, in association with other military, academic, and industry partners. The analysis and feedback provided through these tests is then supplemented by online self-assessment tools, guidance and assistance provided by an assigned mentor, and feedback provided by a team of independent human resource professionals.

It is important to note that the results of this screening and evaluation are purely informative, especially those produced through the standardized test battery. The feedback that is provided is only intended to refine an individual's preferences, rather than prescribe or bind an individual to an occupation. Ultimately, the decision is left to the individual.

This testing, evaluation, and feedback provides a wealth of personal data in the form of a talent profile, that reduces an individual's uncertainty about the value of a particular match with a prospective occupation. This profile is stored on a secure, but easily accessible online database, that is reviewable by both the individual and prospective occupational branch (as applicable). In turn, this information also reduces each branch's uncertainty about the value of a particular match with an individual.

Presented with this data, individuals and occupational branches, *both* submit their preferences for one another inside the marketplace. An algorithm is then used to form matches that are most preferred by the individual and the branch. As mismatches occur, the algorithm proceeds forward, deferring less acceptable matches (those that are least preferred by the branch), and pursuing the most preferred option for each cadet. Order of merit is considered, but only to break the tie between two cadets who are equally preferred by a branch. Priority is granted to cadet and branch preferences, rather than order of merit. It is important to note, that this model is adapted from Gale and Shapley (1962) research on game theory, and Nobel prize winning economist Alvin Roth's (1982, 2012) original research on "deferred acceptance" matching processes.

By contrast, TBS employs a merit-based model with a forced quality distribution. In this case, class rank is established through an individual's academic, military, and leadership aptitude, as evaluated through the course curriculum. Then, based on a directive issued in 1977, the assignment market is regulated by evenly distributing the supply of occupational specialties to each "third" of the graduating class of officers. In this market, priority for selection is granted to individuals in the top of each third, who secure that ranking based on their order of merit.

This analysis also concluded that that a majority of the effective matching methods presently employed by USMA may be feasibly applied at TBS. In the near term, this includes the identification of the knowledge, skills, abilities, and talents critical to each MOS. These attributes must be critical to fulfilling the duties and responsibilities inherent within the MOS, not just those that are socially desirable or acceptable. It also includes the development of associated standardized testing measures that may be administered online and therefore do not detract from the TBS curriculum. Over the long term, this includes initiating talent assessment prior to commissioning, lengthening the MOS assignment process, and reducing the burden on TBS. The Marine Corps should also reconsider its measurement of quality and associated quality distribution, or "thirds," model. Further explanation of these recommendations is provided at the end of this chapter.

A more detailed assessment of each organization's process is offered in the following section. The results are also captured in Table 11.

Table 11. Research Question 2, Results: Matching Process Comparison among USNA, TBS, MARSOC, and USMA

	United States Naval Academy	United States Marine Corps, The Basic School	Marine Forces, Special Operations Command	United States Military Academy
General Characteristics				
Process requirement	Service and occupational assignment	Occupatoinal assignment	Personnel selection	Occupational assignment
Throughput and Frequency	~1,000 midshipmen (MIDN) -1 graduating class per year.	~150 Marine Officers per class -Approximately 7 classes per year	~200 Marines per class -Approximately 3 classes per year	~1,000 cadets each year. -1 graduating class per year
Assignment Scope	US Navy (USN): Surface Warfare, Surface Warfare - Nuclear, Information Warfare, Aviation, EOD, SEALs US Marine Marine Corps (USMC): Aviation, Ground	(24) Military Occupational Specialties	Officer: Special Operations Officer (SOO) Enlisted: Critical Skills Operater (CSO)	(18) occupational "branches
Timeline	4 years	6 months	Phase 1: 3 weeks Phase 2: Undisclosed	4 years
Heterogeneity and Information Asymmetry				
Personality	USN: None USMC: None	None	1) MMPI: Minnesota Multiphasic Personality Inventory 2) NEO PI-R: Neuroticism, Extravesion, Openness to Experience Personality Inventory - Revised	Talent Assessment Battery: 1) Rational bio-data inventory 1.0 2) Rational bio-data inventory 2.0 3) Cognitive Reflection Test 4) Big 5 personality indicator 5) Test of personal intelligence 6) Grit test 7) Spatial Ability 8) GRE-A
Cognitive Ability / Aptitude	USN: ASTB (Aviators) USMC: ASTB (Aviators)	Aviators: ASTB	1) MAB-II: Multidimensional Aptitude Battery-II 2)TAIS: The Attentional and Interpersonal Style 3) VSOT: Visual Spatial Orientation Test	
Occupational traits: knowledge, skills, abilities, talents	USN: Professional Training for Midshipmen (PROTRAMID), informational briefings, interaction with faculty and staff USMC: Leatherneck, Marine Air-Ground Task Force (MAGTF), interaction with faculty and staff	1) Classroom and field training 2) MOS handbook provides an occupational overview, associated prerequisites, training requirements, common responsibilities, recommended reading and online training resources. 3) Education continuum: information briefs and mixers	MARSOC maintains a set of undisclosed traits.	1) Branch storyboards and video, identify the key intelligences, skills, knowledge, behaviors, talent priorities associated with that particular branch 2) Individual mentorship 3) Online self-assessment tool 4) Independent human resource professional review
Testing for alignment with occupational traits	Community specific screening events (SWO-N, EOD, SEALs, IWC, USMC)	None	Yes	1) TAB (see above) 2) Online self-assessment and resume tool set to "tease out" unique individual talents 3) Interviews
Marketplace attributes				
System	Order of merit system (OOM) with forced preferences	OOM system with quality distribution	Personnel Selection	Talent-based system
Overcoming congestion	Timeline: 2+ years	Timeline: 20-week process	N/A	Timeline: 3+ years
Safety (risk minimization)	(-): Must select an unrestricted line (URL) preference (Surface Warfare, Nuclear Program, Navy Aviation or Marine Corps) as their first preference. If qualification and screening standards have been met, can select SEAL, EOD and SWO. (-): Under accessed communities will be filled equitably by pulling a fair share from over accessed community	(-) MOSs are distributed equally to each third of the class. OOM interrupted by thirds; an individual ranked in the bottom of the first "third" is less likely to get his/her MOS than an individual at the top of the second "third."	N/A	(+): Branch of Choice Active Duty Service Obligation (BRADSO) - commitment to serve three add'l years to increase your chances of getting the occupation.
Two-sided interaction	USN: SWO-N*, IWC, SEALs, EOD USMC: Yes	(None). Students Staff Platoon Commander (SPC) is expected to represent the USMC	N/A	Interview with prospective occupational field
Data management				
Systems or software platform(s) utilized to manage data	Midshipmen Information System (MIDS)	None	Amazon Web Service hosted data management system (Whole Marine)	Each cadet has personal profile on US Army talent management website

1. General Characteristics

A review of each organization's general characteristics revealed three unique matching requirements: service and occupation, occupation only, and personnel selection. TBS and USMA each confront the requirement for occupational assignment, only. By comparison, USNA must assign individuals to military occupations (Surface Warfare, Aviation, Explosive Ordnance Disposal [EOD], etc.) and to military services (U.S. Navy and U.S. Marine Corps). MARSOC's process is limited to personnel selection for one specific occupation.

TBS must address several challenges that are not confronted by the other organizations. TBS must complete its matching process at a higher frequency than any other organization and must address the broadest scope of occupational assignments. While USMA is afforded more than a year to assign cadets to one of 18 occupational branches, TBS must assign officers to one of 24 occupational specialties in less than four months.

2. Heterogeneity and Information Asymmetry

An examination of the methods employed by each organization to address heterogeneity and information asymmetry revealed several effective approaches taken by USMA and MARSOC. By comparison, TBS's current MOS assignment process only meaningfully addressed one out of the four attributes included in this portion of the analysis.

a. Personality, Cognitive Ability / Aptitude

(1) USNA and TBS

USNA and TBS each administer the Aviation Selection Test Battery (ASTB) for individuals pursuing a Naval Aviator contract. However, similar aptitude tests are not used to assess potential in other career fields. As discussed in the background section of this report, although the GCT was administered for several decades, it was never a component of the MOS assignment process.

In 2019, the Marine Corps announced the GCT's replacement, the CCAT (MARADMIN 294/19). According to an article published by the *Camp Pendleton News,*

"Many private sector employees use the Criteria Cognitive Aptitude Test (CCAT) for job placement…The CCAT examines the tester's logic, spatial reasoning and verbal ability" (Roses, 2019, p. 1). The Marine Corps requested volunteers from multiple Marine Corps bases to participate in a pilot study in 2019 (Roses, 2019). The test is web-based and is expected to take approximately 15 minutes. However, as of January 2021, it was not yet a component of the occupational matching process.

(2) MARSOC

MARSOC's selection process incorporates a battery of personality tests including the MMPI and the Neuroticism, Extraversion, Openness to Experience Personality Inventory-Revised (NEO PI-R). The MMPI was originally developed to assess individuals suspected of mental health issues (Butcher, 2010). However, the test is offered in several forms and is considered within MARSOC's selection process as an assessment of personality. The NEO PI-R is also used as a personality assessment. When assessing the results of this test, particular attention is given to the conscientiousness dimension as MARSOC—like Barrick and Mount (2000) and Borghans et al., (2008)—find this personality trait to be positively correlated with job performance (K. Burke, personal communication, January, 20, 2021). It should be noted that these testing methods must be interpreted by trained and certified personnel.

MARSOC administers three separate tests to assess cognitive ability. The Attentional and Interpersonal Style (TAIS) and the Visual Spatial Orientation Test (VSOT) are utilized to assess an individual's ability to maintain composure under high-pressure situations, while the Multidimensional Aptitude Battery-II (MAB-II) is used to assess a range of aptitudes to include verbal and performance intelligence quotients. It should be noted that the VSOT was created specifically for MARSOC's selection process by Horizon Performance, LLC.

(3) USMA

USMA's TAB represents the most versatile and transferable battery of tests. The TAB is a three-hour, proctored exam, comprised of approximately eight sub-components, specifically designed to assess a cadet's cognitive ability, personality, grit, and spatial

ability (OEMA, n.d.). However, this test is not intended to address these aspects individually, nor is it intended to be a performance evaluation. Instead, TAB results are presented by talent attribute, in percentile format, "expressed as an individual's ranking within their peer population," according to Colarusso et al. (2016, p. 25). Expressed in these terms, talent measures provide USMA with important insight regarding which individuals may best align with a particular branch. It also provides that same information to the individual. Figure 23 provides an example of a cadet's TAB feedback report.

It should be noted that the TAB was developed with the assistance of academic and private industry partners. These include OEMA, the Army Research Institute, USMA's Department of Behavioral Sciences, and "other top scholars in the fields of personality and career suitability assessment," according to Colarusso et al. (2016, p. 25).

Talent	Definition	Percentile (n^{th})
BODILY KINESTHETIC	Coordinated, dexterous, hands-on person. Keen sense of body and sensory awareness. Learns through physical activity.	28
COMMUNICATOR	Precise, efficient, and compelling in both written and spoken word.	<= 25
CROSS-CULTURALLY FLUENT	Aware of and able to operate across different cultural settings (e.g., organizational, demographic, ethnographic, and generational).	90
DETAIL-FOCUSED	Thorough, perceptive and precise in all matters. Possesses a keen eye - notices everything.	<= 25
INNOVATIVE	Creative, inquisitive and insightful. Easily identifies new solutions and catalyzes change.	46
INSPIRATIONAL LEADER	Motivates teams to work harmoniously and productively towards a common goal.	45
INTERDISCIPLINARY	Integrates and applies expert knowledge from multiple disciplines into a coherent overarching perspective.	57
INTERPERSONAL	Skilled in developing appropriate relationships. Able to connect with others to effect positive results.	42
INTROSPECTIVE	Contemplative by nature - self-aware.	61
LOGICAL / ANALYTICAL	Uses reason and thinks in terms of cause and effect. Able to decompose and solve complex problems.	<= 25
MENTALLY TOUGH	Stress tolerant and emotionally mature. Performs well even under extreme psychological duress.	<= 25
MULTI-TASKER	Rapidly processes and prioritizes multiple demands simultaneously. Takes appropriate action.	61
PERCEPTIVE	Effectively discerns the deeper meaning or significance of one's observations (e.g., events, people and communication).	<= 25
PHYSICALLY FIT	Physically tough, gritty and tenacious. Performs well even under extreme physiological duress. Committed to a lifestyle of physical fitness.	31
PROBLEM SOLVER	Able to choose between best practices and unorthodox approaches to reach a solution. Accomplishes the task.	<= 25
PROCESS DISCIPLINED	Diligently abides by procedures designed to ensure accuracy, effectiveness and safety.	<= 25
PROJECT MANAGER	Able to determine requirements, develop work processes, delegate responsibilities, and lead teams to desired outcomes.	56
PRUDENT RISK TAKER	Acts boldly yet maintains appropriate focus upon personal, Soldier, and unit safety.	50
SPATIALLY INTELLIGENT	Easily perceives, understands and operates within the multi-dimensional world.	37
TECHNOLOGICALLY ADEPT	Understands and comfortably uses the latest technologies.	84

Figure 23. Research Question 2, U.S. Army Talent Assessment Battery Feedback Report. Source: Colarusso et al. (2016, p. 26).

b. Occupational Traits: Knowledge Skills, Abilities and Talents

Apart from MARSOC, given its unique circumstance, each organization provided occupational information to individuals. USMA demonstrated the most thorough approach.

(1) USNA

USNA has not explicitly identified the occupational characteristics associated with each occupation or branch of service. However, students are exposed to this information through various opportunities.

USNA offers several immersive training opportunities, most of which are required summer training events. First, midshipmen are introduced to a broad spectrum of opportunities in the Navy and Marine Corps. The hallmark of these opportunities is Professional Training for Midshipmen (PROTRAMID), which immerses rising juniors in each of the Navy's four communities. Then, as midshipmen approach graduation and focus on a potential career path, their training experience narrows.

Midshipmen at USNA also learn about available alternatives through their interaction with faculty and staff. Approximately 50% of academic instructors are active-duty military, including officers from both the U.S. Navy and U.S. Marine Corps. Each of the 30 companies that comprise the Brigade of Midshipmen is also assigned a Company Officer and Senior Enlisted Advisor, from the U.S. Navy or U.S. Marine Corps.

(2) TBS

TBS provides occupational information through classroom and field training events, the Marine Officer MOS assignment handbook (Everly, 2019), and the MOS education continuum. During classroom and field training, students are assigned various functional roles and responsibilities. As students prepare and execute their responsibilities during these training exercises, they are inherently exposed to the unique characteristics of several occupational specialties. As these events take place, students are also encouraged to interact with the staff, which is composed of experienced officers and enlisted Marines with various MOS backgrounds.

The MOS handbook, developed in 2019, significantly improved the amount of occupational information provided to each student. It includes a description of the common responsibilities, training requirements, and recommend reading associated with each MOS.

Students are also required to participate in three educational MOS briefs. Briefs are organized along the three primary MOS groupings: "Combat Arms, Information and Aviation, and Combat Service Support" (Everly, 2019). Each brief is followed by an MOS "mixer" during which students are encouraged to engage experienced officers in that grouping.

While these materials, training opportunities, and briefings are informative, they are less advantageous, given that TBS has not outlined the specific knowledge, skills, abilities, and talents critical to a particular MOS. They are also not fully exhaustive, as much of TBS's training only provides insight into a small segment of available occupations.

(3) USMA

USMA demonstrated the most comprehensive approach to providing information about each occupational specialty. USMA, like TBS, also created reviewable media for each occupational branch. These are referred to as "branch storyboards," and provide the intelligences, skills, knowledge, behaviors, and talent priorities associated with each branch. These are also available online, in video format. An example of a branch storyboard is provided in Figure 24.

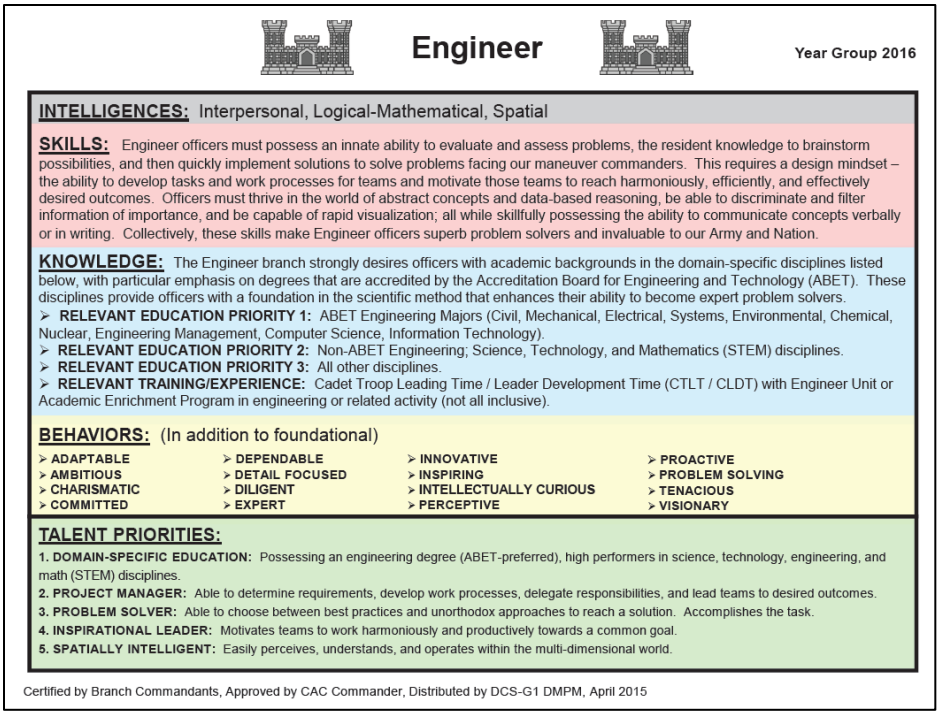

Figure 24. Research Question 2, U.S. Army Occupational Branch Storyboard. Source: Colarusso et al. (2016, p. 50).

c. Testing for Alignment with Occupational Traits

(1) USNA

USNA conducts community specific screening events for several occupations. Screening methods include personal interviews, a review of academic achievement, and specialty designed physical screening activities. This is particularly the case for the Surface Warfare-Nuclear (SWO-N), EOD, Information Warfare Community (IWC) and Naval Special Warfare (NSW) programs.

Midshipmen pursuing the Marine Corps must participate in "Leatherneck" the summer prior to their senior year. This training event serves as both an evaluation of the prospective Marine officer and as an educational opportunity.

(2) TBS

TBS's curriculum includes a broad range of military skill training, education, testing, and evaluation, to include martial arts, land navigation, weapons proficiency, water

survival, small-unit tactics, and combat lifesaving. This training and education *does* provide valuable insight into an individual's aptitude for a particular MOS. However, this training and education only relates to approximately one-third of available MOSs, insight for individual's interested in the remaining MOSs is not as readily available.

Of note, these events were never designed, nor intended, to measure an individual's aptitude or talent for a particular occupation. Rather, these events are intended to prepare officers for duty in the operating forces. Any insight gained about a particular occupation during this training and education is coincidental.

The MOS handbook, designed as an interactive resource, does provide students with some insight. As students review the description of each MOS they are prompted to envision themselves within the MOS, to consider the aspects of the MOS which interest them, and to annotate the "training, degrees, hobbies, and/or interests," that may align with the MOS (Everly, 2019). This encourages introspection and self-assessment, both of which were recommended in the vocational psychology literature reviewed during this study.

(3) USMA

As discussed previously, USMA administers the TAB to test for occupational skills, knowledge, and talent. Once students are informed of their TAB results, they can easily associate their feedback to the attributes listed on the storyboard. To assist them in this process, USMA cadets meet with an assigned mentor who helps review and interpret the feedback provided through the TAB. TAB results are also reviewed by an independent team of human resource professionals, which "generates a list of 'best-fit' options for each cadet (typically from four to eight branches, contingent upon an individual's talent profile)" (Colarusso et al., 2016, p. 26).

3. Marketplace Attributes

This set of attributes examines the sample's ability to efficiently match individuals with a service or occupation. This analysis revealed this process to be significantly challenging, as in many cases the market must cope with an imbalance between the number of individuals (supply) who prefer a particular occupation or service and the associated

number of vacancies (demand) for that occupation or service. MARSOC was excluded from this portion of the analysis as it uses a personnel selection model, wherein individuals are selected for a single occupation.

a. System

(1) USNA

USNA follows an assignment processes that is heavily influenced by order of merit (class rank). Class rank is determined by a range of performance variables, which includes moral, mental, and physical attributes. The matching system then utilizes this ranking system for occupation or service assignment, giving preference to those of a higher rank.

USNA also regulates their assignment market. During service selection, midshipmen are required to enter approximately five preferences. However, preferences two through five, are limited to the Surface Warfare, Nuclear Surface Warfare, Navy Pilot, Naval Flight Officer, or Marine Corps selections. According to USNA, this requirement is in place "to ensure all [Unrestricted Line] accession goals are met" (Buck, 2019).

(2) TBS

Recall from the background that TBS also uses an order of merit structure and regulates the assignment market with a "thirds" approach. In this case, class rank is used to stratify the population of officers who require an MOS assignment into top, middle, and bottom third cohorts. Then, available MOSs are allocated evenly to each of these thirds.

This approach is taken for two reasons. The first reason is to protect less "desirable" or "popular" occupational fields from being assigned a cohort of officers who all graduated in the bottom third of their company. By evenly distributing the supply of MOSs to each third of the assignable population, each MOS is assured it will receive a "fair-share" of quality (Everly, 2019). The second reason is to protect individuals who may not have been top performers during TBS but may excel in the operating forces. To this end, equal opportunity for occupations is provided to the bottom, middle, and top third of students in each graduating company.

As TBS's matching process begins, priority for selection is granted to individuals in the top of each third. If an individual's first MOS preference is still available from among the quantity allocated to that third, the match is formed. Human feedback is present in this model, as the company staff is authorized to deviate from an individual's assigned occupational specialty to form a more compatible match.

(3) USMA

USMA's market is designed to align more closely with the structure of supply and demand. This system is intended to achieve equilibrium based on individual talent for a particular branch, not according to their class rank. To carry out this approach, USMA considers at least three ranking systems. The first is the individual's preferences for occupational branches, which are ranked ordinally. The second set of ranks is the branch's preferences for specifical individuals. These are ranked by "most preferred," "preferred," and "least preferred." The third is the individual's order of merit within their commissioning source.

An algorithm is then employed to form matches that are most preferred by the individual and the branch. As mismatches occur, the algorithm proceeds by deferring less acceptable matches (those that are least preferred by the branch) and pursuing the most preferred option for each cadet. Unlike TBS and USNA, order of merit is secondary and is only utilized to discern between individuals who are placed in the same preference category by a particular branch.

b. Overcoming Congestion

USMA and USNA are four-year institutions and therefore have a considerably longer timeline than TBS. Graduates of these institutions gain valuable experience through formalized training programs and through interaction with the faculty, staff, and prior-enlisted students.

By contrast, TBS's training curriculum is 6 months in duration. The actual MOS assignment process must be completed in just 4 months. This condensed timeline poses an even greater risk for officers who arrive at TBS via direct, shorter commissioning programs

like PLC or OCC. Graduates of these sources are commissioned in a matter of months, or even weeks. This provides little opportunity for individuals to gain valuable experience and compare occupational alternatives. By comparison, individuals commissioned through an ROTC program or USNA are provided the opportunity to consider alternatives discovered during summer training, or through interaction with their military faculty and staff.

c. Two-Sided Interaction

(1) USNA

USNA's level of two-sided interaction is dependent upon the community. Highly specialized communities, like the SWO-N, EOD, IWC, and NSW programs all incorporate heightened levels of interaction with applicants. The Marine Corps also convenes a board to select future Marine Corps officers.

(2) TBS

Of the organizations considered, TBS's approach incorporated the least amount of two-sided interaction. The closest representative for the "demand" side of the market is the student's SPC. This individual is responsible for insight regarding an individual's likelihood for success, or congruence with a particular occupation. This is a subjective view, based on the SPC's level of experience and opinion of the knowledge, skills, and behavior needed to succeed in a particular occupation. In turn, only the "supply" side of the market is represented.

(3) USMA

USMA's matching process best incorporated both sides of the matching market. As discussed in the previous section, preferences are submitted by both the "supply" (officer) and "demand" (branches / occupations) sides of the market. The demand side of the market is represented by an occupational "branching board." Each board is composed of senior officers from within the occupation and is responsible for reviewing cadet profiles and determining the cadet's likely congruence with a particular branch. This congruence is measured in terms of "most preferred," "preferred," and "least preferred." According to

Colarusso et al., this is a blind process that considers the "information collected over the…branch education and mentorship program," and does not consider an individual's personally identifiable information (2016, p. 30).

Rather than being forced to accept an individual based on their preference and order of merit, this two-sided interaction provides branches with the opportunity to determine the degree to which an individual meets their needs, and to establish this preference within the market. In turn, USMA's matching process functions more comparably to a traditional labor market, wherein organizations interact with prospective employees prior to hiring.

d. Safety (risk minimization for individuals in the market)

(1) USNA and TBS

The forcing functions used by TBS and USNA place individuals operating in the matching marketplace at increased risk, by comparison to those operating in USMA's market. This is specifically the case for students at TBS. Here, individuals at the top of the middle and bottom third are granted a higher priority for selection, than those at the bottom of the first and second third. This means that individuals ranked in the bottom of the top third are less likely to be assigned their top preference, by comparison to individuals at the top of the middle "third," despite having a higher class rank.

Although these measures are implemented to ensure less desirable occupations are adequately filled, they interfere with the market's ability to clear on its own. Simply stated, the supply for MOSs is set before a demand signal is established.

USNA and TBS's forced allocation models also influence market participants to behave strategically. Individuals who believe (most likely, incorrectly so) that they are near the bottom of their third, may intentionally perform poorly during a graded event to move down in class rank, but into the top of the next third. Other participants may feel that their class rank jeopardizes their chance of being assigned their top choice. Confident that they will receive their second or third choice, these individuals may strategically reorder their preferences.

(2) USMA

As discussed previously, USMA employs a two-sided market structure, wherein branches and individuals interact. This feature incentivizes branches to share additional information and possibly even recruit personnel. Together, with the results of the TAB, this interaction provides valuable insight regarding the occupation and the value of a particular match, including among those that may not have otherwise been considered. This inherently increases awareness for occupations that may traditionally be viewed as "less desirable," and informs individual preferences accordingly. This allows the market, even for those occupations that are "less popular," to clear more naturally, than through forced allocation.

As an added protective measure for individuals, USMA implemented the Branch of Choice Active-Duty Service Obligation (BRADSO) option. This is an option available to individuals who believe they may be at risk of not being assigned their desired branch. Students who utilize the BRADSO option increase their chance of assignment, in exchange for an additional three years of obligated service.

e. Information Management

Organizations must employ a reliable data management system to properly collect, analyze, and responsibly share the amount information collected from each individual. USNA, USMA, and MARSOC each have the digital infrastructure necessary to accomplish this critical component.

(1) USNA

USNA maintains the Midshipmen Information System (MIDS), a web-based application that stores individual information and serves as the platform to submit service preferences. In this way, MIDS facilitates the flow of information between the individual and the service selection board. However, after graduation, students must request permission to gain access to the information—like academic transcripts—stored in MIDS.

(2) MARSOC

MARSOC also maintains a robust information management application. Like the aptitude test identified in the previous section, "Whole Marine," MARSOC's information management application, was also developed by Horizon Performance, LLC. It is hosted by Amazon Web Service (AWS). This application is designed to track a candidate's performance assessments, provide advanced analytics, present this information clearly to the assessment and selection staff, and guide decision making (Horizon Performance, 2020). In this context, information is stored for the benefit of the organization, not the individual. However, information collected on the individual during the selection process is maintained and can be utilized to shape future personnel decisions.

(3) USMA

USMA utilizes the U.S. Army's talent management (https://talent.army.mil/) website, where a profile for each West Point cadet is maintained. This site hosts the online self-assessment tool, branch storyboard's, TAB results, and allows cadets to explore the current talent demands of each branch. Here, a wealth of information is provided to help cadets consider their various opportunities. Given that this information is stored on a U.S. Army website, rather than a USMA platform, Army officers can continue to benefit from the data after graduation. A screenshot of the Army's branching website is provided in Figure 25.

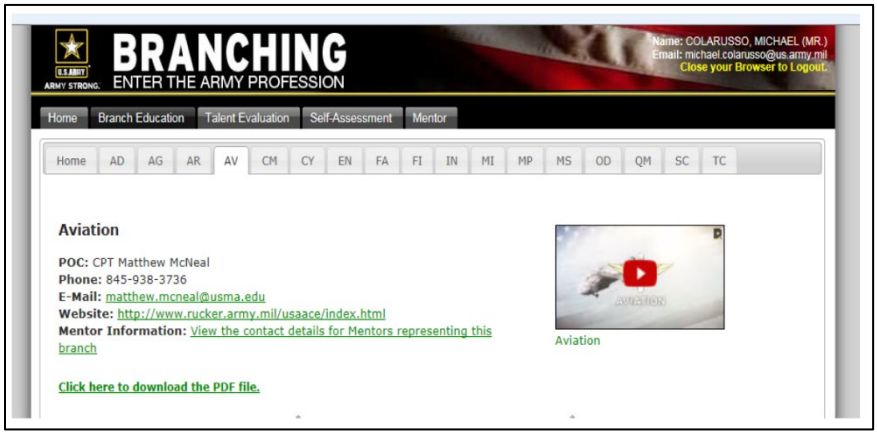

Figure 25. Research Question 2, Screenshot of U.S. Army Talent Management website. Source: Colarusso et al. (2016, p. 23).

(4) TBS

The U.S. Marine Corps could generate a similar benefit by tying into its existing web-based application, "Marine Online." Information collected here during TBS, would still be available to both the individual and the service, even after TBS graduation.

D. RESULTS OF THE U.S. ARMY, TALENT-BASED ASSESSMENT PILOT STUDY

The U.S. Army's talent-based branching model consistently outperformed both TBS and USNA's matching. Presented with this finding, it is prudent to review the results of the process's pilot study conducted on approximately 3,000 West Point Cadets, from the graduating classes of 2013, 2014, and 2015. The study found that approximately 40% of students changed their first occupational preference, roughly 90% modified at least one of their top three occupational preferences, and 97% modified at least one of their top five occupational preferences (Colarusso et al., 2016). It was also discovered that "80 percent of cadets [received] their top branch choice compared to 77 percent for graduating classes from the last 4 years of the legacy branching model" (Colarusso et al., 2016, p. 32).

The results of the study reveal two important findings. The first is that individuals *do* change their preference based on the information they are provided through the matching process. They also indicate a higher number of cadets were assigned their top preference, by comparison to the legacy system.

E. DISCUSSION

General Berger, Commandant of the Marine Corps, noted several concerns regarding talent management in his *Commandant's Planning Guidance* (2019). The following section is intended to summarize the results of Research Question 2 and demonstrate their correspondence to the remarks made by General Berger in his planning guidance.

> Our manpower system was designed in the industrial era to produce mass, not quality. We assumed that quantity of personnel was the most important element of the system, and that workers (Marines) are all essentially interchangeable. (Berger, 2019 p. 7)

By comparison to MARSOC and USMA, TBS's use of an order of merit and thirds-based allocation system appears more focused on quantity, rather than quality. At present, order of merit is based on a set of knowledge, skills, and abilities that only align with approximately half of the occupations available for assignment. This same order of merit is then used to divide the class, distribute the number of MOSs evenly, and to grant preference to the individuals at the top of each third. Precision decreases further as the individuals who are already guaranteed an MOS are removed from the order of merit, and new individuals have just moved into position at the top of the middle and bottom third, somewhat arbitrarily. Yet, these individuals now have a higher probability of being granted their top preference, by comparison to individuals at the bottom of the top and middle thirds, despite having a lower, class rank.

By contrast, USMA and MARSOC each employed sophisticated testing methods, clearly defined criteria, and data analytics to inform their assignment and selection processes. Furthermore, USMA's matching marketplace ensures both sides of the market are appropriately represented. In doing so, they have protected against individuals imposing themselves on a particular occupation, simply based upon their order of merit. These practices are all more closely aligned with labor market theory, traditional business practice, and an increasing number of military organizations.

It is worth considering these two approaches within the context of the Anderson et al.'s (2004) research which identified the three types of "fits" embedded within a match: P-J, P-T, and P-O fit. From this perspective, TBS's order of merit system, which combines academic, military, and leadership scores appears better suited to establish a P-O fit, by comparison to USMA's talent-based assessment. USMA's approach is more closely aligned with a P-J fit.

> In the current manpower model, primary occupational fields are set early in a career and Marines are essentially stuck either accepting it for an entire career or choosing separation. Even talented, high-performing officers have changing interests over time. (Berger, 2019 p. 7)

Individuals constantly evolve. This is particularly the case for the personnel serving in the Marine Corps. The average age of officers included in the final sample of Research

Question 1 was approximately 24. As Quiodback et al., 2013 indicated, individuals within this age group experience the greatest change in personality, values, and preferences.

To address this inevitable growth and evolution, matching processes have evolved to consider a broader range of personal characteristics. Each of these characteristics provides a small snapshot but when pieced together provides a much more holistic picture of the individual's potential. Traditionally, matching processes have included physical fitness, leadership capability, and academic background. However, additional characteristics, to include personality traits and aptitude (cognitive ability) must be taken into consideration.

It may be argued that TBS currently addresses cognitive ability through academic testing or evaluation during field training. However, these forms of evaluation align more closely with a measure of *ability* or achievement, rather than *aptitude*. According to the American Psychological Association, ability tests are those that measure an individual's present level of competence (American Psychological Association (APA), 2020a). Comparatively, aptitude tests are those that, "measure potential for acquiring knowledge or skill. Aptitude tests are thought of as providing a basis for making predictions for an individual's future success" (APA, 2020b).

Though subtle, this distinction between ability and aptitude is important. By comparison to tests that measure ability, those that measure aptitude, provide far more insight into how an individual may progress, grow, and change as they enter the operating force. This is an important implication for processes designed to develop matches that are capable of enduring, even as the individual evolves.

> We do not currently collect the data we need systematically, we lack the processes and technology to make sense of the data we do collect, and we do not leverage the data we have to identify the decision space in manning, training, and equipping the force. (Berger, 2019 p. 14)

The results of this analysis indicate that TBS's MOS assignment process relies on less personal data by comparison to MARSOC and USMA. This not only hinders the Marine Corps' ability to shape the force in the near term, through improved MOS assignment practices, but also over the long term, as part of a larger, more effective talent

management system. If stored and managed properly, this data could also be used to shape future employment, promotion, or command selection decisions over the course of a Marine's career. Furthermore, if the same cognitive and non-cognitive testing were to be administered after TBS, it would better optimize the officer's talent as they continue to learn, grow, and progress through their career.

F. CONCLUSION

Research Question 2 explored individual factors, not currently considered within the Marine Corps' MOS assignment process that could be considered to improve occupational specialty match quality. This analysis identified that improving match quality relies on methods that reveal the characteristics of the individuals and occupations in the market, reveal the potential value of a potential match to each side of the market, by discerning among the various options and reducing the level of uncertainty and in establishing a market structure that effectively forms a match between the two sides.

In terms of reducing heterogeneity and uncertainty, MARSOC and the U.S. Army demonstrate several methods to properly assess and evaluate an individual's skills, talents, and behaviors. The U.S. Army's talent-based branching model is also highly capable of using this information to inform individuals of the occupation(s) for which they best align. Finally, the U.S. Army's two-sided market and "deferred acceptance" algorithm also demonstrates the most effective means of matching individuals with the most suitable occupation.

Incorporating these concepts within the Marine Corps' MOS assignment process is possible without interruption to the existing curriculum. In the short term, this involves identifying the knowledge and skills associated with each occupation and the development of testing, to measure an individual's knowledge, skills, abilities, and aptitude. These tests can be developed with the help of private industry, as exhibited by the U.S. Army, MARSOC, and the Marine Corps Recruit Depot at Parris Island, and can be administered after working hours. Over time, the MOS assignment process should be dissociated from TBS to increase the amount of time that individuals can compare alternative options and

to facilitate the establishment of a more efficient, two-sided occupational assignment marketplace.

VI. CONCLUSION, DISCUSSION, RECOMMENDATIONS

A. CONCLUSION

The first objective of this research was to examine how match quality, as measured by MOS preference received, impacted a Marine Corps officer's length of service and performance. To explore this relationship, multiple linear and multivariate logistic regression models were used to determine the relationship between MOS preference received, and performance and length of service, respectively. The second objective was to explore which occupational assignment methods and processes may be feasibly applied at TBS to improve match quality. This objective was studied through a comparative analysis of military organizations with matching processes with a similar scope and scale.

1. Research Question 1

a. Research Question 1, Model 1: Performance

The results of the multiple linear regression model, to examine the relationship between MOS preference received and performance, indicated positive, statistically significant results. This was particularly the case for individuals who received their first MOS preference, as this variable was found to be statistically significant at the $p < 0.001$ level of significance in four of the first five iterations of the model and was still statistically significant at the $p < 0.01$ level of significance in the fifth iteration. Although it is difficult to place this benefit into practical terms, as the conversion between RV and the report's average is normalized across reporting seniors, it is safe to conclude that the impact of being assigned a first MOS preference is equivalent to less than a change in one letter grade (B to C, C to D) for one FITREP PAR.

b. Research Question 1, Model 2: Length of service

The multivariate logistic regression model to explore longevity did not reveal a consistent, positive, statistically significant relationship between MOS preference received and length of service. Contrary to the expectation, the model revealed that individuals who received their first MOS preference demonstrated lower odds of reaching *YrsComm5* and

YrsComm6, at the $p < 0.001$ level of significance. Additional analysis using the same regression model and control variables found that neither gender nor race made a consistent, statistically significant difference in predicting length of service. The only variable found to be a consistent, statistically significant predictor of length of service was commissioning through a service academy. However, the impact of this variable was also negative across all models.

These results do not necessarily represent a case against match quality. Given collinearity between the variables representing TBS performance, MOS preference received, and performance in the operating forces, and an inability to control for reason for departure from military service, Model 2 may not truly reveal match quality's impact on length of service. It should also be noted that similar evidence of lower continuation rates, particularly among service academy graduates and high performers helped encourage the U.S. Army's investment in match quality to improve its occupational assignment model (Wardynski et al., 2009; Colarusso et al., 2016).

c. Research Question 1, Summary

The results of Research Question 1 indicate that improving the existing MOS assignment process's ability to generate match quality may also improve career outcomes, particularly performance. However, additional statistics and further analysis may help reveal match quality's true impact on increasing length of service among Marine Corps officers. Exploring feasible ways in which the Marine Corps can improve the MOS assignment process is the subject of research question 2.

2. Research Question 2

Research Question 2 examined three matching and selection processes presently employed within the DOD. This analysis revealed several assessment methods, tools, and measures, aside from performance, which may improve match quality, with little interruption to the existing curriculum.

Of the organizations reviewed, the U.S. Army's "talent-based branching" most effectively addresses the essential occupational matching process components. These

include methods to reveal the true characteristics of the individuals and occupations in the market, reduce the level of uncertainty among participants, indicate the value of a potential match, and establish a market structure that effectively forms a match between the two sides.

To address heterogeneity, USMA administers a battery of standardized, talent-based assessments, developed by USMA, in association with other military, academic, and industry partners. Results are provided in an easily digestible format which displays an individual's strengths across a wide range of talent categories. Informed of their talents, cadets can then review the "branch storyboards" which identify the knowledge, skills, abilities, and talents associated with each occupation. Cadets are assisted in these efforts by online self-assessment tools, an assigned mentor, and feedback provided by a team of independent human resource professionals.

To form effective matches, USMA constructed an efficient marketplace that registers input from both the individual and the occupation, enables each side to consider possible alternatives, and employs a well-established algorithm. This algorithm prioritizes the preferences stated by each side of the market, rather than the individual's order of merit. Order of merit is only utilized but only to break the tie between two cadets who are equally preferred by a branch.

When considered against the backdrop of the existing body of literature on match quality, USMA's process presents several appealing benefits:

- Measures taken to assess, evaluate and inform individuals of the skills, talents, and behaviors that align with a range of MOSs, reduces uncertainty for both the organization and the individual. It also prompts individuals to explore occupations they may not have otherwise considered, including those that are traditionally viewed as "less desirable." This inherently stimulates demand across a broader range of occupations and produces intrinsic motivation for particular occupations. As demonstrated in Ryan and Deci's research regarding self-determination theory, allowing individuals to discover their own personal value and

commitment has far greater outcomes by comparison to forcing individuals into an undesirable match (2000).

- USMA's two-sided market structure incentivizes interaction between each side of the market. By comparison to TBS's present approach, this presents occupations (the "demand" side of the market) with the opportunity to determine the degree to which an individual meets their needs and to establish this preference within the market. This encourages occupations to exchange information with prospective candidates, decreasing the amount of uncertainty about certain occupations, including those that are "less desirable." This two-sided interaction also enables the market to function as a more traditional matching market. Individuals cannot just select and impose themselves on an occupation or job, based solely on order of merit, they also must be chosen or preferred (Roth, 2012).

- The establishment of a separate matching process relieves U.S. Army commissioning sources of the responsibility to develop and implement curriculum that also addresses occupational assignment. This not only reduces the strain on the commissioning source, it also addresses Anderson et al.,'s research (2004) which suggested that multiple levels of matching occur in the workplace including the person-job, person-team, and person-organization fit. "Talent-based branching" enables the U.S. Army to confront the challenge of the person-job and person-team fit, while allowing its commissioning sources (including USMA) the opportunity to address the person-organization fit.

- The branching process's battery of aptitude testing provides richer insight into the individual's potential within a particular occupation. This enables the development of a match that is much more capable of enduring, even as the individual evolves.

- The U.S. Army's accompanying data infrastructure not only helps facilitate matching in the near term, it also helps shape future employment, promotion and selection decisions over the long term.

The qualitative aspect of the study also demonstrated the plausibility of introducing several tools and methods to improve the current MOS assignment process, with little interruption to the existing curriculum. In the short term, this included the careful identification of the knowledge skills, and attributes associated with each occupation and the ability to test for these characteristics in a cost-effective manner. It was recommended that TBS engage with private industry to identify these traits and to develop a battery of tests which can be administered and reviewed after normal working hours. The precedent to partner with private industry for this purpose has already been established at Marine Corps Recruit Depot and within MARSOC. Over the long term, recommendations were provided to implement these talent-based assessments and the MOS assignment process prior to TBS, create a two-sided market structure to facilitate MOS community input and to establish an efficient matching marketplace driven by a "deferred acceptance" algorithm.

B. DISCUSSION

The literature and results of this analysis also indicate that the tools and procedures used to generate match quality also add meaningful value beyond the scope of MOS assignment. Maintaining the results of cognitive and non-cognitive assessments at the point of accession, performance outcomes in the operating forces, and standardized tests administered mid-career, could better inform individual employment, assignment, and development-related decisions. This human capital data could continue to optimize selection for specific billets, special duty assignments, education programs, or even command.

Match quality efforts could also optimize recruiting and accession efforts. The introduction of cognitive and non-cognitive assessments could help assemble a much richer panel of characteristics that are associated with success, beyond the present set of academic, military, and leadership scores. Trends among these new characteristics could help inform the development of advertising media to target and acquire individuals who,

for example, are naturally predisposed to being more innovative or adaptive. This could provide a much more dynamic and purposeful approach than current recruiting efforts.

Over the long term, as the character of war changes and the Marine Corps confronts a new set of operational challenges, it could tailor recruiting efforts toward the most relevant natural skills and behavioral attributes. This same level of adaptability could also be employed within individual occupational specialties.

C. RECOMMENDATIONS

Under perfect conditions, TBS would mirror USMA's present matching approach. This would include the identification of the knowledge and skills associated with each MOS. It would also include the development and implementation of online self-assessment tools, personal mentorship programs and a talent assessment battery to accurately test for an individual's natural talents, personality, and aptitude.

This information would be presented to officers in an easy-to-understand format. It would then be stored in a secure, but accessible, online data system, that would create information symmetry between the individual and prospective MOSs. Equipped with this increased amount of information, including the value of a particular match, individuals and MOSs would both submit their preferences. TBS would then allow the market to clear on its own, driven by a "deferred acceptance" algorithm, and unregulated by the forced allocation of MOSs. Ideally, "quality," would be evaluated by an individual's aptitude for a particular occupation, rather than according to the present one-size-fits-all valuation system.

Since changes of this magnitude take time and considerable resources, the following recommendations are provided for the short and long term. This section also includes recommendations for future research.

1. Short-Term Recommendations

a. Talented at What? Define Talent for Each MOS

Within the context of occupational assignment, talent is not absolute. Each occupation requires a unique set of knowledge and skill. The Marine Corps must determine

how talent is defined within the context of each MOS. To do so, TBS should immediately invest in identifying and documenting the knowledge, skills, and attributes that align with each MOS. This effort should identify the unique, or above baseline attributes, necessary for success in a particular field, not just those that socially desirable or acceptable. In other words, attributes that are identified as valuable across all MOSs, like physical fitness, should be removed from consideration and replaced by those that are exclusive to either a single, or very few, MOSs.

b. Develop Methods to Test for Individual Talent

Individuals are naturally more disposed to some occupations others and occupations require a unique set of skills. In turn, TBS should develop the ability to measure an individual's knowledge, skills, abilities, and aptitude. At a minimum this should include both cognitive and non-cognitive assessment. Feedback provided from this testing and analysis should be presented in a format that clearly conveys an individual's talent strengths and alignment (or misalignment) across a range of MOSs.

These tests should be administered online. This will ensure the time required to conduct these exams does not interfere or detract from the already time-constrained TBS curriculum.

c. Engage with Private Industry

The precedent to engage with private industry to identify the knowledge, skills, and attributes associated with a particular occupation and develop the associated testing measures has already been established in the Marine Corps. Both MARSOC and Marine Corps Recruit Depot, Parris Island have leveraged private industry to perform this function.

In 2019, Marine Corps Recruit Depot, Parris Island, South Carolina, initiated a contract for the implementation of a "commercial off the shelf (COTS) software solution that will measure, weigh, and report clearly defined performance attributes Drill Instructors (DI)" (Performance Work Statement (PWS), 2019). Included in the scope of work is the development of a "competency model" that outlines the "skill, knowledge, and other key attributes that a DI should embody," and the implementation of an "automated software

solution set that captures DI attributes and profiles and leverages that data to increase efficiencies and to enhance DI training and development" (PWS, 2019). It should be noted that Horizon Performance, LLC, the same company that developed the testing and software solutions for MARSOC, was also awarded this contract.

Of note, this engagement is in line with General Berger's planning guidance, wherein he states: "We will make strategic investments in data science, machine learning, and artificial intelligence…These investments will be focused on the application of existing systems and tools (COTS and GOTS)" (Berger, 2019, p. 14-15).

d. Occupational Recommendations should Be Informative, Not Directive

TBS (and students) should view the results of these cognitive and non-cognitive assessments, and their associated recommendations for occupational specialty, as non-binding. New testing and evaluation methods should serve to refine an individual's preferences and inform an individual of the value of a potential occupational match. They should not be used to dictate or prescribe an occupational specialty.

2. Long-Term Recommendations

a. Expand Testing and Evaluation to Commissioning Sources

The Marine Corps should strive to implement talent-based assessments prior to TBS. Although TBS has satisfied this critical requirement for many decades, 6-months is not an ideal timeline for occupational assignment. Instead, individuals should be afforded the opportunity to conduct talent-based assessments, review their results, and begin considering various occupational alternatives prior to attending TBS. Midshipman at USNA and in ROTC programs could begin as early as the fall of the senior year. Individuals participating in a direct commissioning program could begin talent-based assessments after they are medically qualified. Extending testing and evaluation over a longer period will increase the individual's ability to consider these results and compare alternatives, thereby increasing the effectiveness of the matching process.

b. Reconsider "Quality" and the "Thirds" Model

The present model maintains a conflicting interpretation of quality. The traditional viewpoint of the "thirds" model is that it protects less "popular" or "trendy" MOSs from being assigned a cohort of officers who all graduated in the bottom third of their TBS company. This implies the order of merit system is an accurate measure of quality. However, an opposing viewpoint is that the "thirds" model protects those who may have performed poorly during TBS but may improve once they are assigned an occupational specialty and enter the operating forces. This viewpoint implies a flaw in the order of merit system's ability to measure quality.

As a corrective measure, TBS should exchange its order of merit-based system and associated thirds model, for an occupational talent-based assessment of quality. Rather than view quality from the perspective of a uniform grading scale, quality should be measured through talent-based assessment, and considered the strength of association between an individual's talents and a prospective MOS. In other words, match quality, as viewed by the degree of fit, or joint benefit to be gained by a particular occupational match, should guide the process, not order of merit.

Recall, that when USMA implemented its model, 40% of cadets "changed their top branch preference…90% changed at least one of their top three branch preferences and 97% changed at least one of their top five branch preferences." This suggests that as individuals are informed of their natural talent, knowledge, skills, and aptitude through formalized testing and empirical data, their preferences do change. It also indicates that individuals may naturally align themselves across a broader range of MOSs, thereby decreasing the need for forced allocation.

c. Establish an MOS Selection Board, Create Two-Sided Market Interaction

Successful organizations rarely make hiring decisions without having interacted with a prospective employee to determine whether that individual meets their firm's needs. Over the long term, as the MOS matching process is initiated prior to TBS and the frequency with which occupational matching must occur decreases, the Marine Corps should convene and MOS selection board for each MOS. As a representative of the

"demand" side of the market, each MOS board should establish its preference for individuals in rank order. To establish this ranking, the board may rely on personal interviews and/or the empirical data provided through testing and evaluation.

d. Establish an Efficient Matching Marketplace

Given the ability to recognize the value of a particular match through advanced testing and evaluation, the establishment of both sides of the market, and an online talent database, the Marine Corps should establish an efficient matching marketplace. This marketplace should be driven by a "deferred acceptance" algorithm, designed to form matches that are most preferred by the individual and the MOS selection board.

3. Recommendations for Future Research

This study investigated how match quality, as measured by MOS preference, impacted a Marine Corps officer's length of service and performance in the operating forces, and the way in which the current MOS assignment process may be improved. As noted in the Limitations section of Research Question 1, exit survey data to document the reason for departure from military service would better inform a study of this nature. It would also be prudent to examine the assignment process's present ability to generate match quality. It is difficult to conduct research of this nature, given the inability to measure the outcome of the match which was never formed.

However, data to facilitate a study of the present MOS assignment process would include initial MOS preference rankings in addition to final preference rankings, student interviews, and reliable exit survey data. In combination with the same career outcome data used in this analysis, this additional preference ranking data would help identify the process's ability to accurately shape preferences. Student interviews would also help provide insight into the qualities of the present process. As previously identified, exit survey data would help clarify which individuals departed service due to a mismatch with their assigned MOS.

An alternative method could be to conduct a randomized control trial. This trial would compare performance and length of service, between a treatment group of

individuals who were matched under the existing model, and a control group of individuals who were matched through a proposed model. Tracking and comparing career outcomes between these two groups, over time, would best identify which process produces better match quality.

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APPENDIX. DATA TABLES

Estimate of the effect of MOS preference received on length of service (Logit, Odds-Ratio)							
YrsComm [x]	**5**	**6**	**7**	**8**	**9**	**10**	**11**
MOS_Pref_Rcvd_1	0.389*** (-7.29)	0.516*** (-5.08)	0.874 (-0.88)	0.477*** (-4.92)	1.080 (0.66)	0.917 (-0.74)	1.179 (0.80)
MOS_Pref_Rcvd_2	0.472*** (-4.89)	0.491*** (-4.66)	0.837 (-0.93)	0.933 (-0.34)	1.224 (1.31)	0.993 (-0.05)	1.057 (0.22)
MOS_Pref_Rcvd_3	0.376*** (-6.01)	0.577** (-3.07)	0.730 (-1.46)	0.747 (-1.28)	1.708** (2.66)	1.624* (2.51)	0.567 (-1.96)
Commission_EnlProg	2.093** (2.73)	1.188 (0.53)	0.177*** (-3.47)	0.245*** (-3.92)	0.254*** (-4.35)	0.410** (-2.91)	0.133*** (-4.10)
Commission_OtherReserve	1.000 (.)	14.736*** (3.77)	1.658 (1.07)	0.179*** (-8.50)	0.141*** (-11.58)	3.113*** (3.60)	0.018*** (-12.26)
Commission_ROTC	1.567*** (3.49)	0.927 (-0.59)	0.491*** (-3.57)	0.813 (-0.83)	0.427*** (-5.11)	0.368*** (-7.02)	0.081*** (-10.18)
Commission_SvcAcademy	0.994 (-0.05)	0.571*** (-4.70)	0.123*** (-12.52)	0.100*** (-13.89)	0.149*** (-13.13)	0.213*** (-10.57)	0.085*** (-9.50)
Demo_Gender	1.289 (1.72)	0.975 (-0.17)	0.635** (-2.72)	0.492*** (-4.40)	0.631** (-2.86)	0.564*** (-3.41)	0.580 (-1.71)
Demo_Age	0.904*** (-4.31)	1.139*** (3.97)	1.073 (1.77)	0.968 (-1.05)	0.967 (-1.22)	0.963 (-1.36)	1.081 (1.69)
Demo_EDU_MoreThanBach	0.428*** (-3.46)	0.812 (-0.47)	1.133 (0.20)	2.364 (1.41)	1.352 (0.73)	0.881 (-0.29)	2.059 (0.94)
Demo_Race_NonWhite	0.628*** (-5.00)	0.543*** (-5.95)	1.276 (1.66)	0.892 (-0.88)	1.211 (1.57)	1.792*** (4.66)	0.508*** (-3.34)
PriorEnlisted	2.130** (2.84)	0.530 (-1.94)	0.934 (-0.14)	1.032 (0.09)	1.317 (0.90)	1.002 (0.01)	1.009 (0.02)
TBS_Third_Top	0.971 (-0.27)	0.967 (-0.28)	1.084 (0.54)	1.299 (1.80)	1.089 (0.67)	1.214 (1.54)	1.222 (0.96)
TBS_Third_Middle	0.865 (-1.40)	0.998 (-0.02)	1.219 (1.29)	1.410* (2.36)	1.145 (1.08)	1.080 (0.63)	1.258 (1.10)
N	6952	6350	5356	4411	3412	2247	996
pseudo R^2	0.041	0.050	0.106	0.144	0.097	0.086	0.310

Exponentiated coefficients; *t* statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Estimate of the effect of MOS preference received on length of service, with additional analysis on gender (Logit, Odds-Ratio)							
YrsComm [X]	**5**	**6**	**7**	**8**	**9**	**10**	**11**
MOS_Pref_Rcvd_1	0.396*** (-7.01)	0.523*** (-4.83)	0.939 (-0.39)	0.435*** (-5.22)	1.034 (0.27)	0.871 (-1.15)	1.092 (0.42)
f_MOS_Pref_Rcvd_1	0.814 (-0.71)	0.886 (-0.43)	0.623 (-1.46)	1.808 (1.86)	1.547 (1.34)	1.858 (1.82)	3.438 (1.89)
MOS_Pref_Rcvd_2	0.472*** (-4.90)	0.491*** (-4.66)	0.828 (-0.99)	0.945 (-0.27)	1.234 (1.36)	1.008 (0.05)	1.080 (0.31)
MOS_Pref_Rcvd_3	0.375*** (-6.01)	0.576** (-3.08)	0.725 (-1.49)	0.758 (-1.21)	1.726** (2.70)	1.652** (2.58)	0.570 (-1.93)
Commission_EnlProg	2.098** (2.74)	1.190 (0.54)	0.184*** (-3.43)	0.239*** (-3.96)	0.250*** (-4.37)	0.403** (-2.96)	0.129*** (-4.14)
Commission_OtherReserve	1.000 (.)	14.717*** (3.77)	1.658 (1.07)	0.179*** (-8.48)	0.141*** (-11.60)	3.108*** (3.59)	0.018*** (-12.29)
Commission_ROTC	1.567*** (3.49)	0.927 (-0.59)	0.492*** (-3.56)	0.808 (-0.85)	0.425*** (-5.14)	0.366*** (-7.04)	0.079*** (-10.24)
Commission_SvcAcademy	0.995 (-0.05)	0.571*** (-4.70)	0.123*** (-12.53)	0.100*** (-13.88)	0.149*** (-13.13)	0.212*** (-10.59)	0.081*** (-9.59)
Demo_Gender	1.430 (1.70)	1.032 (0.16)	0.781 (-1.11)	0.379*** (-4.63)	0.536** (-3.13)	0.446*** (-3.83)	0.376* (-2.49)
Demo_Age	0.904*** (-4.32)	1.139*** (3.97)	1.073 (1.75)	0.969 (-0.99)	0.968 (-1.18)	0.964 (-1.34)	1.083 (1.74)
Demo_EDU_MoreThanBach	0.427*** (-3.46)	0.812 (-0.47)	1.128 (0.20)	2.329 (1.38)	1.350 (0.73)	0.859 (-0.34)	1.942 (0.85)
Demo_Race_NonWhite	0.628*** (-4.99)	0.544*** (-5.94)	1.278 (1.67)	0.894 (-0.86)	1.214 (1.58)	1.794*** (4.67)	0.507*** (-3.35)
PriorEnlisted	2.127** (2.83)	0.529 (-1.94)	0.905 (-0.20)	1.048 (0.13)	1.324 (0.92)	1.011 (0.04)	0.991 (-0.02)
TBS_Third_Top	0.970 (-0.29)	0.966 (-0.29)	1.076 (0.49)	1.313 (1.87)	1.096 (0.72)	1.220 (1.57)	1.233 (1.00)
TBS_Third_Middle	0.866 (-1.39)	0.999 (-0.01)	1.232 (1.36)	1.389* (2.25)	1.137 (1.02)	1.072 (0.57)	1.248 (1.06)
N	6952	6350	5356	4411	3412	2247	996
pseudo R^2	0.041	0.050	0.106	0.145	0.097	0.087	0.313

Exponentiated coefficients; *t* statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Estimate of the effect of MOS preference received on length of service, with additional analysis on race (Logit, Odds-Ratio)							
***YrsComm* [X]**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
MOS_Pref_Rcvd_1	0.398***	0.450***	0.857	0.438***	0.995	0.888	1.113
	(-6.45)	(-5.40)	(-0.92)	(-4.79)	(-0.04)	(-0.92)	(0.47)
nw_MOS_Pref_Rcvd_1	0.934	1.490*	1.084	1.303	1.433	1.155	1.220
	(-0.38)	(2.00)	(0.28)	(1.05)	(1.48)	(0.60)	(0.54)
MOS_Pref_Rcvd_2	0.473***	0.484***	0.835	0.925	1.220	0.994	1.057
	(-4.88)	(-4.73)	(-0.94)	(-0.38)	(1.29)	(-0.04)	(0.22)
MOS_Pref_Rcvd_3	0.376***	0.574**	0.729	0.744	1.703**	1.622*	0.564*
	(-6.00)	(-3.09)	(-1.46)	(-1.30)	(2.64)	(2.50)	(-1.97)
Commission_EnlProg	2.092**	1.199	0.177***	0.246***	0.256***	0.412**	0.132***
	(2.73)	(0.56)	(-3.46)	(-3.90)	(-4.31)	(-2.89)	(-4.09)
Commission_OtherReserve	1.000	14.838***	1.660	0.179***	0.142***	3.117***	0.018***
	(.)	(3.78)	(1.07)	(-8.48)	(-11.56)	(3.60)	(-12.25)
Commission_ROTC	1.566***	0.929	0.491***	0.814	0.428***	0.368***	0.081***
	(3.49)	(-0.57)	(-3.56)	(-0.82)	(-5.10)	(-7.01)	(-10.15)
Commission_SvcAcademy	0.993	0.574***	0.123***	0.100***	0.149***	0.213***	0.085***
	(-0.06)	(-4.66)	(-12.51)	(-13.87)	(-13.14)	(-10.56)	(-9.48)
Demo_Gender	1.290	0.971	0.635**	0.493***	0.633**	0.564***	0.579
	(1.72)	(-0.20)	(-2.73)	(-4.38)	(-2.84)	(-3.41)	(-1.72)
Demo_Age	0.904***	1.139***	1.073	0.967	0.967	0.963	1.081
	(-4.31)	(3.96)	(1.77)	(-1.08)	(-1.24)	(-1.37)	(1.70)
Demo_EDU_MoreThanBach	0.428***	0.816	1.133	2.355	1.350	0.886	2.069
	(-3.46)	(-0.46)	(0.20)	(1.40)	(0.73)	(-0.28)	(0.95)
Demo_Race_NonWhite	0.651**	0.448***	1.232	0.774	1.051	1.689***	0.467**
	(-3.18)	(-5.74)	(1.09)	(-1.38)	(0.33)	(3.32)	(-2.98)
PriorEnlisted	2.133**	0.531	0.937	1.039	1.319	1.000	1.009
	(2.84)	(-1.93)	(-0.13)	(0.11)	(0.90)	(0.00)	(0.02)
TBS_Third_Top	0.971	0.964	1.084	1.299	1.089	1.215	1.218
	(-0.27)	(-0.31)	(0.53)	(1.80)	(0.67)	(1.54)	(0.94)
TBS_Third_Middle	0.865	0.993	1.218	1.408*	1.145	1.080	1.260
	(-1.39)	(-0.06)	(1.29)	(2.35)	(1.08)	(0.63)	(1.11)
N	6952	6350	5356	4411	3412	2247	996
pseudo R^2	0.041	0.051	0.106	0.144	0.098	0.086	0.310

Exponentiated coefficients; *t* statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Estimate of the effect of MOS preference received on performance (OLS)					
YrsComm [X]	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
MOS_Pref_Rcvd_1	0.723***	0.641***	0.601***	0.590***	0.293**
	(0.117)	(0.116)	(0.115)	(0.115)	(0.112)
MOS_Pref_Rcvd_2	0.370*	0.342*	0.300*	0.295*	0.236
	(0.145)	(0.143)	(0.143)	(0.142)	(0.137)
MOS_Pref_Rcvd_3	0.153	0.168	0.137	0.135	0.158
	(0.166)	(0.164)	(0.163)	(0.163)	(0.157)
2011.TBSClassYear	0.228	0.113	0.055	0.066	0.071
	(0.181)	(0.180)	(0.179)	(0.179)	(0.173)
2012.TBSClassYear	0.245	0.169	0.093	0.113	0.142
	(0.184)	(0.181)	(0.181)	(0.180)	(0.174)
2013.TBSClassYear	-0.325	-0.367	-0.426*	-0.419*	-0.353
	(0.191)	(0.188)	(0.188)	(0.187)	(0.181)
2014.TBSClassYear	0.094	0.112	0.026	0.059	0.101
	(0.194)	(0.194)	(0.193)	(0.193)	(0.186)
2015.TBSClassYear	0.526**	0.570**	0.544**	0.552**	0.553**
	(0.191)	(0.191)	(0.190)	(0.190)	(0.183)
2016.TBSClassYear	0.119	0.166	0.154	0.209	0.182
	(0.192)	(0.191)	(0.190)	(0.190)	(0.183)
2017.TBSClassYear	-0.896***	-0.800***	-0.793***	-0.742***	-0.750***
	(0.187)	(0.186)	(0.185)	(0.185)	(0.179)
2018.TBSClassYear	-1.397***	-1.557***	-1.569***	-1.522***	-1.576***
	(0.217)	(0.216)	(0.215)	(0.215)	(0.207)
2019.TBSClassYear	1.321***	-0.170	-0.229	-0.384	-0.325
	(0.397)	(0.403)	(0.402)	(0.403)	(0.388)
2020.TBSClassYear	2.718**	0.891	0.934	0.822	0.640
	(0.962)	(0.955)	(0.951)	(0.949)	(0.916)
Commission_EnlProg		2.377***	2.528***	1.589***	1.275***
		(0.143)	(0.189)	(0.248)	(0.240)
Commission_OtherReserve		0.372	0.369	0.338	0.340
		(0.217)	(0.219)	(0.219)	(0.211)
Commission_ROTC		0.293*	0.229	0.201	0.069
		(0.122)	(0.127)	(0.126)	(0.122)
Commission_SvcAcademy		0.697***	0.670***	0.659***	0.409**
		(0.130)	(0.133)	(0.132)	(0.128)
Demo_Gender			0.818***	0.819***	1.418***
			(0.145)	(0.144)	(0.141)
Demo_Age			-0.015	-0.073**	-0.043
			(0.023)	(0.025)	(0.024)
Demo_EDU_MoreThanBach			1.229***	1.312***	0.978**
			(0.338)	(0.338)	(0.327)
Demo_Race_NonWhite			-0.784***	-0.792***	-0.347***
			(0.102)	(0.102)	(0.100)
PriorEnlisted				1.463***	1.033***
				(0.251)	(0.242)
TBS_Third_Top					2.811***
					(0.107)
TBS_Third_Middle					1.552***
					(0.105)
_cons	91.930***	91.542***	92.070***	93.375***	91.313***
	(0.158)	(0.163)	(0.564)	(0.606)	(0.591)
N	9214	9214	9214	9214	9214
R^2	0.021	0.050	0.060	0.064	0.129

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