Improving NEC Fit

Steven W. Belcher

with

David L. Reese and Kletus S. Lawler

February 2016

CNA
ANALYSIS & SOLUTIONS

Distribution

Photography Credit: 080126-N-7981E-830 Sonar Technician (Surface) 1st Class Mark Osborne supervises Sonar Technician (Surface) 2nd Class Randy Loewen, left, and Sonar Technician (Surface) 3rd Class Roland Stout, right, as they monitor contacts on an AN/SQQ-89V15 Surface Anti-Submarine Combat System, aboard the guided missile destroyer, USS *Momsen* (DDG 92). Ships and aircraft assigned to Carrier Strike Group 9 are under way off the coast of Southern California participating in a Joint Task Force Exercise (Jan. 26, 2008). U.S. Navy photo by Mass Communication Specialist 2nd Class James R. Evans (Released).

Approved by: **February 2016**

Alan J. Marcus, Acting Director
Fleet and Operational Manpower Team
Resource Analysis Division

Abstract

Navy Enlisted Classifications (NECs) denote special skills beyond those associated with a rating. They are used in defining manpower requirements and in managing personnel by tracking sailors who have acquired these skills. NEC Fit is one of two primary metrics that Navy leadership uses to assess enlisted fleet manning. It has been scrutinized for several years because fleet levels have been below target goals. This study identifies major issues that prevent the Navy from achieving higher NEC Fit and recommends actions to mitigate those issues and improve fleet Fit levels.

Many processes and factors affect NEC Fit. This study focuses on enlisted distribution, ship modernization, and the executability of NEC requirements. It examines the distribution process to determine whether it is aligned to maximize NEC Fit, analyzes how and why system upgrades affect NEC Fit, and investigates fleet NEC requirements to determine whether their paygrade structures impede higher Fit levels.

This page intentionally left blank.

Executive Summary

Navy Enlisted Classifications (NECs) are special skills that extend beyond those associated with a rating. They are used in defining manpower requirements and in personnel management to track sailors who have acquired these skills.

NEC Fit issues

The Navy primarily uses Rating Control Number (RCN) Fit and NEC Fit to measure and assess enlisted fleet manning levels.[1] In general, Fit measures the quantity and quality of the crew relative to the unit's authorized requirements. RCN Fit measures how well units are manned at the rating/community (occupation) and payband (experience) levels; NEC Fit measures how well a unit's requirements for specialized skills, as defined by the NECs attached to authorized billets, are filled by the crew.

For the past two years, Fit levels for critical NECs have been 12 to 15 percentage points below RCN Fit, and levels for non-critical NECs have been even lower. The levels in September 2014 indicate that a quarter of the critical NEC requirements on guided-missile destroyers (DDGs) were not filled. Given the importance of these skills to unit readiness, Navy leadership is concerned with these low levels and has prioritized efforts to improve NEC Fit.

Study objectives and scope

This study has two broad objectives: (1) identify and analyze the major issues that prevent the Navy from achieving higher NEC Fit and (2) recommend actions that the Navy can take to mitigate those issues and improve NEC Fit. NEC Fit is the end product of many Manpower, Personnel, Training & Education (MPT&E) processes, including recruiting, training, personnel allocation, and distribution. Numerous factors, both within and outside the MPT&E world, affect the ability of these

[1] The Navy calculates other metrics to assess enlisted manning—RCN Fill, NEC Fill, and NEC Aggregate Percent (which we define in the report)—but RCN and NEC Fit are the most common.

processes to ultimately assign qualified sailors to fill fleet NEC requirements. Because a study of all these processes and factors is beyond the resources of this study, we concentrated our efforts in three areas:

- Enlisted distribution process
- Ship modernization program
- Paygrade structure of NEC requirements

Findings

Our investigation uncovered five major findings. The paragraphs that follow describe each one in turn.

A recent change in how the distribution system calculates NEC shortfalls better aligns the distribution process with the NEC Fit metric. In February 2011, the Navy changed how the information system supporting the distribution process calculates a unit's NEC manning levels. Before the change, the system counted all the NECs held by crewmembers, regardless of whether the crewmembers were assigned a distribution NEC (DNEC). From an NEC Fit perspective, this could cause situations in which the distribution system assessed a unit as having sufficient NECs on board to fill all the authorized requirements even though the Fit metric shows NEC gaps. After the change, the system only counts crewmembers who are DNEC'd to the NEC. Because NEC Fit measures the number of DNEC'd sailors relative to NEC requirements, the new calculation produces an NEC demand signal that seeks to maximize NEC Fit.

System upgrades with new NEC requirements degrade NEC Fit. In-service units that receive system upgrades with new NEC requirements suffer decreases in their measured NEC Fit. Our analysis shows that it takes up to 15 months from the date of the new NEC requirements in the Total Force Manpower Management System (TFMMS) for Fit levels to reach their steady state. The primary reason for the decrease in Fit is not the upgrade but how (and when) the new requirements are entered in TFMMS. We found that new NEC requirements become the authorized requirements 9 to 12 months before the start of the installation period. This means that Fit is measured against a system that won't be on board for almost a year. It is not surprising, therefore, that Fit levels are very low during this time.

Out-year manpower requirements in TFMMS do not reflect future NEC changes due to modernization, resulting in training mismatches. New manpower requirements for in-service units scheduled for system upgrades are entered into TFMMS about one year before installation. The Navy's process for planning, resourcing, and scheduling schoolhouse training focuses on requirements three years in the future. Consequently, using TFMMS out-year requirements as the basis for NEC school plans can result in inaccurate plans for some NECs. It will underestimate training

requirements (which will result in insufficient training capacity) for new system NECs and will overestimate requirements (which will result in unused training resources) for legacy system NECs.

Modernization increases apprentice NEC training requirements. System-specific journeyman NECs often have system-specific apprentice NECs as prerequisites. Sailors who are in training for journeyman NECs for a new system and who were previously trained on an older system (which is usually the case when new systems are introduced) will need to retake part of the apprentice-level training for the new system to earn the prerequisite NECs. This additional throughput in new-system apprentice NEC training can cause capacity-requirement mismatches (which can affect Fit by limiting the number of sailors earning these NECs) if not accounted for in the training planning process.

Some NEC requirements are difficult to fill because their paygrade structure is not aligned with current personnel management and training policies. Most surface sonar technician (STG) jobs that require a journeyman NEC are expected to be filled by sailors on their second sea tours. However, about half of these NEC requirements are tied to E-5 billets, and we found that most E-5 STGs at sea are still on their first sea tours. Because journeymen NECs are not part of STG accession training, these sailors have limited opportunities to earn the journeyman NEC during their first sea tours.

Recommendations

We offer several recommendations to address these issues and ultimately improve fleet NEC Fit. As discussed above, the Navy has already addressed a misalignment in the distribution process by changing how the system calculates NEC manning levels. We recommend two other actions within this process to improve NEC Fit:

- Look for more opportunities to have detailers assign secondary DNECs to improve NEC Fit. A sailor can be assigned to fill two NEC requirements (i.e., assigned a primary and secondary DNEC) provided both NECs do not represent full-time jobs. Taking full advantage of these opportunities will enable detailers to fill more NEC Fit gaps that are not reported by the distribution system.

- Improve the management of information in the Enlisted Distribution and Verification Report (EDVR), particularly DNECs. Actively managing the EDVR can improve NEC Fit in several ways. On many units, managing sailors' DNECs can significantly improve NEC Fit. NECs that have high Aggregate Percent but low Fit levels are prime candidates for potential DNEC reassignments. Reassigning DNECs, however, should be done only if the sailor is in a position to perform the job that requires the skills.

In the longer term, the transition to billet-based distribution (BBD) for enlisted sailors will transform the enlisted distribution system and eliminate many of these issues. Under BBD, sailors will be detailed to specific billets. A requisition will contain all the qualifications (rate, rating, primary and secondary NEC) of the vacant billet. The current limitation of only one NEC attached to a requisition will no longer exist. In addition, the information systems supporting BBD will automate the assignment and reassignment of sailors to billets to improve NEC utilization, which, in turn, will improve NEC Fit.

To lessen the effects of system upgrades on NEC Fit, we recommend the following changes to TFMMS and the Student Input Plan (SIP) process:

- *Set the effective date of new system NEC requirements in TFMMS to coincide with the installation date.* Manpower requirements for a new system should not appear as the current authorized requirement until the system has been installed. TFMMS is able to define the month and year of future manpower requirements. Each record in TFMMS has effective start and end dates that define the timeframe in which the billet information in that record is valid.

- *Enter future modernization manpower changes in TFMMS at least three years in advance.* Modernization program offices plan system upgrade schedules well in advance of the installation. TFMMS should be synced with these plans, and its out-year requirements should reflect these scheduled changes.

- *Plan for training increases in apprentice NECs that are prerequisites for new system journeyman NECs.* Many sailors who are in training for journeyman NECs for new systems will need to retake part of the apprentice training to satisfy prerequisites. The SIP process needs to account for this to ensure sufficient training capacity to fill all the apprentice and journeyman NECs.

Improving the alignment between NEC requirements and the Navy's personnel management and training policies is a more difficult challenge. We believe the first step is to identify those NECs and ratings that have significant misalignments between career path expectations and execution. We suggest focusing this review on journeyman NEC requirements in high-tech, sea-intensive ratings.

These misalignments stem from a more systemic issue that creates challenges for enlisted manning—namely, that manpower requirements are defined by paygrade, whereas many personnel management policies (e.g., sea-shore flow) are defined by length of service. MPT&E initiatives, such as defining first-term billets and using this information to determine accession requirements, help to highlight this issue and can ultimately reduce the magnitude of these misalignments. But this issue requires further investigation to seek a better two-way alignment between how manpower requirements are defined and the processes, procedures, and policies that govern how the Navy grows, manages, trains, develops, and assigns its enlisted workforce.

Contents

Introduction **1**

Background 1
Tasking and scope 2
Organization of document 3

Assessing NEC Manning Levels **4**

NEC manning metrics 4
NEC Aggr% 4
NEC Fill 5
NEC Fit 5
NEC manning in DRRS-N 5
NEC Fit vs. RCN Fit 6

Does the Enlisted Distribution Process Maximize NEC Fit? **8**

Enlisted distribution 8
Distribution NEC demand signal 9
Determining NEC shortages 10
Attaching NECs to requisitions 12
NEC utilization: Aggr% vs. NEC Fit 12
Actions to improve NEC Fit 13

Do System Upgrades Affect NEC Fit? **15**

Navy's platform modernization program 15
Anti-submarine warfare (ASW) combat system improvement program for DDGs 15
Effects of AN/SQQ-89 upgrades on NEC Fit 19
Ship-level effects 19
Causes of NEC Fit decrements 20
Class-level effects 26
Planning for modernization generated manpower changes 27
Student input plan process 27
Future year NEC requirements in TFMMS 28
Increases in training requirements 29
Actions to lessen the effects of system upgrades on NEC Fit 30

Are NEC Requirements Executable? 32

STG NEC Fit levels 32
STGs on DDG-51 ships 34
Inventory vs. requirements 35
NEC training opportunities for fleet sailors 36
Paygrade effects beyond STG NECs 37
Actions to improve journeyman NEC Fit 38

Conclusions and Recommendations 40

Major findings 40
Recommendations 41
Improve the enlisted distribution process 41
Lessen the effects of system upgrades 42
Make NEC requirements more executable 43

References 44

List of Figures

Figure 1. Average RCN and NEC Fit levels for DDG-51-class ships 2
Figure 2. Ratio of Fit NECs to RCN billets on four classes of operational units 7
Figure 3. Number of billets and NECs by division on DDG-51 ships 7
Figure 4. Overview of enlisted personnel allocation and distribution process ... 8
Figure 5. NEC Aggr% vs. Fit for critical NECs on DDG-51 ships (September 2014) 13
Figure 6. Variants of the AN/SQQ-89 system installed on DDG-51-class ships 17
Figure 7. AN/SQQ-89 A(V)15 installation plan 18
Figure 8. Fit levels for NEC-0527 on DDG-51-class ships 19
Figure 9. NEC Fit relative to the timing of new requirements in TFMMS 22
Figure 10. NEC history of crewmembers before and after installation of upgrades 25
Figure 11. STG NEC Fit profile for three groups of DDGs 26
Figure 12. Effects of system upgrades on average Fit for DDG-51-class ships 26
Figure 13. Current and future year sea-duty requirements for NEC-0524 28
Figure 14. Paygrade distribution of sailors who earned NEC-0524 from 2010 to 2014 30
Figure 15. STG NEC Fit levels (September 2014) 33
Figure 16. STGs on DDGs: Paygrade by YOS profile 34
Figure 17. Population vs. requirements misalignment: E-5 STGs on DDGs 35
Figure 18. Distribution of when sailors earned NEC-0527 relative to their first fleet date 37
Figure 19. Requirements and Fit gaps for CNECs with 100-percent threshold levels on DDG-51 ships 38

This page intentionally left blank.

List of Tables

Table 1. DDG AN/SQQ-89(V) system NEC requirements 16
Table 2. Yearly authorized requirements for NEC-0527 20
Table 3. Timing of new NECs in TFMMS relative to the ship's SRA dates 21
Table 4. BA, inventory, and Fit levels for newly commissioned DDGs 23
Table 5. STG inventory by paygrade and sea tour 35

This page intentionally left blank.

Glossary

ACB	Advanced Capabilities Build
Aggr%	NEC Aggregate Percent
ARIS	Active Readiness Information System
ASW	Anti-Submarine Warfare
BA	Billets Authorized
BBD	Billet-Based Distribution
C5I	Command, Control, Communications, Computer, Combat, and Intelligence
CNEC	Critical Navy Enlisted Classification
COMNAVPERSCOM	Commander, Naval Personnel Command
CVN	Carrier, Fixed-Wing Aircraft, Nuclear
DDG	Guided-Missile Destroyer
DNEC	Distribution Navy Enlisted Classification
DRRS-N	Defense Readiness Reporting System - Navy
EAIS	Enlisted Assignment Information System
EDVR	Enlisted Distribution Verification Report
EMR	Enlisted Master Record
EPRES	Enlisted Personnel Requisition System
EPM	Enterprise Performance Management System
ET	Electronic Technician
FYDP	Future Year Defense Plan
IWS	Integrated Warfare Systems
MCA	Manning Control Authority
MPT&E	Manpower, Personnel, Training & Education
NAVMAC	Navy Manpower Analysis Center
NAVSEA	Naval Sea Systems Command
NEC	Navy Enlisted Classification
NMP	Navy Manning Plan
NPC	Navy Personnel Command
NTSP	Navy Training Systems Plan
PCD	Precommissioning Detachment
PCU	Precommissioning Unit
PEO	Program Executive Office
PNEC	Primary NEC
RCN	Rating Control Number
SIP	Student Input Plan

SME	Subject Matter Expert
SNEC	Secondary NEC
SRA	Selected Restricted Availabilities
SSN	Attack Submarine, Nuclear
STG	Surface Sonar Technician
TAD	Temporary Additional Duty
TFMMS	Total Force Manpower Management System
UIC	Unit Identification Code
USFFC	United States Fleet Forces Command
VFA	Strike Fighter Squadron
YOS	Years of Service

Introduction

Background

Since 2005, the Navy has measured and assessed enlisted fleet manning using two primary metrics: Rating Control Number (RCN) Fit and Navy Enlisted Classification (NEC) Fit. RCN Fit measures how well units are manned at the rating/community and payband levels.[2,3] NEC Fit measures how well the specialized skills of a unit's crewmembers, as defined by NECs, match those required by the unit's authorized billets.[4] The Navy computes Fit levels for all non-closed-loop NECs and for a subset of these NECs that warfare community experts have identified as being critical to a unit's mission capability.

Figure 1 shows quarterly snapshots of RCN and NEC Fit levels for DDG-51-class ships (guided-missile destroyers) over the past five years.[5] During this time, RCN Fit has been relatively stable, with levels ranging from 84 to 89 percent. NEC Fit, however, has varied more, and its levels have been much lower. Over the past two years, Fit levels for critical NECs have been 12 to 15 percentage points below RCN Fit, and levels for non-critical NECs have been even lower. The levels in September 2014 indicate that a quarter of the critical NEC requirements on DDGs were not filled. Given the importance of these skills to unit readiness, Navy leadership is concerned with these low levels and has prioritized efforts to improve NEC Fit.

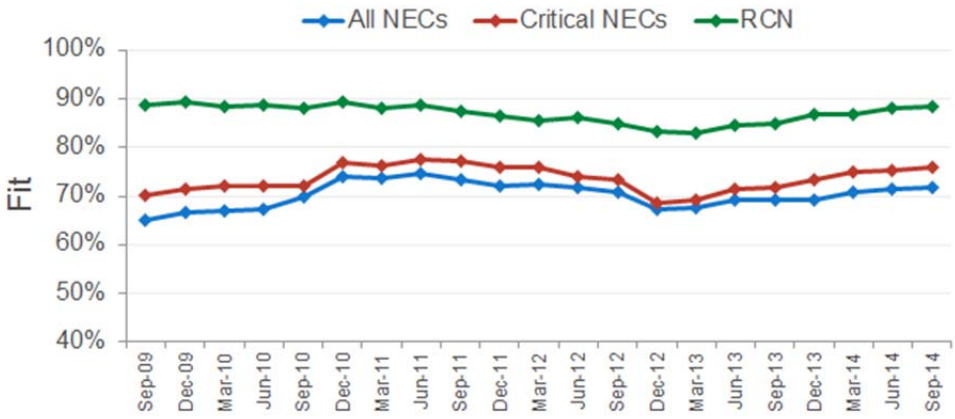
[2] RCNs represent enlisted distribution communities. Most are defined by a rating, but some are defined by one or more NECs (mostly closed-loop NECs that define a distribution community).

[3] Paybands are defined as apprentice (E-1 through E-4), journeyman (E-5 through E-6), and supervisor (E-7 through E-9).

[4] An NEC identifies a non-rating-wide skill, knowledge, aptitude, or qualification that must be documented to identify both people and billets for management purposes [1].

[5] For this study, we computed NEC Fit levels using onboard personnel data in the Enlisted Master Record (EMR) and current month billet authorizations in the Total Force Manpower Management System (TFMMS). Consequently, our onboard personnel counts do not include sailors on temporary additional duty (TAD). In addition, for class average Fit, we excluded units that had billets but no onboard personnel.

Figure 1. Average RCN and NEC Fit levels for DDG-51-class ships



In 2014, CNA completed a study of enlisted fleet manning that focused primarily on RCN Fit [2]. In it, we analyzed issues in the manpower, personnel, training, and education processes and policies that cause or contribute to fleet RCN Fit gaps and identified actions to mitigate these issues and improve RCN Fit. The Assistant Deputy Chief of Naval Operations for Manpower, Personnel and Training (N1B) asked CNA to continue this work by identifying and analyzing issues that prevent the Navy from achieving higher fleet NEC Fit.

Tasking and scope

This study has two broad objectives: (1) identify and analyze the major issues that prevent the Navy from achieving higher NEC Fit and (2) recommend actions that the Navy can take to mitigate these issues and improve fleet NEC Fit.

NEC Fit is the end product of many Manpower, Personnel, Training & Education (MPT&E) processes, including recruiting, C-school training, personnel allocation, and distribution. Numerous factors, both within and outside MPT&E's control, affect the ability of these processes to ultimately assign enough qualified sailors to fill fleet NEC requirements. Because a study of all these processes and factors is beyond the resources of this study, we narrowed the scope by focusing our investigation in three areas:

- Enlisted distribution process
- Ship modernization program
- Paygrade structure of NEC requirements

In examining the enlisted distribution process, our primary concern was whether it is designed to maximize NEC Fit. In other words, are the systems and business rules that are used in generating the distribution NEC demand signal for sailors aligned with how the Fit metric measures NEC manning?

The Navy's modernization program installs new systems on platforms to correct maintenance and performance issues and improve warfighting capability. In some cases, system upgrades change the platform's manpower requirements, usually in the form of new NECs. Our examination of the Navy's modernization program addresses two issues: (1) how system upgrades that bring new NEC requirements affect fleet NEC Fit and (2) how the MPT&E enterprise plans for and executes these new requirements.

NEC requirements are attached to billets that have paygrade requirements. Previous research in CNA's enlisted fleet manning study found that billet paygrade structures can cause challenges in filling billets at the rating and payband levels if they are not aligned with the Navy's personnel management processes and policies. Because NEC requirements are managed and filled differently than rating requirements, we investigate whether the paygrade structure of some NEC requirements poses challenges in filling them with qualified sailors.

Organization of document

We present our analysis and findings in five sections. The first reviews the set of metrics the Navy uses to assess NEC manning. The second section examines the enlisted distribution process and its relationship to NEC Fit. In the third section, we examine the Navy's modernization program, specifically the ASW improvement program on DDG-51-class ships, and its effects on NEC Fit. We also identify issues that hamper the MPT&E organization's ability to plan for the manpower changes that result from system upgrades. The fourth section investigates whether NEC requirements are executable based on their paygrade structure, and the fifth section summarizes our major findings and recommendations.

Assessing NEC Manning Levels

Personnel readiness is a major component of unit readiness. Having the required number of qualified sailors on board is essential for a unit to perform its warfighting mission. For its enlisted force, the Navy defines and measures sailor quality by rating, paygrade, and NEC. Accordingly, fleet leadership, in conjunction with the Navy Personnel Command (NPC), developed a set of metrics that measure not only the number of sailors on board, but how well their qualifications and experience levels match the unit's authorized manpower requirements.

NEC manning metrics

The Navy developed three metrics to assess NEC manning: NEC Fit, NEC Fill, and NEC Aggregate Percent (Aggr%). Each metric gives a slightly different perspective of a unit's NEC manning. Not all NECs are included in these metrics. Specifically, closed-loop NECs that define a distribution community are excluded from the NEC manning metrics because they are accounted for in RCN Fit and Fill. In addition, the Navy reports two sets of NEC manning levels: one for all NECs (except those in RCN Fit) and one for just the critical NECs. Critical NECs represent those skills that are deemed crucial for a unit to perform its mission. Subject matter experts (SMEs) within each warfighting community have identified which NECs are critical on each unit. They've also defined the minimum manning level (i.e., threshold) for each critical NEC.

NEC Aggr%

NEC Aggr% measures the combined (i.e., aggregate) specialized skills of the entire crew, regardless of whether the sailors are in positions to use those skills. It equals the ratio of the number of NECs on board (i.e., held by crewmembers in their personnel records) to the number of authorized NEC requirements (i.e., NECs attached to authorized billets).[6,7] Because NEC Aggr% accounts for all crewmembers'

[6] It counts only those NECs for which the unit has a requirement.

[7] This includes both primary NECs (PNECs) and secondary NECs (SNECs).

skills (whether used or unused), it gives an upper bound measure of the crew's aggregate skills.

NEC Fill

NEC Fill is a slightly more restrictive measure in that it does not count NECs on board that are in excess of the unit's requirement. It equals the ratio of the number of NECs on board (i.e., held by the crew) that are not in excess of the authorized requirement to the number of authorized NECs. For example, if a ship has six sailors on board with NEC-0524, but requires only four, all six would count in NEC Aggr%, but only four would count in NEC Fill. Whereas NEC Aggr% can exceed 100 percent, NEC Fill cannot.

NEC Fit

NEC Fit measures more than the crew's total skill sets. It also accounts for how these sailors are used by crediting an NEC Fit match only if a sailor who holds the NEC is designated to use that skill. It uses the distribution NEC (DNEC) as the basis for this designation. DNECs signify the NEC requirements that a sailor is expected to fill. A sailor can be assigned up to two DNECs. NEC Fit equals the number of sailors who are both distributed to (DNEC'd) and hold the NEC (or senior NEC) in their inventory divided by the number of authorized NEC requirements.[8]

For some NECs, there is an additional constraint that the sailor belong to the source rating of the NEC. If an NEC has multiple source ratings, as identified in the NEC manual [1], the sailor can be from any of the source ratings and does not have to match the rating of the billet to which the NEC is attached. For all other NECs, a sailor of one rating may not be substituted for another rating, even though he or she holds the same NEC. Reference [3] describes other rules used in NEC Fit calculations that pertain to certain NECs.

NEC manning in DRRS-N

United States Fleet Forces Command (USFFC) operates the Defense Readiness Reporting System–Navy (DRRS-N), which, in conjunction with its supporting Personnel Figure of Merit (PFOM) Module, calculates and reports personnel readiness

[8] The rules for calculating NEC Fit changed in 2014. They formerly included a payband restriction as in RCN Fit. All NEC Fit levels in this paper were calculated using the new rules.

measures for fleet units and the tasks and missions they perform. PFOM is a single measure that combines four components of personnel readiness: RCN Fit, NEC Fit, Officer Fit, and a fleet training course component.[9]

Although the personnel Fit metrics (RCN, NEC, and Officer) and PFOM have many similarities, they were developed for different purposes. The Fit metrics provide a measure of how well a unit's total manpower requirements are met. They measure the performance of the MPT&E enterprise in providing fleet units with the right number and right type of personnel. The purpose of DRRS-N's PFOM, however, is to relate personnel resources to readiness. It does this by calculating PFOM measures for each task and mission that the unit is expected to perform. It then translates the PFOM scores to readiness levels (i.e., Ready, Qualified Ready, or Not Ready). As a result, if a unit has gaps in its personnel resources, DRRS-N will show the readiness implications in each mission area.[10]

DRRS-N also tracks how well critical NECs are manned. Although critical NEC manning affects the PFOM score the same as non-critical NEC manning, critical NEC levels can override the readiness levels (i.e., Ready, Qualified Ready, or Not Ready) associated with these scores. If the manning threshold level for a critical NEC is not met, that task will receive a "Not Ready" assessment.

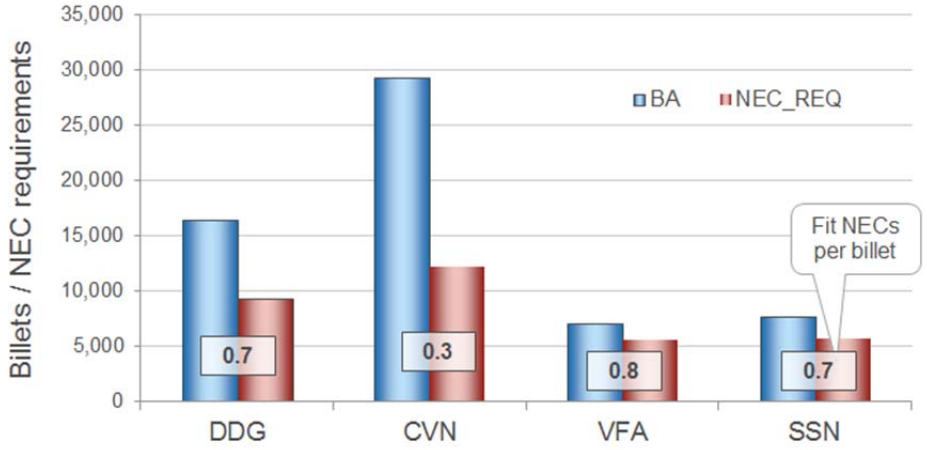
NEC Fit vs. RCN Fit

The importance of NEC Fit relative to RCN Fit in measuring a unit's manning depends, in part, on the ratio of NEC requirements (only those NECs that are included in NEC Fit) to total billets. Figure 2 from [2] shows the ratio of these NECs to billets on DDGs, nuclear aircraft carriers (CVNs), strike fighter (VFA) squadrons, and nuclear submarines (SSNs). The ratios range from a low of 0.3 for CVNs to a high of 0.8 for VFA squadrons. This suggests that NEC Fit is a less important manning measure for carriers than for the other units.

[9] The training course component measures how many sailors completed fleet-required F- and T-school courses.

[10] See [4] for a more complete description of the PFOM metric and its relationships to RCN and NEC Fit.

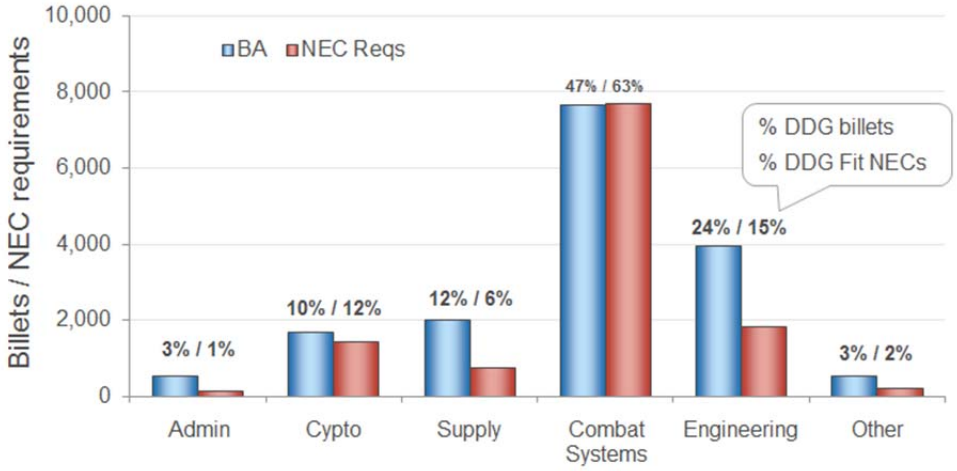
Figure 2. Ratio of Fit NECs to RCN billets on four classes of operational units



Source: [2].

In addition, NEC requirements are not evenly distributed across all ratings. They tend to be concentrated in the more technical ratings (e.g., Electronic Technician (ET)). Figure 3, also from [2], shows the number of billets (blue columns) and NEC requirements (red columns) by division on DDG-51-class ships. It includes only billets that are used in Fit calculations. NEC requirements (and, therefore, the NEC Fit metric) are dominated by the combat systems division. This implies that NEC Fit may be a more important measure of personnel readiness in the warfare mission areas (e.g., anti-air warfare mission) than in engineering/propulsion or supply.

Figure 3. Number of billets and NECs by division on DDG-51 ships



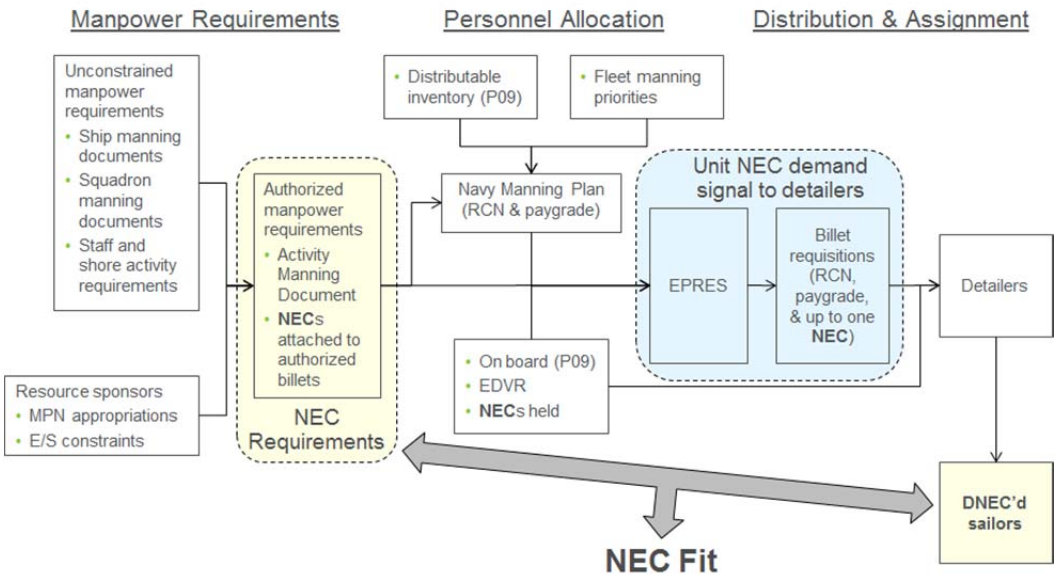
Source: [2].

Does the Enlisted Distribution Process Maximize NEC Fit?

Enlisted distribution

The enlisted distribution process assigns sailors who are in the distributable inventory to fleet units to fill current and projected manning shortfalls.[11] Figure 4 shows the distribution process and its relationships to manpower requirements and the personnel allocation process. The diagram also shows the role of NEC Fit within these processes.

Figure 4. Overview of enlisted personnel allocation and distribution process



[11] Not all sailors are in the distributable inventory. Those who are not include sailors in a student, TPPH (transients, patients, prisoners, and holdees), or limited-duty status.

For fleet units, Navy Manpower Analysis Center (NAVMAC) determines fiscally unconstrained manpower requirements based on the unit's Required Operational Capability/Projected Operating Environment (ROC/POE). The unit's resource sponsor then decides which requirements to fund. The funded (or authorized) manpower requirements make up a unit's activity manning document (AMD). These authorized requirements are also entered into the TFMMS, which is the Navy's authoritative source for all manpower requirements. Each authorized billet is defined by a rating, paygrade, and up to two NECs. Authorized billets serve as the basis for both the RCN and NEC Fit and Fill metrics.

Unit manning targets are defined by a combination of billets authorized (BA) and the Navy Manning Plan (NMP). NMP defines the unit's feasible target for manning levels given the available distributable inventory and the personnel policies that govern the allocation of this inventory. NMP is based on short-term projections of available inventory, which are estimated using projected rotation dates, output from accession training pipelines, and authorized billet information in TFMMS. NMP defines manning targets for each distribution community (ratings and closed-loop NECs) and paygrade. These targets represent the highest level of manning that an activity should expect.

The distribution process involves two main actions. The first is determining a unit's manning shortfalls and generating distribution demand signals (i.e., requisitions) to send to the detailers. The second action is selecting and designating sailors for assignment to the unit to fill these shortfalls.

NEC Fit measures the number of sailors DNEC'd to a unit relative to its authorized NEC requirements. Because detailers are responding to the distribution demand signal, we examined whether this demand signal is designed to maximize NEC Fit. In other words, are the systems and business rules that are used in generating the NEC component of the distribution demand signal aligned with how the Fit metric measures NEC manning?

Distribution NEC demand signal

To understand the NEC distribution demand signal, we need to review how NEC requirements are attached to billet requisitions. Reference [5] describes how requisitions are produced in the enlisted distribution system.[12] A requisition is a signal to the detailers (Pers-4) that a manning shortfall exists at the unit. It is issued

[12] There have been important updates to the requisition process, which is described in [5]. Our description of the process includes these changes.

when there is a calculated shortfall of onboard personnel to NMP. The Enlisted Personnel Requisition System (EPRES) generates requisitions using NMP and projections of onboard manning for nine months in the future. The system comprises three modules. The "balancing module" determines the number of requisitions to be issued for each activity, by distribution community (RCN) and paygrade. The "NEC module" attaches NEC requirements to the requisition. And the "priority module" puts the requisitions into the order in which the Manning Control Authority (MCA) would like the requisitions to be filled.[13]

The NEC module assigns non-closed-loop NECs to requisitions. An NEC on a requisition represents a signal to bring the activity to the level of NEC manning mandated by its authorized billets.

Assigning NECs to requisitions involves two steps. The first is to determine the unit's NEC manning levels (or shortages). The second step is to assign those NECs that have shortages to billet requisitions. We describe each of these steps below.

Determining NEC shortages

For each NEC that appears on an authorized billet, the module calculates the following quantities:

- Number of NEC requirements attached to authorized billets, counting both primary and secondary NECs (*NEC_Req*)[14]
- Number of sailors who are DNEC'd to the NEC and hold the NEC (*DNEC_Hold*)
- Number of sailors who are DNEC'd to the NEC and do not hold the NEC (*DNEC_Not_Hold*)
- Number of sailors who hold the NEC but are not DNEC'd (NEC_*INV*)

In February 2011, the Navy changed how the distribution system calculates NEC manning levels. We review both the old and new calculations next.

[13] USFFC is the MCA for fleet units; the MCA for shore activities is Commander, Naval Personnel Command (COMNAVPERSCOM).

[14] Although NMP manning targets are usually less than the number of authorized billets, this does not reduce NEC requirements. Both the distribution demand signal and Fit metric are based on the full number of authorized NECs.

Old calculations

Before the change, the NEC module calculated NEC shortages by subtracting the sum of the number of sailors who were DNEC'd and the number of sailors who held the NEC from the number of NEC requirements, as shown below:

$$NEC\_Shortage = NEC\_Req - (DNEC\_Hold + DNEC\_Not\_Hold + NEC\_INV) \quad (1)$$

In other words, the computation counted all the NECs held by crewmembers, regardless of whether the crewmembers were DNEC'd to the NEC. Thus, NEC manning levels more closely reflected the NEC Aggr% metric than the NEC Fit metric.

From an NEC Fit perspective, these calculations could cause situations in which the distribution system assessed a unit as having sufficient NECs on board to fill all the authorized requirements even though the Fit metric shows NEC gaps. If the system assesses an NEC as fully manned, it will not generate a request (i.e., attach the NEC to a requisition). Without a request, the detailers would not distribute sailors with that NEC to the unit unless someone from the MCA or NPC placement division intervenes to change the requisition or inform the detailers of NEC Fit gaps.

New calculations

To address these issues, the Navy changed how the system determines NEC shortages. The new calculation, which is shown below, counts only crewmembers who are DNEC'd to the NEC.

$$NEC\_Shortage = NEC\_Req - (DNEC\_Hold + DNEC\_Not\_Hold) \quad (2)$$

This change better aligns the distribution process to the NEC Fit metric. The reason for including sailors who are DNEC'd but do not hold the NEC (recall that these sailors do not count in NEC Fit) is that the system is projecting future NEC shortages (i.e., nine months out). Therefore, it must account for sailors who already have been ordered to the unit (i.e., assigned a DNEC) but have not yet arrived because they are in training to earn the NEC (but do not yet hold the NEC).[15]

[15] These changes affect NEC manning levels in the EPRES file in the Enlisted Assignment Information System (EAIS). The fields in the Active Readiness Information System (ARIS) system, which also show unit NEC manning levels, were never updated; consequently, they still show levels based on the old calculations.

Attaching NECs to requisitions

The second step involves assigning those NECs that have shortages to requisitions. The NEC module matches NEC shortages against the distribution community requisitions from the balancing module. Assigning NECs to requisitions must comply with the source rating and paygrade requirements of that NEC as defined in the NEC Manual. If there are insufficient requisitions on which to post a unit's NEC shortfalls, priority is given to the most poorly manned skills. The NEC module can attach only **one** NEC to a requisition, which can be a limitation, especially for high-tech ratings that often have two NEC requirements attached to a billet.

NEC utilization: Aggr% vs. NEC Fit

Earlier we stated that NEC Fit measures how sailors' skills are utilized because it only credits an NEC Fit match if a sailor who holds the NEC is designated to use that skill (i.e., is DNEC'd). In some respects, this gives a measure of how well the crew's specialized skills are being employed.

To gain insight into how effectively NEC skills are utilized, we examined the relationship between NEC Aggr% (i.e., the total number of NECs held by crewmembers) and NEC Fit (i.e., the number of DNEC'd crewmembers). We restricted our look to the most important NECs (i.e., critical NECs (CNECs)) and also accounted for the paygrade of the billets to which these NECs are attached. Figure 5 shows the relationship in September 2014 for CNECs on DDG-51-class ships. The upper left chart contains CNECs attached mostly to apprentice (E-3 and E-4) billets. The upper right chart contains CNECs that are evenly split between apprentice and journeyman (E-5 and E-6) billets. The bottom left chart contains CNECs attached only to journeyman billets, and the bottom right chart contains CNECs attached only to supervisor (E-7 to E-9) billets. Note that, by definition, NEC Fit must be less than or equal to NEC Aggr%.

The data reveal that there are a significant number of CNECs that have high Aggr% levels (above 90 percent) but much lower Fit levels (at least below 80 percent and, for some, much lower). These CNECs, which are in the shaded area of each chart, are prime candidates to investigate whether any of the sailors who held one of these NECs could have been assigned to use that skill (i.e., DNEC'd) to improve CNEC Fit. It is possible that some of these sailors were using these skills but never were assigned the DNEC.

DNECs are recorded and managed in the Enlisted Distribution and Verification Report (EDVR) system. Units are encouraged to actively manage DNECs within the EDVR and to request changes in assigned DNECs when appropriate. Unfortunately, a

detailed investigation of EDVR management (and the potential to improve utilization of NECs) was beyond the scope of this study.

Figure 5. NEC Aggr% vs. Fit for critical NECs on DDG-51 ships (September 2014)

Actions to improve NEC Fit

The change in how EPRES calculates NEC shortfalls was an important step in aligning the distribution system with the NEC Fit metric. Because NEC Fit measures the number of DNEC'd sailors relative to NEC requirements, calculating a unit's NEC shortfalls based on DNECs and not on the crew's entire NEC inventory creates a distribution demand signal that seeks to maximize NEC Fit.

We propose two other actions within the distribution process to improve NEC Fit:

- *Assign secondary DNECs to improve NEC Fit.* Our understanding is that EPRES attaches only one NEC to a requisition, even if there are other NECs on the unit with shortfalls that are eligible to be attached to the requisition. Detailers, however, can assign sailors to fill two NEC requirements (i.e., assign a primary and a secondary DNEC), provided both NECs do not represent full-time jobs. This enables detailers to assign sailors a secondary DNEC to fill NEC Fit gaps

that are not reported by the distribution system. To perform this function, the detailers would need access to unit-level NEC Fit data that are available in the Enterprise Performance Management (EPM) system. Because some sailors are assigned two DNECs, we know that detailers do this to some degree. Determining the extent of these actions relative to the opportunities, however, was beyond the scope of this study. Therefore, our recommendation is to look for more opportunities to have detailers assign secondary DNECs to improve NEC Fit. Taking full advantage of these opportunities will fill more of the NEC Fit gaps that are not reported by the distribution system.

- *Better manage information in the EDVR, particularly DNECs.* Actively managing the EDVR can improve NEC Fit in several ways. On many units, managing sailors' DNECs can significantly improve NEC Fit. NECs that have high Aggr% but low Fit levels are prime candidates for potential DNEC reassignments. Reassigning DNECs, however, should be made only if the sailor is in a position to perform the job that requires the skills.

In the longer term, the transition to billet-based distribution (BBD) for enlisted sailors will transform the enlisted distribution system and eliminate many of these issues. Under BBD, sailors will be detailed to specific billets. A requisition will contain all the qualifications (rate, rating, primary and secondary NEC) of the vacant billet. The current limitation of only one NEC attached to a requisition will no longer exist. In addition, the information systems supporting BBD will automate the assignment and reassignment of sailors to billets to improve NEC utilization, which, in turn, will improve NEC Fit.

Do System Upgrades Affect NEC Fit?

Navy's platform modernization program

The Navy's modernization program continually updates operational platforms and their Command, Control, Communications, Computer, Combat, and Intelligence (C5I) systems to keep pace with technological advances and changing warfighter needs. Its goal is to ensure that these units are capable of defeating evolving threats while meeting service life requirements and future operational commitments.

Although a necessary part of a platform's life cycle, this program adds to the challenges of manning fleet units with the right numbers and types of sailors because some modernization actions change a platform's manpower requirements. Weapon system upgrades, in particular, often bring new NEC requirements.

In this section, we investigate how system upgrades affect NEC Fit. We separate upgrades into two types: (1) those installed on existing ships to replace legacy systems and (2) those installed on new construction ships. We are concerned mostly with the first type because they are installed on platforms (usually during maintenance availabilities) whose crewmembers were most likely trained to operate and maintain the legacy system.

For our investigation, we selected the DDG modernization program, which provides mid-life upgrades (our type 1) to ensure that DDG-51-class ships maintain mission relevance and remain an integral part of the Navy's surface force. Modernization changes are also being introduced to new construction DDG-51 ships (our type 2) to increase their baseline capabilities and provide commonality between new construction ships and modernized in-service ships [6].

Anti-submarine warfare (ASW) combat system improvement program for DDGs

To further narrow our focus, we examine the modernization program for the AN/SQQ-89(V) ASW combat system on these ships. This system provides surface warships with an undersea/ASW detection, localization, classification, and targeting capability [7].

As of September 2014, three variants of the AN/SQQ-89 system were installed on DDG-51-class ships: AN/SQQ-89(V)4/6, AN/SQQ-89(V)15, and AN/SQQ-89A(V)15. Each variant has a unique set of NEC requirements. Table 1 lists all the surface sonar technician (STG) NEC requirements on DDG-51 ships and the variants of the AN/SQQ-89 system to which they apply. Figure 6 shows the apprentice-, journeyman-, and supervisor-level STG jobs and NEC requirements for each variant [7].

Table 1. DDG AN/SQQ-89(V) system NEC requirements

NEC	Title	Variant applicability
0411	AN/SQQ-89(V)4/6 Operator	AN/SQQ-89(V)4/6
0429	MK 116 Mod 7 Operator	AN/SQQ-89(V)4/6
0430	MK 116 Mod 7 Maintenance Technician	AN/SQQ-89(V)4/6, (V)15, A(V)15
0450	Advanced Acoustic Analysis	AN/SQQ-89(V)4/6, (V)15, A(V)15
0455	AN/SQS-53C Maintenance Technician	AN/SQQ-89(V)4/6
0466	AN/SQQ-89 Sonar Watch Supervisor	AN/SQQ-89(V)4/6
0521	AN/SQQ-89(V)15 Operator	AN/SQQ-89(V)15
0522	AN/SQQ-89(V)15 Maintenance Technician	AN/SQQ-89(V)15
0523	AN/SQQ-89(V)15 Journeyman	AN/SQQ-89(V)15
0524	AN/SQQ-89A(V)15 Operator	AN/SQQ-89A(V)15
0525	AN/SQQ-89A(V)15 Maintenance Technician	AN/SQQ-89A(V)15
0527	AN/SQQ-89A(V)15 Journeyman	AN/SQQ-89A(V)15
0417	Surface Ship ASW Specialist	AN/SQQ-89(V)4/6, (V)15, A(V)15

The new technology upgrade AN/SQQ-89A(V)15 Advanced Capabilities Build (ACB) and Technical Insertion (TI) versions are being installed on forward-fit (i.e., new) DDGs and selected back-fit (i.e., in-service) DDG-51 and CG-47 ships. The three apprentice- and journeyman-level NECs that are required to operate and maintain this system are NEC-0524 (sensor operator), NEC-0525 (operator/maintenance technician), and NEC-0527 (sonar watch supervisor) [7].

Figure 7 shows the most recent back-fit installation schedule, by hull, for the AN/SQQ-89A(V)15. The schedule, which was published by the Naval Sea Systems Command (NAVSEA), shows the installations that have occurred each year since 2009 and those planned for each year out to 2025. Since 2010, the Navy has upgraded between four and six ships per year, and current plans call for this rate to continue through 2021.

Figure 6. Variants of the AN/SQQ-89 system installed on DDG-51-class ships

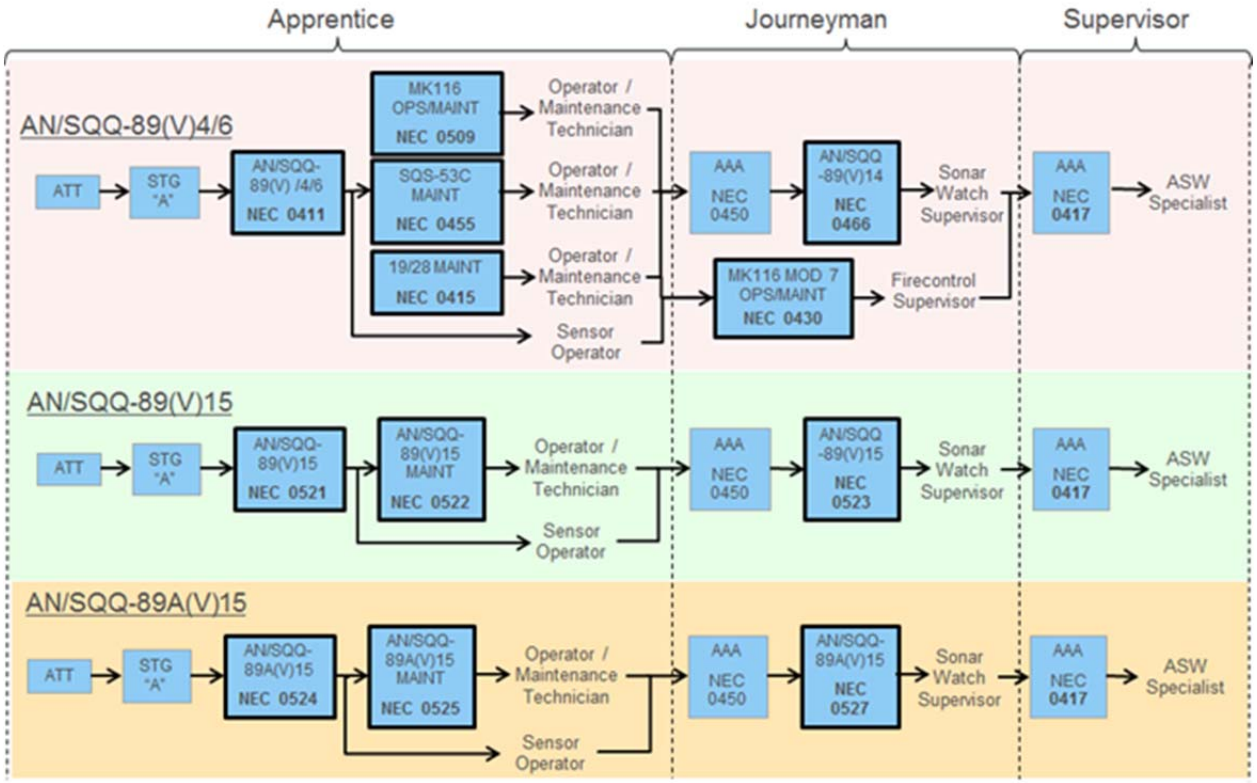
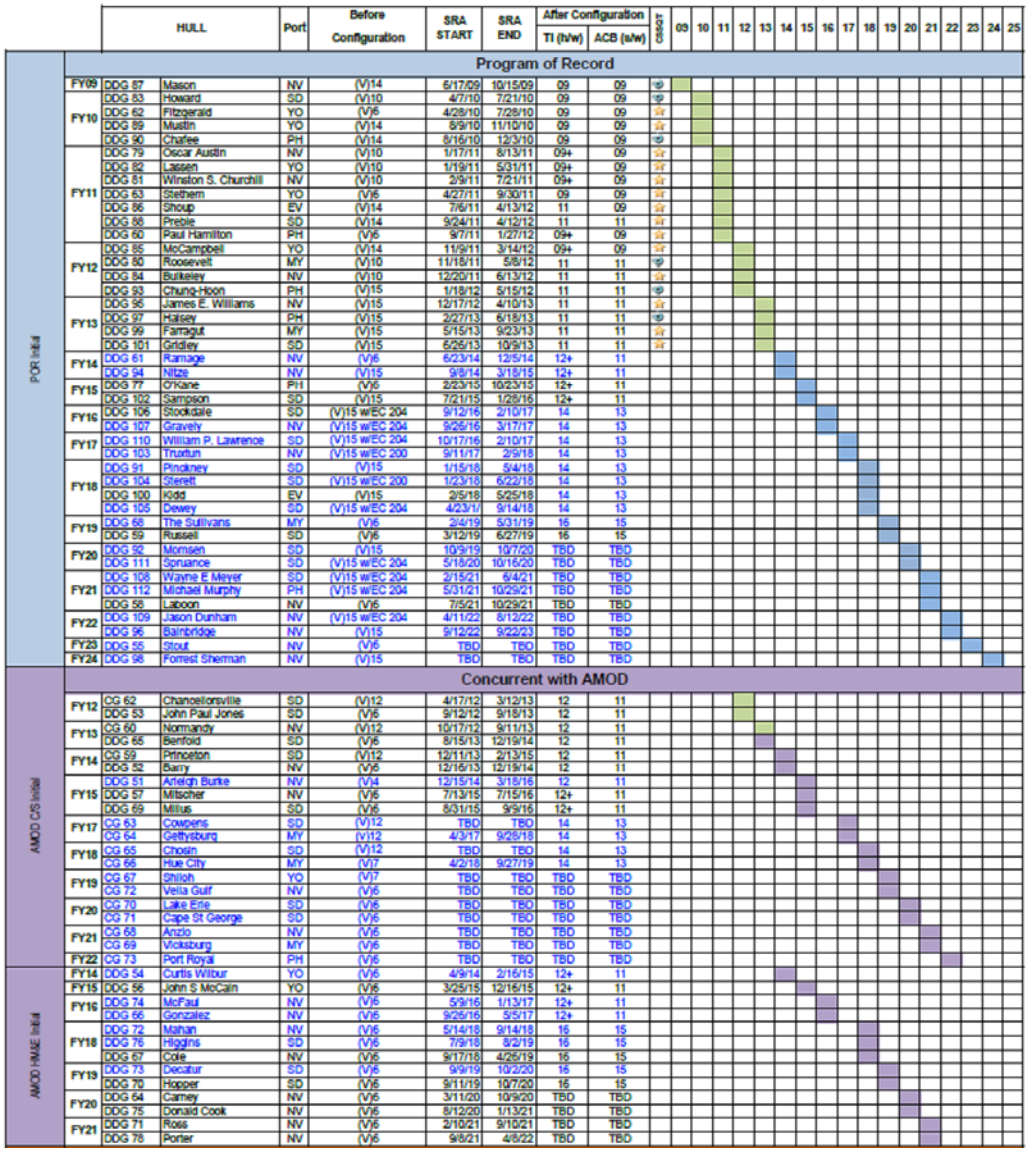


Figure 7. AN/SQQ-89 A(V)15 installation plan[a]



		HULL		Port	Before Configuration	SRA START	SRA END	After Configuration TI (h/w)	After Configuration ACB (s/w)	CBSGT	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
	Program of Record																										
POR Initial	FY09	DDG 87	Mason	NV	(V)14	5/17/09	10/15/09	09	09																		
	FY10	DDG 83	Howard	SD	(V)10	4/7/10	7/21/10	09	09																		
		DDG 62	Fitzgerald	YO	(V)6	4/28/10	7/28/10	09	09																		
		DDG 89	Mustin	YO	(V)14	6/9/10	11/10/10	09	09																		
		DDG 90	Chafee	PH	(V)14	8/16/10	12/3/10	09	09																		
	FY11	DDG 79	Oscar Austin	NV	(V)10	1/17/11	8/13/11	09+	09																		
		DDG 82	Lassen	YO	(V)10	1/19/11	5/31/11	09+	09																		
		DDG 81	Winston S. Churchill	NV	(V)10	2/9/11	7/21/11	09+	09																		
		DDG 63	Stethem	YO	(V)6	4/27/11	9/30/11	09	09																		
		DDG 86	Shoup	EV	(V)14	7/6/11	4/13/12	11	09																		
		DDG 88	Preble	SD	(V)14	9/24/11	4/12/12	11	11																		
		DDG 60	Paul Hamilton	PH	(V)6	9/7/11	1/27/12	09+	09																		
	FY12	DDG 85	McCampbell	YO	(V)14	11/9/11	3/14/12	09+	09																		
		DDG 80	Roosevelt	MY	(V)10	11/18/11	5/8/12	11	11																		
		DDG 84	Bulkeley	NV	(V)10	12/20/11	6/13/12	11	11																		
		DDG 93	Chung-Hoon	PH	(V)15	1/18/12	5/15/12	11	11																		
	FY13	DDG 96	James E. Williams	NV	(V)15	12/17/12	4/10/13	11	11																		
		DDG 97	Halsey	PH	(V)15	2/27/13	6/18/13	11	11																		
		DDG 99	Farragut	MY	(V)15	5/15/13	9/23/13	11	11																		
		DDG 101	Gridley	SD	(V)15	8/26/13	10/9/13	11	11																		
	FY14	DDG 61	Ramage	NV	(V)6	6/23/14	12/5/14	12+	11																		
		DDG 94	Nitze	NV	(V)15	9/8/14	3/18/15	12+	11																		
	FY15	DDG 77	O'Kane	PH	(V)6	2/23/15	10/23/15	12+	11																		
		DDG 102	Sampson	SD	(V)15	7/21/15	1/28/16	12+	11																		
	FY16	DDG 106	Stockdale	SD	(V)15 w/EC 204	9/12/16	2/10/17	14	13																		
		DDG 107	Gravely	NV	(V)15 w/EC 204	9/26/16	3/17/17	14	13																		
	FY17	DDG 110	William P. Lawrence	SD	(V)15 w/EC 204	10/17/16	2/10/17	14	13																		
		DDG 103	Thurlun	NV	(V)15 w/EC 200	9/11/17	2/9/18	14	13																		
	FY18	DDG 91	Pinckney	SD	(V)15	1/15/18	5/4/18	14	13																		
		DDG 104	Sterett	SD	(V)15 w/EC 200	1/23/18	6/22/18	14	13																		
		DDG 100	Kidd	EV	(V)15	2/5/18	5/25/18	14	13																		
		DDG 105	Dewey	SD	(V)15 w/EC 204	4/23/1/	9/14/18	14	13																		
	FY19	DDG 68	The Sullivans	MY	(V)6	2/4/19	5/31/19	16	15																		
		DDG 59	Russell	SD	(V)6	3/12/19	6/27/19	16	15																		
	FY20	DDG 92	Momsen	SD	(V)15	10/9/19	10/7/20	TBD	TBD																		
		DDG 111	Spruance	SD	(V)15 w/EC 204	5/18/20	10/16/20	TBD	TBD																		
	FY21	DDG 108	Wayne E Meyer	SD	(V)15 w/EC 204	2/15/21	6/4/21	TBD	TBD																		
		DDG 112	Michael Murphy	PH	(V)15 w/EC 204	5/31/21	10/29/21	TBD	TBD																		
		DDG 58	Laboon	NV	(V)6	7/5/21	10/29/21	TBD	TBD																		
	FY22	DDG 109	Jason Dunham	NV	(V)15 w/EC 204	4/11/22	8/12/22	TBD	TBD																		
		DDG 96	Bainbridge	NV	(V)15	9/12/22	9/22/23	TBD	TBD																		
	FY23	DDG 55	Stout	NV	(V)6	TBD	TBD	TBD	TBD																		
	FY24	DDG 98	Forrest Sherman	NV	(V)15	TBD	TBD	TBD	TBD																		
	Concurrent with AMOD																										
AMOD C/S Initial	FY12	CG 62	Chancellorsville	SD	(V)12	4/17/12	3/12/13	12	11																		
		DDG 53	John Paul Jones	SD	(V)6	9/12/12	9/18/13	12	11																		
	FY13	CG 60	Normandy	NV	(V)12	10/17/12	9/11/13	12	11																		
		DDG 65	Benfold	SD	(V)6	8/15/13	12/19/14	12	11																		
	FY14	CG 59	Princeton	SD	(V)12	12/11/13	2/13/15	12	11																		
		DDG 52	Barry	NV	(V)6	12/16/13	12/19/14	12	11																		
	FY15	DDG 51	Arleigh Burke	NV	(V)4	12/15/14	3/18/16	12	11																		
		DDG 57	Mitscher	NV	(V)6	7/13/15	7/15/16	12+	11																		
		DDG 69	Millus	SD	(V)6	8/31/15	9/9/16	12+	11																		
	FY17	CG 63	Cowpens	SD	(V)12	TBD	TBD	14	13																		
		CG 64	Gettysburg	MY	(V)12	4/3/17	9/28/18	14	13																		
	FY18	CG 65	Chosin	SD	(V)12	TBD	TBD	14	13																		
		CG 66	Hue City	MY	(V)7	4/2/18	9/27/19	14	13																		
	FY19	CG 67	Shiloh	YO	(V)7	TBD	TBD	TBD	TBD																		
		CG 72	Vella Gulf	NV	(V)6	TBD	TBD	TBD	TBD																		
	FY20	CG 70	Lake Erie	SD	(V)6	TBD	TBD	TBD	TBD																		
		CG 71	Cape St George	SD	(V)6	TBD	TBD	TBD	TBD																		
	FY21	CG 68	Anzio	NV	(V)6	TBD	TBD	TBD	TBD																		
		CG 69	Vicksburg	MY	(V)6	TBD	TBD	TBD	TBD																		
	FY22	CG 73	Port Royal	PH	(V)6	TBD	TBD	TBD	TBD																		
AMOD HMSE Initial	FY14	DDG 54	Curtis Wilbur	YO	(V)6	4/9/14	2/16/15	12+	11																		
	FY15	DDG 56	John S McCain	YO	(V)6	3/25/15	12/16/15	12+	11																		
	FY16	DDG 74	McFaul	NV	(V)6	5/9/16	1/13/17	12+	11																		
		DDG 65	Gonzalez	NV	(V)6	9/26/16	5/5/17	12+	11																		
	FY18	DDG 72	Mahan	NV	(V)6	5/14/18	9/14/18	16	15																		
		DDG 76	Higgins	SD	(V)6	7/9/18	8/2/19	16	15																		
		DDG 67	Cole	NV	(V)6	9/17/18	4/25/19	16	15																		
	FY19	DDG 73	Decatur	SD	(V)6	9/9/19	10/2/20	16	15																		
		DDG 70	Hopper	SD	(V)6	9/11/19	10/7/20	16	15																		
	FY20	DDG 64	Carney	NV	(V)6	3/11/20	10/9/20	TBD	TBD																		
		DDG 75	Donald Cook	NV	(V)6	8/12/20	1/13/21	TBD	TBD																		
	FY21	DDG 71	Ross	NV	(V)6	2/10/21	9/10/21	TBD	TBD																		
		DDG 78	Porter	NV	(V)6	9/8/21	4/8/22	TBD	TBD																		

Source: Program Executive Office (PEO) Integrated Warfare Systems (IWS), Undersea Systems, IWS5, *AN/SQQ-89 A(V)15 Fielding Plan* (Dec. 5, 2014).

a. Green cells represent completed installations; blue and purple cells represent current and future installations.

Effects of AN/SQQ-89 upgrades on NEC Fit

To determine the impact of AN/SQQ-89 upgrades on NEC Fit, we first examine the immediate effects on individual ships that have received this upgrade. We then look at the longer term effects across the class of DDG-51 ships.

Ship-level effects

We begin our investigation by analyzing Fit levels for NEC-0527, which is the journeyman sonar watch supervisor NEC for the AN/SQQ-89A(15) system. In September 2014, 38 ships had this system installed. The average Fit level for this NEC across these ships was 66 percent.

Figure 8 shows the distribution of NEC-0527 Fit for individual ships. Each DDG has an authorized requirement for five sailors with this NEC. The distribution shows that 7 of the 38 ships were 100 percent Fit (i.e., no gaps) and 15 were 80 percent Fit (i.e., one NEC Fit gap). Of more interest were the 4 ships with 0 percent Fit and the 2 ships with 20 percent Fit. These 6 ships reduce the average Fit level for this NEC on DDG-51 ships from 78 percent to 66 percent.

Figure 8. Fit levels for NEC-0527 on DDG-51-class ships

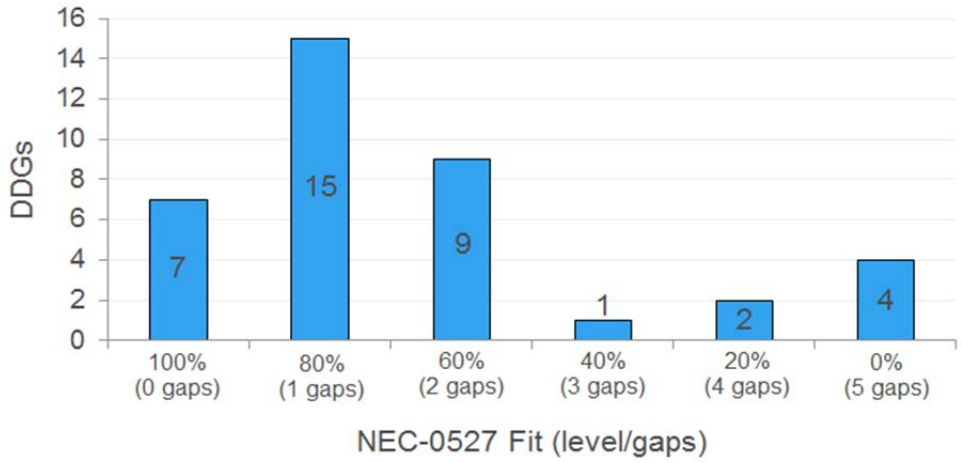


Table 2 contains the requirements for NEC-0527 in TFMMS for these six ships from FY10 to FY15. All four ships with zero Fit (i.e., five Fit gaps) in September 2014 received an ASW system upgrade in FY14, as indicated by the change in requirements from zero to five, and one of the ships with 20 percent Fit received an upgrade in FY13. These results clearly indicate that system upgrades do affect NEC Fit.

Table 2. Yearly authorized requirements for NEC-0527

Hull	NEC-0527 Fit gaps[a]	NEC-0527 end-of-FY requirements					
		FY10	FY11	FY12	FY13	FY14	FY15
DDG-51 A. Burke	5	0	0	0	0	5	5
DDG-61 Ramage	5	0	0	0	0	5	5
DDG-77 O'Kane	5	0	0	0	0	5	5
DDG-94 Nitze	5	0	0	0	0	5	5
DDG-54 C. Wilbur	4	0	0	0	5	5	5
DDG-83 Howard	4	6	6	5	5	5	5

Source: TFMMS.

a. In September 2014.

Causes of NEC Fit decrements

To determine the reasons for the degradation in NEC Fit when new systems are installed, we examined (1) the timing of when the new NECs became the authorized requirement in TFMMS relative to when the installations occurred and (2) the retraining (and awarding of new NECs) of current crewmembers who have NECs for the legacy system.

Timing of new NEC requirements in TFMMS

From 2009 through 2013, 18 destroyers were upgraded with the AN/SSQQ-89(V)15 system. Table 3 contains the dates of the Selected Restricted Availabilities (SRA) during which the system was installed and the date (month and year) that the new NECs became the authorized requirements in TFMMS. It also shows the times from the TFMMS change dates to the start and the end dates of the SRA. On average, the new NECs became the requirement about 273 days before the start of the SRA (or 408 days before the end of the SRA).

Next, we plotted current-month Fit levels for the new NECs (0524, 0525, and 0527) as a function of the time since these NECs became the requirement on each ship.[16] Figure 9 shows the average levels for each NEC. For reference, we show the approximate SRA period. We also label the period from the date of the new requirement in TFMMS to the SRA as the "post-TFMMS, pre-installation" and the period after the SRA as "post-installation."

[16] Recall that NEC Fit is based on authorized requirements in TFMMS. Current-month Fit, which we use in this study, is based on current-month requirements. The Navy also reports P09BA Fit, which is based on projected authorized requirements nine months in the future.

Table 3. Timing of new NECs in TFMMS relative to the ship's SRA dates

Hull	SRA start date	SRA end date	TFMMS NEC change date[a]	SRA start date to TFMMS change (days)	SRA end date to TFMMS change (days)
DDG-87	6/17/2009	10/15/2009	Sep-08	286	404
DDG-83	4/7/2010	7/21/2010	Mar-09	396	500
DDG-62	4/28/2010	7/28/2010	Aug-09	267	357
DDG-89	8/9/2010	11/10/2010	Nov-09	278	369
DDG-79	1/17/2011	8/13/2011	Mar-10	316	522
DDG-82	1/19/2011	5/31/2011	Mar-10	318	450
DDG-90	8/16/2010	12/3/2010	Apr-10	135	242
DDG-85	11/9/2011	3/14/2012	Sep-10	428	553
DDG-81	2/9/2011	7/21/2011	Oct-10	128	290
DDG-63	4/27/2011	9/30/2011	Jan-11	116	269
DDG-80	11/18/2011	5/8/2012	Feb-11	287	457
DDG-88	9/24/2011	4/12/2012	Feb-11	233	431
DDG-60	9/7/2011	1/27/2012	Mar-11	186	326
DDG-93	1/18/2012	5/15/2012	Mar-11	317	434
DDG-84	12/20/2011	6/13/2012	Apr-11	259	432
DDG-95	12/17/2012	4/10/2013	Mar-12	286	399
DDG-97	2/27/2013	6/18/2013	Mar-12	356	467
DDG-99	5/15/2013	9/23/2013	Jul-12	314	442
			Average	**273**	**408**

Source: NAVSEA AN/SQQ-89 Installation schedule (December 2014) and TFMMS.

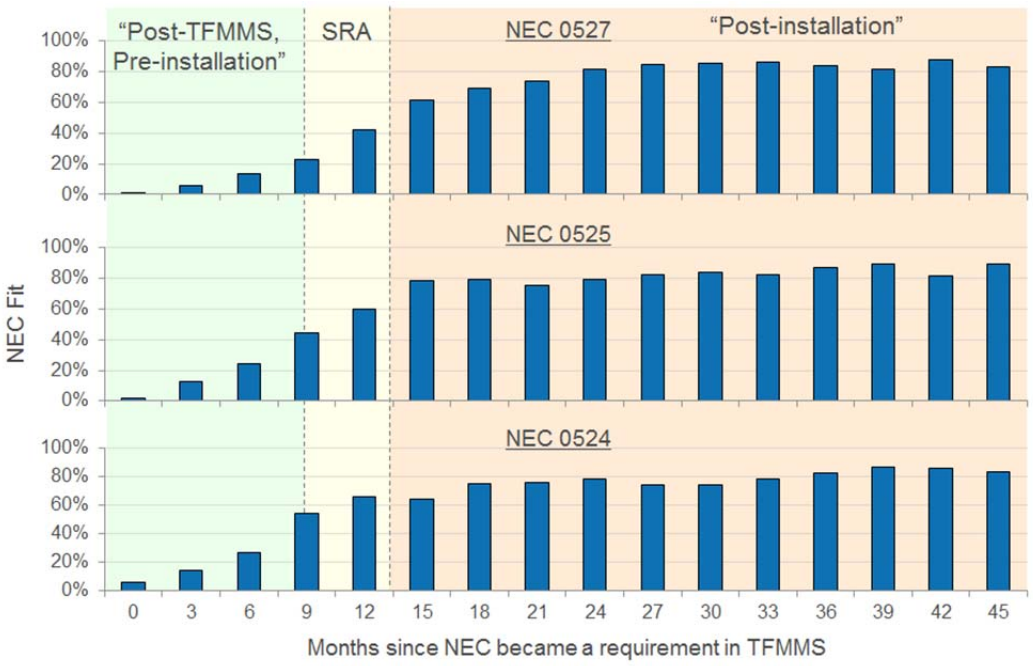
a. Effective dates of manpower requirements in TFMMS are defined by year and month.

We see that Fit levels are very low during the post-TFMMS, pre-installation period, although they do increase with time. These levels increase at a faster rate during the installation (SRA) period. On one hand, for the apprentice NECs (0524 and 0525), Fit continues to rise for a short time following the installation period but quickly levels off at about 80 percent. The journeyman NEC (0527), on the other hand, also continues to rise during and after the installation but at a much slower rate. It takes nearly a year after the end of the installation period before it also levels off at about 80 percent.[17]

These profiles reveal two problems. First, the new NECs become the authorized requirement much too early in TFMMS. The date of these new requirements should align with the installation period, not 9 to 12 months before. Otherwise, current-month Fit during the post-TFMMS, pre-installation period is measuring NEC manning for systems that have not yet been installed. As we will discuss in more detail later in the report, the effective dates of future requirements can be defined in TFMMS.

[17] Later in the report, we discuss possible reasons why journeyman-level NECs, in general, have lower Fit levels.

Figure 9. NEC Fit relative to the timing of new requirements in TFMMS



Issues with the timing of new manpower requirements in TFMMS and their potential effects on fleet Fit extend beyond the changes due to modernization. They also occur in newly commissioned ships and affect both RCN and NEC Fit. When we calculated average RCN and NEC Fit for DDG-51-class ships (see Figure 1), we found that the full-crew manpower requirements for new ships appear in TFMMS 15 to 24 months before the commissioning date, whereas the personnel assigned to the unit identification codes (UICs) of these ships do not appear until 3 to 6 months before the commissioning dates (see Table 4). Consequently, there are 15 or more months (green-colored cells in Table 4) during which TFMMS shows authorized requirements, but the personnel database shows no sailors on board. Including these ships in the class average will lower RCN and NEC Fit by several percentage points.

Table 4. BA, inventory, and Fit levels for newly commissioned DDGs

Hull	Metric	Sep. '09	Dec. '09	Mar. '10	Jun. '10	Sep. '10	Dec. '10	Mar. '11	Jun. '11	Sep. '11	Dec. '11	Mar. '12	Jun. '12	Sep. '12	Dec. '12
DDG 110 USS *Lawrence* (commissioned Jun. 2011)	Fit BA	44	244	244	244	244	244	244	244	244	249	249	251	251	265
	Fit INV	0	0	0	0	0	0	211	220	223	228	226	237	239	243
	RCN Fit	0%	0%	0%	0%	0%	0%	86%	90%	91%	92%	91%	94%	95%	92%
	NEC Fit	0%	0%	0%	0%	0%	0%	81%	85%	87%	87%	86%	78%	79%	74%
DDG 111 USS *Spruance* (commissioned Oct. 2011)	Fit BA	43	247	247	247	247	247	247	247	247	250	250	250	250	266
	Fit INV	0	0	0	0	0	0	0	217	216	221	216	218	220	227
	RCN Fit	0%	0%	0%	0%	0%	0%	0%	88%	87%	88%	86%	87%	88%	85%
	NEC Fit	0%	0%	0%	0%	0%	0%	0%	61%	68%	70%	80%	86%	86%	79%
DDG 112 USS *Murphy* (commissioned Oct. 2012)	Fit BA	3	113	113	113	113	248	248	248	248	248	248	248	248	265
	Fit INV	0	0	0	0	0	0	0	0	0	0	0	203	224	233
	RCN Fit	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	82%	90%	88%
	NEC Fit	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	69%	76%	72%

Part of the problems with new ships is that crewmembers who are assigned to the ship before its commissioning are assigned to precommissioning units (PCUs) and detachments (PCDs), both of which have different UICs.[18] We do not know whether the Navy Fit computations account for this issue. Even if they do, there are still periods during which TFMMS will show full-crew requirements for the current month, while the number of sailors assigned to a ship or its PCUs is well below the full-crew requirement.

To address this issue, each month PERS-4013 and USFFC-N1P collaborate to determine which units to exclude from fleet Fit levels that are presented in the CNO-level metrics briefs. For example, in May 2015, 107 sea units (i.e., UICs) totaling almost 7,200 authorized billets and nearly 3,000 sailors were excluded from RCN and NEC Fit calculations. Although this action removes the effects that units with large inventory-billet mismatches have on aggregate RCN and NEC Fit, it does not address the effects caused by NEC changes from system upgrades.

Retraining of crewmembers

When new systems are installed on ships, crewmembers receive training, usually from the manufacturer/organization that installs the system. The issue with regard to NEC Fit, however, is whether these crewmembers earn the new NECs from this training. If they don't, NEC Fit will show gaps even though the crew has been trained to operate and maintain the new system. And even if they do, if there are delays in awarding these NECs, Fit levels will show gaps until the NECs appear on the sailors' personnel records.

To answer these questions, we looked at the NEC history of STG apprentice and journeyman crewmembers who were on board a DDG-51 ship prior to an upgrade installation and remained on board after the installation was complete. For these sailors, we compiled lists of their NECs and assigned DNECs before and after the installation period (i.e., SRA). We then counted the number of crewmembers with the new AN/SQQ-89A(V)15 NECs and DNECs for both periods. In reviewing the data for individual ships, we identified three outcomes (see Figure 10) and grouped the ships accordingly. In the first group of ships (green rows), most of the crewmembers received a new NEC (and new DNEC) after the installation. In the second group (red rows), almost all the crewmembers never received a new NEC while assigned to those ships. And in the third group (gray rows), most of the crewmembers arrived with a new NEC (and new DNEC) before the installation occurred.

[18] Precommissioning crews can form once the keel is laid and can continue until the ship is commissioned. They consist of personnel assigned to the PCU, which is located at the shipyard, and the PCD, which is located at the ship's homeport.

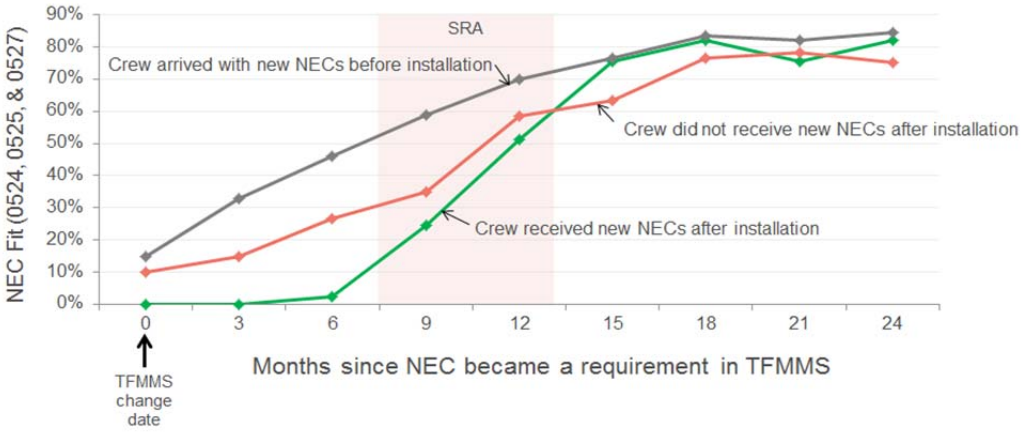
Figure 10. NEC history of crewmembers before and after installation of upgrades

	Hull	Location	SRA end date	A/J crew-members	Held NECs			Distribution NECs			
					New NECs before SRA	New NECs after SRA	New NEC Change	New DNECs before SRA	New DNECs after SRA	New DNEC Change	
Crew received new NECs after installation	DDG 80	Florida	05/08/12	3	0	2	+2	0	1	+1	Improved Fit after installation
	DDG 90	Hawaii	12/03/10	8	0	6	+6	0	6	+6	
	DDG 62	Japan	07/28/10	5	0	2	+2	0	0	0	
	DDG 89	Japan	11/10/10	8	2	6	+4	1	4	+3	
	DDG 84	Norfolk	06/13/12	7	2	7	+5	2	7	+5	
Crew did not receive new NECs after installation	DDG 60	Hawaii	01/27/12	6	0	0	0	0	0	0	Poor Fit after installation
	DDG 87	Norfolk	10/15/09	5	0	0	0	0	0	0	
	DDG 95	Norfolk	04/10/13	7	0	0	0	0	0	0	
	DDG 99	Florida	05/15/13	8	2	2	0	2	2	0	
	DDG 93	Hawaii	05/15/12	8	4	4	0	4	4	0	
Crew arrived with new NECs before installation	DDG 63	Japan	09/30/11	9	6	6	0	6	6	0	Improved Fit before installation
	DDG 82	Japan	05/31/11	8	5	6	+1	6	6	0	
	DDG 85	Japan	03/14/12	3	2	2	0	2	2	0	
	DDG 79	Norfolk	08/13/11	6	5	5	0	5	5	0	
	DDG 81	Norfolk	07/21/11	5	3	4	+1	3	4	+1	
	DDG 88	San Diego	04/12/12	5	5	5	0	5	5	0	
	DDG 83	San Diego	07/21/10	9	7	7	0	7	7	0	
			Total	110	43	64	+21	43	59	+16	

We pulled the homeport location of each ship to see whether the outcome depended on location. For example, one might speculate that ships homeported in San Diego would be more likely to get their current crewmembers retrained because the ASW Training Center is there. But this does not seem to be the case because ships from the same location are in multiple groups.

Next, we plotted the average Fit level for NECs 0524, 0525, and 0527 as a function of time since the NECs became a requirement in TFMMS for each of these groups (see Figure 11). Again, we show the approximate SRA period. As expected, each group has a different Fit profile. For the first group (new NECs after the installation), Fit is nearly zero during the post-TFMMS, pre-installation period, but it increases quickly during and after the installation. For the second group (crewmember never received the new NECs), the increase in Fit is more gradual and reflects the arrival of new crewmembers with the new NECs. For the third group (crewmembers with new NECS who arrived before the installation), Fit levels increased during the post-TFMMS, pre-installation period and continued during the installation period as more crewmembers reported on board with the new NECs. We are not sure of the reasons for the three outcomes, but this is an issue that warrants further investigation.

Figure 11. STG NEC Fit profile for three groups of DDGs



Class-level effects

So far, we've examined the effects of system upgrades on individual ships' Fit levels. Now we turn to the effects of introducing new NECs on DDG-51-class average Fit.

Figure 12 plots the average DDG-51-class Fit levels for NECs 0524, 0525, and 0527 at three-month intervals over the past five years. It shows that the Fit levels for each of these NECs has increased significantly over this period.

Figure 12. Effects of system upgrades on average Fit for DDG-51-class ships

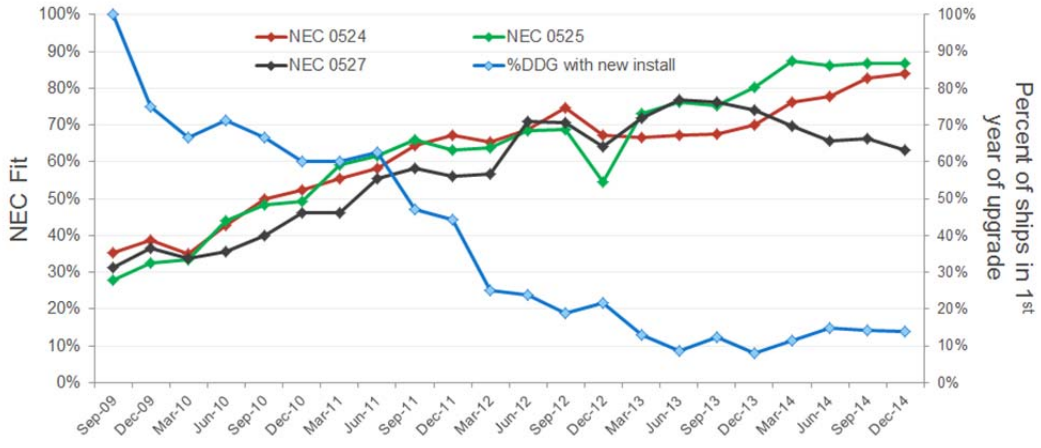


Figure 12 also shows the percentage of DDG-51 ships with the AN/SQQ-89A(V)15 that are in the pre-installation period (i.e., time from when the new NEC requirements appear to TFMMS to the end of the SRA period) or for new ships the 12 months prior to when the first sailors are assigned to the ship's UIC. The results show a strong inverse relationship. As more ships receive the new system, the percentage of ships in the period when unit-level Fit is low becomes less and less. Conversely, over time, a larger percentage of the ships with upgrades have passed this transition period and reached their steady-state NEC Fit levels.

Planning for modernization generated manpower changes

As we've shown, some system upgrades come with new NEC requirements, and these changes have a short-term negative effect on NEC Fit. Here, we examine how the Navy accounts for these new requirements in developing its long-range training plans.

Student input plan process

The process by which the Navy determines future training plans is known as the student input plan (SIP) process. It comprises several phases. The first phase is determining the future training student throughput requirements—that is, how many sailors the Navy will need to put through each of its training courses. The second phase involves conducting a feasibility study to determine, for each course, whether there be will sufficient capacity (i.e., instructors, classrooms, and technical training equipment) to train the required throughput. If so, the requirement becomes the SIP. If not, the learning center asks its resource sponsor for additional resources to execute the requirement. If more resources are provided, the requirement becomes the SIP. If not, the course becomes constrained, and its SIP is limited to the available capacity. Once the final plans are developed, the learning centers build course schedules and allocate quotas (class seats) to the various student groups (e.g., regular active duty Navy, selected reserve Navy, and Marine Corps).

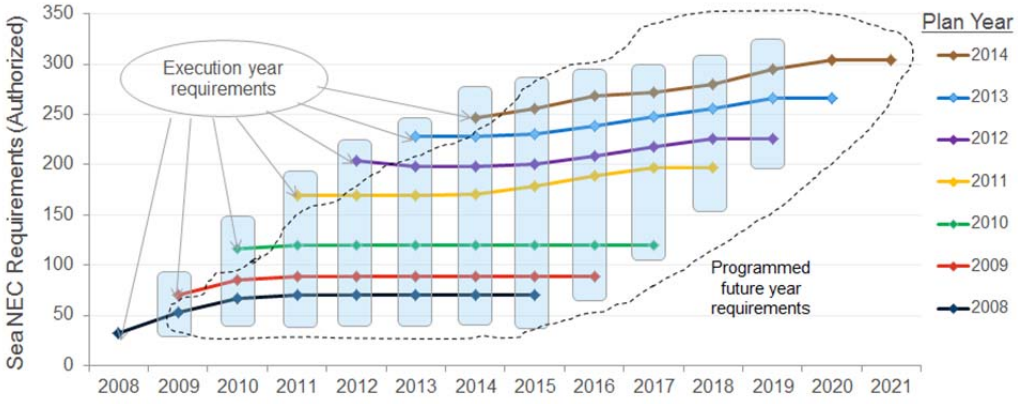
Because we are concerned with the changes in NEC requirements due to platform modernization, our interest in the SIP process lies in how future throughput requirements are determined for NEC-producing C-schools. The SIP process plans for training requirements three years in the future. The basis for determining student throughput is the Navy's future manpower requirements. For C-school planning, these are the NEC requirements attached to authorized billets. The authoritative source for these requirements is TFMMS, which contains billet requirements and authorizations for the current fiscal year and each year of the Future Year Defense Plan (FYDP).

Future year NEC requirements in TFMMS

Earlier, we showed that manpower requirement changes due to system upgrades appear in TFMMS about a year before the installation. Although this timing supports the enlisted distribution process, which looks at requirements nine months in the future, it does not support the SIP process. Because the SIP process looks at requirements three years in the future, it will not see changes in NEC requirements that result from system upgrades during this three-year period. This can cause significant overprojections and underprojections of future training plans for these NECs.

To illustrate, Figure 13 shows the current and future year authorized sea-duty requirements for NEC-0524 that appeared in TFMMS over the past seven years. Each horizontal line represents the current and future year requirements that were in TFMMS at the end of each fiscal year. For example, the dark blue line on the bottom shows the current and future year requirements in TFMMS in September 2008, and the brown line at the top shows the requirements in TFMMS in September 2014.

Figure 13. Current and future year sea-duty requirements for NEC-0524



Source: TFMMS.

Changes that occur along the horizontal lines are future year manpower requirement projections that primarily reflect force structure changes (in this case, new DDGs with the AN/SQQ-89A(V)15 system that increase the number of NEC-0524 billets). Because these changes are reflected in future year requirements, they are accounted for when determining NEC training requirements in the SIP process.

Changes in the vertical columns, however, represent yearly changes that were not reflected in the previous year's future requirement projections. Most of these changes stem from new system installations on in-service ships under the

modernization program. Because these changes were not included in the previous year's future year manpower requirements, they were, most likely, not accounted for when determining NEC training requirements in the SIP process. This is problematic because the magnitude of these changes far exceeds that of the changes that were included in the future year requirements.

For NEC-0524, the changes in requirements due to system upgrades would have had a substantial impact on training plans. The SIP process that was conducted in 2008 focused on training requirements in 2011. According to Figure 13, at that time the projected requirement for NEC-0524 in 2011 was 71. Jumping forward to 2011, however, we see that the actual requirement turned out to be 169. In this case, the SIP would be well below the required throughput, which would likely lead to a shortage of NEC-0524 trained sailors in 2011.[19]

Increases in training requirements

Another issue arising from the modernization program that complicates training planning is the prerequisite training for new journeyman NECs. When a new system is installed, the Navy trains recruits to fill the new apprentice-level NECs. The amount of training for accessions will not change unless the length of training for the new NECs differs from the legacy NECs. If the training times are similar, the amount of training should be the same because the increase in training for the new NECs should be offset by a decrease in training for the old NECs.

This is not the case for some journeyman NECs because they have prerequisite NECs known as component NECs. To be eligible to earn these journeyman NECs, the sailor must hold the component NEC. For example, NEC-0524 (sensor operator) is a prerequisite for NEC-0527 (sonar watch supervisor). Thus, if a sailor is selected to be a sonar watch supervisor on an AN/SQQ-89A(V)15 ship but had previously been a sensor operator on another variant of this system, he would need to attend training for NEC-0524 in addition to the training to earn NEC-0527. This adds to the training requirements for some apprentice NECs.

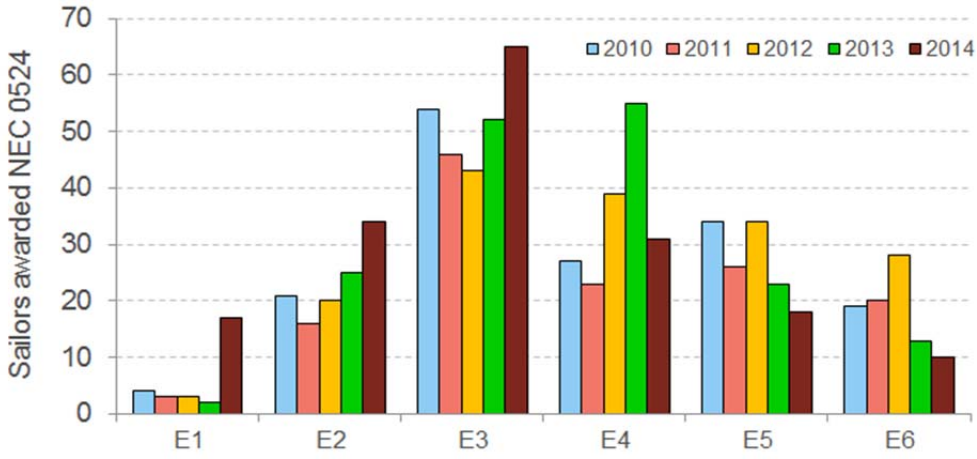
To verify that this does occur, we identified sailors who earned NEC-0524 in each of the past five years (2010-2014). Figure 14 shows the paygrade distribution of these sailors by year. Sailors earning this NEC ranged from E-1s to E-6s. All the sea duty requirements for NEC-0524, however, belong to E-3 or E-4 billets. But the data show a significant number of E-5 and E-6 sailors earning this NEC. When we further

[19] The SIP process tries to account for emerging requirements by continually updating the training plan for each fiscal year. As the plan gets closer to execution, however, the ability to make significant adjustments decreases, especially if the course load is at or near capacity.

examined these sailors, we found that about 77 percent went on to earn NEC-0527, which implies that they earned NEC-0524 to satisfy the prerequisites.

This additional training does not pose a problem if it is accounted for in the SIP process. If it is not, there will be insufficient capacity to train enough sailors to fill all the NEC-0524 and NEC-0527 requirements.

Figure 14. Paygrade distribution of sailors who earned NEC-0524 from 2010 to 2014



Source: Enlisted Master Record (EMR).

Actions to lessen the effects of system upgrades on NEC Fit

The primary reason why system upgrades negatively affect NEC Fit is not that they bring new NEC requirements but rather how (and when) these new requirements are entered in TFMMS.

We offer two improvements to better manage these requirements in TFMMS:

- *Set the effective date of new system NEC requirements in TFMMS to coincide with the installation date.* Manpower requirements for a new system should not appear as the current authorized requirement until the system has been installed. Under these rules, current-month NEC Fit would always be measured against the actual systems on board. TFMMS has the capability to define the date (month and year) of future manpower requirements. Each record in TFMMS has effective start and end dates that define the timeframe

during which the billet information in that record is valid.[20] For example, suppose a current E-5 billet will change to an E-6 billet in October 2016. TFMMS will contain two records for this billet. The record with the E-5 paygrade will have an effective end date of September 2016, and the record with the E-6 paygrade will have an effective start date of October 2016. Future changes to a billet's NEC requirements can be defined in the same manner.[21]

- *Enter future modernization manpower changes in TFMMS at least three years in advance.* Modernization program offices plan system upgrade schedules well in advance of the installation. TFMMS should be synced with these plans, and its out-year requirements should reflect these scheduled changes. Without this change, the training requirements determination phase of the SIP process will need to augment the NEC requirements in TFMMS with projected NEC changes based on these installation schedules.

In addition to changing how manpower requirements are managed in TFMMS, we recommend two other actions to lessen the effects of system upgrades on NEC Fit:

- *Plan for training increases in apprentice NECs that are prerequisites for new system journeyman NECs.* Sailors who are in training for journeyman NECs for new systems but who worked on legacy systems as apprentices will likely need to attend some of the apprentice training for the new system to satisfy prerequisites. If this additional throughput is not accounted for in the SIP process, there will be insufficient capacity to train the required number of sailors to fill all the apprentice and journeyman NECs.

- *Ensure that all retrained sailors are awarded new NECs.* Our analysis reveals wide variation in the NEC inventory of crewmembers who received training during the installation of new systems. On some ships, nearly all those crewmembers received the NECs for the new systems, whereas, on others, none or very few crewmembers were awarded the new NECs. Assuming that all crewmembers are trained on new systems, this most likely represents inaction by the ship to request the new NECs or delays in processing these requests and updating the sailors' personnel records.

[20] Effective dates are defined using a five-digit format in which the first digit represents the century (2 or 3), the second and third digits represent the year (00-99), and the fourth and fifth digits represent the month (01–12).

[21] The effective start date for the first record would be the date of the last billet change, or 00000 if there were no changes since the billet was established. The effective end date for the second record would reflect another planned change (further in the future), or 99999, which indicates no more changes.

Are NEC Requirements Executable?

With few exceptions, the Navy's military workforce is a closed labor market. The Navy recruits, develops, and grows a workforce to meet its manpower requirements. Personnel management, training, and assignment policies govern how the Navy works to align this workforce to requirements. Most of the Navy's manpower requirements, however, are defined piecemeal—that is, unit by unit. Sometimes the aggregation of these requirements results in billet structures that are not aligned with the current set of personnel and training management policies. These misalignments or unexecutable billet structures inevitably result in a mismatch between inventory and requirements that has a negative impact on fleet manning.

CNA's previous investigation of fleet RCN Fit identified unexecutable billet structures as an underlying cause of RCN Fit gaps for some ratings and paybands [2]. Defining what is executable or unexecutable is difficult because this depends on various MPT&E policies (such as advancement rules and sea-shore flow policies) and on retention.

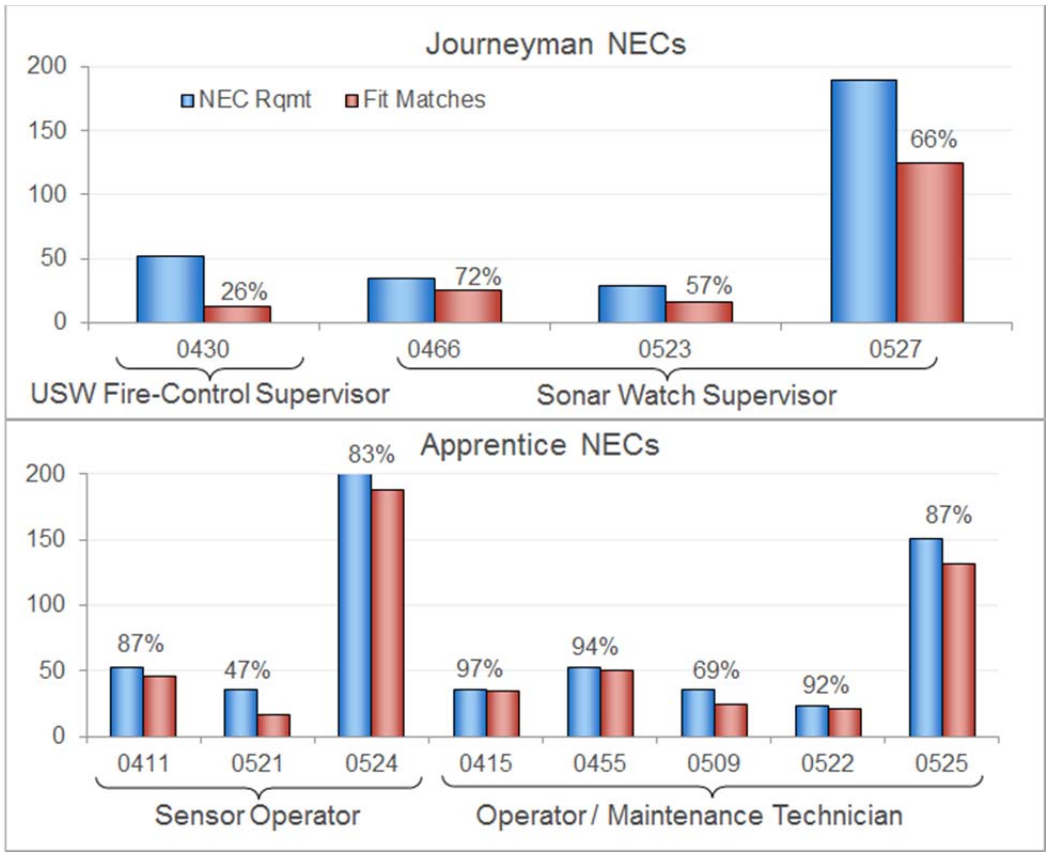
Filling NEC requirements differs from filling rating requirements. Except for closed-loop NECs (which are not part of NEC Fit), the Navy does not grow and maintain an inventory of qualified sailors to match all fleet NEC requirements. Many sailors who are selected to fill these requirements are sent to school en route to their assignment to earn the NEC. Regardless of these differences, we still need to investigate whether the billet structures of NEC requirements contribute to low Fit levels.

Once again, we examine this issue by continuing our analysis of Fit levels for STG NECs.

STG NEC Fit levels

In examining Fit levels for STG NECs, we discovered that the levels for journeyman NECs have been much lower than for apprentice NECs. Figure 15 shows the levels for these two groups of NECs in September 2014. The top chart shows the Fit levels across DDG-51-class ships for journeyman NECs (i.e., sonar watch and undersea warfare fire-control supervisors). The bottom chart shows Fit levels for the apprentice NECs (i.e., sensor operators and operator/maintenance technicians). The average Fit level for journeyman NECs was 59 percent, whereas the average for apprentice NECs was 84 percent.

Figure 15. STG NEC Fit levels (September 2014)

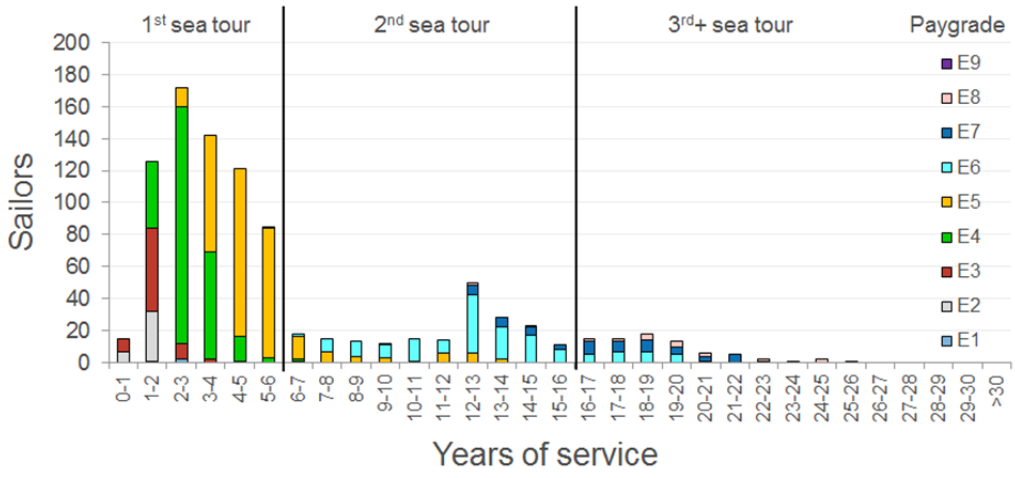


This 25-percentage-point difference prompted us to investigate why Fit levels for journeyman NECs were so much lower. Our approach was to analyze STGs on DDG-51 ships from a paygrade and career path perspective (i.e., how many STGs in each paygrade were on their first, second, or later sea tour) and then compare these groups with the paygrade structure and career path expectations of the NEC requirements. This analysis assumes that DDG billets requiring journeyman STG NECs are intended to be filled mostly by sailors on their second sea tours (as implied back in Figure 6). This assumption is supported by the fact that these NECs are not part of accession training and, therefore, are not expected to be filled by sailors on their first sea tours. In addition, the NEC manual states that sailors must be at least E-4s to be awarded these NECs [1].

STGs on DDG-51 ships

We compiled personnel data from the Enlisted Master Record (EMR) file on STG sailors who were serving on DDG-51-class ships in September 2014. Figure 16 shows the paygrade by year-of-service (YOS) profile for these sailors. We then divided these sailors into three groups based on whether they were likely serving on their first, second, or third (or later) sea tours. We estimated the YOS boundaries for each group using STG sea tour and initial contract lengths.[22] We defined sailors with 6 or fewer years of service as being on the first sea tour, between 6 and 16 years as being on the second sea tour, and beyond 16 years as being on the third or later sea tour. Table 5 shows the number of sailors by paygrade in each group. Under these assumptions, 72 percent of crewmembers are on their first sea tours, 21 percent are on their second sea tours, and 7 percent are on their third or later sea tours.

Figure 16. STGs on DDGs: Paygrade by YOS profile[a]



Source: EMR.

a. Inventory as of September 2014.

[22] STGs can enlist with four- or six-year obligation contracts. Tour length for the first and second STG sea tour is 54 months.

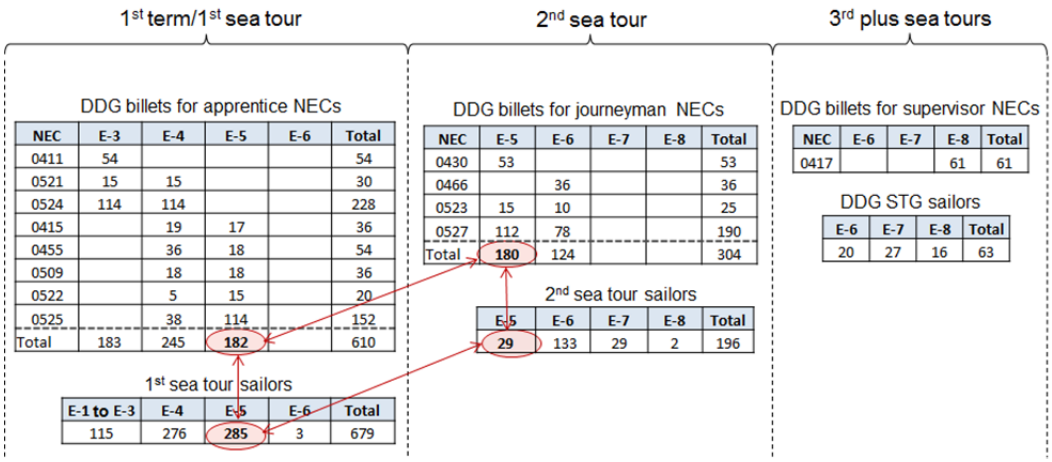
Table 5. STG inventory by paygrade and sea tour

Paygrade	1st sea tour	2nd sea tour	3rd+ sea tour
E-1 to E-3	115	-	-
E-4	276	-	-
E-5	285	29	-
E-6	3	133	20
E-7	-	29	27
E-8	-	2	16
Total	679	196	63

Inventory vs. requirements

Next, we examined STG manpower requirements on DDG-51-class ships. All authorized billets for STGs on these ships have one NEC requirement. We grouped the requirements as apprentice level (which we equate to first sea tour), journeyman level (which we equate to second sea tour), and supervisor level (which we equate to third and later sea tours) based on the NEC attached to the billet. Figure 17 shows the results. The top table in each career phase contains the number of authorized billets by NEC and paygrade. For example, there are 610 apprentice (i.e., first-tour) billets, 304 journeyman billets, and 61 supervisor billets.

Figure 17. Population vs. requirements misalignment: E-5 STGs on DDGs



Source: TFMMS and EMR.

The final step was to compare the NEC billet requirements with the STG population. The bottom table in each phase shows the crewmembers (from Table 3). Notice that the E-5 billets are spread evenly between apprentice (first term/first sea tour) and journeyman (second sea tour) NEC requirements. Also note that nearly all the E-5 STGs on DDGs (91 percent) are likely on their first sea tours.

This misalignment creates a problem because, as mentioned earlier, these journeymen NECs are not part of STG accession training. In order for first-term E-5 STGs to fill journeyman NEC requirements, they would need to get the NEC training during their first assignments. It is difficult, however, to send sailors away for NEC training. The STG journeyman supervisor NECs require schoolhouse training, which is offered only at the ASW Training Center in San Diego, California. Furthermore, the training for these NECs is, on average, about 29 weeks in length.[23]

NEC training opportunities for fleet sailors

In the previous section, we stated that it is difficult for sailors on board ships to get the formal schoolhouse training that is required to earn most NECs. To confirm this, we examined sailors who earned NEC-0527 in the past five years. We were interested in when these sailors earned this NEC, specifically whether it was during their first sea tours or en route to their second sea tours. Figure 18 shows the distribution of when these sailors earned this NEC as a function of years since they first reached the fleet. Because the first sea tour for STGs is 54 months, we assumed that anyone who earned the NEC within five years of reaching the fleet most likely earned that NEC while serving in the first tour, and anyone who earned the NEC after five years probably earned the NEC en route to the second sea tour.

Based on these assumptions, only about a quarter of these sailors earned this NEC during their initial sea tours. This supports our claim that it is difficult for sailors to get NEC training while assigned to a ship; this situation, combined with the paygrade structure of the billets requiring journeyman NECs, contributes to low Fit levels.

[23] The training pipeline for this NEC comprises three courses: K-210-0529 (11 weeks), A-130-0063 (16 weeks), and A-130-0073 (2 weeks).

Figure 18. Distribution of when sailors earned NEC-0527 relative to their first fleet date[a]

Source: EMR.

a. Based on sailors who earned NEC-0527 from 2010 through 2014.

Paygrade effects beyond STG NECs

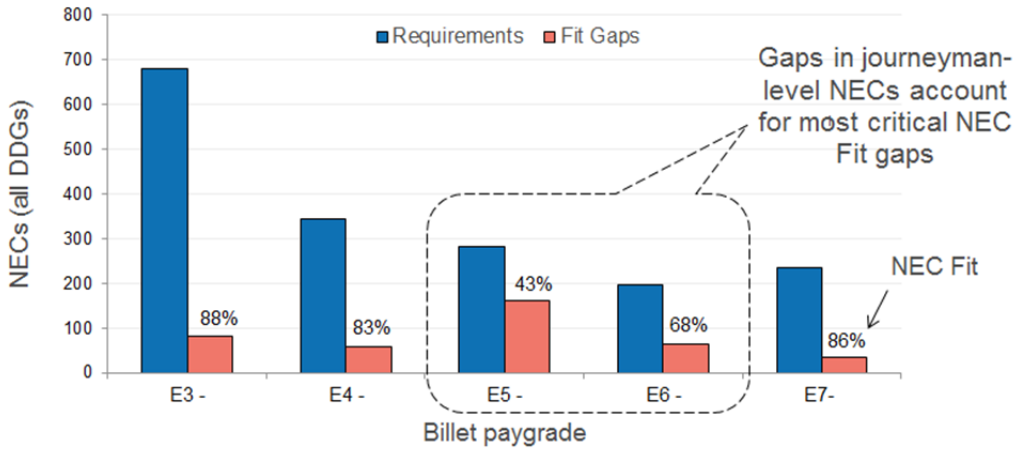
So far, our investigation of the effects of paygrade on NEC Fit has focused on NECs in the STG rating. To determine if these effects apply to NECs across other ratings, we examined the manning levels of all critical NECs on DDG-51 ships. The manning target for a critical NEC is defined by its DRRS-N threshold which, by definition, is the percentage of NEC requirements that must be filled (i.e., the minimum Fit level) to meet fleet readiness requirements.[24]

We narrowed our examination of CNECs to those with a 100-percent threshold. To identify the effects of paygrade on NEC Fit, we divided these critical NECs into five groups based on the NEC's minimum billet paygrade as defined in the NEC manual (i.e., E-3 and above, E-4 and above, E-5 and above, E-6 and above, and E-7 and above). We then summed the number of NEC requirements and NEC Fit gaps for each group using Fit data from September 2014.

[24] Critical NECs with only one billet requirement on board a unit have a threshold of 100 percent. Those with more than one requirement have thresholds that range from 50 to 100 percent.

Figure 19 shows the results. The blue columns represent the number of NEC requirements (with 100-percent thresholds) across all DDG-51 ships. The red columns show the total number of NEC Fit gaps (with the percent labels showing the corresponding NEC Fit levels). The data clearly show that most of the Fit gaps for critical NECs occur in the journeyman-level paygrade groups (with those in the E-5 and above group accounting for the largest portion). These results are consistent with our findings in the STG rating and indicate that the paygrade of NEC requirements, particularly journeyman-level NECs attached to E-5 billets, affect NEC Fit levels in other ratings.

Figure 19. Requirements and Fit gaps for CNECs with 100-percent threshold levels on DDG-51 ships



Actions to improve journeyman NEC Fit

Improving the alignment between NEC requirements and current personnel management and training policies is a more difficult challenge. The misalignment we found for journeyman STG NECs is just one example of a more systemic issue that creates challenges for enlisted manning—namely, that manpower requirements are defined by paygrade, whereas many personnel management policies (e.g., sea-shore flow) are defined by length of service.

The relationship between paygrade and length of service is nebulous. It varies by rating and changes with time. From an NEC manning perspective, the crux of the issue is the alignment between career path expectations (i.e., when in a career do we expect sailors to perform the jobs that require the NEC?) and career path execution (i.e., where in their career paths are sailors who are in the paygrades of the NEC requirements?). When these two are not aligned—given the limited opportunities for

sailors to attend NEC-awarding training—filling NEC requirements becomes more difficult.

We believe that the first step in addressing this problem is to identify those NECs and ratings that have significant misalignments between career path expectations and execution. Based on our limited look, this review should focus on journeyman NEC requirements in high-tech, sea-intensive ratings. We suggest determining, for each of these ratings, the percentage of at-sea E-5 sailors who are on their second sea tours and comparing these numbers with the number of E-5 journeyman NEC requirements.

For ratings with NECs that have large mismatches (like the STGs), there are two options for improvement. One is to change the paygrade structure of the unit's requirements. For our STG example, this would entail converting E-5 billets to E-6 billets. The second option is to change personnel management policies. For example, shortening the first sea tour would increase the percentage of at-sea E-5 sailors who are on their second sea tours. Obviously, any change to either requirements or personnel management will have other implications that need to be considered in determining the best set of actions to address these issues.

Such MPT&E initiatives as defining first-term billets and using this information to determine accession requirements help to highlight this issue and can ultimately reduce the magnitude of these misalignments. But this issue requires further investigation to seek a better two-way alignment between how manpower requirements are defined and the processes, procedures, and policies that govern how the Navy grows, manages, trains, develops, and assigns its enlisted workforce.

Conclusions and Recommendations

This section summarizes our major findings and recommendations.

Major findings

Our investigation of how the enlisted distribution process, ship modernization program, and paygrade structure of NEC requirements affect NEC Fit uncovered five major issues that we believe prevent the Navy from achieving higher fleet NEC Fit:

1. *The recent change in how the distribution system calculates NEC shortfalls better aligns the distribution process with the NEC Fit metric.* In February 2011, the Navy changed how the information system supporting the distribution process calculates a unit's NEC manning levels. Before the change, the system counted all the NECs held by crewmembers, regardless of whether the crewmembers were assigned a distribution NEC (DNEC). From an NEC Fit perspective, this could cause situations in which the distribution system assessed a unit as having sufficient NECs on board to fill all the authorized requirements even though the Fit metric shows NEC gaps. After the change, the system only counts crewmembers who are DNEC'd to the NEC. Because NEC Fit measures the number of DNEC'd sailors relative to NEC requirements, the new calculation produces an NEC distribution demand signal that seeks to maximize NEC Fit.

2. *System upgrades with new NEC requirements degrade NEC Fit.* In-service units that receive system upgrades with new NEC requirements suffer decreases in their measured NEC Fit. Our analysis shows that it takes up to 15 months from the date of the new NEC requirements in TFMMS for Fit levels to reach their steady state. The primary reason for the decrease in Fit is not the upgrade but how (and when) the new requirements are entered in TFMMS. We found that new NEC requirements become the authorized requirements 9 to 12 months before the start of the installation period, which means that Fit is measured against a system that won't be on board for almost a year. Therefore, it is not surprising that Fit levels during this time are very low.

3. *Out-year manpower requirements in TFMMS do not reflect future NEC changes due to modernization, resulting in training mismatches.* New manpower

requirements for in-service units scheduled for system upgrades are entered in TFMMS about one year before installation. The Navy's process for planning, resourcing, and scheduling schoolhouse training focuses on requirements three years in the future. Consequently, using TFMMS out-year requirements as the basis for NEC school plans can result in inaccurate plans for some NECs. It will underestimate training requirements (which will result in insufficient training capacity) for new system NECs and overestimate requirements (which will result in unused training resources) for legacy system NECs.

4. *Modernization increases apprentice NEC training requirements.* System-specific journeyman NECs often have system-specific apprentice NECs as prerequisites. Sailors who are in training for journeyman NECs for a new system and who were previously trained on an older system (which is usually the case when new systems are introduced) will need to retake part of the apprentice-level training for the new system to earn the prerequisite NECs. This additional throughput in new system apprentice NEC training can cause capacity-requirement mismatches (which can affect Fit by limiting the number of sailor earning these NECs) if not accounted for in the training planning process.

5. *Some NEC requirements are difficult to fill because their paygrade structure is not aligned with current personnel management and training policies.* Most STG jobs that require a journeyman NEC are expected to be filled by sailors on their second sea tours, but about half of these NEC requirements are tied to E-5 billets, and we found that most E-5 STGs at sea are still on their first sea tours. Journeymen NECs are not part of STG accession training, so these sailors have limited opportunities to earn the journeyman NEC during their first sea tours.

Recommendations

We offer several recommendations to mitigate the major issues in our three focus areas and ultimately improve fleet NEC Fit.

Improve the enlisted distribution process

The Navy has already addressed the most significant issue in the distribution process by changing how the system calculates NEC manning levels. To further improve the alignment between the distribution NEC demand signal and the NEC Fit metric, we recommend the following actions:

- Look for more opportunities to have detailers assign secondary DNECs to improve NEC Fit. A sailor can be assigned to fill two NEC requirements (i.e., assigned a primary and secondary DNEC) provided both NECs do not represent

full-time jobs. Taking full advantage of these opportunities will enable detailers to fill more NEC Fit gaps that are not reported by the distribution system.

- Better manage information in the Enlisted Distribution and Verification Report, particularly DNECs. Actively managing the EDVR can improve NEC Fit in several ways. On many units, managing sailors' DNECs can significantly improve NEC Fit. NECs that have high Aggr% but low Fit levels are prime candidates for potential DNEC reassignments. Reassigning DNECs, however, should be done only if the sailor is in a position to perform the job that requires the skills.

In the longer term, the transition to billet-based distribution for enlisted sailors will transform the enlisted distribution system and eliminate many of these issues. Under BBD, sailors will be detailed to specific billets. A requisition will contain all the qualifications (rate, rating, primary and secondary NEC) of the vacant billet. The current limitation of only one NEC attached to a requisition will no longer exist. In addition, the information systems supporting BBD will automate the assignment and reassignment of sailors to billets to improve NEC utilization, which, in turn, will improve NEC Fit.

Lessen the effects of system upgrades

To lessen the effects of system upgrades on NEC Fit, we recommend the following actions:

- *Set the effective date of new system NEC requirements in TFMMS to coincide with the installation date.* Manpower requirements for a new system should not appear as the current authorized requirement until the system has been installed. TFMMS has the capability to define the date (month and year) of future manpower requirements. Each record in TFMMS has effective start and end dates that define the timeframe in which the billet information in that record is valid.

- *Enter future modernization manpower changes in TFMMS at least three years in advance.* Modernization program offices plan system upgrade schedules well in advance of the installation. TFMMS should be synced with these plans, and its out-year requirements should reflect these changes.

- *Plan for training increases in apprentice NECs that are prerequisites for new system journeyman NECs.* Sailors who are in training for journeyman NECs for new systems but who worked on legacy systems as apprentices will likely need to attend some of the apprentice training for the new system to satisfy prerequisites. If this additional throughput is not accounted for in the

student input plan process, there will be insufficient capacity to train all the apprentice and journeyman sailors.

- *Ensure that all retrained sailors are awarded new NECs.* Our analysis reveals wide variation in the NEC inventory of crewmembers who received training during the installation of new systems. On some ships, nearly all those crewmembers received the NECs for the new systems; on others, no crewmembers (or very few) were awarded the new NECs. Assuming that all crewmembers are trained on new systems, this most likely represents inaction by the ship to request the new NECs or delays in processing these requests and updating the sailors' personnel records.

Make NEC requirements more executable

Improving the alignment between NEC requirements and the Navy's personnel management and training policies is a more difficult challenge. To address this problem, we suggest identifying those NECs and ratings that have significant misalignments between career path expectations and execution. Focus on journeyman NEC requirements in high-tech, sea-intensive ratings, and compare the percentage of at-sea E-5 sailors who are on their second sea tours with the number of E-5 journeyman NEC requirements.

There are two ways to improve ratings with NECs that have large mismatches: (1) change the paygrade structure of the unit's requirements (e.g., convert STG E-5 billets to E-6s) or (2) change personnel management policies (e.g., shorten the first sea tour to increase the percentage of at-sea E-5 sailors who are on their second sea tours). Other implications that result from such changes will require careful consideration.

These misalignments stem from a more systemic issue that creates challenges for enlisted manning—namely, that manpower requirements are defined by paygrade, whereas many personnel management policies (e.g., sea-shore flow) are defined by length of service. MPT&E initiatives, such as defining first-term billets and using this information to determine accession requirements, help to highlight this issue. It will take further investigation, however, to identify a better way to align how manpower requirements are defined with how the Navy trains, develops, and assigns its enlisted workforce.

References

[1] Navy Personnel Command. 2014. *Manual of Navy Enlisted Manpower and Personnel Classifications and Occupational Standards, Volume II, Navy Enlisted Classifications (NECs).* NAVPERS 18068F.

[2] Belcher, Steven W., David M. Rodney, Molly F. McIntosh, Peggy A. Golfin, Warren T. Sutton, and Henry S. Griffis. 2014. *Improving Enlisted Fleet Manning.* CNA. DRM-2014-U-007586-Final.

[3] Computer Sciences Corporation. 2013. *Enlisted NEC Fit Common Operating Definitions.* CSC.

[4] Belcher, Steven. 2010. *How Do Personnel Readiness Measures in DRRS-N Compare With MPT&E's Personnel Fit Measures? (Unclassified Version).* CNA. CAB D0023950.A1/Final.

[5] Schwartz, Susan. 1993. *Requisition Production in the Enlisted Distribution System.* CNA. CIM 314.

[6] Chief of Information, United States Navy. "United States Navy Fact File, Destroyers - DDG." America's Navy. Dec. 2014. Accessed Jun. 15, 2015. http://www.navy.mil/navydata/fact_display.asp?cid=4200&tid=900&ct=4.

[7] Program Executive Office Integrated Warfare Systems. 2014. *Navy Training System Plan (NTSP) for the AN/SQQ-89(V) Surface Ship Undersea Warfare Combat System.* N96-NTSP-S-30-8102K.

The CNA Corporation

This report was written by CNA Corporation's Resource Analysis Division (RAD).

RAD provides analytical services—through empirical research, modeling, and simulation—to help develop, evaluate, and implement policies, practices, and programs that make people, budgets, and assets more effective and efficient. Major areas of research include energy and environment; manpower management; acquisition and cost; infrastructure; and military readiness.

DRM-2015-U-011116-1REV

CNA Corporation is a not-for-profit research organization
that serves the public interest by providing
in-depth analysis and result-oriented solutions
to help government leaders choose
the best course of action
in setting policy and managing operations.

Nobody gets closer—
to the people, to the data, to the problem.

CNA
ANALYSIS & SOLUTIONS

www.cna.org • 703-824-2000

3003 Washington Boulevard, Arlington, VA 22201