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STRATEGIC WARFIGHTING READINESS: EVALUATING THE NAVY RESERVE CROSS-ASSIGNMENT PROGRAM

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by

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The Navy Reserves augment the active duty with sailors who live away from fleet concentration areas. Thus, they must travel to provide support. Reservists bring civilian expertise that is specific to mission areas of their supported units. To get the right sailors with the right skills to the right command at the right time, this study develops a tool seeking to optimize the cost efficiency of personnel-billet assignments within a defined budget, without sacrificing their readiness. Using a tailored mixed-method approach, this research focuses on the reserve travel component and a series of qualitative matching scales. This thesis develops a prototype to increase qualitative matches between reserve personnel and their billets while also reducing travel costs. The prototype is based on a specific community of officers, and this study finds that optimal personnel-billet matches' value can be sustained for this community, but for 64 percent of the original cost. Future researchers can apply this prototype and alter the matching scales to the specific needs of each community. Ultimately, the prototype developed in this study seeks to maximize cost-effective use of the reserve labor supply, and ensures reservists bring the critical skills and experience to our strategic warfighting readiness, aligned with the vision of the Chief of Navy Reserve.

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STRATEGIC WARFIGHTING READINESS: EVALUATING THE NAVY RESERVE CROSS-ASSIGNMENT PROGRAM

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ABSTRACT

The Navy Reserves augment the active duty with sailors who live away from fleet concentration areas. Thus, they must travel to provide support. Reservists bring civilian expertise that is specific to mission areas of their supported units. To get the right sailors with the right skills to the right command at the right time, this study develops a tool seeking to optimize the cost efficiency of personnel-billet assignments within a defined budget, without sacrificing their readiness. Using a tailored mixed-method approach, this research focuses on the reserve travel component and a series of qualitative matching scales. This thesis develops a prototype to increase qualitative matches between reserve personnel and their billets while also reducing travel costs. The prototype is based on a specific community of officers, and this study finds that optimal personnel-billet matches' value can be sustained for this community, but for 64 percent of the original cost. Future researchers can apply this prototype and alter the matching scales to the specific needs of each community. Ultimately, the prototype developed in this study seeks to maximize cost-effective use of the reserve labor supply, and ensures reservists bring the critical skills and experience to our strategic warfighting readiness, aligned with the vision of the Chief of Navy Reserve.

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LIST OF ACRONYMS AND ABBREVIATIONS

AC	Active Component
AQD	Additional Qualification Designator
CNR	Chief of Navy Reserve
CNRF	Commander, Navy Reserve Force
CNRFC	Commander, Navy Reserve Force Command
DOD	Department of Defense
DON	Department of Navy
IAP	In Assignment Processing
IP	Information Professional
NEC	Navy Enlisted Classification
PRD	Projected Rotation Date
PQS	Personnel Qualification Standards
RC	Reserve Component
SELRES	Selected Reserves
TRUIC	Training Unit Identification Code
UMUIC	Unit Mobilization Unit Identification Code

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EXECUTIVE SUMMARY

The U.S. Navy Reserves augments the active duty with sailors who are ready to mobilize, and provides rapid support to active duty initiatives. The active component designates known gaps in their capabilities, and uses reserve billets to fill those deficiencies. Reservists bring skills and experience, specific to the mission areas of the active duty units they support. However, most reservists do not live near fleet concentration areas. As such, the drilling component of the Reserves—the Selected Reserves—must frequently travel to where their operational support billets, or jobs, reside. Currently, more than half of all Selected Reserves must travel to their operational support units no less than five times per year. These reservists charge the U.S. government more than 100,000 round trips, at a cost of more than $150 million, each fiscal year (Commander, Navy Reserve Force Command, 2022a and 2022b, & Defense Travel Management Office, 2022 and n.d.). Thus, there is a clear need to maximize the cost efficiency of their operational usage. Given the fight for fiscal resources among programs in the Department of Defense, the Reserve Component must adapt, in order to sustain strategic warfighting readiness under budgetary constraints.

The Selected Reserves cross-assignment program cannot be eliminated, but it can be refined, in order to sustain its purpose at a reduced cost. The objective of this study is to assist Reserve leadership in making cost effective decisions, based on the following four goals: 1) Determine the current cost effective use of cross-assigned reservists that sustains warfighting readiness. 2) Determine the labor supply across the Reserves, in order to ascertain efficiencies and wastage of those who must travel. 3) Assess the current billet assignment process. 4) Assess corrective policy courses of action, so as to maximize the Reserve labor supply; striving toward optimal cost efficiency. Achieving these objectives culminate with an optimization prototype, which qualitatively sustains readiness at a lower cost, and may be applied across the Reserves.

This was a mixed method study, which included both quantitative modeling and cost optimization modeling. It used data from Commander, Navy Reserve Force Command on the current personnel-billet combinations in the Selected Reserves. This study

monetized the benefits of using reservists, compared to equivalent civilians, based on their current pro-rated salaries, within their fields of expertise. Because reservists fill known gaps in active duty operations, the difference—compared to equivalent civilians – was quantified as the benefit. Furthermore, all transportation and sustainment costs were standardized: so as to account for airfare, mileage reimbursements, rental car usage, lodging and per diem, specific to each billet location. Both costs and benefits were standardized over the minimum fiscal year requirements for the fulfillment of operational training and support. Qualitative scales were applied to the benefits, which either sustained or diminished the monetized dollar values of each current personnel-billet combination. These were based on community or specialty, paygrade and location matches. The prototype for optimization was run on a sample subset within the data, in order to test validity and efficacy.

The prototype tested the sample to 'maximize' sustained benefits, based on qualitative values indicative of readiness, and quantifiable travel costs. The optimization matrix reassigned personnel to billets that maximized their qualitative value, and reduced standardized travel costs to sustain them. The results compared current combinations to optimized combinations, and found that commensurate levels of warfighting readiness remained steady, but at 36 percent lower transportation costs. The optimization prototype also increased net benefits by a healthy 5 percent, when compared to current personnel-billet combinations. In addition, the total miles travelled by all reservists decreased by 5.9 percent. The optimized reassignments resulted in nearly a 6 percent decrease in those cross-assigned; thus reducing the total sailors who must travel at a cost to the government. The optimized assignments also increased paygrade matches by more than 4 percent; indicating an increase in qualitative work value, based on new billet requirements. When extrapolated across the Selected Reserves, based on the sample optimization, travel costs charged to the government may be reduced by more than $50 million each fiscal year, without sacrificing qualitative warfighting readiness.

Key conclusions: 1) The cross-assignment program is moderately cost effective in getting the right personnel to the appropriate command, at the right time. The current structure is reasonable in assigning within state boundaries, but lacks filling billets when

crossing state lines. 2) The Reserves is adequate in qualitatively sustaining warfighting readiness. But, improvement may be made, specifically with paygrade matches, so as to better align with current instruction. 3) The unrestricted, or general, warfare communities are extremely apt for cross-assignment; but there is a clear discrepancy between the billets and personnel available within states of fleet concentration. Some states have more billets available than personnel available, but still bring in out-of-state members to fill them; despite having commensurate personnel closer to their billet locations. 4) There are inefficiencies in the billet assignment process, but many of the issues arise from the timing in which reservists become available for assignment. Complicating this is the issue of possible billet 'exchanges', which relies on the members to proactively engage two chains of command in order to find a more efficient billet.

Recommendations:

1. Limit, in priority order, reserve members during the billet application cycles, to local fills, intra-state fills, followed by direct assignment to nearest billet. Qualitatively, job type (specialty) should be the highest priority, followed by a paygrade (experience) match.
2. Provide policy guidance that identifies which reserve communities are prioritized to execute the threat-based approach, as dictated by Navy Reserve leadership.
3. Mandate billet assignment 'swaps' between commensurate personnel, if their new billet assignments are closer to the other, and if both are in the first six months of billet-fill.
4. Extend tour lengths of cross-assigned personnel to three or four years.

This prototype was based on a sample 'two million-dollar problem,' but can be applied to the 'one hundred fifty million-dollar problem.' The prototype developed here is flexible enough to accommodate the needs of all reserve communities' requirements. These include: different qualitative scaled values specific to additional criteria; altered pay scales of civilian equivalents for monetized benefits; and modified distributions of data with more demographic information. As previously stated, if this optimization prototype is

extrapolated across the reserves, the government may save more than $50 million each fiscal year, while sustaining commensurate levels of strategic warfighting readiness. Doing so aligns with the vision of current Reserve leadership, in order to sustain lethality in a cost efficient manner.

References

Commander, Navy Reserve Force Command (2022a). *CNRFC N1 SELRES Manning Cube*. [Unpublished Raw Data on Personnel Billet Matches in the SELRES of the Navy Reserve]. Total Force Manpower Management System, My Navy Assignments Platform and Navy Standard Integrated Personnel System. (Compiled by Naval Information Warfare Center). https://private.navyreserve.navy.mil/.

Commander, Navy Reserve Force Command (2022b). *CNRFC RPD Manning Cube*. [Unpublished Raw Data on Billet Requirements as Managed by Reserve Personnel Directors]. (Maintained by CNRFC, N123 Force Structure Branch). https://private. navyreserve.navy.mil/.

Defense Travel Management Office (2022, November 15). *Domestic Rental Car Ceiling Rates*. https://www.travel.dod.mil/Programs/Rental-Car/.

Defense Travel Management Office (n.d.). *Travel and Transportation Rates: Mileage Rates*. Retrieved January 7, 2023 from https://www.travel.dod.mil/Travel-Transportation-Rates/Mileage-Rates/.

Defense Travel Management Office (n.d.). *Travel and Transportation Rates: Per Diem Rates*. Retrieved January 6, 2023 from https://www.travel.dod.mil/Travel-Transportation-Rates/Per-Diem/Per-Diem-Rate-Lookup/.

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I. INTRODUCTION

A. BACKGROUND

Commander, Navy Reserve Force Command (CNRFC) articulates that the Navy Reserve Cross-Assignment program is designed to augment their active duty counterparts with mobilization ready sailors who do not live within a reasonable commuting distance of fleet concentration areas (DoN, 2017). These members bring a subset of skills specific to mission areas of their supported units; often determined by their unique abilities and experience acquired in conjunction with their civilian lives. Navy Reserve Augment Units sustain Personnel Qualification Standards (PQS) for each reserve member, tailored to their mobilization billets. These coded billets are recalled to support the Active Component (AC) with mobilizations and other special order types of continuous support to active duty initiatives. The U.S. Navy and its Reserve Component (RC) must adapt, in order to win our nation's wars with strategic placement for timely readiness. But this comes at a cost, considering the perpetual scarcity of resources in the Department of Defense, both in finances and in manpower and manning. The U.S. Navy Reserve must adapt accordingly, in response to budget constraints, but not at the expense of readiness.

The cross-assignment program cannot be eliminated due to the urgent need to bring qualified personnel to augment AC missions in alignment with the Chief of Navy Reserve's vision of strategic warfighting readiness. Cross-assigned members provide a benefit in sustaining those initiatives. However, the purpose may be achieved with a reduced cost, via tailored policy decisions focused on those most apt to be cross-assigned; the critical skills or communities within the RC most necessary for strategic readiness, or other nuances within the Reserve labor force. This includes a focus on the reserve billets themselves, as well as the personnel filling them; in conjunction with the process that aligns the two together for timely operational support. The objective of this research is to assist Reserve leadership in making cost effective and informed decisions regarding the warfighting readiness of the Navy Reserves, and the program that enables the best military-civilian combination of skills and experience.

B. OBJECTIVES

This thesis has three primary goals:

- Determine the current cost effective usage of cross-assigned reservists who are required to travel no less than five times per year to qualify and support their active duty counterparts.
- Determine the labor supply across all Reserve demographics and locales to ascertain efficiencies, wastage and focus areas to improve policy recommendations.
- Assess the first two objectives, and how they may simultaneously sustain strategic warfighting readiness under a total force policy.

Research has been conducted on both financial and budgetary items in the Reserves writ-large, as well as specific training research. Past studies were conducted regarding the billet assignment process, as well as demographic analysis of personnel across both the RC and AC. However, this thesis may uncover prescriptive policy recommendations to refine the program that sustains strategic warfighting readiness with the appropriate service members at a reduced cost. These research efforts are confined to the Selected Reserves (SELRES) portion of the RC; yet results from this study may assist senior decision makers within the U.S. Navy in effecting more efficient future organizational restructures during both periods of downsizing and increased manning. This is due to an emphasis on reserve billets, and secondarily, the members who fill them from the Navy Reserve labor supply across the nation.

C. RESEARCH QUESTIONS

Primary Question

- How cost effective is the cross-assignment program in providing personnel with the necessary skills to the appropriate command at the right time for warfighting readiness?

Secondary Questions

- Which individual, regional and warfare community demographics are most apt for cross-assignment; and which are most necessary to be cross-assigned?
- What inefficiencies exist within the billet assignment process, thus affecting the cross-assignments of personnel and their associated travel costs across fleet concentration areas?
- What corrective policy courses of action will maximize the Reserve labor supply inventory, both regionally and demographically; as well as make the cross-assignment program more cost efficient?

D. SCOPE

The scope of research investigates the total proportionality of all reserve sailors in a cross-assigned status, as well as those within specific regions, locales and warfare communities. This reveals program options to minimize travel costs while sustaining warfighting readiness in the Reserves with targeted recommendations across regions and warfare communities. Standardized travel pays and travel costs will be used for consistency to illuminate where the cuts should be made or expanded. However, the primary focus is on reserve billets with quantitative analysis of the members filling them. The scope of this study further explores optimal billet matching so reservists may cost efficiently fill all jobs necessary to sustain warfighting readiness.

The scope focuses on the Navy Reserve, but more specifically the SELRES component. This excludes the Individual Ready Reserve, the Training and Administration of the Reserves, and the Retired Reserve List which also fall under the RC, but are not the focus of program refinement. The cross-assignment policy only affects those in a SELRES status, including those in both a pay and non-pay status. Thus, a review of current and recommended future organizational structure to support those recommendations will be based on a qualitative and econometric cost effective analysis of the cross-assignment policy.

E. METHODOLOGY

This thesis will use a mixed method approach of quantitative modeling and cost optimization modeling for analysis and comparison. It will include descriptive analysis based on strong assumptions, with speculative recommendations to answer the primary research question, as well as the last secondary question (number 4). The purpose is to determine the cost effectiveness of reservists who are cross-assigned, the labor supply across RC demographics and locales, and to ascertain efficiencies, and wastage; and focus on areas to improve policy. This includes standardized travel costs in the program, with weighted adjustments across locales of fleet concentration areas, from the Defense Travel System and Government Services Administration.

To answer the first two secondary research questions (numbers 2 and 3), economic and econometric assessments will compare costs to transport, pay and train reservists, identify the demographics most apt for cross-assignment, and determine inefficient areas of wastage. This will include standardized training time and travel costs for the proportion of reservists who are cross-assigned. It will then use linear programming to find optimal billet matching, based on a speculative value system, combined with standardized travel costs. These methods will isolate prescriptive policy recommendation to maximize efficiency within the Cross-Assignment program, further answering the final secondary research question (number 4).

There is no current literature specific to the Cross-Assignment program, other than policy instruction and oversight. However, a systematic literature review of reserve budgeting, training, management and billet selection will illuminate inefficiencies in the program, while identifying features of warfighting readiness. Qualitative and econometric findings will be integrated with extrapolated costs, standardized pays and discount rates in order to formulate cost efficient courses of action. These courses of action will be derived from econometric analysis of regional and warfare demographics as the cost parameters, while linear programming will compare the costs and benefits across them. This combination shapes prescriptive recommendations for program improvement with qualitative assessments of billet assignment, and economic implications of program cost effectiveness.

F. ORGANIZATION OF STUDY

This thesis is divided into five chapters. Following this introduction, Chapter II delineates a literature review, including current program instruction and policy, as well as past theses and research on RC budgeting and management structures. Chapter II further dissects the current billet assignment process, a general overview of the Reserve labor supply, and reports on Reserve usage and efficiency. This chapter illuminates where this research fills some of those gaps that are not currently addressed. Chapter III displays the data and descriptive statistics used for qualitative and econometric analysis, as well as the primary sources used for policy recommendations. This chapter includes analytical methods of parsing the data for analysis before policy recommendations may be made with qualitative assessments. Chapter IV provides the results from qualitative and economic analysis across all of the cost and benefit parameters. These results are paired with policy recommendations in Chapter V, for further discussion. This final chapter also notes deficiencies in the study, and answers the research questions with a conclusion of the research findings, and recommendations for future studies.

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II. LITERATURE REVIEW

This chapter covers current policy and instructions of the Cross-Assignment program in the U.S. Navy Reserves. It reviews past theses and reports on Reserve budgeting, training and management structures, as well as the evolution of all three in the Post-9/11 world. This chapter further delineates what constitutes strategic warfighting readiness under the vision of the Chief of Navy Reserve (CNR). It also illuminates the current billet assignment process in the Reserves to fill all billets associated with Navy Reserve Augment Units, as many of these are filled by non-local or cross-assigned sailors. Finally, this chapter highlights more recent reports from the Office of the Secretary of Defense regarding Reserve Forces Policy and cost effective use of the Reserve Component (RC). The research questions of this thesis align with this thinking for detailed cost effective and econometric analysis in the ensuing chapters.

A. CURRENT CROSS-ASSIGNMENT PROGRAM INSTRUCTIONS AND STRATEGIC WARFIGHTING READINESS

Prior to recommendations, it is imperative to understand current policy. The Reserve Personnel Manual is the authoritative source for managing U.S. Navy reservists. Instructions of interest within the Reserve Personnel Manual that pertain to cross-assigned personnel are subsections 1000–010, 1300–010 and 1300–060.

1. The Reserve Personnel Manual

Instruction 1000–010 outlines management of the Reserve Unit Assignment Document; which is the official manning document and manpower authorization for all Selected Reserve (SELRES) units (Department of the Navy (DON), 2018). Instruction 1000–010 further explains billet *alignment* under their nearest Navy Operational Support Centers for administrative purposes. This instruction governs how these SELRES personnel are allocated to and therefore managed within their respective reserve units; including those in a cross-assigned status.

Instruction 1300–010 directs the billet *assignment* process for all SELRES members (DoN, 2018), while subsection 1300–060 forms policy for the management and

responsibilities of both local and cross-assigned personnel (DoN, 2017). It is important to note that the term Navy Operational Support Center was recently replaced with Navy Reserve Center, so the two are used interchangeably in instructions since 2017. However, they perform the same functions. The terms Cross-Assigned Out and Cross-Assigned In were also recently replaced with Non-Locally Assigned. But, these terms differ across instruction updates. As such, the terms Navy Reserve Center, Cross-Assigned Out and Cross-Assigned In are used in the following sections for continuity and simplicity.

2. Reserve Unit Management and Billet Assignments

Instruction 1000–010 in the Reserve Personnel Manual designates codes for the Selected Reserve Functional Area and Sex of SELRES members assigned to their respective Reserve Unit Activity Documents. These codes are then used to manage both officers and enlisted members on those activity documents, as the codes delineate the criteria of who may fill a given billet during the subsequent billet assignment process. Instruction 1000–010 directs that all information to establish these codes is based on the authoritative Career Management System – Interactive Detailer process on official manpower. In turn, these codes, based on authoritative manpower processes, generate the Reserve Unit Activity Document. This document *aligns* all SELRES members within the unit under local Navy Reserve Center management.

It is essential to note that instruction 1000–010 does not prioritize the billet *assignment* process. It *aligns* all members in reserve units for management purposes, while referencing the billet assignment process directed in instruction 1300–010. This configuration includes members not filling a local billet for a specific unit. The Reserve Unit Activity Document, created from the Selected Reserve Functional Area and Sex codes, notes the advertisement status for vacant slots, as well as leadership roles within those reserve units (DoN, 2018). Unit leadership roles are defined with criteria for all interested and qualified members. Advertisements list vacant positions via online billet application platforms including the Career Management System – Interactive Detailer for enlisted members and the Reserve Force Management Tool for officers. This is normally done about six months prior to the Projected Rotation Date (PRD) of the current fill, or

remains open if the billet awaits an available SELRES member of at least a close fit to billet criteria.

However, the annotated Selected Reserve Functional Area and Sex codes are flexible to provide billet assignment opportunities that support the missions and mobilization requirements of their Navy Reserve Augment Units (DoN, 2018). Navy Reserve Augment Units are connected to their Active Component (AC) counterparts so their codes account for the member's rating, paygrade, Navy Enlisted Classification (NEC) or Officer Additional Qualification Designator (AQD), and sex for all billets on the Reserve Unit Activity Document. This flexibility permits effective management of members assigned to each reserve unit, and links their operational support with AC command structures. This RC to AC configuration is key, as every Reserve Unit Identification Code is affiliated with an Active Unit Identification Code; thus illuminating the importance of member availability to fill vacant or soon to be unfilled billets.

Instruction 1300–010 in the Reserve Personnel Manual directs the billet *assignment* process referenced in 1000–010, with coordination between Navy Reserve authorities and their Operational Support Officers for SELRES mission support. It bridges the Reserve Unit Activity Document management in 1000–010 to the governance policy of cross-assigned personnel in 1300–060. Instruction 1300–010 defines local, cross and exact billet matches when connecting Reserve Unit Activity Document management to cross-assigned personnel compliance.

Instruction 1300–010 specifies application cycle timelines and matching criteria via the Career Management System – Interactive Detailer for enlisted members and Reserve Force Management Tool for officers. This instruction further defines billet eligibility, establishes PRDs for prospective billet fills and manages Inactive Duty Training orders. Instruction 1300–010 also structures the billet requirements, including the maintenance of required NECs and AQDs among various specialties and communities across the Navy, as well as repercussions for failure to maintain them (DoN, 2018). More importantly, it designates responsibilities of the Navy Reserve Center, the Navy Reserve Augment Unit and the member for orders compliance.

Understanding this 'bridge' in billet assignment is critical to effectively manage cross-assigned personnel. Instructions 1000–010 and 1300–010 jointly dictate the timely availability of billet vacancy, and prospective members to fill them. They also direct that they be appropriately coded for the Navy Reserve Augment Unit, the Navy Reserve Center and the AC unit with whom the Navy Reserve Augment Unit is associated. Targeting these aspects uncover recommendations to increase cost effectiveness of the cross-assignment program; yet still maintain strategic warfighting readiness.

3. Managing Cross-Assignments

> A local billet is defined as one within a reasonable commuting distance of 100 miles. When a local billet is not available, Sailors will be assigned to billets at other NRAs to meet mobilization requirements across the Navy Reserve Force, referred to as a cross-assignment. (DoN, 2017)

Commander, Navy Reserve Force Command (CNRFC) policy is to maximize local billet fills. Based on timing of entry, either from the AC or direct RC accession, many are filled with cross-assigned members. Cross-assigned sailors fill billets in a Reserve unit managed by a Navy Reserve Center other than their own, normally at a unit more than 100 miles from their home of record. So, a cross-assigned member will train locally under one Navy Reserve Center, but their operational support is owned by a unit under a different one.

Instruction 1300–060 in the Reserve Personnel Manual defines two key administrative pieces to understanding the cross-assignment process. A cross-assigned sailor is Cross-Assigned Out from their local training unit under one Navy Reserve Center; and is Cross-Assigned In to the unit where their mobilization billet resides under a different support center (DoN, 2017).

To distinguish support centers, the 'local' Navy Reserve Center is the *closest* one to SELRES personnel, as per their home of record in the Navy Standard Integrated Personnel System. This includes those who reside more than 100 miles from the nearest Navy Reserve Center. As long as their mobilization billet is managed by the same support center as their training unit, a member residing more than 100 miles from their nearest support center is considered 'local,' even though they live outside a 'reasonable commute.'

Illustratively, a SELRES member may live over 100 miles from Navy Reserve Center San Antonio, but as the *closest* support center, it manages their training unit. This remains true even if that same member fills a billet for operational support and unit mobilization managed by Navy Reserve Center Houston. Cross-assigned sailors are not just relegated to members who cross state lines, although many of them do.

However, due to this arrangement, cross-assigned sailors have two chains of command. They have a chain of command for medical and administrative training purposes under their Training Unit Identification Code (TRUIC) which handles their Fitness Reports and Evaluations, and is managed by one Navy Reserve Center. Their second chain of command for operational support and involuntary mobilization readiness falls under their Unit Mobilization Unit Identification Code (UMUIC), which is managed by a separate Navy Reserve Center.

It is imperative to maintain constant communication to manage cross-assigned members, as dictated by instruction 1300–060 of the Reserve Personnel Manual. Their administrative items are completed by their TRUIC chain of command. However, all orders routed via the Navy Reserve Order Writing System require UMUIC command approval before routing back to the Navy Reserve Center of their TRUIC. Local and In-Assignment Process members have simpler routing through one Navy Reserve Center. But cross-assigned members must rely upon proactive management of their respective chains of command for orders support from two units under two different support centers.

4. Strategic Warfighting Readiness under a Navy Total Force Policy

> In this era of strategic competition, we must be ready. The Navy Reserve's role as a critical enabler and a source of strategic depth is our organizational mandate. Our Navy and our joint forces are counting on each of you to contribute to assuring our allies and partners, deterring our competitors, and decisively competing and winning across the spectrum of conflict, in all domains, when called upon. Warfighting readiness is our only priority. (Chief of Navy Reserve Public Affairs Office (CNRPAO), 2022)

In May 2022, the Chief of Navy Reserve articulated a vision for the RC mission to provide strategic depth and deliver operational capabilities to the Navy (CNRPAO, 2022). The amended fighting instructions were designed to ensure warfighting readiness with a

force that is trained and ready to win fights in sustained combat operations across domains (CNRPAO, 2022). To accomplish this goal, the RC uses the Navy Reserve Cross-Assignment program to capitalize on the diverse personnel away from major naval hubs. These reservists bring skills specific to mission areas of their supported units, acquired in conjunction with their civilian lives. Aligned with this vision, reservists provide critical warfighting capabilities united to mission requirements. But this vision requires reservists who are trained, able and available to deliver cost-effective operational support in a timely manner (DoN, 2022b).

The Department of Defense (DOD) defines readiness in a joint publication as the ability of U.S. armed forces to meet the demands of all assigned missions (DoD, 2020). In a Navy RC context, and more specifically the reserve cross-assignment program, it is the timely availability of mobilization-ready SELRES members. The crux of strategic warfighting readiness is flexibility and responsiveness, in order to enhance the Navy Total Force. Senior RC leadership mandate it, but U.S. citizens rely upon it for survival.

RC integration into AC mission support cannot be overstated. The strategic warfighting readiness, stemming from the timely availability listed above, directly supports the Navy Total Force Policy. Total Force Policy is the assimilation of all forces, including the RC, for mission achievement. This integration guides Navy manpower and manning procedures for effective usage and management, as AC and RC billets and mission pillars are aligned for operational use.

The Government Accountability Office (GAO) states that while service branches historically manage their manpower policies, rising costs in sustaining personnel highlight the need of RC to AC integration. The office establishes that a defined Total Force Policy, with an effective force management, enables decision makers to sustain warfighting readiness at minimum cost (GAO, 1979). In 2020, the Reserve Forces Policy Board found that the RC represents 38 percent of total forces, necessitating further integration for future operational support. This Board recommends more integration in order to enhance operational effectiveness, increase training readiness and sustain higher retention rates across the spectrum (Punaro, Improving the Total Force, 2020). More of their historical findings and conclusions are found near the end of this chapter.

5. Key Takeaways of Managing the SELRES for Warfighting Readiness

1. Local members have matching TRUICs and UMUICs under one Navy Reserve Center.
2. In-Assignment Process sailors are not currently filling a billet and therefore have only a TRUIC under one Navy Reserve Center.
3. Cross-assigned members have non-matching TRUICs and UMUICs. They rely on two chains of command for all training and operational support.
4. Strategic Warfighting Readiness is timely RC availability and responsiveness to AC requirements. This requires planning for both training readiness and billet placement.
5. Total Force Policy integrates the RC into AC organization for mission completion. This requires effective usage and management of RC capabilities for operational use.

CNRFC policy and instruction pertinent to cross-assigned sailors is critical as they are currently required to travel no less than five times per year. These include four quarterly Inactive Duty Training Travel periods for 'drill' weekends and a two-week Annual Training. Since cross-assigned personnel orders for travel are processed by two different units under two distinct Navy Reserve Centers, and include travel pay considerations, this provides the impetus for qualitative policy recommendations. Defined measures, including RC availability and billet placement, are needed to analyze warfighting readiness for quantitative policy recommendations.

B. HISTORICAL RESERVE BUDGETING, TRAINING AND MANAGEMENT

When considering the budget for the U.S. Navy Reserves, it is important to understand historical patterns, both before and since September 11, 2001; when defense department and management structures changed. Past theses and reports on the Navy budget have a notable impact on cost effective analysis in this thesis, as the RC must operate within a clearly defined budget, which changes annually. This is especially true, as

this research centers on funding the travel component to all Navy Reserve travel in support of AC initiatives.

1. U.S. Navy Budget Policy and Growth

Edward Zawislak examined the RC across all services, primarily focused on composition under a Total Force Policy and the funding process. He found that the RC was utilized in a more prominent role, due to higher operational tempo and increasing commitments that contributed significant levels of equipment and personnel to execute the Total Force Policy. Across the RCs, the Ready Reserve contributed nearly 30 percent of manpower to the total military force of the United States (Zawislak, 2000). In accordance with his findings, the DOD cannot sustain operations without direct RC support, thus highlighting the significant impact that a strategically ready reserve has upon mission capability. This directly affects RC planning, programming and budgeting; highlighting the necessity for a cost effective reserve fighting force.

Zawislak emphasized budgeting due to increased RC usage, which is still true over 20 years later. He interviewed DOD personnel that conducted the Planning, Programming and Budgeting System (PPBS—now the PPB Execution process) to understand budgetary allotments to all RCs. This included their reactions to amplified usage over time. He found a 1300 percent increase in RC output from 1989 to 2000, yet when adjusted for inflation, RC funding decreased by more than 10 percent (Zawislak, 2000). Zawislak construed this result to be based on a budgetary structure of claimants buying programs, and associated capabilities within the U.S. Navy. Despite the fact that peacekeeping and weapons of mass destruction operations contributed to increased RC usage after the fall of the Soviet Union, he established that the RC is resourced as a lower priority within the DON. However, Zawislak further concluded that the Total Force Policy must adapt so that the RC will remain feasible, going forward.

Analyzing Navy Reserve budgets from 1970 to 1987, Guy Leary (1987) found a 113 percent growth in the RC budget, nearly three times that of the AC budget allotments during the same time frame (Leary, 1987). His methods included descriptive data analysis for funding authorities, but Leary justified the RC share of funding due to notable growth

in personnel, both in volume and proportion of total Navy forces. He concluded that the Navy's RC budget was more affected by the Reagan Administration's DOD buildup; rather than the established Total Force concept.

Furthermore, Leary noted that annual changes in the RC's budget were incremental, which was indicative of the established budget. He ascertained that the Navy RC earned a fair share of the total Navy budget (Leary, 1987) as the RC portion of funding trended upward for most years during his study. His findings noted RC personnel growth of nearly 13 percent, with a corresponding 22 percent decrease in AC Navy personnel during the 18-year study (Leary, 1987). The remarkable growth of RC personnel, and more designated RC missions, justified increased budgets for future operations. This remains true more than 30 years later.

Charles Heller (1994) conducted qualitative analysis of the RC of the Armed Forces, and detailed the Navy RC management structure. His analysis forecast status and roles for the RC into the future, after the fall of the Soviet Union. Heller annotated the pay structures for RC and AC members and their budgeting impacts, including allowances. More importantly, he emphasized a RC that is strategically organized and well trained to handle increasing complexities. Heller's study highlights the responsibility of Naval Reserve Force Command for administration, training and operational readiness of Navy reservists. The SELRES end strength of 118,000 accounted for about 12 percent of the total Navy force, not including an additional 160,000 personnel in the Individual Ready Reserve (Heller, 1994). However, he concluded that to adequately fight future conflicts, the RC must be well-defined and strategically managed when mobilizing reservists. This includes not only fiscal responsibility, but also managerial alignment for what constitutes strategic warfighting readiness.

Heller's research found that the U.S. Navy Reserve contributed 100 percent of total assets in harbor protection, composite aircraft, strike rescue and heavy airlift (Heller, 1994). Therefore, the Navy RC sustained a significant footprint among U.S. Navy activities, including cargo handling, intelligence, shipping control, security and military sealift. He further emphasized RC training for fleet operations and enhanced readiness, but also concluded that additional manpower was needed to support the AC. Heller's analysis

of training and management structures pairs strategic warfighting readiness with fiscal measures to meet those ends. An increasing reliance on the RC for future support emphasizes the critical need to sustain its strategic warfighting readiness.

2. Management and Training to Integrate Reservists

Albert Bailey (1975) found that funding and education directly affected management of the Reserves under a Total Force Policy. At the end of the Vietnam War, Bailey recommended that the Reserves separately obtain the appropriate funding to sustain their combat capabilities. He concluded that the Navy RC must be fully integrated in all AC Fleet Exercises for continuous year-round training (Bailey, 1975). Bailey acknowledged that perpetual work on multi-faceted missions throughout the year enhances the relationship between the AC and RC across all communities and specialties. This enables strategic warfighting readiness, spreads knowledge and understanding of the Navy Reserves and sustains the RC's role under the Total Force Policy. More importantly, it justifies the need for RC members to interface with the AC on a consistent basis, regardless of where those reservists originate.

Sustaining the RC role under a Total Force Policy necessitates a litany of standardized training evolutions, so as to ensure all reservists are prepared to fulfill their duties upon recall to active duty. Some specialties dictate additional training specific their requirements, but all reservists must complete General Military Trainings each fiscal year to be considered mobilization ready. The Chief of Naval Operations (CNO) routinely publishes administrative directives for required training in support of that mobilization and warfighting readiness. The directive outlining training for fiscal year 2023 required completion of domestic abuse, operations security, cyber awareness, counterintelligence awareness, equal opportunity and suicide prevention (CNO, 2022).

It is important to note that the entire list of required trainings may vary each year, with some required biannually, and others triennially. Regardless of requirements, all listed modules must be completed each fiscal year or the members are unable to provide operational support to the AC. While Inactive Duty Training Travel periods focus on operational readiness for the RC mobilization unit, they may also administer general

trainings. But they must submit verification of completion to the member's local training unit under their local Navy Operational Support Unit, who is responsible for tracking their completion.

This matters because it is simpler to complete standardized training locally, without travel. This way, members may focus on operational, rather than administrative readiness during their four yearly Inactive Duty Training Travel periods. Limiting General Military Training to periods at a member's local command focuses operational training with operational commands, and will maximize warfighting readiness more cost efficiently.

A RAND corporation report (2019) found that integrating RC and AC leadership staffs increases the unity of command necessary for effective warfighting and training. However, this option faces organizational structure limitations. The authors focused on the means of increasing readiness through case studies of managerial frameworks. The report argued to establish a unity of command to the greatest extend possible. But they acknowledged constraints on the duties RC members, in part time roles, may perform under different Title 10 and Title 32 authorities (Rohn et al., 2019).

Despite the constraints, the report contended that integrating RC and AC leadership staffs maximizes readiness, by diminishing administrative burdens RC members face when recalled for support. Therefore, the authors recommended to co-locate RC and AC units for best flexibility; and to increase permeability for seamless transitions of RC members between inactive and active duty status (Rohn et al., 2019). This requires coordination between AC and RC management structures, which will enhance reserve integration into AC mission sets, for more effective warfighting readiness.

Richard Mazza (1992) emphasized the increased dependency on the RC and determined that the RC must shift from pure mobilization training to contingency response, and continuous related support. In the context of military downsizing after DESERT STORM, Mazza endorsed structural changes across the RC organization, management, manpower and training. Doing so better supports the Total Force Policy and National Military Strategy. He established that the management structure for both SELRES and the Training and Administration of the Reserves must facilitate receptive flexibility to AC

mission requirements. Mazza further suggested that RC leadership mirror their AC counterparts with shared administrative resources to remove duplicate command functions and enhance readiness (Mazza, 1992). This includes senior RC organizations at regional and national levels as well as individual Navy Reserve Augment Units for dispersed execution of those AC missions. Doing so enhances cost effectiveness of RC usage and training.

Most importantly, Mazza found that population growth rates in different locales do not simply translate to available manpower within the RC labor supply (Mazza, 1992). This affects the thinking of placing more billets along national coastlines or near city population centers as well as the billet matching process. He adamantly recommended future demographic studies to ascertain quantity and quality of available manpower across regions and locales to establish future locations of SELRES billets. Mazza concluded that RC support to AC missions transfers the responsibility of training reservists to the AC gaining commands who use them, rather than 'in-house' reserve unit training. However, he noted that doing so necessitates a system to translate AC support to quantifiable measures of RC warfighting readiness (Mazza, 1992).

3. Key Takeaways from RC Funding, Management, Training and Usage

1. Reserve Component usage has prominently increased over the last 50 years, with a swelling reliance upon the RC for AC mission completion.
2. Reserve Component funding has increased, but with varying degrees commensurate to the AC and increased RC usage. This is indicative of budgetary inefficiencies.
3. RC management must be fully integrated with AC leadership and administrative resources for cost efficient flexibility to AC missions, including standardized training.
4. RC manpower must target warfare communities and locales for effective billeting and training with tangible measures of strategic warfighting

readiness. This requires studies designed to predict the quantity and quality of future RC manpower to fill billets.

Understanding and applying these takeaways are imperative, for cost efficient means of sustaining warfighting readiness via the Navy Reserve Cross-Assignment program. This requires qualitative and econometric analysis, with economic implications in Chapter IV for prescriptive policy endorsements in Chapter V.

C. RESERVE ASSIGNMENTS, LABOR SUPPLY AND PROGRAM DISCUSSIONS

Before any recommendations may be made to improve the billet assignment process, it is important to understand the RC labor supply, as well as past discussions on reserve programs. Part A analyzed current policy and instruction for billet assignments under the Reserve Personnel Manual. However, this section delineates past research of billet matching. Reports on RC labor supply supplement the understanding of current deficiencies where progress may be made. Past program discussions illuminate from where these questions arise.

1. Reserve Billet Assignments and Application Process

All reserve members are responsible to apply for their billets throughout their careers, except their first one. Reserve recruiters normally assign the initial billet for new SELRES members joining the RC. When service members depart the AC, they coordinate with a Career Transition Officer for possible billet selection; or they are directly assigned their first billet upon RC accession. This is normally to an Operational Support Unit (now known as a Readiness Support Unit) under the jurisdiction of a single Navy Reserve Center. When new service members directly access to the RC without prior AC experience, there is some negotiating between the prospective RC member and the reserve recruiter.

After initial billets, the subsequent billet application process requires officers to apply via the Junior Officer APPLY system or the APPLY board for senior officers seeking command. Enlisted personnel use the Career Management Systems – Interactive Detailer (CNRFC, 2022c). Once on their respective application platforms, members search for

available billets in their preferred regions. There is no restriction to search only for billets in their locale of residency.

CNRFC policy stated in Part A only applies to the billet selection process of prioritizing local billet fills before cross-assignments. But this does not preclude members from seeking billet options outside their locales during the initial applications. Each applying member must list comments for their billet choice preferences. They are then screened based on matching criteria in their rank, paygrade and warfare community. In some cases, additional qualifications may be deemed necessary for certain billet options.

Service members may add further justifications in the application; including family considerations and administrative needs, if the member is returning from orders or mobilizations. This may include TRUIC changes between Navy Reserve Centers, or other civilian life changes that necessitate different billets in their applications. Enlisted Coordinators see these comments for enlisted billet and personnel matching.

If a member is unable to fill a local billet or be matched elsewhere, they are temporarily listed as In Assignment Processing (IAP). They may remain as such for no more than 90 days while applying for billets via the Career Management System – Interactive Detailer or Junior Officer APPLY platforms. If no billet is matched during that time, members may be directly assigned to a vacant job closest to their rank, paygrade and qualifications, including a cross-assignment. Personnel found IAP for more than 120 days are then transferred out of a pay status and put into a Voluntary Training Unit (DoN, 2022a).

Cross-assigned members, whether through application or direct assignment, may apply for a local vacant billet in their respective application platforms, before their PRDs. However, they normally must do so within six months, or two quarterly application cycles of filling their current billet. This requires coordination between the member, local and cross-assigned chains of command, and their Navy Reserve Center. This seldom occurs without proactive management of all parties, and is contingent upon the timing of a local billet becoming vacant.

Paul Robards (2001) studied possible billet matching options for AC enlisted members. While not specific to the Navy RC billet filling process, his research illuminated qualitative insight that may also increase RC billet matching efficiency. He established that Two-Sided Matching Theory was an acceptable alternative approach for 294 detailers to assign the more than 300,000 AC sailors to commands across the nation (Robards, 2001). He found this to be a systematic matching sequence of two elements, the prospective command and individual sailor, based on preferences for both in a voluntary setting. Because there was no standard procedure to optimally assign sailors to billets, Robards' Two-Sided Matching Theory guaranteed stability in aligning 'suitable' matches between individual sailors and future commands.

Much like RC billet applications, AC sailors input personal preferences via web-based platforms. However, the AC also suffers from the inability of prospective commands to do the same for adequate two-sided matching of requirements and preferences. Robards argued in favor of this to permit AC commands to input desired traits and skills, and their relative importance for quality matching. Sadly, he concluded that two-sided matching could not be directly applied to the current AC Navy billet assignment process (Robards, 2001), although he noted that aspects should be modified to at least increase efficiency. Thus, experimentation may find improvement in the 'increased optimality' of matches; even if it falls short of completely optimal matches.

Robards inferred the failure to apply this matching theory, due to fixed assignments for all sailors. Established tour lengths create instability in the timing necessary to match preferences when vacant slots become available. He further articulated that repeated matching cycles, based solely on such incentivized behavior, will have unforeseen effects, due to frequent billet application series in the year. Robards hypothesized that this may result in sailors 'gaming' the system, thus defeating the matching theory before it realizes positive results (Robards, 2001).

Robards concluded that Two-Sided Matching doesn't ensure priority billets are filled, due to the timed nature across subjectively matched preferences during the year (Robards, 2001). Furthermore, he determined that since the Navy billet assignment process is not voluntary, many sailors are then forced into undesired billets. This weakens the

stability function of Two-Sided Matching Theory, thus diminishing a strength of this concept as applied to military manpower and manning. However, pieces of the theory may be applied if targeted correctly in specific communities.

2. Navy Reserve Labor Supply

It is now established that billet matching within the RC is contingent upon timing of vacant jobs, or when a new member enters the RC. End strength of the AC workforce affects the total possible reservists becoming available for billet assignment. While direct RC accessions from the civilian labor supply affects this timing, the majority of reserve personnel come from the AC upon their separation, or completed terms of service. All of which are dictated by congressional limits to funding, and authorized end strengths.

> Military billets, active and reserve, are funded through the application of programmed end strength. Total active and reserve end strength for a given year is fixed and can only be changed through the PPBES process. Total military manpower authorizations are limited to programmed end strength. (DoN, 2021).

The Total Force Manpower Policies and Procedures instruction is the authoritative reference and tool guiding all manpower requirements that support AC missions. It delineates the manpower *process* supporting the Navy Total Force concept, and establishes responsibilities to sustain support to the appropriate mission capabilities. This instruction also discerns between manpower requirements for mission accomplishment and the manning to fulfill them. The manning, or filling of billets designated by manpower, includes reservists in RC billets that directly support AC billets at their supported commands.

This instruction accounts for changes in manpower end strength that subsequently affect possible manning and billet assignments. This may include creating new billets or the deletion of existing ones, based on mission requirements that are determined by the required operational capabilities of each command. Changes in these requirements directly affect RC billets aligned with their mission sets. It is therefore critical to understand the relationship between the available RC labor supply and the required operational capabilities of manpower in the AC. A change in one alters where and when an RC billet

is filled, which in turn affects RC members in a cross-assigned status, rather than locally filling an AC operational requirement.

Manpower authorizations are funded manpower requirements that support the required operational capabilities of AC missions. But authorizations must match manpower requirements in each member's paygrade, designator or other special qualifications, unless constrained by external influences (DoN, 2021). This directly affects matching RC personnel to billets, as authorized billets must be balanced with changing end strengths. The process is further compounded by the timing of RC labor availability, which is why it is common to have 'gapped' billets among reserve commands.

The Congressional Budget Office (2006) studied recruiting and retention in the AC and RC of the Navy based on these end strength impacts. The report found the AC was challenged with managing end strength reductions that retained the 'right' people while encouraging some to voluntarily opt out without harming future recruiting and retention. The AC policy to facilitate downsizing was to encourage transfers to the RC, thus affecting an influx of new labor supply to the RC. Historically, the AC and RC will increase or decrease together in end strength, but not necessarily in the same proportions. There is also often an offset in the timing of RC upward or downward trend in end strength, relative to the AC. As such, drawdowns in AC manning often lead to a glut of labor supply attempting to enter the RC.

The Congressional Budget Office found that over a seven-year period, the AC downsized by nearly 20,000 while RC end strength reduced by less than 17,000 members (CBO, 2006). For clarity, the RC is much smaller in size relative to the AC, so proportionally the RC actually lost more personnel. However, the difference of nearly 3,000 recently AC sailors includes a large number attempting to remain in the service in some capacity. Their option is to access into the RC. This affects billet matching while remaining contingent upon the type of prospective labor supply that comes from multiple communities or specialties.

As a consequence, the Congressional Budget Office report also found recruits directly accessing into the RC without prior AC experience began to decline by more than

ten percent per year (CBO, 2006). Furthermore, RC recalls to active duty simultaneously increased during the same period, indicative of increasing AC reliance on RC personnel when their end strength is reduced. The report further concluded that AC drawdowns provide phenomenal RC recruiting opportunities with more seasoned personnel available for future recall. The bottom line is that AC end strength authorizations have direct influence over the availability and type of RC labor supply, thus altering the billet matching process as well.

The Center for Naval Analyses completed a study of the demographics within the RC across all services, including the Navy RC. Their findings facilitate a better understanding of the Navy RC labor supply. The research discovered the following notable aspects of those who comprise the RC labor force *compared* to the AC (CNA, Population Representation in the Military Services: Fiscal Year 2017 Summary Report, 2017).

1. Enlisted

4.7 percentage points more whites,

3.8 percentage points more women

1.6 percentage points less blacks, 5.3 percentage points less Hispanics

Nearly identical in Asians.

2. Officers

Nearly identical in whites

1.5 percentage points more blacks, 1.7 percentage points more women

1.5 percentage points less Hispanics, 1 percentage point less Asians

3. Married

Enlisted men and women are considerably less likely to be married

Difference in marriage rates do not narrow until over 40 years of age

12 to 27 percentage points less likely among men

9 to 22 percentage points less likely among women

4. Age

RC members are older than AC members

Nearly 70 percent of AC enlisted are under 30 whereas barely 52 percent of RC enlisted are younger than 30

Less than 2 percent of AC enlisted or over 45, but nearly 11 percent of RC enlisted are older than 45

About 26 percent of AC officers are over 40, but nearly 35 percent of RC officers are older than 40

Only 13 percent of AC officers are over 45, but 29 percent of RC officers are older than 45

The first two observations are reasonable variations to see across any given year. The RC consistently has more women represented, has mixed results in black personnel serving, but is less represented by Hispanics. However, the above observations show reasonable variance across years. Yet, the last two observations are quite striking. AC members are overwhelmingly more likely to be married than RC personnel during the primary years of service, which doesn't narrow until near retirement age for both AC and RC members (CNA, Population Representation in the Military Services: Fiscal Year 2017 Summary Report, 2017). In addition, the labor supply in the RC is notably older, with many providing support well into their forties and early fifties. This report sheds light on at least two aspects of the RC labor force, regardless of where they live, their race or their ethnicity.

Reserve leadership sustains an online snapshot that tracks monthly updates to the status of the Navy Reserve, which highlights the labor reservists provide to the AC. In December 2022, the Navy SELRES community monitored more than 45,000 members in a pay status, including over 12,000 officers and nearly 33,000 enlisted members. During this month, nearly 12,000 personnel conducted AC support via Annual Trainings, mobilizations or other special orders support as managed by 118 Navy Reserve Centers and 21 Naval Air Force Reserve Squadrons (CNR, 2023). The SELRES community tracks between 45,000 and 48,000 personnel annually. This includes members not filling a billet and mobilized personnel who disappear from SELRES visibility due to AC conversion

until completion. As such, these mechanisms have a time lag in tracking the reserve labor force currently in-use across mission sets.

3. Past Discussions and Reserve Component Recommendations

It is important to understand previous inquiries and reviews, to answer questions regarding RC management and effective usage. This holds true even if they find different conclusions based on the same evidence. The Reserve Forces Policy Board is an independent committee that advises strategies, policies and practices to improve aspects of the RC. Similar to their 2020 report on Improving the Total Force, their 2014 report on RC Use also recommended to revise the Department of Defense Total Force Policy with more integration. The 2014 study also recommended to expand key skills in the RC and increase investment in RC readiness; while simultaneously using available RC manpower.

The 2014 report found that for about $50 billion annually, the U.S. maintains an operationally engaged RC, which held nearly 40% of the Department of Defense's end strength, for only 9 percent of the total budget (Punaro, Reserve Component Use, 2014). It recommended the RC remain flexible to provide operational support in manning and capability, to fulfill a spectrum of missions across the AC. Due to inefficient management structures, the report urged to improve AC and RC integration, so as to efficiently use available RC manpower. Doing so will increase RC cost advantages, while creating more investment in future RC readiness. The report emphasized that the RC is cost-effective in providing skilled and seasoned warfighting capabilities, yet noted options to increase RC budget savings. These findings focused on integrating overhead costs for both operations and management, which stressed headquarter restructuring.

The Board recommended to articulate a viable RC mission under defense strategic guidance, while sustaining operational training, without waiting for future conflicts to force its necessity. The report rejected the notion that the RC role is either a strategic or operational one. The Board advocated that the RC may fulfill both roles simultaneously, thus endorsing enhanced organization and training to expedite timely usefulness at the onset of future conflicts. However, their recommendations focused on balancing AC and RC forces via intensive integration.

The report acknowledged fiscal restraints, but proposed the RC as an affordable option to retain warfighting capabilities while accounting for AC end strength fluctuations. This critical recommendation sustains warfighting readiness, by fluidly integrating RC management with AC command structures for shared resources. But they found integration must occur during both training and operational employment. Doing so preserves the RC from massive end strength reduction to mitigate risks from variation in the AC end strength. More importantly, it hedges against future uncertainties and sustains cost-effective means of warfighting readiness.

The integration recommendation aligns with recent CNRFC statements on the future of the Navy's RC. In 2015, CNRFC addressed the Armed Forces Communications and Electronics Association, stating that the RC must be integrated with the newest missions and capabilities. This echoed the Reserve Force Policy Board report to integrate at both training and operational employment levels. CNRFC reiterated past recommendations that as the AC transitions to future capabilities, so must the RC. From 2005 to 2015, RC readiness impacted combatant commander capabilities, but fiscal limitations and reduced mobilizations challenged operational proficiency, despite employing reservists' combined civilian and military skills (Anderson, 2015). As such, despite years of research recommending such changes, the process is ongoing, with mixed results. More research is necessary for meaningful changes to occur, going forward.

4. Key Takeaways to Understand RC Billet Matching and Labor Supply

1. Reservists apply for jobs based on personal preferences, their PRDs and their general communities of experience or training.
2. Reserve commands fill their billets based on availability and general community restrictions, but no associated preferences. There are limited options to exchange cross-assigned personnel for local billet fills.
3. Ideal billet matching between sailors and RC commands does not exist within the assignment process, due to the involuntary nature of filling 'gaps' and availability.

4. Active Component end strength and manpower authorizations directly influence the RC labor supply, availability, usage and billet matching.

5. The RC demographically mimics the AC, but is notably older and more likely to be married, while geographically dispersed.

6. Nearly a quarter of the RC labor supply provide some form of operational support to the AC, in any given month.

7. The RC is cost efficient in providing operational capabilities, but must better integrate administratively, while sustaining warfighting readiness. Budgetary limitations and evolving missions hamper full RC integration.

These takeaways demonstrate the difficulties facing the RC, when matching billets based on the available labor supply and the timeliness of their availability. The RC mimics the AC in many ways, but it is inherently reliant upon the manpower and manning of the AC. This makes sense given the design of the RC to supplement the AC. However, the RC has intrinsic issues that prevent ideal matching, thus forcing any cost efficient improvements to the margins. These start with better integration to AC leadership. But they continue with targeted improvements to RC training, and the billeting of cross-assignments, both of which sustain warfighting readiness.

D. SUMMARY

There was no literature on the Cross-Assignment program, except instructions in the Reserve Personnel Manual, and references governing management procedures. However, the systematic literature review in this chapter covered elements that affect the program. Budgeting, management, training and billet selection analyses impact those cross-assigned, and their augmentation to the AC with cost effective strategic warfighting readiness. The review of these elements highlights systemic challenges to overcome, and inefficiencies that may be improved.

1. Common Threads Across the Literature

Extensive review of literature pertaining to elements affecting the Cross-Assignment program revealed the following commonalities:

1. Current instructions and policies illuminate time management issues to administer cross-assigned SELRES sailors for effective operational use.
2. RC usage has increased over time, with a bigger role in AC mission completion under the Total Force Policy; but not necessarily with commensurate funding.
3. RC integration with the AC is absolutely necessary for strategic warfighting readiness that is cost effective under an allocated budget.
4. RC training and management structures require refinement, due to multiple order types of operational support.
5. Optimal billet matching with the RC labor supply is contingent upon timing of RC accession and AC end strength. This reinforces the need for RC integration, and cost efficient means of strategic placement.

2. Noted Deficiencies and Past Recommendations

Cross-assigned sailors have multiple chains of command that require frequent pro-active communications for operational support, in order to sustain their training and mobilization requirements. Their availability and responsiveness to AC initiatives defines strategic warfighting readiness, but they require extensive planning, and are affected by billet placement. Poor execution, even under a viable Total Force Policy, puts overall warfighting readiness at risk. This multi-layered administration of cross-assigned sailors demands thorough RC integration into AC organizations for effective operational utility.

Increased RC usage over time is indicative of higher reliance on the RC for mission completion. Because RC funding increased with varying degrees proportional to the AC, this highlights budgetary inefficiencies, which have been noted within multiple past research reports. This necessitates RC leadership integration with AC command structures, for more cost efficient use of RC operational capabilities and shared resources. The analyses and findings of Edward Zawislak, Charles Heller and Albert Bailey support this notion, as framed under the Total Force Policy. Guy Leary amplifies the need for RC

integration, with historical budgetary trend analysis that supports Heller's budget-based study, recommending refined RC management structures.

Between 1997 and 2017, the Navy RC fluctuated between nearly 57,000 to more than 95,000 personnel while the AC total service members spanned from about 371,000 to over 485,000 personnel (CNA, Population Representation in the Military Services: Fiscal Year 2017 Summary Report, 2017). The SELRES subset contained over 45,000 members of nearly 105,000 personnel under the total Navy RC as of December 2022 (CNR, 2023). Because the SELRES has a sizeable portion of the Navy RC, the funding 'share' allocated to the RC holds great import to sustain training readiness. This is true regardless of increases or decreases in total proportionality of cross-assigned SELRES members.

The literature stresses, to varying degrees, that RC training and its management must be refined. This refinement impacts the types of orders SELRES members must perform via Active Duty for Training, Annual Training, Recalls, Inactive Duty Training Travel and Mobilizations. These order types are detailed to missions and training requirements across warfare communities with different execution authorities. Yearly trainings mandated by the Chief of Naval Operations must reflect these refined measures to push administrative requirements to local commands, for maximum operational efficiency.

Current RC billet matching and labor supply literature demonstrate issues with the timing of available RC members, contingent upon the AC end strength. While the RC is older and more apt to be married than the AC, their cost efficiency in providing operational capability is not the issue. RC members provide continuous operational support to the AC on a monthly basis. The timing in which they are available, via their billet placement is where improvement may be made.

RC commands fill their billets based on availability and general community restrictions; whereas the individual sailors may apply based on personal preferences. While this counters positive results in Paul Robards' two-sided matching theory, he recommended future studies to implement some of its aspects on a smaller scale. He argued that, if targeted correctly in the margins of specific communities, it may have more success

(Robards, 2001). It is the alignment of personnel to billets that provides the right 'skills' to the right command at the right time which sustains warfighting readiness.

Aligned with that thought, Richard Mazza recommended future demographic studies on quality and quantity of available manpower to establish future RC billets. Mazza also endorsed management changes to support the Total Force Policy with a flexible RC, yet he highlighted the need for quantifiable measures of warfighting readiness (Mazza, 1992). His call for demographic studies on a smaller scale sync with Robards' recommendation for simulations of optimal billet matching.

3. Filling the Gaps with a Narrower Focus

The common threads across the literature, and endorsements for future studies paint an incomplete picture pertinent to managing the Navy RC. This research follows Richard Mazza's recommendation for demographic studies. It targets members across warfare communities, paygrades and regions for those currently cross-assigned, and those necessary to be cross-assigned. This study extends previous research analyzing RC to AC integration that has been called for by the other authors and reports. But this thesis has a narrower focus to the travel cost component for SELRES personnel, who are a subset of the RC.

This research applies Paul Robards' two-sided matching theory, but on a smaller scale that seeks optimization via linear programming. It also qualitatively matches personnel to billets based on a value versus cost scale, rather than sailors to RC commands. This indirectly assigns members to the commands, but accounts for the involuntary nature of billet assignment that is detrimental to effective two-sided matching theory. To do so, this study applies qualitative matching values based on occupational category or warfare community, rank and location of both the billets and personnel. These subjective values will be paired with standardized minimum costs to transport the SELRES members before linear program analysis for optimal placement.

Cross-assigned sailors cost no less than five yearly round trips of travel pay. This mixed method will account for budgetary limitations, consider availability constraints and speak to current instructions for billet matching of the RC labor supply. This study absorbs

the qualitative and quantitative issues addressed in the literature. It speaks to a need for quantifiable measures of RC warfighting readiness; based on timing, location and availability. It also seeks to reveal corrective policy options that maximize the RC labor supply, in order to make the cross-assignment program more cost efficient. It must do so by identifying SELRES personnel for cross-assignment, and optimally placing them in billets in order to sustain strategic warfighting readiness.

III. DATA, SCOPE AND METHODOLOGY

This chapter merges insights, concepts and findings from past literature into a mixed method study. This study uses qualitative values and quantitative data to analyze the cost effectiveness of the Navy Reserve Cross-Assignment program. The steps shown here culminate with economic implications for analysis and findings found in Chapter IV. The data herein is acquired from the office of Commander, Navy Reserve Force Command.

The following sections:

1. Define the compiled data sources, their contents, and limitations.
2. Delineate the descriptive statistics that focus the scope of research.
3. Describe how benefits were monetized, and how costs were standardized for comparisons.
4. Detail the value scales, their justifications, and their applications to monetized benefits.
5. Describe the development of billet-matching matrices, for the optimized billet assignments of SELRES personnel; and the limitations of scope and methods.

A. THE DATA

1. Sources, Compilation and Augmentation

The CNRFC office provided the data for this research with their unclassified *CNRFC N1 SELRES Manning Cube*. The provided data set is a compilation that merges two components. Billet information is derived from the Total Force Manpower Management System. Personnel information is pulled from the Navy Standard Integrated Personnel System, with more data from the My Navy Assignments portal that displays current matches. The Naval Information Warfare Center – Atlantic compiled these programs for easier use and access by leadership. The Total Force Manpower Management System and Navy Standard Integrated Personnel System are authoritative sources that

display current status at the moment of their data incorporation. Future researchers may find them at: https://www.nsips.navy.mil/nsipsclo and https://tfmms.sscno.nmci.navy.mil.

Upon receipt of the data, this research added elements from the *CNRFC Reserve Personnel Director Manning Cube*. This augmented the data with billet-specific requirements, such as paygrade and warfare community necessities. These pieces enhanced the later monetized benefit comparisons, for potential billet matching during data manipulation.

This thesis added comparable civilian equivalent salaries to their military counterparts. This was done in order to monetize the benefits of using SELRES sailors instead of outsourcing to civilian support of AC missions and initiatives over the required work days. The difference in pay indicates the associated 'benefit' of using SELRES sailors. This research also added defense travel cost information for airfare, mileage reimbursements, rental cars and per diem. This travel cost information came from the Defense Travel Management Office; which runs the Defense Travel System, as well as the Government Services Agency. These sources provided travel costs over the minimum required travel periods for support. These resources may be found at: https://www.defensetravel.dod.mil and https://cpsearch.fas.gsa.gov/. All costs to per diem, lodging, airfare, mileage reimbursements, and rental cars were based on fiscal year 2023. Military salaries reflect fiscal year 2023 updates; while civilian salaries reflect a January 2023 snapshot from the Bureau of Labor Statistics and other business reporting tools such as Payscale. A complete description of how benefits were monetized and compared to travel costs is found in Section C of this chapter.

2. Data Explained

The initial data provided by the *CNRFC N1 SELRES* Manning Cube, included 48,712 rows of observations from December 2022. However, there were 546 'duplicate' rows of the same person or billet, and were subsequently discarded. Thus, only 48,166 observations reflected the entirety of all SELRES members. These rows displayed 28 columns of observed traits for each, including those of both the individual and their associated billets. Another 9,820 observations did not reflect 'complete' billet information,

due to blank columns, and were also discarded for consistency. Of these 9,820 discarded observations, 3,766 members were not in a reserve billet due to recall and mobilizations to active duty, which prohibited them from being reflected on reserve manning documents. Others were simply awaiting billet assignment at the time of data capture, indicative of their status as IAP.

As such, the usable dataset included 38,346 observations of personnel-billet combinations. Observed traits included status as an officer or enlisted, rank, paygrade and general (warfare) community specialties. They noted security clearance levels, billet assignment dates, PRDs and pay status. Importantly for this research, the data listed: cities, states and zip codes for each member's local and operational support units. This thesis focuses on the travel component, for cost effectiveness of reservists who must travel for training and support. Thus, the points of origin and destination are of high import in the analysis of this research. Refer to Table 1 for definitions of observations and traits between members and billets. It defines observations and variables from the original data acquisition in the *CNRFC N1 SELRES Manning Cube*, prior to billet requirements added from the *CNRFC Reserve Personnel Director Manning Cube*. This is observational, rather than experimental, data.

Table 1. Observations and Variables Defined. Adapted from Commander, Navy Reserve Force Command (2022a).

Observation ID	Definition	Observation ID	Definition
BIN	Billet ID Number (7-digits)	*O/E*	Officer or Enlisted status
billet.BTITLE	Title (Name) of Billet	*RATE/RANK*	Rate (E) of Paygrade / Rank (O)
BILL_ASG_DT	Date Assigned to Billet (YYYYMMDD) -- Start Date	*RTNG/DESG*	Rating (E) of Occupational Specialty / Designator (O) of Same
PRD	Projected Rotation Date (YYYYMMDD) -- End Date	*billet.REC_TY*	Billet Record Type of Billet-Fill. C=Cross-Assigned. L=Local Fill
SCRTY_LVL	Security Clearance Level V=Top Secet w/SCI Eligible (Highest) T=Top Secret Only S=Secret.	*PAYGD*	Paygrade: Indicative of Time-Exper. on Enlisted/Officer scales
		PAY	Member Payment Status: 1 = In a Pay Status. 9 = Not in Pay Status
NRA	Navy Reserve Activity: 3-4 digit Code of Member's Assigned (Local) Reserve Center	*billet.AUIC*	Billet's Active Unit ID Code (Active Command to whom Reserve Unit is Aligned for Ops Support
RPC / RPC Description	Reserve Program Codes / 2-digit codes that group Communities of Specialization	*Home City/State/Zip*	Member's Home (Record) City, State & Zip Code, as per Navy Standard Integrated PERS System
TRUIC	Training Unit Identification Code	*UMUIC*	Unit Mobilization Unit Ident Code
TRUIC City/State/Zip	Training Unit ID Code: City, State and Zip Code (Member's Local Training Command)	*UMUIC City/State/Zip*	Unit Mobilization Unit ID Code: City, State, Zip Code (Member's Cross-Assigned Cmd-Ops Support)

Notes: Zip Codes, TRUICs, UMUICs and AUICs are 5 digits. If TRUICs and UMUICs match, the member is Locally Assigned. If non-matched, the member is Cross-Assigned. Ratings are 3–6 alpha-numeric characters. Designators are 4 digits.

The observations are largely comprised of categorical or qualitative variables; both ordinal and nominal. There is a heavy emphasis on billet identification, locations of both the members and commands, as well as codes indicative of personnel qualifiers. Additional observations from the *CNRFC Reserve Personnel Director Manning Cube* supplemented billet-specific requirements, but of a similar qualitative nature. Later data manipulation that used algorithms such as Stata and Python, required the creation of binary and other indicator variables. But nothing more substantial in data quality was added. Microsoft Excel, its linear programming and Solver mechanisms were the primary tools used for data analysis. MATLAB was also used for supplemental data analysis. These programs merged

information from the Government Services Agency, the Defense Travel Management Office, and the Bureau of Labor Statistics, for the monetization of benefits and costs.

3. Limitations to the Data

Notable limitations of the data include the following.

1. Data is a snapshot, with no time variance. This applies to both the primary data capture in the CNRFC N1 SELRES Manning Cube, and the supplemental information in the CNRFC RPD Manning Cube. CNRFC updates them monthly.
2. No individual level demographic information provided by CNRFC.
3. Data mixes categorical variables that are both ordinal and nominal. Data manipulation was required for algorithm processing.
4. Upon data inspection, some variables were missing cells, or contained cells with incorrect digit totals and alpha-numeric alignments. This required some 'inference,' but 2,072 more observations were dropped.

B. THE PROBLEM TO SOLVE

1. Theory and Assumptions

This research relied upon the theory of labor demand. Because this thesis focused on the SELRES subset under the U.S. Navy RC, the labor supply is the collection of SELRES members who provide work in support of the AC. In this model, the output is a service: strategic warfighting readiness. The labor demand signal originates with the AC, and their priorities of mission and capability requirements. Thus, the AC derives much of its output of warfighting readiness from the SELRES. If the AC increases the output demand from the RC, then the SELRES community must demand more labor to sustain that warfighting readiness. But this includes funding to transport the SELRES members; hence why the Cross-Assignment Program cannot be eliminated. The only substitutes to sustain the readiness output are the AC itself, or to outsource the labor to civilians with equivalent skills and experience to their SELRES counterparts. Outsourcing to civilians

was the only acceptable alternative that was considered, since SELRES billets are designed to support identified gaps in the AC. So, reliance on the AC as a substitute was not considered. If it were, SELRES billets would not need to exist in the first place.

This thesis focused on minimizing spending with increased efficiency under a delineated budget. The only means of reducing travel costs is to fill billets with qualified members closer to them. Thus, a baseline of monetized benefits is compared to civilian equivalents near the billet locations. This is demonstrated in the matrices development for optimized billet assignments. These matrices then show how to increase cost effective use of the SELRES labor force.

2. Econometric Baseline with Descriptive Statistics

An econometric baseline was first established to determine which demographics across communities, locales and paygrades were currently most apt for cross-assignment. This baseline answered Richard Mazza's call for demographic studies that ascertain available manpower in the RC labor supply. However, this econometric baseline distinguished from the RC writ-large, and focused on the travel component of the SELRES community. This demographic baseline focused later analysis, by examining the 'bigger picture' across officer versus enlisted, community versus specialty, and state to state comparisons. These initial findings were the impetus for further narrowing of the study, to where it was most pertinent or illustrative of the necessary concepts.

This research used Stata and Python for components of data manipulation, in conjunction with Microsoft Excel algorithms. In order to establish the econometric baseline of demographics, binary variables were created in the raw Excel data file, for those cross-assigned or in a local billet. The same was done for the 50 states, and 24 paygrades, spanning enlisted, officers and warrant officers in the SELRES. Doing so made the data 'readable' into Stata to discern which paygrades and which states were currently most frequently in a cross-assigned status. Along with different Python coding applied to the raw data, this provided 'some' indication of which communities were cross-assigned most often. Both coding algorithms illustrated frequencies and likelihoods of which ratings

(enlisted) and designators (officers) were cross-assigned. These included snapshots of their points of origin and destination, for location and travel distance usage in later analysis.

C. THE (MIXED) METHOD

1. Monetization of Benefits

In order to monetize the benefits, this research compared average salaries of equivalent civilians to their SELRES counterparts who fill similar roles, in their support to the AC. These salaries were scaled according to seniority and experience; to make them equivalent to SELRES members at senior, mid-level and junior levels of skills and expertise. Pay differences were weighted according to proportions of senior, mid-level and junior members in the data, for accurate comparisons. Equivalent civilian pay scales were taken from the Bureau of Labor Statistics.

Base pay days for SELRES members were calculated, using the fiscal year 2023 pay charts, sustained by the U.S. Navy online. These base pay days were then compared to the daily pay equivalent of their civilian counterparts. This was done to their respective paygrades, in order to accurately monetize the 'delta' as the benefits for SELRES services. The 'delta,' or difference in what the Navy pays its SELRES members versus comparable civilians, was annotated as the 'benefit.' This is a benefit because it highlights, through payment to SELRES members, what value the Navy puts on their services. These daily pays were then extrapolated, according to the five minimum required travel periods of work that instruction mandates cross-assignees complete each fiscal year. Thus, the 'benefit' of using cross-assigned sailors was monetized, for easy comparisons to the costs necessary to transport them; for the four drill weekends and a single Annual Training.

Monetized benefits include 'inflation' for the return on investment to the Navy. Like any private firm, there is an expected return in productivity that is monetized as revenue. In this case: monetized warfare readiness. The Bureau of Labor Statistics (BLS) found that an average of 33 percent of wages include benefits across industries (BLS, 2022). Those are not included in these standardized benefits, so they are assumed as 'transferred' to the Navy. A Columbia University study found that productivity, or return to firms, averaged a 6 percent annual return on investment, across industries (Bartel, 2000).

Furthermore, a RAND study (2008) found that the average fringe benefit rate, or proportion of benefits to wages for an employee, hovered near 20 percent (Karoly, 2008). Since the Navy invests in training its members, this is feasible to apply for accurate 'inflation' of expected return on investments. However, to remain conservative, this research took the middle ground and assumed a 20 percent average return on investment.

Please refer to the below equation for a visual of how monetized benefits were standardized and calculated. All pays were weighted based on distribution within the SELRES samples. Rationale for 30 base pay days is described in the next section.

$$\Big(\big((Std\ Military\ Pay - Avg\ Equivalent\ Civilian\ Pay\ ) \div 365\big) \times 30\Big) \times 1.2$$

2. Monetary Cost Associations

This thesis used the Defense Travel Management Office and Government Services Agency for travel costs. Travel costs were weighted by locale: for zip code-based per diems, average cost per flight mile under government contracts, average mileage reimbursement for driving miles, and average rental car daily rates. Correlating to the members required to travel, the costs were standardized to the minimum five required travel periods. Thus, it sustained comparable costs to the monetized benefits of work provided, during the same lengths of days.

The distances between zip codes of the members' home and their operational support units provided travel cost calculations. These zip codes connect each member's home of residence to that of their UMUICs (operational support unit). It is important to note that the members' home zip codes were used for travel calculations, since many members do not necessarily reside in the same zip code as their TRUIC (local unit). But, if a member's TRUIC matches their UMUIC, they are considered a local fill. Thus, there is no reimbursable travel and no cost to the Navy. This holds higher value. If these codes do not match, then the member is cross-assigned, with an associated distance for standardized travel costs.

Airfare was based on a national average of $0.20 per flight mile; as the crow flies from the zip code of their home of record to that of their operational support unit. This was

only applied if the distance was at least 200 miles or more. If the distance was shorter than that, a $0.65 mileage reimbursement cost was applied; as the member could reasonably drive it for support. Per diem—which includes meals and incidentals—and nightly lodging rates, were based on the zip code of the UMUIC. Rental car rates were based on national average minimums, in the state of the operational support unit. SELRES orders in the Defense Travel System, always default to the cheapest rental car available in the locale of orders support. Furthermore, these rental car rates were only applied to areas that were more than 200 miles from the member's home of record; as they would not need them if they drove 200 miles or less.

Due to oddities in how SELRES are paid for drill weekends, versus Annual Trainings, the following numbers apply for consistency. Twenty-six per diem days, 21 nights of lodging, 21 daily rates of rental car use. These are calendar days over five round trips, which correlate to 30 base pay days, because SELRES receive two base pay days for each 'drill' day, but only one base pay day for each active duty day. So, while it's only covering 26 calendar days, each SELRES member is receiving 30 base pay days. As such, 30 base pay days were used for equivalent civilians to sustain consistency of monetized benefits in comparison to standardized travel costs.

Please refer to the below equation for how costs were standardized and calculated. All are weighted to the zip codes and states of where the billets reside.

$$\Big(\big((26 \times PerDiem) + (21 \times Lodging) + (21 \times RentalCar)\big) + \big(0.2 \times AirMiles(> 200) \boldsymbol{OR}\ 0.65 \times Mileage(\leq 200)\big)\Big)$$

Rental cars are only included if flights are used. Conversely, mileage is used if there is no required flight nor rental car usage for trips within 200 miles.

3. Scales to Discern Value

As a mixed method study, qualitative and quantitative information were merged. Qualitative measures of paygrades, communities, locations and security clearances were scaled as proxies of strategic warfighting readiness. Warfare communities determine occupational specialty and importance to AC missions; while security clearances are

valued in priority billets and usable across billets. Paygrades determine levels of experience and expertise within those fields; while discrepancies in locations add a scaled value, indicative of higher cost to sustain adequate billet matching. The Information Professional (IP) community does not have variance in specialty assignment, nor required security clearance, because it is a managed community. It was an ideal SELRES officer community to examine for illustrative purposes. However, these matching criteria are useful, when applied to other 'less' managed communities, in order to replicate the research. This will sustain scaled value matches for cost effectiveness. Reference Table 4 for details of these scales. Their implications to the billet-matching optimization process are included. These scales are applied to officers in a specific community for illustrative purposes.

Table 2. Qualitative Value Matching Scales Source: Kyzer (2021).

Personnel-Billet Value Matching Scales in Current Assignments							
Local or Cross-Assigned based on Location (State)		**Paygrade (Personnel-Billet) Matching**		**Reserve Personnel Code (RPC) to Designator Matching**		**Clearance Level Bonus (Priority Fills)**	
Locally Assigned:	1	Personnel-Billet Exact Match:	1	RPC-Designator Exact Match:	1	Top Secret / SCI Eligible (V):	$5,845
Cross-Assigned (Same State):	1.25	Personnel-Billet Non-Match (by only 1):	1.25	RPC-Designator Non-Match (Very Similar):	1.25	Top Secret Only (T):	$4,425
Cross-Assigned (Out of State):	2	Personnel-Billet Non-Match (by 2):	2	RPC-Designator Non-Match (Slightly-Similar):	1.5	Secret (S)	$420
Same State: Member stays under same Reserve Component Command (RCC). Out of State: May cross RCCs for admin control.		Personnel-Billet Non-Match (by 3):	3	RPC-Designator Non-Match (Non-Similar):	2	Unknown --PERS / Billet Requirement	$1,764
		Personnel-Billet Non-Match (by ≥ 4):	4			Clearances: $$ Bonus added to Monetized Benefits. Unknown PERS/Billet Req's: Weighted avg for all security background investigations. Dollars are 2021 Costs	
Monetized Benefits divided by Scales. Closer matches sustain higher benefits. Incentivizes matches.							

SCI: Secure Compartment Information. Designators used for Officers for illustrative purposes.

As is seen in Section D, these scalars are divided into the monetized benefits determined earlier. Therefore, to sustain the 'benefits,' a 1 is the ideal score to receive for paygrade, location and community matches. Closer matches will then sustain higher levels of the monetized benefits; thus these scalars incentivize more matches for cost efficiency.

Please reference Appendix A for more detailed instructions of matrices development that incorporates these scalars.

A member may sometimes be cross-assigned within their own state, if the state is large enough. So, a 1.25 was used for a non-local member residing in the same state; compared to a 2, if the cross-assigned member is from out of state. Location mismatches are penalized for lost work productivity due to administrative workload across reserve regions that require multiple command or Navy Reserve Center inputs. But, if the cross-assigned member is still in the same state, they fall under the same Reserve Component Command, which minimizes some of that administrative burden. However, these still take away some amount of time to manage, which distracts from the operational support while the cross-assignees is on orders.

This logic is supported by research conducted by the Center for American Progress. They found three prominent forms of administrative burdens: learning, psychological and compliance costs (Schweitzer, 2022). Psychological costs are not pertinent to this scaling. Yet, learning and compliance costs are illustrated in situations where SELRES members cross domains and rely on multiple chains of command. Most SELRES members will not fully understand the complexity of the management system without interfacing with their commands, which track the mechanisms. But, multiple actions must be 'signed off' by different commands. Most administrative items are handled by the local command, but operational items are handled by the operational support unit (DoN, 2017). When crossing Reserve Component Commands, routing chain lengths and 'wait times' double. This delays the time it takes for systems to reflect updates. As such, this requires pro-active leadership from multiple locations. Also, there is effort necessary to sustain all 'paperwork' for each administrative action, only made more inconvenient without timely access while on orders. These burdens, at a minimum, take time away from focusing on the operational support. As such, location mismatches are penalized.

Reserve Personnel Code to designator (or ratings for the enlisted) matches are designed to keep the SELRES members supporting their warfare communities. It is penalized if a member is assigned to community outside their own, because work

productivity is clearly lost outside their specialties. Although some communities have some overlap, the scalars incentivize members to remain in support of their specialties.

Billet paygrade requirements are malleable; so as to handle a difference of one up or down, in member paygrade. It becomes an issue for qualitative readiness, when the paygrade matches differ by more than one. Experience matters in the occupational specialties, but it is an assumed risk, when they are close to manpower requirements. This is why a difference in one paygrade is only partially penalized, but as the difference becomes greater, the penalty becomes too high; as skills and experience are lost. This is a prominent issue when going 'up' paygrades for support, and less of one when going 'down' paygrades for the necessary experience to fill the job. However, going down paygrades must still receive a penalty; as it may force a senior member to work under a more junior member, which is detrimental to efficiency in the workplace.

Security clearances are considered a 'bonus' to the monetized benefits. This assumes that civilian equivalents do not have a clearance that SELRES members do. This added 'benefit' is based on the 2021 costs for background investigations of the various clearance levels. As such, it is 'added' to the monetized benefits.

Please reference below equation that accounts for 'added' bonus of security clearance levels to the monetized benefits.

$$\Big(\Big(\big((Std\ Mil\ Pay - Avg\ Equiv\ Civ\ Pay) \div 365\big) \times 30\Big) + Sec.Clear.Cost\Big) \times 1.2$$

D. THE (OPTIMIZATION) SOLUTION

1. Two-Sided Billet-Matching Matrices Development

Two-sided billet-matching for this research is based on a smaller scale version of Paul Robards' two-sided matching theory. In this case, it is only between the members and the billets, instead of between members and commands. Doing it this way, works around the deficiencies noted in his study and provides and objective 'stabilizing' agent to make it work more efficiently.

The monetized benefits matrix was developed by generating four sub-matrices of equal dimensions, based on the sample community: Information Professionals (IP). Each matrix aligned personnel in the columns, with billet-specific requirements in the rows. The first three sub-matrices were based on paygrade, community specialty, and location matches. The paygrade sub-matrix compared personnel paygrades to billet required paygrades. The location match sub-matrix compared where the personnel originated to where the billet resided. The community specialty sub-matrix contrasted the personnel designator to the billet required designator. Sub-matrices were aligned in the same order, for consistency in monetization across all cells. Cells of intersection within these sub-matrices, corresponded to the possible personnel to billet combination. Each sub-matrix was then monetized. These used the standardized benefits determined as the difference in SELRES pay scales to their equivalent civilians over the standardized work days required by instruction. Then, each sub-matrix correlated their scaled values, as described in the last section, to ascertain how much of the benefit was sustained or reduced in each possible combination.

Upon completion of this step, these three matrices were then averaged in each cell of personnel-to-billet combination. These averages then added the 'additional' benefit of the security clearance, as determined by the cost for their respective background investigations. Thus, a monetized benefit matrix was crafted, which annotated each possible personnel-billet combination and their associated benefit. At this point, the 20 percent 'inflation' of monetary benefits was calculated to the final matrix of all possible personnel-billet combinations.

The monetary cost matrix was more straightforward. This involved three sub-matrices in its development. First, a sub-matrix was crafted based on per diems and nightly lodging costs associated with the zip codes of the billets. Each cell was a combination between the personnel's local command and the billet's operational command. If these were the same, the member was local, and became zero cost to the government. The same was done for rental car costs. If local command and operational command were the same, there was no cost to the government. But the rental car costs were annotated as the national average based on the locale of the billet for accuracy. In order to calculate the airfare and

mileage reimbursements as costs to the government, each personnel's home zip code was correlated to their potential billet zip codes. Again, if their local and operational commands were the same, there was no reimbursement or airfare costs. Where they were not the same, a $0.20 per flight mile (as the crow flies) was applied for distances over 200 miles; and a $0.65 per drive mile was applied for distances less than 200 miles.

These three matrices were then added together for cumulative cost based on all possible personnel-billet combinations in the cost matrix. Thus, the research established a monetized benefits matrix and a monetary cost matrix for comparisons as each corresponding cell were based on the same possible combinations. This research was then able to accurately 'subtract' the costs of each combination from the benefits of each combination. Ratios of dollars spent to the benefits of each combination was considered, but simple subtraction made the most sense for accurate analysis. Each personnel to billet combination now had a cumulative effect of cost efficiency associated with them.

2. Optimized Personnel-Billet Matching

In order to 'optimize' the possible personnel-billet matches, this research took the above two final matrices, and created a new Cost-Benefit matrix. It reflected the remaining 'benefit' dollars, after accounting for all possible costs associated with each possible combination. Then a linear program was run in Microsoft Excel as an 'assignment' problem, which also used MATLAB for multivariable analysis. This 'assignment' problem was designed to ensure only one person filled each possible billet, based on their remaining benefit dollars, but to 'maximize' benefit dollars.

A few constraints were added to ensure that senior officers were not assigned to junior positions and vice-versa. This required constraints to 'group' possible matches together, with senior officer matches, mid-grade officer matches, and junior officer matches. This minimized gross paygrade mismatches, shortened distances between matches, yet sustained warfighting readiness, based on the qualitative scaled criteria. The end result showed the necessary personnel-billet match combinations that maximize usage of 'cost' dollars to sustain the 'benefits', compared to civilian alternatives providing the

work. Please see Chapter IV for a 'proof' of concept as a prototype illustration of these matrices, and their useful applicability.

The above matrices development is illustrated in Appendix A. Future researchers may reference this Appendix for their own optimization matrices for other communities, in both the AC and the RC.

3. Limitations and Assumptions

This research assumes voluntary participation of SELRES members and many will accept 'non-desired' billets during their service. It assumes that possible matches exist to fill all billets while also accounting for unavailable 'frozen' billets. This thesis assumes that optimization is possible within each community of SELRES members, so as to collectively 'build the whole' for optimized matching. Also, this study assumes that location, community, and paygrade matches are reasonable proxies for warfighting readiness. Finally, this research assumes that costs for security clearances are a 'benefit;' but only when compared to equivalent civilians who do not have one.

'Bleed over' of personnel filling billets across communities is a limitation impacting usability. Optimal billet matching may only be feasible in managed communities; as was the case for the Information Professional specialty. In concept, optimal billet matching matrices can be applied on smaller scales, across communities. But it may require more 'manipulation' to ensure feasibility is sustained across specialties with varying guidance. There is some judgement necessary when 'aligning' Reserve Personnel Codes with designators and enlisted ratings. Joint commands can alter the 'clear-cut' designator cut-offs. This research also cannot account for 'local' SELRES members who are reimbursed mileage when supporting their local command, if they live outside 50 miles from their local command. On normal drill weekends, these local sailors are furnished with lodging if they reside outside the 50-mile radius of the command address.

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IV. ANALYSIS OF THE 'OPTIMIZED' PROGRAM

This chapter provides the results from qualitative and economic analysis across the defined cost and benefit parameters. It also fills in the gaps from previous literature in Chapter II, and illustrates the methodology described in Chapter III. This chapter provides a narration of the big picture problem, illustrates the need for optimization, demonstrates the effectiveness of the prototype on a single subset of SELRES officers, and describes its applicability across the SELRES. The prototype validated here finds optimal personnel-billet matches for one community. But it may be applied across the SELRES, while also permitting experts in those fields to alter the qualitative matching criteria specific to their needs. Importantly, this chapter illustrates how to maximize the cost effective use of the Reserve labor supply. All results demonstrated here answer the research questions of this study; and are paired with policy recommendations in Chapter V for further discussion. This will, in turn, offer decision makers cost efficient means of sustaining strategic warfighting readiness.

A. THE (COSTLY) BIG PICTURE PROBLEM

This thesis sought cost effective means to sustain warfighting readiness, by getting the right people with the right skills and experience to the right command, at the right time. But it started with a big picture view, prior to focusing on the appropriate elements for optimization. This is necessary to ascertain adequate measures that may be applied across the entire SELRES.

1. The 50,000 Foot View: (Travelling) Across the Nation

Initial review of the descriptive data showed that more than half of all SELRES are cross-assigned, illustrating a costly 'big picture' problem. Refer to Table 3 for the big picture breakdown of available personnel and billets within the SELRES community.

Table 3. SELRES Cross-Assignments in the Data. Adapted from Commander, Navy Reserve Force Command (2022a).

Total SELRES:		48,166		
Non-Fill Totals:		9,820	"Froze" Billets:	3,766
Portion:	*20.39%*		True Gap Billets:	6,054
Filled Billets:		38,346	Available	
Portion:	*79.61%*			
Cross-Assigned		21,114		**55.06%**
	Officers:	7,080	10,721	*66.04%*
	Enlisted:	14,034	27,625	*50.80%*

Notes: Static snapshot from December, 2022.

As per Table 3, one-fifth of SELRES were not filling any billet. But, of the more than 38,000 SELRES currently filling a billet, about 55% of them were doing so under a cross-assigned status. Although a smaller subset of the data, officers are the driving factor behind proportional cross-assignment; with nearly two-thirds of SELRES officers travelling no less than five times per year for operational training and support. Note that "froze" billets are billets not available for assignment; as the previous holder is recalled or mobilized to active duty. Thus, the personnel no longer reflect on reserve manning documents, but the billet is still considered 'unfilled.'

To narrow the scope for optimization, this research focused only on the available personnel and available billets with which to pair them. There are currently over 38,000 combinations; and more than 6,000 billets remain unfilled, excluding the 'frozen' billets. Just based upon the minimum training requirements, more than 21,000 of these personnel-billet combinations charge the Navy over 105,000 round trip travel costs each fiscal year. This is a clear indicator for the need of optimization. Based on conservative travel cost averages across both officers and enlisted members, these 105,000 round trips cost the government in excess of $150 Million each fiscal year. This 50,000-foot view provides the necessary view for the Navy Reserves to remain good stewards of the budget and fiscal

resources they possess. But first, this research narrows the scope and focuses on officers, as a test run for further analysis.

2. The 40,000 Foot View: Officers Drive Up Costs

Because officers are, proportionally, the driving factor behind cross-assignments, this research focused on them. This found the 'biggest offenders,' who were driving up transportation costs. See Table 4 for listing of SELRES officer communities most frequently travelling for operational support.

Table 4. Community Officers on the Move: Cross-Assignments. Adapted from Commander, Navy Reserve Force Command (2022a).

	Cross-Assignment Sample		
	Total **Officers**: 10,721	Total **Enlisted**: 27,625	
Cross-Assign Proportion	**66.04%**	**50.80%**	
Designators	*Officer Designator Cross-Assign Proportions*		
13XX	Aviation	1,508 / 1,730	87.17%
18XX	Info War Comm	1,540 / 1,861	82.75%
11XX	Surf / Sub / SOF	1,565/ 2,034	76.94%
31XX	Supply Corps	475 / 647	73.42%
15XX	Aerospace Engineer	149 / 207	71.98%
16XX	Strategic Sealift	296 / 446	66.37%
12XX	Human Resource	87 / 145	60.00%

Notes: 11XX (Surf/Sub/SOF) is Surface, Subsurface and Special Operations Forces. All Designators refer solely to Officers within the data, but does not show all communities.

As illustrated in Table 4, the unrestricted line warfare communities of surface, subsurface, aviation and special warfare have high a propensity for cross-assignments. These communities of officers are authorized to fill each other's billets, as they are considered general warfare communities. So, it's not overly surprising to see ample cross-assignments. However, they may be optimized, to sustain the 'right' levels of cross-assignments to critical commands for program cost efficiency.

The notable surprise was that a managed restricted line warfare community like the Information Warfare Community (18XX) has such a high volume of cross-assignment. This community fills more specialized billets across domains, including both joint and integrated warfare commands. Yet, as a managed community, they may only fill Information Warfare billets; unlike their unrestricted line counterparts. As such, there must be other factors driving their cross-assignment. Thus, they must be filling billets for each other across their subsets of Oceanography, Cyber Warfare, Intelligence, Information Professional (IP), Maritime Space and Cryptologic Warfare officers. However, this is counterintuitive. Each of their community managers and instructions dictate they remain within their specialties, except for (rare) extenuating circumstances.

This 40,000-foot view instigated further focus and narrowing of the study for the ideal community, upon which to predicate the prototype of 'optimization.' The added focus ideally minimizes the 'bleed over' of inter-community billet-fills. Doing so provides an accurate picture, in order to adequately apply the optimization prototype, for reduced costs that qualitatively sustains warfighting readiness. This research analyzed regional locales for information of other correlated factors that drive their cross-assignments.

3. The 30,000 Foot View: Crossing State Lines

Looking more closely on members across communities in the SELRES, the regional analysis highlighted problems that necessitate optimization. This was important when associating the standardized minimum costs to transport them across both state and regional lines. A closer inspection of a sampling of the data descriptively displayed some states with Cross-Assigned In and Cross-Assigned Out reservists, including discrepancies

between available billets and members to fill them. See Table 5 for reference. Note that this is only a sample, and is not exhaustive of all states in the data.

Table 5. Crossing State Lines: Personnel Cross-Assignments. Adapted from Commander, Navy Reserve Force Command (2022a).

Cross-Assignments by State					
State	Personnel Available	Billets Available	Difference (Bills > Pers)	Billet-Fills from Out of State	Personnel Leaving State
California	5,153	8,767	3,614	6.1%	3.5%
Florida	3,669	3,580	-89	12.4%	7.9%
Maryland	1,364	3,301	1,937	15.8%	28.2%
Texas	3,882	2,970	-912	12.4%	14.3%
Virginia	3,536	4,742	1,206	11.5%	7.0%
Washington	1,341	1,669	328	38.3%	35.9%

Processed in Python and formatted in Microsoft Excel.

As seen in Table 5, large portions of SELRES personnel living in Maryland, Texas and Washington are cross-assigned outside their home states. Furthermore, states with fleet concentration areas including California, Florida, Maryland and Virginia have notable proportions of their billets filled by out of state members. The data presents an interesting distribution of cross-assigned reservists. This illuminates an issue for further analysis.

Now, there are large states, which may 'cross-assign' members within their states, due to lengthy distances between commands. This assuredly occurs, and does not directly imply that all their cross-assignees are departing their home states. However, Maryland, and Washington average over 1,000 more billets than available members to fill them. Although to a lesser degree, states with fleet concentration areas such as California and Virginia suffer from the same problem. They have plenty of available billets to fill, but are sending ample numbers of their in-state residents elsewhere, at a cost to the Navy. So, why would so many reservists leave their home states when there are more than enough billets

to fill? The data shows a discrepancy that directly affects the cost effective usage of the SELRES labor supply. This issue, presented by the descriptive statistics from the data, provided further impetus for analysis.

These descriptive baseline snapshots of cross-assignments showed where to target for billet assignment optimization. It highlighted subsets with high volume cross-assignments that focused this study; but also areas that are sending their own members away, while bringing out of state reservists to support. All of this comes at an increase travel cost to the Navy. But this requires a smaller scale effort to demonstrate how cost effectiveness may be optimized; which sustains readiness, but also drives downs costs, so each dollar spent maximizes the output.

B. THE 'OPTIMIZATION' PROTOTYPE IN ACTION

A small scale effort on a managed officer community demonstrates the necessary targeted approach. This can collectively 'build the whole' across the SELRES, for increased cost efficiency. The target community for prototype demonstration is the IP community of officers. It is managed, which means the 'bleed over' of inter-community billet-fills is minimized. This permits an enhanced focus on the qualitative matching processes, which then illustrates the maximized benefits of using SELRES officers, compared to their civilian equivalents. But more importantly, it uncovers where the changes must be made to reduce costs, without sacrificing any warfighting readiness.

1. The 20,000 Foot View: Testing the Prototype

The SELRES IP officer community currently has 189 officers filling 189 billets, across multiple commands. It has a reasonable distribution of senior, mid-grade and junior officers. This is because the SELRES tends to be 'top-heavy' with more service-members at higher paygrades across both officers and enlisted. This sample distribution contained 9 senior paygrades (O-6), 108 mid-grade officers (O-5 and O-4 paygrades), and 72 junior officers (O-1, O-2 and O-3 paygrades). These distributions were weighted proportionally within the sample, and compared to equivalently weighted civilian counterparts for comparison of benefits.

As a managed community, none of the officers in this sample fill billets outside their designators (1825), nor do any non-IP officers fill 1825 billets. This made it the ideal community to test the optimization matrices prototype, yet it may still illustrate the benefits of using this prototype across other 'less ideal' communities. The big picture comparisons described in Chapter III established that all benefits are compared to equivalent civilians. This prototype looks internally, so as to find optimal matches among paygrades, communities and locations. Although many of the senior officers filled 10XX billets, these are considered community matches because those 10XX billets were all Commanding Officer billets, fillable by any fully warfare-qualified senior officer.

IPs are the cyberspace operations and communications officers for the Navy. Their expertise lies in managing computer systems, networks, cyberspace and communications. As such, their civilian equivalents are in the information technology fields. The Bureau of Labor Statistics (2022) and civilian reporting agencies including Payscale (2023), provided their average salaries across occupations within the information technology areas of expertise, for adequate comparisons of monetized benefits.

In order to sustain consistency across monetized value comparisons, the weighted 'pays' of each were taken into consideration. Senior IP officers fill leadership positions in reserve units. As such, they were weighted against civilian senior software engineers, information technology directors and solutions architects. Mid-grade officers were then compared to software engineers, information technology managers and project managers. Junior officers were compared to systems administrators, software developers, network engineers and data analysts. These approximate comparisons maintained consistency for similar jobs they perform in their respective fields of work. Thus, there is precision in monetizing the benefits of using SELRES officers over the standardized fiscal year work days; rather than outsourcing to civilians who reside near the SELRES billet locations.

After weighting the distribution of sample officers, then standardizing their daily pay rates for each fiscal year of required work; these were compared to the same weighting of average salaries across their civilian counterparts, near billet locations. The research found that the Navy pays $1,289 more to its SELRES IP officers than it would to equivalent civilians, for the fiscal year work requirements. Thus, the 'benefit' of using SELRES

officers, rather than outsourcing, is $1,289 per member over the course of minimum fiscal year requirements.

After scaling internally for paygrade, location, community and clearance matches, while acknowledging the security clearance is an 'added' bonus since civilians may likely not have one; a perfect local match sustains a $7,988 'benefit.' When inflated for return on investment, as per the literature, that same perfect local match sustains a $9,584 'benefit' to the Navy throughout the minimum fiscal year work requirements; when compared to civilian alternatives. Any deviation from a perfect match diminishes that sustained benefit.

Paygrade and location mismatches were more pertinent in this particular sample. This is because all SELRES officers were insulated within the IP community for billet matches, and every IP officer has a minimum top secret clearance, with eligibility for secure compartmented information access. If this prototype is applied to other communities with more variance in community matches and security clearances; it will notably change the sustained monetized benefit value for the possible personnel-billet combinations.

After each possible personnel-billet combination was established with a sustained benefit remaining, the optimization algorithm was run against all possible cost combinations. This algorithm used the linear programming function (assignment problem) in Microsoft Excel Solver, with assistance from the MATLAB software to maximize the sustained benefits. Running the 'assignment problem' with a few constraints to minimize extraneous paygrade matches, the optimization altered the personnel-billet assignments to maximize the monetary return. Refer to Table 6 for the results, as well as a comparison to current personnel-billet combinations.

Table 6. The Benefits of 'Assignment' Optimization. Adapted from Commander, Navy Reserve Force Command (2022a and 2022b).

Cost Efficiency in Personnel-Billet Combinations				
	Current Combinations	*Optimized Combinations*	*Change(s)*	*Proportional Change*
Benefits	$ 1,790,492	$ 1,792,399	$ 1,907	0.11%
Costs	$ 213,395	$ 135,990	$ (77,406)	**-36.27%**
Net Benefit	$ 1,577,097	$ 1,656,409	$ 79,313	**5.03%**

Value/Cost indicates the total 'benefit' dollars for each dollar spent to transport the member.

As per Table 6, the current combinations of all 189 personnel-billet matches sustain a monetized benefit of $1.79 million, but must pay more than $200,000 to transport them from their homes of record to their billet locations. These costs account for those who may live close enough to drive, if they live within 200 miles of their billet location for support. However, for distances greater than 200 miles, it is assumed that they fly and must use a rental car once in the locale of their billet. This also accounts for the per diem and lodging available in each specific zip code of billet location.

In contrast, the optimized personnel-billet combinations, based on the qualitative paygrade and location matches, sustains roughly the same level of benefits. However, when optimized, the cost to transport them decreases by more than 36 percent! This illustrates that the same benefits may be sustained across the sample, but for 36 percent less in costs. When extrapolated across the SELRES, that 36 percent reduction correlates to about a $54 million decrease in costs!

In addition, it is possible to increase the net benefits between billet assignments and the necessary costs, by a healthy 5 percent. Thus, this indicates that it is possible to sustain the necessary qualitative measures of strategic warfighting readiness, with notably higher

cost efficiency, under a specified budget. The next section delineates the specific qualitative improvements made possible by this prototypical optimization process.

2. The 10,000 Foot View: The Prototype Delivers Quality

This prototype, consisting of a series of matrices that feed multiple streams of qualitative data, is helpful in getting the matches closer to ideal assignments. Because this is a mixed method study, it is important to ensure that not only costs decrease, but that warfighting readiness is not sacrificed in the process. As such, paygrade matches are indicative of capability within each community or specialty. Getting those closer to perfect matches sustains the necessary skills and experience for effective job execution. Location matches reduce administrative workloads that detract from operational sustainment.

Both paygrade and location matches are critical to ensure that SELRES members are ready and able for timely availability to all AC requirements. This is especially true, given the nature of the Navy's global mission, and the reserves' directive to supplement the AC in wartime support. Imperatively, this has strategic implications. When reservists are recalled to support AC initiatives, there is a reasonable expectation of at least 75 percent efficiency for the 24/7 workloads that emerging conflicts necessitate of our manpower. That can then be pushed up to 100 percent efficiency after a brief time table of training, while in route to their designated locations of support.

Now this is the first foray into optimizing the assignment process, but it is flexible enough to accommodate other communities' needs and requirements. However, in this alpha-test, there was a notable uptick in qualitative matches. Refer to Table 7 for the results of the optimization in comparison to the current personnel-billet combinations.

Table 7. Optimized Assignments, Paygrades and Distances. Adapted from Commander, Navy Reserve Force Command (2022a and 2022b).

Qualitiative Efficiency			
	Current Combinations	*Optimized Combinations*	*Proportional Change*
Local Fills	72.5%	74.1%	2.2%
Cross-Assigned	27.5%	25.9%	**-5.8%**
Paygrade Match	66.7%	69.3%	**4.0%**
≤ 1 Paygrade Different	95.8%	97.9%	2.2%
≥ 2 Paygrade Different	4.2%	2.1%	-50.0%
Miles Travelled	117,934	110,977	**-5.9%**

Proportional changes: between current and optimized percentages, not percentage point differential

As Table 7 indicates, the optimized personnel-billet combinations decreases the sample's cross-assignment rate by nearly 6 percent. This is good, as it not only decreases the costs incurred by the government in travel costs, but also indicates that more personnel live near their billets. Thus, it shortens the time necessary for reservists to be ready for recall to the AC. This is indicated by the 5.9 percent reduction in total miles necessary for reservists to travel for operational support. The Navy currently does a good job getting reasonable paygrade matches, within no more than one paygrade difference, as dictated by instruction. But, the optimization brings it closer to qualitative matches. While the increases are 'on the margins,' it notably brings the SELRES closer to filling the necessary qualitative aspects necessary, for providing rapid and effective support to the AC.

It is important to note here that, due to the 'top heavy' nature of the SELRES, there are more mid-grade billets available than there are mid-grade officers. Furthermore, there are more junior officer personnel (O-1 and O-2) than there are junior officer billets available. As such, there is a required 'up-fill;' where an O-1 or O-2 fills an O-3 or O-4 billet. Thus, there will be 'some' differences of two (2) paygrades. The idea of this optimization is to minimize that, by eliminating the need for 'more than one' paygrade differences at O-3 and above, where the majority of billets reside.

This optimization relegated those with a 'more than one' paygrade difference to the O-1s and O-2s filling O-3 and O-4 billets. Hence, the uptick in paygrade matches, for both perfect matches AND those within one paygrade difference. But all 'more than one' paygrade differences in the optimized sample, are now just the most junior officers filling O-3 and O-4 billets. This is indicated by the 50 percent reduction in 'more than one' paygrade differences; and brings the matches in closer alignment with current instruction.

It is important to note that the optimization did not alter assignments within the same states. All combination changes occurred among members coming from other states. Cross-assignments decreased, and paygrade matches increased, but location matches were only inter-state related; with no intra-state match changes. Some billet changes occurred within the same unit to facilitate those cross-assignment changes. But, this just corrected some of the 'oddities' in assignments; likely stemming from when SELRES members become available, as seen in Chapter II. Refer to Figure 1 to see some changes in the mid-grade officer assignments that were incurred by the optimization.

Optimized' PERS-Billet Assignments

						All PYGD Numbers are for Officers			
						Unchanged		Current	New Billet
BIN	BIN (No.)	New BIN (No.)	billet.LvC	New billet.LvC	Change (LvC)?	RANK	P.PYGD	B.PYGD	New B.PYGD
0001874	9	9	L	L	0	CAPT	6	5	5
3626429	10	10	L	L	0	CDR	5	5	5
3597327	11	11	L	L	0	CDR	5	5	5
3591967	12	12	L	L	0	CDR	5	5	5
3483465	13	13	L	L	0	CDR	5	5	5
3474435	14	14	L	L	0	CDR	5	5	5
3369610	15	50	L	L	0	CDR	5	5	4
3352611	16	36	C	C	0	CDR	5	5	5
3352561	17	16	L	L	0	CDR	5	5	5
3339876	18	39	C	C	0	CDR	5	4	5
3326888	19	137	L	L	0	CDR	5	3	4
3040148	20	20	L	L	0	CDR	5	4	4
3022822	21	21	L	L	0	CDR	5	5	5

Note: P.PYGD is the member's. B.PYGD is the billet required paygrade. New B.PYGD is their new billet requirement. Red numbers are a difference. Visual above is manipulated data that was analyzed for this original creation of a Figure.

Figure 1. Billet (Paygrade) Assignment Changes. Adapted from Commander, Navy Reserve Force Command (2022a and 2022b).

As seen in Figure 1, billet 19 (of the sample) initially had an O-5 filling an O-3 billet. But through optimization, this member was reassigned to an O-4 billet, thus increasing the qualitative match. This occurred while other O-5's were reassigned to O-5 billets, even though they already filled O-5 billets. Many of these occurred within the same units, so as to facilitate other cross-assignees becoming local. But, the matches increased the sustained value, as their skills and experience were now more commensurate with billet requirements; making them more prepared for AC support via recall or mobilization.

C. FINDINGS AND FILLING THE GAPS

Over all, the prototype performed well, within the small sample of 189 officers who filled 189 billets. This research used a mixed method approach for analysis; merging qualitative values with monetary costs. Because this is based on strong assumptions with speculative benefits, this is not an absolute, or a guarantee of what is a benefit. However, the prototype does illustrate the ability to reduce costs, while sustaining qualitative benefits of some kind. There may be other 'benefit' parameters not included nor considered. But, this prototype does establish the baseline regarding what can sustain those qualitative measures at a reduced price tag. The travel costs are standardized to the minimum travel requirements; so the cost savings do not account for SELRES members who perform more than the minimum required training support. As such, the savings should be viewed proportionally, and as starting point that can only increase cost reductions. As previously noted, if this sample may be extrapolated across the entire SELRES, similar levels of warfighting readiness may be sustained for $54 million less each fiscal year.

1. Findings Tied to the Research Questions

The sample optimization does, however, provide some answers to the research questions. These findings will be paired with more detailed policy recommendations (answering the fourth research question) in Chapter V. The following section provides brief answers to the first three questions.

(1) How cost effective is the cross-assignment program in providing personnel with the necessary skills to the appropriate command at the right time for warfighting readiness?

This study found that the cross-assignment program is somewhat cost effective in getting the right personnel to the appropriate command at the right time. But, there is clearly room for improvement. Because there were no intra-state billet changes, but there were inter-state billet changes, this indicates that the system is reasonable within state boundaries, but lacks in filling billets across state lines. This is a critical piece that drives up travel costs as airfare is assuredly included. However, this may be due to the timing of SELRES availability when they enter the reserves, and are eligible for billet assignment.

Considering the current paygrade and location matches, the Reserves is more than adequate in sustaining warfighting readiness. It can be just a 'bit' better on the margins. This process must be expanded upon, account for the specific needs across different communities, and requires further testing in different samples. This should be done, because the SELRES IP community may be the outlier in terms of both qualitative assignments and travel costs.

(2) Which individual, regional and warfare community demographics are most apt for cross-assignment; and which are most necessary to be cross-assigned?

This research also provided hard evidence to answer the second research question. The warfighting communities, especially the unrestricted line, are extremely apt for cross-assignment. This may stem from the same billet assignment process issues described earlier. But, the discrepancy, in billets available and personnel available in the states, indicates that many are leaving their home states. Because some states have more billets available than available personnel, this highlights a need for further analysis. However, because no personally identifiable information specific to the personnel was provided in the data, other than their billet assignments, this research was unable to further discern more.

But it readily appears that the most necessary cross-assignments reside in the unrestricted (general) warfare communities. This is indicated by policy, which permits

aviators, subsurface, surface and special operations forces to fill each other's billets regularly. But there is clearly room for 'optimization;' even with their different paradigms of operation.

(3) What inefficiencies exist within the billet assignment process, thus affecting the cross-assignments of personnel and their associated travel costs across fleet concentration areas?

There are 'some' inefficiencies in the billet assignment process, with limited policy change options. Because a cross-assigned sailor must proactively pursue conversations with their local and cross-assigned chains of command, it is rather difficult to force 'billet swaps,' without the member initiating the process. Under this instructional paradigm, the member is not incentivized to do so, without extenuating personal circumstances forcing it. This is because the members are able to capitalize on the personally lucrative travel pays associated with travel, assuming their civilian lives permit regular travel.

Ideally, this occurs within 6 months of assignment; while there is still plenty of time for their acquisition and acclimation to their new billet. However, to make this more feasible, there must be an option to extend billet tour lengths for sustained mobilization readiness. This aligns with Battle Orders 2032, promulgated by Commander, Navy Reserve Force (CNRF), to decrease administrative inefficiencies of cross-assignees, and to lean into the future by achieving efficiencies of scale with budgetary responsibility (CNRF, 2022). However, it is apparent that the current two-year billet assignments for cross-assignees is not adequate. At a minimum, they should be extended to at least three years, to mimic their locally-assigned counterparts.

Holistically, this prototype was based on a localized 'two million-dollar problem,' but can be applied to the 'one hundred fifty million-dollar problem.' Doing so must consider extending tour lengths, so as to sustain these cost efficient methods. This will also permit discount rate calculations for extended benefits, even if the benefit parameters incorporate different assumptions. Furthermore, the current prototype, through additional testing, must be conducted no less frequently than every other year. This must be done to account for the rotating nature of billet changes, especially in the current two-year billet assignment requirement for all cross-assigned sailors under current instruction.

All qualitative and economic findings incorporated extrapolated costs and standardized pays. This combination shapes the prescriptive recommendations for program refinement seen in Chapter V. It is clear that the current process does 'well enough,' but may clearly become better stewards of its delineated budgetary restraints. Strategic warfighting readiness can be sustained, but it may be done at a lower cost.

2. Filling the Gaps in Literature

This research, through the sample optimization, filled in a few gaps of the existing literature. These gaps span budgetary efficiency, structural management, available manpower, quantifiable measures of warfighting readiness, and optimal billet matching. Filling these gaps must align with current instructions, or include recommendations for potential policy updates, as seen in Chapter V.

Edward Zawislak (2000), Guy Leary (1987), and the Congressional Budget Office (2006), illustrated the increased usage of the RC over time. This research speaks directly to that fact. The optimization prototype, produced here, provides a means to make the SELRES more cost efficient; especially as the AC increasingly relies upon the RC for operational support. As Zawislak (2000) noted, the current budgetary structure consists of claimants who buy programs, and their associated capabilities. The SELRES cross-assignment program does not fall under such a paradigm, but the cross-assignment process does provide associated capabilities with the available RC labor supply. Leary (1987) ascertained that the RC receives a 'fair share' of the overall DON budget. But in this research, the cross-assignment process must be more cost efficient with their use of that 'fair share' of dollars that are allocated to them from the DON's budget for reserve usage. In this case, this research fills that gap of cost efficiency, under a designated budget which is shared under the DON writ-large.

Bailey (1975), Rohn et al. (2019), Punaro (2014 & 2020), and the Chief of Naval Operations (2022), all acknowledged the integrated nature of the RC to AC initiatives, under a Total Force Policy. They illustrated inefficient management structures, and the need to increase readiness across the training continuum, for the available RC manpower. This research demonstrates the qualitative nature of optimized matches, which will enable

thorough training, but without undue costs for sustainment. The optimization prototype shown here requires integrated RC and AC leadership, because RC billets fill known gaps in AC capabilities. By increasing those qualitative matches, warfighting readiness is sustained for the available RC manpower; thus filling these known gaps in the literature.

More importantly, they may be sustained with timely availability of SELRES sailors who are now in closer proximity to their billets. This minimizes the logistical travel time to bring them to the forefront of the Navy's global mission. Furthermore, due to undue administrative management burdens, required general trainings may be completed locally. This will then increase the operational focus of each member at their operational units, yet remain aligned with the Chief of Naval Operations' (2022) training directive. This study also found a means to increase RC budget savings, and an increased efficiency in RC manpower usage; which enhances operational effectiveness. These findings answer the recommendations from Punaro (2014 & 2020).

Richard Mazza (1992) and Paul Robards (2001) called for quantifiable measures of warfighting readiness, and simulations of billet matching that could minimize 'gaming' of the matching system. This study heavily emphasizes these components in the literature, but also fills some of their gaps. This research determines measures of strategic warfighting readiness with qualitative solutions. Paygrade, community, location and security clearance matches are indicative of the qualitative values necessary to sustain warfighting readiness. While these particular values are more pertinent to the sample optimization, they may be readily modified, or added to, when applied to other SELRES communities. Thus, this research directly speaks to the gap identified by Mazza (1992).

This research also affirms Mazza's (1992) assertion that population growth rates across locales do not directly translate to available manpower within the RC labor supply. However, this research equally suffers from a lack of demographic information concerning personnel, other than their billet assignments. Thus, this study could not fill that known gap without personally identifiable information regarding the personnel; which was denied by the source of data. However, this study addresses Robards' (2001) recommendation to simulate billet matching options, so as to mitigate much of the 'gaming' that plagued his research with two-sided billet matching. By monetizing the benefits of using SELRES

sailors to fulfill their instructionally required training, and running the optimization program, the new assignments removed possible 'gaming' of the system, with direct matches that benefit the Navy. Thus, this study fills that gap for optimized cost efficiency in billet assignments across the SELRES, based on this sample optimization.

Filling the above gaps noted in the literature satisfies some of the needs for future researchers to build upon. More than that, this study also illustrates means to increase cost efficiency, even if some benefit parameters are tailored to the needs of other SELRES communities. Refer to Appendix A for instructional visuals of how these parameters may be modified. This study addresses some of these gaps, while also acknowledging some of the same deficiencies that preclude more thorough analysis. But it does provide enough for some prescriptive recommendations in Chapter V. Most importantly, this research does so while aligned with current instructions in the Reserve Personnel Manual, among other manpower guidance documents. This demonstrated prototype provides the baseline for enhancements of the SELRES community that will sustain strategic warfighting readiness; but cost efficiently, under a strict budget.

V. CONCLUSION AND RECOMMENDATIONS

This final chapter encapsulates the big picture of findings and implications of the optimization prototype for personnel-billet matching. It further ties them to the strategic vision of current instruction and RC leadership. This chapter also pairs the results of analysis in Chapter IV with policy recommendations for consideration by those same senior decision makers. It notes the deficiencies in the study, while amplifying the answers to the questions posed by this research. This chapter also makes recommendations for future studies, based on the output demonstrated by the optimization prototype illustrated in this research.

A. TRANSFORMATION THROUGH 'OPTIMIZATION'

The Navy Reserves are enduring a renovation period. This calls for new means of achieving desired end-states, as determined by leadership, and dictated by world events.

1. Strategic Warfighting Readiness: A Manpower Problem

The RC must remain flexible and agile, so as to provide rapid response support to AC initiatives and evolving mission sets. These ideas center on preparation to face current challenges, and providing focus to conflicts on the horizon. Optimization of current resources, and cost efficient methods of execution, are paramount to sustain strategic warfighting readiness.

> We are transforming obsolete elements of our force structure from a post-9/11 response force to deliver relevancy in an era characterized by strategic competition. The decisions we make this decade, and the actions we implement, will determine the Navy Reserve's relevancy for the balance of this century…we measure and define warfighting readiness through two complementary components: billet-specific mission readiness and mobilization readiness. (Commander, Navy Reserve Force (CNRF), 2022)

Battle Orders 2032, released in December of 2022, articulate a clear vision that focuses on strategic warfighting readiness. This readiness emphasizes quantifiable measures of success, or achievement of that readiness. Mobilization readiness is based on training and administration of the reservists themselves. However, this research directly

supports the billet-specific mission readiness; which sustains RC lethality when supporting AC operations.

As Commander, Navy Reserve Force articulated in the Navy Reserve Fighting Instructions, all lines of effort are directed towards the objective of strategic warfighting readiness (CNRF, 2022). The strategic component stems from the ability of SELRES to mobilize in less than 30 days, in response to emerging threats across the globe. As illustrated in Chapter II and Chapter IV of this study, strategic readiness is predicated upon the timely availability of reservists to support. Billet-specific readiness, with swift mobilization of the sailors filling them, enhances that strategic capability. This study provides cost efficient means of sustaining that readiness, with SELRES members now closer to their operational support units; thus making them available for quicker recall.

In order to sustain billet-specific readiness, there must be higher fidelity to billet requirements. These include items such as Navy Enlisted Classifications, Navy Officer Billet Classifications, Additional Qualification Designations and other secondary qualifiers for SELRES personnel. This necessitates a clearer system of preferences versus requirements from the supported commands, during the assignment process. Subsequently, this dictates levels of billet-specific readiness of the members filling them.

The prototype demonstrated in this study speaks (generally) to paygrade matches as indicative of qualitative experience and skills; and speaks to location matches as indicative of levels of administrative burdens that detract from operational support. Community matches address fields of specialty when supporting the AC, and clearance levels increase the accessibility for SELRES members to fully support AC initiatives. However, without more fidelity on other readiness factors that are needed to sustain billet-specific readiness, this prototype will remain just that: a prototype.

In this situation, non-manpower personnel are forced to resolve manpower problems, because each member must sustain various qualifications in their records. The optimization matrices demonstrated by the prototype only address the cost efficiency of certain types of combinations, predicated on these basic qualitative measures. Thus, strategic warfighting readiness remains a manpower problem.

2. Strategic Warfighting Readiness: A Manpower Solution

Manpower problems require manpower solutions. These affect the subsequent manning of the billets, under current manpower and manning instructions. As illustrated by the optimization prototype, there are clearly ways to sustain commensurate warfighting readiness at a reduced cost.

Modifying the qualifiers in the sample optimization will still reduce costs in some capacity. It is just a matter of what correlated factors are assumed to be incorporated in the methodology; but the framework is established. The precise reduction, conservatively, lies somewhere between 10 percent and the 36 percent cost reduction seen in the sample optimization. Why? Because more variables, restraints and constraints will only alter aspects of the optimization. The mechanics of how personnel-billet combinations are formed, are firmly established. The costs of transportation and sustainment are quantifiable; directly from standardized sources used by the government. The component that changes the most is the monetization of benefits, and to whom they are compared. But, all aspects of the optimization model are based on current instruction, and are aligned with the vision of current RC leadership. If the sample was an outlier, and the accurate cost reduction is only about 20 percent, then the extrapolated cost savings to the government across the SELRES, is more than $30 million each fiscal year.

The key is in the timing of availability. The Navy has a global mission, and RC readiness hinges on 24/7 wartime support availability. This requires a reasonable expectation that reservists, when mobilized, will arrive with 75 percent work efficiency; and may reasonably be brought up to 100 percent efficiency in short order. Initial analysis showed the preponderance of cross-assignments lay within the unrestricted line (general) warfare communities. But there is notable variability across the SELRES with personnel-billet combinations. As such, the various community managers may apply aspects, if not all of this optimization matrix, as the starting point to increase efficient personnel-billet matches across the force.

This optimization process is not a perfect solution, but it may springboard further refinement. This is because the benefits illustrated here are speculative, but initial results

show that increased cost efficiency is achievable. Regardless, the manpower problem is solvable with a manpower solution. The puzzle pieces are there, now it is just a matter of their alignment.

B. 'OPTIMIZED' RESOURCE MANAGEMENT

As seen in the 'big picture', this is a manpower problem, solvable by a manpower solution. This research has some limitations, but still answers the three critical questions to understand the current problem. It incorporates past knowledge in the literature, and presents realistic possibilities of cost efficient means to sustain the warfighting readiness of the reserve force. But, these possibilities come with reasonable recommendations. If even some of them come to fruition, the mission and vision of current RC leadership may be realized.

1. (Almost) The 'Right Stuff': Answering the Questions

(1) How cost effective is the cross-assignment program in providing personnel with the necessary skills to the appropriate command at the right time for warfighting readiness?

The cross-assignment program is cost effective in getting qualified personnel to the necessary commands, with only a few discrepancies. The timing, based on distance, in which they arrive, may be improved. This is indicated by the fact that there were no intra-state billet changes, but there were inter-state billet swaps. Thus, most assignments are reasonable. But, the system directly assigns across state lines frequently enough to drive up transportation costs, even if there are commensurate billets available closer to the member's home of record.

The current system may be stymied by the timings in which prospective SELRES members enter the force. This is understandable during the first billet assignment for a new SELRES member. But, during subsequent billet applications cycles, there should be prioritization of 'closer' billets. Current instruction mandates that local fills are preferred and should be filled first. But in application, it falters at the margins.

(2) Which individual, regional and warfare community demographics are most apt for cross-assignment; and which are most necessary to be cross-assigned?

The unrestricted line warfare communities are highly apt for cross-assignment, but this aided by the permissive use of assigning billets among them. But, it is clear that there are sub-optimal assignments in place; which do not correlate between the available billet and personnel within state borders for alignment. Without more demographic information specific to the personnel, this remains incompletely answered. However, there is room for improvement within these communities, to make them more cost efficient in supporting the stated vision of RC leadership. This will require further analysis in order to ascertain the accurate qualitative measures that sustain their warfighting readiness. However, the general warfare communities are clearly the most necessary to be cross-assigned. This is because their specific qualifications and skills are most pertinent in the global power competition with American near peers. Given the precariousness of limited resources, cost efficiency must be improved, even if only on the margins.

(3) What inefficiencies exist within the billet assignment process, thus affecting the cross-assignments of personnel and their associated travel costs across fleet concentration areas?

There are clearly inefficiencies in the billet assignment process, but they come with limited policy change options. Timing and availability are the driving factors in this case. In order to increase cost efficiency, mandated billet swaps must occur. However, this runs counter to current status, where the individual member initiates the process for billet transfer. The optimization prototype shows what *should* be done for efficiency, based on paygrades, locations and communities. But it still boils down to the member proactively engaging two chains of command for a billet change, thus altering what *can* be done.

Furthermore, the current lack of fidelity to billet requirement management makes optimal billet-matching more difficult. In order to improve this circumstance, manpower and manning must implement measures for what specific qualifications, skills and other pre-requisites are preferred versus required for optimal billet matching. This requires visibility in the system when the members, and respective detailers, are viewing available

billets; so they may ascertain what matches are prioritized, in alignment with the first question. Without this component—and based on what the prototype in this study illustrates—the remaining options for improvement are more limited. In addition, this is amplified by community managers who rely on the manpower documents, but often place members in a 'placeholder' status. For example, the 10XX community holds all fully warfare qualified officers across all officer communities. This is considered a general warfare grouping; but includes restricted line, or non-general warfare officers. This was seen in the example optimization of this study.

2. The 'Right Stuff': Recommendations to Policy

(1) Limit, in priority order, reserve members during the billet application cycles, to local fills, intra-state fills, followed by direct assignment to nearest billet. Qualitatively, job type – or specialty – should be the highest priority, followed by a paygrade – or experience – match.

Reasoning: The above lineup should be based on listed qualifications, experience and any other secondary information to enhance the matching process. Doing so ensures higher cost efficiency, while sustaining qualitative readiness. This is contingent upon further testing of the optimization prototype in this study. But, should the priority lineup fail, the optimization matrix should be run on available billets, and assigned accordingly. Thus, there remains applicability of the optimization matrix; to at least sustain paygrade, community and location matches for qualitative value to the matches.

Caveat: this relies on higher fidelity and management of manpower requirements.

(2) Provide policy guidance that identifies which reserve communities are prioritized to execute the threat-based approach as dictated by Navy Reserve leadership.

Reasoning: This may vary by mission set and national priorities. Other communities may fall into support roles, thus altering the paradigm; especially given the joint nature of current warfighting.

Caveat: Without explicit policy instruction regarding the effect of prioritization, it may become a 'hit or miss' attempt to optimize cost efficiency. This defeats some of the

merits offered by the optimization prototype. However, the prototype may still be applied on even smaller scales, to offset 'some' of the ambiguity.

(3) Mandate billet assignment 'swaps' between commensurate personnel, if their new billet assignments are closer to the other, and if both are in the first six months of billet-fill.

Reasoning: This is much like the current process to directly assign a member to a billet outside the job application cycles. It also capitalizes on the shortened travel distances, which lessens the times necessary for readiness training. But, it does so without sacrificing qualitative warfighting readiness, and at a lower cost.

Caveat: This is contingent upon improved manpower requirement management AND if this process can overcome the member-initiated process between two distinct chains of command.

(4) Extend tour lengths of cross-assigned personnel to either three or four years.

Reasoning: This enables maximum usage of the respective SELRES members; as the first year is often used to 'qualify' the members in their billets. In their current two-year assignment for cross-assignees—as mandated by current instruction—much of their potential benefit is lost, while still increasing travel costs. Furthermore, this option makes cross-assignees mimic their locally-assigned counterparts. This recommendation aligns with the current vision of the Commander, Navy Reserve Force; to decrease administrative inefficiencies and sustain fiscal responsibility (CNRF, 2022).

> Continued efforts to…deliver Navy warfighting capabilities best suited for the Reserve Component, delivered at reduced costs and within acceptable risk for warfighting readiness remains the focus. (CNRPAO, 2022)

This prototype analyzed a $2 million example, but illustrated the ability to solve the $150 million problem, if appropriately applied across the SELRES communities. This optimization leans into the future, by demonstrating cost efficient options that support the Navy's global mission, and sustaining strategic warfighting readiness. Conflict may emerge swiftly, but through rigorous application of this prototype, we can be ready with both human and fiscal resources. However, current policy must be refined, so as to

capitalize on this option, and perpetuate a reserve force that is ready to fight with minimal notice.

3. The 'Right Stuff'—We Wish We Had: Limitations

There is variability in the reserve force with personnel-billet combinations. The benefits in this study are speculative, subject to upgrades and modifications. While the initial econometric analysis was run via Stata and Python, all matrices were run through Microsoft Excel. However, there were limitations to the decision variables it could process, even on such a small sample. As such, MATLAB was required, so as to ascertain the optimal personnel-billet matches that garnered the most monetized benefits.

Future researchers may use this prototype for further analysis and application to other RC communities. A unique limitation was the lack of individual-level demographic information regarding those who filled the billets. Only billet-specific information of the personnel combinations was provided by the data. That particular piece will prove invaluable to future research; which will increase the accuracy of monetary analysis, based on the precision of methodology applied here. Further subjective correlation of qualitative components to what determines a 'benefit' is subject to additional expertise within other fields. The sample of Information Professional officers was chosen for its simplicity, so as to illustrate the possibilities. But, the prototype is flexible, so as to accommodate more incorporated information for more accurate assessments. Refer to the Appendix for illustration of future potential changes or modifications necessary to the prototype.

APPENDIX. PROTOTYPE ILLUSTRATED

This appendix serves to illustrate basic usage of the optimization prototype. All figures included here are snapshots of matrices development and formulas that remain malleable to the needs of other communities. The logic contained herein sustains precision for consistent application of cost-benefit analysis. This accounts for additional or modified cost and benefit parameters from subject matter experts in specific reserve communities.

a. SELRES Community to Equivalent Civilians Comparison Baseline

In order to sustain consistent logic for reasonable comparisons in the prototype, the median or average incomes must be accounted for in the civilian sector. Standardized pay scales for reservists are available. Civilian equivalent salaries for daily rate accounting are found at the Bureau of Labor Statistics, and business reporting modules, such as Payscale.

O6 Leadership Equivalent	Median Salary	**O4-O5 Mid MGMT Equivalent**	Median Salary	**O1-O3 Div MGMT Equivalent**	Median Salary	
Senior Software	$123,235	Software Engineer	$93,457	Systems Administrator	$66,578	
Info Tech (IT) Director	$143,260	Info Tech (IT) Manager	$90,394	Software Developer	$76,784	
Solutions Architect	$119,961	Proj. Mgr (Unspec/Gen)	$83,078	Network Engineer	$73,432	Below is a Weighted (Median) Salary from Sample Size for Equivalent Civilian Information Professional (IP) Careers similar to Military Paygrades based on Experience
		Proj. Mgr, Info Tech (IT)	$88,677	Systems Engineer (IT)	$71,061	
				Info. Tech Consultant	$79,442	Sample Size Weighted (Median) Salary
				Data Analyst	$68,105	**$84,579.65**
Averages Over Officer Tiers	$128,819		$88,902		$72,567	Rounded to Nearest Dollar
Weighted Avgs (Sample)						
9/189 (O-6s)	**$6,134.22**	108/189 (O-4s/O-5s)	**$50,800.86**	72/189 (O1s/O2s/O3s)	**$27,644.57**	**$84,580**
9xO6		47xO5 / 61xO4		3xO1 / 19xO2 / 50xO3		

Notes: The above 'weights' the equivalent civilian salaries to the distribution in the sample.

Figure 2. Establishing 'Weighted' Benefits from Distribution. Adapted from Payscale (2023).

Notice that the average or median pays are 'weighted' based on the distribution within the sample. Example: if there are 10 percent senior reservists, 30 percent mid-grade members and 60 percent junior reservists, then the equivalent weights should apply to their civilian counterparts. Figure 2 displays this key information. Further modifications may be made, pending the thoughts of subject matter experts within a specific reserve community, of either officers or enlisted members. This matters because the 'delta' or difference in pays between SELRES and civilians is considered the monetized 'benefit. See Table 8 for similar weighting of the SELRES officers in the sample used for the prototype.

Table 8. Reservists' Weighted Pay Scales. Adapted from Goering (n.d.).

Military Pay Scales for O1-O6 to be weighted based on Sample Size		
O6 standardized to 20 years (Senior level, retirement minimum)		
O4-O5 standardized to 14 years (~mid-point of O4-O5s in sample)		
O1-O3 standardized to 8 years (middle of group before O4 at 10 years, with deference to O3's as larger group)		
	Monthly	Monthly (Sample) Weighted
O6 > 20 years	$12,050	$573.81
O5 > 14 years	$9,389	$2,334.83
O4 > 14 years	$8,951	$2,888.95
O3 > 8 years	$7,120	$1,883.60
O2 > 8 years	$5,799	$582.97
O1 > 8 years	$4,577	$72.65
Weighted (Sample) Monthly Salary		**$8,336.80**
Weighted (Sample) Yearly Salary		**$100,042**

The above table includes notes from this study's matrices development. But monthly salaries were weighted to distribution of the sample.

As seen in Table 8, the average salaries were also weighted to the distribution in the sample. Furthermore, the average salaries of each grouping (senior, mid-grade and junior) were assumed near the mid-point of each paygrade for consistency. In addition, the junior officers pay were weighted up to account for more O-3 versus O-1 and O-2 members.

Upon completion of the above, the difference was taken between $100,042 and $84,580 to find that over a fiscal year, SELRES officers were paid about $15,462 more per

yearly requirements. Standardizing down to the daily 'benefit' of nearly $43, the 'benefit' was calculated over the 30 base pay days (but 26 calendar days) to about $1,289 for all fiscal year requirements. Similar measures must be maintained across other communities.

b. Monetized Benefit Matrices Development

Each matrix was of the same dimensions, 189 by 189, accounting for all personnel and billet combinations in the sample. There were matrices for paygrade, location and community matches. These were averaged across all possible combinations, then added the security clearance 'bonus', as civilian equivalents were not likely to have them. Once this was done, each combination was multiplied by 1.2 to account for the 'return on investment' of the benefit to the Navy for using their services, rather than outsourcing to civilians. Refer to Figure 3 for an illustration for 'part' of this process. Note, that this is only the upper left hand quadrant of the entire benefits matrix (of current personnel-billet matches).

	INCLUDES 20% inflation of benefits (as per literature)												
									Personnel (PERS) Identification				
Billet ID:	O6	O6	O6	O6	O6	O6	O6	O6	O6	O5	O5	O5	O5
	A	B	C	D	E	F	G	H	I	J	K	L	M
1	$ 9,584	$ 9,413	$ 9,327	$ 9,327	$ 9,327	$ 9,327	$ 9,413	$ 9,327	$ 9,327	$ 9,310	$ 9,224	$ 9,224	$ 9,310
2	$ 9,413	$ 9,584	$ 9,327	$ 9,327	$ 9,327	$ 9,327	$ 9,413	$ 9,327	$ 9,327	$ 9,310	$ 9,224	$ 9,224	$ 9,310
3	$ 9,327	$ 9,327	$ 9,584	$ 9,327	$ 9,327	$ 9,327	$ 9,327	$ 9,327	$ 9,327	$ 9,224	$ 9,224	$ 9,224	$ 9,224
4	$ 9,327	$ 9,327	$ 9,327	$ 9,584	$ 9,327	$ 9,413	$ 9,327	$ 9,584	$ 9,327	$ 9,224	$ 9,224	$ 9,224	$ 9,224
5	$ 9,327	$ 9,327	$ 9,327	$ 9,327	$ 9,584	$ 9,327	$ 9,327	$ 9,327	$ 9,584	$ 9,224	$ 9,310	$ 9,224	$ 9,224
6	$ 9,327	$ 9,327	$ 9,327	$ 9,413	$ 9,327	$ 9,584	$ 9,327	$ 9,413	$ 9,327	$ 9,224	$ 9,224	$ 9,224	$ 9,224
7	$ 9,413	$ 9,413	$ 9,327	$ 9,327	$ 9,327	$ 9,327	$ 9,584	$ 9,327	$ 9,327	$ 9,310	$ 9,224	$ 9,224	$ 9,310
8	$ 9,327	$ 9,327	$ 9,327	$ 9,584	$ 9,327	$ 9,413	$ 9,327	$ 9,584	$ 9,327	$ 9,224	$ 9,224	$ 9,224	$ 9,224
9	$ 9,224	$ 9,224	$ 9,224	$ 9,224	$ 9,481	$ 9,224	$ 9,224	$ 9,224	$ 9,481	$ 9,327	$ 9,413	$ 9,327	$ 9,327
10	$ 9,310	$ 9,310	$ 9,224	$ 9,224	$ 9,224	$ 9,224	$ 9,310	$ 9,224	$ 9,224	$ 9,584	$ 9,327	$ 9,327	$ 9,413
11	$ 9,224	$ 9,224	$ 9,224	$ 9,224	$ 9,310	$ 9,224	$ 9,224	$ 9,224	$ 9,310	$ 9,327	$ 9,584	$ 9,327	$ 9,327
12	$ 9,224	$ 9,224	$ 9,224	$ 9,224	$ 9,224	$ 9,224	$ 9,224	$ 9,224	$ 9,224	$ 9,327	$ 9,327	$ 9,584	$ 9,327
13	$ 9,310	$ 9,310	$ 9,224	$ 9,224	$ 9,224	$ 9,224	$ 9,310	$ 9,224	$ 9,224	$ 9,413	$ 9,327	$ 9,327	$ 9,584
14	$ 9,310	$ 9,310	$ 9,224	$ 9,224	$ 9,224	$ 9,224	$ 9,310	$ 9,224	$ 9,224	$ 9,413	$ 9,327	$ 9,327	$ 9,413
15	$ 9,224	$ 9,224	$ 9,224	$ 9,481	$ 9,224	$ 9,310	$ 9,224	$ 9,481	$ 9,224	$ 9,327	$ 9,327	$ 9,327	$ 9,327
16	$ 9,310	$ 9,310	$ 9,224	$ 9,224	$ 9,224	$ 9,224	$ 9,310	$ 9,224	$ 9,224	$ 9,413	$ 9,327	$ 9,327	$ 9,413
17	$ 9,310	$ 9,310	$ 9,224	$ 9,224	$ 9,224	$ 9,224	$ 9,310	$ 9,224	$ 9,224	$ 9,413	$ 9,327	$ 9,327	$ 9,413
18	$ 9,069	$ 9,069	$ 9,069	$ 9,155	$ 9,069	$ 9,155	$ 9,069	$ 9,155	$ 9,069	$ 9,224	$ 9,224	$ 9,224	$ 9,224

Notes: All monetized benefits reflect current combinations. Numbers listed in each cell reflect a combination of data manipulation from CNRFC (2022a and 2022b), security clearance costs from Kyzer (2021) and pay scale information from Goering (n.d.) and Payscale (2023).

Figure 3. Current Combination Benefits (Sample). Adapted from Commander, Navy Reserve Force Command (2022a and 2022b), Payscale (2023), Goering (n.d.) and Kyzer (2021)

As seen in Figure 3, each cell represents the current combinations among personnel-billet matches, and their potential matches, if they were reassigned elsewhere. This is done prior to optimization. The following equation was used to incorporate all sub-matrices (all of equal dimension) into this combination matrix.

$$= \left(\left(\left(\frac{Paygrade\ Matches!\,(Cells) + Location\ Matches!\,(Cells) + Community\ Match!\,(Cells)}{3} \right) + Clearance\ Match!\,(Cells) \right) * 1.2 \right)$$

The above equation was used, where it took the sustained 'benefits' of each match, then added the 'bonus' security clearance, prior to multiplying by 1.2 for the 'inflated' return on investment to the Navy. Future researchers may rearrange this set up to account for nuances specific to their community, based on their correlated factors of understanding. But the prototype 'auto-populates' the rest, based on their modified inputs. Any changes in a submatrix, or different weights applied in the standardized pay scale portion is automatically included in calculations in later matrices.

The following section shows how to use, modify and update the submatrices. The paygrade match submatrix is used to illustrate. Please see Figure 4 for reference.

P.PYGD (Cell) Reminder		D4	D5	D6	D7	D8	D9	D10	D11	D12
				Personnel ID (Paygrade)						
		A	B	C	D	E	F	G	H	I
	1	1	1	1	1	1	1	1	1	1
	2	1	1	1	1	1	1	1	1	1
	3	1	1	1	1	1	1	1	1	1
	4	1	1	1	1	1	1	1	1	1
Billet ID	5	1	1	1	1	1	1	1	1	1
	6	1	1	1	1	1	1	1	1	1
	7	1	1	1	1	1	1	1	1	1
	8	1	1	1	1	1	1	1	1	1
	9	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
	10	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
	11	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
	12	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
	13	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
	14	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
	15	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
	16	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
	17	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25
	18	2	2	2	2	2	2	2	2	2
	19	3	3	3	3	3	3	3	3	3
	20	2	2	2	2	2	2	2	2	2

Figure 4. Scaling the Matches in Submatrices

Figure 4 illustrates the scaling process in the prototype. Future researchers may modify 'how much' benefits should be reduced. But in this case, 1 was for perfect matches, 1.25 for near matches, then 2 and 3 for lower matching levels. This matters, because this research 'divided' the sustained benefits, based on the qualitative value associated with perfect, near and lower matches. See below formula for an example of how each submatrix was formulated for precision and consistency in the logic behind the compiled 'benefits'. This is specific to Microsoft Excel. Other formulas similar to this one may be used in other data processing algorithms.

$$= (((IF(ABS(Cell - Cell) = 3,3,IF\left(ABS(Cell - Cell) = 2,2,IF\left(ABS(Cell - Cell) = 1,1.25,IF(ABS(Cell - Cell) = 0,1,4)\right)\right)\right)$$

The above required a certain order to ensure the appropriate values were input into each combination cell. A three-paygrade difference needed a 3, a two-paygrade difference needed a 2, but a one-paygrade difference required a 1.5. The alternative of four (4), was included on back end to account for any superfluous match of a four-paygrade (or more) difference from billet requirement. Absolute values were used for simplicity in Microsoft Excel, since each personnel and billet paygrade (requirement) were reduced to simple numbers in their respective cells. This enabled the formula to work.

It is recommended to have specific cells used for the 'qualitative value', where each output after the "= number" in the formula, is specific to a reference cell. This permits easier 'testing' where a researcher changes one cell; which then auto-populates the submatrix. This is carried over to other affected matrices.

There are also syntax items such as quotations ("") around the output value, which sustains consistency in output, but also avoids multiple 'errors' or 'values' listed in the output cells in each submatrix. The paygrade match submatrix was used to illustrate these concepts. All other submatrices follow similar patterns, even if the output scalars (1, 1.25, 2, 3, etc) are changed or modified in anyway. Changing these will still auto-populate other connected submatrices, due to consistent equations used throughout.

c. Monetary Cost Matrices Development

Cost matrices and submatrices were a bit simpler to do. Similar scalars used in the benefits section are used for cost development matrices.

Figure 5 illustrates the compilation of all costs associated with each billet location from the personnel locations. Zip codes were the basis for both. Scalars for air miles and reimbursable driving miles were multiplied in, but were coupled with IF(AND statements to negate 'double counting' of costs; if members travelled by commercial air, rather than driving via personally owned vehicles. Also, if a member is locally assigned (their local and operational units have the same identification code), there are no reimbursable expenses, even if the member still travels some moderate distance.

Python Merged GSA Data for Each Zip Code Combo		TRUIC (Personnel) Codes												
		O6	O6	O6	O6	O6	O6	O6	O6	O6	O5	O5	O5	O5
	PERS ID:	A	B	C	D	E	F	G	H	I	J	K	L	M
		89627	83001	84313	83924	88716	82931	89664	83924	88716	83878	88191	86759	84097
	89627	$ -	$ 6,006	$ 3,480	$ 3,480	$ 3,480	$ 3,480	$ 3,297	$ 3,480	$ 3,480	$ 3,297	$ 3,480	$ 3,480	$ 3,465
	83001	$ 3,297	$ -	$ 3,480	$ 3,480	$ 3,480	$ 3,480	$ 3,297	$ 3,480	$ 3,480	$ 3,297	$ 3,480	$ 3,480	$ 3,465
	84313	$ 5,298	$ 8,007	$ -	$ 5,298	$ 5,298	$ 5,298	$ 5,298	$ 5,298	$ 5,298	$ 5,298	$ 5,298	$ 5,298	$ 5,466
	83924	$ 5,944	$ 8,653	$ 5,944	$ -	$ 5,944	$ 5,944	$ 5,944	$ -	$ 5,944	$ 5,944	$ 5,944	$ 5,944	$ 6,112
	88716	$ 5,524	$ 8,233	$ 5,524	$ 5,524	$ -	$ 5,524	$ 5,524	$ 5,524	$ -	$ 5,524	$ 5,040	$ 5,524	$ 5,692
	82931	$ 5,948	$ 8,657	$ 5,948	$ 5,948	$ 5,948	$ -	$ 5,948	$ 5,948	$ 5,948	$ 5,948	$ 5,948	$ 5,948	$ 6,116
UMUIC (Billets) Codes	89664	$ 3,297	$ 6,006	$ 3,480	$ 3,480	$ 3,480	$ 3,480	$ -	$ 3,480	$ 3,480	$ 3,297	$ 3,480	$ 3,480	$ 3,465
	83924	$ 5,944	$ 8,653	$ 5,944	$ -	$ 5,944	$ 5,944	$ 5,944	$ -	$ 5,944	$ 5,944	$ 5,944	$ 5,944	$ 6,112
	88716	$ 5,524	$ 8,233	$ 5,524	$ 5,524	$ -	$ 5,524	$ 5,524	$ 5,524	$ -	$ 5,524	$ 5,040	$ 5,524	$ 5,692
	83878	$ 3,297	$ 6,006	$ 3,480	$ 3,480	$ 3,480	$ 3,480	$ 3,297	$ 3,480	$ 3,480	$ -	$ 3,480	$ 3,480	$ 3,465
	88191	$ 5,524	$ 8,233	$ 5,524	$ 5,524	$ 5,040	$ 5,524	$ 5,524	$ 5,524	$ 5,040	$ 5,524	$ -	$ 5,524	$ 5,692
	86759	$ 3,312	$ 6,021	$ 3,312	$ 3,312	$ 3,312	$ 3,312	$ 3,312	$ 3,312	$ 3,312	$ 3,312	$ 3,312	$ -	$ 3,480
All UMUICs listed here, but Combos are	84097	$ 3,297	$ 6,006	$ 3,480	$ 3,480	$ 3,480	$ 3,480	$ 3,297	$ 3,480	$ 3,480	$ 3,297	$ 3,480	$ 3,480	$ -
	85752	$ 3,297	$ 6,006	$ 3,480	$ 3,480	$ 3,480	$ 3,480	$ 3,297	$ 3,480	$ 3,480	$ 3,297	$ 3,480	$ 3,480	$ 3,465
	83924	$ 5,944	$ 8,653	$ 5,944	$ -	$ 5,944	$ 5,944	$ 5,944	$ -	$ 5,944	$ 5,944	$ 5,944	$ 5,944	$ 6,112
	87032	$ 3,297	$ 6,006	$ 3,480	$ 3,480	$ 3,480	$ 3,480	$ 3,297	$ 3,480	$ 3,480	$ 3,297	$ 3,480	$ 3,480	$ 3,465
	87032	$ 3,297	$ 6,006	$ 3,480	$ 3,480	$ 3,480	$ 3,480	$ 3,297	$ 3,480	$ 3,480	$ 3,297	$ 3,480	$ 3,480	$ 3,465
	82604	$ 5,937	$ 8,646	$ 5,937	$ 5,937	$ 5,937	$ 5,937	$ 5,937	$ 5,937	$ 5,937	$ 5,937	$ 5,937	$ 5,937	$ 6,105

Notes: Snapshot of the upper left quadrant for illustrative purposes only. Information compiled from the General Services Administration and Defense Travel Administration Office; then incorporated into manipulated data from Commander, Navy Reserve Force Command (2022a and 2022b).

Figure 5. Travel Costs Compiled. Adapted from Commander, Navy Reserve Force Command (2022a and 2022b), General Services Administration (n.d.), and Defense Travel Administration Office (2022 and n.d.).

All costs in each cell represents the possible cost combinations across all personnel-billet matches. Each cell incorporates the manipulated data from CNRFC (2022a and 2022b), but accounts for per diem, lodging, rental car use, mileage reimbursement and

travel distances between member's home of record to location of billet. This travel information came from the General Services Administration (n.d.) and Defense Travel Management Office (2022 and n.d.) search engines for per diem, rental car, lodging and airfare rates. See below equation for the compiled costs in the cost matrix.

$$Per\ Diem + Lodging + Rental\ Cars\ Cost + Airfare\ Zip\ Code\ Costs$$

The airfare zip code costs include an equation in that submatrix to nullify costs if within 200 miles, indicating the member is driving their personally owned vehicle. The following equation was used to make this distinction, prior to incorporation into the cost matrix. Note that all cost scalars (although similar to benefit calculations) use more IF(AND statements in Microsoft Excel. See the equation following Figure 5 for reference.

$$IF(AND(Cell <> Cell, Cell \leq 200), (Cell * MileageReimbursement) * 2, IF(AND(Cell <> Cell, Cell > 200), (Cell * AirfareCost\ per\ mile) * 2, 0))$$

There were specified reference cells listing the cost per mile (reimbursable for those driving if within 200 miles) and for average airfare per mile. They were all multiplied by two to account for round trips. Each cell also accounted for possible local versus cross-assignments. If the local and operational support codes matched, they are considered local, thus making them a zero (0). If they did not match, then the mileage rates were applied for consistency. This was applied across the entire mileage submatrix, so each possible local match cost nothing, whereas the new distances between new combinations reflected if they would drive or fly. The same was applied to the rental car submatrix. A member only used rental cars if they flew, but did not if they drove their personally owned vehicle.

d. Cost-Benefit Matrices Development

The final cost-benefit matrix was a simple 'subtraction' process where each corresponding cells of costs were subtracted from their correlated benefit combination. This was done from the ultimate benefits matrix (189 by 189) to the ultimate costs matrix (189 by 189). These then reflected the sustained 'benefits' of current combinations, which was then run through MATLAB for optimal or maximized benefits remaining. The

MATLAB output indicated (via binary 1 and 0) where the new match should be assigned for optimal value. Running a SUMPRODUCT between this optimal match matrix to the current monetized combinations (benefits – costs) outputs the new optimal benefits remaining. These then showed where to reassign each personnel to billet match for optimal cost savings with qualitative scales included to sustain warfighting readiness.

See Figure 6 for visual of current monetized personnel-billet combinations (accounting for costs) and the following equation for calculation.

		Benefits - Costs (Sustained Benefits)	TRUIC (Personnel) Codes											
Billet ID:			O6	O6	O6	O6	O6	O6	O6	O6	O6	O5	O5	
		PERS ID:	A	B	C	D	E	F	G	H	I	J	K	
			89627	83001	84313	83924	88716	82931	89664	83924	88716	83878	88191	
1		89627	$ 9,584	$ 3,407	$ 5,847	$ 5,847	$ 5,847	$ 5,847	$ 6,116	$ 5,847	$ 5,847	$ 6,013	$ 5,744	
2		83001	$ 6,116	$ 9,584	$ 5,847	$ 5,847	$ 5,847	$ 5,847	$ 6,116	$ 5,847	$ 5,847	$ 6,013	$ 5,744	
3		84313	$ 4,029	$ 1,320	$ 9,584	$ 4,029	$ 4,029	$ 4,029	$ 4,029	$ 4,029	$ 4,029	$ 3,926	$ 3,926	
4		83924	$ 3,383	$ 674	$ 3,383	$ 9,584	$ 3,383	$ 3,468	$ 3,383	$ 9,584	$ 3,383	$ 3,279	$ 3,279	
5		88716	$ 3,803	$ 1,094	$ 3,803	$ 3,803	$ 9,584	$ 3,803	$ 3,803	$ 3,803	$ 9,584	$ 3,700	$ 4,270	
6		82931	$ 3,379	$ 670	$ 3,379	$ 3,465	$ 3,379	$ 9,584	$ 3,379	$ 3,465	$ 3,379	$ 3,276	$ 3,276	
7	UMUIC (Billet) Codes	89664	$ 6,116	$ 3,407	$ 5,847	$ 5,847	$ 5,847	$ 5,847	$ 9,584	$ 5,847	$ 5,847	$ 6,013	$ 5,744	
8		83924	$ 3,383	$ 674	$ 3,383	$ 9,584	$ 3,383	$ 3,468	$ 3,383	$ 9,584	$ 3,383	$ 3,279	$ 3,279	
9		88716	$ 3,700	$ 991	$ 3,700	$ 3,700	$ 9,481	$ 3,700	$ 3,700	$ 3,700	$ 9,481	$ 3,803	$ 4,373	
10		83878	$ 6,013	$ 3,304	$ 5,744	$ 5,744	$ 5,744	$ 5,744	$ 6,013	$ 5,744	$ 5,744	$ 9,584	$ 5,847	
11		88191	$ 3,700	$ 991	$ 3,700	$ 3,700	$ 4,270	$ 3,700	$ 3,700	$ 3,700	$ 4,270	$ 3,803	$ 9,584	
12		86759	$ 5,911	$ 3,202	$ 5,911	$ 5,911	$ 5,911	$ 5,911	$ 5,911	$ 5,911	$ 5,911	$ 6,014	$ 6,014	
13		84097	$ 6,013	$ 3,304	$ 5,744	$ 5,744	$ 5,744	$ 5,744	$ 6,013	$ 5,744	$ 5,744	$ 6,116	$ 5,847	
14		85752	$ 6,013	$ 3,304	$ 5,744	$ 5,744	$ 5,744	$ 5,744	$ 6,013	$ 5,744	$ 5,744	$ 6,116	$ 5,847	
15		83924	$ 3,279	$ 570	$ 3,279	$ 9,481	$ 3,279	$ 3,365	$ 3,279	$ 9,481	$ 3,279	$ 3,383	$ 3,383	
16		87032	$ 6,013	$ 3,304	$ 5,744	$ 5,744	$ 5,744	$ 5,744	$ 6,013	$ 5,744	$ 5,744	$ 6,116	$ 5,847	
17		87032	$ 6,013	$ 3,304	$ 5,744	$ 5,744	$ 5,744	$ 5,744	$ 6,013	$ 5,744	$ 5,744	$ 6,116	$ 5,847	
18		82604	$ 3,132	$ 423	$ 3,132	$ 3,218	$ 3,132	$ 3,218	$ 3,132	$ 3,218	$ 3,132	$ 3,286	$ 3,286	
19		88868	$ 5,630	$ 2,921	$ 5,630	$ 5,630	$ 5,630	$ 5,630	$ 5,630	$ 5,630	$ 5,630	$ 5,716	$ 5,716	

Notes: All monies seen above are compiled from data manipulation in CNRFC (2022), salary information from Goering (n.d.) and Payscale (2023), and travel costs from General Services Administration (n.d.), Kyzer (2021) and Defense Travel Management Office (2022 and n.d.). Costs were subtracted from monetized benefits for each possible combination.

Figure 6. Current Sustained 'Benefits'. Adapted from Commander, Navy Reserve Force Command (2022a and 2022b), General Services Administration (n.d.), Defense Travel Management Office (2022 and n.d.), Kyzer (2021), Goering (n.d.), and Payscale (2023)

All combinations of benefits remaining in each corresponding cell is the current 'benefit' remaining after all possible costs are accounted. Please see below equation for how these were calculated. It involved merging the benefits matrix and the costs matrix, each of which were built upon three to four submatrices for precision calculations.

$$(Monetized\ Benefits\ (Matrix)!\,Cell{:}\,Cell - Monetized\ Costs\ (Matrix)!\,Cell{:}\,Cell)$$

After this was completed, and MATLAB determined the optimal (maximized benefits) assignments, this new optimal matrix was multiplied by the current combinations matrix. This was done using the SUMPRODUCT function. See below:

$$= SUMPRODUCT(Cell{:}\,Cell, Cell{:}\,Cell)$$

Each matrix MUST be of same dimensions or this to work. In the sample of this research, it was 189 by 189. But this outputs the new benefits compared to the current combinations (run the summation down the 'diagonal' in current combinations matrix).

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LIST OF REFERENCES

Anderson, S. (2015, March). Navy Reserve – Ready, Innovative, Agile. *CHIPS*. https://www.doncio.navy.mil/chips/ArticleDetails.aspx?ID=6040.

Bailey, A. E. (1975). *Naval Reserve Management Under the Navy's Total Force Policy*. (10945/20960) [Master's thesis, Naval Postgraduate School]. NPS Archive: Calhoun.

Bartel, Ann P. (2000). Measuring the Employer's Return on Investments in Training: Evidence from the Literature. *Industrial Relations*. *Vol. 39* (No. 3), https://www0.gsb.columbia.edu/faculty/abartel/papers/measuring_employer.pdf.

Bureau of Labor Statistics (2022). *Employer Costs for Employee Compensation – September 2022*. (USDL-22-2307). U.S. Department of Labor. https://www.bls.gov/news.release/pdf/ecec.pdf.

Center for Naval Analyses (2017). *Population Representation in the Military Services: Fiscal Year 2017 Summary Report*. Office of the Under Secretary of Defense, Personnel and Readiness. https://www.cna.org/pop-rep/2017/summary/summary.pdf.

Chief of Naval Operations (2022, September 6). *Fiscal Year 2023 General Military Training Requirements*. (NAVADMIN 201/22). https://www.mynavyhr.navy.mil/References/Messages/.

Chief of Navy Reserve Public Affairs Office (2022, May 17). *Chief of Navy Reserves Releases Navy Reserve Fighting Instructions 2022: Updates Design, Train and Mobilize Lines of Effort, Announces Develop the Force*. https://www. navy.mil/Press-Office/News-Stories/Article/ 3035206/chief-of-navy-reserve-releases-navy-reserve-fighting-instructions-2022-updates/.

Chief of the Navy Reserve (2023, January). *U.S. Navy Reserve: By the Numbers*. https://www.navyreserve.navy.mil/About-Us-Leadership/Status-of-the-Navy-Reserve/.

Commander, Navy Reserve Force Command (2022a). *CNRFC N1 SELRES Manning Cube*. [Unpublished Raw Data on Personnel Billet Matches in the SELRES of the Navy Reserve]. Total Force Manpower Management System, My Navy Assignments Platform and Navy Standard Integrated Personnel System. (Compiled by Naval Information Warfare Center). https://private.navyreserve.navy.mil/.

Commander, Navy Reserve Force Command (2022b). *CNRFC RPD Manning Cube*. [Unpublished Raw Data on Billet Requirements as Managed by Reserve Personnel Directors]. (Maintained by CNRFC, N123 Force Structure Branch). https://private. navyreserve.navy.mil/.

Commander, Navy Reserve Force Command (2022c). *Manpower Quick Reference Documents*. https://navy-reserve-wiki.readthedocs.io/en/latest/general/manpower/.

Commander, Navy Reserve Force (2022, December 15). *Battle Orders 2032*. Chief of Navy Reserve Public Affairs Office. https://www.navyreserve.navy.mil/Portals/35/Graphics/Battle%20Order%20Plan%202032-V35.pdf.

Congressional Budget Office (2006). *Recruiting, Retention, and Future Levels of Military Personnel*. (Pub 2777). https://www.cbo.gov/publication/18187.

Defense Travel Management Office (2022, November 15). *Domestic Rental Car Ceiling Rates*. https://www.travel.dod.mil/Programs/Rental-Car/.

Defense Travel Management Office (n.d.). *Travel and Transportation Rates: Mileage Rates*. Retrieved January 7, 2023 from https://www.travel.dod.mil/Travel-Transportation-Rates/Mileage-Rates/.

Defense Travel Management Office (n.d.). *Travel and Transportation Rates: Per Diem Rates*. Retrieved January 6, 2023 from https://www.travel.dod.mil/Travel-Transportation-Rates/Per-Diem/Per-Diem-Rate-Lookup/.

Department of Defense (2020, December 1). *Joint Personnel Support*. (Joint Publication 1-0). Office of the Chairman of the Joint Chiefs of Staff. https://www.jcs.mil/Portals/36/Documents/Doctrine/pubs/jp1_0.pdf.

Department of Defense (2022, October 1). *Military Benefits: Military Pay Charts*. https://militarybenefitsinfo/2023-military-pay-charts/.

Department of the Navy (2017, November 22). *Cross-Assignments*. (RESPERSMAN 1300–060). [CH-11]. Commander, Navy Reserve Forces Command (CNRFC). https://www.navyreserve.navy.mil.

Department of the Navy (2018, July 19). *Changes to the Navy Reserve Personnel Manual*. (RESPERSMAN 1000–010/1300-010). [CH-12]. Commander, Navy Reserve Forces Command (CNRFC). https://www.navyreserve.navy.mil.

Department of the Navy (2021, July 2). *Navy Total Force Manpower Policies and Procedures*. (OPNAVINST 1000.16L). Office of the Chief of Naval Operations. https://www.secnav.navy.mil/doni/Directives/01000%20Military%20Personnel%20Support/01-01%20General%20Military%20Personnel%20Records/1000.16L%20With%20CH-3.pdf.

Department of the Navy (2022a, August 16). *Changes to the Navy Reserve Personnel Manual*. (RESPERSMAN 1300–080). [CH-14]. Commander, Navy Reserve Forces Command (CNRFC). https://www.navyreserve.navy.mil.

Department of the Navy (2022b). *U.S. Navy Reserve: Mission, Vision and Organization*. Retrieved November 17, 2022 from https://www.navyreserve.navy.mil/About-Us/.

General Services Administration (n.d.). *Federal Acquisition Service: Contract Airfare Estimator*. Retrieved January 7, 2023 from https://cpsearch.fas.gsa.gov/.

General Services Administration (n.d.). *Per Diem Rates*. Retrieved January 14, 2023 from https://www.gsa.gov/travel/plan-book/per-diem-rates?.

Goering, Thomas (n.d.). *Military Pay Charts*. Retrieved January 8, 2023 from https://www.navycs.com/charts/2023-military-pay-chart.html.

Government Accountability Office (1979, January 24). *DOD 'Total Force Management' – Fact or Rhetoric?*. (FPCD-78-82). Office of Public Affairs. https://www.gao.gov/products/fpcd-78-82.

Heller, C. E. (1994). *Total Force: Federal Reserves and State National Guards*. (ADA 289696). U.S. Army War College Strategic Studies Institute. https://apps.dtic.mil/sti/pdfs/ADA289696.pdf.

Karoly, Lynn A. (2008). *Valuing Benefits in Benefit-Costs Studies of Social Programs*. (TR 643) RAND Corporation. https://www.rand.org/pubs/technical_reports/TR643.html.

Kyzer, L. (2021, September 7). *How Much Does It Cost to Obtain a Clearance – FY 2022/23 Costs Go Down*. Clearance Jobs. https://news.clearancejobs.com/2021/09/07/how-much-does-it-cost-to-obtain-a-clearance-fy-2022-23-costs-go-down/.

Leary, G. B. (1987). *An analysis of the United States Naval Reserve budget growth.* (10945/22628) [Master's thesis, Naval Postgraduate School]. NPS Archive: Calhoun.

Mazza, R. C. (1992). *Naval Reserve: an organization in transition*. (10945/23982) [Master's thesis, Naval Postgraduate School]. NPS Archive: Calhoun.

Payscale (2023). *Salary for Industry: Information Technology (IT) Services*. Retrieved January 14, 2023 from https://www.payscale.com/research/US/Industry=Information_Technology_(IT)_Services/Salary.

Punaro, A. L. (2014, February). *Reserve Component Use, Balance, Cost and Savings: A Response to Questions from the Secretary of Defense*. (RFPB Report FY14-02). Chairman, Reserve Forces Policy Board. Department of Defense. https://rfpb.defense.gov/portals/67/documents/reports/annual%20report/final%20signed%20report%20without%20slides.pdf.

Punaro, A. L. (2020, August). *Improving the Total Force: Using the National Guard and Reserves*. (RFPB Report FY20-01). Chairman, Reserve Forces Policy Board. Department of Defense. https://rfpb.defense.gov/Portals/67/RFPB%20Improving%20the%20Total%20Force%202020%20Report.pdf.

Robards, P. A. (2001). *Applying two-sided matching processes to the United States Navy Enlisted assignment process*. (10945/10845) [Master's thesis, Naval Postgraduate School]. NPS Archive: Calhoun.

Rohn, L.L., A.G. Schaefer, G.A. Schumacher, J. Kavanagh, C. Baxter, A.G. Donohue (2019). *Integrating Active and Reserve Component Staff Organizations: Improving the Chances of Success*. (RR 1869). RAND Corporation. https://www.rand.org/pubs/research_reports/ RR1869.html.

Schweitzer, J. (2022). *How to Address the Administrative Burdens of Accessing the Safety Net*. Center for American Progress. https://www.americanprogress.org/article/how-to-address-the-administrative-burdens-of-accessing-the-safety-net/.

Zawislak, E. L. (2000). *United States policy and budgeting for the reserves components*. (10945/7817) [Master's thesis, Naval Postgraduate School]. NPS Archive: Calhoun.

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