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Approved by:

March 2017

A handwritten signature in black ink that reads 'Linda Cavalluzzo'.

Linda Cavalluzzo,
Vice President and Director
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Introduction

Purpose of Monograph

Navy manpower planning is the process by which the Navy and other branches of government endeavor to provide the personnel necessary to man the fleet. It is a rich and complex topic that has a large body of institutional knowledge and a large body of prior research. It is a multidisciplinary subject, and there are many complicated long-standing problems.

Gaining an understanding of Navy manpower planning is not easy: there's a lot to learn and no standard texts. Moreover, knowledge is diffuse and not captured in one place. The goal of this document is to provide an overview of the process. The target audience is anyone who wants a broad understanding of Navy manpower planning—for example, someone moving into a leadership position in the management of Navy personnel. We also point people in the right direction to obtain further information on the many intricacies and issues. We leave out many details because we don't want to obscure a main message in a forest of details. We are aiming to be “roughly right” and convey the big ideas and key information. We apologize for any resulting lack of precision.

Navy manpower planning has been described as “getting the right person to the right place at the right time.” This simple statement addresses the layers of complexity that apply to the management of Navy military personnel. An example provides some insights.

Consider the task of ensuring that the Navy has an ample supply of proficient destroyer commanding officers in the year 2017. For this to happen, an extensive sequence of events must have occurred over many years:

- The Navy recruited sufficient surface warfare officers at the beginning of the 21st century.
- The Navy provided career development to these officers.
- The Navy retained enough high-quality officers to provide a good “quality cut” for selection of officers for career advancement.
- The promotion of officers in each cohort met legal and policy guidelines.
- The personnel distribution system selected excellent officers to fill the commanding officer billets when the vacancies for these assignments arose.

Each of these events is complicated and also needs to be consistent with the other events. Moreover, multiyear planning inevitably involves a lot of uncertainty and trade-offs between short- and long-term considerations. Hence, the successful management of this task requires a lot of understanding of many personnel management issues and how they work together. The purpose of this monograph is to help provide such an understanding.

Navy personnel management focuses on several categories of personnel: active duty personnel, reserves, civil servants, and contractors. Different considerations (legislation, policies, objectives, personnel management objectives, etc.) apply to each personnel category. This monograph focuses on active duty personnel, who are the primary concern of Navy management.

Top-Level View of the Navy Manpower Planning Process

We start by providing a top-level view of Navy manpower planning. The discussion is rife with jargon, so we introduce terms as we proceed.

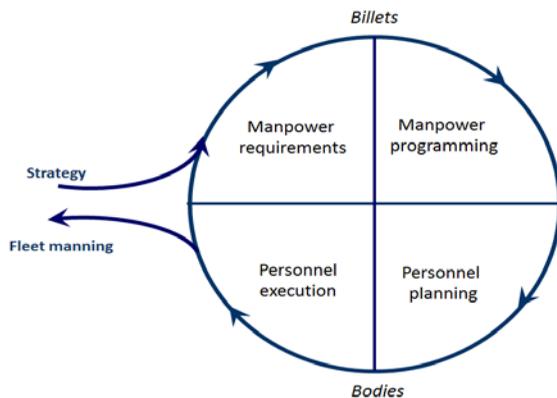
There is a fundamental distinction between the jobs that are required to enable the Navy to operate and the people who undertake them. Navy use of the term

manpower is different from the generic term *manpower planning*, which is used in industry and academia to describe the entire process of matching the supply of people with the demand for people. The Navy uses *manpower* to describe the jobs and *personnel* to describe the people filling the jobs. The Navy avoids confusion by using the phrase *manpower, personnel, training, and education (MPT&E)* to refer to the entire process of determining manpower requirements and obtaining personnel to match the requirements. Navy MPT&E has four major steps:

1. Determining manpower requirements (the *billets*)
2. Obtaining the funding (i.e., *programming*) for the required manpower
3. Planning to obtain and professionally develop the required personnel (the *bodies*)
4. Executing the personnel plans to match the bodies with the billets

Figure 1, taken from a Naval Postgraduate School course on Navy MPT&E [1], is informative.

Figure 1. MPT&E Process



The diagram shows a cyclical flow of events. The starting point is national defense strategy and priorities that provide a strategic demand signal to the

Navy, leading to a need for manpower. The *manpower requirements* process produces a detailed set of manpower requirements (i.e., the numbers of billets required at each Navy activity, specified by skill and seniority level). The next step is the *manpower programming* process, in which the Navy produces budgets to fund the manpower requirements. There are inevitable compromises in the manpower programming process, as the needs for manpower are balanced against budget constraints. The end product of manpower programming is a set of billets that are funded by Congress (*authorized* billets), which provides input to the next step in the process, *personnel planning*.

Personnel planning addresses every stage of personnel management, including recruitment, training, career planning and development, education, advancement or promotion, and managing retention. The plans for each stage of personnel management interact with each other and need to be consistent. For example, recruiting plans should be consistent with training schedules and class sizes. The end product should be plans that enable the Navy to attain the personnel required to man the authorized billets. The final stage in the MPT&E process is *personnel execution*, when Navy personnel managers take steps to implement the plans. These steps include everything from the recruiting of personnel to the assigning of personnel to jobs. Execution of the plans frequently calls for judgment regarding the trade-offs between competing priorities, such as balancing how well the personnel fit the jobs with the travel costs of making the assignments. The end product and primary objective of the entire MPT&E process is the manning of the fleet—that is, the numbers of personnel assigned to Navy operational units and how well their skills, experience, and seniority match the manpower requirements of these units.

Inevitably, fleet manning is imperfect. Some of the reasons for this are that plans are made with assumptions regarding the future, which rarely occur exactly as anticipated (the MPT&E process is complex, and interactions between

various decisions are difficult to fully understand, leading to an inconsistent set of MPT&E decisions), and budget constraints may make it impossible to execute all plans perfectly. Hence, there is a feedback loop: the state of fleet manning will cause MPT&E managers to make decisions in future plans to address problems.

The Time Dimension in MPT&E

The need to make decisions today for events in the future is the underlying cause of much of the complexity and many of the constraints that bound and affect Navy MPT&E. One cannot understand Navy MPT&E without understanding the profound impact of time on MPT&E management.

The starting point is the closed labor market nature of military personnel. Navy personnel are almost all recruited at a young age, and then trained and developed for lengthy careers. For example, the Navy does not advertise in *The New York Times* for commanding officers of Navy ships; the Navy recruits ensigns today to provide commanding officers 15-20 years in the future. The closed labor market imposes many restrictions on Navy personnel: decisions today will affect Navy personnel for many years as cohorts of personnel gradually age. Consequently, personnel managers need to make trade-offs between the state of personnel today and the state of personnel in the future. Decisions to meet personnel goals or budgets today may have short-term benefit but adverse effects in the long term, and vice versa. A central tenet and motivation of MPT&E planning is to produce plans that reconcile near- and long-term goals. We provide more details about this later in the monograph.

Long-term plans are inherently using forecasts regarding the future. Such plans have to make assumptions regarding the future, and these assumptions are typically somewhat incorrect. Hence, long-term plans are subject to a margin of error/uncertainty. Unfortunately, plans are frequently presented as precise

estimates (e.g., the Navy will need 38,000 enlisted accessions in 2020). It is preferable to provide margins of error in such forecasts (e.g., the Navy will need somewhere between 37,000 to 39,000 enlisted accessions in 2020). An appreciation of uncertainty is an essential part of MPT&E management.

“Optimal” MPT&E management decisions require trade-offs between current and future needs, and it may frequently be more efficient to spend some money today to save money tomorrow. However, that is not the nature of defense manpower budgets. Manpower budgets are not fungible between years: each fiscal year has a budget and the Navy must manage personnel in order to keep within budget limits. This frequently leads to decisions that may be beneficial in the short term but are harmful to the long-term welfare of the Navy. For example, toward the end of a fiscal year the Navy may stop the regular movement of personnel to new assignments, as funds for making moves between assignments run low. This may save some travel funds in the short term, but it may have long-term detrimental effects, such as causing personnel shortages in the fleet and clogging up training pipelines in the future when large numbers of personnel move at the same time as the Navy “catches up” on the delayed moves.

MPT&E Management Structure

Many organizations are involved in the management of Navy personnel. An understanding of what they are, their respective responsibilities, and their organizational interactions is necessary to appreciate how Navy MPT&E operates. Here we provide a brief description of these organizations and discuss their work in more detail later in this monograph.

The Chief of Naval Personnel (CNP) has the central role in Navy MPT&E. The Navy's official website¹ notes that:

CNP is a three-star admiral responsible to the Chief of Naval Operations (CNO) for Navy's manpower readiness. CNP also serves as Deputy Chief of Naval Operations (Manpower, Personnel, Training and Education/N1) and oversees the Bureau of Naval Personnel, Navy Personnel Command and the Navy Manpower Analysis Center. CNP's conglomerate serves as the single resource for all strategy and resource policies concerning manpower and training programs.

CNP's immediate staff comes from his position as OPNAV N1. OPNAV tends to reorganize every few years, including frequent reorganizations in OPNAV N1. However, there are three divisions within N1 that endure over time and are fundamental to the work within N1:

- N10, responsible for financial management of the Military Personnel Navy (MPN) appropriation that pays for military personnel
- N12, responsible for implementing the policy, planning, and programming of Navy manpower requirements (i.e., it manages the *billets*)
- N13, responsible for policies and plans that apply to Navy personnel (i.e., it manages the *bodies*)

There are other organizations within N1. All of them are important, though some are incidental to this monograph (e.g., N16, which has responsibility for MPT&E information systems).

The Navy Personnel Command (NPC), located in Millington, Tennessee, is a second key organization within Navy MPT&E management. NPC can be thought of as the organization that implements the policies developed in OPNAV N1. The primary divisions within NPC follow:

¹ See http://www.navy.mil/navydata/leadership/cnp_resp.asp.

- PERS-3, *Personnel Information Management*, manages personnel records.
- PERS-4, *Career Management*, comprises the detailers who assign personnel to jobs.
- PERS-8, *Career Progression*, runs the boards for officer promotions and senior enlisted personnel advancements.²
- PERS-9 has responsibilities for reserve personnel management.

The Bureau of Personnel (BUPERS) is a third organization within Navy MPT&E management organization, also located in Millington, and has several divisions. The key division for our discussion is BUPERS-3, *Military Community Management*, which has responsibility for planning the careers of individual skills (communities) for both officers and enlisted personnel. The division of functions between OPNAV N1, NPC, and BUPERS has evolved over time and is complicated. The management structure is correspondingly complicated. CNP is the head of BUPERS and also the head of OPNAV N1. The BUPERS Deputy is the Deputy Chief of Naval Personnel (DCNP), who is also double-hatted as the Commander, Navy Personnel Command. This makes organization charts suitably complex, though, in a practical sense, CNP is the boss in Washington and DCNP is the boss in Millington and reports to CNP.

The Navy Manpower Analysis Center (NAVMAC) develops manpower requirements for all afloat units. It is located in Millington and reports to OPNAV N12. Another Navy organization in Millington is the Navy Recruiting Command (NRC). NRC recruits both enlisted personnel and officers. NRC reports to OPNAV N1.

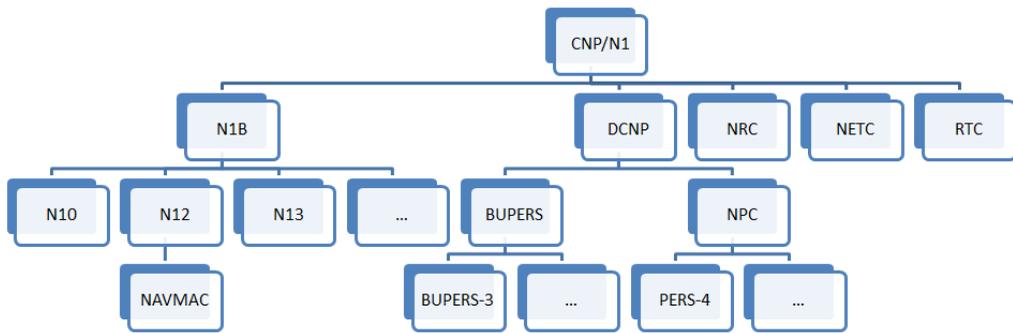
Navy personnel receive training throughout their careers. Some training is directed at individuals with the aim of enhancing their individual skills and expertise. Other training is directed at units with the aim of enhancing unit

² In Navy parlance, officers are promoted and enlisted personnel are advanced.

proficiency. The Navy Education and Training Command (NETC), manages and undertakes most of the individual training in the Navy.³ The majority of individual training is directed at enlisted personnel, either in initial skill training to qualify for a Navy rating or in subsequent training to acquire expertise in specific areas/equipment. NETC also manages initial education of officers in Reserve Officer Training Corps (ROTC) programs and Officer Candidate Schools. In addition, the Navy Recruit Training Command (RTC), in Great Lakes, Illinois, conducts bootcamp for all new enlisted sailors. NETC and RTC report to OPNAV N1.

The foregoing organizations make up what has been called the MPT&E Enterprise, and it is through them that CNP manages Navy MPT&E. The following diagram (Figure 2) provides an organization chart of the MPT&E Enterprise.

Figure 2. Navy MPT&E Enterprise



KEY

- | | |
|--------------------------------|---|
| CNP = Chief of Naval Personnel | N1 = Deputy Chief of Naval Operations (MPT&E) |
| NPC = Navy Personnel Command | BUPERS = Bureau of Personnel |
| NRC = Navy Recruiting Command | NETC = Navy Training & Education Command |
| RTC = Recruit Training Command | NAVMAC = Navy Manpower Analysis Center |

³ Equipment manufacturers may provide (*factory*) training on new equipment to pertinent sailors when the equipment is installed in the fleet. Such training is not managed by NETC.

There are other organizations that represent the fleet in MPT&E management. These organizations articulate manpower requirements and are the “customers” of CNP; that is, the primary responsibility of CNP is to provide sufficient suitable personnel to man the fleet, and these fleet organizations focus on whether fleet manning is adequate.

The primary fleet organization is United States Fleet Forces Command (FFC), located in Norfolk, Virginia. One part of FFC’s mission is to train, certify, and provide combat-ready forces to Combatant Commanders. FFC N1, *Personnel Development and Allocation*, advises the Commander, FFC on all matters relating to the effective and efficient management of the 260,000 active duty, reserve, civilian, and contractor personnel assigned to U.S. Fleet Forces, U.S. Pacific Fleet, U.S. Naval Forces Europe, U.S. Naval Forces Central Command, and U.S. Naval Forces Southern Command. FFC N1 is the primary organization for expressing fleet manning concerns and considerations to the CNO’s staff.

FFC was originally the Commander in Chief Atlantic Fleet. The corresponding organization in the Pacific area of operations is Commander, U.S. Pacific Fleet (PACFLT). PACFLT N1, *Total Fleet Force Manpower and Personnel* directorate, leads all workforce matters relating to military (active duty and reserve), civilian, and contractor personnel employed throughout the Indo-Asia-Pacific area of responsibility (AOR). PACFLT N1 supports the strategic mission of providing combat-ready forces and operating forward in global areas of consequence by collaborating with and partnering with United States Fleet Forces (USFF).

The Type Commanders (TYCOMs), Commander Surface Forces (SURFOR), Commander Aviation Forces (AIRFOR), and Commander Submarine Forces (SUBFOR) have responsibilities to train, man, and equip their respective operating forces. TYCOM training responsibility is for unit-level training, whereas NETC provides individual training. The N1 organizations within the

TYCOMs monitor and manage manning in their units and are the principal spokespersons for manning issues within their units.

In the remainder of this document, as we address various MPT&E processes, we will frequently refer to the above organizations and their roles in individual aspects of MPT&E management. Initially, we will describe each process and associated organizations in isolation. Then, we will address the interactions between the processes, including the many potential coordination challenges that may occur at the seams between organizations.

Requirements

There are some differences in the processes for determining military manpower requirements for officers and enlisted personnel. Hence, we describe them separately—different processes and policies between officers and enlisted personnel persist throughout Navy MPT&E—and we will continue to treat them separately. Manpower requirements are statements of the quantity and quality (skills, seniority) of people required to perform the work under consideration, without regard to any practical constraints (typically fiscal). Navy policies and procedures for determining manpower requirements are specified in [2], *Navy Total Force Manpower Policies and Procedures*, a detailed instruction that provides a wealth of information.

Billet Descriptions

Each job in the Navy is a billet. A billet is described/defined in a number of ways, including the following:

- The activity where the billet is located
 - The activity is described by a unique unit identification code (UIC).
- The grade of the billet
 - Officer billets have 10 grades (O-1 to O-10), from ensign to 4-star admiral.
 - Enlisted billets have 9 grades (E-1 to E-9), from seaman recruit to master chief petty officer.
- Primary expertise required for the billet

- Officers have a primary area of expertise (e.g., surface warfare officer, or supply corps officer), which is called their *designator*.
- Enlisted personnel have a primary area of expertise (e.g., sonar technician), which is called their *rating*.
- Every billet will have either a designator (officer) or rating (enlisted personnel).
- Secondary expertise required for a billet. Some billets require more specialized skills than defined by a designator or rating
 - Officer secondary expertise requirements address such areas as joint duty experience or a graduate degree in operations research. These skills are defined by *additional qualification designators (AQDs)* and *subspecialty codes*.
 - Enlisted personnel secondary expertise requirements address such areas as knowledge regarding the maintenance of a particular type of Aegis fire control system. Such skills are defined by *Navy Enlisted Classifications*, or NECs.

The foregoing descriptors are the language building blocks for describing Navy MPT&E; everything is built upon them.

Categories of Manpower

Manpower requirements are divided into three categories:

- Afloat requirements
- Shore requirements
- The individuals account

Afloat requirements refer to jobs (billets) for all afloat units (ships, squadrons, submarines, etc.). *Shore* manpower requirements refer to billets for all shore activities (OPNAV staff, schools, supply depots, etc.). The *individuals account* refers to the amount of time personnel spend in a nonproductive status away from a duty station (traveling between duty stations, attending a Navy school in preparation for full duty, etc.). There are distinct processes for estimating the manpower requirements in the three manpower categories. Accordingly, we address them individually.

Afloat Manpower Requirements

Manpower requirements for afloat units are developed by NAVMAC. NAVMAC has a number of functions in support of Navy manpower requirements determination. Its central function is developing manpower requirements for the fleet. The NAVMAC website (<http://www.public.navy.mil/bupers-npc/organization/navmac/Pages/default3.aspx>) contains numerous informative briefings describing its work. The command overview brief [3] contains the following summary of NAVMAC's work: "we define, translate, and classify the Navy's work into a workforce structure and position demand signal to sustain a combat ready force...."

NAVMAC principal products are ship manpower documents (SMDs), which specify manpower requirements for ships and submarines, and squadron manpower documents (SQMDs), which specify manpower requirements for aviation squadrons. The methodologies for developing SMDs and SQMDs are fundamentally the same: workload engineering and observations are used to categorize the work and the amount of labor required to accomplish the work.

The starting point for developing an SMD or SQMD is a statement of required operational capability and projected operational environment (ROC/POE), which defines the wartime mission(s), the capabilities to be achieved, and the environment under which the missions will be conducted. For example, an SMD

may note that full surface warfare capabilities are to be achieved and sustained for 60 days at sea in wartime. NAVMAC analyzes and determines in accordance with [2] the minimum **quality** (paygrade, rating, etc.) and **quantity** of manpower required to accomplish 100 percent of capabilities as defined in the latest approved ROC/POE.

The SMD and SQMD methodology for enlisted personnel has four distinct steps:

1. Categorize the labor required—watch standing, preventive maintenance, corrective maintenance, facilities maintenance, etc.
2. Use empirical methods to determine the workload for each labor category.
3. Use Navy workweek standards (see [2]) to determine the required numbers of personnel.
4. Use NAVMAC staffing tables to assign paygrades.

The steps are not identical for SMDs and SQMDs (e.g., squadrons do not have watch-standing requirements). Nevertheless, the above description provides a top-level overview of the process. Much detail has been omitted, and the reader should consult the NAVMAC website for further details.

Officer manpower requirements determination is different. In SMDs, officers exist for three reasons: command authority (e.g., a department head), tactical watch standers, and specialized skill/knowledge (e.g., staff JAG/attorney). In squadrons, officer requirements are also driven by determining manpower requirements for aircrews (pilots, naval flight officers (NFOs), etc.).

NAVMAC has been producing SMDs and SQMDs for many years. Nothing is perfect, and aspects of SMDs and SQMDs are routinely and reasonably questioned. Overall, however, they follow a reproducible method for estimating manpower requirements, and they are accepted throughout the Navy, the

Office of the Secretary of Defense (OSD), and Congress as a reasonably accurate depiction of afloat manpower requirements.

The situation is much less defined for the determination of ashore manpower requirements and the individuals account.

Shore Manpower Requirements

Manpower requirements for shore activities are governed by the Shore Manpower Requirements Determination (SMRD) program. Guidance for the SMRD program is found in [2]. FFC takes part in determining manpower requirements for shore activities that are in its chain of command and has documented the SMRD process in [4]. The starting point for SMRD is a Mission, Functions, and Task (MFT) statement. MFTs are prepared and approved according to guidelines established in an OPNAV instruction [5], which states that each shore activity requires an MFT statement and that:

- **Missions** are concise, unclassified general statements of what the activity is to accomplish.
- **Functions** are workload derived from the main elements of an activity's mission.
- **Tasks** are workload accomplished in connection with existing program policy directives or written tasking assignments.

In most situations, commands prepare MFTs for organizations under their administrative chain of command.

Reference [2] notes that SMRD shall be used for activities governed by an MFT statement in order to:

- Determine and validate shore manpower requirements based on valid, approved workload.
- Link peacetime and mobilization manpower requirements.

Moreover, the purpose of the SMRD is to:

- Review, measure, and assess required shore activity workload in terms of directed MFTs across all conditions of readiness.
- Determine the minimum manpower requirements necessary to accomplish the shore mission.
- Determine whether the tasking used to develop requirements is authorized by higher authority.
- Standardize like activities and/or functions.

There are some fundamental differences between the shore and afloat manpower requirements determination processes. First, in shore manpower requirements determination, to a large extent, commands determine their own requirements, whereas an independent organization (NAVMAC) determines afloat manpower requirements. Concerns regarding bias, whether conscious or not, accompany shore manpower requirements determinations. Second, afloat manpower requirements are typically more concrete and easier to measure than shore manpower requirements. In addition, afloat units have more similarity in the structure/content of their manpower requirements than is found between ashore units. For example, a large part of afloat manpower requirements is to conduct required maintenance, and the determination of these requirements is empirical and based on statistics regarding preventive maintenance schedules and expected failure times. Conversely, MFTs typically contain many tasks that are much less precisely defined. For example, consider the mission, functions, and tasks of the Naval War College, as specified in [6]. One part of the mission for the Naval War College is:

Educate and Develop Leaders. NAVWARCOL shall provide current, rigorous and relevant professional military education (PME) programs supporting the Navy's Professional Military Education Continuum. These PME programs must meet the standards required in law and policy and be accessible to the

maximum number of qualified U.S. officers and Navy enlisted personnel, civilian employees of the U.S. Government, and international senior enlisted leaders and officers. The education should foster an active and growing community linked by PME including leadership with professional ethics that furthers global maritime security. The desired effect is a career continuum of PME, including leadership development and professional ethics, which produces a group of leaders of character. These leaders have trust and confidence in each other and are operationally and strategically minded, critical thinkers, proficient in joint matters, and skilled naval and joint warfighters prepared to meet the operational level of war (OLW) and strategic challenges of today and tomorrow.

One of the functions that derives from this mission is *Navy PME with Embedded Joint PME (JPME)*, which gives rise to numerous tasks, including the following:

Provide resident, senior-level education (SLE) through a program of Navy PME with embedded JPME Phase II in the College of Naval Warfare, and intermediate-level education (ILE) through a program of Navy PME with embedded JPME Phase I in the College of Naval Command and Staff. These professional programs are for selected naval officers, officers of other services, civilian officials of the U.S. Government, and senior enlisted personnel.

These MFT statements are well written and appropriate. However, they address tasks where the manpower requirements are much harder to quantify. This is the nature of manpower requirements determination for much of the shore establishment.

The Individuals Account

The Navy has requirements for personnel at both afloat and shore activities. However, personnel are not always at these activities. Personnel may be in training, moving between duty stations, sick, in the brig, and so on. Such

personnel are accounted for in *the individuals account*. The Navy needs to pay personnel while they are in such a status; consequently, it needs to budget for the individuals account. OPNAV N12 has oversight over the individuals account requirements determination process and follows policy guidance provided in [2].

The individuals account requirements determination process is largely statistical and based on MPT&E plans (size of the force, extent and length of training courses, etc.) and historical size of the individuals account. There have been many analyses of the required size of the individuals account, or some part of it. (For example, a recent Center for Naval Analyses (CNA) report [7], provides a methodology for estimating the extent of enlisted student manpower requirements.) Execution of the account, however, has been an almost constant problem within Navy MPT&E (i.e., the numbers of personnel in the individuals account far exceed the numbers of billets) largely because of unwillingness on the part of the Navy, OSD, and Congress to properly fund the individuals account.

Programming

Programming is the process of providing funding to the required billets. It is a multiyear process with many moving parts.

PPBE Process

Programming takes place within the Department of Defense's (DoD's) resource allocation process, the *Planning, Programming, Budgeting, and Execution (PPBE)* process. A briefing from the 2010 Department of the Navy Human Resource Conference [8] provides a good description of the PPBE process, and we draw from it in the text that follows to provide an overview. Direction for the PPBE process is provided by DoD Directive 7045.14 [9].

First, we introduce the PPBE *components*:

- **Planning** establishes strategic priorities and capabilities required to achieve the strategy.
- **Programming** applies resources to programs that provide the capabilities required to achieve the strategic priorities. It is a top-down process that allocates future resources between competing requirements, and is the starting point for the budget.
- **Budgeting** properly prices the programs, develops justification, and formulates an execution plan. Budgeting is a bottom-up process that provides detailed cost estimates and identifies disconnects between guidance from planning/programming and recent execution.
- **Execution** performs the approved plan.

A crucial understanding of PPBE is that constrained resources drive the process:

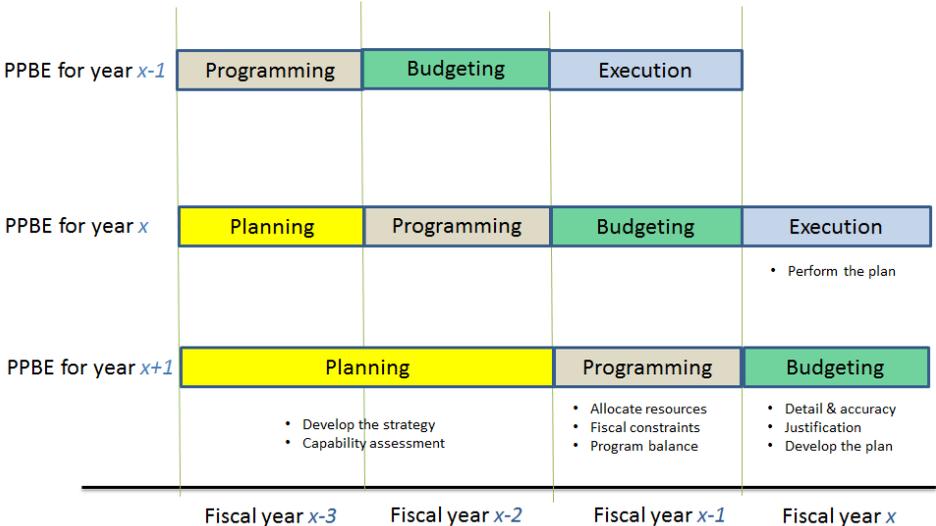
- The process is successive—from within the Navy and the Marine Corps to the Department of the Navy, to OSD, and to the Office of Management and Budget (OMB).
- Understanding of requirements and their relative priorities is essential.
- The end result must achieve balance between the programs and total obligation authority (TOA).

Military manpower is a part of the PPBE process, and funding for military manpower takes place in the context of the funding for the remainder of DoD, such as acquisition of new weapons systems and R&D.

The PPBE process results in a seven-year Future Years Defense Program (FYDP): the current (*execution*) year, next year (the *budget* year), and 5 *program* years beyond the budget year. Manpower authorizations are aligned to the FYDP. It is an iterative process: each year the PPBE process produces plans, updating previous plans that are now a year closer to execution, and developing a new plan for the year that has now moved into the FYDP time horizon. Figure 3 illustrates the PPBE overlapping “cycles.” It shows that planning for a particular year starts several years in advance. For example, consider the PPBE for fiscal year x . Planning occurs in fiscal year $x-3$, programming occurs in fiscal year $x-2$, budgeting occurs in fiscal year $x-1$, and execution occurs in fiscal year x . Programming builds on prior year’s planning, budgets build on prior year’s programming, and so on.

The development of authorizations for Navy billets is just one part of this process.

Figure 3. PPBE Overlapping Cycles



Authorizations

The end products of manpower programming are *authorized billets* (BA). Billets are authorized when Congress provides funding for the billets. BA is the target that personnel planners endeavor to meet.

Two categories of organizations play key roles in the development of authorizations: *resource sponsors* and *Claimants/Budget Submitting Offices (BSOs)*.

Resource sponsors are OPNAV organizations (N2/N6, N4, etc.) that are responsible for an identifiable aggregation of resources that constitute inputs to warfare and supporting tasks. Their span of responsibility includes interrelated programs or parts of programs located in several mission areas. They ensure an effective and balanced program within assigned fiscal controls, and they assist during internal Navy budget reviews to maintain a balanced

program. Resource sponsors work in a top-down manner, applying top-level guidance and constraints to resources in their span of responsibility.

Claimants/BSOs are the organizations that develop the authorization of billets at individual activities. They work in a bottom-up fashion. The requirements determination process produces the individual required billets at each activity. The Navy information system, the Total Force Manpower Management System (TFMMS), lists each billet in the Navy, including a wide variety of information, such as the activity, grade/rank, and skill. TFMMS also notes the required billets and the subset of authorized billets. The programming process provides the decisions regarding which required billets are authorized. The BSOs include such organizations as BUPERS, Naval Air Systems Command, and PACFLT. The BSOs submit budgets to authorize individual billets, in a bottom-up process. These submissions are reconciled with the top-down constraints provided through the resource sponsors, leading to a list of authorized billets.

High-level guidance and constraints are, by their very nature, not all very detailed. For example, Congress will pay for a fixed number of Navy billets. Congress does not specify which billets; it's the job of the resource sponsors working with the BSOs to determine which billets to authorize. Congress provides the Navy funds in a number of appropriations. Critical to Navy MPT&E is the Military Personnel Navy (MPN) appropriation, which pays for active duty Navy personnel.⁴ Congress provides two constraints in the MPN account: a specified number of dollars to pay for personnel, and a limit on the number of personnel that may be on active duty at the end of the fiscal year (*endstrength*). The number of Navy personnel on active duty varies throughout the year and is typically higher in the summer months when large numbers of accessions join the Navy after leaving high school. The average cost of a sailor also varies

⁴ The Reserve Personnel Navy (RPN) appropriation pays for the Reserves. The Operations and Maintenance Navy (O&M,N) appropriation pays for civilians. Contractors are funded by a variety of appropriations. They are not a major consideration here.

during the year—driven by personnel actions, such as advancements or promotions. The dollars appropriated in the MPN account are based on this annual personnel cycle. The nature of this cycle causes the numbers of man-years of labor that derive from the MPN appropriation to be lower than the endstrength specified by Congress. Managing personnel to stay within MPN dollar limits and also meet endstrength goals is a central part of Navy MPT&E.

Also note that the MPN appropriation is for a single fiscal year, which constrains MPT&E management. Many MPT&E issues require consideration of actions over many years; that’s the nature of a closed labor market. There are many occasions where “optimal” decisions may require spending money now in order to be in a better situation several years in the future. However, single-year appropriations do not lend themselves to such actions, and the legal imperative to not overspend the MPN account frequently results in long-term negative effects and inefficiencies.

The reconciliation of top-down constraints with the bottom-up nature of TFMMS results in documents called *programmed authorizations*. There are two such documents: *enlisted programmed authorizations (EPA)* and *officer programmed authorizations (OPA)*. EPA and OPA describe the numbers of authorizations for each paygrade within each skill area (e.g., commander submarine officers or chief petty officer sonar technicians). EPA and OPA are aggregate data and do not describe the numbers of authorizations at individual activities. EPA and OPA are produced twice a year. Each time they are produced, the authorizations in TFMMS are reconciled with EPA and OPA targets, thus providing a list of individual authorized billets that meets aggregate OPA and EPA totals. In the six months following the production of the latest EPA and OPA, many manpower changes occur. For example, budget cuts may cause aggregate manpower goals to be reduced, or individual activities may amend/update their billets in TFMMS. This can lead to a situation in which the aggregate goals are somewhat inconsistent with the detailed authorization

goals specified in TFMMS. Such inconsistencies are some of the many reasons why manning levels are imperfect. In particular, OPA and EPA provide an input demand signal to personnel planning, and TFMMS provides an input demand signal to personnel distribution. If OPA/EPA and TFMMS are not aligned, personnel plans and distribution may also be imperfectly aligned.

Discretionary Spending

The Navy's MPN budget is large—almost \$30 billion annually. This makes the MPN account a major target when savings are being sought in budget deliberations. A potential budget cut may seem quite small from a percentage perspective. For example, a \$1 billion cut in the MPN appropriation would be a little over a 3-percent cut, which seems initially to be comparatively small. However, this is not so, and there is very little room for maneuver on the part of MPT&E managers in implementing budget cuts in the MPN account. This is because most MPN expenditures follow directly from the number of authorizations; if there are personnel in uniform, they will get paid. In addition, the MPN account includes obligations for providing health care funding to military retirees. Consequently, there are few options regarding how to save MPN dollars without reducing the number of personnel in uniform—an option that is typically both militarily and politically unacceptable. In fact, Navy MPT&E managers typically note that less than 5 percent of the MPN account is discretionary spending (i.e., CNP has the ability to cut expenditures in this part of the appropriation). There are a limited number of actions CNP can take to reduce MPN expenditures, and these actions routinely occur. Such actions include the following:

- Cutting back on permanent-change-of-station (PCS) moves
- Back-loading accessions until the end of the fiscal year to reduce the person-years of labor for which the Navy pays

- Delaying advancements and promotions until later in the fiscal year
- Delaying selective reenlistment bonus payments until the next fiscal year
- Taking cuts in the individuals account

Nobody claims that such actions are desirable, and they all have negative effects, but they are preferable to actions that would involve a reduction in endstrength. This is an area where the single-year nature of the MPN appropriation is unfortunate. The Navy could implement more efficient fiscal management if it had the ability to plan expenditures over a multiyear timeline.

Personnel Planning

The next quadrant in Navy MPT&E is *personnel planning*, where Navy staff make plans to obtain personnel that match authorization levels in both quantity and quality. There are many parts to personnel planning, and we will address all of them in this section. First, however, we present the analytic framework for managing and understanding Navy MPT&E. This framework is the foundation of Navy personnel management, and it is against this framework that all of the above issues are addressed.

Analytic Framework

Closed Labor Market, Survival Curves, and Paygrade “Pyramids”

A closed labor market is the foundation of military personnel management. The management of personnel in any organization gives rise to many questions regarding the numbers of mid-grade staff, the numbers of senior staff, and potential staff shortages or excesses in the future. In a closed labor market, personnel enter with zero experience and gradually develop experience over numerous years. If we use years of service to measure experience, we have the following obvious fundamental observation that the number of personnel with n years of service in year t is at most the number of personnel that had $n-1$ years of service one year ago in year $t-1$. For example, if we want 100 personnel with 10 years of experience next year, we need at least 100 personnel with 9 years of experience this year. This leads to a graph that is ubiquitous in Navy personnel management, a length-of-service distribution. Figure 4 is an example of such a graph.

Figure 4. Length-of-Service Distribution for OS Rating

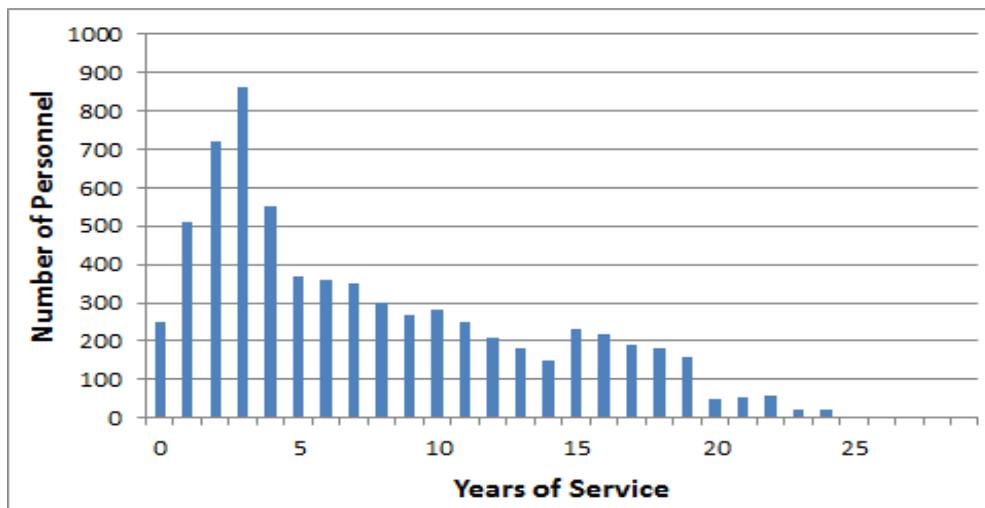


Figure 4 exhibits the distribution of personnel by length of service for the Operations Specialist (OS) rating. This graph was taken from a routine briefing found on the Navy Personnel Command (NPC) website and describes the state of the OS rating in the summer of 2016. The x-axis shows the years of service of OS personnel. The y-axis shows the number of such personnel. The figure shows, for example, that there are approximately 850 OS personnel with 3 years of service, 550 OS personnel with 4 years of service, and so on. If we want to forecast how many personnel will have 5 years of service one year from now, we take the number of personnel who currently have 4 years of service (i.e., 550) and multiply it by the percentage of personnel with 4 years of service that we expect to remain on active duty for the next year.

The graph shows that the number of OS personnel increases in the first few years of service, an apparent contradiction to the declining cohort nature of a closed labor market. The reason for this discrepancy is that Figure 4 does not account for the flows of personnel into the OS community, mostly via

accessions as non-rated personnel. If we were to include in Figure 4 the “pipeline” of personnel who will flow into the OS community, then we would derive declining cohort sizes.

The number of personnel who remain from one year to the next is the continuation rate. Hence if we have a continuation rate of 0.9 and 100 personnel this year, next year we will have $100 * 0.9 = 90$ personnel. If we iterate these computations, we can compute how many personnel remain (“survive”) for two or more years.

There is a well-developed complex statistical methodology for studying personnel in such a manner. It is the study of “wastage systems.” The textbook, *Statistical Techniques for Manpower Planning*, by David Bartholomew and Andrew Forbes [10], provides an excellent description of these methods.

Many questions that arise in personnel planning require forecasts of how many personnel with a particular experience level the Navy will have some number of years from now and what actions the Navy should take to ensure that it has a sufficient number of such personnel. A *survival curve* is closely related to a length-of-service distribution and is frequently used in such deliberations. Describing a survival curve requires some notation. Suppose the number of personnel with n years of service in year t is $INV(n,t)$, and the continuation rate between n and $n+1$ years of service is $CR(n)$. Then we have the following relationship:

$$INV(n+1, t+1) = INV(n, t) * CR(n)$$

We can repeat this calculation to obtain:

$$INV(n+2, t+2) = INV(n, t) * CR(n) * CR(n+1), \dots \text{ etc.}$$

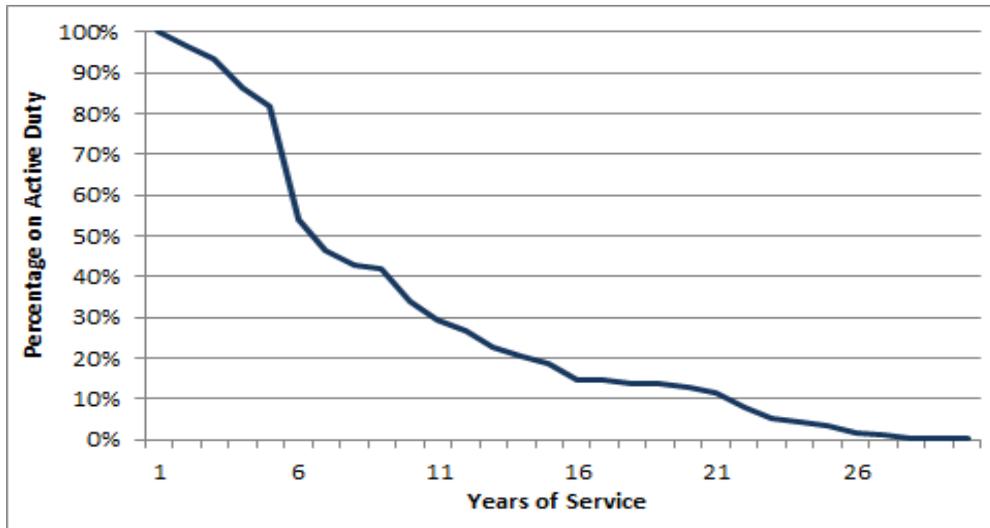
Suppose we recruit X personnel, who enter the Navy with no years of service. One year from now, we will have $X*CR(0)$ personnel with 1 year of service, two years from now we will have $X*CR(0)*CR(1)$ personnel with 2 years of service,

and so on. We can continue these computations for an entire Navy career,⁵ providing the following results: the number of personnel who will remain on active duty for n years is given by:

$$X * CR(0) * CR(1) * \dots * CR(n-1), \text{ where } 0 \leq n \leq 29$$

Figure 5 is a plot of these data, a survival curve that shows the percentages of accessions that remain on active duty (*survive*) for each year of service. Figure 5 is a realistic example of a survival curve for Navy personnel. We will frequently reference such curves/data in the remainder of the text that addresses personnel planning.

Figure 5. Sample Survival Curve



The closed labor market also implies constraints on paygrade structures. That's because personnel are advanced/promoted as their careers progress and they acquire experience. For example, it is not possible to have a community where all the personnel are commanders/O-5s (for officers) or chief petty officers/E-7s (for enlisted personnel); the Navy needs junior personnel to age and

⁵ With few exceptions, personnel are limited to 30 years of active duty.

progress into senior personnel. This leads to the notion of a paygrade “pyramid” that describes the relative sizes of authorizations in each paygrade. Figures 6 and 7 show the paygrade structure for all officer and all enlisted personnel billets, respectively, based on recent authorizations. In Figure 6, we group all the admiral billets (O-7 to O-10) due to the very small numbers of them. In Figure 7, following Navy practice, the lowest billet paygrades, E-1 to E-3, are grouped together.

We can see that the so-called pyramids are not exactly pyramid shaped. Notably, there are fewer O-1 and O-2 authorizations than O-3 authorizations. The reason for this is that personnel may remain in one paygrade much longer than another, and authorizations for one grade will be spread over a different number of cohorts than authorizations for another grade. In particular, most officers are in the O-1 and O-2 paygrades for 2 years each, and the O-3 paygrade for 6 years. If we “spread” the authorizations over the applicable years of service, we would attain a more realistic pyramid shape.

Numerous implications may be derived from Figures 6 and 7, notably in the area of promotions and advancements. Promotions and advancements in the Navy are vacancy-driven processes and are computed separately for each skill area.⁶ For example, the number of personnel who promote from O-4 to O-5 is based on the number of vacancies at O-5 (i.e., O-5 authorizations less O-5 inventory), and the number of vacancies will tend to increase as the number of O-5 authorizations grows.

The rules governing enlisted advancement and officer promotion are quite different. Officer promotions are tightly controlled by Congress,⁷ with strict limits applied to timing and promotion opportunity. Enlisted advancements are much more flexible and governed largely by service chief policies: there are

⁶ Unrestricted line officers (surface warfare officers, aviators, etc.) are considered together as one skill area (competitive category).

⁷ See the Defense Officer Personnel Management Act and U.S Title 10.

time-in-grade requirements to advance from one grade to the next, but, beyond that, timing and opportunity may and do vary widely. Nevertheless, the billet paygrade distribution provides insights into advancement/promotions.

Figure 6. Officer Pyramid

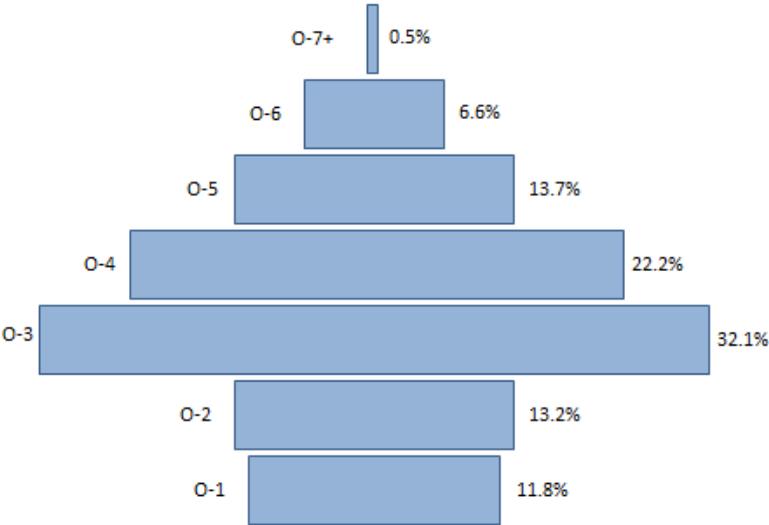
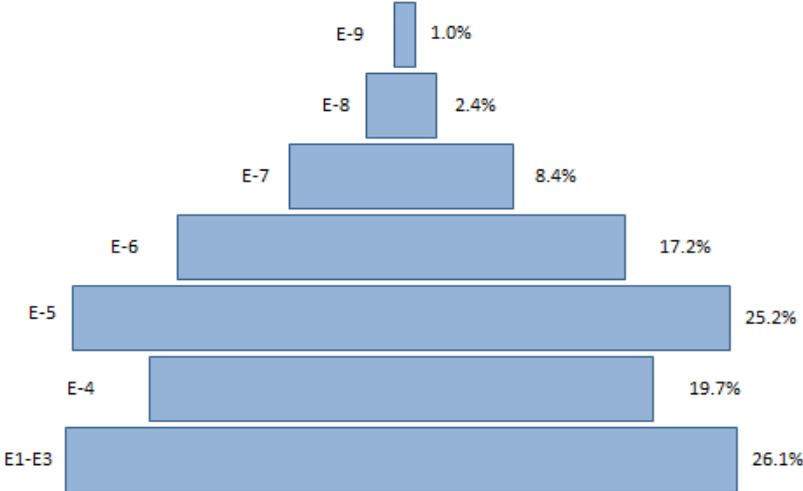


Figure 7. Enlisted Pyramid



We will revisit paygrade pyramids later in this monograph.

Components of Personnel Planning

Making use of the analytic framework, we are now in a position to address the intricacies of personnel planning. There are numerous parts/components of personnel planning, including the following:

- Strength planning
- Community management
- Accession planning
- Recruiting
- Training and education
- Advancement or promotion
- Compensation

These components are distinct personnel management processes, and we address each component below. There are also a variety of important topics that play a key role in personnel planning and are not personnel management processes, but they merit attention due to their importance in Navy MPT&E management. We address four such issues:

- The use of econometric modeling in personnel planning
- The use of decision support systems in personnel planning
- The choice of continuation rates in personnel planning
- The management of women in the Navy

Strength Planning

Personnel planning can be either “top down” or “bottom up.” The top-down planning ensures that Navy personnel, as a whole, meet budget constraints and high-level guidance. This top-level planning is called *strength planning*. Strength planning is on the boundary between the Requirements and Personnel Planning quadrants. It is the process of determining an affordable target for personnel planners.

Strength planning is mainly budget driven and, for that reason, has been undertaken by the staff in OPNAV N10, *Total Force Resource Management Division*, the part of N1 that ensures that the Navy lives within the MPN budget. As previously noted, the MPN appropriation has two major constraints:

- The total budget for the MPN account
- The upper limit on the number of personnel who may be on active duty at the end of the fiscal year (*endstrength*)

The MPN appropriation provides funds for all aspects of personnel compensation (base pay, incentive pays, etc.) and the costs of moving personnel between duty stations. This all has to be managed to ensure that budgets are not overspent. The approach taken to managing the budget is setting some limits on personnel plans (e.g., total accessions, total change-of-station moves) and phasing a variety of personnel actions throughout the year to adjust the costs. The actions that are phased include accessions and advancements/promotions. The end result is a *strength plan* that will enable the Navy to meet the constraints of the MPN appropriation. EPA and OPA are products of the strength planning process, and provide an affordable manpower target.

The strength plan, by necessity, is developed at an aggregate (All Navy, or ALNAV) level of detail. The majority of personnel planning and management

occurs at a more detailed, individual skill level. There is an obvious need for the sum of the individual plans to add up to and be aligned with the aggregate ALNAV strength plan. However, this consistency is difficult to attain, and inconsistencies that lead to inefficiencies in personnel management occur all the time. We address this in more detail below.

Community Management

The bottom-up planning entails planning for individual communities and is called *community management*. We continue by providing an overview of community management.

BUPERS-3, primarily located in Millington, Tennessee, conducts community management. Community managers consider one community at a time and have the job of trying to build and maintain an inventory of personnel in that community that meets distinct objectives/constraints:

- Personnel will follow a career path that describes the assignments that personnel will/should receive as their careers develop.
- The supply of personnel will meet both current and future authorization limits, including meeting aggregate goals regarding numbers of personnel in each paygrade, numbers of personnel on sea duty, and the like.

One of the major problems facing community managers is that they must abide by constraints and policy guidance that have been largely developed independent of each other and are not always consistent. This frequently produces goals that cannot simultaneously be met, resulting in imperfect/inefficient decision-making. We illustrate this point by considering a long-standing problem faced by the surface warfare officer (SWO) community manager.

The SWO career path contains a number of milestone tours. Initially, junior officers go to sea for division officer tours. Then, they have a shore assignment

before returning to sea as a department head, after roughly 8 years of service. The department head tour is a milestone in a SWO career: the Navy screens officers for this tour and needs to have a sufficient supply of qualified officers to fill all of the department head billets. Consequently, SWO accession requirements are based on accessing a sufficient number of junior officers to fill the department head billets 8 years in the future. The SWO community manager considers historical retention behavior to estimate the number of accessions required to provide sufficient department heads. Unfortunately, this number is far in excess of the number of SWO ensign (O-1) billets, forcing difficult decision-making: either access the number of SWOs to fill current ensign authorizations—and have a future shortage of department heads—or access sufficient SWOs to fill future department head billets—and have excess ensigns. The Navy chooses the latter option. It's the preferred solution to a problem brought about by inconsistency between career paths, the numbers of billets, and retention rates. Better solutions to such problems require improved coordination between the many parts of the Navy that contribute to and affect Navy MPT&E.

The foregoing overview of community management shows that community managers address many aspects of personnel planning. We now provide some details regarding each part of personnel planning. We address both officers and enlisted personnel as we proceed, pointing out similarities and differences in how they are managed. We also address community management in more detail.

Accession Planning

Personnel planners set targets for the number of recruits in accession plans. These targets describe how many personnel the Navy wants to recruit in a particular fiscal year in each skill area. For example, the Navy may plan to recruit 1,000 Operations Specialists in fiscal year 2017.

An obvious starting point for accession planning is to compute the number of new personnel required to meet authorization goals by the end of the fiscal year. This computation is based on a forecast of how many personnel will be on active duty at the end of the year and comparing that number with authorizations. However, the decision to recruit a certain number of personnel will have implications for many years as the entering group of personnel (the *cohort*) gradually ages and acquires more seniority; a small accession cohort in one year will lead to a small cohort with one year of service next year, and so on. Moreover, authorization levels may change over time. If a community is facing a large change in authorizations two to three years from now, it may make sense to address this prospective change in current recruiting. So, recruiting sufficient accessions to meet the authorization goals for the current fiscal year may not always be the best thing to do, when considered in a multiyear context. The previous example for surface warfare officers is a good example of accession needs that are based on a multiyear consideration.

The survival curve, as illustrated in Figure 5, is extensively used in accession planning. We may use the survival curve to compute a *steady-state* inventory. If we choose a set of continuation rates that we assume will apply for many years, and we access the same number of personnel each year, we will develop an inventory where the number of personnel with any particular year of service will remain the same from one year to the next, and the longevity distribution of personnel matches the survival curve. Such an inventory is called steady state because its longevity distribution remains unchanged from one year to the next. The sum of the numbers of personnel across each year of service is the total number of personnel in the community, and we can scale accessions appropriately to attain a total inventory that matches total authorizations. The benefit to using this approach to accession planning is that it provides an inventory whose experience mix is relatively unchanged from one year to the

next. Stability is a good thing, and the Navy makes extensive use of this approach in accession planning.

A consequence of using a stable survival curve approach is that the Navy may need to take other personnel management actions to ensure that the Navy attains desired endstrength within MPN appropriation limits. Such actions could include compensation changes to induce desired retention changes, amending the timing of promotions, and so on. An alternate approach is to use accessions as a strength valve, and recruit sufficient accessions to meet that year's endstrength target. Such an approach will minimize the need for other personnel management actions, but it will lead to different-sized cohorts from one year to the next. In practice, the Navy usually follows plans that are a mixture of the above approaches to accession planning—that is, the Navy allows limited variations in accession cohorts from one year to the next, and at the same time takes complementary personnel management actions to attain desired endstrength targets.

The benefits of having a stable stream of accessions may be easiest to see in times when authorizations are changing rapidly. Previous CNA research [11] addressed this situation at the end of the Cold War when there were large rapid declines in authorizations. This research showed that setting accession targets to meet endstrength will lead to very small cohorts being accessed as authorizations rapidly decline. This will be followed by years of larger accession cohorts as authorizations stabilize. The unevenly sized cohorts will lead to large variations in losses as these cohorts start to leave the Navy, which will, in turn, lead to significant variations in future accession cohorts. Conversely, setting accession levels to meet the steady-state requirements of the future (reduced) endstrength will result in a smooth transition from current strength to future strength levels, accompanied by stable accession levels/cohort sizes in the years ahead.

The downside of aiming for a steady-state inventory is that we may not meet short-term goals, and the resulting inventory may not provide a paygrade distribution that matches authorizations. Frequently, there is no easy solution because the community's paygrade distribution (i.e., pyramid) and continuation behavior may be incompatible. The previous SWO example is just one of the many situations that do indeed arise where it is not possible to attain an inventory that matches authorizations over an extended period of time. Prior research [12] analyzes relationships between paygrade structure, length of service, and promotion policies and shows that there are situations where the billet structure is unexecutable (i.e., it cannot be attained). An underlying reason for this is the nature of the requirements determination and authorization process. Billets are bought one billet at a time, and there are no systemic checks to ensure that the resulting billet structure provides a reasonable billet structure that can be executed. For example, a 2012 CNA study [13] analyzed the Navy's shipbuilding plans and noted that mine countermeasure ships (MCMs) are being phased out of service, with littoral combatant ships (LCSs) taking on mine-warfare missions. This results in the elimination of all E-3 and E-4 sea duty billets for the Mineman rating, making the community unexecutable. Navy leadership is aware of this problem, and will take actions to address the situation. However, it highlights the lack of a needed systemic evaluation of the overall required billet structure in the requirements determination process.

Recruiting

There are many differences between the recruiting of officers and enlisted personnel, and we describe them separately.

Officer Recruiting

Most officers are recruited via the United States Naval Academy (USNA) and Naval Reserve Officer Training Corps (NROTC), where young men and women receive an undergraduate college education and become officers upon graduating. A smaller number of officers are recruited via Officer Candidate School (OCS), a comparatively short program of classroom instruction of military subjects, physical training, and leadership for college graduates. Historically, the Navy has used OCS as a valve to increase or decrease, as needed, the number of officer recruits. The Navy also has programs that allow enlisted personnel to become officers; these programs offer upward mobility for high-quality enlisted personnel.

The above discussion applies to recruiting for a large majority of required skills (*designators*) (submarine officers, human resource officers, etc.). The Navy recruits personnel to be officers first, and they pick and/or are selected for a particular expertise area later. The situation is different for specialized professional skills (doctors, lawyers). The Navy gives direct appointments to qualified professionals at more senior paygrades and also offers required education to obtain the professional qualifications, in return for several years of obligated service.

Entrance into all of the foregoing programs is competitive, and the Navy has few problems obtaining sufficient high-quality recruits. The medical corps is an area where there have been frequent difficulties recruiting sufficient officers.

An officer has a minimum service obligation on receiving a commission. The obligation is typically 5 years, depending on the commissioning source. An officer may acquire an additional obligation, depending on the designator pursued by the officer; some designators may entail substantial additional training.

Enlisted Recruiting

The goals for total enlisted recruiting are divided among Navy ratings, following plans from the community managers. Aptitude requirements are included in Navy recruiting goals, and potential recruit aptitude is measured in a test administered to all personnel endeavoring to enlist in the U.S. military, the Armed Services Vocational Aptitude Battery (ASVAB). The Navy (as well as the other services) uses the ASVAB test to determine eligibility to join the Navy. ASVAB scores also determine how qualified potential recruits are for individual military occupational specialties (ratings).⁸

Navy ratings vary widely in the aptitude required to enter the ratings. For example, a recruit must have very high ASVAB scores to enter an enlisted nuclear rating, whereas other ratings require lower test scores.

Enlisted personnel also have a service obligation—the length of their enlistment. This obligation varies between 4 and 6 years on active duty, depending on the length of the initial training for the selected occupational specialty (i.e., rating).⁹ Typically, high-tech ratings require substantial training and lead to a 6-year obligation, whereas low-tech ratings require less training and lead to a 4-year obligation.¹⁰

The Navy and all the other services also prefer that recruits are high school graduates. A motivation for this is the desire to have recruits who complete their obligated service. Roughly one-third of recruits leave the Navy before the end of their initial obligations, large numbers of them in the first year of service. Such losses are called *first-term attrition*. This is clearly undesirable,

⁸ Further details regarding the ASVAB may be found on <http://official-asvab.com>.

⁹ All non-prior-service enlistments incur an 8-year obligation. Personnel who leave the Navy before serving 8 years will spend the remainder of the 8 years in the individual ready reserve.

¹⁰ There are exceptions with the recent creation of 5-year obligations for numerous sea-intensive ratings where the obligation is tied to tour lengths.

and the Navy seeks to minimize such attrition. High school graduates have shown the tenacity to “stay the course” and achieve a goal. There is substantial empirical evidence that attrition rates for high school graduates are lower than for recruits who did not complete high school (see [14]). Consequently, the services want recruits to be high school graduates in addition to having high ASVAB scores. This has not been a problem in recent years because of the employment stability and relatively good compensation offered by military service. In times of a booming economy, however, it becomes increasingly difficult to recruit personnel, especially in high-tech skills where there are many well-paid jobs in the private sector. In such situations, the Navy may need to recruit more personnel who perform well on the ASVAB test but are not high school graduates.

The timing of accessions during a fiscal year is another important issue to Navy personnel managers. There are many ways to vary the timing of accessions and attain the same total number of accessions. A number of different and sometimes conflicting objectives affect decisions regarding the phasing of accessions:

- Having more accessions in the summer to follow high school graduation—the largest source of recruits
- Having more accessions toward the end of a fiscal year to save MPN expenditures
- Level-loading accessions throughout the year to provide a steady stream of recruits to training pipelines and, from there, to their fleet assignments

There is no one correct answer to such decision-making: decisions may vary from one community to another, and the external economy may also play a significant role. The Navy needs some recruits to enlist throughout the year. To accomplish this, it obtains commitments from recruits to join the Navy several months in the future. Recruits enter a *delayed entry program* (DEP), while they

are awaiting their time to enlist. Some potential recruits drop out of the DEP, and that number increases as time spent in the DEP increases. Managing the DEP to control DEP attrition and provide the desired flow of recruits into the Navy is an important task for Navy recruiters.

The development of the Navy's recruiting plan balances the above considerations, attempting to find the "best" plan for the current situation and future requirements. Incentives are used to further the recruiting goals. For example, nuclear trained personnel require lengthy expensive education, in which recruits train on a nuclear reactor. The number of personnel that can train on the reactor at any one time is limited, so it makes financial sense to level-load accessions throughout the year, increasing the annual production of nuclear-trained personnel. The Navy provides financial incentives (an *enlistment bonus*) to join the Navy, but recruits spend several months in the DEP before entering the nuclear-trained petty officer pipeline. The enlistment bonuses reduce DEP attrition among the very high quality recruits who pursue this career. Similar analysis can be carried out for every rating. Such analyses involve trade-offs between various factors, such as the costs of enlistment bonuses, potential reductions in schoolhouse training costs, and the flows of trained personnel to the fleet (for example, see [15]). Increases in level loading of accessions may produce further savings for the Navy but are inhibited by such constraints as the MPN budget, which drives the Navy toward back-loading accessions later in the year to save MPN dollars.

The economy has a variety of effects on recruiting. As noted earlier, it's harder to recruit in boom times and vice versa. This plays out in ways that are not immediately apparent. Notably, in bad economic times, the number of recruits already in the workforce (i.e., ages 22 to 35) substantially increases (see [16]). Such recruits enter the Navy throughout the year, making it much easier to level-load accessions because of a decreased reliance on high school graduates.

The Navy has several thousand enlisted personnel assigned as recruiters; it's expensive to recruit 30,000 personnel each year. There are consistent budget pressures on the size of the recruiting force. In good recruiting times (typically when the economy is in recession), the recruiting force tends to get cut. This causes problems when recruiting gets tougher, because it takes a couple of years to reestablish a larger productive workforce. Increases to recruiter productivity are a means of addressing budget concerns (i.e., find a way of recruiting the same number of personnel with a smaller number of recruiters). Automation is a means of increasing productivity. The Navy has provided recruiters with a variety of automated tools, and this has improved productivity. NRC has a variety of objectives in its recruiting, including high recruiter productivity, demographic diversity, and geographic diversity. Improvements with regard to one objective need to be balanced against progress with regard to other objectives. For example, a potential means of increasing productivity is to focus recruiter attention in geographic areas where it has historically been easier to recruit and to pay little attention to areas where it has been difficult to recruit personnel. This may indeed improve productivity, but potential impacts on demographic and geographic diversity need to be considered. References [17-19] provide details and analysis of this issue.

Training & Education

Navy military personnel receive a variety of training and education during the course of their careers. Personnel receive individual training and education in schoolhouses/educational establishments. They also receive substantial operational training in the fleet. The Commander, Naval Education & Training Command has responsibility for individual schoolhouse training and education, and we provide an overview of such training and education below.

We begin by noting the distinction between training and education. The following quote from [20] conveys the differences:

A father is supposed to have said: "If my daughter told me she was getting sex education in school I'd be pleased. If she told me she got sex training I'd go straight to the police." Training is about practice, about skill, about learning how to do things. Education is about fostering the mind, by encouraging it to think independently and introducing it to knowledge of the physical and cultural world. It's about theory, understanding and a sense of values.

In the context of the Navy:

- Training teaches a specific skill, especially by practice, and is used to prepare personnel for specific assignments, typically the current or next assignment.
- Education focuses on learning new skills, knowledge, and perspectives, and is used to prepare personnel for future unspecified assignments.

Enlisted personnel, being more vocationally oriented, receive more training than education. Officers receive a lot more education, preparing them for future nonspecific leadership assignments. In what follows, we address officers and enlisted personnel separately, providing some details regarding their training and education.

Officer Training & Education

All officers enter the Navy with an undergraduate degree. Most officers spend their first couple of years obtaining qualifications for a specific designator. For example, prospective pilots learn how to fly at Naval Flight School, attaining their designation as a pilot, prior to an initial operational tour. Another example is surface warfare, where prospective SWOs attend a relatively short Surface Warfare Officers School before receiving their first operational assignment. Prospective SWOs receive training during their initial assignment, leading to qualification as a SWO. As noted earlier, some officers (doctors, lawyers, etc.) are already qualified when they receive their commissions.

Much of the above learning is operational training, and officers continue to receive such training as their careers develop. For example, prospective commanding officers attend a school as part of preparation for taking command.

Officers also receive a variety of education during their careers. The nature, extent, and timing of this education depend on the designator/career path of the officer. The following is a summary of the types of education provided to officers:

- Joint Professional Military Education (JPME) prepares officers for future assignments in a joint environment.
- Graduate education prepares officers for specialized *restricted line* careers, such as engineering duty officers, and may be a prerequisite for such a career.
- Graduate education broadly prepares officers for more senior leadership roles.

Graduate education is, de facto, a requirement for officer career advancement in today's Navy. A Navy instruction [21] provides policy and procedural guidance. A detailed understanding of the role of graduate education in an officer career may be found in [22].

The timing of the education is career path dependent. Officer careers are tightly defined and constrained. There are limited opportunities to receive education, and the opportunities vary by designator. For example, many SWOs receive graduate education after they have completed their initial at-sea assignments, after 4-5 years of service. However, pilots typically need to wait until they have completed more than 10 years of service before they have an opportunity for graduate education.

Officers may have three types of qualifications:

- The *Designator* provides a framework for officer career development and identifies primary specialty qualifications, associated legal and specialty categories, and competitive categories for promotion.
- An *Additional Qualification Designator (AQD)* identifies skills and knowledge needed to perform the duties and/or functions of a billet in addition to those identified by the designator. An AQD involves special qualifications usually attained through training and/or experience.
- *Subspecialty codes* identify professional disciplines secondary to an officer's primary specialty (Designator). Subspecialties require a master's or higher degree program from an institution of higher learning. The Navy employs subspecialty codes to facilitate the assignment of subspecialists to subspecialty-coded billets and generate the Navy's advanced education requirements.

Subspecialty codes cause difficulties in Navy MPT&E management. As noted, the need for subspecialty codes plays a large role in generating the Navy's advanced education requirements: billets are coded as requiring an officer with a particular subspecialty code, and officers are educated to acquire that expertise. However, officers will likely receive the education when it fits into their overall Navy career, and that may be many years before they have an opportunity to take an assignment to use the subspecialty code. Consequently, many officers never have an assignment that calls for their particular subspecialty code, and concerns are occasionally raised regarding low subspecialty code utilization rates. However, low utilization rates do not mean that subspecialty code education is wasted. Instead, the value of graduate education may best be found in the critical thinking skills it brings to the students, and these skills may be used everywhere. Indeed, Admiral Mullen, a previous Chairman of the Joint Chiefs of Staff, noted how much he valued his graduate education and that he used it throughout his career.

Enlisted Training & Education

Enlisted personnel receive training throughout their careers. Initially, they receive sufficient training to prepare them for their initial assignment. They receive more training as their careers develop, and this training helps to prepare them for subsequent assignments.

All recruits, except those with prior military service, attend Navy bootcamp immediately after enlisting. Bootcamp—officially called Navy Recruit Training Command (RTC)—is located in Great Lakes Illinois, north of Chicago. Bootcamp training indoctrinates new recruits into the military and Navy way of life. It is a 7- to 9-week program.

After bootcamp, sailors require and receive additional training for the skill they are entering. Most sailors attend an A-school where they receive initial training for a particular rating. Sailors become rated (i.e., they progress from being a recruit into a member of a rating) as they complete their A-school training. The length of A-school varies greatly depending on the rating, ranging from 5 weeks to over a year. Highly technical and special-forces ratings have the longest A-schools.

A small percentage of sailors go to a fleet assignment without entering a rating. Such personnel receive three weeks of training after bootcamp and then take a fleet assignment on a Professional Apprentice Career Track (PACT) where they can qualify for a rating via on-the-job-training.

Some sailors receive additional specialized training after A-school before taking an assignment. Such training, at a C-school, will train a sailor in a particular subspecialty within the rating. For example, sailors entering the sonar technician (STG) rating may attend a C-school, where they will learn to operate a particular piece of equipment, the AN/SQQ-89(V)2/(V)9 sonar. On graduating from this school, the sailor will receive a Navy Enlisted Classification (NEC)

number 0406. NECs show specialized expertise within the broad occupational category of a rating. Sailors may attain additional NECs as their careers develop, typically attending a C-school en route to a subsequent assignment. NECs play a very important role in determining a sailor's career/assignments and in determining how well manned a Navy unit is. The Navy measures the extent to which each rating's authorizations are manned, and it also measures the extent to which NEC requirements are filled by the crew.

Personnel managers develop plans for training demand. The planning methodologies are different for A-schools and C-schools. A-school planning follows from the accession planning for individual communities, which we described above. The accession plans show the need for new entrants into each rating. A-school planners consider the number of sailors that need to enter an A-school to produce the desired number of A-school graduates, making allowances for a number of sailors that will drop out of the course before completion. The extent of such A-school attrition is estimated based on historical patterns.

The demand for C-schools is determined in a different fashion than A-school planning. C-school planners base their plans on projected authorizations three years into the future for the NEC under consideration. The rationale for looking that far out is that C-schools take time to plan and schedule, and C-school length may be several months. Hence, today's C-school planning may not produce C-school graduates until years into the future. C-school planners consider authorizations three years into the future as the target to aim for. There is no obvious simple way to compute the required number of personnel who need to attend C-school and attain a particular NEC because a comparison of the number of personnel currently holding an NEC with the prospective authorizations for the NEC is not sufficient to estimate the demand for new NEC-holding personnel. The reason for this is that personnel do not use their NECs on every assignment. Thus, there is always a need for more personnel

holding an NEC than authorizations for the NEC. Moreover, some personnel holding the NEC may leave the Navy during the next three years, reducing the supply of trained personnel. C-school planners address this problem by estimating the annual demand for NEC-holding personnel as one-third of the authorizations for the NEC. This is a reasonable first-order approximation of the demand for NECs.

A description of all Navy NECs may be found in [23]. CNA has conducted many analyses of NEC utilization and how to improve NEC manning. References [24-26] are comparatively recent analyses and provide good explanations of this topic.

The Navy is one of the world's largest trainers. Each year, in excess of 30,000 personnel enlist in the Navy, and they all receive training. They also receive training as their careers progress. This costs a lot of money, and the search for efficiencies in training is a perennial issue. Navy training has adapted in many ways to budget constraints: the number of classes has been reduced, class sizes have tended to grow, and many schools have been consolidated to one location. This has all been necessary and has mostly been laudable. However, these training efficiencies have caused some unintended and unfortunate consequences. The reduced availability of schools has caused some students to spend a significant amount of time at a school, awaiting the start of a course they will attend. This unproductive time comes at the expense of some commands going undermanned. When there are fixed numbers of personnel, if there is an increase in personnel awaiting training, there will be a decrease in manning elsewhere, typically in the fleet. In addition, the initiative to consolidate training from two or more locations to one location has reduced the number of schoolhouses and has saved significant training infrastructure costs. However, the consolidation of training sites has other costs. Some have been direct costs. For example, the Navy now has to pay travel costs to fly personnel across the country to receive training. Other costs have been

indirect, such as when the lack of availability of local training causes personnel to miss the training, thus reducing their knowledge. There is no easy answer to all of this: finding the right balance between giving the best training to personnel and keeping the training budget under control is a constant challenge.

The Navy has been training personnel throughout its existence, and the need for updates is constant—whether in terms of training, organization, content, or delivery methods. There have been many attempts to improve Navy training. At the beginning of the 21st century, for example, the CNO chartered an Executive Review of Navy Training to develop a strategy and implementation plan for revolutionizing Navy training [27]. The *Revolution in Training* produced many ideas and recommendations for improving training, and the Navy attempted to implement them. Some progress was made, but many concerns still remain. Also, training requirements evolve, as they always do, as the Navy and technology evolve. This leads to a need for further improvements in training. Currently, the Navy is pursuing an initiative, *ready relevant learning*, in which sailors receive less formal training on entering the Navy before their first assignment. Sailors receive more training as their careers progress, when and where the training is needed. As then CNP Moran noted in recent testimony to Congress [28]:

Ready Relevant Learning delivers the right training at the right time—continual training in a mobile, modular environment to help ensure that knowledge is refreshed, renewed, and relevant to changing platforms or technologies. This provides Navy with the best-qualified and skilled personnel through resourcing efficiency and at a reduced time-to-train.

A major challenge with this initiative will be the ability to move training to the waterfront. Further information regarding ready relevant learning may be found in [29], a briefing by CNP to the CNO in April 2015. Ready relevant learning may make progress in Navy training. However, we should expect that further improvements will continue to be needed.

Individuals Account

As previously noted, the individuals account is how the Navy accounts for time when personnel are not at a permanent duty station. The Navy budgets for a substantial number of man-years to pay for all of this time. The largest part of the individuals account is allocated to the time when personnel are students. The budgeting of all time in the individuals account is subject to perennial strain: the Navy and Congress understand that the individuals account is necessary, but it is always an area where efficiencies are sought and budget cuts are taken when money is tight. Hence, the individuals account is rarely ever funded appropriately. There is not enough money to pay for all the time required in the individuals account and, in particular, in a student status. The Navy's response to a lack of student funds is *not* to stop sending personnel to schools. Instead, the Navy understands that personnel must receive their training, personnel are sent to training, and the student part of the individuals account is overexecuted (i.e., there are more student man-years than were budgeted). As noted before, manning is a zero-sum game; hence, student overmanning results in too few personnel elsewhere, typically resulting in undermanning on sea duty. This is a persistent problem dating back decades, and MPT&E managers are always seeking ways to reduce the size of the individuals account. However, other MPT&E actions may have the opposite effect on the individuals account. Notably, when accessions are back-loaded until the end of the fiscal year, there will likely be bottlenecks in training pipelines, with many personnel at a schoolhouse awaiting an opportunity to enter a class, which increases the size of the individuals account. It's difficult to find the correct balance between school class size and frequency, the phasing of accessions throughout the fiscal year, and the size of the individuals account.

Career Planning

Career planning is one of the most complex tasks in Navy MPT&E. Community managers have responsibility for career planning. As noted above, they consider one community at a time and have the job of endeavoring to build and maintain an inventory of personnel in that community that meets distinct objectives/constraints:

- Personnel will follow a career path that describes the assignments that personnel will/should receive as their careers develop.
- The supply of personnel will meet both current and future authorization limits, including meeting aggregate goals regarding numbers of personnel in each paygrade, numbers of personnel on sea duty, and so on.

Other staff in the MPT&E Enterprise have responsibility for individual parts of personnel planning (e.g., promotion planning). The community managers work closely with all such staff and strive to integrate/ reconcile individual plans. We address officer and enlisted community management separately and identify some of the key issues and concerns. We describe examples for one officer community and one enlisted community, each of which exemplifies the issues that community managers need to address.

Officer Community Planning

We consider the submarine officer community. Table 1, taken from BUPERS-3 webpages within the Navy Personnel Command website, shows career paths in the submarine officer community.

Table 1. Submarine Officer Career Path

(from www.public.navy.mil/bupers/npc/Pages/default.aspx)



SUBMARINE OFFICER CAREER PATH & MILESTONES



Officer:	Commissioning Date:	Year Group:	Goal	Actual
Tour	Nominal YCS	Milestone		
Division Officer (32-36 mo, 12 mo after PNEO)	1.5 YCS	Reporting Date		
		Promotion to O-2 (Comm Date +2 yrs)		
		Promotion to O-3 (Comm Date +4 yrs, 1 st day of next month)		
		First COPAY Bonus Opportunity: Minimum Service Obligation minus 1 year		
Professional Development Milestones: <input type="checkbox"/> Submarine Qualified <input type="checkbox"/> Engineer Qualified				
Post JO Shore (24 mo)	4.5 - 5.5 YCS	1 st DH Screen at 5 YCS (Year Group + 5)		
		2 nd DH Screen at 6 YCS (Year Group +6)		
Professional Development Milestones: <input type="checkbox"/> Graduate Degree				
SOAC (6 mo)	6.5 - 7.5 YCS	SOAC Goal: Jan 7.5 YCS		
Department Head (DH) (32 mo)		O-4 Promotion Board ~9 YCS		
		1 st XO Screen (30%) at 9 YCS		
		Promotion to O-4 (YCS + 10 +1)		
		2 nd XO Screen (50%) at 10 YCS		
Professional Development Milestones: <input type="checkbox"/> Command Qualification				
Post DH Shore (24 mo)	9 - 10 YCS	3 rd XO Screen (20%) at 11 YCS		
		4 th XO Screen for XOSS at 12 YCS		
Professional Development Milestones: <input type="checkbox"/> JPME Phase I (Required to serve in Command)				
Executive Officer (XO) (20 mo)	12 YCS	PXO School Goal: Aug of 12 YCS		
		PXO Promotion Gate: Aug 13 YCS (Ensure XO FITREP before In Zone for O-5)		
		Complete JPME I prior to CO Screening - NAVADMIN 93/5.		
		1 st CO Screen (30%) at 14 YCS		
		2 nd CO Screen (50% at 15 YCS		
Post XO Shore (24 mo)	14 YCS	O-5 Promotion Board ~15 YCS		
		3 rd CO Screen (20%) at 16 YCS		
		Promotion to O-5 (YCS + 16 +1)		
Professional Development Milestones: <input type="checkbox"/> JPME Phase II				
PCO School (9 mo)	16 YCS	PCO School Goal: Sep of 16 YCS		
CO		PCO Promotion Gate: Sep 17 YCS (Ensure 2 CO FITREPS before In Zone for O-6)		
Post CO Shore	19 YCS	Last COPAY Contract: Comm. Date + 25 years (5 yr)		
		O-6 Promotion Board ~21 YCS		
		Promotion to O-6 (YCS + 22 +1)		
		Last COPAY Contract: Comm. Date + 26 years (4 yr)		
		Last COPAY Contract: Comm. Date + 27 years (3 yr)		
Professional Development Milestones: <input type="checkbox"/> Joint Duty Assignment <input type="checkbox"/> Joint Specialty Officer				
Major Command (24 mo)	22 YCS	Major Command Goal: 22-23 YCS		
		Last COPAY Bonus Payment: Comm. Date + 29 years		
Notes				
(1) Promotion boards estimated. Best resource is "Officer 5 Yr Promotion Plan", specific eligibility for each year is identified in a December NAVADMIN. CO/XO/DH boards in May, MC boards in November each year.				
(2) Professional Development Milestones: JPME PH I is only "requirement" from Joint/Grad Ed perspective but completion of these milestones will afford individual more detailing options.				

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Enclosure (19)

Table 1 shows a complex and tightly orchestrated career path:

- A set sequence of tours of well-defined lengths
- Promotion timing at fixed points in a career
- Screening for more senior career milestone tours at set points in a career, together with prescribed percentages of officers that will get selected for the career milestones
- Timelines of achieving professional development milestones (a graduate degree, obtaining joint education, etc.)

There is little flexibility in this career path. The lack of flexibility is driven by legislation: Congress has provided strict guidance to officer development. This guidance is spelled out in the Defense Officer Personnel Act (DOPMA), U.S. Title 10, and the Goldwater Nichols Act. DOPMA and Title 10 specify the timing of promotions and the percentages of personnel that are promoted. The Goldwater Nichols Act legislates the need for joint education and experience in order to attain flag or general officer rank. An officer community manager needs to comply with these constraints while mapping out a career path that will provide appropriate career development.

For example, the submarine community believes that submarine commanding officers should be commanders and that a successful command tour is a prerequisite to becoming a captain. This implies a narrow range in an officer career where a command tour will occur (at 17 to 18 years of completed service, as shown in Table 1).

The constraints regarding screening and promotion opportunity describe the required size of a cohort (year group) that is being considered. For example, given a number of vacancies for promotion to commander, the number of officers being considered needs to be of a certain size to attain a specified promotion opportunity. The size of the cohort is the result of the size of the accession cohort many years ago and the continuation behavior of the cohort

as their careers progressed. It is a balancing act to have the many career planning and development considerations synchronized to allow the community to develop as desired.

Unrestricted line (URL) officer career paths direct all officers toward operational commands. Success is measured against making progress with career milestones that are steps toward operational command, and promotions are based on the ability to attain these career milestones and succeed in them. URL officers are considered generalists who attain broad knowledge and expertise before attaining command. This uniform approach to URL management constrains the ability of an officer to have successful a career that is not on a command track. This approach to officer management has served the U.S. Navy well, but it is not the only way to manage officers. For example, the British Royal Navy has career paths where officers can and do specialize in a particular part of operations (e.g., an engineering officer, responsible for all non-weapon-related mechanical and electronics systems). Such officers may not promote as quickly as line operational officers, but they may remain on active duty for many years and have successful specialized careers.

The U.S. Navy, when faced with a need for some specialization among its URL officers, responds in a variety of ways. It may seek to create an alternate path for specialization within the URL career path. The most successful example of this is nuclear-qualified surface warfare officers, who operate the propulsion plants on nuclear-powered ships. The Navy has developed a path that allows SWO nukes to obtain all the required expertise to operate nuclear power plants and also develop the required expertise to attain operational command. The Navy has also developed specialist career paths within URL career paths that allow officers to move away from an operational command track and specialize in such areas as missile defense or anti-terrorism/force protection. Most of the officers entering specialty career paths come from the SWO community. There has been limited progress with specialty career paths because there are

comparatively few billets, building a career within a specialty career path is difficult, and promotion opportunity is limited.

As an alternative, the Navy may decide to break off a part of the URL and create a separate community, where officers develop with the required specialty. For example, the Foreign Affairs Officer (FAO) community was created roughly 10 years ago, to provide officers with political-military (POL-MIL) expertise. The FAO community, with a separate designator, was created because of the failure to develop sufficiently qualified POL-MIL officers within a URL community. A major problem with the development of specialized officers, whether it is within URL communities or as a separate community, is the fragmentation of the officer corps into small groups of billets where it is difficult to attain sufficient numbers of billets at all grades to allow for career progression and promotion. There are pros and cons in all of these situations, and there does not appear to be one approach that is best in all situations. Instead, the Navy has adopted a pragmatic approach of having a variety of ways to balance the need for both generalist URL officers and officers who provide more specialized expertise. Further information regarding officer career management and community planning are provided in [30] and [31]. Navy briefings regarding specialty career paths and innovations in the SWO career path are provided in [32] and [33].

Enlisted Community Planning

We consider the Operations Specialist (OS) as an example of an enlisted rating. Once again, we take information from BUPERS-3 pages on the Navy Personnel Command website (www.public.navy.mil/bupers-npc/Pages/default.aspx). Table 2 presents the career path goals and considerations for this community. It shows the typical career path development for OS personnel, the length of their assignments, the average time it takes to promote, the division of their time

between sea and shore duty, and options they have for progressing to more senior careers as officers.

There is also a variety of information regarding the aggregate behavior of the OS community on the BUPERS-3 webpages. Figure 4 (addressed previously) provides the length-of-service distribution. Table 3 compares the current inventory to programmed authorizations (EPA), for each paygrade, for both the current year (FY16) and next year (FY17). Table 4 compares the ending FY16 inventory to billets authorized, for each paygrade, for sea duty and shore duty billets. Table 5 shows the tour lengths (in months) for both sea duty and shore duty for first, second, and subsequent tours of duty. Table 6 provides some statistics regarding advancement opportunity in the OS rating and compares the data to comparable data for the Navy as a whole.

The task for the community manager is to develop plans that will provide a supply of personnel that meet all of the goals and considerations described in Table 2, Figure 4, and Tables 3 through 6. For example, Table 2 shows a variety of billets for a third sea tour, and billet authorizations quantify the extent of such billets, both today and in the future. Table 2 also notes a typical career path, where sailors go to sea after their initial training. This initial sea tour is followed by an initial shore tour, after which personnel move between sea and shore tours. Community managers need to plan to ensure that there will be a sufficient supply of personnel on their third sea tour to meet the authorized demand signal, both today and in the future. Such plans need to address the size of cohorts, annual continuation rates, the flows of personnel between sea and shore duty, tour lengths, et cetera, and forecast how inventories will evolve in the years ahead.

Table 2. OS Career Path

Operations Specialists operate RADAR, navigation and communication equipment in the Combat Information Center (CIC) aboard ship. The air, surface, and subsurface tactical situations are plotted, observed, evaluated and communicated in CIC. No two OSs will have the same career pattern; however, on average, the successful OS will complete these career milestones in about the same sequence.

YEARS OF SERVICE	CAREER MILESTONES	AVERAGE TIME TO PROMOTE	COMMISSIONING OR OTHER SPECIAL PROGRAMS	SEA/SHORE FLOW	TYPICAL CAREER PATH DEVELOPMENT
26-30	OSCM	20.5 Yrs	CMC, Senior Enl Academy	36	Follow on Sea/Shore Tours.
23-26	OSCM OSCS	20.5 Yrs 17.3	CMC, CSC	36	4th Sea Tour Billet: CMDCM, Departmental LCPO, 3M Coordinator, CSSE. Duty: CVN, LHD, LHA. Qualification: SEA, TAO.
20-23	OSCM OSCS OSC	20.5 Yrs 17.3 13	CWO, CMC, CMDCS.	36	3rd Shore Tour Billet: Admin/Operational Staff, LCPO. Duty: ATG. Qualification: MTS, SEA, CDO/ACDO.
16-20	OSCS OSC OS1	17.3 Yrs 13 9.4	LDO, CWO, OCS, MECP, CMDCS, RDC, Recruiting, Instructor.	42	3rd Sea Tour Billet: AICS, Dept/Div LCPO, CICWO, USTAC, CSSE, LCAC Oper. Duty: Ship, Craft Unit. Qualification: SEA, CICWO, CSTT, Navigator, Craft Master.
12-16	OSC OS1	13 Yrs 9.4		36	2nd Shore Tour Billet: LCPO/LPO. Duty: ATG, Admin/Operational Staff, Instructor, Recruiting, RDC. Qualification: GCCS WO, COP ADV, CTPM, TDC, ICO, MTS.
8-12	OS1 OS2	9.4 Yrs 3.6		60	2nd Sea Tour Billet: LPO, Air Controller, LCAC Navigator, Ship, Craft Unit, Staff. Qualification: GCCS Oper./WO, COP ADV, TDC, LPO, Watch Sup, Watch Officer.
4-8	OS2 OS3	3.6 Yrs 1.7	STA-21, OCS, MECP, RDC, Recruiting, Instructor.	36	1st Shore Tour Billet: Admin/Operational Staff. Duty: Instructor, Recruiting, RDC. Qualification: GCCS, TDC, MTS.
1-4	OS3 OSSN	1.7 Yrs 1.3	STA-21, OCS, MECP, Naval Academy, NROTC	60	1st Sea Tour Billet: Operator. Duty: Ship. Qualification: RADAR Oper, Track Sup, Watch Sup, GCCS Oper, TDC, SCAC, Shipping, Piloting, Air Controller.
1+/-	OS3 OSSN OSSA Accession Training	9 Months		N/A	Recruit Training and all schools or training events required to be completed prior to reporting to their first operational command.
YEARS OF SERVICE	CAREER MILESTONES	AVERAGE TIME TO PROMOTE	COMMISSIONING OR OTHER SPECIAL PROGRAMS	SEA/SHORE FLOW	TYPICAL CAREER PATH DEVELOPMENT

Once again, it is a balancing act to synchronize all of the aforementioned factors to attain the desired numbers of personnel in the right places at the right times. However, it's not as tightly constrained as officer community planning. The timing of advancement is much less constrained than for

officers, and it adjusts as vacancies wax and wane. There are limits to the flexibility in advancement because in an unconstrained environment, some communities would have zero vacancies while others would have 100 percent opportunity; community managers take steps to avoid this. Also, there is more variation in the sequencing of tours for enlisted personnel than in constrained career paths in officer communities.

Further information regarding enlisted community planning may be found in [34].

Table 3. OS Rating: End FY16 Inventory vs. FY16 EPA and FY17 EPA

	E1-3	E4	E5	E6	E7	E8	E9	TOTAL
Inventory	642	1082	2579	1117	661	189	37	6307
FY16 EPA	908	1065	2756	1121	613	165	33	6661
% Inventory to FY16 EPA	71%	102%	94%	100%	108%	115%	112%	95%
FY17 EPA	835	1052	2675	1106	602	171	33	6474
% Inventory to FY17 EPA	77%	103%	96%	101%	110%	111%	112%	97%

Table 4. OS Rating: End FY16 Sea Duty and Shore Duty Manning

PG	SEA			SHORE			SEA + SHORE		
	INV	BA	INV/BA	INV	BA	INV/BA	INV	BA	INV/BA
E1-3	496	702	71%	57	14	407%	553	716	77%
E4	926	894	104%	112	122	92%	1038	1016	102%
E5	1557	1849	84%	827	809	102%	2384	2658	90%
E6	609	608	100%	443	455	97%	1052	1063	99%
E7	321	239	134%	312	355	88%	633	594	107%
E8	77	82	94%	102	76	134%	179	158	113%
E9	13	14	93%	22	18	122%	35	32	109%
Total	3999	4388	91%	1875	1849	101%	5874	6237	94%

Table 5. OS Rating: Tour Lengths (months)

Tour	Sea	Shore
1st	53	36
2nd	60	36
3rd	42	36
4th	36	36
5th	36	36
6th	36	36
7th	36	36

Table 6. OS Rating: FY16 Advancement Opportunity

	E1-3	E4	E5	E6	E7	E8	E9
All Navy	TIR	29.00%	16.60%	11.60%	20.80%	11.50%	13.80%
OS	TIR	100.00%	54.30%	3.40%	19.40%	14.70%	5.80%

Advancement or Promotion

We have already briefly addressed advancement and promotion. We now provide a little more detail.

Our first observation is that promotions/advancements are mostly a vacancy-driven process: the number of personnel who are advanced from one grade to the next is the number of vacancies at the next paygrade. For example, suppose there are 100 E-7 authorizations and 90 personnel who have the grade E-7. Then, there are $100 - 90 = 10$ vacancies for E-7, and that is the number of personnel who will be advanced from E-6 to E-7. This is not the case in all grades: personnel are advanced automatically from E-1 to E-2 to E-3, and from O-1 to O-2 to O-3 after a specific period of time. These underlying regulations regarding the timing of advancements and promotions have a major impact on the structure of the personnel inventory, as we will explain below.

We address officers (*promotion*) and enlisted personnel (*advancement*) separately because they are governed by very different regulations.

Officer Promotions

As noted earlier, officer promotions are tightly managed and subject to numerous constraints, from congressional legislation to policies from DoD and the Navy regarding the implementation of the legislation. References [35] and [36] provide a description of the pertinent legislation and policies. There are many considerations in determining office promotions. The five most important considerations are vacancies, time-in-grade requirements, competitive categories, promotion opportunity, and flow points.

Vacancies

The number of vacancies is the difference between authorizations and the size of the inventory for that paygrade. However, there is a time-dimension to it: the Navy plans for promotions in the following year and, consequently, needs to forecast vacancies in the following year. These forecasts need to project today's inventory into the future and need to account for officers who leave the Navy and officers who are promoted into the next paygrade.

Time-in-grade requirements

Officers need to spend a minimum amount of time in a grade (TIG) prior to promotion to the next grade. The TIG requirements are shown in Table 7. These requirements have little impact on officer promotions because Congress specifies flow points (see below), the longevity of officers when they are promoted.

Table 7. Officer Promotion Minimum TIG Requirements

Promotion to Grade	TIG Requirements
O-2	18 months
O-3	2 years
O-4	3 years
O-5	3 years
O-6	3 years
O-7	1 year

Competitive categories

Officers compete for promotions within groupings of personnel (*competitive categories*). It is a service prerogative to define competitive categories, and the Navy's are promulgated in SECNAV Instruction 1400.1B [37]. In summary, the Navy considers all URL officers (SWOs, aviators, submarine officers, etc.) together as one competitive category, but it considers each restricted line (engineering duty officers, intelligence officers, etc.) and staff officer (medical corps, supply corps, etc.) designator as separate competitive categories. Having individual competitive categories within restricted line and staff corps officers facilitates the Navy's ability to have the correct supply of officers in each of the specialized officer categories.

The consideration of URL officers as one competitive category is a complex issue. From some perspectives, URL officers are leaders, their designator is secondary, and indeed many billets are coded for any URL officer; it results in all the URL communities being considered jointly with the same promotion opportunity constraints, when officers are selected for promotion.¹¹ But it does

¹¹ This does not necessarily result in the same promotion opportunity for each URL community. For example, the promotion board may decide to select a higher proportion of submarine

produce some mismatches between officer personnel designators and officer billets in the more senior paygrades (there are ostensible “excesses” of aviators in the control grades of O-4 to O-6, leading to aviators filling a large majority of the “any URL” officer billets, and corresponding “shortages” of control-grade SWOs). This is a problem that has no one correct solution, and any other definition of competitive categories would have implications—some good, and others not so good. The Navy’s decision is a trade-off between conflicting considerations.

Promotion opportunity

Promotion opportunity is the ratio of the number of vacancies to the number of officers being considered for promotion. The number of officers being considered (the *promotion zone*) is set by Navy MPT&E managers. All officers are listed in order of seniority on a lineal list, the Navy sets the promotion zone as a number of officers on the lineal list, and the size of the promotion zone can be and is adjusted to vary the promotion opportunity.

The promotion zone plays a major role in officer personnel management. Most officers who are selected for promotion are within the promotion zone. A small number of officers are selected “below zone”—exceptional officers, who are being rapidly promoted. In addition, a small number of officers are selected “above the zone” (i.e., they were in zone last year, failed to be promoted then, but have been selected at their second opportunity). Officers who twice fail to select are no longer considered for promotion, and officers who fail to select for O-4 are forced to leave the service. The Navy sets guidelines for the maximum years of commissioned service for officers in each grade.

officers than surface warfare officers, within the constraints for total URL promotion opportunity.

Flow point

The flow point is the average number of years of commissioned service officers have when promoted to the next higher grade. Evidently, changing the size of the promotion zone will change the flow point. Congress provides guidance regarding promotion opportunity and timing, and DoD and the Navy implement the guidance via policies. Table 8 provides a summary of these directives.

Table 8. Promotion Opportunity and Flow Point

Promotion to Grade	Flow point	Opportunity
O-2	2 years	All fully qualified
O-3	4 years	All fully qualified
O-4	10 years +/- 1 year	80% +/- 10%
O-5	16 years +/- 1 year	70% +/- 10%
O-6	22 years +/- 1 year	50% +/- 10%

It is worth noting that all of the above policies are set independently of the billet paygrade structure and continuation rates within each competitive category. This is important because the billet paygrade distribution and the continuation rates will largely determine how many vacancies arise each year and the length of service of officers eligible for promotion. Such data are often in conflict with guidance regarding promotion opportunity and flow points. One of the most important jobs in officer personnel management is setting policies (retention incentives, etc.), flow points, and promotion opportunity to allow promotions to occur within policy guidance.

Enlisted Advancements

Enlisted advancements are more fluid and more loosely managed than officer promotions. The underlying process is that personnel advance to fill vacancies and the timing of advancement in a career is allowed to float in order to match advancements and vacancies. There are no set limits to advancement opportunity, and opportunity will vary as retention rates and any changes in billet authorizations occur.

There are limits on how rapidly enlisted personnel may advance (see Table 9). Table 9 shows that enlisted personnel may advance rapidly through the lower grades. In addition, ratings with higher aptitude requirements may also provide automatic advancements of recruits to E-4 as they graduate from A-school.

Table 9. Enlisted Time-In-Grade Requirements

Grade	Minimum time in grade
E-1 to E-2	9 months
E-2 to E-3	9 months
E-3 to E-4	6 months
E-4 to E-5	12 months
E-5 to E-6	36 months
E-6 to E-7	36 months
E-7 to E-8	36 months
E-8 to E-9	36 months

The Navy also limits how long personnel can remain in a paygrade without advancing. The Navy has a high-year tenure policy [38] that promulgates the policy. Table 10 shows the length of service limits for each paygrade.

Table 10. Enlisted High-Year Tenure Limits

Grade	Years of Service
E-1 to E-2	4
E-3	5
E-4	8
E-5	14
E-6	20
E-7	24
E-8	26
E-9	30

It is worth noting that enlisted advancement is a key component of enlisted compensation. The rationale for this follows. One of the rules of compensation is that all personnel in the same paygrade with the same length of service receive the same basic pay. If ratings have the same distribution of billets among paygrades, basic pay compensation in these ratings will be much the same because advancement rates will be much the same. This is a constraint to efficient management, where the compensation required to recruit and retain personnel varies widely according to the skills and aptitudes of the sailors (e.g., it requires more money to retain nuclear-trained petty officers than aviation boatswain's mates). The Navy addresses this problem by use of the paygrade structure within a rating; higher skilled communities typically have more senior paygrade structures than lower skilled communities. This results in more advancement opportunities and more rapid advancements in the higher skilled ratings (i.e., the Navy uses paygrade structure as a compensation tool in the enlisted Navy).

Compensation

The Overall Structure of Compensation

The starting point and basis of military compensation is that all personnel receive Regular Military Compensation (RMC).¹² RMC is defined as the sum of basic pay, average basic allowance for housing, basic allowance for subsistence, and the federal income tax advantage that accrues because the allowances are not subject to federal income tax. RMC represents a basic level of compensation that every servicemember receives—directly or indirectly, in-cash or in-kind—and that is common to all military personnel based on their paygrade, years of service, and family size.

Targeted Pays

Much of MPT&E management is focused on the management of subsets of personnel, such as personnel on sea duty and personnel with specific skills, such as Aegis fire control technicians, where the Navy is trying to influence personnel behavior. Compensation is a primary tool for influencing behavior—that is, giving money to personnel to join and or remain in scarce skill areas, giving money to personnel to spend more time at sea, and so on. RMC is a crude tool in such situations because it is given to all personnel, not just the group of personnel under consideration. Consequently, the Navy has a wide variety of incentive pays that are directed at certain groups of personnel in an attempt to influence behavior in a desirable fashion. Such compensation includes:

¹² See <http://militarypay.defense.gov/Calculators/RMC-Calculator/>.

- Enlistment bonuses—paid to recruits who join hard-to-fill skill areas
- Reenlistment bonuses—paid to personnel to reenlist in ratings where the Navy has personnel shortages
- Sea pay—paid to personnel to incentivize them to remain on sea duty for longer periods of time
- Hazardous duty pay—paid to personnel who perform hazardous duties, such as parachute jumping and demolition of explosives
- Imminent danger pay—paid to personnel in areas designated as dangerous
- Assignment incentive pay—compensates personnel for certain unusual and/or hard-to-fill assignments
- Continuation pay—paid to personnel in some communities to incentivize their retention

The foregoing pays are primary tools in personnel management, and they are reasonably efficient in the sense that they are paid to a group of personnel to address a particular personnel management concern. One measure of efficiency in compensation is *economic rent*. In our context, economic rent measures the extent of compensation that is unnecessarily paid to personnel to achieve the desired workforce. For example, consider reenlistment bonuses, which are paid to all personnel in specified ratings who reenlist in specific parts of their careers. The bonus will induce some personnel to reenlist, but it is also paid to personnel in that rating who would have reenlisted without a bonus. The bonuses paid to the personnel who would have reenlisted without a bonus are economic rent. An efficient compensation system minimizes economic rent. Hence, reenlistment bonuses are not perfectly efficient, but they are much more efficient than paying all personnel in the Navy to reenlist.

Retirement

The military retirement system is a foundational part of compensation. Military compensation has (at least) two purposes:

- Adequately compensate the personnel who defend our nation.
- Influence the behavior of personnel to obtain the personnel that the service needs (i.e., pay them sufficient to recruit and retain them).

The retirement system has served both purposes well: it is universally viewed as providing generous benefits, and it has fundamentally influenced the behavior of military personnel. Following World War II, the U.S. government wanted to have a military that emphasized youth and vigor, and the military retirement system that has been in place since then has furthered this purpose. This retirement system, which has very recently been modernized, had the following structure. It is based on a 20-year cliff vesting structure, where personnel receive zero retirement benefits until they attain 20 years of service. At that point, they are entitled to a lifetime pension that is regularly adjusted for inflation after they retire. The size of the annual pension is 2.5 percent of basic pay multiplied by the number of years of service. For example, a servicemember retiring after 25 years of service receives $25 \times 2.5 \text{ percent} = 62.5 \text{ percent}$ of base pay as a pension. This retirement system incentivizes personnel to remain on active duty for 20 years and then incentivizes them to leave; it is a system that incentivizes youth and vigor. These incentives have worked very well, and it has been a hallmark of continuation rates that most personnel that attain 10 years of service remain until they have 20 years of service. This, in turn, has been a central underpinning of Navy personnel planning: the Navy needs many experienced personnel (10+ years of service), and the retirement system enables the attainment of this requirement. Much of Navy compensation is predicated on the retention behavior that the retirement system induces.

The above retirement system may have worked well, but it has been subject to a variety of criticisms for many years:

- It is unfair. Notably, 83 percent of those serving in the military will receive no retirement benefit.
- It is inflexible and has disadvantages with regard to force shaping. There is a strong incentive for personnel to leave shortly after 20 years, which is not desirable in some skills.
- It is expensive, and costs are projected to further increase.

As one can see, the strengths of the system from one perspective are shortfalls from another perspective. A summary of concerns with this military retirement system may be found in [39].

The Fiscal Year 2013 National Defense Authorization Act (NDAA) established the Military Compensation and Retirement Modernization Commission (MCRMC) to develop and recommend compensation and retirement system reforms for the armed services. The NDAA for Fiscal Year 2016 contains the MCRMC's recommended changes to the current defined-benefit retirement system available to servicemembers with 20 or more years of service. The new retirement system, which will be effective for all new servicemembers in 2018, is a blended retirement plan that will reduce the defined benefit in the current plan but will add an employer-matching Thrift Savings Plan (TSP) and a continuation bonus. The new plan reduces the defined benefit in the current retirement plan by 20 percent. The services will automatically contribute 1 percent of the servicemember's base pay to the TSP and then will match servicemember contributions up to maximum of 5 percent of base pay. The service contributions to the member's TSP will vest at the completion of 2 years of service (YOS). The services will also pay servicemembers a continuation bonus at 12 YOS equal to 2.5 times their monthly base pay. It is unclear how this new retirement system will affect retention; the government's intent is to

maintain previous continuation behavior. This may indeed prove to be true in aggregate, but there may be many variations among skills. It will take several years to fully appreciate the impact of the new retirement system on personnel management. Further details regarding the new retirement system may be found in [40].

Important Topics in Personnel Planning

The foregoing discussion of personnel management has focused on MPT&E processes (advancement, compensation, etc.), and most of personnel planning is organized in that manner. There are other considerations, however, that do not fall into this framework. Some of these considerations address the methods used to analyze Navy MPT&E. Other considerations address specific topics, such as the role of women in the Navy. We address these topics below.

Econometric Modeling

Managers of compensation are always asking the question, “How much money do we need to pay to accomplish our personnel management goals?” For example, as previously noted, the manager of the reenlistment bonus program wants to know how much must be paid in reenlistment bonuses to achieve an increase in the reenlistment rate to a desired level. Such questions require an understanding of the relationships between compensation and personnel behavior. Econometric modeling, a part of economics, is routinely used to answer such questions. Roughly speaking, econometric modeling identifies relationships between compensation and human behavior. The statistical technique of regression analysis is used to quantify the relationships. The Navy uses these relationships to forecast how much compensation is required to obtain the desired behavior. There are many texts that describe econometric modeling, including [41], which is a standard reference.

A substantial body of analysis is devoted to building econometric models for Navy and military compensation. References [42-44] describe foundational work from over 35 years ago. This research provides the underpinning of more recent models.

Decision Support Systems

All of the personnel planning processes we have described involve making plans for some number of years into the future, and they include forecasts regarding how personnel inventories will change and evolve over time. The Navy uses a variety of software models/decision support tools to make such forecasts. The Navy has been developing and using such tools for many years, and it continues to do so; obtaining a perfect forecasting model is an elusive goal, and the Navy continues to develop improved models.

A primary complicating factor in the development of forecasting models is that the processes are not independent of each other, and hence the models cannot consider the processes independently. For example, changes in accessions affect the flows of personnel through training pipelines to the fleet. Thus, we need models that forecast both accessions and fleet manning. Continuing in that vein, we conclude that the Navy needs models that simulate and forecast all Navy personnel planning processes simultaneously. Unfortunately, as we describe next, the Navy lacks such a comprehensive modeling capability.

There are numerous models that simulate and forecast a part of Navy MPT&E personnel planning. Such models fall into three broad categories:

- Models that simulate one part of personnel planning (e.g., a forecast of the size of the individuals account)
- Models that make aggregate forecasts of the entire Navy (e.g., forecasts of total accessions in the Navy)

- Models that forecast future inventories within one Navy community (e.g., a forecast of future SWO inventories that accounts for future losses, accessions, or promotions)

Different Navy offices use different models to develop their plans. A drawback to this approach is that the model forecasts are not independent of each other, and they may not be mutually consistent. Moreover, the models will likely have been developed independently and will make different assumptions and use different techniques in making their forecasts. This leads to plans that may be inconsistent.

A major problem with inconsistent plans/forecasts occurs between strength planning and community management. We have observed that strength planning is an aggregate process in which budget limits are applied to the Navy as a whole and macro-level plans for recruiting, compensation, and the like, are developed that meet the budget constraints. Conversely, community management involves detailed development of community-specific plans that address the various processes described earlier (recruiting, retention, advancement, compensation, etc.) for each community. Strength planning tools/models and community management tools/models have been developed independently, and they are used independently of each other, leading to frequent lack of agreement between the ALNAV forecasts produced in strength plans and the sum of the individual community forecasts.

Community managers and strength planners try to work together to produce consistent plans. This is difficult because the Navy lacks tools that aid the reconciliation of top-down and bottom-up plans. In practice, the ALNAV strength plans tend to take precedence because of budget imperatives. However, these ALNAV strength plans may not consider and/or address the many problems that may become apparent when individual communities are considered. Note that this situation did not always exist. In the 1970s, the Navy Personnel Research and Development Center developed an enlisted inventory

forecasting model, ADSTAP (Advancement, Strength, and Training Plans) [45]. ADSTAP simulated the naval enlisted personnel system and produced output regarding strength levels, manpower budgets, accessions, promotions, training, losses, and so on. ADSTAP produced ALNAV forecasts and forecasts of individual ratings, where the sum of the parts (ratings) equaled the whole (ALNAV). The forecasts produced by ADSTAP may not have been perfect, but at least they provided a consistent set of projections that informed the entirety of personnel planning. Unfortunately, ADSTAP was written for a mainframe computer and stopped being used when Navy personnel planning shifted from mainframes to personal computers.

With the advent of personal computers, there have been many efforts to produce decision support tools for personnel planners. A relatively recent review of these models may be found in [46]. These models all have merit, but a comprehensive suite of decision tools that provides consistent output to all parts of personnel planning remains elusive.

Choice of Continuation Rates

One of the more complicated and least understood parts of all personnel planning and associated forecasting tools is the choice of continuation rates that drive the forecasts. All personnel forecasts are based on an assumption that a certain percentage of personnel will remain on active duty from one year to the next—that is, the continuation rate. The choice of continuation rate will have a major impact on forecasts. However, the continuation rates used in forecasts are typically in the background, the recipients of the forecasts may not be aware of the choice of continuation rates, and continuation rates may not be subject to much scrutiny. Frequently, inconsistencies between model forecasts may be caused by different choices of continuation rates. However, this may not be apparent to the user, who will merely know that he or she has received two inconsistent forecasts.

The choice of appropriate continuation rate depends on the question being asked. Consider the following three situations.

Produce a forecast of how many personnel with 10 years of service will leave the Navy next year. This is a short-term projection at an aggregate level. So, it makes sense to look at recent continuation behavior and use a continuation rate that is the percentage of personnel with 10 years of service that left the Navy last year.

Forecast the percentage of SWO accessions that will remain on active duty until they have 8 years of service. This is a longer term projection of one officer community. It makes sense to use historical continuation rates for SWOs in this forecast. However, we are now looking 8 years into the future, and it is unlikely that today's continuation rates will be maintained for the next 8 years. Instead, the forecaster may decide to use an average of the past 5 years of continuation rates as the basis of the forecast.

Forecast the continuation behavior of E-6 OS personnel with 9 years of service. Here we have a very detailed question. We could use historical behavior of E-6 OS personnel with 9 years of service. There are few such personnel, however, and confidence in forecasts based on a small number of observations is lessened because of the wide margin of error in such a forecast. In this situation, we may make use of more aggregate data (with a much larger sample size) in conjunction with the very detailed data (with a small sample size), and produce some type of weighted average.

A lesson to be learned from the above examples is that there is no one correct choice of continuation rates. Instead, the forecaster makes a choice that is appropriate for the question being asked. However, different forecasts frequently overlap in the projections they produce, and the overlap may have different results for the reasons described above. The consumer of forecasts

needs to be aware of the continuation rates used in the projections. A detailed analysis of the choice of continuation rates may be found in [47].

Women in the Navy

The role of women in the Navy (and in all of the services) has evolved and changed enormously during the past 20 years. Female participation in the workforce has grown dramatically in the past 60 years: women were roughly 27 percent of the workforce in 1950 and 47 percent of the workforce in 2009 [48], and the Navy has been a part of this evolution. Restrictions regarding serving in combat have almost disappeared, and women are increasingly found in all skill areas. The Navy has taken many steps to encourage the increased participation of women in the Navy, both in the numbers of women serving in the Navy and in the variety of skills they possess. The motivation for this increase may be understood by considering a 2015 speech¹³ from ADM Michele Howard (at that time the VCNO):

Women currently make up about 17 percent of the Navy. Women made up only 5 percent of the Navy when she joined in 1978. The reason women were such a small percentage of the Navy was that up until 1967, women could only be 2 percent of the armed forces; it was the law. And up until 1967, women could only be the rank of captain or colonel, and there could only be one of them at a time. That was the law.

Women make up about 46 percent of the civilian workforce, and studies by the Department of Labor have found that an organization achieves optimal performance when its workforce maintains at least 25 percent of whatever the minority sex might be. Without that, there are always accusations of tokenism and stereotyping. For that reason, the Navy ought to be shooting for a Navy that's about 25 percent women. At that level workplace relationships get normalized.

¹³ Ref: *Stars & Stripes*, May 2015.

Progress in increasing the participation of women in the Navy has been affected by a mixture of practical considerations, cultural change, concern regarding the management of women in the Navy as they move into nontraditional areas, and differences in behavior between men and women. It has not proved easy to recruit women into nontraditional areas with extensive sea duty, and then also retain these personnel. Progress has been gradual and consistent. The Navy has learned lessons and adapted to the increased participation of women in the Navy, and the proof of progress is that women serving in nontraditional roles is now routine.

A practical concern regarding women serving on sea duty is ensuring that there is female accommodation. Making changes to provide separate male and female berthing takes time and has been a primary and ongoing consideration in the pace of assigning women to sea duty. Details regarding the impact of berthing considerations on the integration of women into sea duty assignments may be found in [49-51].

Another concern regarding assigning women to sea duty has been to ensure that there are senior women aboard to provide guidance and leadership to junior personnel. This has been complicated by the need to “grow” senior women in nontraditional skills, which takes several years. The Navy has addressed all of these concerns in its plans for the integration of women into sea duty. For example, the Navy has recently started assigning women to submarines, and the plans for the integration of women have addressed these concerns [51].

The Navy has taken steps to increase the overall participation of women in the Navy. In particular, the Navy has established goals for the percentage of recruits that are female. The purpose of these goals appears to have been to provide a specific stretch target for recruiters, with the exact size of the goals not based on any empirical, operational, or behavioral considerations. Between 1991 and 2014, female enlisted accessions grew from 10 percent to 23 percent

of enlisted accessions. Between 1990 and 2010, female URL officer accessions grew from 8 percent to 16 percent of total URL officer accessions. However, female personnel have lower retention rates than male personnel. Hence, the rise in accessions has not been completely matched in the size of the female inventory. For example, between 1991 and 2014, while female enlisted accession was growing from 10 to 23 percent of all accessions, the size of the enlisted female inventory grew from 10 to 18 percent of all enlisted personnel.

There are many reasons why female retention is lower than male retention. One obvious reason is that having children/raising a family is not compatible with an arduous sea-duty-intensive lifestyle. The Navy has introduced a career intermission program to allow personnel to take a “time out” for personal reasons and then return to active duty and resume their careers. Participation in this program has, so far, been limited.

An unintended consequence of setting goals for female enlisted accessions has been a slight lowering in the quality of recruits, as measured by their ASVAB scores. It appears that women have lower propensity than men for a Navy life, making it harder to recruit women than men and resulting in a drop in average quality.¹⁴ However, there is evidence that standardized tests do not measure the aptitudes of women as well as men. Hence, such differences in ASVAB scores may have no meaningful impacts.

¹⁴ ASVAB scores of at least 50 are described as upper mental group. NRC statistics show that, between 2007 and 2016, male recruits have been 84.5 percent upper mental group, whereas female recruits have been 77.5 percent upper mental group.

Personnel Execution

We now turn our attention to the final quadrant of the Navy MPT&E process, *personnel execution*. It is here that “the rubber meets the road” as MPT&E managers endeavor to execute all their plans and attain an inventory that is distributed to meet all the various goals. Plans may extend over several years, but execution is measured and managed over the course of the current fiscal year. We describe three major processes that occur in *personnel execution*: monitoring of the execution of plans, leading to intra-year adjustments; the movement of personnel through training pipelines; and personnel distribution, where personnel receive their assignments to jobs (billets).

Monitoring Execution of Plans

As described above, each fiscal year starts with plans for accessions, promotions/advancements, endstrength, et cetera. As the fiscal year progresses, MPT&E managers manage the progress of these plans. This monitoring has at least three distinct purposes:

- Tracking the progress of each plan
- Tracking the progress toward attaining endstrength
- Ensuring that the Navy stays within the MPN budget

There are many reasons why plans may not execute as planned/desired. For example, retention may not be at forecast levels, recruits may not join the Navy at the planned rates, and there may be changes to the budget during execution that cause plan changes that are needed to remain within budget limits.

The Navy makes intra-year adjustments to each plan, as necessary, to remain on track for the execution year goal. For example, recruiting plans include monthly recruiting goals, and the Navy may miss these goals in a month, leading to adjustments to the goals in later months to ensure that total annual recruiting is on target.

Frequently, some of the above objectives are in conflict with each other. Usually it is limits on MPN expenditures that constrain the ability to execute plans as intended. Ensuring that MPN expenditures are within budget is the top priority. Attaining desired endstrength is a second priority, and all other plans are a lesser priority. Consequently, when faced with strains on MPN expenditures, the Navy strives to take actions to keep within the MPN budget while maintaining endstrength. These actions, as noted above when we addressed discretionary MPN spending, include:

- Cutting back on permanent-change-of-station moves
- Back-loading accessions until the end of the fiscal year
- Delaying advancements and promotions until later in the fiscal year

(Previously, we also described cuts to the individuals account as a means of reducing the MPN budget. However, reducing the individuals account will have little effect on MPN expenditures in execution because the Navy mostly trains personnel as required and independent of the size of the individuals account budget.¹⁵)

Moving Personnel Through Training Pipelines

The Navy recruits roughly 30,000 enlisted personnel each year. All receive training before moving on to their initial permanent duty stations. There are

¹⁵ The Navy does cut temporary duty under instruction (TDI) budgets in execution, which pays for training in transit.

many different training paths, depending on the prospective ratings of the personnel. During the course of the training, some personnel drop out and leave the Navy; others are reclassified from one prospective rating to another and change training accordingly. The movement of personnel through training pipelines is difficult to understand and manage effectively, and is studied in detail by the Navy's Production Management Office (PMO) in Millington. The PMO employs the methods of supply chain management to analyze the movement of personnel through training pipelines. Supply chain management is an operations research technique that is used in industry to analyze the flows of products through a supply chain, or production line. In this example, the "product" is trained sailors. Details regarding supply chain management may be found in [52].

One of the more complex challenges in managing the flows of personnel through training pipelines is the manner in which personnel are assigned to A- and C-schools. The Navy plans for a certain number of personnel to enter each A-school in any given year and sends an appropriate number of personnel to each A-school without consideration of the ultimate destinations (i.e., duty stations) for the personnel: they are "pushed" into the system in aggregate with the understanding/belief that jobs will await them after they complete their training. Some training pipelines involve C-schools after A-schools, but the methods of assigning personnel to these schools are different. Students do not receive orders to attend a C-school until a vacancy for a suitably qualified sailor is identified, and they receive orders to attend the appropriate C-school before being assigned to fill the vacancy: sailors are "pulled" into C-schools. Personnel managers need to synchronize the flows of personnel that are pushed into A-school with the demand for personnel that are pulled into C-school. If the flows of personnel into A-school are too large, many A-school graduates will wait unproductively for orders. If the flows of personnel into A-school are too small, there will be insufficient personnel entering C-school, leading to gapped billets

in the fleet. A detailed analysis of the flows of personnel between A- and C-schools may be found in [53].

Personnel Distribution

Personnel distribution is the process of assigning personnel to jobs (billets). There are many different and frequently conflicting considerations regarding assignment decisions. Moreover, it is a large challenge; the Navy makes tens of thousands of assignments every year because personnel change duty stations every few years.

PERS-4, part of the Navy Personnel Command, is the primary organization responsible for making personnel assignments. “Detailers” are the PERS-4 staff that interact with Navy personnel and make the assignments. A simplified description of the assignment process follows.

Personnel have assignments for a set period of time and have a projected rotation date (PRD) when their assignment is coming to an end. Nine months before the PRD, personnel and PERS-4 start communicating to make follow-on assignments. The available potential assignments (requisitions) are based on vacancies that are forecast to occur 9 months in the future for two reasons: (1) other personnel move from their current assignments or leave the Navy and (2) some new billets may be authorized, while other billets may be disestablished.

Decisions regarding assignment are based on numerous criteria, including the following:

- The priority of the assignment
- The preferences of the personnel
- PCS costs
- “Billet gaps” that arise when personnel arrive after the vacancies occur

- Matching of all skills between personnel and billets (rating, paygrade and NEC for enlisted personnel, designator, paygrade, AQDs, and subspecialty codes for officers)
- How much time personnel are given regarding their move date (orders notification)
- The pertinence of assignments for personnel career paths
- The need for en route training, including the availability and timing of the training
- Individual personal characteristics (e.g., having an exceptional family member who requires special schooling or medical care or having a spouse who is also on active duty)

The *priority* of the assignment depends on a variety of factors, including the manning level of the UIC, whether the unit concerned will soon be deploying, and whether the UIC is always given a high priority (e.g., ballistic missile submarines).

Currently, assignments are made in a sequential process, one at a time. Intuitively, this process seems amenable to an operations research approach in which multiple assignments are made simultaneously and an “optimal” set of assignments is attained. There are many similar situations in other parts of society where such an optimal assignment process occurs. For example, residency assignments for newly qualified physicians are made simultaneously, using operations research decision algorithms. There have been several efforts during the past 30 years to build such an automated optimal assignment process for Navy personnel. These efforts have failed, however, largely because of the complexities and idiosyncrasies of Navy personnel assignments. Nevertheless, there is hope that progress in this area can and will be made in the not too distant future. The Navy is currently modernizing its personnel distribution information systems, and it is feasible that an assignment decision

system may follow. Some previous CNA research [54] provides an appropriate methodology for such an endeavor.

It's not easy to find a single source of information on personnel distribution. A 2002 briefing on the Navy enlisted personnel distribution process [55] provides a good overview of the entire process, is mostly still current, and provides the considerations that also apply to officers, even if specifics are different.

One perennial personnel distribution issue is geographic stability. Many personnel want to remain in one location, and the Navy tries to accommodate this while ensuring that the needs of the Navy are met. There are limits to how much geographic stability is attainable while meeting the needs of the Navy by filling outstanding requisitions. This is largely an enlisted personnel issue; most officers understand that their careers will almost inevitably lead to many moves between different locations. There is a large body of research regarding how to improve geographic stability and attainable limits to geographic stability. Three references, spanning 20 years, provide a broad perspective of this topic [56-58].

Fleet Manning

The end objective of the entire Navy MPT&E process is to produce appropriately manned fleet units. Hence, the Navy pays particular attention to fleet manning. In all of the foregoing discussions, we addressed issues at some form of aggregate level (e.g., excess junior surface warfare officers). Fleet manning is measured at a disaggregated level; it addresses the manning of individual units. There are three primary measures of fleet unit manning, all of which measure only enlisted personnel, and each provides important insights

into the extent to which the units have an appropriate number of personnel aboard: Rating Control Number (RCN)¹⁶ Fill, RCN Fit, and NEC Fit.

RCN Fill. RCN Fill is defined as the number of Current on Board (COB) personnel divided by the count of current Billets Authorized (BA) for each community in the UIC.

RCN Fit. RCN Fit distinguishes whether personnel match community (RCN) and pay-band authorizations. Paygrades are considered in three bands: apprentice is E-1-E-4, journeyman is E-5-E-6, and supervisor is E-7-E-9. RCN Fit is defined as the number of COB personnel divided by BA, where excess personnel are excluded from the computations. The one exception to this rule is that excess personnel in higher pay-bands may fill gaps in lower pay-bands.

NEC Fit. NEC Fit measures the extent to which onboard personnel meet NEC requirements. NEC Fit considers whether personnel have been detailed to use an NEC in an assignment, known as a Distribution NEC (DNEC). NEC Fit is defined as the number of COB personnel who are both distributed to and hold the NEC divided by BA.

There are some additional, comparatively minor, constraints that apply to these metrics. References [59-60] provide additional details.

The Navy has established standards for RCN Fill, RCN Fit, and NEC Fit, which units are expected to meet. It is how Fleet Forces Command (FFC) measures the success of BUPERS in providing personnel to the fleet. The standards have evolved over the past 10 years and are currently promulgated by an FFC instruction [61]. Current standards are part of an overall policy for managing operating forces, known as the Optimal Fleet Response Plan (O-FRP) [62]. Fit and Fill standards vary between units, where front-line units (forward deployed naval forces, carrier strike groups, etc.) have higher standards than other units.

¹⁶ RCNs represent enlisted distribution communities. Most are defined by a Navy rating, but some are defined by a combination of rating and NECs.

Also, manning goals are tied to the operating cycle of the units, where the manning goals are lower when units are in a maintenance phase.

The Navy's ability to meet Fit and Fill standards is based on overall manning levels. When the Navy is short of personnel, the fleet suffers, and vice versa. In recent years, overall manning levels have been high and fleet Fit and Fill levels have been correspondingly high, though some areas of shortages persist. Further details regarding the Navy's ability to meet Fit and Fill standards may be found in [26, 60, 63].

FFC and the TYCOMs monitor manning on individual units and take extraordinary actions to ensure that units deploy with appropriate manning. In particular, the TYCOMs focus on NEC manning on prospective deploying units, and they identify whether there are deficiencies in key NECs. The TYCOMs will move personnel from one unit to another (either on a temporary or permanent basis) to address such shortages. Fortunately, there are comparatively few such moves because they are disruptive both to the concerned personnel and to the units losing the personnel.

Feedback Loops and Process Interactions

We have reached the end of the cycle described in Figure 1, but that figure also shows feedback loops, where the output of personnel execution informs and influences future MPT&E management. As previously noted, much of MPT&E management consists of multiyear plans. As time passes and plans are executed, the results observed in personnel execution frequently diverge from the plans. The Navy updates plans accordingly, subject to budget constraints.

Problems arise because some feedback and interactions between different aspects of Navy MPT&E are readily understood, while other processes interact in a complex fashion, causing second- and third-order effects that are not immediately apparent. An example of readily understood feedback is that the Navy is undermanned in a particular rating at the end of a year. This knowledge will inform and lead to updates in plans for this rating, potentially leading to increases in accessions, retention bonuses, and so on.

We provide two examples of areas where feedback and interactions are problematic and difficult to react to. The purpose of these examples is to highlight the complexities of Navy MPT&E and show how difficult it is to successfully manage Navy personnel.

Evolution of Requirements

The Navy develops requirements one at a time. For example, when the Navy builds a new ship, it buys the billets for that ship. Conversely, when the Navy decommissions a ship, the Navy removes authorizations for the associated billets. Similarly, authorizations ebb and flow as equipment is introduced and phased out. There are thousands of billet changes each year, and the entirety of Navy billets changes accordingly. Many of these changes are insignificant, but

some may affect the pyramid structure in a community, changing the dynamics of career paths, accessions, advancement, sea-shore flow, and so on. For example, a growth in billets in a rating at the E-6 level will lead to increased speed of advancement to E-6, and slower advancement from E-6 to E-7. There isn't anything inherently wrong with such changes, but the Navy may reach the point where it is difficult, if not impossible, to manage the rating and produce an inventory that matches authorizations.

For example, in the operations specialist rating, there are persistent shortages of E-5 personnel at sea. This is caused by the combined effect of the billet structure, advancement rates, and sea-shore flow. The OS rating is in a situation where it can't readily attain the desired number of E-5 personnel on sea duty. In some years, but not others, this has been offset by an excess of E-6 personnel on sea duty.

In another example, as previously noted, Navy plans call for the phasing out of mine-countermeasure ships, with mine-warfare missions falling to the littoral combatant ship (LCS) class. This change will cause problems for the Mineman (MN) rating because mine-countermeasure ships currently provide all the E-4 sea duty billets for the MN rating, with LCS billets mostly being at least at an E-5 level. Consequently, there will be nowhere for MN personnel to have an initial sea tour. Navy leadership is aware of this issue and is addressing it, but it is an example of how evolution in requirements can lead to problems in execution.

Billet changes occur gradually, and the impact of each billet change may be small or insignificant, but the cumulative result of billet changes may be an unexecutable billet structure. Frequently, there is no clear answer to the problems that arise. Sometimes, the "best" answer may be to revisit the billet changes and make some alterations, leading to a billet structure that is executable. Further information in this area may be found in [13, 60].

Synchronization of Equipment Modernization With School Plans

The Navy plans for C-schools and executes plans to send personnel to C-school by considering the prospective need for personnel to fill NEC gaps; prospective NEC gaps are based on prospective NEC authorizations. This process does not work well during periods of equipment modernization because schedules for installing and removing equipment are frequently imprecise and subject to last-minute modifications. The net result is that the NEC training is typically behind schedule in producing trained personnel for new equipment, and often it continues to train personnel for equipment that is about to be removed. A remedy to this problem would require closer coordination between MPT&E managers and the systems commands that install new equipment. Such closer coordination is certainly feasible, but it is difficult given the different priorities of the respective organizations. Further information regarding the synchronization of equipment modernization with school plans may be found in [25].

Last Thoughts

We have tried to provide an overview of Navy manpower planning. We hope we have also conveyed the complexity of Navy MPT&E, and that there are few simple answers to the many issues facing Navy MPT&E managers. Good management decisions can be and are being routinely made. Such decisions, however, nearly always require flexibility and a broad perspective regarding their immediate and secondary/unanticipated consequences.

We have focused on active duty Navy personnel. The Reserves, civil servants, and contractors also make important contributions to the running of the Navy, but they are secondary to our active duty military personnel. Hence, they are omitted from this monograph to provide a more sharply focused document.

We have described the processes and issues that are the foundations of Navy MPT&E management. A variety of topics are not addressed. For example, we did not address matters regarding ethnicity because the Navy has made great progress in race relations during the past 40 years to the point where it is not a central issue in Navy MPT&E management. We also did not address such topics as sexual abuse or quality-of-life programs because, although important, they are not part of the foundations of Navy MPT&E management.

Glossary

ACOL	Annualized Cost of Leaving (model)
AIRFOR	Commander, Naval Air Forces
ALNAV	All Navy
AOR	Area of Responsibility
AQD	Additional Qualification Designator
BA	Billets Authorized
BSO	Budget Submitting Office
BUPERS	Bureau of Personnel
CNO	Chief of Naval Operations
CNP	Chief of Naval Personnel
COB	Current On Board
DEP	Delayed Entry Program
DNEC	Distribution Navy Enlisted Classification (NEC)
DoD	Department of Defense
EPA	Enlisted Programmed Authorizations
FAO	Foreign Affairs Officer
FFC	United States Fleet Forces Command
FY	Fiscal Year
FYDP	Future Years Defense Program
ILE	Intermediate-Level Education
Individuals Account	Personnel in a Student, Transient, Patient, Prisoner, or Holdee Status
JPME	Joint Professional Military Education
LCS	Littoral Combatant Ship
Manpower	Requirements for Personnel
MCM	Mine Countermeasures

MFT	Mission, Functions, Tasks
MN	Mineman
MPN	Military Personnel, Navy Appropriation
MPT&E	Manpower, Personnel, Training & Education
NAVMAC	Navy Manpower Analysis Center
NDAA	National Defense Authorization Act
NEC	Navy Enlisted Classification
NETC	Navy Education & Training Command
NFO	Naval Flight Officer
NPC	Navy Personnel Command
NRC	Navy Recruiting Command
NROTC	Navy Reserve Officers Training Corps
O-FRP	Optimized Fleet Response Plan
O&M,N	Operations and Maintenance, Navy Appropriation
OPA	Officer Programmed Authorizations
OS	Operations Specialist
OSD	Office of the Secretary of Defense
PACFLT	Pacific Fleet
PCS	Permanent Change of Station
Personnel	The People in Uniform
PMO	Production Management Office
POL-MIL	Political-military
PPBE	Planning, Programming, Budgeting, and Execution
PRD	Projected Rotation Date
Programming	The Process of Providing Funding for Billets
RCN	Rating Control Number
ROTC	Reserve Officers Training Corps
RPN	Reserve Personnel, Navy Appropriation
RTC	Recruit Training Command

SAPR	Sexual Assault Prevention and Response
SLE	Senior-Level Education
SMD	Ship Manpower Document
SMRD	Shore Manpower Requirements Determination
SQMD	Squadron Manpower Document
STG	Sonar Technician - Surface
SUBFOR	Commander, Submarine Forces
SURFOR	Commander, Naval Surface Forces
SWO	Surface Warfare Officer
TDI	Temporary Duty Under Instruction
TFMMS	Total Force Manpower Management System
TIG	Time In Grade
TYCOM	Type Commander
UIC	Unit Identification Code (a unique unit identifier)
URL	Unrestricted Line (officer)
USFF	United States Fleet Forces
USNA	United States Naval Academy
YOS	Years of Service

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