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THESIS

DIRECT OFFICER ACCESSIONS: EFFECTING THE TIMELINE FOR ESTABLISHING A CYBER-COMMUNITY WITHIN THE MARINE CORPS

by

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March 2020

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13. ABSTRACT (maximum 200 words)

In 2004, the United States military officially recognized cyberspace as its own warfighting domain. This recognition ultimately led to the creation of the 10th Combatant Command—U.S. Cyber Command—in 2017. The swift action created a capability deficit to fill within the Marine Corps. Lateral moves from the signal intelligence and communication communities have been used to fill this gap. However, lateral movers do not necessarily equate to community maturity and expertise. The recent changes to the 2018 and 2019 National Defense Authorization Acts (NDAA) provide the Marine Corps with the option to speed up the establishment of a mature cyber-community with technical experts. The acts loosen the restrictions placed on the direct officer accessions method for acquiring officer talent. This thesis utilizes a mixed method approach to explore both the numeric and cultural implications for enacting such a policy. The quantitative analysis uses a series of fixed inventory Markov chain models. The qualitative analysis rests on a literature review combined with an ethnographic approach. The research provides a balanced demonstration of the potential cultural and manpower management implications for enacting such an accessions method.

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DIRECT OFFICER ACCESSIONS: EFFECTING THE TIMELINE FOR ESTABLISHING A CYBER-COMMUNITY WITHIN THE MARINE CORPS

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ABSTRACT

In 2004, the United States military officially recognized cyberspace as its own warfighting domain. This recognition ultimately led to the creation of the 10th Combatant Command—U.S. Cyber Command—in 2017. The swift action created a capability deficit to fill within the Marine Corps. Lateral moves from the signal intelligence and communication communities have been used to fill this gap. However, lateral movers do not necessarily equate to community maturity and expertise. The recent changes to the 2018 and 2019 National Defense Authorization Acts (NDAA) provide the Marine Corps with the option to speed up the establishment of a mature cyber-community with technical experts. The acts loosen the restrictions placed on the direct officer accessions method for acquiring officer talent. This thesis utilizes a mixed method approach to explore both the numeric and cultural implications for enacting such a policy. The quantitative analysis uses a series of fixed inventory Markov chain models. The qualitative analysis rests on a literature review combined with an ethnographic approach. The research provides a balanced demonstration of the potential cultural and manpower management implications for enacting such an accessions method.

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LIST OF ACRONYMS AND ABBREVIATIONS

CBA	cost benefit analysis
DOD	Department of Defense
ECP	enlisted commissioning program
FY	fiscal year
GAR	grade adjusted recapitulation
HQMC	Headquarters Marine Corps
LDO	limited duty officer
M&RA	Manpower and Reserve Affairs
MAGTF	Marine Air Ground Task Force
MAPE	mean absolute proportional error
MARSOC	Marine Corps Special Operations Command
MECEP	Marine Corps enlisted commissioning program
MOS	military occupational specialty
NDAA	National Defense Authorization Act
NPS	Naval Postgraduate School
OCS	officer candidate school
ROTC	reserve officers' training corps
TBS	The Basic School
TFDW	Marine Corps Total Force Data Warehouse
UAV	unmanned aerial vehicle
URL	unrestricted line officer
USMC	United States Marine Corps
VBT	values-based training
VMU	Marine Unmanned Aerial Vehicle Squadron

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Semper Fidelis. Isaiah 25:1, Colossians 3:23, and Jeremiah 17:7.

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I. INTRODUCTION/EXECUTIVE SUMMARY

> The other services sell themselves as a means to something better… The Marine Corps doesn't sell itself as a means to something else, it sells itself as the destination. You want to be a Marine, we'll promise you one thing—a set of blues.
>
> —Lieutenant General Robert E. Milstead

A. BACKGROUND

The computer and networking age has ushered in a host of opportunities and threats. The advancements in technology and computing capacities have unleashed a multitude of avenues in gaining a competitive advantage for military operations. Those opportunities have, in turn, grown to such a degree that the cyber-environment is now considered its own military warfighting domain, full of possibilities and risks.

Regardless of the circumstance, losing is not an option. The Marine Corps fights, and wins, our nation's battles. As such, the Marine Corps must swiftly establish superiority in the newly created cyber domain. Fortunately, the institution has begun the process toward meeting the demands of the new environment.

The first step toward superiority was creating a new occupational field that specializes in cyber warfare. However, competition for experts in this domain creates an obstacle for the Marine Corps to reach its objective of creating and sustaining a healthy cyber officer population. Moreover, the generation of this new capability comes with several challenges including, but not limited to: identifying who and where are the subject matter experts to build the knowledge and experience base; deciding the force structure for each rank and their corresponding duties; how fast can the Corps build the community given the closed talent development environment; what types of career paths will they have access to; and how will the institution retain this talent when competing against a lucrative civilian sector?

B. PURPOSE

In the most simplistic terms, the purpose of this research is to start the discussion on the feasibility for the Marine Corps to utilize the direct officer accessions method to aid in meeting manpower requirements. It seeks to provide decision-makers with a holistic perspective when considering the estimated quantitative results. The specific primary and secondary research questions are:

Primary:

- Given a desired force structure, what is the timeline to reach a mature state?

Given the test model for this research, we found that the cyber community does not reach a mature state within five years utilizing only regular officer accessions.

- How will direct officer accessions impact the timeline to reach a mature state?

Through the use of direct officer accessions, the cyber community could reach maturity within four to five years.

Secondary:

- How will direct officer accessions affect the culture within the cyber community and the Marine Corps?

The direct officer accessions program could cause significant changes to the cultures within the cyber community and the Marine Corps.

C. ASSUMPTIONS

The research rests on a list of decided assumptions. Those assumptions and a brief definition follow. We acknowledge the research findings could range vastly when these levers are manipulated. Nonetheless, they provide the necessary baseline to build the discussion.

Future force strength. The predictive Markov chain models were built on information provided by Headquarters Marine Corps (HQMC) via the most current grade adjusted recapitulated (GAR) spreadsheet. The GAR numbers range from year to year; however, we assume that the GAR will not change for the next five years during this research.

Entry-level officer training. The officers brought in through this accession method at the O4 and O5 level would not be attending the current versions of the officer candidate school (OCS) and the basic school (TBS). Given the age range—38 to 45—these individuals have a higher propensity for physical injury.

Promotions. These officers—hypothetical accessions—would be in their own competitive category for promotion. They would not have the same work history, experience, and deployments to compete against others throughout the fleet.

Compensation. Military pay structures are public knowledge; however, industry pay structures are not public knowledge. It is assumed that the Marine Corps would know the necessary compensation package to entice cyber experts to join.

Career track and command opportunities. These officers would follow a career track similar to limited duty officers (LDO) in a restricted status. They could hold key billets within their own community. They would not be afforded the opportunity to command or serve in billets outside their expertise.

D. LIMITATIONS

Limitations and a brief description follow. We acknowledge that these limitations influence the results and conclusions offered.

Small recruiting population. The population capable to fulfill the needs required are limited. The density of this population diminishes as the requirements increase, e.g., height and weight standards, physical fitness tests.

Level of expertise. Industry does not have universal standards indicating the various levels of expertise. Educational standards also vary among institutions. Moreover, Marine Corps billet requirements are not linked to levels of education or industry certificates.

Motivational incentives. Compensation packages are only part of the equation in acquiring human resources. Individual motivation incentives vary among a populace. Geographical location, propensity toward military service, and contractual lengthen of service limit the scope of the research.

E. METHODOLOGY

This study implements a mixed methodology approach to explore the research questions. This approach maximizes the strengths of both qualitative and quantitative analyses to provide a balanced rendering of the research (Parylo, 2012). Oksana Parylo (2012) states that educational material tends to utilize this type of methodology to inform their audience. Given the purpose for the research, we aim to educate the Marine Corps audience and begin the dialogue regarding the effects of direct officer accessions within the institution.

The quantitative chapter utilizes a series of mathematical predictive models (Parylo, 2012) to estimate the effects direct officer accessions could have on reaching a mature cyber community. The models utilize data from both the cyber and unmanned aerial vehicle (UAV) communities within the Marine Corps. The data from the cyber community covers one year of history, whereas the UAV data ranges back throughout the past eight years. Collectively, these data sets will aid in producing various Bartholomew fixed-inventory and fixed-recruiting equations to estimate the effects of the two different officer accession methods.

For the qualitative analysis chapter, we turn to an exhaustive review of relevant literature in organizational behaviors and cultures, and utilize an ethnographic method to observe and interpret how the accessions method could impact the Marine Corps and its culture. This methodology best fits the research project due to my observational experience within the Marine Corps that enables me to provide relevant context to the material for the Marine Corps audience.

F. RESULTS AND CONCLUSION

Through the use of only the regular accessions method, the cyber community would not reach maturity within a five-year time horizon. However, we found that the cyber community could reach maturity within four to five years. By implementing a mixed accessions method that incorporates both regular and direct officer accessions the community could reach maturity in both a low and high attrition environment. We took these results and then examined the potential effects on organizational culture within the Marine Corps.

This research explored how organizational culture and people influence one another and were tied to organizational purpose and mission. These concepts were viewed from both a militaristic and business perspective in hopes to gain a better understanding of the symbiotic relationship. We also examined important aspects about the human resource development process. The research illustrates how matching, recruiting, and training pipelines all matter to sustaining organizational culture stability. Furthermore, we learned that people tend to behave in line with organizational culture when they perceive to have preexisting matching values and time exists to assimilate into the culture: the human development pipeline matters.

Ultimately, we recommend against utilizing this form of officer accessions to meet end strength requirements. The cultural implications for such a program surpass the potential technical acumen gained. The Marine Corps ought to continue meeting its personnel requirements via lateral moves among Marines within the institution. However, should the Marine Corps truly desire to pursue this type of accessions, it ought to formally conduct a cost benefit analysis (CBA) on the program and then strongly consider the potential ripple effects into the various other aspects of the institution.

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II. BACKGROUND

Four elements, and their history, are important to consider and understand prior to answering the question of how direct officer accessions could affect the Marine Corps. The elements follow in a sequential order and are: the National Defense Authorization Act (NDAA), the precedence in direct officer accessions, the cyberspace warfare domain, and the unmanned aerial vehicle (UAV) community. All four of these areas lay the foundational work in establishing context for the research.

The NDAA serves as the first and foundational element to consider. Without the two most recent changes to the NDAA, the research questions are rendered moot. The changes relieve the prior restrictions to the direct officer accession mechanism. Those restrictions are the focus of the second element in this chapter. Prior to the 2018 and 2019 NDAAs, there was a more limited version of direct officer accessions created by the Uniformed Services Health Professions Revitalization Act of 1972. This congressional act led a change in the United States Code under Title 10; the creation of Section 533, which enables civilians to trade their work experience for entry-level rank at the point of commissioning. The next section explores the creation of the cyberspace warfare domain. Similar to the changes in the NDAA, without the recent establishment of the cyberspace warfare domain the research would not be necessary. Last, a section on the creation of the Marine Corps' UAV community provides context to the quantitative model utilized in Chapter IV. The UAV community most closely resembles what the Marine Corps aims to achieve in establishing a new community from the ground up.

A. NATIONAL DEFENSE AUTHORIZATION ACT

Basically, Congress holds the keys to the federal purse. There are two different pieces of legislation—passed by Congress—that unlocks the funding for the military: appropriations bill and authorization bill. The appropriations bill provides a generic framework on the funding for the military. The authorization bill, known as the NDAA, gives the military the ability to spend the appropriated funds (Candreva, 2017).

Every fiscal year since 1961, the legislature has passed a version of the NDAA that funds the military (House Armed Services Committee, n.d.). The two-step process for funding the military gives this particular piece of legislation a high priority for approval each year. Due to the high priority in funding the military for national security, a natural sense of urgency in getting the legislation passed develops. This sense of necessity enables legislators to attach non-military funding aspects to the bill. The adjustments do not occur every year but when they do occur it is significant.

The FY19 NDAA contains two significant adjustments to manpower management in the officer corps. One adjustment pertains to the age limit a potential officer must be under to qualify for commissioning (Robbert, Kidder, Lee, Schaefer & Waggy, 2019). The other adjustment allows the service branches to directly access officers at the rank of O-6 and below (Robbert et al., 2019). The combination of Sections 501 and 502 within Title V of Subtitle A gives the Department of Defense (DOD) a new ability to acquire highly experienced human capital (Robbert et al., 2019).

B. DIRECT OFFICER ACCESSIONS—UNIFORMED SERVICES HEALTH PROFESSIONS REVITALIZATION ACT

The United State Marine Corps (USMC) has 45 officer occupational field specialties (Headquarters United States Marine Corps [HQMC], 2019). All of those specialties have a corresponding USMC training school designed to develop a basically trained officer prior to their assignment to an operational unit. Lacking among the 45 officer occupational fields are specialties for physician and chaplain officers. These services are performed by officers within the United States Navy.

The two missing officer specialties are skillsets that have a direct, and competitive, civilian counterpart. Our nation has countless hospitals filled with doctors of all different sorts that seem to be in a constant state of demand. Also, our nation has countless places of worship filled with the necessary clergymen to perform the duties of each particular religion. Thus, there are plenty of options for employment beyond military service.

As the nation shifted away from conscription, the DOD began to realize it would have a serious problem in maintaining the human resources necessary to fill the

requirements within the medical corps (Uniformed Services University, 2019–2020). As such, in 1972 the United States Congress passed a bill titled “Uniformed Services Health Professions Revitalization Act.” This bill aimed at addressing the shortages in the physician community by offering civilian students interested, and qualified, for medical school an alternative to achieving their education in trade for a commitment to serve a set number of years in the military (Eiseman & Chandler, 2005). According to Cervero et al. (2018), this system of training and sourcing the military with qualified medical officers has been an undisputed success.

While the Uniformed Services Health Professions Revitalization Act of 1972 aided in solving part of the medical field dilemma, it did not address the chaplaincy corps. A different sort of change would be needed to address the chaplaincy corps and complete the medical field requirements. That change would come via an amendment to the United States Code.

Title 10 of the United States Code deals specifically with the authorities of the Armed Forces. In 1980, an amendment was made to Title 10 that inserted section 533 to the code (Service credit upon original appointment as a commissioned officer, 2010). This amendment enabled service branches to grant rank credits for particularly qualified training, education, and experience (Service Credit Upon Original Appointment as a Commissioned Officer, 2020). However, there were limitations to this amendment. The individual could not be over the age of 42 at the time of commissioning without getting a waiver and the rank credit was capped at O-4 level (Service Credit Upon Original Appointment as a Commissioned Officer, 2020).

Thus, the birth of the direct officer commission. Individuals seeking commission through this avenue do not have to start at the O-1 level and work their way up through the ranks with time in service. Historically, this approach was primarily utilized to fill the ranks within the medical, legal, and chaplaincy fields. However, the Army has already added cyber to the list of areas qualifying for a direct officer commission (U.S. Army, 2020a).

C. A NEW WARFIGHTING DOMAIN—CYBERSPACE

The term "warfighting domain" has a relatively young history. Prior to the turn of the 21st century, the legislature and DOD thought of military action only occurring in three different dimensions: air, land, and sea (Heftye, 2016). This thought perspective matched well to the big three military service branches—Army, Navy, Air Force. However, as the United States emerged out of the Cold War and into what is now known as the era of War on Terrorism, the paradigm of military thinking started to shift toward a domain construct. The adjusted thinking would later include two other dimensions, or domains: space and cyber.

Within the past twenty years, the military has shifted toward warfighting domains that number five. The thought process started with the Chairman of Joint Chiefs of Staff document titled "Joint Vision 2010" published in 1996 (Heftye, 2016). The Chairman's Vision started the process that ultimately ended in the creation of another combatant command—Space Command—and another subject matter for military members to master—cyber.

The military's industrial complex adjusted to the chairman's vision statement in 1996 and swiftly embarked on developing the new warfighting domain. In 2004, the Joint Chiefs of Staff officially named cyber as a warfighting domain that would include personnel from all four major military services. Within four short years, cyber would be created into its own sub-unified command per the direction of Secretary Gates. As of 2017, cyber received its most recent adjustment under the stewardship of Secretary Mattis and cyber was elevated to be its own unified command—the 10th combatant command for the United States (U.S. Cyber Command, n.d.).

This year marks the ten-year anniversary of the Marine Corps' first endeavor into the cyber domain. In 2010, under the command of Lt. Gen. George Flynn, the Marine Corps opened its doors to the institution's newest unit: MARFORCYBER (McCombs, 2010). The personnel within the unit would not have their own military occupational specialty (MOS) until early 2018. The Marine Corps released an administrative message, MARADMIN: 136/18, under the direction of General Neller to create the newest set of seven MOSs to

carry the institution into the future within the new warfighting domain (U.S. Marine Corps [USMC], 2018).

Another large adjustment to the cyber community occurred within the U.S. Code under Title 10. In 2017, the code was updated to accurately reflect the known cyber community. Under these authorities, the U.S. military can now establish training and education facilities to specifically equip military personnel for service within the cyber community (Cyber Scholarship Program, 2019). This action further solidified the presence of a cyber-community within the warfighting domains.

D. THE PROXY COMMUNITY FOR MODEL DEVELOPMENT—UNMANNED AERIAL VEHICLE

The cyber community is not the only community the Marine Corps has had to build within the past half-century. The unmanned aerial vehicle (UAV) community had a similar path to creation. Both communities were birthed out of sourcing from similar occupational fields until the Marine Corps at large would codify their permanent existence. The cyber folks would come from two communities—signal intelligence and communications (Schogol, 2017). The UAV folks would also come from two communities—Marine aviation command and control and aviation at large (UAS Vision, 2013).

The early stages of the cyber community were unstable and manned with personnel from the signal intelligence and computer communication MOS fields. Personnel assigned to a cyber-based unit would be given a secondary, additional MOS for the time served in those billets. This additional MOS would not replace their primary MOS. Once they were done serving in the cyber billet, they would return to their previous MOS and continue down that career path (Schogol, 2017). That method of manning would remain in effect until 2018—when the Marine Corps declared cyber to be its own community with its own primary MOS fields.

The establishment of the UAV community was similar to that of cyber, although a lot slower. Prior to the standup of Marine Unmanned Aerial Vehicle Squadron 1 (VMU-1) in 1996, the Marine used small drones primarily for close order battle and reconnaissance units (Davis, 2016). As the thinking of warfighting changed heading into the War on

Terrorism Era, the Marine Corps began to heavily invest in the UAV technology. Eventually the Marine Corps would create its own squadrons specifically designed to utilize the UAV technology.

When the VMU units finally did come into existence, of which there are three, the Marine Corps created the necessary MOSs for the enlisted personnel to source the new units; however, they sourced the officers on a limited basis from two outside MOSs (UAS Vision, 2013). The UAV community finally codified their officer corps in 2012 by establishing the primary MOS of 7315. This action stopped the officer corps from bouncing back and forth between their primary occupational field and the UAV field. The VMU units could begin the process of stabilizing and generating their own cultural norms.

Since the establishment of a primary MOS for the UAV community, the Marine Corps continues to utilize a mixture of lateral movers via a selection board process and entry-level training to meet its human resource requirements (USMC, 2019b). This is also the same process the Marine Corps is using to build the cyber community (Seck, 2018 and USMC, 2019d). Therefore, a link exists in the methodology between the cyber and UAV communities in how they are manned to serve as a basis for the research.

E. SUMMARY

Thus, the conditions have been set for the Marine Corps to consider an additional officer accessions method. The recent changes to the NDAAs provide the means and authorities for the program to be created. Akin to the medical, legal, and religious occupational fields, the cyber community is considered a specialty area that qualifies for direct officer accessions. Last, the Marine Corps has a community – UAV – with enough similarities to serve as a proxy for testing the potential effects of a direct officer accessions program. In the next chapter we begin the process of testing by conducting a quantitative analysis.

III. QUANTITATIVE ANALYSIS

Now we turn to developing a mathematical model to forecast future inventory levels that involve two different accession methods, along with shifting attrition rates. The cyber community has only one year of data available—fiscal year (FY) 2019—which is insufficient to build a forecasting model. Thus, as stated in chapter 2, the UAV community will serve as a point of departure for the forecasting. The UAV and cyber communities parallel each other in a number of areas—strong external draw to the civilian sector, speed in community development, origins rooted in lateral movers, etc.—that allow us to reasonably expect the model could be implemented.

A. DATA SOURCE

We built a two-year forecasting model based on data from the Marine Corps' UAV community – 7315 and 7301. The data was received from the Marine Corps Total Force Data Warehouse (TFDW) and are end of FY snapshots – September 30 – for the cyber and UAV communities. There is only one FY snapshot for the cyber community – 2019. There are eight FY snapshots for the UAV community – 2012 to 2019 – each data snapshot contains four key variables: individual identifier, fiscal year, MOS, and rank. These variables enable us to identify individual Marines, in a specific MOS, over the course of time, and how they transition from one state to another throughout the period of observation. The target forecasting numbers used in the estimate portions of testing are actual numbers provided by Manpower and Reserve Affairs (M&RA), Headquarters Marine Corps (HQMC). Those numbers are from the GAR and are viewable in Appendix A.

B. ANALYSIS TOOLS

We utilized two software tools to conduct the analysis, the R program and Microsoft Excel. First, we utilized the R program to process the data into a series of state matrices. Examples of these matrices are given in Tables 1 and 2. Next, we utilized Microsoft Excel to build a series of flows matrices, an aggregated probability matrix, check

for data stationarity, and ultimately a transition matrix to forecast manning requirements. Last, we returned to R for the coding to compute the results for each given scenario.

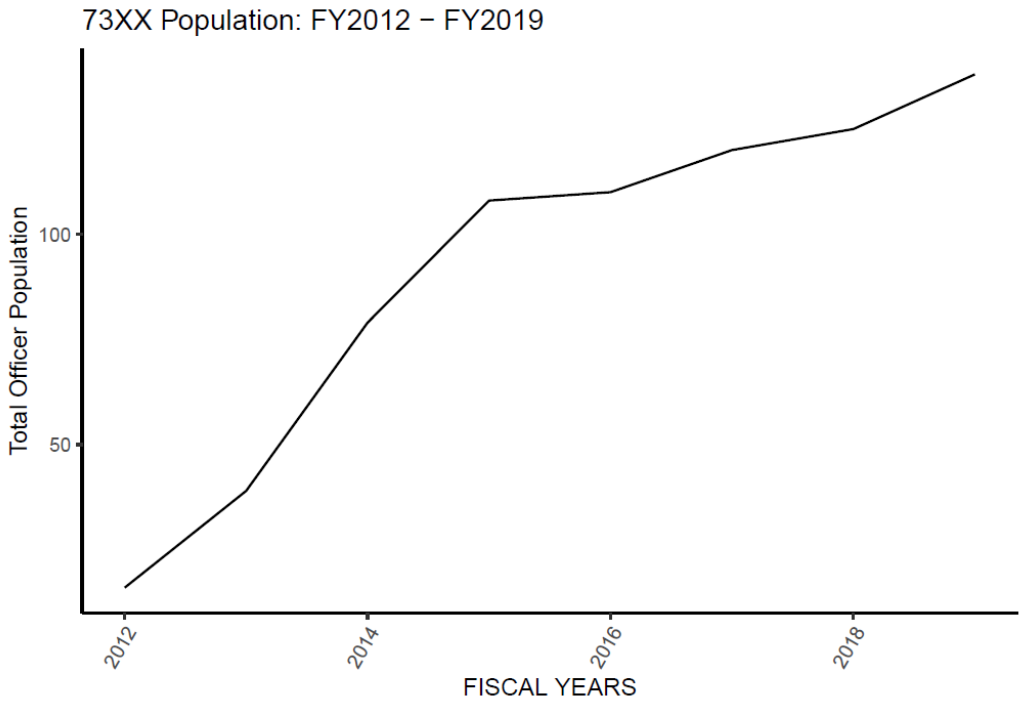
C. UAV COMMUNITY

The following material demonstrates how we built, tested, and validated a two-year forecasting model using the UAV data. This model in the next section will be applied to the cyber community and implemented for the given scenarios.

1. Initial Observations

A series of vision checks is first run to observe how the data behaves. The visual inspection informs the decision-making process in attempting to fit particular conceptual mathematic models and identifying any potentially problematic areas. In our case, we conducted three visual tests to observe how the data behaves, and determine if our objective in utilizing a forecasting model would be possible.

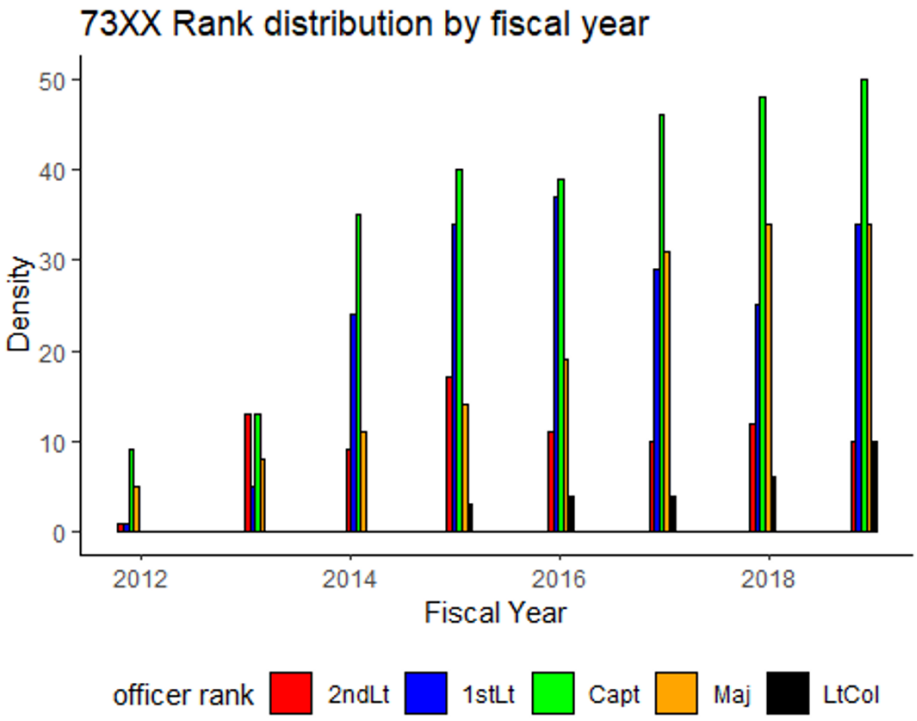
In the first graph – Figure 1—we observe the total change in officer population throughout the past eight fiscal years. The rate of change is noticeably more aggressive in the early years of MOS development, compared to the later years of stability. The obvious change in rate around FY 2015 is something we will keep in mind when we start fitting a model.



Adapted from source information detailed in Chapter III, Section A.

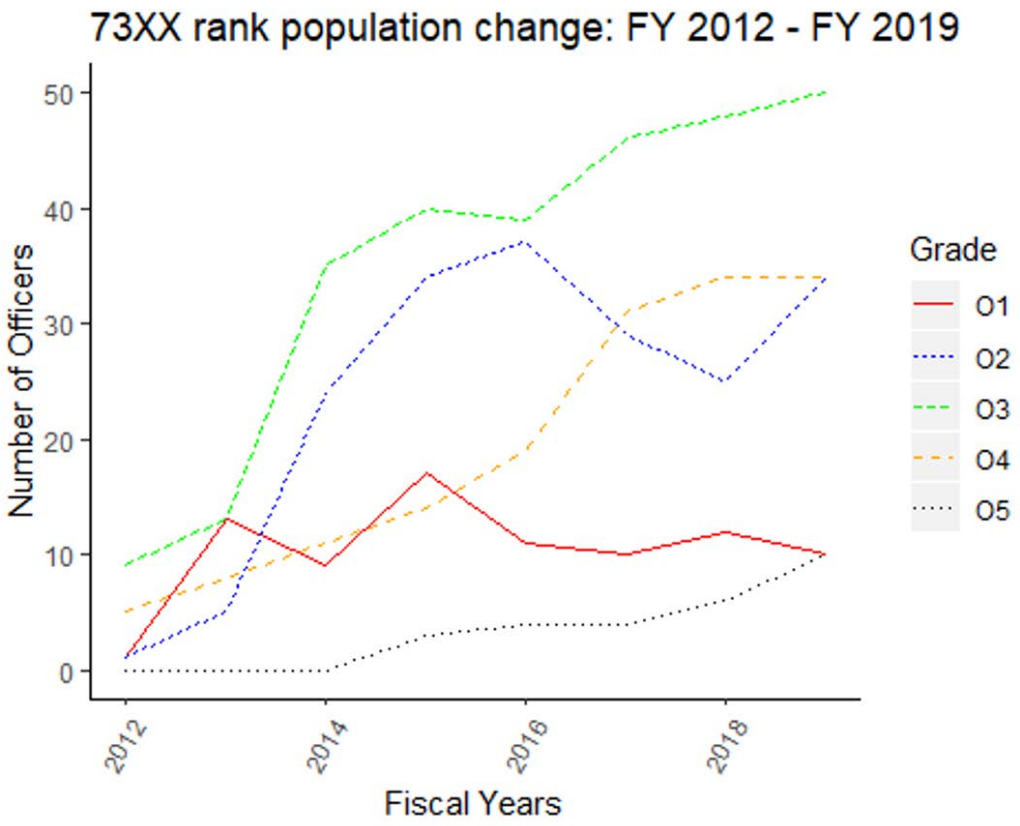
Figure 1. Total officer population over time

Next, we construct two graphs to observe how the individual ranks fluctuate within each FY throughout the observation period. These graphs will display any trends, variance patterns, or erratic behavior. Figures 2 and 3 provide us with that information.



Adapted from source information detailed in Chapter III, Section A.

Figure 2. 73XX rank distribution by fiscal year



Adapted from source information detailed in Chapter III, Section A.

Figure 3. 73XX rank population change: FY 2012—FY 2019

Figures 2 and 3 display characteristics consistent with fitting a forecasting model. One of the key characteristics to observe is a form of constant change over a period of time. This is observed in the later FYs when the UAV community starts to approach a more stable state of manning.

2. Markov Model

We utilize a series of Markov chain models to predict how the cyber community might meet the set requirements for the next three fiscal years. This conceptual model demonstrates how, "…a sequence of random variables [personnel], which correspond to the states [continue, promote, or attrite] of a certain system, in such a way that the state at one time epoch [FY] depends only on the one in the previous time epoch" (Ching & Ng,

2006, p. 1). Figure 4 graphically depicts this system as individuals flow from state *i* to state *j* between the ranks of O1 to O5.

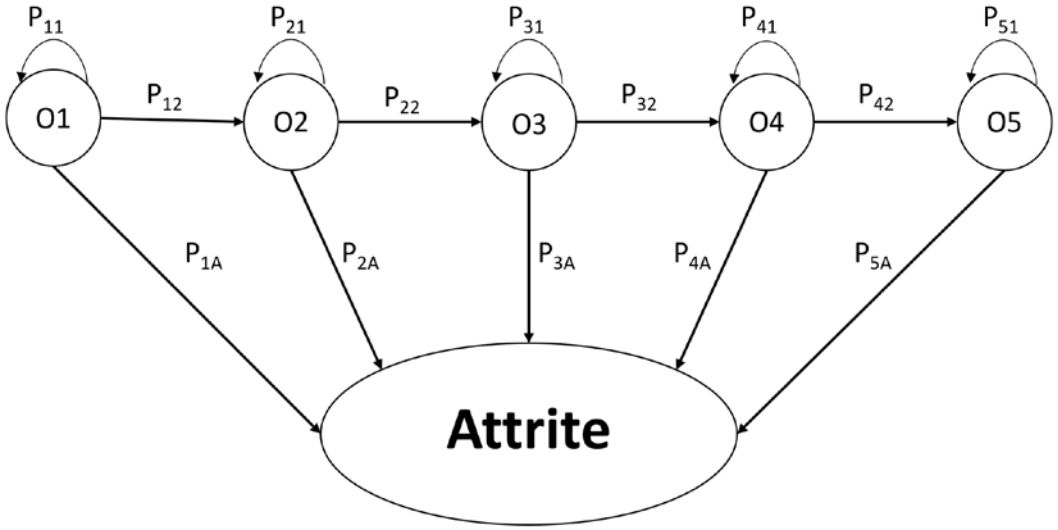


Figure 4. Markov model for ranks O1 to O5

This system enables us to know where each individual is and how they transition between states. Let f = the total number of individuals in a given state. Let i = the "from" state of origin and j = the "to" state transitioning to. Thus, utilizing the data from TFDW and the R software, we wrote script – Appendix B – enabling us to observe each individual in the system and how they moved throughout the time period, e.g., random f_{ij} combinations. Let n_i = the number of individuals who started the time-step in state i. The R script counts the f_{ij} combinations and places them into a table. Table 1 displays the total number of UAV officers at the end of each respective FY. Table 2 displays the number of UAV Marine officers who continued in their current rank during the given year.

Table 1. Total number of UAV officers at FY end

These are stocks on 30 Sep of the year indicated. So, the END of the listed FY.									
	2012	2013	2014	2015	2016	2017	2018	2019	2020
O1	1	13	9	17	11	10	12	10	0
O2	1	5	24	34	37	29	25	34	0
O3	9	13	35	40	39	46	48	50	0
O4	5	8	11	14	19	31	34	34	0
O5	0	0	0	3	4	4	6	10	0
Totals	16	39	79	108	110	120	125	138	0

Adapted from source information detailed in Chapter III, Section A.

Table 2. Total number of UAV officer continued in current rank during FY

These are flows DURING the given year.									
	2012	2013	2014	2015	2016	2017	2018	2019	2020
O1	0	0	2	1	5	1	2	0	0
O2	0	0	4	22	23	19	15	10	0
O3	0	8	10	30	29	27	34	35	0
O4	0	5	7	8	13	19	28	29	0
O5	0	0	0	0	3	4	3	6	0
Totals	0	13	23	61	73	70	82	80	0

Adapted from source information detailed in Chapter III, Section A.

Tables 1 and 2, along with one each for promote, attrite, and access, were utilized to create a series of flowcharts in Microsoft Excel. An example of a yearly flow chart is given on the left-hand side of Table 3. The flow chart leads to the creation of a probability transition matrix—the right-hand side of Table 3. According to Sales (1971), the f_{ij} combinations meet the requirements to be considered binomially distributed. Thus, we can estimate the transition probability by: $\hat{p_{ij}}=f_{ij}/n_{i.}$

Table 3. Demonstration of building a transition matrix

"To State"

"From State"

Flows During 2018							
	O1	O2	O3	O4	O5	Attrite	Total
O1	2	7				1	10
O2		15	12			2	29
O3			34	6		6	46
O4				28	3	0	31
O5					3	1	4

During 2018							
	O1	O2	O3	O4	O5	Attrite	Total
O1	0.2	0.7	0	0	0	0.1	1
O2	0	0.51724	0.41379	0	0	0.06897	1
O3	0	0	0.73913	0.13043	0	0.13043	1
O4	0	0	0	0.90323	0.09677	0	1
O5	0	0	0	0	0.75	0.25	1

Adapted from source information detailed in Chapter III, Section A.

Markov models assume that the transition probability is stationary. According to Sales (1971), we can test to ensure the transition matrix is actually considered sufficiently *close enough* to this assumed characteristic of stationarity. We accomplish this by constructing a confidence interval around the annual transition matrices and then testing to see if the aggregate transition matrix is contained within that confidence interval (Sales, 1971).

To discover what the proper number of years, and which years, are necessary to develop an accurate transition matrix, a test for data stationarity is conducted. This process aggregates the individual transition matrices for a given set of years (t), builds a confidence interval around each annual matrix, and then tests for whether or not the aggregate probability lies within the aggregated confidence interval (Sales, 1971). If the transition probability is between the confidence internal, it is observed as a success and given the number 1 and a zero otherwise. Table 4 displays the test results for only FY 2019, utilizing an aggregated transition matrix spanning FY 2013 through FY2019.

Table 4. Model test results for FY19

FY 19 Containment Test Results						
	O1	O2	O3	O4	O5	Attrite
O1	0	0	0	0	0	1
O2	0	0	0	0	0	0
O3	0	0	1	1	0	0
O4	0	0	0	1	1	1
O5	0	0	0	0	0	0

Adapted from source information detailed in Chapter III, Section A.

To determine the percentage of accuracy for the matrix, we sum the number of success—$\hat{p}_{ij}(t)$—in the blue boxes and divide by the total number of transitions (blue boxes) possible for the year—(t). In this case, there were 6 successes in 14 transition opportunities. Thus, the percentage of accuracy is ~ 42.86%. According to Sales (1971), the previously mentioned percentage falls well short of the recommended 60% threshold for stationarity, which is not considered sufficiently close enough to build predictive models for forecasting.

3. Model Selection

Having established the methodology, we then turned to discovering the proper model, by conducting 21 different tests. We started the process by conducting a series of incremental tests until we found a model that sufficiently met the 60% or higher standard. We found that a three-year model spanning FY 2017 to FY 2019 and a two-year model spanning FY 2018 to FY 2019 achieved the threshold with 64.29% and 78.57% accuracy respectively (see Table 5). We also found that a four-year model from FY 2016 to FY 2019 was close to the threshold with 57.14% accuracy.

Table 5. Incremental stationarity test results

UAV Incremental Stationarity Test Results						
	FY13-FY19	FY14-FY19	FY15-FY19	FY16-FY19	FY17-FY19	FY18-FY19
Years	7	6	5	4	3	2
Comparisons	98	84	70	56	42	28
Successes	41	41	31	32	27	22
Proportion	0.418	0.488	0.443	0.571	0.643	0.786

Adapted from source information detailed in Chapter III, Section A.

We then took the four-year, three-year, and two-year models and applied them to all the different year combinations to test which model was most likely to be effective. This improves the likelihood of obtaining the proper model by empirical evidence and not mere chance. Those results are given in Tables 6—8.

Table 6. Four-year model test results

UAV Four-Year Incremental Stationarity Test Results				
	FY13-FY16	FY14-FY17	FY15-FY18	FY16-FY19
Years	4	4	4	4
Comparisons	56	56	56	56
Successes	18	22	26	32
Proportion	0.321	0.393	0.464	0.571

Adapted from source information detailed in Chapter III, Section A.

Table 7. Three-year model test results

UAV Three-Year Incremental Stationarity Test Results					
	FY13-FY15	FY14-FY16	FY15-FY17	FY16-FY18	FY17-FY19
Years	3	3	3	3	3
Comparisons	42	42	42	42	42
Successes	13	17	14	22	27
Proportion	0.310	0.405	0.333	0.524	0.643

Adapted from source information detailed in Chapter III, Section A.

Table 8. Two-year model test results

UAV Two-Year Incremental Stationarity Test Results						
	FY13-FY14	FY14-FY15	FY15-FY16	FY16-FY17	FY17-FY18	FY18-FY19
Years	2	2	2	2	2	2
Comparisons	28	28	28	28	28	28
Successes	9	17	9	11	20	22
Proportion	0.321	0.607	0.321	0.393	0.714	0.786

Adapted from source information detailed in Chapter III, Section A.

4. Model Validation: Bartholomew's Fixed-Inventory and Recruiting

These test results give us an avenue to proceed in the forecasting. We believe the two-year model will most sufficiently work. Next, we conduct a cross-validation test utilizing the model on sets of known data to forecast inventory. We utilize the Bartholomew inventory equation for this validation, works for both inventory and recruiting scenarios:

$$\boldsymbol{n}(t+1) = \boldsymbol{n}(t)\boldsymbol{P} + R\boldsymbol{r}$$

where:

- $\boldsymbol{n}(t+1)$ is the inventory vector in the next timestep,
- $\boldsymbol{n}(t)$ is the current inventory vector,
- $\boldsymbol{P}$ is a matrix of (transient) transition probabilities,
- $R()$ is a scalar equal to the number of accessions, and
- $\boldsymbol{r}$ is a vector that describes how accessions are distributed across states.

We conduct the cross-validation process by assuming we are, in time, at October in the fiscal year we are predicting. We have just observed the previous two years of data. Knowing what the actual numbers are in the end of the fiscal year we are forecasting, we can utilize the inventory equation to validate the two-year transition matrix model. We executed this cross-validation three times in sequential order by stepping forward in time from FY 2017 to FY 2019. Tables 9—11 display these results.

Table 9. Two-year model cross-validation, predicting FY 2017

Cross-validation on FY15 - FY16 to predict FY17							
	O1	O2	O3	O4	O5		Total
FY16 Starting Inventory	10	29	46	31	4		120
Predicted FY17 Inventory	11.3	30.7	43.7	31.7	9.0		126.3
Actual FY17 Inventory	10	29	46	31	4		120
Absolute Proportional Error (APE	0.131	0.057	0.050	0.023	1.240		0.053
MAPE	**0.300**						

Adapted from source information detailed in Chapter III, Section A.

Table 10. Two-year model cross-validation, predicting FY 2018

Cross-validation on FY16 - FY17 to predict FY18							
	O1	O2	O3	O4	O5		Total
FY17 Starting Inventory	10	29	46	31	4		120
Predicted FY18 Inventory	11.43	25.08	46.88	37.80	5.36		126.55
Actual FY18 Inventory	12	25	48	34	6		125
Absolute Proportional Error (APE	0.048	0.003	0.023	0.112	0.107		0.012
MAPE	**0.059**						

Adapted from source information detailed in Chapter III, Section A.

Table 11. Two-year model cross-validation, predicting FY 2019

Cross-validation on FY17 - FY18 to predict FY19							
	O1	O2	O3	O4	O5		Total
FY18 Starting Inventory	12	25	48	34	6		125
Predicted FY19 Inventory	11.7	34.5	49.7	42.0	7.3		145.1
Actual FY19 Inventory	10	34	50	34	10		138
Absolute Proportional Error (APE	0.171	0.013	0.007	0.235	0.271		0.05162
MAPE	**0.139**						

Adapted from source information detailed in Chapter III, Section A.

The cross-validation process suggests we have a proper model. The high mean absolute proportional error (MAPE) value in the FY 2015—FY 2016 model to predict FY 2017 inventory is expected given the lack of stationarity in the model—32%. As the years progress forward, the stationarity increases into acceptable limits, which yields to the lower MAPE results.

5. Model Demonstration

Utilizing the same inventory equation, we now demonstrate how this model could be used to predict the inventory in the UAV community over the next five years. With the inventory equation, initial inventory vector, aggregated transition matrix, and proportional distribution vector, we developed a code in R to produce the optimal solution for accessions that achieves end strength requirements. The code for these calculations is provided as Appendix C.

a. Fixed Inventory

The fixed-inventory forecast begins with the Bartholomew inventory equation: $\boldsymbol{n}(t+1) = \boldsymbol{n}(t)\boldsymbol{P} + R\boldsymbol{r}$. All the following information allows us to optimize for R—the blue shaded area in Table 14. Recall, the aggregated transition matrix—$\boldsymbol{P}$—shown in Table 12 had a 78% containment rate during the validation process. The initial inventory vector – $\boldsymbol{n}(0)$ – is provided in Table 13. Our target inventory numbers were given by M&RA and are displayed in Table 15. The proportional distribution of accessions—$\boldsymbol{r}$—is given in Table 14. The $\boldsymbol{r}$ vector must sum to 1. Finally, with the given information we are able to calculate the optimal accession plan to achieve the manning targets set forth in the GAR. Table 16 displays the optimal accessions for the five-year span.

Table 12. UAV FY18-19 aggregated transition matrix

UAV FY18-FY19 Aggregrated Transition Matrix					
	O1	O2	O3	O4	O5
O1	0.091	0.818	0	0	0
O2	0	0.463	0.407	0	0
O3	0	0	0.734	0.106	0
O4	0	0	0	0.877	0.108
O5	0	0	0	0	0.900

Adapted from source information detailed in Chapter III, Section A.

Table 13. Initial inventory for 73XX in October 2019

	O1	O2	O3	O4	O5	Total
n(0)	10	34	50	34	10	138

Adapted from source information detailed in Chapter III, Section A.

Table 14. Proportional distribution of accessions

	r				
R	O1	O2	O3	O4	O5
	1	0	0	0	0

Table 15. 73XX MOS GAR

73XX MOS				
FY20	FY21	FY22	FY23	FY24
245	258	269	275	281

Adapted from source information detailed in Chapter III, Section A.

With information from Tables 12—15 coded in R, we are able to calculate the optimal solution shown in Table 16. Again, the accessions distribution—***r***—in this model restricted entry to the O1 level. There are no lateral movers or direct officers accessed in this demonstration.

Table 16. UAV fixed-inventory demonstration

	FY20	FY21	FY22	FY23	FY24
O-1 Accession Only	121.8	37.1	39.4	36.8	37.7

Adapted from source information detailed in Chapter III, Section A.

b. Sensitivity Analysis

The Markov chain models assume constant parameters; however, we know that the parameters for quantitative mathematical models do not remain constant (Soetaert & Petzoldt, 2010). Thus, we must conduct a sensitivity analysis on the optimal solution to test for reasonable variance in the parameters. Also, the sensitivity analysis prevents us from hand selecting the optimal numbers to reach the desired target inventory. The two Monte Carlo methods provide the means to conduct the sensitivity analysis on the optimal solution in Table 16.

(1) Monte Carlo—Optimal Solution

The first sensitivity analysis involves testing the optimal solution around a confidence interval. The sensitivity is produced by constructing a triangle distribution centered on the $\hat{p_{ij}}$ with lengths of +/- .05. The Monte Carlo code provided as Appendix D runs the optimal solution through a series of slightly different transition matrices 1,000 times and produces 1,000 different optimal solutions. The results of these computations are given in Table 17. The value in this type of analysis is that it accounts for the fact that we may have guessed in getting the correct transition matrix the first time, for the next five years of manning.

Table 17. UAV fixed-inventory demonstration sensitivity results #1

95 % Confidence interval for optimal solution per FY					
	FY20	FY21	FY22	FY23	FY24
lower	119.5	32.4	34.7	32.3	32.9
mean	121.8	37.2	39.4	36.8	37.7
upper	124.2	42.1	43.8	41.4	42.4

Adapted from source information detailed in Chapter III, Section A.

Another benefit to conducting this sort of sensitivity analysis is that it produces an empirical confidence interval that doubles as a planning tool for decision-makers in the years ahead. The upper and lower bounds of the optimal solution can serve as metrics for academic planners to coordinate future school seat availabilities. This information can also aid in planning to ensure adequate instructor staff personnel are maintained throughout the forecasted time period.

(2) Monte Carlo—End Strength

Last, we test to see how these optimal solutions impact the overall targeted end strength. To accomplish this, we change the inputs of the inventory equation, treat it as a fixed-recruiting model that yields an ending inventory, and again vary the transition matrix slightly 5,000 times. The results are seen in Table 18; again, the code is provided as Appendix E.

Table 18. UAV fixed-inventory demonstration sensitivity results #2

95% Confidence interval for end strength per FY					
	FY20	FY21	FY22	FY23	FY24
lower	242.6	251.8	259.6	262.3	265.4
mean	244.9	258	269.1	275.1	281.1
upper	247.4	264.3	278.5	288.1	297.1
target	245	258	269	275	281

Adapted from source information detailed in Chapter III, Section A.

The relatively small differences in the confidence intervals from the sensitivity analysis lead us to believe that the model is relatively stable and adequate for forecasting. The lower and upper bounds do begin to increase at year four and beyond, which is expected. The model was built on two years of previous data, so it is reasonable to expect its accuracy to decrease once the forecasting extends beyond the years of previous observation.

As was the case with the optimal solution sensitivity analysis, this provides a benefit to decision-makers beyond merely validating the model. The benefit is that the

analysis provides a band of lower and upper end strength projections for the year. Currently, Congress mandates service branch end strength and each service must be within two percent of that authorized end strength by the close of the fiscal year. Thus, this analysis gives manpower managers a planning width to aid in achieving overall service end strength.

D. CYBER COMMUNITY

Given we do not have any previous data on the cyber community to build a forecasting model, we selected a proxy community to perform the forecasting. Thus, the UAV model will be implemented for the forecasting in the cyber community.

1. Point of Departure

The analysis for the cyber community follows the same techniques as seen in the UAV demonstration. However, the analysis deviates from the demonstration by varying criteria to account for reasonable changes in the environment. We adjust two factors—regular and mixed accessions—under two different conditions—low and high attrition rates—to yield four different scenarios. Once each scenario is complete, we check for sensitivity in the same fashion as the demonstration.

2. Setting Model Parameters

Still utilizing Bartholomew's inventory equation—$\boldsymbol{n}(t+1) = \boldsymbol{n}(t)\boldsymbol{P} + R\boldsymbol{r}$—we perform a five-year accessions forecast on the 17XX community. Similar to the UAV demonstration, we are solving for an optimal R under various conditions. Table 19 displays the given beginning inventory for FY 2020—$n(0)$. The transition matrix—$\boldsymbol{P}$—will vary to show changes in the attrition rates. How we vary $\boldsymbol{P}$ is seen in Tables 21—23 along with discussion. Our target inventory from the GAR is provided in Table 20 and will remain constant throughout. The rank distribution vector—$\boldsymbol{r}$—for scenarios 1 and 2 only allows O1 level accessions. But the $\boldsymbol{r}$ vector will change for scenarios 3 and 4 to account for direct officer accessions in a mixed accessions approach. The $\boldsymbol{r}$ vectors are provided in Tables 26 and 27, along with their respective discussion (see page 31).

Table 19. Initial inventory for 17XX in October 2019

	O1	O2	O3	O4	O5	Total
n(0)	12	10	50	29	8	109

Adapted from source information detailed in Chapter III, Section A.

Table 20. 17XX MOS GAR

17XX MOS				
FY20	FY21	FY22	FY23	FY24
147	159	173	172	190

Adapted from source information detailed in Chapter III, Section A.

Table 21 is the preferred two-year aggregated transition matrix from the UAV community. We utilize this matrix as the baseline to build the low and high attrition transition matrices, and each probability row must sum to one. To get the desired attrition rates, we force the Attrite column to the determined value and then proportionally adjust the corresponding blue state probabilities such that the row still sums to one. Tables 22 and 23 are the low and high attrition matrices used to conduct the forecasting.

Table 21. UAV FY18-19 Full aggregated transition matrix

UAV FY18-FY19 Full Two-year Aggregrated Transition Matrix						
	O1	O2	O3	O4	O5	Attrite
O1	0.091	0.818	0	0	0	0.091
O2	0	0.463	0.407	0	0	0.130
O3	0	0	0.734	0.106	0	0.160
O4	0	0	0	0.877	0.108	0.015
O5	0	0	0	0	0.900	0.100

Adapted from source information detailed in Chapter III, Section A.

In the low attrition scenarios, we forced the attrition levels for O3 and O5 officers down considerably. The O3 officers' attrition rate was cut approximately in half. The O5 officers' attrition rate was reduced similarly.

Table 22. Cyber low attrition transition matrix

Cyber Low Attrition Transition Matrix						
	O1	O2	O3	O4	O5	Attrite
O1	0.091	0.818	0	0	0	0.091
O2	0	0.463	0.407	0	0	0.130
O3	0	0	0.774	0.146	0	0.080
O4	0	0	0	0.877	0.108	0.015
O5	0	0	0	0	0.960	0.040

Adapted from source information detailed in Chapter III, Section A.

In the high attrition scenarios, we force the attrition levels for O3 and O5 officers up considerably. The O3 officers received an approximate 5% increase in attrition; the O5 officers received a similar bump up to 15% attrition.

Table 23. Cyber high attrition transition matrix

Cyber High Attrition Transition Matrix						
	O1	O2	O3	O4	O5	Attrite
O1	0.091	0.818	0	0	0	0.091
O2	0	0.463	0.407	0	0	0.130
O3	0	0	0.714	0.086	0	0.200
O4	0	0	0	0.877	0.108	0.015
O5	0	0	0	0	0.850	0.150

Adapted from source information detailed in Chapter III, Section A.

Before moving onto the accessions vector, we checked each attrition ***P*** matrix to see if they were within the reasonable limits for time in grade (TIG) requirements. This check is accomplished by constructing the Fundamental Matrix. We found that each ***P*** matrix was within those limits. However, it is important to note that the O1 community TIG result appears short by roughly a year. This occurs because we do not observe an officer in a MOS community until after they have completed OCS, TBS, and are in their respective training school pipeline. These schools account for approximately one year of TIG. This will vary depending on the community's length of initial school. For the sake of our analysis, we are considering the UAV and cyber entry level schools to be

approximately the same length of time. The following tables display the fundamental matrices (Tables 24 & 25).

Table 24. Cyber low attrition fundamental matrix

Cyber Low Attrition Fundamental Matrix					
	O1	O2	O3	O4	O5
O1	1.100	1.676	3.019	3.585	9.652
O2	0	1.862	3.354	3.984	10.725
O3	0	0	4.421	5.251	14.137
O4	0	0	0	8.125	21.875
O5	0	0	0	0	25.000

Adapted from source information detailed in Chapter III, Section A.

Table 25. Cyber high attrition fundamental matrix

Cyber High Attrition Fundamental Matrix					
	O1	O2	O3	O4	O5
O1	1.100	1.676	2.386	1.670	1.199
O2	0	1.862	2.651	1.856	1.333
O3	0	0	3.494	2.447	1.757
O4	0	0	0	8.125	5.833
O5	0	0	0	0	6.667

Adapted from source information detailed in Chapter III, Section A.

Last, we alter the proportional distribution vector to simulate the changes in accession methodology. Table 26 is a regular entry level accession program. The proportions of each rank in the vector must sum to one. By placing a *1* in the O1 category and *0*s for the other rank categories, we force the model to allow only O1 accessions.

Table 26. Regular accessions vector

	r				
R	O1	O2	O3	O4	O5
	1	0	0	0	0

Table 27 displays the changes in the accessions vector. We spread out the distribution of accessions to mimic the methodology of direct officer accessions at various levels. We still maintain a proportion of entry level accessions under these conditions, as seen by the 0.2 in the O1 category.

Table 27. Mixed-level accessions vector

	r				
R	O1	O2	O3	O4	O5
	0.2	0.25	0.4	0.1	0.05

3. Scenarios

It is reasonable to expect the personnel environment to ebb and flow over time. As such, we test for these ebb and flow environments by varying the attrition rate to the extremes. We vary the attrition rate due to literature supporting its correlated connection to overall economic strength of the country. The economic strength of the country effects both the UAV and cyber communities by having a corresponding external pull toward the civilian sector. Also, each of the following scenarios are built to address the differences between the regular accessions and a mixed accessions approach.

This scenario development enables us to answer the primary research questions:

- Given a desired force structure, what is the timeline to reach a mature state?
- How will direct officer accessions impact the timeline to reach a mature state?

Note: we consider the community to be mature when the inventory for mid to senior level officers meet or exceed the GAR levels.

a. Scenario 1: Regular Accessions and Low Attrition

The first scenario simulates the Marine Corps' regular accession method during a period of low attrition. Utilizing Tables 19, 20, 22, and 26 along with the same R code from the UAV demonstration, we calculated the optimal accessions solution. The numbers seen in Table 28 are only O1 level accessions throughout the five-year span.

Table 28. Scenario #1 optimal solution results

Scenario #1 Results

Low Attrition	FY20	FY21	FY22	FY23	FY24
Regular Accessions	45.2	22.4	26.4	12.2	30.7

Adapted from source information detailed in Chapter III, Section A.

Given the optimal solution in Table 28, we then insert these numbers back into inventory equation to calculate the inventory per rank for each fiscal year, as shown in Table 29. These results are compared to the desired inventory found in the GAR, shown in Table 30.

Table 29. Rank specific inventory results—scenario #1

Scenario #1 Inventory Results						
	O1	O2	O3	O4	O5	Total
FY19	12.0	10.0	50.0	29.0	8.0	109.0
FY20	46.3	14.4	42.8	32.7	10.8	147.0
FY21	26.6	44.6	39.0	35.0	13.9	159.0
FY22	28.8	42.4	48.3	36.4	17.1	173.0
FY23	14.8	43.2	54.7	38.9	20.3	172.0
FY24	32.0	32.1	59.9	42.1	23.7	189.9

Adapted from source information detailed in Chapter III, Section A.

Table 30. 17XX GAR inventory per rank

17XX GAR Inventory per Rank					
	O1/O2	O3	O4	O5	Total
FY19	22	50	29	8	109
FY20	19	81	24	23	147
FY21	22	84	29	24	159
FY22	22	88	37	26	173
FY23	22	79	44	27	172
FY24	23	95	45	27	190

Adapted from source information detailed in Chapter III, Section A.

In this scenario, the regular accessions program overproduces officers in the O1 and O2 ranks while underproducing for the O3—O5 ranks. Given this transition matrix, the TIG per each rank – see Table 24 – is already on the quicker side of normal, so promoting the surplus of O1/O2 officers would not solve this problem. Thus, the community does not reach the desired maturity by FY 2024 due to the lack of officers in the mid to senior level ranks. However, the target total population of 190 officers in FY 2024 is achieved.

b. Scenario 2: Regular Accessions and High Attrition

The second scenario tests the regular accessions program in the opposite attrition environment. We start by using Tables 19, 20, 23, and 26 to calculate the optimal solution for accessions, with the results provided in Table 31. Along with the first scenario, these are O1 level officers entering the Marine Corps cyber community per year.

Table 31. Scenario #2 optimal solution results

Scenario #2 Results					
High Attrition	FY20	FY21	FY22	FY23	FY24
Regular Accessions	52	28.6	32.6	20.2	40.1

Adapted from source information detailed in Chapter III, Section A.

As with the first scenario, we insert the optimal solution back into inventory equation to calculate the inventory per rank for each fiscal year. The inventory results are given in Table 32. We again compare these results to the target inventories in the GAR (Table 30).

Table 32. Rank specific inventory results—scenario #2

Scenario #2 Inventory Results						
	O1	O2	O3	O4	O5	Total
FY19	12.0	10.0	50.0	29.0	8.0	109.0
FY20	53.1	14.4	39.8	29.7	9.9	147.0
FY21	33.4	50.1	34.3	29.5	11.6	159.0
FY22	35.3	50.6	44.9	28.8	13.1	172.7
FY23	23.4	52.3	52.6	29.1	14.2	171.7
FY24	42.2	43.4	58.9	30.1	15.2	189.8

Adapted from source information detailed in Chapter III, Section A.

Comparing the results between Tables 30 and 32, the initial issues from the first scenario only intensify: the O1 and O2 population grew by 21 officers, making that population over the GAR target by 62 officers; the overage of junior officers created a shortage in the mid to senior level officer populations; the O3 population missed the target by 36 officers; and, the O4 and O5 populations fell short by 15 and 12, respectively. Again, the target total population of 190 officers in FY 2024 is achieved.

c. Scenario 3: Mixed Accessions and Low Attrition

We turn to test how the inventory projections are impacted by implementing a mixed accessions approach. For this scenario, we utilize Tables 19, 20, 22, and 27 to calculate the optimal solution for accessions. In Table 33, the results of this calculation are displayed.

Table 33. Scenario #3 mixed accessions optimal solution results

Scenario #3 Mixed Accessions Optimal Solution Results					
	O1	O2	O3	O4	O5
r	0.2	0.25	0.4	0.1	0.05
FY20	9.0	11.3	18.1	4.5	2.3
FY21	4.4	5.6	8.9	2.2	1.1
FY22	4.9	6.1	9.8	2.5	1.2
FY23	2.0	2.5	3.9	1.0	0.5
FY24	5.6	7.0	11.2	2.8	1.4

Adapted from source information detailed in Chapter III, Section A.

With the optimal solution, we turn again to the inventory equation to calculate the individual inventory (Table 34).

Table 34. Rank specific inventory results—scenario #3

Scenario #3 Inventory Results						
	O1	O2	O3	O4	O5	Total
FY19	12.0	10.0	50.0	29.0	8.0	109.0
FY20	10.1	25.7	60.8	37.3	13.1	147.0
FY21	5.4	25.8	66.5	43.8	17.7	159.0
FY22	5.4	22.4	71.7	50.6	22.9	173.0
FY23	2.4	17.2	68.6	55.8	27.9	172.0
FY24	5.8	17.0	71.2	61.7	34.2	190.0

Adapted from source information detailed in Chapter III, Section A.

In this case, the cyber community reaches maturity at approximately FY 2023 by accessing roughly 81 personnel via the direct officer accessions method. The total number of direct accessions is broken down to 15 O4/O5 officers and 66 O2/O3 officers. By holding $\boldsymbol{r}$ and $\boldsymbol{P}$ constant throughout the five-year span, the O4 and O5 communities develop a surplus of 16 and 7 officers. However, a shortage of 24 officers occurs at the O3 level during the same time period. Additionally, the O1/O2 officer ranks match their target inventory exactly, and total end strength target was achieved.

d. Scenario 4: Mixed Accessions and High Attrition

In this last scenario, we vary the attrition rate to the high condition while maintaining the mixed accessions approach. We utilize Tables 19, 20, 23, and 27 to calculate the optimal solution shown in Table 35.

Table 35. Scenario #4 mixed accessions optimal solution results

Scenario #4 Mixed Accessions Optimal Solution Results					
	O1	O2	O3	O4	O5
r	0.2	0.25	0.4	0.1	0.05
FY20	10.4	13.0	20.8	5.2	2.6
FY21	6.2	7.8	12.4	3.1	1.6
FY22	7.0	8.7	14.0	3.5	1.7
FY23	4.4	5.5	8.7	2.2	1.1
FY24	8.1	10.1	16.2	4.0	2.0

Adapted from source information detailed in Chapter III, Section A.

For the final time, we calculate the individual inventory and compare it with the GAR. Table 36 displays the results of the mixed accessions program during a period of high attrition.

Table 36. Rank specific inventory results—scenario #4

Scenario #4 Inventory Results						
	O1	O2	O3	O4	O5	Total
FY19	12.0	10.0	50.0	29.0	8.0	109.0
FY20	11.5	27.4	60.6	34.9	12.5	147.0
FY21	7.3	29.9	66.9	39.0	16.0	158.9
FY22	7.6	28.5	73.9	43.4	19.5	172.9
FY23	5.1	24.9	73.1	46.6	22.3	172.0
FY24	8.5	25.8	78.5	51.2	26.0	190.0

Adapted from source information detailed in Chapter III, Section A.

The cyber community reaches maturity approximately at FY 2024 by accessing 144 individuals through the direct officer accessions method. The 144 individuals are broken down into 27 O4/O5 officers and 117 O2/O3 officers: the O1/O2 officer population experiences an overage of 11 officers; the O3 officers are short by 17 officers; the O4 officer population is over by 6 majors; and, the O5 community is over by an officer. Again, the total officer population maintained the target end strength each year per the GAR.

4. Sensitivity Analysis

The Bartholomew inventory equation produces a point estimate based on constant parameters. The parameters may not necessarily remain constant throughout time. Due to the likelihood of shifting parameters, Soetaert and Petzoldt (2010) plainly argue for the necessity in conducting a sensitivity analysis as a part of the model fitting process. Therefore, as with the UAV demonstration, we conduct a sensitivity analysis on the results for each scenario. The results of the analysis are provided in Table 37.

Table 37. Cyber scenarios, Monte Carlo sensitivity analysis results

Monte Carlo Sensitivity Analysis Results

Scenario #1 Results

Confidence interval for optimal solution per FY

	FY20	FY21	FY22	FY23	FY24
lower	43.1	20	23.7	9.2	27.5
mean	45.2	22.5	26.4	12.2	30.7
upper	47.2	24.5	29.1	15.2	33.9
target	45.2	22.4	26.4	12.2	30.7

Confidence interval for end strength per FY

	FY20	FY21	FY22	FY23	FY24
lower	145.1	154.8	166.8	163.6	179.6
mean	147	159	173.1	172.1	190.2
upper	149	163.3	179.4	180.8	201.1
target	147	159	173	172	190

Scenario #2 Results

Confidence interval for optimal solution per FY

	FY20	FY21	FY22	FY23	FY24
lower	50	26.1	30	17.4	37.1
mean	52	28.6	32.6	20.1	40
upper	54.2	31.2	35.3	23.1	43
target	52	28.6	32.6	20.2	40.1

Confidence interval for end strength per FY

	FY20	FY21	FY22	FY23	FY24
lower	145	155	167.2	164.2	180.6
mean	147	159.1	173.1	172.2	190.2
upper	149.1	163.3	179.3	180.5	200.5
target	147	159	173	172	190

Scenario #3 Results

Confidence interval for optimal solution per FY

	FY20	FY21	FY22	FY23	FY24
lower	43.1	19.5	21.5	6.4	24.4
mean	45.1	22.2	24.5	9.8	27.9
upper	47.2	24.9	27.5	13.1	31.3
target	45.2	22.2	24.5	9.8	27.9

Confidence interval for end strength per FY

	FY20	FY21	FY22	FY23	FY24
lower	144.9	154.5	165.8	162.1	177.6
mean	147	159	173	172.1	190.1
upper	149.1	163.6	180.3	182.3	203.2
target	147	159	173	172	190

Scenario #4 Results

Confidence interval for optimal solution per FY

	FY20	FY21	FY22	FY23	FY24
lower	50	28.4	31.8	18.4	36.8
mean	52	31.1	34.9	21.7	40.3
upper	54.1	33.7	37.8	25.1	43.9
target	52	31.1	34.9	21.8	40.4

Confidence interval for end strength per FY

	FY20	FY21	FY22	FY23	FY24
lower	145	154.7	166.4	163.1	179.2
mean	147	159	173	172.1	190.1
upper	149	163.4	179.9	181.5	201.8
target	147	159	173	172	190

Adapted from source information detailed in Chapter III, Section A.

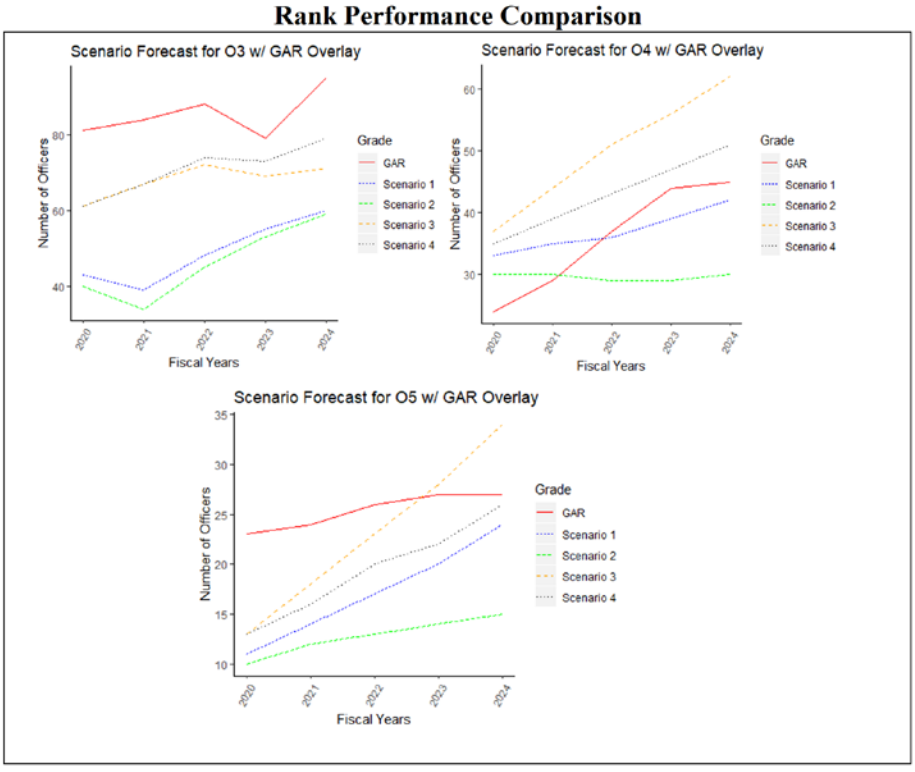
The reliability of our point estimates for each of the scenarios does decrease with each passing fiscal year, which is expected with forecasting models. However, the increase in spread for each point estimate does not negate the overall model and/or the conclusions we can draw from it. Table 37 indicates that we ought to develop a new two-year model as each year of data becomes available.

E. RESULTS AND DISCUSSION

The first research question asks how long it takes for the cyber community to reach maturity through solely a regular accessions method. We found that the community will not reach maturity within the tested five-year span, given only this method of accessions. Also, we found that for the community to meet each of its overall target FY end strength goals there would be large distortions in the rank distributions. As it is not ideal to simply have enough people in the system if they are not in the proper place, so while this

accessions method would meet the overall requirement it would also cause major issues in job fitting.

Therefore, we believe the mixed accessions approach increases the speed for the cyber community to reach a mature state in comparison to the regular accessions approach. We base this conclusion on how each rank achieves the targeted GAR inventory under the varying environmental conditions. To show this, we condense the results of the tables in each scenario into Figure 5 that displays individual rank performance per scenario, over the FYs, and with the GAR. The GAR line is the key identifier. When the individual rank line lies above the red GAR line, that rank has reached maturity. In turn, each scenario line color in the figure corresponds to the result's table color in the previous section.



Adapted from source information detailed in Chapter III, Section A.

Figure 5. Rank performance comparison

We believe the mixed accessions approach that resembles the direct officer accessions method will get the cyber community to maturity within approximately four to five fiscal years. This mixed accessions method would require the Marine Corps to access between 81 and 144 individuals throughout those fiscal years. With the exception of the O3 rank, the 17XX community exceeds the GAR line for O4 and O5 officers around FY 2023. Given that the regular accessions method is not observed to reach maturity within the five-year forecast, this means that this approach will dramatically impact the timeline for the community to reach a mature state.

If the Marine Corps were to implement this program, under these conditions, over the next three to four years, it would have to directly access approximately 31% of the O2 to O5 officer population. Of those accessed through this method, 46 officers in the grade of O4 and O5 would not be attending OCS and TBS. Thus, approximately 15% of the 306 O4 and O5 officers in this population would be directly accessed having not completed OCS and TBS. In considering this scenario, we explore the potential cultural effects these individuals could have on the community and the institution in the next chapter.

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IV. QUALITATIVE ANALYSIS

> Leaders must have a strong sense of the great responsibility of their office; the resources they will expend in war are human lives.
>
> —U.S.M.C. *Warfighting* (1997, p. 57)

The United States Marine Corps is a national asset in the nation's warfighting arsenal. The Corps' capacity to wage war relies on resourcing in both the human and mechanical arenas. As such, the Marine Corps continually faces challenges in maintaining its human resource capital. Since the nation parted ways with a conscription construct for military service, the service branches must compete with industry to acquire, and retain, the nation's best and brightest. This competition reaches new heights of complexity when economic factors are considered. The core of what differentiates military service from civilian occupations is each branch's specific and deeply held culture. This chapter focuses on the human dynamic via an ethnographic research approach. The aim is to discover how the Marine Corps views its most precious resource—people—and how direct officer accessions fit into the equation in terms of the Corps' overall culture of regarding manpower management.

A. CULTURE

"Culture" is broadly defined as "the set of shared attitudes, values, goals, and practices that characterizes an institution or organization" (*Merriam-Webster*, 2020). An expanded perspective of this definition states that: "The term organizational culture is used as an umbrella concept for a way of thinking that takes a serious interest in cultural and symbolic phenomena or aspects in organizations" (Alversson, 2010, p. 13). For the purposes of this research, these are the lens through which we are viewing organizational culture.

However, given its specific organizational culture, military vocation distinguishes itself from any occupation within the civilian sector. This distinction—focus on warrior ethos—is explained in the *Handbook of the Sociology of the Military* (Soeters, Winsolw &

Weibull, 2006). The authors point out that military culture, in board terms, applies to any military force and how each military service has a particular way of viewing and behaving in the world (Soeters et al., 2006). Each force's cultural worldview drives how they conduct their training, accomplish their missions, and recruit their personnel.

B. PEOPLE

"They are a good piece of gear," is a common saying within the Marine Corps. The connation suggests that humans are replaceable and consumable goods. However, this no longer aligns with current Corps' culture, as the most recent commandant has signaled a significant change away from this mindset in his planning guidance. In the *Commandant's Planning Guidance: 38th Commandant of the Marine Corps* (2019), General Berger clearly states his viewpoint on the topic: "Marines are the centerpiece of the Corps—our principle emphasis must focus on recruiting; educating and training; instilling our core values and sense of accountability; equipping; and treating them with dignity, care, and concern" (p. 6).

An emphasis on human resource development is clear in General Berger's statement and it starts with recruiting. The Corps' principle focus must be on recruiting the *right* people. This concern for human resource development and sourcing the correct people shares common ground with businesses around the globe and other military institutions. For example, Paullin et al. (2014) tackle this subject in their research for the U.S. Army by building a quantitative model to identify the *determinants* for successful, and sustained, service within the Army officer corps. They developed a list of 55 knowledges, skills, abilities, and other characteristics—called KSAOs—(see Appendix F for complete listing) to supplement an applicant's SAT and ACT scores and college GPA (Paullin et al., 2014). Their desire was to provide the Army with a more holistic approach to the selection process in recruiting the proper personnel (Paullin et al., 2014). Their study represents many available in the pursuit for screening, selecting, and recruiting the *right* person for military service.

Recruiting quality people represents only a portion of the human resource development process. Culturally developing people to fit into your organization takes time.

Boas Shamir (2011) astutely makes this point in the article titled *Leadership Takes Time: Some Implications of (not) Taking Time Seriously in Leadership Research*. Shamir argues that people development encompasses more than just executing a simplified list of training events to render a desired output. The complexity of the human dynamic, the relationships built during the development phase, and the institutional environment all get a say in how the person's talent and cultural assimilation develops over the course of time (Shamir, 2011).

Thus, a systematic theme emerges that will guide the remainder of the chapter. The organization's culture drives the talent they seek, and the quality of the person assumed into the organization will either enhance or deteriorate the culture. And, the assimilation into the new culture takes time to fully develop utilizing a series of training processes. Thus, a reciprocal relationship exists between organizational culture and the people within that organization. Before looking at military or business culture, we turn to how the United States military acquires its people.

C. ACCESSIONS—OBTAINING HUMAN RESOURCES

For the United States, conscription is a thing of the past. The United States military sources its ranks through volunteer service. The responsibility for sourcing each service branch in accordance with Congressional mandates rests on the shoulders of the military recruiters. The recruiters' mission is to find the most qualified individual for military service and aid them in the accession process. The recruiting corps are divided into two different segments: officers and enlisted. The qualifications differ for the enlisted and officer populations. For the enlisted population, once an individual demonstrates they meet the respective service requirements for enlistment, they are "shipped" off to an entry-level boot camp. This is more or less a one size fits all approach. For the officer population, the method of entry varies, depending on service branch, schooling, and desired occupation.

1. Department of Defense–Specific

The Army, Air Force, and Navy have similar officer accession pathways. These services each share four common pathways: attending their service academy; participating in their reserve officers' training corps (ROTC) at a different university; attending officer

candidate—officer training for the Air Force—school; or direct appointments in the areas of medicine, law, ministry, and cyber (U.S. Army [2020b]; U.S. Air Force [n.d.]; & Powers [2019]). Also, two pathways exist to attain a commission from within the enlisted ranks. One pathway offers an opportunity to commission if the servicemember already has a college degree. The other pathway provides opportunities to be selected to attend school, while still on active duty in their current rank, to obtain a college degree (U.S. Army [2020b]; U.S. Air Force [n.d.]; & Powers [2019]). Depending on the route mentioned previously, the prospective servicemember will complete a certain entry-level training program.

2. Marine Corps–Specific

Henry Ford and the Marine Corps share a common mindset in terms of production: simplicity. In replying to a customer's question about color diversity in the newest automobile, Ford boldly stated: "You can have any color as long as it's black" (1923, p. 72). The Marine Corps in essence states the same thing in its recruiting website: you can have an officer [from any commissioning means possible] as long as they complete OCS and TBS (USMC, 2020a). The only exception to this pathway is for Naval Academy graduates who are not required to attend OCS; however, they are required to complete TBS (Ergun, 2003).

As with the other three service branches, the Marine Corps offers three options to obtain a commission. These options include participating in an accredited Naval ROTC (NROTC) program during the college years or being accepted into the platoon leader course (PLC) while attending a college that does not offer an ROTC program (Egrun, 2003). If you are currently an enlisted Marine with a college degree, the individual can apply for a commissioning through the enlisted commissioning program (ECP). Those enlisted without a college degree can apply for the Marine Corps enlisted commissioning program (MECEP), attend college, and then commission. Last, if the prospective candidate possesses a college degree, they can apply to attend the officer candidate school (OCS) and upon graduation be commissioned.

The main point: the Marine Corps has several pathways to become an officer, but a direct accession *is not* one of them. The Corps does not offer a direct commission to any potential officer, regardless of training, education, and/or experience (USMC, 2020a). Everyone, except inter-service transfers, starts at second lieutenant and works their way through the entry-level training programs and subsequent ranks.

3. Into the Unknown: Another Option

For the Marine Corps, the direct officer accession pathway has never been considered. Until now, the Marine Corps saw no need to create such a pathway since the only specialty it could have applied to were legal officers. However, the situation has changed since the creation of the cyber-community in 2017 and changes were made to the Title 10 authorities within the 2018 and 2019 NDAA. The Marine Corps may need to consider such a pathway to maintain a healthy population among the occupations like cyber, that have a strong external pull toward the civilian workforce.

If a direct officer accessions pathway were created, within the Corps' what would be the effects? Academic literature addressing the Marine aspect of this topic does exist, at least in generic terms, regarding accession and retention.

For example, in 2003, a Marine Corps Naval Postgraduate School (NPS) student specifically examined if the current pathways to commissioning serve as an indicator for future promotions and/or career retention beyond the first contract obligation. Levent Egrun (2003) utilized a bivariate probit model to determine if the commissioning source affected career development for the Corps' officers. The summary of his findings points to a slight correlation between officer's accession pathway and their long-term promotion rates to O-5 and O-6 (Egrun, 2003). However, he believes this correlation has more to do with prior military experience before commissioning, e.g. ROTC service, marital status, and age (Egrun, 2003). Thus, it could be inferred that the accession method does indicate a person's intent to assimilate to the Marine Corps' culture.

However, Egrun's study occurred prior to the Marine Corps' stop-loss in 2004, and also in the early stages of the war on terrorism. Ann Parcell on the other hand, writing for CNA, explores the same subject for the unrestricted line (URL) officers within the Navy

in 2008. The URL officer corps equates to the general officer population within the Marine Corps, exempting the legal officers and limited duty officers (LDO). Her study sought to answer if there was a *best* source for officer accessions (Parcell, 2008). Interestingly, she found that there was no significant difference in the accession pathways of Naval Academy graduates, those who attended OCS, or those within the NROTC program (Parcell, 2008). Again, the timing of her report proves worthy of consideration in light of the findings. The United States was considered to be in a great recession over the span of her report. She acknowledges the impact of the economy as possibly influencing the results (Parcell, 2008).

Shifting back to the Marine Corps and progressing three years in time to 2011, Darrell Glaser examines the various factors that could impact promotability and long-tendered service. In his article titled *Time Varying Effects of Human Capital on Military Retention*, Glaser (2011) argues that the source of accession is only one part of the larger story in why personnel do what they do with their careers. Glaser's point deals more with the topic of firm-specific human capital development. He states: "officers who acquire more firm-specific human capital early in a career reveal themselves to be good matches over time to remain in the Marine Corps longer, accumulate additional human capital, and become less likely to separate for jobs in the civilian economy" (Glaser, 2011, p. 231).

Last, we consider a study that most closely aligns to this research and the subject of Marine Corps cyber-community direct officer accessions. In 2012, authors Juli Schmidt and Walter Colvin examined the differences in servicemembers who accessed via the Uniformed Services University of the Health Sciences—the birthplace of the direct officer accessions method—and those who directly accessed into the Navy via the Armed Forces Health Professions Scholarship program. They found that those who attended the military service school had higher retention rates compared to those officers who completed the scholarship program (Schmidt & Colvin, 2012). The key here: the students at the University Services University are commissioned as junior officers prior to the commencement of their degree program and serve as a commissioned officer throughout their time in school—indoctrination occurs earlier via this method (Schmidt & Walter, 2012). Schmidt and Walter (2012) point out how this is different from those who attend a

medical school of their choice under the Armed Forces Health Professions Scholarship program and then commission into their respective service as an O-3 officer. One could argue that those who choose to attend the Uniformed Services University have more of a militaristic mindset compared to those who are more technically minded in pursuing a degree from a competitive school and yet still serve their country.

Two themes surface from this analysis. One is that despite the relevance/value of these studies, none deal with overall skill effectiveness and/or potential impacts to cultural norms within the unit and/or institution at large. The other is that officers with more previous militaristic exposure remained within the institution longer and had slightly higher upward mobility rates. This theme coincides with Soeters' (et al., 2006) point that those individuals who have longer periods of *socialization* in the institution develop stronger ties to the culture and their willingness to serve longer terms increase. Given these observations, it is important to address how the Marine Corps *socializes* its officers within the institution.

D. OFFICERS—THE MARINE WAY

Intentionality: A word commonly heard in leadership circles and organizational management literature. The Marine Corps' officer development process embodies the definition of intentionality, as the institution sets out to differentiate themselves from their sister services by creating, "[an] attitude that is peculiar to the Corps" (Haliday, 2017, p. 2). This difference starts with how the Marine Corps trains their incoming personnel.

1. Marine Corps Officer Pipeline

Simplicity and uniformity are the tenants of the Marine Corps' officer development pipeline. The pipeline begins with an application to attend OCS and ends once they exit the Marine Corps (Haliday, 2017). If a potential candidate passes through the initial board process, they are given the opportunity to prove their mettle at OCS. The trip to OCS begins a career-long series of tests, trials, screening, and training. For those who do pass through the OCS curriculum, they are given the privilege to wear the eagle, globe, and anchor and the second lieutenant rank. Every officer then makes their way across Interstate 95 to the other side of Marine Corps Base Quantico for approximately six months of training,

education, and indoctrination at TBS. Upon graduating TBS, each officer then reports to their respective military occupational school (MOS) for job specific training (Haliday, 2017).

2. TBS: For Marines Only

Standardization, baselining, and indoctrination in officer performance and behavior begins at OCS and starts solidifying at TBS. Ergun (2003) states the following about TBS: "[it] is the only training program across the four services that provide all officers, regardless of occupational specialty, with identical training" (p.5). This identical training serves as a critical component of the officer development process and begins laying the foundation for the integration into Marine culture. The TBS mission statement provides more clarity on the criticality of this school. The purpose of TBS is: "train and educate newly commissioned and appointed officers in the high standards of professional knowledge, esprit de corps, and leadership required to prepare them for duty as a company-grade officer in the operating forces" (Haliday, 2017, p.397). And here, we circle back to Henry Ford's statement on standardization, "you can have the automobile in any color you like as long as it's black." The Marine Corps demands each officer view every order and task through the lens of the high standards set forth in this entry-level training process.

3. Development: The Well-Rounded Officer

The Marine Corps also demands that its officers develop into *well-rounded* warfighters. One foundational document that implies the well-rounded officer concept is *The Marine Officer's Guide*. The chapter titled "The Profession of Arms" spells out the need for an officer to be balanced in their career development (Haliday, 2018). The components of this balance include: command experience, professional education, combat experience, joint staff duty, and fleet time (Haliday, 2018). These items are part of a larger version of maintaining a balanced career and developing the warrior culture. In Corps' terms, well roundedness refers to being an educated and equipped Marine capable of understanding and operating within, and throughout, the entire Marine Air Ground Task Force (MAGTF) framework. The Marine Corps fights as a MAGTF (Warfighting, 1997). Therefore, the well-rounded officer understands their role in the MAGTF and complies

with the requirements. This concept is a cultural expectation placed on each individual. The expectation stems from the *one team, one fight* mentality. For the team to win, the individuals within must be competently well-rounded in their development. According to Lieutenant Colonel Matthew Hall (2008), becoming a well-rounded officer with a high level of experience and technical expertise precedes being placed into leadership positions of influence.

The deliberate process executed, as previously detailed, aims to achieve institutional norms that will withstand the officer's lifetime. Screening, selection, and training of an individual matters in maintaining cultural norms. In the next section we look at the symbiotic relationship between the individual and the Marine Corps' organizational culture.

E. MARINE CORPS' CULTURE

Using the definition of culture at the beginning of the chapter, we will seek out what Marine Corp culture is and how it is sustained. The starting point for understanding the Corps' culture is understanding the institution's purpose.

1. Culture with a Purpose

Winning. Get the job done. Any other alternatives do not exist within the Marine Corps. The Marine's version of the Bible—*Warfighting*—sheds light on why the Marine Corps aims to produce the culture it owns. In the section titled "The Human Dimension," the book states: "Because war is a clash between opposing human wills, the human dimension is central to war. It is the human dimension which infuses war with its intangible moral factors" (USMC, 1997, p. 13). Additionally, "war is an extreme test of will. Friction, uncertainty, fluidity, disorder, and danger are its essential features" (USMC, 1997, p. 19). Thus, a purpose surfaces for why the Marine Corps develops the culture it possesses—overwhelming internal strength to defeat the enemy's will.

However, internal strength does not mean thoughtless destruction of everything the opposing force possesses, unethical behavior akin to evil acts, nor careless disregard for the human sanctity of life. For a Marine, this internal strength pertains to self-control,

discipline, thoughtfulness, precision, and honor. Again, *Warfighting* provides the following insight: “an act that may break the will of one enemy may only serve to stiffen the resolve of another” (1997, p. 14). The lethalness of the Marine Corps persistent in the constant and consistent dedication to doing the right thing, every time: ethical warriors.

The term *ethical warriors*, broadly defined, comes from historical author Steven Pressfield. In his book—required reading for every Marine per the commandant’s reading list—titled *The Warrior Ethos*, Pressfield (2011) demonstrates how the most feared and honored military forces in the world are the ones who earned that reputation through ethical, moral, and calculated decision-making and behavior. The ethical warrior develops a myriad of moral and character values that guide their every thought and action (Pressfield, 2011). When this development of behavior occurs, each Marine can rightfully declare to the world that there is indeed, “‘No Better Friend, No Worse Enemy’ than a U.S. Marine” (Proser, 2018, p. 4). This statement, coined by General Jim Mattis during his time commanding the 1st Marine Division (Proser, 2018), embodies the purpose of the Marine’s culture.

2. Sustaining Marine Corps’ Culture

“Start with the end in mind,” a phrase coined by Dr. Stephen Covey (2004) in arguing for the principles that guide the activities of highly successful people. The Marine Corps has metaphorically taken a page from his book in seeking to achieve their cultural stability. The institution demands its ranks are filled with individuals who make value-based decisions. Thus, they base their entire screening, training, and educational system on the values-based construct.

The values-based system starts at the moment of contact with a recruiter. In *Beginning the Transformation,* values-based screening means: “the diligent screening of every applicant to ensure they are mentally, morally, and physically qualified” (USMC, 2008, p. 8). This screening, “seeks young men and women who have the fundamental character traits and personal values that will facilitate their transformation to a United States Marine” (2008, p. 8). In other words, the system seeks individuals who, “show a *natural identification* with the existing culture… Through this way of self-selection new

recruits easily become the persons the organization wants them to be" (Soeters et al., 2006, pp. 249–250).

The values-based training (VBT) model applies universally to officers and enlisted. The model weaves the institution's core values through every action displayed, period of instruction given, and task ordered (USMC, 2008). The goal of the repetitive nature of this model is to permanently ingrain a system of core values driven thinking and behavior. The graphical depiction of the model is provided in Figure 6.

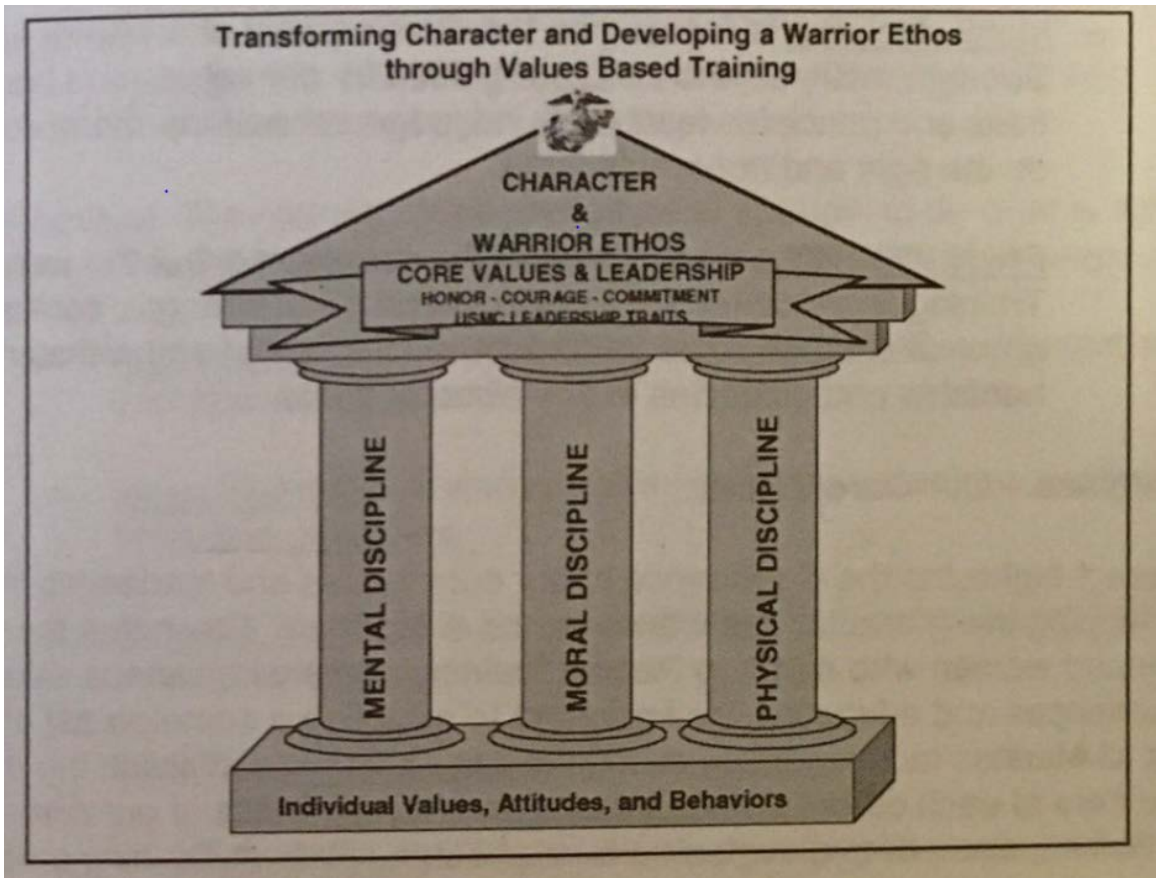

Figure 6. Values-Based Training Model. Source: USMC (2008, p. 13).

The importance in maintaining the systemic transformation that occurs within each Marine is so important that the Marine Corps has published its own literature on the topic. The *Sustaining the Transformation* manual was first published in 1999 and then updated

in 2014. Within this publication, a Marine finds the necessary actions to sustain the Corps' precious culture. The sustaining model is provided in Figure 7.

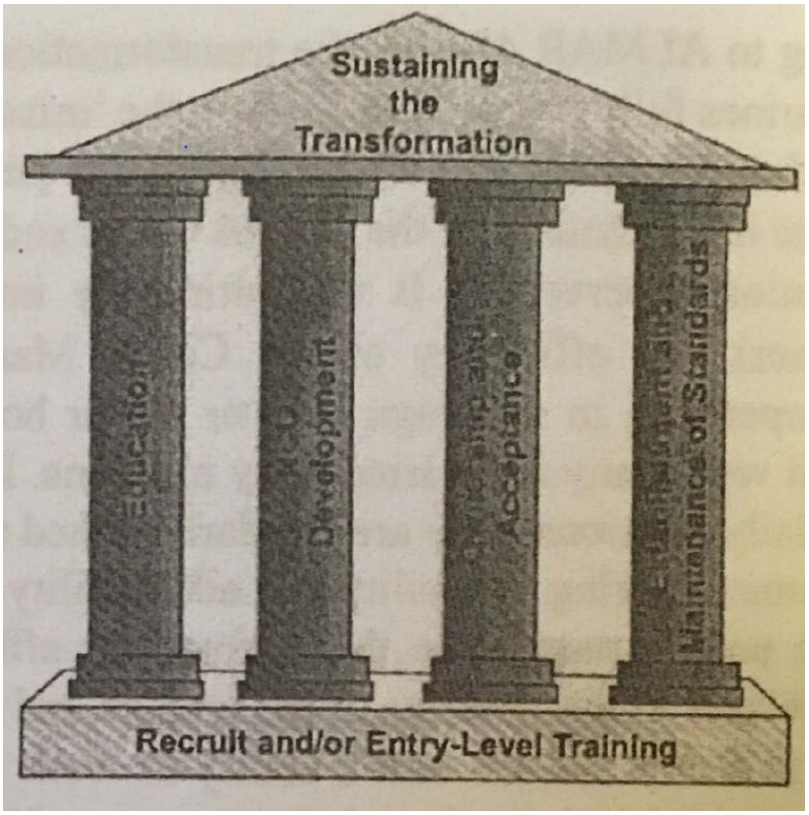

Figure 7. Sustaining the transformation. Source: USMC (1999, p. 70).

There are several elements needed to keep the Marine culture strong. The pillars of education, NCO development, ownership and acceptance, and establishment and maintenance of standards, rest on the foundation set in the entry-level training environment. The key element not visible in the model to sustaining a strong Marine culture is to develop a family type bond (USMC, 2014). This bond links to the Marine Corps' motto: Semper Fidelis. Thus, as family, we are always faithful to each other.

Family can mean different things. Whose family—origin or assumed into? What level of family—immediate or extended? There are also families within families. Thus, collectively understanding the term *family* drives the sustainment theme forward. Within the *Sustaining the Transformation* (2014) manual, family refers to the individual unit

within the Corps. In this context, the commanding officer serves as head of the family, and the direction of the family, the values it ascribes to, and behaviors displayed are all, and in part, derived from the leader (Firing et al., 2009). Therefore, another aspect of sustaining the Marine culture emerges and its responsibility falls onto the leader's plate. The leader's role in sustaining culture surpasses all else.

Thus, two primary mechanisms aid the Marine Corps in sustaining their culture. The values-based system serves a continual source of grounding in what it means to be a Marine. The family aspect brings accountability, support, and reinforcement to our institutional core values. Both mechanisms center on the value of people within the institution and express a degree of commitment to high standards of behavior.

F. LESSONS IN CULTURE FROM BUSINESS

As explored previously in the military context, an organization's culture is linked to the purpose for which it exists. The purpose of a military force appears evident; however, what's the purpose for other types of organizations to exist? Does the purpose of these other organizations have the same shaping power, in terms of culture, as the military does? Are there lessons from the business environment that can be extrapolated into the military context?

1. Organizational Purpose Leads to Organizational Culture

To inform the discussion of organizational purpose leading to organizational culture, consider the business environment. According to Dr. Anita Satterlee, an organizational behavior expert at Liberty University, she states that: "organizations must have a defined mission or aim that is clear to all who work there, as the mission acts as the foundation for the organization's purpose" (2013, p. 46). In this case, we observe a series of linking ideas: mission leads to purpose, purpose leads to culture, and culture leads to people.

Emphasis on a proper foundation and solid set of fundamentals for any organization cannot be underestimated. Consider how a for-profit business—with a customer service bent—can achieve its goals by staying grounded in the fundamentals of purpose, backed

by values, and with sound leadership In the article *From Purpose to Profit*, authors Woody Driggs and Jeffrey Stier (2015) examine and explain how a shoe company's purpose of providing superior customer service—a value modeled by their leaders—eventually leads to the profits necessary to keep the business thriving. They provide the following diagram to visually illustrate how this system operates within the business (see Figure 8).

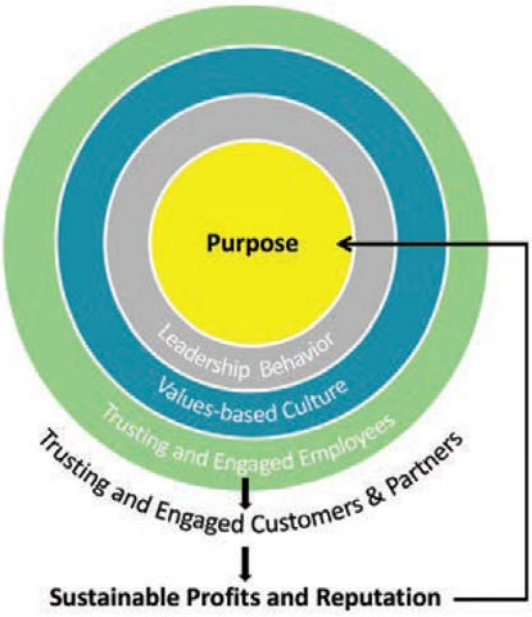

Figure 8. How purpose impacts culture.
Source: Driggs and Stier (2015, p. 6).

Contrary to the shoe company mentioned earlier, an organization like Enron illustrates the damaging effects of a business that has lost its ethical way due to a lack of integrity within the leadership. While looking back to the effects of Enron and on the eve of the Great Recession in America, Professor Dipankar Ghosh (2008) from University of Oklahoma wrote an article stressing the importance, and how to, for businesses to remain ethically sound amid immense pressure to raise profits through unethical behavior. The professor points out that companies which incentivized profit-margins developed a culture with a natural bent toward corruption (Ghosh, 2008). He concludes that companies can

counter this drift by, "[modifying] its compensation so that a percentage of managements' bonus was now derived from environmental compliance, safety, anti-trust, civil rights, and other non-fiscal goals" (Ghosh, 2008, p. 81). Implying that the organization must pay particular attention to the purpose given to its leaders and its symmetry to the organization's purpose. Noncongruence between these two entities yields disastrous results.

2. Talent: From Within or Without

The previous section reveals how the culture of an organization nests into the overall purpose. That purpose then sets a series of cultural norms for everyone within to operate. That culture's sustainability derives from the leadership within the organization. Therefore, an organization that desires to stay ethically sound, true to its purpose, and guided by values toward its objectives will carefully consider who they place in positions of leadership In most non-military organizations, a choice exists between growing the leadership within or reaching to external sources. Both options are coupled to a different set of purposes, and also possess correlating advantages and disadvantages. The following analysis seeks to draw from both perspectives and extrapolate any relevant lessons into the direct officer accession dialogue.

Sourcing talent internally or from external sources has a long history with supporters on both sides. For example, an article from the *Wall Street Journal* by Rachel Silverman and Lauren Weber (2012) argues that outsourcing talent into a business often leads to higher employee pay for the incoming employee, but also lower immediate results. They also point out the growing number of businesses choosing to promote employees within vice hiring from outside sources due to the higher costs of recruiting and compensation in comparison to their overall production (Silverman & Weber, 2012). However, in closing they state a time and occasion exists for hiring talent into the company: during periods of rapid growth or needed organizational change (Silverman & Weber, 2012).

According to another set of scholars, an organization can properly incorporate both internal movers and external hires. In 2014, Bidwell and Keller wrote an article titled

Within or Without? How Firms Combine Internal and External Labor Markets to Fill Jobs that explains how a company does not have to remain solely on either side of the hiring spectrum—all internal or all external. They argue from an empirically based perspective, set on a series of multinomial logit models using data from one firm, that a balanced approach does exist between the two extremes that ultimately satisfies the organization's needs (Bidwell & Keller, 2014). Their study solely focused on job variables such as production, firm-specific skills, performance variability, and internal supply of candidates (Bidwell & Keller, 2014). Moreover, it does align with Silverman and Weber's findings that if the vacated position does not require a high degree of firm-specific talent then external hiring can be done (Bidwell & Keller, 2014). However, the material does not mention the leadership implications or cultural impacts of both hiring techniques.

The debate on whether or not external hires are equally effective compared to internal hires continued into 2016. In the article titled *Lateral Hiring and the Performance of Professional Service Firms: The Moderating Effects of Leverage Ratio*, the authors stated: "whether and how lateral hiring practice contributes to organizational performance remains controversial" (p. 338). However, there was a group of researchers who sought a means to bring the conversation to a decisive close. These four researchers investigated the lateral hiring practices of 148 U.S. law firms across the United States (Kim, Kim, Kim & Byun, 2016). The choice in examining the law firms eliminated the firm specific knowledge associated with Bidwell & Keller's research—law remains constant throughout the country (Kim et al., 2016). They discovered a relationship between internal and external hiring that follows an upside-down U-Shape, implying that a firm does benefit from lateral hiring to a specific point (Kim et al., 2016). Again, this literature does shed light on the technical effectiveness of lateral hiring, but does not address the cultural impacts of laterally hiring partners into law firms.

Last, external hiring practices represent obstacles for internal employees to advance. While seeking to validate the notion of firms' preference toward internal hiring over external hiring, the authors discovered that when those same firms externally hired talent, they created a threat to the upward mobility of their current employees—the same employees that they prefer to hire (Devaro et al., 2019). This creates a paradox for the firm.

Additionally, they discovered, “relatively few external moves are promotions. Promotions, when they occur, are more likely to be internal” (Devaro, Kauhanen & Valmari, 2019, p.1002). This last point aligns to the NDAA’s lateral move criteria, in that the move into service must be equal to or lower than the current level of education, training, and experience.

In closing out the talent from within or without portion, we return to Silverman and Weber. The authors briefly mention a positive effect in externally hiring when a company desires a change in direction (Silverman & Weber, 2012). Their side comment stems from a vast amount of literature in organizational change theory. In *Managing Change*, authors Todd Jick and Maury Peiperl provide the reader with six modules related to the topic of organizational change (2011). Of note, within module one is the case study of the cultural change brought to British Airways when they appointed a new chairman from outside the company: Sir John King. The company began down a new path under King’s leadership; it was done by reducing the current staff members and bringing in new leadership like Colin Marshall (Jick, and Peiperl, 2011). This illustrates the powerful cultural changes that can occur when externally hiring talent, specially at higher levels of the organization.

3. Maintaining the Culture: Leadership

Hiring talent externally, from a performance perspective, appears to be a mixed bag. However, doing the same from a leadership perspective is not so much of a mixed bag. Significant amounts of literature clearly state leadership talent matter a great deal to organizational performance and behavior.

Essentially, the leader stands as the keeper of ethical corporate culture. Michael Small (2006) makes this point in the article titled *Management Development: Developing Ethical Corporate Culture in Three Organisations* while investigating three organizations—HMAS Stirling, Fleet Base West; the Policy Academy of the Western Australia Police Service; and Engineering Enterprises Pty Ltd. He states, “In developing an ethical corporate culture, ethical theory and organisation theory are seen as being dependent on and complementary to each other …Arrogance, ignorance and a disregard of the law, it was stated, are no longer acceptable requirements for today’s executives and

managers. In fact, the exact opposite of these three characteristics is now said to be essential" (2006, p. 592). He concludes with three points to maintaining an ethical corporate culture. The first, and most relevant, point to this discussion, states: "the CEO and senior staff of each organisation must lead by example and set the right tone" (Small, 2006, p. 599).

However, setting the right tone and providing the correct example alone will not ensure a business remains culturally sound. In Rachel Fichter's (2018) article titled "Do the Right Thing! Developing Ethical Behavior in Financial Institutions," she acknowledges another factor at work in establishing ethical behavior: individual choice. This thought stems from the following statement, "In a complex and fast-changing environment, it is likely to be difficult, if not impossible, for even the most ethical of leaders to achieve alignment between desired and actual behaviors" (p. 71). Thus, there are limits to the leader's influence on organizational culture and ethical behavior.

It follows to explore the boundaries of the leadership influence, especially those within the middle-management ranks. "The Dark Side of Visionary Leadership in Strategy Implementation: Strategic Alignment, Strategic Consensus, and Commitment" article offers insight into topic. The authors utilized data from two Western Europe companies in the customer service industry to model whether or not alignment in business strategy throughout all levels of management impacts overall organizational performance (Ate et al., 2018). They concluded "that team manager visionary leadership is positively related to team strategic consensus and commitment only to the extent that the team manager is strategically aligned with the CEO. When strategic alignment with the CEO is low, team manager visionary leadership is negatively related to consensus and commitment" (2018, p. 21). The misalignment mentioned by the authors can result in damaging effects throughout the business, both in individual performance, organizational performance, and to cultural norms.

G. TECHNICAL EXPERTS AND SPECIALIZATION: LIMITED DUTY OFFICERS AND MARINE CORPS SPECIAL OPERATIONS COMMAND

To some point, every organization has a certain degree of specialization and technicality. As seen with the law firms, externally hiring partners into an organization that requires a high degree of specialization, and are equally governed by the same set of social norms, can produce positive results. The individuals who are externally hired are familiar enough with the community at large and have the technical expertise to quickly turn to performing the necessary tasks. Therefore, we close this chapter by examining the concept of specialization at the individual and organizational level within the military, which is applicable to the cyber-community.

1. The Technical Experts: LDOs

The Marine Corps has developed a system for creating technical experts, known as LDOs, and then injecting them into various units at different levels. The warrant officer becomes a restricted officer – LDO – via a board selection process (Marines, 2019). They bring with them a certain level of expertise and experience that otherwise would not be available; they are truly considered technical experts with sound leadership abilities (Haliday, 2017). By design they are not authorized to go outside the boundaries of their specification, unless they apply for unrestricted status and are granted approval (Haliday, 2017). They remain true to their design as specialists.

Hiding in plain sight, the LDO wears identical rank as unrestricted officers. The rank symbolizes authority, position, and responsibility (Haliday, 2017). Even though these specialists wear identical rank, the identification of these individuals comes swiftly via speech and aura. Knowingly or otherwise, they wield to a powerful principle found in Helio Gracia's (2012) book—communicating via actions. In most cases, their very presence communicates a high level of experience and expertise. Furthermore, there are not high concentrations of them within any particular unit. They are scattered throughout commands and serve as advisors to the commander. Regardless of their population density, they possess a tremendous amount of influence on the culture around them. If they care about something as an expert, so does everyone else.

2. Specialization: MARSOC

Even within highly specialized organizations, a common thread of a mission unites its members. For example, law firms are filled with highly technical lawyers who practice various portions of law; yet, they are linked together in the sense that they are all individuals who practice law. Such is the case with doctors and hospitals, and the Marine Corps is no different. As the Corps possesses a vast array of experts who specialize in warfighting. The common thread that links all of these experts is the Marine credo of "every Marine a rifleman."

However, this credo—found within *Leading Marines*—does not imply generalization or a plug and play mentality between individuals throughout the organization. The publication itself provides ample instruction and clarity on the seemingly contradictory environment. The credo means, "an expeditionary force in readiness. And because it is expeditionary, it is also austere. Austerity places a premium on the role of every Marine. There are no 'rear area' Marines, and no one is very far from the fighting during expeditionary operations" (USMC, 1995, p. 14). Context matters. Consider the fighting conducted in yesteryears of environments, the riflemen were always on the frontlines of the force. The credo speaks of this same fighting spirit that ought to be within each Marine, regardless of occupational specialty.

The credo has withstood the test and pressure of time, even in recent years, and continues to be a part of the driving force in Marine culture. The most recent, and fiercest, test came during the creation and solidification of the Marine Corps Special Operations Command (MARSOC)—a collection of highly specialized warfighters. The battle over ideological implications the new unit would create are thoroughly detailed in Sean Barrett's work titled *Always Faithful, Always Forward: Marine Corps Culture and the Development of the Marine Corps Forces Special Operations Command.* Barrett (2018) points out that the community defended their existence via a communications campaign of, "Marines are who we are: special operations are what we do" (p. 261). Extreme emphasis was given to the fact that this community of experts were, and are, Marines first and always (Barrett, 2018). The information campaign won over the higher echelons of leadership and the highly specialized unit remains to date (Barrett, 2018).

Maintaining the "Marine" tie between the MARSOC community and the institution underpins the "every Marine a rifleman" credo. This tie requires the MARSOC community to send its officers to serve as a series commanders at each Marine Corps Recruit Depot, officer selection officers within recruiting command, and as students to NPS (Barrett, 2018). These assignments are subtle reminders to the community that they are indeed Marines first and special operations operators only in deed. Therefore, even though the institution allowed a highly specialized community to be established they maintain that being a Marine supersedes all else.

H. SUMMARY

In this chapter, we sought to address the research's secondary question. We wanted to know how the 15% of direct accession officers found in Chapter III could impact the organizational culture within the Marine Corps. We started by looking at organizational culture and the people within.

Organizational culture and people were the primary focus of this chapter, and we explored how these two concepts influenced one another and were related to organizational purpose and mission. We also viewed them both from a militaristic and business perspective in hopes to gain a better understanding of their symbiotic relationship.

We also learned important aspects about the human resource development process. Matching, recruiting, and training pipelines all matter to sustaining organizational stability. We learned that people tend to behave in line with organizational culture when they perceive to have preexisting matching values and they have had time to assimilate into the culture. Ultimately, the human development pipeline matters.

Last, we learned lessons on hiring internally and externally, how most organizations possess a level of expertise, and how organizations are collections of specialization experts. It is clear that externally acquiring talent is a mixed bag on the performance scale. However, externally hiring is counterproductive when it disrupts cultural stability. Additionally, firm-specific expertise does not translate to external organizations to the same degree and industry-specific expertise. Thus, externally acquiring 46 officers into the senior leadership levels would yield a significant cultural disruption.

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V. CONCLUSION AND POLICY IMPLICATIONS

> You can get everything else wrong, but if you get the people right, you will be all right. Whereas you can get everything else right, but if you get the people wrong, you are going to be in trouble.
>
> —Brigadier General William J. Bowers

Just because something can be done, does not mean it ought to be done. As discussed in Chapter II, through a series of events, the conditions have been set to enable the Marine Corps to implement a direct officer accessions program. These include the development of the cyberspace warfare domain, creation of the 17XX MOSs, and changes to the 2018 and 2019 NDAAs. These all may seem providential; however, there are effects associated with breaking the norm to implement a new accessions method. This research examines some of those effects and provides recommendations.

A. PRIMARY RESEARCH QUESTIONS ANSWERED

The material contained within this thesis sought to answer two primary empirical questions. Chapter III took data obtained from HQMC's TFDW on the cyber and UAV community to answer the following:

- Given a desired force structure, what is the timeline to reach a mature state?
- How will direct officer accessions impact the timeline to reach a mature state?

Via the manpower perspective, we began by exploring how implementing such an accessions method could impact and affect the Marine Corps. Through the use of a Markov chain model and Bartholomew's fixed-inventory and fixed-recruiting equation on UAV data in Chapter III, we learned that the cyber community will not reach maturity by utilizing the regular accessions method within only a five-year horizon. Moreover, the regular accessions method caused significantly disproportionate distributions of officers

throughout the rank structure. Thus, we concluded that the O1 entry level accessions program would not bring the cyber community to maturity within the next five fiscal years.

However, we also learned that through the use of a mixed accessions method, resembling a direct officer accession program, the community could reach a mature state within the next four to five fiscal years. For this to occur, the Marine Corps would have to directly access approximately 81 to 144 individuals, from the O2 to O5 officer levels, over the next three to four years. Of those accessed through this method, 46 officers in the grades of O4 and O5 would not be attending OCS and TBS. Thus, approximately 15% of the 306 O4 and O5 officers in this population would be directly accessed having not completed OCS and TBS.

B. SECONDARY RESEARCH QUESTION ANSWERED

Next, by assuming that the Marine Corps would consider implementing the direct officer accessions program, we sought to test how this policy could affect the institution. Thus, we built the following research question:

- How will direct officer accessions affect the culture within the cyber community and the Marine Corps?

Observing how a direct officer accessions program could bring the cyber community to maturity rather quickly, we continued with the examination of the cultural implications that could be associated with such a program. We observed how the Marine Corps deliberately develops its officer corps to be MAGTF officers, who are well-rounded, and firmly grounded in a high standard of warrior ethos. We learned that the training pipeline greatly influences the indoctrination of the individual and shapes their worldview toward cultural stability and consistency.

Next, we explored the effects of importing talent into an organization. We did this by observing how the talent inject affected the business sector. While specialized talent can be directly imported into an organization, such as medical, law, and clergy, with minor cultural effects, we found that injected specialized talent under these conditions does not have universally equal effects in nonspecialized areas. The examined areas of medical, law,

and clergy have fundamental behaviors, cultures, and expectations that transcend the individual organization. And, while the Marine Corps does have areas of varying specialization, it does not have the same transcendent cultural norms as its civilian counterparts.

In most cases, organizations that inject leadership talent do so to produce organizational change. Injecting 15% of the cyber community's mid to senior leadership via direct officer accessions who do not complete the entry level training pipeline is a recipe for changing culture. While these folks bring with them a high level of technical expertise, we found there are cultural effects that could exceed the benefit.

C. ASSUMPTIONS ADDRESSED

As mentioned, this research rests on a couple of assumptions regarding entry-level officer training and promotions. Specifically, we assumed the Marine Corps would still send directly accessed officers at the O2/O3 level to OCS and TBS prior to attending the MOS school. We also assumed the Marine Corps would be willing to develop a condensed version of OCS, akin to the Navy's ODS, to indoctrinate and instruct the O4 and O5 officers who are directly accessed. Last, we assumed the Marine Corps would be willing to permanently develop a single competitive promotion category to advance these officers. Relaxing or shifting any of these assumptions would greatly influence the results of this work.

D. POLICY RECOMMENDATIONS

We derived three primary policy recommendations from this research. Those recommendations are:

- The Marine Corps should not develop a direct officer accessions program
- Continue the lateral move accessions methodology
- Conduct a CBA on the program

Our first, and foremost, recommendation is that the Marine Corps should not create a direct officer accessions program. We found in Chapter III that implementing this type

of officer accessions could result in damaging the institution's culture. Additionally, we found that this methodology could set in motion the urge to utilize it in several other areas of expertise: logistics, financial, administrative, etc.

Secondly, per Chapter II the Marine Corps is currently staffing the cyber community by conducting lateral moves from the communications and signal intelligence communities. While this process does take away qualified officers in those MOSs, it also injects Marines into the new cyber community who do not have to be indoctrinated into the Marine Corps culture. Also, as Lieutenant Colonel Hall (2008) pointed out in the well-rounded officer concept, there is more to being an effective field grade officer than just being technically proficient. For example, consider the ripple effect in executing this program. Examples include: acceptance among other MOSs within the institution, billet selection preference and/or discrimination, internal acceptance among enlisted Marines, and a host of other unknown effects. These ripples could have far-reaching and generational effects on the institution.

Last, if the institution decides to move forward with this sort of a program, in spite of our recommendations, they should conduct a thorough CBA to more accurately inform their decision-making. There are several assumptions and limitations to this research that effected its outcome. The CBA could thoroughly explore those assumptions and limitations, as well as many other items not mentioned in this literature, and more adequately address these concerns.

APPENDIX A. GRADE ADJUSTED RECAPITULATION

The following chart is adapted from source information detailed in Chapter III, Section A.

FY20						
MOS		O5	O4	O3	O2/1	Total
1702	ASR	13	14	63	14	104
	TOTAL A-BILLETS	13	14	63	14	104
	TOTAL B-BILLETS	7	5	11	0	23
	TOTAL A+B BILLETS	20	19	74	14	127
	NAR BILLETS	20	19	74	14	127
	T2P2	4	6	9	1	20
	NAR	24	25	83	15	147
	GAR	23	24	81	19	**147**

FY21						
MOS		O5	O4	O3	O2/1	Total
1702	ASR	14	19	66	14	113
	TOTAL A-B	14	19	66	14	113
	TOTAL B-B	7	6	14	0	27
	TOTAL A+B	21	25	80	14	140
	NAR BILLE	21	25	80	14	140
	T2P2	4	6	9	1	20
	NAR	25	31	89	15	160
	GAR	24	29	84	22	**159**

FY22						
MOS		O5	O4	O3	O2/1	Total
1702	ASR	16	24	70	14	124
	TOTAL A-BILLETS	16	24	70	14	124
	TOTAL B-BILLETS	8	8	15	0	31
	TOTAL A+B BILLETS	24	32	85	14	155
	NAR BILLETS	24	32	85	14	155
	T2P2	4	6	9	1	20
	NAR	28	38	94	15	175
	GAR	26	37	88	22	**173**

FY23						
MOS		O5	O4	O3	O2/1	Total
1702	ASR	16	31	73	14	134
	TOTAL A-B	16	31	73	14	134
	TOTAL B-B	8	10	0	0	18
	TOTAL A+B	24	41	73	14	152
	NAR BILLE	24	41	73	14	152
	T2P2	4	6	9	1	20
	NAR	28	47	82	15	172
	GAR	27	44	79	22	**172**

FY24						
MOS		O5	O4	O3	O2/1	Total
1702	ASR	16	31	74	14	135
	TOTAL A-BILLETS	16	31	74	14	135
	TOTAL B-BILLETS	8	11	16	0	35
	TOTAL A+B BILLETS	24	42	90	14	170
	NAR BILLETS	24	42	90	14	170
	T2P2	4	6	9	1	20
	NAR	28	48	99	15	190
	GAR	27	45	95	23	**190**

FY25						
MOS		O5	O4	O3	O2/1	Total
1702	ASR	16	31	74	14	135
	TOTAL A-B	16	31	74	14	135
	TOTAL B-B	8	11	16	0	35
	TOTAL A+B	24	42	90	14	170
	NAR BILLE	24	42	90	14	170
	T2P2	4	6	9	1	20
	NAR	28	48	99	15	190
	GAR	27	45	95	22	**189**

FY26						
MOS		O5	O4	O3	O2/1	Total
1702	ASR	16	31	74	14	135
	TOTAL A-BILLETS	16	31	74	14	135
	TOTAL B-BILLETS	8	11	16	0	35
	TOTAL A+B BILLETS	24	42	90	14	170
	NAR BILLETS	24	42	90	14	170
	T2P2	4	6	9	1	20
	NAR	28	48	99	15	190
	GAR	27	45	95	22	**189**

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APPENDIX B. R CODE—STATE MATRICES

This code chunk sets the workspace for the model building.

```
rm(list=ls())
setwd("C:/MyLocalFolder/R Stuff")
library(readxl)
full <- read_xlsx("Thesis.xlsx," range = cell_cols("A:H"))
colnames(full)[1] <- "FY"
colnames(full)[2] <- "ID"
colnames(full)[7] <- "Rank"

work <- subset(full, select=c(ID, FY, Rank))
#work$state <- paste(work$Rank,work$zone, sep="_")

#keep in mind that the FY is the Sep 30 of the year indciated.
#row/observation

## sort by ID, then by year:
work.sort <- work [order(work$ID,work$FY),]
## create columns to eventually tally up flows
work.sort$continue = 0
work.sort$attrite = 0
work.sort$access = 0
work.sort$promote = 0
```

Next, we create a loop that steps through each row and compares the row we're on (ith row) with the following row. We do this until the second to the last.

```
for (i in 1:nrow(work.sort)-1)
{
ID.x <- work.sort [i,1]
ID.y <- work.sort [i+1,1]
if(identical(ID.x, ID.y))
{
#if IDs are identical, this guy is some sort of a "continue"
#only count as "continue" if not already counted as accession

#mark continue, though this might become unnecessary
work.sort [i,4]=1

#promotions?
#check out current rank, or rank for that row/year
Rank.x <- as.numeric(substr(work.sort [i,3],2,3))
```

```
#check out rank following year
Rank.y <- as.numeric(substr(work.sort [i+1,2],2,3))
#if rank y greater than x, then this is a promotion
if(Rank.y > Rank.x)
{
#mark as a promotion—we mark current row so we can tell from which state
#the person was promoted
work.sort [i,11]=1
}
else{
#if not a promotee
Zone.x <- substr(work.sort [i,6],1,1)
Zone.y <- substr(work.sort [i+1,6],1,1)
if (Zone.y==‘a’ & Zone.x==‘b’)
{
work.sort [i,12]=1
}
}

#check for same state
State.x <- work.sort [i,7]
State.y <- work.sort [i+1,7]
if(identical(State.x, State.y))
{
#if same state, then mark same
work.sort [i,13]=1
}
}
else
{
#if the two IDs are different, it must mean the current row is an attrite(last entry for that
ID)
#and it must mean the next row is an accession (first entry for that ID)
work.sort [i,5]=1
work.sort [i+1,6]=1
}
}
```

This last code chunk builds the state matrices.

```
#create matrix to collect flows of continues by state and year
continue.mat <-matrix(0, nrow = 14, ncol= 18)
rownames(continue.mat)<-c(“O1,” “O2,” “O3,” “O4,” “O5”)
colnames(continue.mat)<-
c(“2012”,”2013”,”2014”,”2015”,”2016”,”2017”,”2018”,”2019”)
```

```
#create matrix to collect flows of promotes by state and year
promote.mat <-matrix(0, nrow = 14, ncol= 18)
rownames(promote.mat)<-c(“O1,” “O2,” “O3,” “O4,” “O5”)
colnames(promote.mat)<-
c(“2012”,”2013”,”2014”,”2015”,”2016”,”2017”,”2018”,”2019”)

#create matrix to collect flows of age-ups by state and year
age.mat <-matrix(0, nrow = 14, ncol= 18)
rownames(age.mat)<-c(“O1,” “O2,” “O3,” “O4,” “O5”)
colnames(age.mat)<-c(“2012”,”2013”,”2014”,”2015”,”2016”,”2017”,”2018”,”2019”)

#create matrix to collect flows of attrites by state and year
#attrite matrix actually needs one additional year
attrite.mat <-matrix(0, nrow = 14, ncol= 19)
rownames(attrite.mat)<-c(“O1,” “O2,” “O3,” “O4,” “O5”)
colnames(attrite.mat)<-c(“2012”,”2013”,”2014”,”2015”,”2016”,”2017”,”2018”,”2019,”
“2020”)

#create matrix to collect flows of accessions by state and year
access.mat <-matrix(0, nrow = 14, ncol= 18)
rownames(access.mat)<-c(“O1,” “O2,” “O3,” “O4,” “O5”)
colnames(access.mat)<-c(“2012”,”2013”,”2014”,”2015”,”2016”,”2017”,”2018”,”2019”)

#create matrix to collect flows of sames by state and year
same.mat <-matrix(0, nrow = 14, ncol= 18)
rownames(same.mat)<-c(“O1,” “O2,” “O3,” “O4,” “O5”)
colnames(same.mat)<-c(“2012”,”2013”,”2014”,”2015”,”2016”,”2017”,”2018”,”2019”)

#create matrix to collect totals by state and year
total.mat <-matrix(0, nrow = 14, ncol= 18)
rownames(total.mat)<-c(“O1,” “O2,” “O3,” “O4,” “O5”)
colnames(total.mat)<-c(“2012”,”2013”,”2014”,”2015”,”2016”,”2017”,”2018”,”2019”)

for(i in 1:nrow(work.sort))
{
if(work.sort [i,8]==1)
{
#we add a year to the year coordinate because the convention is to count the flow DURING
the year
continue.mat [as.character(work.sort [i,7]), as.character(work.sort [i,3]+1)]<-
continue.mat [as.character(work.sort [i,7]), as.character(work.sort [i,3]+1)]+1
}
if(work.sort [i,9]==1)
{
```

```
#last entry is marked attrite, so actual attrite occurs during next year.
attrite.mat [as.character(work.sort [i,7]), as.character(work.sort [i,3]+1)]<-
attrite.mat [as.character(work.sort [i,7]), as.character(work.sort [i,3]+1)]+1
}
if(work.sort [i,10]==1)
{
access.mat [as.character(work.sort [i,7]), as.character(work.sort [i,3])]<-
access.mat [as.character(work.sort [i,7]), as.character(work.sort [i,3])]+1
}
if(work.sort [i,11]==1)
{
#we add a year to the year coordinate because the convention is to count the flow DURING
the year
promote.mat [as.character(work.sort [i,7]), as.character(work.sort [i,3]+1)]<-
promote.mat [as.character(work.sort [i,7]), as.character(work.sort [i,3]+1)]+1
}
if(work.sort [i,12]==1)
{
#we add a year to the year coordinate because the convention is to count the flow DURING
the year
age.mat [as.character(work.sort [i,7]), as.character(work.sort [i,3]+1)]<-
age.mat [as.character(work.sort [i,7]), as.character(work.sort [i,3]+1)]+1
}
if(work.sort [i,13]==1)
{
#we add a year to the year coordinate because the convention is to count the flow DURING
the year
same.mat [as.character(work.sort [i,7]), as.character(work.sort [i,3]+1)]<-
same.mat [as.character(work.sort [i,7]), as.character(work.sort [i,3]+1)]+1
}

total.mat [as.character(work.sort [i,7]), as.character(work.sort [i,3])]<-
total.mat [as.character(work.sort [i,7]), as.character(work.sort [i,3])]+1
}
#promote.df <- as.data.frame(promote.mat)
library(openxlsx)
openxlsx::write.xlsx(as.data.frame(promote.mat), file = "1_pomote_flows.xlsx,"
row.names = TRUE)
openxlsx::write.xlsx(as.data.frame(age.mat), file = "1_age_flows.xlsx," row.names =
TRUE)
openxlsx::write.xlsx(as.data.frame(same.mat), file = "1_same_flows.xlsx," row.names =
TRUE)
openxlsx::write.xlsx(as.data.frame(access.mat), file = "1_accessions.xlsx," row.names =
TRUE)
```

```
openxlsx::write.xlsx(as.data.frame(attrite.mat), file = “1_attrition_flows.xlsx,” row.names = TRUE)
openxlsx::write.xlsx(as.data.frame(total.mat), file = “1_totals.xlsx,” row.names = TRUE)
```

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APPENDIX C. R CODE—OPTIMAL SOLUTIONS

This code chunk sets the workspace for the model.

```
#Fixed-Inventory Model
rm(list=ls())
library(optimbase)
library(Matrix)
library(neldermead)

#Transition Matrix
P <- rbind(c(0.090909091,0.818181818,0,0, 0), c(0, 0.462962963,0.407407407,0, 0), c(0,
        0,      0.77383,0.14617,0), c(0,0,0,0.876923077,0.107692308), c(0,0,0,0, 0.96))
rownames(P) <- c("O1," "O2," "O3," "O4," "O5")
colnames(P) <- c("O1," "O2," "O3," "O4," "O5")
P

#the initial inventory vector
n_0 <- c(12, 10, 50, 29, 8)
names(n_0)<- c("O1," "O2," "O3," "O4," "O5")
n_0

#little r, which shows the distribution of all accessions (elements MUST sum to 1)
r <- c(1,0,0,0,0)
names(r) <- c("O1," "O2," "O3," "O4," "O5")
r

#setting the inventory targets for future years
t <- c(147, 159, 173, 172, 190)

squared_dev <- function(x,y)
{
return((x-y)^2)
}

fixed_inventory <- function(x=NULL,index=NULL,fmsfundata=NULL){
return(list(f=squared_dev(sum(n_0 %*% P + x [1]*r),t [1])+
squared_dev(sum((n_0 %*% P + x [1]*r) %*% P + x [2]*r), t [2])+
squared_dev(sum(((n_0 %*% P + x [1]*r) %*% P + x [2]*r) %*%P + x [3]*r), t [3])+
squared_dev(sum((((n_0 %*% P + x [1]*r) %*% P + x [2]*r) %*%P + x [3]*r) %*%P +
x [4]*r),
t [4])+
squared_dev(sum(((((n_0 %*% P + x [1]*r) %*% P + x [2]*r) %*%P + x [3]*r) %*%P +
x [4]*r)
```

```
%*%P + x [5]*r), t [5]),
g=c(),
c=c(),
gc=c(),
index=index,
this=list(costfargument=fmsfundata)))
}
#create a vector of initial values for the decision variables.
x0 <- transpose( c(1.0,1.0,1.0,1.0,1.0) )
#create new neldermead object
nm <- neldermead()
#inform this object that the number of decision variables is 5, in this case
nm <- neldermead.set(nm,'numberofvariables',5)
#inform this object that is must use the fixed_inventory function as the objective function
nm <- neldermead.set(nm,'function',fixed_inventory)
#pass the vector of inital values to the nm object
nm <- neldermead.set(nm,'x0',x0)
#set the number of max iterations to 1000
nm <- neldermead.set(nm,'maxiter',1000)
#set the number of function evals to 1000
nm <- neldermead.set(nm,'maxfunevals',1000)
#tell the nm object to seach for the optimal solution—i.e., solve the NLP
nm <- neldermead.search(nm)
#give us a summary of the output
summary(nm)

#grab the optimal solution
optimal_Rt <- as.data.frame(t(c(nm$optbase$xopt,nm$optbase$fopt)))
```

APPENDIX D. R CODE – OPTIMAL SOLUTION SENSITIVITY ANALYSIS

Before this sensitivity analysis can be executed, the optimal solution has to be created again. Utilize the code from Appendix C. Ensure the probabilities for the transition matrices match.

```
#Monte Carlo

library(triangle)

#Transition Matrix
base_P <- rbind(c(0.090909091,0.818181818,0,0,0), c(0,0.462962963,0.407407407,0,0),
c(0,      0,0.77383,0.14617,0), c(0,0,0,0.876923077,0.107692308), c(0,0,0,0,0.96))
rownames(P) <- c("O1," "O2," "O3," "O4," "O5")
colnames(P) <- c("O1," "O2," "O3," "O4," "O5")
base_P

draw_P <- function()
{
#create a new matrix P with the same dimensions of base_P. Fill it with 0s.
P <- matrix(0,nrow(base_P),nrow(base_P))
for(i in 1:nrow(base_P))
{
for(j in 1:ncol(base_P))
{
#if a zero appears in the base_P matrix, set the corresponding element in P to zero
if(base_P[i,j]==0)
{
P[i,j]<-0
}
#if the base_P element is non-zero, then randomly select a value nearby
#and plug it into P
else
{
P[i,j]<-rtriangle(1,base_P[i,j]-0.03, base_P[i,j]+0.03, base_P[i,j])
}
}
}
#print(P)
return(P)
}

optimal_solutions <- data.frame(R1=numeric(),R2=numeric(),R3=numeric(),
```

```
R4=numeric(),R5=numeric(),opt_values=numeric())

for(i in 1:1000)
{
#select a new P
P <- draw_P()
#re-solve the optimization problem
x0 <- transpose( c(1.0,1.0,1.0,1.0,1.0) )
nm <- neldermead()
nm <- neldermead.set(nm,'numberofvariables',5)
nm <- neldermead.set(nm,'function',fixed_inventory)
nm <- neldermead.set(nm,'x0',x0)
nm <- neldermead.set(nm,'maxiter',1000)
nm <- neldermead.set(nm,'maxfunevals',1000)
nm <- neldermead.search(nm)
optimal_solutions [i,] <- as.data.frame(t(c(nm$optbase$xopt,nm$optbase$fopt)))
print(i)
}

head(optimal_solutions)
summary(optimal_solutions)

emp_conf_int <-data.frame(R1=numeric(),R2=numeric(),R3=numeric(),
R4=numeric(),R5=numeric(),opt_values=numeric())
for(i in 1:6)
{
emp_conf_int [1,i] <- quantile(optimal_solutions [,i], 0.025)
emp_conf_int [2,i] <- mean(optimal_solutions [,i])
emp_conf_int [3,i] <- quantile(optimal_solutions [,i], 0.975)
}
row.names(emp_conf_int) <- c("lower," "mean," "upper")

emp_conf_int
```

APPENDIX E. R CODE – END STRENGTH SENSITIVITY ANALYSIS

This last chunk of code creates the confidence interval for the end strength sensitivity analysis. This code must be added to that in Appendix C and D.

```
#the dataframe otpimal_Rt contains the optimal solution to the (base_P) fixed-intventory problem
optimal_Rt <- as.numeric(optimal_Rt)
#create a dataframe to capture the end-strength estimates for each year in the planning horizon
fut_es <- data.frame(Y1=numeric(),Y2=numeric(),Y3=numeric(),Y4=numeric(),Y5=numeric())
#replicate this 5000 times
for(j in 1:5000)
{
#draw a new P matrix
P <- draw_P()
#create a dataframe to capture the future inventory vectors (5 years by 4 states) for each replication.
fut_n <- data.frame(O1=numeric(),O2=numeric(),O3=numeric(),O4=numeric(),O5=numeric())
#the first row is special since it is based on n_0
fut_n [1,] <- as.data.frame(n_0 %*% P + optimal_Rt [1]*r)
#record the total endstrength for that first year
fut_es [j,1] <-sum(fut_n [1,])
#iterate out from year 2 to year 5
for(i in 2:5)
{
#calculate the inventory vector for future year j
fut_n [i,] <- as.data.frame(as.numeric(fut_n [i-1,]) %*% P + optimal_Rt [i]*r)
#record the total end-strength for future year j and replication i
fut_es [j,i] <- sum(fut_n [i,])
}
fut_n$totals <- rowSums(fut_n)
}

head(fut_es)

emp_conf_int2 <- data.frame(Y1=numeric(),Y2=numeric(),Y3=numeric(),Y4=numeric(),Y5=numeric())
for(i in 1:5)
{
emp_conf_int2[1,i] <- quantile(fut_es [,i], 0.025)
```

```
emp_conf_int2[2,i] <- mean(fut_es [,i])
emp_conf_int2[3,i] <- quantile(fut_es [,i], 0.975)
emp_conf_int2[4,i] <- t [i]
}
row.names(emp_conf_int2) <- c(“lower,” “mean,” “upper,” “target”)

emp_conf_int2
```

APPENDIX F. KSAOS

Source: Paullin et al. (2014, pp. 275 – 277).

Mapping Officer Leader/Management Major Duties (MDs) Onto Performance Components

Performance component	Officer leader/management MD(s)
1. Technical proficiency	• Technical MDs, both those common to all officers and those relevant only to an officer's branch
2. Communication	• Communicate mission goals and objectives • Establish and communicate professional standards • Listen actively to others • Communicate information appropriately and effectively • Demonstrate cultural sensitivity in communication • Create and disseminate a vision of the future
3. Initiative, persistence, and effort	• Model the Army Values and Warrior Ethos • Lead with confidence in adverse situations • Effectively deal with reasonable setbacks and failures • Engage in self-development activities • Expand knowledge of technical, technological, and tactical areas • Expand conceptual and interpersonal capabilities
4. Counterproductive work behavior	• Model the Army Values and Warrior Ethos • Lead with confidence in adverse situations • Effectively deal with reasonable setbacks and failures • Maintain mental health and well-being
5. Supervisory, manager, and executive leadership performance	
• *Consideration, support, person-centered:* Providing recognition and encouragement, being supportive when under stress, giving constructive feedback, helping others with difficult tasks, building networks with and among others.	• Balance the requirements of mission with the welfare of followers • Build trust with other units within the Army • Build trust with individuals, groups, and organizations outside the Army • Resolve conflict through consensus-building and negotiation • Listen actively to others • Foster effective teamwork and cooperation • Create a fair and inclusive work environment • Demonstrate a concern for people and their well-being

Performance component	Officer leader/management MD(s)
	• Accept and effectively deal with reasonable setbacks • Direct others to work toward mission accomplishment • Communicates information appropriately and effectively
• *Initiating structure, guiding, directing:* Providing task assignments, explaining work methods, clarifying work roles, providing tools, critical knowledge, and technical support.	
• *Goal emphasis:* Encouraging enthusiasm and commitment for the group/organization goals, emphasizing the important missions to be accomplished.	• Communicate mission goals and objectives • Influence others to work toward mission accomplishment
• *Empowerment, facilitation:* Delegating authority and responsibilities to others, encouraging participation, allowing discretion in decision making.	• Empower subordinates to exercise initiative and take ownership over work • Create an environment that fosters innovative and critical thinking • Encourage open communications and diverse points of view
• *Training, coaching:* One-on-one coaching and instruction regarding how to accomplish job tasks, how to interact with other people, and how to deal with obstacles and constraints.	• Train and develop others • Counsel, coach, and mentor others
• *Serving as a model:* Models appropriate behavior regarding interacting with others, acting unselfishly, working under adverse conditions, reacting to crisis or stress, working to achieve goals, showing confidence and enthusiasm, and exhibiting principled and ethical behavior.	• Lead with confidence in adverse situations • Demonstrate cultural sensitivity in communication • Maintain own mental health and well-being • Demonstrate self-awareness and self-understanding • Engage in self-development activities
Component 6. Management performance (hierarchical)	
• *Decision making, problem solving, and strategic innovation:* Making sound and timely decisions about major goals and strategies. Includes gathering information from both inside and outside the organization, staying connected to important information sources, and forecasting future trends and formulating goals (innovative or potentially profitable) to take advantage of them.	• Model conceptual, analytic, and evaluative skills to others • Expand knowledge of technical, technological, and tactical areas • Create and disseminate a vision of the future • Identify and adjust to external influences on the mission or organization • Make decisions that reflect an understanding of sphere of influence
• *Goal Setting, planning, organizing, and budgeting:* Formulating operative goals; determining how to use personnel and resources (financial, technical, logistical) to accomplish goals; anticipating potential problems; estimating costs.	• Establish mission goals and objectives • Execute plans to accomplish the mission
• *Coordination:* Actively coordinating the work of two or more units, or the work of several work groups within a unit. Scheduling operations. Includes negotiating and cooperating with other units.	• Prioritize, organize, and coordinate tasks for oneself, individuals, teams, and other organizational units • Build and maintain working relationships with other units within the Army • Build and maintain working relationships with individuals, groups, and organizations outside the Army
• *Monitoring unit effectiveness:* Evaluating progress and effectiveness of units against goals; monitoring costs and resource consumption.	• Enforce performance requirements • Monitor and evaluate operational effectiveness

Performance component	Officer leader/management MD(s)
• *External representation:* Representing the organization to those not in the organization (e.g., customers, clients, government agencies, nongovernment organizations, the "public"); maintaining a positive organizational image: serving the community; answering questions and complaints from outside the organization.	• Develop and maintain cultural awareness • Develop and maintain relevant geopolitical awareness
• *Staffing:* Procuring and providing for the development of human resources. Not one-on-one coaching, training, or guidance; but providing the human resources the organization or unit needs.	• Assess current developmental needs of others • Facilitate the ongoing development of others • Match individual and group capabilities and commitment to task • Identify and leverage opportunities to improve individual, group, and organizational performance
• *Administration:* Performing day-to-day administrative tasks, keeping accurate records, documenting actions; analyzing routine information, and making information available in a timely manner.	• Identify, obtain, allocate, and manage resources
• *Commitment and compliance:* Compliance with the policies, procedures, rules, and regulations of the organization. Full commitment to orders and directives, together with loyal constructive criticism of organizational policies and actions.	• Model the Army Values and Warrior Ethos
7. Peer/Team leadership performance	• Same as Component 5 when performed in a peer rather than a hierarchical context
8. Team member/Peer management performance	• Same as Component 6 when performed in a peer rather than a hierarchical context

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