Enhanced Billet Analysis Tool: Data Requirements

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CRM D0021573.A2/Final
January 2010

CNA
ANALYSIS & SOLUTIONS

Approved for distribution: January 2010

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Enhanced Billet Analysis Tool

The Enhanced Billet Analysis Tool (BAT) is a Microsoft Access application that allows users to quickly determine how changes to the force structure and the shore infrastructure affect the Navy's manpower requirements. It provides four major capabilities to help manpower analysts study current and future manpower requirements.

1. It can determine how changes to the force structure (and shore infrastructure) affect manpower requirements and costs within the Future Year Defense Plan (FYDP).
2. It can estimate how changes to the force structure (and shore infrastructure) affect shore manpower requirements.
3. It can forecast future manpower requirements beyond the FYDP (out to 30 years).
4. It provides the capability to examine the effects of changing manpower requirements for individual force structure units or shore activities on the Navy's total requirements.

The Shore / Support Module within BAT models two types of relationships: it estimates (1) how changes to the force structure (and shore infrastructure) affect the size and composition of the Navy's Individuals Account and (2) how changes to the force structure affect shore manpower requirements. For the Individuals Account, it estimates the change in student billet requirements for enlisted initial skills (i.e., A-School) training, skills progression (i.e., Navy Enlisted Classification (NEC)) training, and recruit training. It also estimates the change in enlisted and officer billet requirements to properly account for personnel in a transient or holdee status (i.e., the T&H portion of the Individuals Account).

For shore and support activities, the Shore/Support Module estimates manpower requirements in three work function areas—training and education, maintenance, and health care services. In the area of training and education, it estimates the change in instructor requirements for A- and C-School training. For maintenance functions, it estimates the changes in billet requirements at ship and aviation intermediate- and depot-level maintenance activities that result from increasing or decreasing the number of ships, submarines, and aviation squadrons. And, in the area of health care services, it estimates the changes in manpower requirements for the segment of the health care force that provides medical care to nondeployed, active-duty Servicemembers and their dependents but is not directly tied to medical mobilization requirements during wartime or in support of contingency operations.

BAT data requirements

To perform these calculations, BAT requires a substantial amount of data. At its heart lie billet data that define the military and civilian manpower requirements for each operational unit and support activity in the Navy. These data come directly from the Navy's Total Force Manpower Management System (TFMMS), which is the single, authoritative repository for Total Force manpower requirements and authorizations.[1] BAT contains data on every activity (both Navy and non-Navy) that has a requirement for Navy manpower. It also contains military and civilian manpower cost rates.

To support the manpower requirements calculations within the Shore/Support Module, BAT requires data on:

- Enlisted A-school training
- Enlisted NEC training
- Enlisted recruit training
- Ship hull intermediate- and depot-level maintenance

1. To keep BAT at the unclassified level, the tool uses only unclassified TFMMS data.

- Shipboard system intermediate- and depot-level maintenance
- Aircraft intermediate- and depot-level maintenance
- Health care service functions
- Commercial activity functions.

To keep BAT and its output relevant, these data sets need to reflect current data through periodic updates. We recommend updating the TFMMS data bimonthly and all the other data sets annually.

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Introduction

Background

The Enhanced Billet Analysis Tool (BAT) is a Microsoft Access application that allows users to quickly determine how changes to the force structure and the shore infrastructure affect the Navy's manpower requirements. BAT grew from the original Billet Analysis Tool, which CNA developed in 2006, and the Shore/Support Module that followed in 2007.[2, 3] In addition to having all the capabilities of these tools, this latest version of BAT includes new features (e.g., the ability to forecast requirements beyond the FYDP) that enhance its value by expanding the range of issues it can address.

Enhanced Billet Analysis Tool

BAT provides four major capabilities to help manpower analysts study current and future manpower requirements:

1. Using data from TFMMS, it can determine how changes to the force structure (and shore infrastructure) affect manpower requirements and costs within the FYDP.
2. It can estimate how changes to the force structure (and shore infrastructure) affect shore manpower requirements and the size of the Navy's Individuals Account (e.g., enlisted student billet requirements).

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2. For a more complete description of the original BAT, see CNA Annotated Briefing D10014545.A2, *Billet Analysis Tool (BAT)*, Sep 2006.
3. For a more complete description of the Shore/Support Module, see CNA Annotated Briefing D0017103.A1, *Billet Analysis Tool Development: Shore/Support Manpower Requirements Module*, Oct 2007.

3. It can forecast future manpower requirements beyond the FYDP (out to 30 years).

4. It provides the capability to examine the effects of changing manpower requirements for individual force structure units or shore activities on the Navy's total requirements.

This last capability also allows users to define manpower requirements for future platforms (not yet in TFMMS) and include these platforms in scenarios to forecast future requirements.[4]

BAT is a data-intensive, computer-based analytical tool. Within it is a condensed version of the TFMMS, which contains all military and civilian manpower requirements as well as information on every operational unit and support activity that has a requirement for Navy manpower. BAT also contains numerous data sets that support the Shore/Support Module, which estimates how changes to the force structure affect manpower requirements at shore activities and within the Navy's Individuals Account (IA).

Organization of this report

This document describes BAT's data requirements. We review all the data sets that are used in the tool. For each data set, we define the data elements and identify the source(s) of these data. Many of the data in BAT come directly from official Navy data systems or publications and, therefore, require little or no processing to prepare for input into the tool. There are calculations in BAT, however, that require data parameters that either are not tracked directly by the Navy or that exist but in a slightly different context from how the parameter is used in the tool.[5] For these cases, we derived the required parameters using manpower, personnel, and training data from both Navy

4. For a more complete description of the Enhanced Billet Analysis Tool, see CNA Annotated Briefing D0018789.A2, *Enhanced Billet Analysis Tool (V2),* Oct 2008.

5. In this report, we describe the calculations within the Shore/Support Module that estimate changes in manpower requirements at shore activities and in the Navy's Individuals Account.

and CNA sources. We identify these parameters in this report and describe the processes we used to compute their values.

We organized the discussion of data requirements around the modules in BAT that they support. We begin with the TFMMS manpower requirements and activity data sets that support the Run Excursion and Future Planning Modules. We then discuss the data sets that support the student billet, instructor billet, maintenance, and health services calculations in the Shore/Support Module. Lastly, we describe the data sets that support the Commercial Activity (CA) Function Analysis Module.

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Navy manpower requirements and costs

At the heart of the BAT lie billet data that define the military and civilian manpower requirements for each operational unit and support activity in the Navy. These data come directly from the Navy's TFMMS—the single, authoritative repository for Total Force manpower requirements and authorizations. For military manpower, BAT includes both billet requirements and authorizations. *Billet requirements* represent what is needed to perform the mission according to the ship, aviation squadron, or shore manning document; *billet authorizations* are requirements that the Navy has funded through Military Personnel–Navy (MPN) or Reserve Personnel–Navy (RPN) appropriations for fill by active-duty or reserve personnel, respectively—either Selected Reserves (SELRES) or full-time support (FTS) Reserves. For civilians, TFMMS contains billet authorizations only. To keep the structure of the civilian data consistent with that of the military data, we set civilian billet requirements equal to authorizations.

BAT billet data

Although BAT contains data on every billet in the Navy, it does not contain all the data fields that are in TFMMS. BAT uses only a subset of these fields, primarily those that describe the type of personnel (officer, enlisted, civilian), skills (e.g., rating and NEC), and experience level (i.e., paygrade) that the billet requires. Billet data in BAT are stored in a table called *billet1s*. Table 1 lists the data elements in this data set and gives a short description of each element. All the data in *billet1s* come directly from TFMMS with one exception—the Changed Enterprise field. This data field, which identifies the Navy Enterprise that owns the billet, comes from a report generated within the N10 organization.[6]

6. If a billet is owned by more than one Enterprise, fractional portions of the billet are assigned to two or more Enterprises. In BAT, we assign each billet to a single Enterprise based on who owns the largest share.

Table 1. Structure of BAT's billet data table: *billet1s*

Field name	Description
MP_type	Manpower category (see table 1)
Code	Same as MP_type
OEWC_r	Type requirement (Officer/Enlisted/Warrant Officer/Civilian or Contractor)
OEWC_a	Type authorization (Officer/Enlisted/Warrant Officer/Civilian or Contractor)
AUIC	Unit Identification Code
PFAC	Primary functional area
SFAC	Secondary functional area
RI	Requirements indicator
R_PNOBC	Primary NOBC
R_SNOBC	Secondary NOBC
R_PAQD	Primary officer AQD
A_SAQD	Secondary officer AQD
Changed Enterprise	Enterprise
occ_r	Rating/Designator associated with requirement
pay_r	Paygrade associated with requirement
occ_a	Rating/Designator associated with authorization
pay_a	Paygrade associated with authorization
SumOfCFY	Number of billet requirements-Current FY
SumOfFY1	Number of billet requirements-FY+1
SumOfFY2	Number of billet requirements-FY+2
SumOfFY3	Number of billet requirements-FY+3
SumOfFY4	Number of billet requirements-FY+4
SumOfFY5	Number of billet requirements-FY+5
SumOfFY6	Number of billet requirements-FY+6
SumOfFY7	Number of billet requirements-FY+7
SumOfA_CFY	Number of billet authorizations-Current FY
SumOfA_FY1	Number of billet authorizations-FY+1
SumOfA_FY2	Number of billet authorizations-FY+2
SumOfA_FY3	Number of billet authorizations-FY+3
SumOfA_FY4	Number of billet authorizations-FY+4
SumOfA_FY5	Number of billet authorizations-FY+5
SumOfA_FY6	Number of billet authorizations-FY+6
SumOfA_FY7	Number of billet authorizations-FY+7
A_PNEC	Primary NEC- associated with authorizations
A_SNEC	Secondary NEC- associated with authorizations
R_PNEC	Primary NEC- associated with requirements
R_SNEC	Secondary NEC- associated with requirements
REQ_EMC	EMC associated with requirements
AUTH_EMC	EMC associated with authorizations

Table 1. Structure of BAT's billet data table: *billet1s (continued)*

Field name	Description
CLMT_CODE	Claimant
CA_FUNC	Commercial Activity function
mob	Flag to indicate if billet is an "addition duty to" health care service requirement
CA_REASON	Commercial Activity reason
CFY_d	Number of billet requirements- month of billet file (Current FY)
A_CFY_d	Number of billet authorizations- month of billet file (Current FY)
new_ca_func	For internal use
parent_UIC	For internal use

Extracting billet data from TFMMS

TFMMS comprises two databases: a billet database and an activity database. The billet data in BAT come from the TFMMS billet database. In pulling data from TFMMS, we extract only the data fields that are used in BAT. We also exclude unwanted records based on a set of rules that we discuss below. In addition, where possible, we aggregate data to reduce the size of the data set. We applied several rules when extracting billet data from TFMMS:

- Additional duty (ADDU) manpower authorizations: To prevent double counting billet authorizations in "Additional Duty" status, we include only "Additional Duty To" authorizations (i.e., billets with the Manpower Accounting Category Code (Mpwr_AC) not equal to "N"). We do not include "Additional Duty From" billets (Mpwr_AC equal to "N") because these authorizations do not count against the FYDP.
- Peacetime and mobilization requirements: Based on discussions with the sponsor, we select only billets that are required in either peacetime and mobilization or just in peacetime (i.e., Peacetime Requirement (PR) code = 1 or 2). We exclude billets that are required only under mobilization.
- Personnel Exchange Program (PEP): This program provides an exchange between the USN military personnel and personnel from other military services, including Foreign Service. TFMMS includes two sets of requirements: one for the activity

in which the foreign officer (or other U.S. service Officer/Enlisted) will serve and one in which the USN Officer/Enlisted will serve. To avoid double counting, we include only one set of billets by excluding the non-DoD-funded PEP billets, which have the Manpower Resource Code (MRC) equal to "PP."

- Consolidate billet data over effective dates: Each requirement in TFMMS is assigned a unique Billet Identification Number (BIN). However, because a requirement for a billet or an attribute of a billet can change over time, each billet record in TFMMS is identified by two effective date fields: a start date and an end date. These dates define the time period during which the information in that record is valid (or in effect).[7] Because of the way in which the requirements and authorization are defined across the years (there will only be a requirement or authorization for the years within the period defined by the effective dates), we are able to collapse the data—in essence, removing the need for effective dates and reducing the number of records. If the only change across multiple records for a billet is a change in requirement (or authorization) by FY, we collapse this information into a single record by summing the requirements for each fiscal year field. If one or more of the billet's attributes change (e.g., rating or paygrade), we keep separate records with correct requirements data over the fiscal year fields. Thus, each record contains valid information for the time period of CFY to FY+7.

- Aggregate like billets at an activity: We also reduce the size of the billet data set by aggregating identical requirements at an activity into a single record. For example, if an activity requires three machinist mates of the same paygrade and with the same NEC requirements (and all the other parameters that we use in BAT are the same), we consolidate these requirements into a

7. For example, if a billet has two records (the first with an effective date period of 0000 to 9/30/09 and the other with an effective date period of 10/1/09 to 9999), the first record contains the correct billet information up until October 1, 2009, at which time the correct information for that billet resides in the second record.

single record with the billet requirement and authorization fields set to three. Whereas TFMMS contains at least one record entry for each billet requirement, BAT does not.

When generating output tables, BAT can group and display billets by manpower category. Navy billets fall into one of five categories: active duty, reserve active (or FTS), reserve inactive (or SELRES), government civilian, and contractors. Table 2 shows the data fields in TFMMS and the rules we used to map billets to these five categories. We created a sixth category, which we call "Unknown," to account for military requirements that could not be mapped due to missing or incomplete data.

Table 2. Manpower type categorizations

MP_TYPE	Manpower category	Appropriation category	Manpower Resource Code	Manpower Type
MPN	Regular active duty	MPN	AD, MD, ST, TR	E, O
FTS	Reserve active (FTS)	RPN	RT, TT, RP, RR	E, O
SELRES	Reserve inactive (SELRES)	RPN	RA	E, O
Civilian	CIV (civilian employee)	OMN		C
Contractor	CONT (contractor)	OMN	CN	C
Unknown	Unknown/other	Blank		E, O, Blank

Labels

Many fields in the TFMMS billet file use codes to describe the skill requirements for a billet. When generating tables to display output in BAT, users have the option to include descriptive labels for these codes. For example, if users are interested in examining the NEC requirements for a force structure scenario, they can include both the NEC code and descriptive label in the output table. BAT currently contains labels for officer designator codes, Additional Qualification Designator (AQD) codes, Naval Occupational Billet Codes (NOBCs), Enlisted Management Communities (EMCs), and NECs.

For each billet skill descriptor, the list of skill codes changes over time. The Navy creates and deletes NECs as platforms/systems are introduced or removed from the fleet. Recently, the Navy created

several new ratings and eliminated others. When updating BAT with new TFMMS data, one must update these label data sets so that each code is mapped to a label. Otherwise, output tables that include labels may not include results for those codes that are missing a label.

Activity data

BAT contains activity-level data for each Unit Identification Code (UIC)—both Navy and non-Navy activities—that has a requirement for Navy manpower. These data, which are stored in a table called *Locstuff*, appear in the activity window within the Run Excursion Module (see table 3). Users build scenarios by selecting activities from this data set.

Table 3. Structure of BAT's activity data table: *Locstuff*

Field name	Description	Source
DWNLD_DATE	Date of TFMMS data	Generated
AUIC	Activity Unit Identification Code	TFMMS
SHORT_NAME	Activity name (short version)	TFMMS
milReq	Largest military billet count across FYDP	TFMMS
civReq	Largest civilian billet count across FYDP	TFMMS
ACODE	10-digit activity code	TFMMS
CLMT_NAME	Activity's manpower claimant	TFMMS
LOCATION	Activity's location defined by city and stat)	TFMMS
GEO_LOC	Activity's location defined by geolocation code	TFMMS
Sea_shore	Type duty (sea or shore) at activity	TFMMS
Activity Category	Broadest level of activity categorization	Generated
Activity Sub-Category	Second level of activity categorization	Generated
Activity Type	Third level of activity categorization	Generated
Force Structure Flag	Flag indicating if activity is force structure unit	Generated
Class	Ship class (for ships and submarines)	Generated
Category	CA Function Code category (I = Force and Direct Support, II = Infrastructure)	TFMMS
I	Activity billets coded as CA Function Code category I	TFMMS
II	Activity billets coded as CA Function Code category II	TFMMS
UICName	Concatenation of UIC and activity name	TFMMS
parent_UIC	UIC of parent activity (currently not used)	TFMMS
Any_AC	Indicates if activity owns aircraft	Generated
new_UIC	Indicates if UIC created by user (not in TFMMS)	Generated

Table 3 shows the structure of the activity data set. It lists and defines each field and shows the data source. Most data elements come directly from the activity file in TFMMS. To help users navigate through the list of nearly 6,000 activities, we added three fields that categorize these activities. The highest level grouping is "Category," followed by "Subcategory," and "Type." For example, the highest level categorization includes the standard breakout of operational forces into aviation squadrons, combat ships, support ships, submarines, and expeditionary forces. The categorization of shore/support activities is by functional area, such as training and education, supply, recruiting, and maintenance. We also added two fields that show the total count of military and civilian billets at each activity. Finally, we added several other fields that are used internally within BAT.

Updating billet data

The data in TFMMS continually change as force structure units and support activities enter and leave the fleet. In addition, the attributes of individual billets can change. For example, the rating, NEC, or paygrade of a billet may change. To keep BAT and its output relevant, these data sets need to reflect current data through periodic updates. We recommend that BAT be updated with new TFMMS billet and activity data every 2 months.

To facilitate this process, we developed a program that automates the update of TFMMS data. This program generates the billet data set, the activity data set, and all the data sets that contain labels for the skill codes.[8] For the activity data set, this program uses the first four digits of the activity code to map new activities to a category, subcategory, and type, and it updates whether the new unit is a force structure unit and, for ships, to which class it belongs.

8. If users create new UICs though the Edit_UIC Module (either to model future platforms or alternative manning options), they must add them back into BAT after downloading a new version of the tool with updated TFMMS data. This can easily be done in the Edit_UIC Module.

Manpower cost data

BAT computes two basic output measures: manpower requirements and the costs of these requirements. The tool computes costs based on manpower programming rates. Costs are calculated for both billet requirements and billet authorizations.

BAT calculates the cost of manpower requirements using cost rates from the Program Objective Memorandum / Program Review (POM / PR) fiscal guidance memo that N1 issues each year. This memo contains officer and enlisted manpower programming rates (i.e., rates by paygrade) for active duty, FTS, and SELRES personnel. It also contains pay rates for most government civilian wage scales. Cost data in BAT are stored in a table called *MILCOMPRATE*. Table 4 shows the structure of this table. The N1 memo defines the manpower costs for the POM year (FY+2). We calculated the costs for all other years (CFY, FY+1, FY+3, FY+7) using a constant inflation rate.

Table 4. Structure of BAT's manpower cost data table: *MILCOMPRATE*

Field	Description	Example
MILCAT	Manpower category	CIV
MILTYPE	Manpower type	C
GRADE	Wage scale and paygrade	GS16
Pay Rate Source	Source of pay data	Used GS-SES
Pay Table	Source of pay data (table in N1 memo)	GSSES
CFY	Pay rates for current fiscal year	$202,315
FY1	Pay rates for FY+1	$208,385
FY2	Pay rates for FY+2	$213,177
FY3	Pay rates for FY+3	$218,080
FY4	Pay rates for FY+4	$223,096
FY5	Pay rates for FY+5	$228,228
FY6	Pay rates for FY+6	$233,477
FY7	Pay rates for FY+7	$238,847

Student and instructor billet requirements

BAT's Support/Shore Module

CNA developed the Shore/Support Module to help the Navy study manpower requirements within its shore and support infrastructure. This module, when used in conjunction with other BAT modules, provides manpower analysts with more robust estimates of how changes to the force structure affect the Navy's overall manpower requirements.

The Shore/Support Module models two types of relationships. First, it estimates how changes to the force structure (and shore infrastructure) affect the size and composition of the Navy's IA. Second, it estimates how changes to the force structure affect shore manpower requirements. For the IA, it estimates the change in student billet requirements for enlisted initial skills (i.e., A-School) training, skills progression (i.e., NEC) training, and recruit training. It also estimates the change in enlisted and officer billet requirements to properly account for personnel in a transient or holdee status (i.e., the T&H portion of the IA).

For shore and support activities, this module estimates manpower requirements in three work function areas. In *training and education*, it estimates the change in instructor requirements for A- and C-School training. For *maintenance* functions, it estimates the changes in billet requirements at intermediate- and depot-level maintenance activities that result from increasing or decreasing the number of ships, submarines, and aviation squadrons. And, in the area of *health care services*, it estimates the changes in manpower requirements for the segment of the health care force that provides medical care to nondeployed, active-duty Servicemembers and their dependents but is not directly tied to medical mobilization requirements during wartime or in support of contingency operations.

The Shore/Support Module estimates not only manpower effects in terms of number of billets but also the type of billets in terms of enlisted rating (or officer designator) and paygrade. This added feature enables manpower analysts (e.g., community managers) to study the effects on individual communities as well as the entire Navy.

In this section, we describe the data that are used in determining student and instructor billet requirements. First, we describe the manpower calculations and define all the parameters in these equations. Next, we identify and describe the data sets within BAT that contain the values for these parameters. We end by discussing the source(s) of these data along with any offline analysis that we conducted to derive values for these parameters.

Student and instructor billet calculations

A-School training

Student billet calculations

Because A-School training pipelines are more closely tied to enlisted management communities (EMCs) than to ratings, BAT calculates student billet requirements for each community.[9] It then converts these requirements into billet requirements by rating and paygrade to be consistent with output in all the other shore/support function areas. A-School student billet calculations comprise four steps:

1. **Determine student throughput requirements for each A-School training pipeline**. For each enlisted community, BAT calculates the total junior-level billet requirement for all the operational units and support activities in the user-defined scenario. It then estimates the annual student throughput requirement for each training pipeline by multiplying this billet requirement by a fill-rate, which represents the percentage of junior paygrade billets that are filled each year by Sailors directly out of initial training. Mathematically, we can express this as:

9. For example, the initial training program for a nuclear machinist mate (EMC D131) is vastly different from that for a nonnuclear surface machinist mate (EMC B130).

$$Stu(emc) = \left[\sum_{E3}^{MaxPG} FltBA(emc, pg) \right] \times TF(emc) \times Fill\_Ratio(emc) \times (1 + Attr(emc))$$

where

FltBA(emc, pg) = the change in the number of junior fleet (i.e., non-IA) billets in the BAT scenario

MaxPG = the maximum paygrade that defines a junior billet

Fill_Ratio(emc) = the percentage of junior paygrade billets that are filled each year by Sailors directly out of initial training

Attr(emc) = the cumulative attrition rate of the A-School training track

TF(emc) = 0, 1 to indicate whether an EMC has an initial training requirement.

2. **Determine student training days.** BAT calculates student training days by multiplying student throughput (from step 1) by the length of training. Total training time consists of under-instruction (UI) time and not-under-instruction (NUI) time. We set UI time equal to the number of training days in the training pipeline (i.e., sum of course lengths). We account for NUI time by including a factor that defines the ratio of historic NUI time to UI time.[10] Mathematically, we express it as:

$$StuDays(emc) = Stu(emc) \times TrngDays(emc) \times (1 + NUI(emc))$$

where

10. For example, the training pipeline for Aviation Electrician's Mate (EMC A200) has 78 instruction (i.e., UI) days. In FY08, students in this training spent, on average, 53 days in an NUI status, which equates to an NUI factor of 0.68.

Stu(emc) = A-School pipeline student throughput (from step 1)

TrngDays(emc) = the length of the A-School training track (in calendar days)

NUI(emc) = the ratio of NUI time to UI time.

3. **Convert training days to student billets.** Because BAT outputs billet requirements, the next step is to convert training days to student billets. BAT calculates student billets by:

$$StuBA(emc) = \frac{StuDays(emc)}{Workyear(stu)}$$

where *Workyear(stu)* is the number of training days in a year. BAT currently uses a value of 350 days.

4. **Define student billets by rating and paygrade.** BAT outputs the number of student billets by rating and paygrade. It assigns billets to ratings based on a mapping of each EMC to its predominant rating. BAT assigns all A-School student billets to an E3 paygrade.

Instructor billet calculations

Instructor requirements depend on the number of students that need to be trained each year (i.e., throughput), the length of training, and the student-to-instructor ratio (S:I) at which the course is taught. Because the Shore / Support Module in BAT estimates student throughput in its student billet calculation, it uses this throughput as the basis for determining instructor billet requirements.

In December 2005, the Navy canceled its long-standing methodology for calculating instructor requirements (CNETINST 5310.4E). Since then, MPT&E leadership approved a new methodology that is based on results from a recent survey of instructor workweeks. It contains new workload planning factors for the annual amount of instruction (i.e., podium) time that an instructor can provide.

Table 5 shows these new factors. They differ for military and civilian / contract instructors. Because civilian instructors have fewer commitments and additional duty responsibilities, they can devote more time to teaching. The factors also differ by type of course. Instructor-led courses require more instructor preparation and related duty (IPRD) time than self-paced courses in which the instructor plays more of a facilitator role. We used these workload factors in our instructor computations .

Table 5. New instructor workload planning factors

Course type	Podium hours per year	
	Military	Civilian/contractor
Instructor led (group-paced)	884	1,539
Facilitated (self-paced or blended)	1,137	1,664

To calculate instructor billets, the tool starts with student throughput estimates. It then calculates the number of instructor days required to teach these students by dividing this throughput by the average S:I ratio for that training track, and then multiplying the results by the number of instruction days in the training track.[11] Mathematically, this can be expressed by:

$$InstrBA(emc) = \frac{Stu(emc) \times UIDays(emc)}{SI(emc) \times Workyear(Instr)}$$

11. This approach implicitly assumes a level student load. Although this is generally not the case in recruit and A-school training, this assumption greatly simplifies the calculations. In addition, BAT was designed primarily to compute changes in student and instructor billet requirements that would result from changes to the force structure. It was not designed to determine the total student and instructor billet requirements to support all Navy enlisted training.

where

Stu(emc)	=	A-School pipeline student throughput
UIDays(emc)	=	instruction days in the training pipeline
SI(emc)	=	average student-to-instructor ratio over the entire training pipeline
Workyear(Instr)	=	instructor work-days in a work-year.

The tool converts instructor days to instructor billets using the new workload factors that we discussed earlier. Because the annual number of instruction days differs between military and civilian instructors, the tool first computes the instructor requirement in terms of military billets. It then distributes the requirement between military and civilian billets based on the current split of instructor billets. It applies a factor to account for the difference in instruction time availability (i.e., one military billet equates to 0.87 civilian billet).

For military instructor billets, the tool determines the requirement by rating and paygrade. To allocate billets by rating, it uses the same approach that was used for student billets. To allocate across paygrades, it uses the paygrade distribution of all current enlisted initial skills instructor billets.

A-School data requirements

Most of the parameters that are used in calculating student and instructor billets reside within BAT in a table called *A-School Data*. Table 6 shows the structure of this data set. It defines each field and its data source and shows a sample record. Nearly all the data in this table come from three sources: the Navy Integrated Training Resources and Administrative System (NITRAS), TFMMS, and CNA's Street-to-Fleet (STF) database.

Most of the data elements that describe characteristics of the training pipeline come from three NITRAS data sets: A-School Training Track File (ATTF), Training Summary File (TSF), and Master Course Reference File (MCRF). ATTF lists the courses that make up each A-School training track and gives the length of the training track in instruction days and calendar days. TSF contains historic course-level data on student throughput (e.g., enrollees and graduates), student behavior (e.g., attrition), and total training time, which includes a breakout of UI and NUI time.

Table 6. Structure of BAT table: *A-School Data*

Field	Definition	Source	Example
EMC_Code	EMC Code	TFMMS	A400
EMC_Name	EMC_Name	TFMMS	AC
Rating	Dominant rating for EMC	TFMMS	AC
Label	Student manpower type	TFMMS	MPN
Training_Flag	A-School training requirement flag (Y/N)	NITRAS ATTF	Y
UI_Days	Length of training (instruction days)	NITRAS ATTF	75 days
NUI_Factor	Ratio of NUI time to UI time	NITRAS TSF	0.10
SI	Average student-to-instructor ratio	NITRAS MCRF	4.82
Max_PG	Max paygrade defining junior fleet billets	CNA STF	E4
Fill_Ratio	Ratio of A-School grads to junior fleet billets	CNA STF & TFFMS	0.139
Attrition_rate	A-School pipeline attrition rate	NITRAS TSF	0
Training_days	Length of training (calendar days)	NITRAS ATTF	82.5
type	Type of training	N/A	A-School
tf	Training Flag (1, 0)	Internal	1

Although some A-School training tracks consist of a single course, most involve two or more courses. The data in table 6 describe characteristics of the entire training pipeline. In other words, they represent either cumulative values across the entire pipeline (e.g., the length of training equals the sum of individual course lengths) or they represent average values across the entire pipeline (e.g., SI is the average student-to-instructor ratio over all courses in the pipeline).

Average student-to-instructor ratio. Compiling the average S:I for A-School pipelines (and later for NEC training tracks) was challenging. Most Navy courses of instruction are not taught at a single S:I. Instead, they consist of sections or segments that are taught at different ratios. For example, a course may start off with a lecture phase taught at a ratio of 25:1, then break into smaller sections for more hands-on instruction, which is usually taught at much lower ratios (e.g., 8:1, 4:1, or even 2:1). Using data in the MCRF, we calculated the average S:I for each course in an A-School or NEC training pipeline. We accounted for the length of the course segments and the number of class sections for each segment. If the MCRF did not contain S:I data for a course, we used the average ratio for that course type (or a default value of 25:1). Next, we calculated the average S:I for each A-School and NEC training track. For tracks with more than

one course, we calculated a weighted average based on the length of each course. Finally, for enlisted communities and NECs that have more than one training track option, we computed another weighted average based on the percentage of students that enrolled in each pipeline in the previous year (using TSF data).

Fill ratio. The parameter, *Fill_Ratio*, represents the percentage of junior fleet billets (E4 and below) that are filled each year by Sailors directly out of initial training. We compiled this rate by tracking the number of Sailors that enter the fleet for the first time each year relative to the number of junior-level fleet billets. CNA's STF database tracks enlisted Servicemembers from the time they enter the Navy until their first full-duty assignment in the fleet. We used this database to compile, for each Enlisted Management Community, the number of Sailors that entered the fleet each year. Next, we compiled from TFMMS the total number of junior-level fleet (i.e., non-IA) billets for each EMC. We then set the *Fill_Ratio* equal to the ratio of fleet arrivals over fleet junior-level billets. Some EMCs have billets only in senior paygrades and therefore do not directly affect A-School training. (We identify these EMCs in the A-School data set by setting the training flag variable *(tf)* to zero.) In the most recent data update, we defined junior fleet billets as E3 and E4 billets. Consequently, the maximum paygrade was set to E4.

Instructor workforce. The data that BAT uses to distribute instructor billets across paygrades reside in a table called *AC_Inst_p*. Table 7 shows its structure. We compiled these data from TFMMS by using NEC 9502 in conjunction with Commercial Activity Function code U300 (Specialized Skills Training) to identify A-School instructor billets.

Table 7. Structure of table: *AC_Inst_p*

Field	Definition	Example
label	Manpower category	MPN
occ_a	Rating/designator	AC
pay_a	Paygrade	E6
n_inst	Count of instructor billets	62
p	Portion of total instructor billets	0.01
school_type	Type of training (A-School, NEC, recruit)	A-School
type_NEC	NEC training flag	NEC

NEC training

NEC student billet calculations

The process BAT uses to calculate student billets for NEC training is similar to the one for A-School training. First, the tool determines the NEC requirements (both primary and secondary) for the user-defined scenario. Then, for each NEC, it estimates the annual student throughput requirement by multiplying the scenario NEC requirement by a parameter we call NEC *Fill_Rate*. This rate represents the percentage of NEC requirements that are filled each year with Sailors directly out of NEC (or C-School) training. It also includes an attrition factor to account for students who will not complete the training. Mathematically, we can express this as:

$$Stu(nec) = Req(nec) \times Fill\_Rate(nec) \times (1 + Attr(nec))$$

where

$Req(nec)$ = NEC requirements in the BAT scenario
$Fill\_Rate(nec)$ = NEC fill rate
$Attr(nec)$ = NEC pipeline attrition.

BAT calculates the student billet requirement for each NEC by:

$$StuBA(nec) = \frac{Stu(nec) \times TrngDays(nec) \times (1 + NUI(nec))}{Workyear(stu)}$$

where

$Stu(nec)$ = NEC training throughput requirement
$TrngDays(nec)$ = length of the NEC training track in calendar days
$NUI(nec)$ = ratio of NUI time to UI time
$Workyear(stu)$ = training days in a student man-year.

BAT assigns student billets to ratings and paygrades based on the rating and paygrade distribution of the billets that require the NECs. For example, student billet requirements to meet the training demand for all NEC requirements attached to billets for a first-class Firecontrolman (FC1) would be assigned to the FC rating and the E6 paygrade.

NEC instructor billet calculations

BAT calculates instructor billets for each NEC training pipeline based on the number of students that need to go through the training. Mathematically, this is given by:

$$InstrBA(nec) = \frac{Stu(nec) \times UIDays(nec)}{SI(nec) \times Workyear(instr)}$$

where

Stu(nec)	=	NEC training throughput requirement
SI(nec)	=	average student-to-instructor ratio over the entire NEC training pipeline
UIDays(nec)	=	instruction days in the NEC training pipeline
Workyear(instr)	=	work days in an instructor work-year.

As with student billets, BAT outputs instructor billet requirements by rating and paygrade. It assigns billets to ratings using the same approach that was used for student billets. BAT uses the current paygrade distribution of NEC instructor billets (in TFMMS) to distribute these instructor billets across paygrades.

NEC training data

Most of the parameters that are used in calculating student and instructor billet requirements for NEC training reside in a table called *NEC_Final*. Table 8 shows the structure of this data set, identifies the data sources, and shows a sample record. The data in this table come from several sources: NITRAS, TFMMS, and the Enlisted Master Record (EMR) file.

Table 8. Structure of BAT's NEC training data table: *NEC_Final*

Field	Definition	Source	Example
NEC	NEC	TFMMS	0107
NUI_Factor	Ratio of NUI time to UI time	NITRAS	0.10
attrition	NEC pipeline attrition	NITRAS	0.00
type	Type of training	N/A	NEC
NEC_Fill_Rate	Portion of NEC requirements filled each year by Sailors graduating from C-School	EMR and TFMMS	0.18
si	Student-to-instructor ratio	NITRAS	15.00
legend_	Basis for NEC fill rate calculation	N/A	NEC
ui_days	Under-instruction days	NITRAS	14.3
Trng_days	Length of training pipeline (calendar days)	NITRAS	20.0

NEC fill rate. The NEC fill rate represents the fraction of NEC requirements that are filled each year with Sailors directly out of NEC (or C-School) training. To estimate this rate for each NEC, we compared the number of Sailors who earned the NEC during the year with the total number of authorized billets requiring the NEC that year. We defined earning an NEC as having an NEC appear on a Sailor's EMR during that year. Because we only count NECs as earned if they appeared for the first time on a Sailor's record, we feel that this provides a reasonable estimate of the number of Sailors that went through training to earn the NEC.

We compiled the ratio of earned NECs to authorized NEC requirements for each NEC by fiscal year from FY02 to FY06. Although most ratios fell between 0.2 and 0.3, some fell well outside this zone. To reduce this variation, we calculated an average ratio for each NEC category: Rating Series, Aviation Maintenance, Aviation Initial, Naval Aircrewman, Nuclear Propulsion Plant Operator/Supervisor, SPECWAR/Diver, and Special Series.[12] For Rating Series NECs, we also calculated an average fill rate for each rating group. BAT contains all three sets of fill rates (i.e., rates for each NEC, average rates for each NEC category, and average rates for each rating group). Users can select which data set to use in Edit/Select Data option in the Shore/Support Module.

12. We calculated weighted averages based on the number of authorized NEC requirements.

NEC training parameters. Unlike A-School training, where there is a single, unique training pipeline for nearly all enlisted communities, many NECs have more than one training track option. In some cases, these options are essentially the same training offered at different locations, so the training is roughly the same. In other cases, the training tracks differ substantially in length; perhaps these training tracks are tailored to Sailors with different backgrounds and experiences.

Because BAT requires a single set of parameters to describe the training for each NEC, we had to calculate values for training length (UI days and training days), attrition, NUI factor, and student-to-instructor ratio that reflect the average over all training track options. We used the percentage of students that enrolled in each training track to calculate a weighted average for each of these parameters.

The challenges in compiling these values were twofold. The first was compiling a data set that defined all the NEC training pipelines in terms of the individual courses that make up the pipeline. Recall that the Navy tracks most training information at the individual course level, not at the NEC pipeline level. To construct this data set, we obtained two NITRAS-generated files on NEC training tracks. One file contained NEC training tracks that consist of a single course (see table 9). The other contained NEC training tracks that consist of two or more courses (see table 10). We merged these two files and created the data set outlined in table 11.

The second challenge was to take course-level data and compute average values, first for each pipeline, and then over all the pipeline options for each NEC. As with the A-School training pipelines, we used the course-level data to calculate cumulative and average values for length of training, attrition, NUI factor, and student-to-instructor ratio for the entire NEC pipeline. For NECs with more than one training track, we calculated a weighted average based on the number of previous year enrollees for each track.

Table 9. NITRAS multicourse NEC training track data

Field	Description
NEC	Navy Enlisted Classification
PCDP	Pipeline CDP[a]
PCDP_SHORT_TITLE	Short name of pipeline CDP
PCDP STATUS CD	Status of pipeline CDP (active, de-active)
PCDP_LEN	Length of NEC pipeline (calendar days)
P_INSTR_DAYS	Length of NEC pipeline (UI days)
P_ENRL	Number of enrollees in pipeline during fiscal year
P_GRAD	Number of graduates from pipeline during fiscal year
P_UI_DAYS	UI days spent by all students in pipeline
SEG_CDP	Segment course identified by CDP
SEG_SHORT_TITLE	Short name of segment CDP
STATUS_CD	Status of segment CDP (active, de-active)
STATUS_DT	Status date of segment CDP
SEG_LEN	Length of segment course (calendar days)
SEG_INSTDAYS	Length of segment course (UI days)
S_ENRL	Number of enrollees in segment course during fiscal year
S_GRAD	Number of graduates from segment course during fiscal year
S_UI	Number of UI days spent by all students in course

a. CDP stands for course data processing code which is used to identify Navy training courses

Table 10. NITRAS single-course NEC training tracks data

Fields	Description
NEC	Navy Enlisted Classification
CDP	Course CDP
COURSE TITLE	Short name of course
STATUS CD	Status of course (active, de-active)
CRSE LEN*	Length of course (calendar days)
INSTR DAYS*	Length of course (UI days)
ENRL SUM	Previous year enrollees
GRAD SUM	Previous year graduates
AOB UI SUM	Number of UI days spent by all students in course

Table 11. Merged NEC training track data

Fields	Description
NEC	Navy Enlisted Classification
Pipeline Flag	S = single-course pipeline, P = multicourse pipeline
CDP	Course CDP for single-course pipelines or Pipeline CDP for multicourse pipelines
Enrollees	Previous year pipeline enrollees
UI_days	Length of pipeline (UI days)
Trng_Days	Length of pipeline (calendar days)
Segment courses	For multicourse pipelines, number of segment courses
CDP1	CDP of first segment course
CDP2	CDP of second segment course
CDP3	CDP of third segment course
CDPn	CDP of nth segment course

Recruit training

Calculations

Because the vast majority of students who attend A-School come directly from recruit training, BAT calculates student billets for recruiting training based on its student throughput estimates for A-School training. The model calculates student throughput by summing A-School training requirements over all EMCs, as follows:

$$Stu(rtc) = \left[\sum_{emc} Stu(emc)\right] \times (1 + Attr(rtc))$$

where

$Stu(emc)$ = the student throughput requirement for A-School

$Attr(rtc)$ = the recruit training attrition rate.

It then calculates the student billet requirement as shown below:

$$StuBA(rtc) = \frac{Stu(rtc) \times TrngDays(rtc) \times (1 + NUI(rtc))}{Workyear(stu)}$$

where (1)

Stu(rtc)	=	the student throughput requirement
TrngDays(rtc)	=	the length of the recruit training track (in calendar days)
NUI(rtc)	=	the ratio of NUI time to UI time
Workyear(stu)	=	student training-days in a student man-year.

BAT distributes these student billets across the general apprenticeship rates (i.e., Airman, Seaman, Fireman, Constructionman, Hospitalman) based on a data set that maps each EMC to one of these rates. For example, students in recruit training who will go to A-School training for one of the aviation communities are assigned to the Airman (AN) rate. We assign all initial training billets to E3 paygrade.

BAT calculates recruit training instructor billets as follows:

$$InstrBA(rtc) = \frac{Stu(rtc) \times UIDays(rtc)}{SI(rtc) \times Workyear(instr)}$$

where

Stu(rtc)	=	the student throughput requirement
UI_Days	=	the length of the recruit training track (in instruction days)
SI	=	the average student-to-instructor ratio
Workyear(instr)	=	the instructor workdays in a year.

Recruit training data

The data that BAT uses to calculate student and instructor billets for recruit training reside in three tables: *Recruit Training*, *Recruits*, and *RCT_Inst_dist*. *Recruit Training* (see table 12) contains data on the length and characteristics of recruit training. *Recruits* (see table 13) contains data that are used to assign recruit training student billets to one of the general apprenticeship rates. We compiled these data from the EMR by pulling the initial undesignated rate of all Sailors who entered the fleet. We calculated, for each enlisted rating, the portion

of Sailors that had been assigned to each of these rates and assigned the general apprenticeship rate with the highest portion to that rating. For example, table 13 shows that almost 96 percent of Sailors who became Aviation Boatswain's Mates–Equipment (ABEs) entered the Navy as a general apprentice Airman. Consequently, BAT will assign recruit training student billets for Sailors entering the ABE A-School training track to the AN rate. All recruit training student billets are assigned to the E3 paygrade. *RCT_Inst_dist* (see table 14) contains data that are used to distribute recruit instructor billets by manpower type, rating, and paygrade. These data, which we derived from TFMMS, reflect the current distribution of instructor billets at Recruit Training Center, Great Lakes.

Table 12. Structure of BAT's recruit training table: *Recruit Training*

Fields	Description	Source	Example
Attrition Rate	Attrition rate	NITRAS	0.12
UI_days	Under-instruction days	NITRAS	65
Training_days	Course length (days)	NITRAS	63
NUI_factor	Ratio of NUI time to UI time	NITRAS	0.1
mp_type	Manpower type	N/A	MPN
si	Student-to-instructor ratio	NITRAS	181.2
type	Type of training	N/A	Recruit

Table 13. Structure of BAT's recruit training table: *Recruits*

Fields	Description	Example
Rating	A-School rating	ABE
AN	Portion of students entering A-School training pipeline who were airman recruits	0.9589
CN	Portion of students entering A-School training pipeline who were constructionman recruits	0.0000
FN	Portion of students entering A-School training pipeline who were fireman recruits	0.0074
SN	Portion of students entering A-School training pipeline who were seaman recruits	0.0337
HN	Portion of students entering A-School training pipeline who were hospitalman recruits	0.0000
RCT	Undesignated rate assigned to recruit training student billets that feed into this rating	AN

Table 14. Structure of recruit training data table: *RCT_Inst_dist*

Fields	Description	Example
MP_type	Manpower type	MPN
Occ_a	Rating	MM
Pay_a	Paygrade	E9
p	Portion of recruit training instructor billets for rating and paygrade	0.0017

Transients and Patients, Prisoners, and Holdees (TPPH)

Transients, patients, prisoners, and holdees make up the nonstudent portion of the Navy's Individuals Account. Like student billets, these billets are part of the Navy's personnel overhead account and represent additional manpower required to support fleet billets. BAT's Shore/Support Module estimates the requirement for TPPH billets to support active duty fleet billets in the user-defined scenario.

The module calculates billets for transients and billets for patients, prisoners, and holdees separately. Both calculations, however, are based on the concept that each fleet billet contributes to the size of these overhead accounts. Therefore, increasing or decreasing the number of fleet billets should increase or reduce the size of these accounts.

To define these relationships, we looked at the distribution of active duty Servicemembers at specific times over the past several years to see how many were in (1) a transient status, (2) a patient, prisoner, or holdee status, and (3) a full-duty status. We used the accounting category codes in the EMR and Officer Master Tracking File (OMT) to compile these counts by paygrade at 3-month intervals. At each point in time, we computed the ratio of Servicemembers in a transient status to those in full-duty status and the ratio of Servicemembers in a PPH status to those in full duty. We then took the average for each of these ratios over the past 2 years (i.e., last eight quarterly snapshots). Table 15 shows the ratios for each paygrade. These data reside within BAT in a table called *TPPH*.

Table 15. Current transient and PPH factors in BAT

Paygrade	Transient	PPH
E3	2.99%	0.80%
E4	2.41%	0.79%
E5	2.88%	0.56%
E6	2.89%	0.50%
E7	2.80%	0.47%
E8	2.57%	0.43%
E9	2.03%	0.42%
O1	17.96%	4.89%
O2	5.89%	0.55%
O3	4.05%	0.73%
O4	4.09%	0.49%
O5	4.10%	0.70%
O6	2.79%	0.48%
O7	2.45%	0.00%
O8	2.75%	0.00%
O9	1.98%	0.00%
O10	2.78%	0.00%
W2	5.99%	0.99%
W3	3.51%	0.21%
W4	2.65%	0.35%
W5	1.25%	0.46%

Maintenance billet requirements

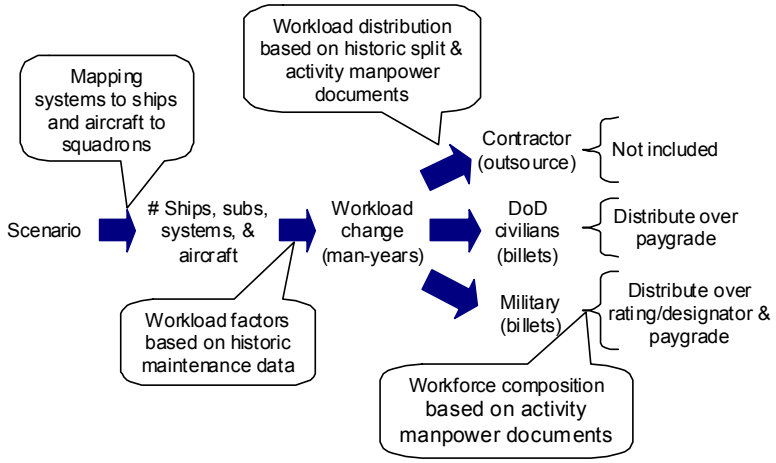
BAT estimates how force structure changes affect manpower requirements at activities that perform intermediate- and depot-level (I- and D-level) maintenance on ships, submarines, shipboard systems, and aircraft.[13] Our method for calculating these requirements ties billet requirements to the annual maintenance workload, which, in turn, is tied to the number of ships, submarines, and aircraft in the force structure scenario. Figure 1 illustrates our basic methodology.

Using historic maintenance data, we constructed workload factors that reflect—for each ship class, shipboard system, and type-model aircraft—the average man-hours of labor that are required per year to maintain a ship, submarine, system, or aircraft. We also compiled data on how this workload is distributed across the three components of the workforce (i.e., military personnel, government civilians, and contractors); BAT uses these data to apportion the workload across these components. For the work that is assigned to military and civilian personnel, BAT converts man-years of labor into billet requirements and, for military personnel, defines these requirements by rating, designator, and paygrade.

In this section, we describe the calculations and data that are used in determining billet requirements for intermediate and depot maintenance functions.

13. Intermediate maintenance includes preventive and corrective maintenance procedures and the installation of minor alterations that are normally beyond the ship's or squadron's capability or capacity. Depot maintenance requires skills and facilities beyond the level of the organizational and intermediate levels and is performed at naval shipyards, private shipyards, ship repair facilities (SRFs), or other shore-based activities. It also includes major alterations and modifications that update and improve the platform's capabilities.

Figure 1. Method for calculating maintenance manpower requirements



Ship-hull maintenance

Calculating billet requirements

BAT calculates the billet requirements to support ship-hull I-level maintenance for each manpower type (i.e., officer, enlisted, and government civilian) using the following equation:

$$Hull\_I\_BA(oec) = \left\{ \sum_{ShipUICs} [W(uic) \times Hull\_IM\_WL(class)] \right\} \times \frac{IM\_WF(oec)}{Workload(oec)}$$

where

ShipUICs = ships in the user-defined scenario
W(uic) = weight assigned in scenario to each ship
Hull_IM_WL(class) = I-level ship-hull maintenance workload factor
IM_WF(oec) = workforce share by manpower type
Workyear(oec) = man-hours of labor in a work-year.

For reasons that we will discuss below, the maintenance workload factor in this equation represents only the maintenance work that is conducted in-house—that is, by military and DoN civilians at Navy facilities. It does not reflect maintenance outsourced to the private sector.

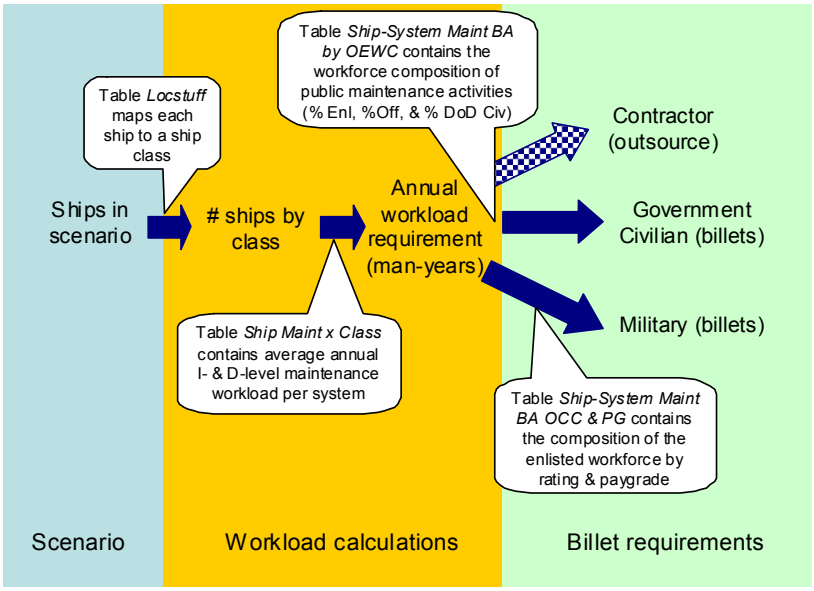
BAT apportions enlisted billet requirements by rating and paygrade and officer requirements by designator and paygrade based on the enlisted and officer billet structures at ship intermediate maintenance facilities. Civilian requirements are reported in aggregate.

BAT uses the same methodology and equation to calculate manpower requirements for depot-level ship-hull maintenance.

Ship-hull maintenance data requirements

The data used to calculate manpower requirements for ship-hull maintenance resides within BAT in three data tables: *Ship Maint x Class*, *Ship-System Maint BA by OEWC*, and *Ship-System Maint BA OCC & PG*. Figure 2 shows where the data from these tables feed into our methodology.

Figure 2. Data tables in ship hull maintenance calculations



Ship Maint x Class, whose structure we show in table 16, contains I-level and D-level maintenance workload factors for each ship class. These workloads represent the average man-hours of labor at public (i.e., government) maintenance facilities that ships undergo each year. This data set contains four other fields that show, for each ship class and maintenance level, the split of work between public and private activities. Although these data are not used in the calculations, they are included to show the user the work split associated with the in-house maintenance factors. The user can change these factors to examine how manpower requirements would change if these allotments were to change.

Table 16. Structure of data table *Ship Maint x Class*

Field	Description
Ship Class	Ship class
I_Manhours_per_System_per_Yr	I-level ship-hull workload factor (man-hours per ship per year)
Percent_I_MIL_CIV	Share of I-level work performed by military and civilian personnel
Percent_I_Contractors	Share of I-level work performed by contractors
D_Manhours_per_System_per_Yr	D-level ship-hull workload factor (man-hours per ship per year)
Percent_D_Mil_Civ	Share of D-level work performed by military and civilian personnel
Percent_D_Contractors	Share of D-level work performed by contractors

Ship-Maint BA by OEWC contains the distribution of in-house maintenance workload by manpower type. *Ship-Maint BA OCC & PG* contains the distribution of military billets by rating/designator and paygrade. Tables 17 and 18 show the structures of two data sets, respectively.

Table 17. Structure of data table *Ship-System Maint BA by OEWC*

Field	Description	Source	Example
Type Maintenance	Intermediate or depot	N/A	Ship I-Level
OEWC	Officer, enlisted, warrant, civilian	N/A	E
Percent_Workforce	Share of workforce	VAMOSC	0.74
WY	Labor hours in a work-year	Various	1,600

Table 18. Structure of data table *Ship-System Maint BA OCC & PG*

Field	Description	Source	Example
Type_Maintenance	Type of maintenance	N/A	Ship I-Level
OEWC	Officer, enlisted, warrant, civilian	N/A	E
occ_a	Rating	N/A	MM
Paygrade	Paygrade	N/A	E5
Percent_Workforce	Share of workforce	TFMMS	12.08%

Workload factors

Our primary data source for compiling maintenance workload factors is the Navy's Visibility and Management of Operating and Support Costs (VAMOSC) management information system. VAMOSC collects and reports U.S. Navy and U.S. Marine Corps historical weapon system operating and support (O&S) costs. It contains the direct O&S costs of weapon systems, some linked indirect costs (e.g., ship depot overhead), and relevant non-cost-related information, such as flying hour metrics, steaming hours, and age of aircraft. It contains data on over 1,700 ships, 91 shipboard systems, and 207 Aircraft Type/Model/Series [1].

VAMOSC contains three databases that track maintenance data for surface ships and submarines: *Ships*, *Detailed Ships*, and *Depot Availabilities* ([1] and [2] document the contents of these databases).

We compiled workload factors for intermediate ship-hull maintenance using Data Element H.0 Manhours–Intermediate Maintenance in the *Ships* database. This element reports the labor manhours performed by intermediate maintenance activities for the repair and alteration of ships. It comprises two subelements:

- H.1 Manhours–Intermediate Maintenance–Afloat: Labor manhours performed by tenders, repair ships, or equivalent afloat intermediate maintenance activities.
- H.2 Manhours–Intermediate Maintenance–Ashore: Labor man-hours performed by ashore intermediate maintenance activities.

Because our focus is on shore manpower requirements, we used sub-element H.2 to compile our workload factors.

Although VAMOSC collects maintenance data of individual ships, it can report aggregate and average data by ship class. Because the workload factors in BAT represent average values for each ship in a class, we used the class average data in VAMOSC to compile these factors. We queried this system to retrieve the total man-days of labor by ship class for each of last 3 fiscal years (i.e., FY06–08). We then divided the annual labor for each class by the number of ships in the inventory. We used the average of these rates over this 3-year period as our workload factors. The second column in table 19 shows the values for these factors currently in BAT.

We compiled workload factors for depot ship-hull maintenance using data in VAMOSC's *Depot Availability* database.[14] Specifically, we used two elements:

- Public Mandays, which represents the total man-days of labor at public shipyards
- SRF Mandays, which represents the total man-days of labor at ship repair facilities.

As before, we queried the system to retrieve the total man-days of labor by ship class for each of last 3 fiscal years. We then summed the public and SRF maintenance labor and divided the total for each class by the number of ships in the inventory. We used the average of these rates over the 3-year period as our workload factors. The fifth column in table 19 shows the values currently in BAT.

To determine the split between maintenance work at public and private depot facilities, we used the total maintenance costs for each ship class that are reported in the following data elements: (a) private total cost, (b) public total cost, and (c) SRF total cost.

14. Our initial plan to compile workload factors for ship-hull depot maintenance was to use two elements in VAMOSC's *Ships* database: K.1: Mandays Total (Public) and K.2: Mandays Total (SRF). Due to the business sensitivity of these data, however, only DoD account holders have access to these elements. Because CNA does not fall into this category, we were unable to access these data.

Table 19. Ship-hull maintenance workload factors

Ship class	I-level ship-hull maintenance workload factor (man-hours per ship per year)	Percent_I_MIL_CIV	Percent_I_Contractors	D_Manhours_per_System_per_Yr	Percent_D_Mil_Civ	Percent_D_Contractors
AE	0	-	-	0	-	-
AFDL-6	1,800	100.0%	0.0%	2,080	100.0%	0.0%
AFS	0	-	-	0	-	-
AGOS	0	-	-	0	-	-
AGSS-555	1,231	-	-	0	100%	0%
AH	0	-	-	0	-	-
AKE	0	-	-	0	-	-
AO	0	-	-	0	-	-
AOE	0	-	-	0	-	-
ARC	0	-	-	0	-	-
ARDM	7,000	100.0%	0.0%	0	100%	0%
ARS-50	6,873			0	100%	0%
AS-39	2,592	100.0%	0.0%	73,728	100%	0%
ATF	-	-	-	-	-	-
CG-47	69,659	100.0%	0.0%	5,159	14%	86%
CV-63	165,412	100.0%	0.0%	332,739	100%	0%
CVN-65	23,000	100.0%	0.0%		4%	96%
CVN-68	48,814	100.0%	0.0%	622,470	38%	62%
DDG-51	28,694	100.0%	0.0%	5,125	26%	74%
DDX-1	28,694	100.0%	0.0%	5,125	26%	74%
FFG-7	29,532	100.0%	0.0%	737	6%	94%
FFG-7R	29,532	100.0%	0.0%	737	6%	94%
HSVX	-	-	-	-	-	-
LCC-19	216,937	100.0%	0.0%	120,608	100%	0%
LCS-1	6,500	100.0%	0.0%	2,050	100.0%	0.0%
LHA-1	27,726	100.0%	0.0%	8,705	10%	90%
LHA-6	27,726	100.0%	0.0%	8,705	10%	90%
LHD-1	65,554	100.0%	0.0%	50,056	35%	65%
LHD-8	65,554	100.0%	0.0%	50,056	35%	65%
LPD-17	6,036	100.0%	0.0%	0	0%	100%
LPD-4	50,845	100.0%	0.0%	982	10%	90%
LSD-41	51,582	100.0%	0.0%	1,638	10%	90%
LSD-49	40,928	100.0%	0.0%	4,465	36%	64%
MCM-1	9,027	100.0%	0.0%	183	18%	82%
MCM-1R	9,027	100.0%	0.0%	183	18%	82%

Table 19. Ship-hull maintenance workload factors (continued)

Ship class	I-level ship-hull maintenance workload factor (man-hours per ship per year)	Percent_I_MIL_CIV	Percent_I_Contractors	D_Manhours_per_System_per_Yr	Percent_D_Mil_Civ	Percent_D_Contractors
MHC-51	2,980	100.0%	0.0%	0	0%	100%
MHC-51R	2,980	100.0%	0.0%	0	0%	100%
PC-1	1,331	100.0%	0.0%	0	9%	91%
PCMS	1,331	-	-	-	-	-
SSBN-726	114,160	100.0%	0.0%	291,079	97%	3%
SSGN-726	96,725	100.0%	0.0%	383,957	99%	1%
SSN-21	35,166	100.0%	0.0%	16,500	100.0%	0.0%
SSN-23	35,166	100.0%	0.0%	21,263	100.0%	0.0%
SSN-688	13,876	100.0%	0.0%	19,316	100.0%	0.0%
SSN-774	4,924	100.0%	0.0%	16,066	100.0%	0.0%

We combined the costs at public shipyards and ship repair facilities and compared this with the cost at private facilities to get the in-house work share for each ship class. The last two columns in table 19 show the split associated with the workload factors currently in BAT.

Workforce data

To determine the distribution of workforce billets, we first identified all activities that have billets coded under the CA function code of J504 for intermediate-level vessel maintenance and K534 for depot-level vessel maintenance. We then reviewed this list of activities and identified those that we felt perform I- or D-level maintenance. For I-level maintenance, we looked for regional maintenance centers and submarine support facilities. For D-level maintenance, we included Navy shipyards and ship repair facilities. For both levels, we compiled a list of UICs from the previous step and pulled billet information for these UICs from TFMMS. We totaled up all the enlisted billets, all the officer billets, and all the civilian billets, and calculated the share of the total workforce for each. We used these results, which are shown in table 20, to populate *Ship-System Maint BA by OEWC*.

To compile a distribution of enlisted billets by rating and paygrade, we first calculated the share of total billets for each rating-paygrade

pair. We then selected the ratings and paygrades that make up the bulk of the workforce. For ship maintenance, we selected 12 ratings and 3 paygrades that, combined, represent about 84 percent of all enlisted billets at these activities. We then recalculated the workforce share for each of these 36 rating-paygrade pairs (normalized to 100 percent). These results, which are shown in table 21, were used to populate the enlisted portion of *Ship-System Maint BA OCC & PG*. We used the same methodology for the officer workforce.

Table 20. Share of ship maintenance workload by manpower type

Maintenance level	OEWC	Workforce share (percentage)
Ship I-level	C	24.3
Ship I-level	E	74.1
Ship I-level	O	1.2
Ship I-level	W	0.4
Ship D-level	C	94.3
Ship D-level	E	5.2
Ship D-level	O	0.5
Ship D-level	W	0.0

Table 21. Data used to apportion enlisted billets by rating and paygrade

	Percentage			
occ_a	E5	E6	E7	Total
MM	13.6	13.7	3.8	31.2
ET	5.1	4.3	4.1	13.5
EM	5.4	4.9	1.3	11.6
HT	6.1	2.5	1.4	10.0
ND	4.5	1.1	1.1	6.7
EN	3.4	2.0	0.8	6.2
GSM	3.6	1.9	0.6	6.2
BM	3.6	0.9	0.2	4.7
FC	0.4	0.8	1.6	2.8
GM	1.0	0.7	0.8	2.5
IC	1.2	0.7	0.5	2.4
STS	1.5	0.5	0.3	2.2
Total	49.4	34.1	16.5	100.0

Ship-system maintenance

Calculating billet requirements

BAT calculates the billet requirements to support I-level maintenance of shipboard systems using a process similar to the one for ship-hull maintenance. As before, it calculates billet requirements for each manpower type by:

$$Sys\_I\_BA(oec) = \sum_{UIC}\left\{\sum_{system}[W(uic)\times \#Sys(uic)\times Sys\_IM\_WL(sys)]\right\}\times\frac{IM\_WF(oec)}{Workload(oec))}$$

where

W(uic) = weight assigned in scenario to each ship
UICs = ship UICs in the user-defined scenario
#Sys(uic) = number of systems on the ship
Sys_IM_WL(sys) = I-level ship-system maintenance workload factor
IM_WF(oec) = workforce share by manpower type
Workyear(oec) = man-hours of labor in a work-year.

BAT determines billet requirements and distributes these requirements by rating/designator and paygrade using the same methodology and data sets that were used for ship-hull maintenance. In addition, BAT uses the same methodology to calculate billet requirements for ship-system D-level maintenance.

Shipboard system maintenance data requirements

The data used to calculate manpower requirements for ship-system maintenance reside in four data tables: *Ship System WL*, *Ship System x UIC*, *Ship-System Maint BA by OEWC*, and *Ship-System Maint BA OCC & PG*. Figure 3 shows where the data from each feed into the calculations. *Ship System WL* contains the I- and D-level workload factors and public/commercial workload split for each ship system (table 22). *Ship System x UIC* contains the number of systems installed on board each ship and submarine (table 23). The other two tables are the same ones that supported ship-hull maintenance calculations.

Figure 3. Data tables in ship system maintenance calculations

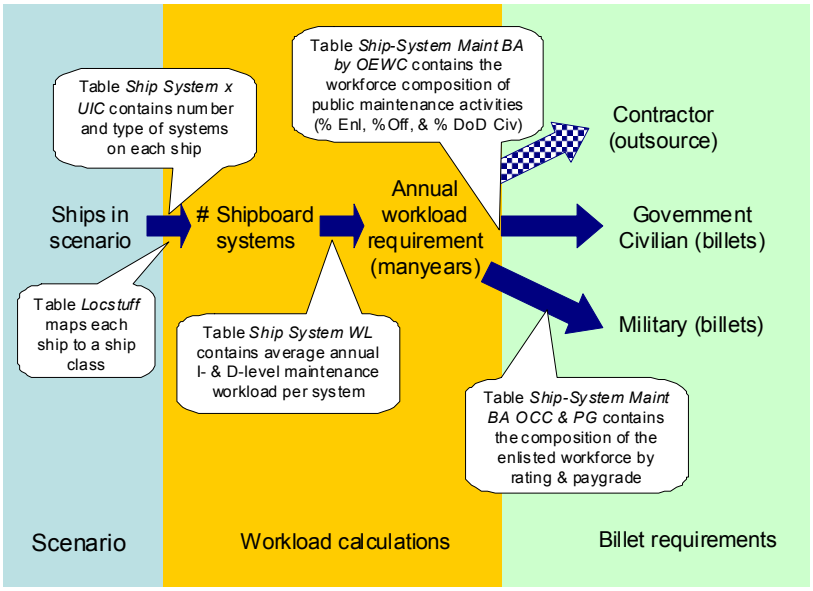


Table 22. Structure of data table *Ship System WL*[a]

Field	Definition
Ship System	Ship system
I_Manhours_per_System_per_Yr	I-level workload factor (manhours of labor per system per year)
Percent_I_MIL_CIV	Share of I-level work conducted in-house (by mil. and gov. civ.)
Percent_I_Contractors	Share of I-level work outsourced (performed by contractors)
D_Manhours_per_System_per_Yr	D-level workload factor (manhours of labor per system per year)
Percent_D_Mil_Civ	Share of D-level work conducted in-house (by mil. and gov. civ.)
Percent_D_Contractors	Share of D-level work outsourced (performed by contractors)

a. The variable Sys_IM_WL(sys) in the equation equates to the field I_Manhours_per_System_per_Yr.

Table 23. Structure of data table *Ship System x UIC*

Fields	Definition	Example
AUIC	Ship UIC	21450
Activity name	Ship name	CG 61 Monterey
System_Name	Name of the system	5"/54 Caliber MK-45 Gun
#Systems	Number of systems on board ship	2

We compiled ship-system workload factors for intermediate maintenance from data in VAMOSC's *Shipboard Systems* database. This database contains O&S costs and noncost-related data on over 90 shipboard systems (see [3] for contents of database). We queried this database to retrieve data for two elements not related to cost:

- Element: A.0 Number of Systems. The total number of systems installed or used by the Navy that are on board commissioned ships.
- Element: H.1 Manhours - Intermediate Maintenance - Ashore. The number of man-hours expended by personnel at ashore maintenance facilities on the repair and alteration of shipboard systems.

We pulled data for these elements by system and fiscal year and calculated the average I-level maintenance workload per system by dividing the total maintenance workload (Element H.1) by the number of systems (Element A.0). We used the average of these ratios (weighted by the number of systems) over the fiscal years as our workload factor. Table 24 (second column) shows the current factors for all systems.

Table 24. Current values in *Ship System WL*

Ship system	I-level workload factor	Work share performed in-house	Work share out-sourced	D-level workload factor	Work share performed in house	Work share out-sourced
AN/SYQ-20 ADVANCED COMBAT DIRECTION SYSTEM	6.0	100%	0%	0.0	-	-
AN/SYQ-7/26/28 TACTICAL MESSAGING	0.1	100%	0%	0.0	-	-
AN/SYS-2 INTEGRATED AUTOMATIC DETECTION AND TRACKING SYSTEM (IADT)	2.9	100%	0%	0.0	-	-
AN/UMK-4(V) NAVY INTEGRATED TACTICAL ENVIRONMENTAL SUPPORT SYSTEM (NITES 2000, SHIP)	0.2	100%	0%	0.0	-	-
AN/UMQ-12A MINI-RAWIN SYSTEM (MRS), GLOBAL POSITIONING SYSTEM (GPS)	0.4	100%	0%	0.0	-	-
AN/URC-107 JOINT TACTICAL INFORMATION DISTRIBUTION SYSTEM (JTIDS)	4.0	100%	0%	0.0	-	-
AN/USC-38 EHF SATCOM	19.3	100%	0%	0.0	-	-
AN/USG-1/2 COOPERATIVE ENGAGEMENT CAPABILITY (CEC)	10.5	100%	0%	0.0	-	-
AN/USQ-119/166/172/184/187(V) GLOBAL COMMAND AND CONTROL SYSTEM - MARITIME (GCCS-M)	14.8	100%	0%	0.0	-	-

Table 24. Current values in *Ship System WL (continued)*

Ship system	I-level workload factor	Work share performed in-house	Work share out-sourced	D-level workload factor	Work share performed in house	Work share out-sourced
AN/USQ-144H ADNS (AUTOMATED DIGITAL NETWORK SYSTEM)	16.7	100%	0%	0.0	-	-
AN/USQ-148E SCI (SENSITIVE COMPARTMENTED INFORMATION) NETWORKS	0.0	100%	0%	0.0	-	-
AN/USQ-153 ISNS (INTEGRATED SHIPBOARD NETWORK SYSTEM)	215.8	100%	0%	0.0	-	-
AN/USQ-185 CENTRIXS-M (COMBINED ENTERPRISE REGIONAL INFORMATION EXCHANGE SYSTEM - MARITIME	0.0	100%	0%	0.0	-	-
AN/USQ-82(V) SHIP DATA MULTIPLEX SYSTEM	38.0	100%	0%	0.0	-	-
AN/WLQ-4(V) / (V)1 COUNTERMEASURE RECEIVING SET	50.8	100%	0%	0.0	-	-
AN/WLR-1H RADAR WARNING SYSTEM	0.0	100%	0%	0.0	-	-
AN/WLR-8(V)2 / (V)5 COUNTERMEASURE RECEIVING SET	169.5	100%	0%	0.0	-	-
AN/WSC-6 SHIPBOARD TERMINAL SYSTEM	50.8	100%	0%	0.0	-	-
COMBAT CONTROL SYSTEM MK-1	16.3	100%	0%	0.0	-	-
COMBAT CONTROL SYSTEM MK-2	61.0	100%	0%	0.0	-	-
COMSEC (COMMUNICATION SECURITY) EQUIPMENT	0.0	100%	0%	0.0	-	-
EMERGENCY DIESEL GENERATORS (EDG)	130.6	100%	0%	0.0	-	-
LM-2500 GAS TURBINE ENGINE	216.2	100%	0%	0.0	-	-
MAIN PROPULSION DIESEL ENGINES (MPDE)	158.5	100%	0%	0.0	-	-
AN/BYG-1(V) SUBMARINE COMBAT CONTROL SYSTEM	28.9	100%	0%	0.0	-	-
AN/SLQ-25/25A NIXIE TORPEDO COUNTERMEASURE TRANSMITTING SYSTEM	12.7	100%	0%	0.0	-	-
AN/SLQ-32 ELECTRONIC WARFARE SYSTEM	73.3	100%	0%	0.0	-	-
AN/SLQ-48(V) MINENEUTRALIZATION SYSTEM	330.6	100%	0%	0.0	-	-
AN/SMQ-11(V) METEOROLOGICAL SATELLITE DATA AND RECEIVER RECORDER	3.5	100%	0%	0.0	-	-
AN/SPQ-12(V) RADAR DISPLAYS AND DISTRIBUTION SYSTEM (RADDS)	0.0	100%	0%	0.0	-	-
AN/SPQ-14(V) ADVANCED SENSOR DISTRIBUTION SYSTEM (ASDS)	0.0	100%	0%	0.0	-	-
AN/SPQ-9B RADAR	0.0	100%	0%	0.0	-	-
AN/SPS-40E RADAR	21.9	100%	0%	0.0	-	-
AN/SPS-48E RADAR	50.3	100%	0%	0.0	-	-
AN/SPS-49(V) RADAR	104.7	100%	0%	0.0	-	-
AN/SPS-55 RADAR	16.0	100%	0%	0.0	-	-
AN/SPS-64(V)3 / (V)9 RADAR	9.7	100%	0%	0.0	-	-
AN/SPS-67(V)1 RADAR	9.6	100%	0%	0.0	-	-
AN/SPS-67(V)3 RADAR	9.2	100%	0%	0.0	-	-
AN/SPS-73(V) RADAR	28.8	100%	0%	0.0	-	-
AN/SQQ-32(V)2 / (V)3 ADVANCED MINEHUNTING SONAR SET	153.1	100%	0%	0.0	-	-

Table 24. Current values in *Ship System WL (continued)*

Ship system	I-level workload factor	Work share performed in-house	Work share out-sourced	D-level workload factor	Work share performed in house	Work share out-sourced
AN/SQQ-89 SURFACE ASW COMBAT SYSTEM	185.2	100%	0%	0.0	-	-
AN/SQS-53A SONAR	8.5	100%	0%	0.0	-	-
AN/SQS-56 SONAR	91.5	100%	0%	0.0	-	-
AN/SRS-1(V) SIGNAL DETECTION-DIRECTION FIND-ING SET	49.4	100%	0%	0.0	-	-
MK-116 UNDER WATER FIRE CONTROL SYSTEM MODS 1,2 AND 4	4.8	100%	0%	0.0	-	-
MK-118 UNDERWATER FIRE CONTROL SYSTEM	18.9	100%	0%	0.0	-	-
MK-15 CLOSE-IN WEAPON SYSTEM (CIWS)	135.2	100%	0%	0.0	-	-
MK-23 TARGET ACQUISITION SYSTEM (TAS)	46.8	100%	0%	0.0	-	-
MK-31 RAM GUIDED MISSILE WEAPONS SYSTEM	29.8	100%	0%	0.0	-	-
MK-41 VERTICAL LAUNCHING SYSTEM	34.9	100%	0%	0.0	-	-
MK-57 NATO SEA SPARROW SURFACE MISSILE SYSTEM (NSSMS)	55.5	100%	0%	0.0	-	-
MK-75 76MM OTO-MELARA GUN	160.2	100%	0%	0.0	-	-
MK-7 AEGIS WEAPON SYSTEM	109.2	100%	0%	0.0	-	-
MK-86 GUN FIRE CONTROL SYSTEM	152.6	100%	0%	0.0	-	-
MK-92 FIRE CONTROL SYSTEM	156.5	100%	0%	0.0	-	-
SECURE TERMINAL EQUIPMENT	0.0	100%	0%	0.0	-	-
SHIPBOARD METEOROLOGICAL AND OCEANO-GRAPHIC OBSERVING SYSTEM (SMOOS)	0.0	100%	0%	0.0	-	-
SHIP SERVICE / EMERGENCY DIESEL GENERATORS (SS/EDG)	0.0	100%	0%	0.0	-	-
SHIPS SERVICE DIESEL GENERATOR (SSDG)	204.2	100%	0%	0.0	-	-
TB-16/BQ SUB FATLINE TOWED ARRAY	40.8	100%	0%	0.0	-	-
TB-23/BQ SUB THINLINE TOWED ARRAY	0.5	100%	0%	0.0	-	-
TB-29/BQ SUB THINLINE TOWED ARRAY	25.1	100%	0%	0.0	-	-
WEAPONS ELEVATORS	33.2	100%	0%	0.0	-	-
5"/54 CALIBER MK-45 GUN	99.7	100%	0%	0.0	-	-
AIRCRAFT ELEVATORS	72.7	100%	0%	0.0	-	-
AN/BLQ-10 ELECTRONIC SUPPORT MEASURES (ESM) SYSTEM	10.7	100%	0%	0.0	-	-
AN/BPS-15 SERIES RADAR	77.2	100%	0%	0.0	-	-
AN/BPS-16(V) RADAR	128.6	100%	0%	0.0	-	-
AN/BQQ-10 SONAR	122.0	100%	0%	0.0	-	-
AN/BQQ-5 SONAR SYSTEM	121.3	100%	0%	0.0	-	-
AN/BQQ-6 SONAR	2050.9	100%	0%	0.0	-	-
AN/BQS-15 SONAR DETECTING-RANGING SET	160.1	100%	0%	0.0	-	-
AN/BRD-7/7A ELECTRONIC COUNTERMEASURE SET	186.6	100%	0%	0.0	-	-
AN/BSY-1(V) COMBAT CONTROL ACOUSTIC-SYSTEM	1175.1	100%	0%	0.0	-	-
AN/BSY-2 SUBMARINE COMBAT SYSTEMS	1690.9	100%	0%	0.0	-	-
AN/SWG-1(V) / 1A(V) HARPOON SHIP COMMAND LAUNCH CONTROL SYSTEM (HSCLCS)	41.4	100%	0%	0.0	-	-

We had planned to compile ship-system workload factors for depot maintenance using Element: J.0 Manhours - Depot Maintenance - Public in the *Shipboard Systems* database. Unfortunately, for reasons cited earlier, we were unable to access these data. Because we could not find another source for these data, we were unable to compile these factors. Keep in mind, however, that BAT has the ability to calculate depot-level maintenance for these shipboard systems. Users simply need to enter values for these workload factors within the Shore/Support Module.

Aircraft maintenance

BAT uses a slightly different approach to calculate manpower requirements for intermediate- and depot-level aircraft maintenance. As with ship maintenance, the calculations use workload factors for each type-model aircraft that represent the man-hours of labor that are required to maintain a single aircraft during the year. For ship maintenance, these factors represent the total labor requirement for a ship or system across all manpower categories (i.e, officer, enlisted, and civilian). Using these factors, BAT calculates the total workload requirement and then apportions this workload across these categories based on the composition of the workforce.

The databases in VAMOSC that track aircraft maintenance are structured differently from those that track maintenance data for ships and shipboard systems. Instead of tracking direct labor hours of maintenance per aircraft, they track the annual costs of the personnel who perform this maintenance. For example, the *Aviation Type Model Series Reporting (ATMSR)* database reports intermediate maintenance costs for military personnel, civilian personnel, and contractors.[15]

15. Our understanding is that the contractor personnel costs represent the cost of contractors who work at DOD Aviation Intermediate Maintenance Department (AIMD) activities. Labor costs for intermediate maintenance conducted by commercial activities are not included in these costs.

Calculating manpower requirements

Unlike ships and submarines, which are individual activities with their own UICs, aircraft belong to aviation squadrons.[16] Consequently, in BAT, users define force structure scenarios that involve aircraft by selecting aviation squadrons. If they assign a weighting factor to a squadron, other than 1 (or -1), BAT will scale the number of aircraft in the squadron by that amount. For example, if the user assigns a weight of 0.75 to a squadron that has 12 aircraft, BAT will reduce the number of aircraft in that squadron to 9. Because the number and type of aircraft assigned to squadrons change over time, users must also select a base year from which BAT pulls the aircraft assigned to each squadron. As we will discuss later, there is a data set in BAT that contains the number and type (by type/model/series) of aircraft assigned to each squadron for each of the next 20 years.

Intermediate maintenance

BAT calculates the billet requirements to support aircraft intermediate maintenance for each manpower type using:

$$AC\_I\_BA(oec) = \sum\sum_{tm} \{W(uic) \times Inv(uic, tm) \times AC\_IM\_WL(tm, oec)\}$$

where

W(uic)	=	scenario weight assigned to a squadron
Inv(uic,tm)	=	number and type of aircraft in the squadron
AC_IM_WL(tm,oec)	=	I-level aircraft maintenance workload factor.

BAT then apportions the total enlisted billet requirement by rating and paygrade and the total officer billet requirement by designator and paygrade. Civilian requirements are reported in aggregate.

16. The activity data set in the scenario module contains a field that indicates whether a squadron (or any UIC) owns aircraft.

Depot maintenance

Because the workforce at aviation depots is almost entirely civilian (see table 25), BAT calculates only civilian billet requirements for aircraft depot maintenance. It calculates these requirements by:

$$AC\_D\_BA(civ) = \sum\sum_{tm} \{W(uic) \times Inv(uic, tm) \times AC\_DM\_WL(tm, civ)\}$$

where

$W(uic)$ = scenario weight assigned to a squadron
$Inv(uic,tm)$ = number and type of aircraft in the squadron
$AC\_DM\_WL(tm,civ)$ = D-level aircraft maintenance workload factor.

Table 25. Authorized billets at aviation depot maintenance activities

AUIC	SHORT_NAME	ACODE	ACTT TITLE	C	E	O
65923	NAVNDEPOT CH PT	1311000300	NAVAVNDEPOT	2,464	-	-
65886	NAVNDEPOT J NWCF	1311001000	NAVAVNDEPOT	2,281	16	9
4274A	NAVNDEPOT J D O	1311001019	NAVAVNDEPOT	132	-	-
65888	NAVNDEPOT NINWCF	1311001900	NAVAVNDEPOT	2,289	9	-

As with intermediate maintenance, BAT reports civilian requirements in aggregate.

Aircraft maintenance data requirements

The data used in calculating manpower requirements for aircraft maintenance reside in four data tables within BAT. Figure 4 identifies these tables and shows where in the methodology they support the calculations.

Table *AC x year* contains the number of aircraft (by type-model-series) that belong to each aviation squadron (or other activity) for each fiscal year out to FY28. We show the structure of this data set in

table 26. For reasons that we will discuss below, we define maintenance workload factor by type-model aircraft (vice type-model-series aircraft). Thus, we needed a data set to map each TMS aircraft to a TM aircraft. Table *TMS to TM* performs this function. Table 27 shows the structure of this data table.

Figure 4. Data tables that support aircraft maintenance calculations

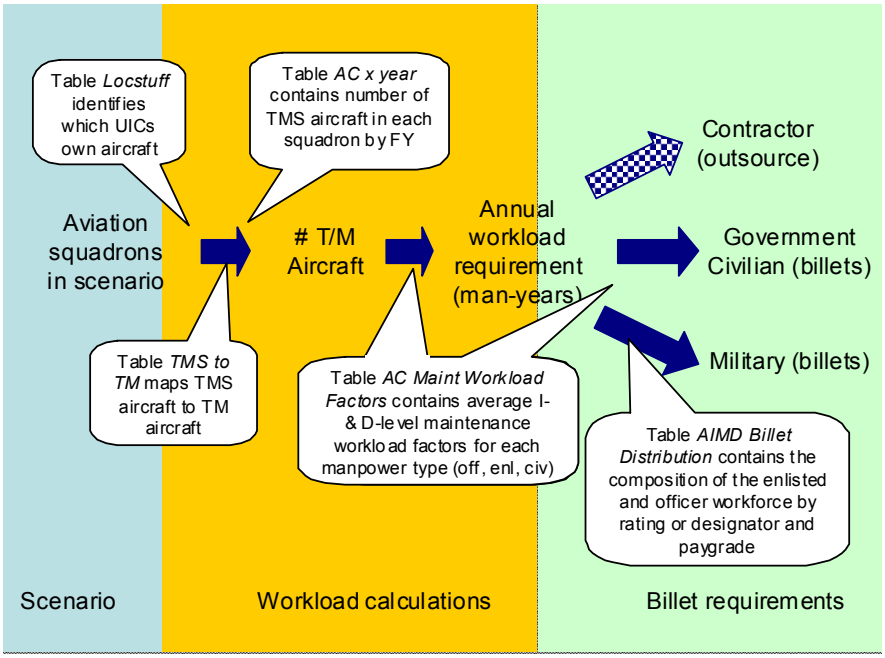


Table 26. Structure of data table *AC x Year*

Field	Description	Sample Data
AUIC	Squadron AUIC	09221
Squadron	Squadron name	VFA-81
Location	Squadron location	NAS Oceana
TMS	Aircraft type/model/series	FA-18C
year	Fiscal year	2007
Inv	Number of aircraft in squadron	12

Table 27. Structure of data table *TMS to TM*

Field	Description	Sample Data
TMS	Type/model/series aircraft	FA-18A
TM	Type/model aircraft	FA-18

Data table *AC Maint Workload Factors* contains, for each TM aircraft, the I-level and D-level maintenance workload factors, which are defined in terms of man-years of labor per aircraft per year. For intermediate maintenance, the table contains factors for enlisted personnel, officers, and DON civilians. For reasons discussed earlier, the table has only a depot workload factor for civilians. Although not used in the calculations, this table also shows the split of depot work among Navy, commercial, and other service (DISMA) facilities. Table 28 shows the structure of this data set, and table 29 shows the current values in BAT.

Table *AIMD Billet Distribution* defines the billet structures of the enlisted and officer AIMD workforces (see table 30). It defines the share of the total enlisted workforce that belongs to each rating-paygrade pair and the share of the total officer workforce that belongs to each designator-paygrade pair.

Table 28. Structure of data table *AC Maint Workload Factors*

Field	Description	Source
TM	Type/model aircraft	N/A
AC2007	Number of aircraft in FY07	VAMOSC
I-type	Maintenance program (in-house or outsourced)	VAMOSC
I-enl	Enlisted I-level maintenance factor (man-years per aircraft)	VAMOSC
I-officer	Officer I-level maintenance factor (man-years per aircraft)	VAMOSC
I-civ	Civilian I-level maintenance factor (man-years per aircraft)	VAMOSC
I-cont	Contractor I-level maintenance factor (man-years per aircraft)	VAMOSC
D-civ	Civilian D-level maintenance factor (man-years per aircraft)	VAMOSC
D-pct_inhouse	Share of depot maintenance conducted in-house	VAMOSC
D-pct_commercial	Share of depot maintenance conducted outsourced	VAMOSC
D-pct_DISMA	Share of depot maintenance conducted at DISMA	VAMOSC

Table 29. Aircraft maintenance workload factors

TM	AC2007	I-type	I-enl	I-officer	I-civ	I-cont	D-civ	D-pct_in house	D-pct_commer-cial	D-pct_DISMA
A-6	104	In-house	10.93	0.33	0.00	0.04	2.17	96.9%	3.1%	0.0%
AV-8	139	In-house	6.74	0.19	0.00	0.00	0.95	93.6%	6.4%	0.0%
C-12	59	Contracted	0.01	0.00	0.00	0.07	0.00	0.0%	100.0%	0.0%
C-130	80	In-house	4.17	0.15	0.03	0.00	0.04	0.5%	39.1%	60.4%
C-2	33	In-house	5.43	0.13	0.00	0.02	3.37	97.2%	2.8%	0.0%
C-20	8	Contracted	2.01	0.09	0.00	0.00	0.00	0.0%	100.0%	0.0%
C-26	7	Contracted	0.00	0.00	0.00	0.00	0.00	0.0%	100.0%	0.0%
C-35	12	Contracted	0.00	0.00	0.00	0.00	0.00	0.0%	100.0%	0.0%
C-37	4	Contracted	0.00	0.00	0.00	0.00	0.00	0.0%	100.0%	0.0%
C-40	9	Contracted	0.01	0.00	0.00	0.00	0.00	0.0%	100.0%	0.0%
C-9	18	Contracted	0.06	0.00	0.00	0.00	0.00	0.0%	100.0%	0.0%
E-2	60	In-house	14.76	0.42	0.00	0.01	1.16	51.7%	48.3%	0.0%
E-6	15	In-house	2.34	0.17	0.00	0.00	0.00	0.0%	0.0%	100.0%
F/A-18	908	In-house	6.16	0.15	0.00	0.02	0.77	96.2%	3.8%	0.0%
F-16	14	Contracted	0.90	0.03	0.00	0.23	0.07	100.0%	0.0%	0.0%
F-5	41	Contracted	0.00	0.00	0.00	0.00	0.01	0.5%	99.5%	0.0%
H-1	264	In-house	2.34	0.07	0.00	0.00	0.57	92.2%	0.0%	7.8%
H-3	13	Contracted	1.05	0.02	0.00	0.00	0.27	3.6%	96.4%	0.0%
H-46	198	In-house	4.53	0.15	0.00	0.00	1.26	98.2%	1.8%	0.0%
H-53	207	In-house	6.46	0.22	0.01	0.00	1.43	100.0%	0.0%	0.0%
H-57	118	Contracted	0.00	0.00	0.00	0.00	0.00	0.0%	100.0%	0.0%
H-60	358	In-house	4.36	0.12	0.00	0.02	0.61	70.7%	24.1%	5.2%
P-3	170	In-house	7.14	0.21	0.00	0.01	1.10	43.7%	56.3%	0.0%
S-3	21	In-house	13.16	0.34	0.00	0.00	0.39	49.6%	50.4%	0.0%
T-2	16	Contracted	0.25	0.00	0.00	0.00	0.07	100.0%	0.0%	0.0%
T-34	268	Contracted	0.02	0.00	0.00	0.00	0.00	0.1%	99.9%	0.0%
T-39	20	Contracted	0.01	0.00	0.00	0.00	0.00	0.0%	100.0%	0.0%
T-44	54	Contracted	0.01	0.00	0.00	0.00	0.00	0.0%	100.0%	0.0%
T-45	187	Contracted	0.00	0.00	0.00	0.00	0.00	0.0%	100.0%	0.0%
T-6	39	Contracted	0.06	0.00	0.00	0.00	0.00	0.0%	100.0%	0.0%
V-22	49	In-house	1.95	0.07	0.00	0.00	0.02	100.0%	0.0%	0.0%

Table 30. Structure of data table *AIMD Billet Distribution*

Field	Description	Sample Data
Type	Maintenance level	Aviation I-Level
OEWC	Off, enl, war, civ	E
occ_a	Rating or designator	AT
Paygrade	Paygrade	E4
Percent_Workforce	Percentage of AIMD workforce	7.98%

Aircraft intermediate-level workload factors

As mentioned earlier, we compiled the aircraft maintenance workload factors from VAMOSC's *ATMSR* database.[17] For intermediate maintenance, we used the following data elements:

- Element 2.1.1.1.1.1, Intermediate Maintenance Military Personnel Costs - Navy - Maintenance - Officer: This element reports the total pay of Navy officer personnel assigned as maintenance personnel to the intermediate-maintenance-level units that maintain Fleet Replacement Squadron (FRS) and regular fleet aircraft.
- Element 2.1.1.1.1.2, Intermediate Maintenance Military Personnel Costs - Navy - Maintenance - Enlisted: This element reports the total pay of Navy enlisted personnel assigned as maintenance personnel to the intermediate-maintenance-level units that maintain FRS and regular fleet aircraft.
- Element 2.1.1.2.1.1, Intermediate Maintenance Military Personnel Costs - Marine - Maintenance - Officer: This element reports the total pay of Marine Corps officer personnel assigned as maintenance personnel to the intermediate-maintenance-level units that maintain FRS and regular fleet aircraft.
- Element 2.1.1.2.1.2, Intermediate Maintenance Military Personnel Costs - Marine - Maintenance - Enlisted: This element reports the total pay of Marine Corps enlisted personnel assigned as maintenance personnel to the intermediate-maintenance-level units that maintain FRS and regular fleet aircraft.
- Element 2.1.2, Intermediate Civilian Personnel Costs: This element reports the cost of government civilian personnel that support Navy and Marine Corps aircraft operations for Regular and FRS aircraft at the intermediate level.
- Element 2.1.3, Intermediate Contractor Personnel Costs: This element reports the cost of contractor personnel (purchased services) that support Navy and Marine Corps aircraft operations at the intermediate level.

17. See [4] for a description of this database.

- Element A1.0, Total Aircraft Number: This element reports the total number of operational aircraft, both regular and FRS, by T/M/S. It include both Navy and Marine Corps aircraft.

Because Navy personnel can maintain Marine Corps aircraft and Marine Corps personnel can maintain Navy aircraft, we summed Navy and Marine Corps personnel costs to determine the workload per aircraft. In addition, because we are interested in manpower requirements for personnel who actually perform maintenance functions, we included the personnel costs of only those positions that directly perform maintenance functions. We queried VAMOSC to retrieve these costs for FY04 through FY07.[18]

Next, we converted these labor costs into work-years. Personnel costs in VAMOSC include base pay, allowances, entitlements, bonuses/incentives, FICA, and retirement accrual. To convert these costs to labor work-years, we divided the enlisted costs by a standard enlisted cost rate ($56,000) and officer costs by the standard officer cost rate ($116,000).

We then calculated labor requirements (in work-years) per aircraft. For each fiscal year, we divided the enlisted and officer workloads by the total number of operational aircraft for that year. We used the average of rates over the 3-year period as the workload factors. Table 31 shows the enlisted personnel costs, aircraft inventory, and enlisted workload factors for each TM aircraft. The last column shows whether the majority of maintenance was conducted in-house or was outsourced, which we determined by comparing military and civilian labor costs to contractor costs.

18. ATMSR reports data by type/model/series (TMS) or by type/model (TM). At first, we compiled maintenance workload factors for each TMS aircraft. However, we found large variations in workload between different series aircraft that could not be explained by age or usage. We then recomputed the workload rates for each TM aircraft and found the rates to be more consistent.

Table 31. VAMOSC data used to determine workload factors for aircraft I-level maintenance

Aircraft TM	I-level maintenance enlisted personnel cost ($K)			Number of aircraft in inventory			Labor (in man-years) per aircraft				Maintenance program
	FY05	FY06	FY07	FY05	FY06	FY07	FY05	FY06	FY07	Ave. FY05-07	
A-6	63,755	64,212	71,695	110	108	104	10.2	10.5	12.15	10.93	In-house
AV-8	53,220	50,166	54,934	137	138	139	6.8	6.4	6.96	6.74	In-house
C-12	40	74	12	67	60	59	0.0	0.0	0.00	0.01	Contracted
C-130	22,709	17,904	19,213	91	82	80	4.4	3.8	4.23	4.17	In-house
C-2	10,178	8,458	11,864	33	33	33	5.4	4.5	6.33	5.43	In-house
C-20	744	908	1,086	8	8	8	1.6	2.0	2.39	2.01	Contracted
C-26	-	-	-	-	-	-	-	-	-	-	Contracted
C-35	1	-	-	10	11	12	0.0	0.0	0.00	0.00	Contracted
C-37	-	-	-	-	-	-	-	-	-	-	Contracted
C-40	8	2	2	8	9	9	0.0	0.0	0.00	0.01	Contracted
C-9	49	84	70	19	19	18	0.0	0.1	0.07	0.06	Contracted
E-2	45,914	57,522	50,644	62	62	60	13.0	16.3	14.87	14.76	In-house
E-6	2,090	2,004	1,874	15	15	15	2.5	2.4	2.20	2.34	In-house
F/A-18	287,301	328,146	311,094	853	889	908	5.9	6.5	6.04	6.16	In-house
F-14	50,079	11,589	0	24	1	0	36.8	204.2	-	43.47	-
F-16	738	961	452	14	14	14	0.9	1.2	0.57	0.90	Contracted
F-5	0	17	0	36	42	41	0.0	0.0	0.00	0.00	Contracted
H-1	37,254	36,538	34,128	275	274	264	2.4	2.3	2.28	2.34	In-house
H-3	3,493	36	35	29	18	13	2.1	0.0	0.05	1.05	Contracted
H-46	54,725	62,373	46,751	221	218	198	4.4	5.0	4.16	4.53	In-house
H-53	76,399	75,200	77,331	209	208	207	6.4	6.4	6.58	6.46	In-house
H-57	14	7	12	120	119	118	0.0	0.0	0.00	0.00	Contracted
H-60	84,907	85,946	87,154	341	343	358	4.4	4.4	4.29	4.36	In-house
P-3	72,345	66,395	66,647	164	173	170	7.8	6.8	6.91	7.14	In-house
S-3	43,554	22,621	9,241	53	27	21	14.5	14.8	7.75	13.16	In-house
T-2	289	180	207	16	16	16	0.3	0.2	0.23	0.25	Contracted
T-34	285	240	391	268	262	268	0.0	0.0	0.03	0.02	Contracted
T-39	0	7	26	21	20	20	0.0	0.0	0.02	0.01	Contracted
T-44	56	39	42	53	54	54	0.0	0.0	0.01	0.01	Contracted
T-45	0	0	0	-	-	-	-	-	-	-	Contracted
T-6	155	123	169	47	40	39	0.1	0.1	0.08	0.06	Contracted

AIMD workforce data

To determine the composition of the intermediate maintenance workforce, we compiled all billets with a CA function code of J501 (intermediate aircraft maintenance) or J502 (intermediate aircraft engine maintenance) that were at an activity that had the

abbreviation AIMD (Aviation Intermediate Maintenance Department) in its title. Table 32 shows these AIMD activities with the billet count for each manpower type (i.e., civilians, enlisted, officers, and warrant officers.) Note that enlisted personnel make up the largest share.

Table 32. AIMD activities with authorized billet counts by manpower type

AUIC	SHORT_NAME	ACODE	ACTT TITLE	C	E	O	W
44492	NAF WASHDC RAIMD	1312013015	NAV AIR FAC	6	25	-	-
44490	NAS NRLNS RAIMD	1432040015	AIR&SURFRESFOR	10	84	2	-
44486	NAS ATLA RAIMD	1432040016	AIR&SURFRESFOR	7	12	-	-
44493	NAS WILGR RAIMD	1432040017	AIR&SURFRESFOR	9	57	1	-
44317	CSFWPAC DET AIMD	1452036015	NAV AIR STATION	1	94	1	-
44329	CVWP DET AIMD	2322001205	MAT/VAQWINGPAC	16	387	2	3
3844A	AIMD EVERETT UNT	2322001219	MAT/VAQWINGPAC	-	4	-	-
44325	NORFOLK AIMD	2328001209	CAEWWING	3	375	9	
44330	AIMD SIGONELLA	2333016817	COM FLT AIR RES	-	247	4	3
44323	CFWP AIMD ATSUGI	2333092007	COM FLT AIR RES	-	-	-	-
44331	CFWP AIMD MISAWA	2333092010	COM FLT AIR RES	1	-	-	-
45459	NS MYPT AIMD	2335000302	HELSEACONTROLWG	1	172	6	2
30244	AIMDCC	2337000112	COMHELTACWING	-	62	2	-
44326	CHSMWP AIMD	2338001050	COMHSLWINGS	14	467	3	2
44314	NAS BRSWK AIMD	2350000507	COMPATWING	2	188	6	1
44319	NAS JAX AIMD	2350001140	COMPATWING	6	450	6	3
44312	AIMD MCBH KBAY	2350010525	COMPATWING	-	18	-	-
44327	NAS OCE AIMD	2354000115	COMLATWING	2	690	10	3
44320	NAS KW AIMD	2354000121	COMLATWING	1	50	1	-
44321	CSFWP DET AIMD	2354001020	COMLATWING	5	510	5	2

To compile the distribution of enlisted billets across rating and paygrade, we first calculated the share of the workforce for each of these rating-paygrade pairs (table 33). We then looked at the ratings and paygrades that made up the bulk of the workforce. For the enlisted workforce, this included nine ratings and four paygrades (E4 through E7), which represented about 88 percent of all I-level billets. We then recalculated the workforce share for each of these 36 rating-paygrade pairs (normalized to 100 percent). We used the same methodology on the officer workforce. These results were used to populate the *AIMD Billet Distribution* data set (see table 34).

Table 33. Enlisted billet authorizations at AIMD activities

occ_a	E3	E4	E5	E6	E7	E8	E9	Total
AT	33	287	471	102	64	12	-	969
AD	26	279	326	76	52	9	-	768
AM	12	152	251	45	36	6	-	502
AS	41	148	195	82	19	8	1	494
AE	10	104	149	33	22	7	-	325
AZ	3	71	130	38	11	1	1	255
AO	6	70	75	45	13	4	-	213
PR	8	43	92	31	9	4	1	188
SK	1	15	49	6	7	1	-	79
MR	-	6	21	6		-	-	33
AME	-	4	4	3	1	-	-	12
MM	-	4	5	1	1	-	-	11
YN	1	2	5	2	1	-	-	11
NC	-	-	-	4	-	-	-	4
IT	-			3	-	-	-	3
ET	-	1	1	-	-	-	-	2
ABE	-		-	1	-	-	-	1
ABF	-		-	1	-	-	-	1
ABH	-		-	1	-	-	-	1
FC	-	1	-	-	-	-	-	1
AB	-		-	-	-	-	1	1
AF	-		-	-	-	-	6	6
AV	-	-	-	-	-	-	10	10
CMD	-	-	-	-	-	-	2	2
Total	141	1,187	1,774	480	236	52	22	3,892

Table 34. Enlisted and officer billet structures at AIMDs

Type	OEWC	occ_a	Paygrade	Percent_ Workforce
Aviation I-level	E	AT	E4	7.98%
Aviation I-level	E	AT	E5	13.09%
Aviation I-level	E	AT	E6	2.83%
Aviation I-level	E	AT	E7	1.78%
Aviation I-level	E	AD	E4	7.75%
Aviation I-level	E	AD	E5	9.06%
Aviation I-level	E	AD	E6	2.11%
Aviation I-level	E	AD	E7	1.45%

Table 34. Enlisted and officer billet structures at AIMDs (continued)

Type	OEWC	occ_a	Paygrade	Percent_ Workforce
Aviation I-level	E	AM	E4	4.22%
Aviation I-level	E	AM	E5	6.98%
Aviation I-level	E	AM	E6	1.25%
Aviation I-level	E	AM	E7	1.00%
Aviation I-level	E	AS	E4	4.11%
Aviation I-level	E	AS	E5	5.42%
Aviation I-level	E	AS	E6	2.28%
Aviation I-level	E	AS	E7	0.53%
Aviation I-level	E	AE	E4	2.89%
Aviation I-level	E	AE	E5	4.14%
Aviation I-level	E	AE	E6	0.92%
Aviation I-level	E	AE	E7	0.61%
Aviation I-level	E	AZ	E4	1.97%
Aviation I-level	E	AZ	E5	3.61%
Aviation I-level	E	AZ	E6	1.06%
Aviation I-level	E	AZ	E7	0.31%
Aviation I-level	E	AO	E4	1.95%
Aviation I-level	E	AO	E5	2.08%
Aviation I-level	E	AO	E6	1.25%
Aviation I-level	E	AO	E7	0.36%
Aviation I-level	E	PR	E4	1.20%
Aviation I-level	E	PR	E5	2.56%
Aviation I-level	E	PR	E6	0.86%
Aviation I-level	E	PR	E7	0.25%
Aviation I-level	E	SK	E4	0.42%
Aviation I-level	E	SK	E5	1.36%
Aviation I-level	E	SK	E6	0.17%
Aviation I-level	E	SK	E7	0.19%
Aviation I-level	O	LDO- Aviation	O1	6.90%
Aviation I-level	O	LDO- Aviation	O2	20.69%
Aviation I-level	O	LDO- Aviation	O3	8.62%
Aviation I-level	O	LDO- Aviation	O4	12.07%
Aviation I-level	O	RL- AMDO	O1	5.17%
Aviation I-level	O	RL- AMDO	O2	6.90%
Aviation I-level	O	RL- AMDO	O3	22.41%
Aviation I-level	O	RL- AMDO	O4	8.62%
Aviation I-level	O	RL- AMDO	O5	8.62%

Aircraft depot-level workload factors

The ATMSR database in VAMOSC reports the costs associated with the depot-level repair of aircraft, aircraft engines, and support equipment. It tracks repairs that are completed by and reported for Navy organic depots, commercial rework facilities, and other military service depot facilities. Rework at other military service depot facilities is conducted through Depot Maintenance Inter-Service Agreements (DMISA). Although VAMSOC tracks contract logistic support (CLS) costs for each TM aircraft, these are aggregated costs and therefore do not show the cost for maintenance. Consequently, we did not include CLS costs when compiling depot maintenance workload rates [4].

We compiled the aircraft depot maintenance workload factors from VAMOSC's ATMSR database. We queried VAMOSC to retrieve the following data elements:

- Element 3.1.1.1, Organic Aircraft Rework Costs - Labor: This element reports the labor costs incurred at organic aircraft rework depots while repairing engines on FRS and regular fleet aircraft.
- Element 3.3.1.1, Organic Aircraft Engine Rework Costs - Labor: This element reports the labor costs incurred at organic aircraft rework depots while repairing FRS and regular fleet aircraft.
- Element 3.6.1.1, Organic Aircraft Emergency Repair Costs - Labor: This element reports the labor costs incurred at organic aircraft rework depots while conducting emergency repair of FRS and regular fleet aircraft.
- Element 3.7.1.1, Organic Aircraft Engine Emergency Repair Costs - Labor: This element reports the labor costs incurred at organic aircraft rework depots while conducting emergency repair of engines on FRS and regular fleet aircraft.

We queried VAMOSC to retrieve these costs by TM aircraft for FY05 through FY07. We then summed these costs by fiscal year for each TM aircraft. Next, we converted these costs to man-years of labor by dividing by the average cost of a civilian man-year (which we derived from

the civilian pay data). We then calculated the annual labor requirement for each aircraft by dividing the total labor by the number of fleet and FRS aircraft in the inventory for that year. We used the average of these rates over these 3 years as our workload factors. Table 35 shows the FY06 and FY07 VAMOSC data (i.e., number of aircraft and total labor costs) and our calculated variables (i.e., total labor and labor per aircraft) for each TM aircraft. The last column contains the workload rates currently in BAT.

Table 35. VAMOSC data used to calculate aircraft depot maintenance workload factors

TM aircraft	Number aircraft in inventory		Annual labor costs		Total labor (work-years)		Labor per aircraft (work-years per aircraft)		
	FY06	FY07	FY06	FY07	FY06	FY07	FY06	FY07	Ave.
A-6	108	104	15,418	15,592	246.70	249.49	2.28	2.40	2.17
AV-8	138	139	8,596	10,700	137.55	171.22	1.00	1.23	0.95
C-130	82	80	165	53	2.64	0.85	0.03	0.01	0.04
C-2	33	33	5,623	7,882	89.98	126.13	2.73	3.82	3.37
C-9	19	18	0	-	0.00	0.00	0.00	0.00	0.00
E-2	62	60	4,876	3,767	78.02	60.27	1.26	1.00	1.16
F/A-18	889	908	44,498	40,751	712.02	652.07	0.80	0.72	0.77
F-14	1	0	1	-	0.02	0.00	0.02	-	0.26
F-16	14	14	70	66	1.11	1.05	0.08	0.08	0.07
F-5	42	41	17	15	0.27	0.25	0.01	0.01	0.01
H-1	274	264	9,985	10,044	159.78	160.72	0.58	0.61	0.57
H-3	18	13	517	253	8.28	4.05	0.46	0.31	0.27
H-46	218	198	17,011	17,335	272.20	277.38	1.25	1.40	1.26
H-53	208	207	20,106	17,884	321.72	286.16	1.55	1.38	1.43
H-57	119	118	-	0	0.00	0.00	0.00	0.00	0.00
H-60	343	358	12,908	14,324	206.55	229.20	0.60	0.64	0.61
P-3	173	170	12,087	11,024	193.41	176.39	1.12	1.04	1.10
S-3	27	21	264	788	4.22	12.61	0.16	0.60	0.39
T-2	16	16	68	48	1.09	0.77	0.07	0.05	0.07
T-34	262	268	2	3	0.03	0.05	0.00	0.00	0.00
T-39	20	20	0	-	0.01	0.00	0.00	0.00	0.00
T-44	54	54	4	-	0.06	0.00	0.00	0.00	0.00
T-45	178	187	1	-	0.02	0.00	0.00	0.00	0.00
V-22	37	49	22	109	0.35	1.75	0.01	0.04	0.02

We compiled the distribution of aircraft depot maintenance between Navy depots, commercial facilities, and other Service facilities using the total costs allocated to each type of maintenance facility. We calculated the annual cost of work at Navy depots by summing the following VAMOSC data elements:

- Element 3.1.1, Organic Aircraft Rework Costs
- Element 3.3.1, Organic Aircraft Engine Rework Costs
- Element 3.6.1, Organic Aircraft Emergency Repair Costs
- Element 3.7.1, Organic Aircraft Engine Emergency Repair Costs.

We calculated the annual cost of work at commercial activities by summing the following VAMOSC data elements:

- Element 3.1.2, Commercial Aircraft Rework Costs
- Element 3.6.2, Commercial Aircraft Emergency Repair Costs
- Element 3.3.2, Commercial Aircraft Engine Rework Costs.

And we calculated the annual cost of work at other Service depots by summing the following data elements:

- Element 3.1.3, DMISA Aircraft Rework Costs
- Element 3.6.3, DMISA Aircraft Emergency Repair Costs
- Element 3.3.3, DMISA Aircraft Engine Rework Costs.

We then calculated, for each TM aircraft, the share of total maintenance costs for each type of maintenance facility. The data and results are shown in table 36.

Table 36. Distribution of depot maintenance work among Navy, commercial, and DISMA facilities

Aircraft type/ model	Number of aircraft FY07	Costs at organic depots ($K)	Costs at commercial facilities ($K)	Costs at DISMA facilities ($K)	Percent of costs at organic depots	Percent of costs at commercial facilities	Percent of costs at DISMA facilities
A-6	104	$90,816	$2,887	$0	97%	3%	0%
AV-8	139	$66,094	$4,546	$0	94%	6%	0%
C-12	59	$0	$11,432	$0	0%	100%	0%
C-130	80	$173	$12,953	$19,979	1%	39%	60%
C-2	33	$29,987	$859	$0	97%	3%	0%
C-20	8	$0	$8,196	$0	0%	100%	0%
C-26	7	$0	$731	$0	0%	100%	0%
C-35	12	$0	$1,812	$0	0%	100%	0%
C-37	4	$0	$3	$0	0%	100%	0%
C-40	9	$0	$2,896	$0	0%	100%	0%
C-9	18	$0	$23,005	$0	0%	100%	0%
E-2	60	$27,386	$25,574	$0	52%	48%	0%
E-6	15	$0	$0	$27,143	0%	0%	100%
F/A-18	908	$301,890	$11,861	$0	96%	4%	0%
F-16	14	$146	$0	$0	100%	0%	0%
F-5	41	$39	$8,041	$0	0%	100%	0%
H-1	264	$52,913	$0	$4,459	92%	0%	8%
H-3	13	$1,127	$30,246	$0	4%	96%	0%
H-46	198	$84,160	$1,584	$0	98%	2%	0%
H-53	207	$124,045	$0	$0	100%	0%	0%
H-57	118	$0	$6,120	$0	0%	100%	0%
H-60	358	$59,807	$20,426	$4,372	71%	24%	5%
P-3	170	$41,488	$53,370	$0	44%	56%	0%
S-3	21	$6,076	$6,169	$0	50%	50%	0%
T-2	16	$106	$0	$0	100%	0%	0%
T-34	268	$18	$20,211	$0	0%	100%	0%
T-39	20	$0	$14,660	$0	0%	100%	0%
T-44	54	$0	$5,236	$0	0%	100%	0%
T-45	187	$0	$3,251	$0	0%	100%	0%
T-6	39	$0	$481	$0	0%	100%	0%

Health care service billet requirements

BAT uses relationships based on the current size of the health care force relative to the size of the active duty force to estimate the change in manpower requirements for health care services. Roughly half of BUMED's shore billets are tied to operational requirements via the medical augmentation program. Personnel in these billets support medical mobilization requirements during wartime or support contingency operations during nonmobilization periods. In deriving relationships on the size of the health care force, we excluded these billets from our analysis and focused on the remaining BUMED billets at medical and dental care facilities.

To identify the segment of the health care service force that we were interested in, we first excluded all health care billets that were mapped to mobilization or additional duty requirements. We excluded additional duty billets (ADDU TO and ADDU FM) by filtering on the manpower accounting code (MPWR_AC) field in TFMMS (exclude billets where MPWR_AC equals N or S). We excluded MOB FROM billets by filtering on the Peacetime Requirement field (i.e., we only included billets where PR = 1 or 2). We excluded MOB TO billets by excluding all billets that have the text phrase “MOB TO” in their billet title. Next, we excluded all health care billets that did not have BUMED as their manpower claimant. By doing this, we excluded billets that provide direct medical support to the Marine Corps. Of the remaining BUMED billets, we included only those at medical or dental care activities (i.e., hospitals, medical centers, dental centers, and medical clinics). We used the first 4 digits of the 10-digit activity code to identify these activities (see table 37).

Having determined the size of the current health care force, our next step was to calculate the ratio of medical billets to all active-duty military billets. We did this for the seven medical service functions: Medical Care, Pathology Services, Pharmacy Services, Preventive Medicine, Radiology Services, Surgical Care, and Dental Care. We

also calculated a single ratio for the medical administrative functions and a single ratio for all remaining functions, which we refer to as medical other. Table 38 shows the CA function codes that we used to define each of these health care functions, and table 39 shows the ratios for these functions based on June 2009 billet data.

Table 37. Activity codes used to identify health care activities

ACODE4	Activity type
2750	Naval medical clinics
3435	Naval hospitals
4170	Naval regional medical centers
4171	Naval dental clinics

Table 38. Health care CA function groups

CA_Fn	Group
H010	Medical administrative
H050	Medical administrative
H100	Medical care
H102	Surgical care
H106	Pathology services
H107	Radiology services
H108	Pharmacy services
H113	Medical administrative
H119	Medical care
H125	Surgical care
H127	Pathology services
H203	Radiology services
H250	Pharmacy services
H350	Dental care
H650	Medical care
H710	Medical other
H999	Medical other
H999E	Medical other
H999G	Medical other

Table 39. Health care service ratios based on June 2009 billet data

Medical function	FY09 BA*	Ratio
Medical care	3175	0.955%
Pathology services	1701	0.512%
Pharmacy services	1315	0.395%
Preventive medicine	978	0.294%
Radiology services	5812	1.748%
Surgical care	1819	0.547%
Dental care	600	0.180%
Medical administrative	2979	0.896%
Medical other	1010	0.304%

Because we derive these ratios directly from TFMMS data, BAT recomputes these ratios every time it executes the queries to calculate the health care billet requirements. Consequently, there is no need to update these ratios. The only data that may need periodic updating are the CA function codes in table 38, which may change over time.

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Work-year data

All equations in the Shore/Support Module that calculate billet requirements contain a variable that defines the number of workdays (or equivalent) in a work-year for that functional area. Values for these variables reside in BAT in the *Workyear* data set. Table 40 shows the data set structure, and table 41 shows the current values.

Table 40. Structure of *Workyear*[a]

Field	Description
Area	Function area
Desc	Description
days_per_workyear	Workdays per year
inst_workdays	Instructor (military) workdays per year
pCiv	Share of work performed by government civilians
pEnl	Share of work performed by enlisted personnel
pOff	Share of work performed by officer personnel
pCont	Share of work performed by contractors
civWY	Civilian work-year equivalent

a. For the training areas, "days_per_workyear" represents training days in a student man-year, and civWY represents the difference between civilian and military instructor workdays in a work-year.

Table 41. Current values in *Workyear*

type	disc	days_ per_ workyear	inst_ work- days	pCiv	pEnl	pOff	pCont	civWY
A-School	A-School training	350	217	0.05	0.95	0	0	0.87
NEC	NEC training	350	217	0.05	0.95	0	0	0.87
Recruit	Recruit training	350	217	0	1	0	0	0.87
Transients	Transients	365	-	-	-	-	-	-
PPH	PPH	365	-	0	-	-	-	1
Ship_I	Ship I-level maintenance	350	-	0.243	0.741	0.016	0	1
Ship_D	Ship D-level maintenance	350	-	0.943	0.052	0.005	0	1
AC_D	Aircraft D-level maintenance	350	-	1	0	0	0	1
AC_I	Aircraft I-level maintenance	350	-	0	0	0	0	1
Health	Health care	230	-	0.1	-	-	-	1

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CA Function Analysis Module

Although the main function of the Shore/Support Module is to determine the impact of force structure changes on shore manpower requirements, the module provides another feature that can help users study shore manpower requirements. The original BAT allows users to change the shore/support infrastructure by adding, deleting, or scaling manpower requirements at individual shore/support activities. They select one or more activities (by UIC), enter the appropriate scaling factor (just as for force structure units), and the tool determines the manpower requirements. The Shore/Support Module provides a similar capability that is designed around Commercial Activity (CA) function areas instead of activities. It allows users to change the shore/support manpower requirements in one or more functional areas and see the resulting change in the Navy's billet structure.

The CA Function Analysis Module serves two functions. First, it enables analysts to study shore manpower requirements by displaying billet authorizations by CA function area. The CA function codes, which exist in TFMMS, identify the type of work associated with every military and government civilian billet in the Navy's operating forces and shore infrastructure. The coding scheme defines a hierarchical structure of work functions. At the highest level, work functions are grouped into Infrastructure and Forces and Direct Support. These categories are segmented into functional groups and subgroups, which are further divided into functions. The Infrastructure category includes 13 functional groups, 43 subgroups, and 332 functions.[19]

The second function of this module is to define the shore structure component of a scenario in the Shore/Support Module. The user

19. In addition to work areas, the Navy allocates billets to a personnel overhead account known as the Individuals Account (IA). BAT identifies and treat IA billets as a separate category.

defines the scenario by selecting CA function areas. Just as in the other scenario modules, the user can define the scenario using the requirements as reflected in TFMMS, or he/she can increase or decrease these requirements by entering a scaling factor. For example, a user may want to include a 15-percent reduction in shore logistics services as the shore component of a scenario that reduces the number of surface ships. The Shore/Support Module will compute the effects of this decrease on IA billets, instructor billets, and health care service billets.

The CA Function Analysis Module is supported by four data sets:

- *Category* defines the highest level CA function categories (see table 42).
- *Group Titles* contains the descriptive title of each CA function group and maps each group to a category (see table 43).
- *Subgroup Titles* contains the descriptive title of each CA function subgroup (see table 44).
- *CA_Code* contains the descriptive title of each CA function and maps each function to a subgroup, group, and category (see tables 45 and 46).

Table 42. Structure of data table *Category*

Category	Category title
I	INFRASTRUCTURE
II	FORCES AND DIRECT SUPPORT

Table 43. Group titles

Group	Group title
1	FORCE MANAGEMENT AND GENERAL SUPPORT
2	COMMUNICATIONS, COMPUTING AND OTHER INFO. SERVICES
3	SCIENCE AND TECHNOLOGY (S&T) AND RESEARCH AND DEVELOPMENT (R&D) MANAGEMENT AND SUPPORT
4	SYSTEMS ACQUISITION, TEST AND EVALUATION, ENGINEERING AND CONTRACTING
5	LOGISTICS
6	PRODUCTS MANUFACTURED OR FABRICATED
7	INSTALLATION/FACILITY MANAGEMENT, FORCE PROTECTION, AND UTILITY PLANT OPERATION AND MAINTENANCE
8	ENVIRONMENTAL SECURITY AND NATURAL RESOURCE SERVICES
9	REAL PROPERTY PROJECT MANAGEMENT, MAINTENANCE AND CONSTRUCTION
10	CIVIL WORKS
11	PERSONNEL AND SOCIAL SERVICES
13	HEALTH SERVICES
14	COMMAND AND INTELLIGENCE
15	EXPEDITIONARY FORCE DEFENSE—OPERATING FORCES
16	HOMELAND DEFENSE—OPERATING FORCES
17	SPACE DEFENSE—OPERATING FORCES
18	CYBERSPACE OPERATIONS—OPERATING FORCES

Table 44. Subgroup titles

Subgroup	Subgroup title
1A	MANAGEMENT AND OPERATION OF THE DOD
1B	OPERATION PLANNING AND CONTROL
1C	MANPOWER MANAGEMENT
1D	SUPPORT EXTERNAL TO DOD
1E	LEGAL SERVICES
1F	PUBLIC AFFAIRS
1G	PROTOCOL OPERATIONS
1H	VISUAL INFORMATION
1J	LEGISLATIVE AFFAIRS
1K	HISTORICAL AFFAIRS
1L	ADMINISTRATIVE SUPPORT
1M	AUDITS AND INVESTIGATIONS
1N	FINANCIAL MANAGEMENT
2A	COMMUNICATIONS, COMPUTING & INFORMATION MAN HQTR
2B	COMMUNICATIONS SERVICES
2C	COMPUTING SERVICES
2D	INFORMATION OPERATION SERVICES
4A	SYSTEMS ACQUISITION

Table 44. Subgroup titles (continued)

Subgroup	Subgroup title
4B	TEST AND EVALUATION
4C	PROCUREMENT AND CONTRACTING
4D	ENGINEERING
5A	MANAGEMENT HEADQUARTERS - LOGISTICS
5B	MAINTENANCE
5C	SUPPLY OPERATIONS
5D	TRANSPORTATION
6A	PRODUCTS MANUFACTURED OR FABRICATED
7A	INSTALLATION/FACILITY MANAGEMENT
7B	SECURITY AT INSTALLATIONS/FACILITIES
7C	UTILITY PLANT OPERATION AND MAINTENANCE
8A	ENVIRONMENTAL SECURITY AND NATURAL RESOURCE SERVICES
9A	REAL PROPERTY PROGRAM AND PROJECT MANAGEMENT
9B	REAL PROPERTY MAINTENANCE, REPAIR AND CONSTRUCTION
10A	CIVIL WORKS
11A	CIVILIAN PERSONNEL SERVICES
11B	MILITARY PERSONNEL SERVICES
11C	PERSONNEL SOCIAL ACTION PROGRAMS
11D	SOCIAL SERVICES
12A	MILITARY EDUCATION AND TRAINING
12B	CIVILIAN EDUCATION AND TRAINING
12C	DEPENDENT EDUCATION
12D	TPPH
13A	HEALTH SERVICES
14A	OPERATIONAL COMMAND AND CONTROL
14B	INTELLIGENCE
15A	EXPEDITIONARY FORCE DEFENSE—OPERATING FORCES
16A	HOMELAND DEFENSE—OPERATING FORCES
17A	SPACE DEFENSE—OPERATING FORCES
18A	CYBERSPACE OPERATIONS—OPERATING FORCES

Table 45. Structure of data table *CA_Code*

Field	Description
Category	I - Infrastructure, II - Forces and Direct Support
Group	Commercial activity group
Sub-group	Commercial activity subgroup
CA_FUNC	Commercial activity function code
Title	CA Function title
Model Relationships	Flag that indicates if function is modeled in BAT

Table 46. CA_Code

Category	Group	Subgroup	CA_FUNC	Title
I	4	4B	A610	Management Headquarters - Test and Evaluation
I	4	4B	A620	Developmental and Operational Test and Evaluation
I	4	4B	A630	Management and Support to Test and Evaluation
I	4	4B	A699	Other Test and Evaluation Activities
I	11	11A	B710	Management Headquarters - Civilian Personnel
I	11	11A	B720	Civilian Personnel Operations
I	11	11B	B810	Management Headquarters - Military Personnel
I	11	11B	B820	Military Recruiting and Examining Operations
I	11	11B	B830	Military Personnel Operations
I	11	11C	B910	Management Headquarters - Personnel Social Action Programs
I	11	11C	B920	Personnel Social Action Program Operations
I	11	11C	B999	Other Personnel Activities
I	1	1N	C110	Management Headquarters - Financial Management
I	1	1N	C120	Management Headquarters - Advocacy
I	1	1N	C400	Budget Support
I	1	1N	C700	Finance/Accounting Services
I	1	1N	C999	Other Financial Management Activities
I	1	1N	C999E	Comptroller Function
I	8	8A	E110	Management Headquarters - Environmental Security
I	8	8A	E120	Environmental and Natural Resources Services
I	8	8A	E120E	Natural Resource Services
I	8	8A	E120F	Cultural Resource Services
I	8	8A	E120G	Environmental Services
I	8	8A	E220	Safety
I	8	8A	E220E	SOH Program Oversight and Management
I	8	8A	E220F	Program Management
I	8	8A	E220G	Technical Support
I	8	8A	E225	Occupational Health Services
I	8	8A	E230	Explosives Safety
I	8	8A	E250	Response to Hazardous Material Mishaps
I	8	8A	E999	Other Environmental Security Activities
I	4	4A	F110	Management Headquarters - Systems Acquisition
I	4	4A	F120	Systems Acquisition - Program Management
I	4	4A	F140	Technology Transfer & International Cooperative Program Management
I	4	4A	F150	Systems Acquisition – Demonstration and Development
I	4	4A	F160	Systems Acquisition - Other Program Support
I	4	4A	F199	Other Systems Acquisition Activities
I	4	4C	F310	Management Headquarters - Procurement and Contracting
I	4	4C	F320	Contract Administration and Operations
I	4	4C	F320E	Contracting Officer Representative (COR)
I	4	4C	F399	Other Procurement and Contracting Activities
I	4	4D	F510	Engineering Support at Maintenance Depots
I	4	4D	F520	All Other Engineering Support
I	4	4D	F520E	Ship Life Cycle Management
I	4	4D	F520F	Ship Construction Oversight

Table 46. CA_Code (continued)

Category	Group	Subgroup	CA_FUNC	Title
I	4	4D	F520G	In-service Engineering Services
I	11	11D	G006	Commissary Management
I	11	11D	G008	Commissary Operations
I	11	11D	G013	Military Exchange Operations
I	11	11D	G013E	Exchange Services Management
I	11	11D	G050	Management Headquarters - Community and Family Services
I	11	11D	G055	Morale, Welfare, and Recreation (MWR) Services
I	11	11D	G060	Family Center Services
I	11	11D	G065	Child Care and Youth Programs
I	11	11D	G080	Homeowners' Assistance Program
I	11	11D	G090	Employee Relocation Assistance Program
I	11	11D	G105	Recreational Library Operations
I	11	11D	G210	Postal Services
I	11	11D	G220	Military Bands
I	11	11D	G900	Chaplain Activities and Support Services
I	11	11D	G902	Casualty and Mortuary Affairs
I	11	11D	G910	Temporary Lodging Services
I	11	11D	G999	Other Social Services
I	13	13A	H010	Management Headquarters-Health Services
I	13	13A	H050	Hospital/Clinic Management
I	13	13A	H100	Medical Care
I	13	13A	H102	Surgical Care
I	13	13A	H106	Pathology Services
I	13	13A	H107	Radiology Services
I	13	13A	H108	Pharmacy Services
I	13	13A	H113	Dental Care
I	13	13A	H116	Veterinary Services
I	13	13A	H119	Preventive Medicine
I	13	13A	H125	Rehabilitation Services
I	13	13A	H127	Alcohol and Drug Rehabilitation
I	13	13A	H203	Ambulatory Care Services
I	13	13A	H250	Medical and Dental Devices Development
I	13	13A	H350	Hospital Food Services and Nutritional Care
I	13	13A	H450	Medical Records and Medical Transcription
I	13	13A	H650	Hospital Supplies and Equipment
I	13	13A	H710	Medical Transportation Services
I	13	13A	H999	Other Health Services
I	13	13A	H999E	Special Studies and Analysis
I	13	13A	H999F	Contact Representatives
I	13	13A	H999G	Professional Affairs
I	1	1M	I110	Management Headquarters-Audit
I	1	1M	I120	Audit Operations
I	1	1M	I510	Personnel Security (Clearances and Background Investigations)
I	1	1M	I520	Criminal and Administrative Investigative Services
I	1	1M	I530	Industrial Security

Table 46. CA_Code (continued)

Category	Group	Subgroup	CA_FUNC	Title
I	1	1M	I999	Other Audit and Investigative Activities
I	5	5B	J410	Organizational & Intermediate Repair & Maintenance Management
I	5	5B	J501	Aircraft
I	5	5B	J502	Aircraft Engines
I	5	5B	J503	Missiles
I	5	5B	J504	Vessels
I	5	5B	J505	Combat Vehicles
I	5	5B	J506	Non-Combat Vehicles and Equipment
I	5	5B	J507	Electronic and Communications Equipment
I	5	5B	J511	Special Equipment
I	5	5B	J511E	Airfield Facilities Equipment.
I	5	5B	J511F	Airfield Ground Electronics
I	5	5B	J518	Support Equipment
I	5	5B	J519	Industrial Plant Equipment
I	5	5B	J520	Test, Measurement & Diagnostic Equipment (TMDE)
I	5	5B	J550	Software Support for Embedded and Mission Systems
I	5	5B	J555	Tactical Automatic Data Processing Equipment (ADPE)
I	5	5B	J570	Armament and Ordnance
I	5	5B	J575	Munitions
I	5	5B	J600	Metal and Other Containers, Textiles, Tents and Tarpaulins
I	5	5B	J700	Portable Troop Support Equipment
I	5	5B	J750	Portable Field Medical and Dental Equipment
I	5	5B	J999	Organizational and Intermediate Repair & Maintenance of Other Equipment
I	5	5B	K410	Depot Management
I	5	5B	K531	Aircraft
I	5	5B	K532	Aircraft Engines
I	5	5B	K533	Missiles
I	5	5B	K534	Vessels
I	5	5B	K535	Combat Vehicles
I	5	5B	K536	Non-Combat Vehicles and Equipment
I	5	5B	K537	Electronic and Communications Equipment
I	5	5B	K539	Special Equipment
I	5	5B	K541	Industrial Plant Equipment
I	5	5B	K546	Test Measurement & Diagnostic Equipment (TMDE)
I	5	5B	K549	Support Equipment
I	5	5B	K550	Software Support for Embedded and Mission Systems
I	5	5B	K555	Tactical Automatic Data Processing Equipment (ADPE)
I	5	5B	K570	Armament and Ordnance
I	5	5B	K575	Munitions
I	5	5B	K600	Metal and Other Containers, Textiles, Tents, and Tarpaulins
I	5	5B	K700	Portable Troop Support Equipment
I	5	5B	K750	Portable Field Medical & Dental Equipment
I	5	5B	K999	Depot Repair and Maintenance of Other Equipment
II	14	14A	M120	Combatant Headquarters-Combatant Commander Command Authority
II	14	14A	M145	Combatant Headquarters-Military Department Command Authority

Table 46. CA_Code (continued)

Category	Group	Subgroup	CA_FUNC	Title
II	14	14A	M150	Support to the Combatant Commanders – Information Sharing Systems
II	14	14A	M150E	Meteorological/ Oceanographic Support
II	14	14A	M160	Combatant Headquarters - Information Operations
II	14	14A	M199	Other Operational Command and Control Activities
II	14	14B	M301	Management Headquarters - Intelligence
II	14	14B	M302	Intelligence Policy and Coordination
II	14	14B	M310	Counterintelligence
II	14	14B	M311	Human Intelligence (HUMINT)
II	14	14B	M312	Imagery Intelligence (IMINT)-DoD
II	14	14B	M313	Signals Intelligence (SIGINT)
II	14	14B	M316	Geospatial Intelligence
II	14	14B	M318	Geospatial Intelligence Acquisition and Processing
II	14	14B	M320	Open Source Intelligence (OSINT) Collection/Processing
II	14	14B	M322	Language Exploitation
II	14	14B	M324	Multidisciplinary Collection and Processing
II	14	14B	M326	Intelligence Communications and Filtering
II	14	14B	M328	All Source Analysis
II	14	14B	M330	Intelligence Production Integration and Analytic Tools
II	14	14B	M334	Intelligence Requirements Management and Tasking
II	14	14B	M399	Other Intelligence Activities
II	15	15A	M415	Combat
II	15	15A	M480	Combat Support
II	15	15A	M510	Combat Service Support
II	16	16A	M610	Homeland Defense Operations
II	17	17A	M810	Military Space Operations
II	18	18A	M910	Computer network attack (CNA) & Computer Network Exploitation (CNE)
II	18	18A	M930	Information Assurance/Computer Network Defense (IA-CND)
I	5	5A	P110	Management Headquarters - Logistics
I	5	5A	P119	Other Logistics Activities
I	5	5B	P120	Management Headquarters - Maintenance
I	10	10A	Q120	Management Headquarters-Civil Works
I	10	10A	Q220	Water Regulatory Oversight and Management
I	10	10A	Q240	Natural Resources Oversight and Management
I	10	10A	Q260	Civil Works Planning Production and Management
I	10	10A	Q420	Bank Stabilization
I	10	10A	Q440	Maintenance of Open Waterways for Navigation
I	10	10A	Q460	Maintenance of Jetties and Breakwaters
I	10	10A	Q520	Operation and Maintenance of Locks and Bridges
I	10	10A	Q540	Operation and Maintenance of Dams
I	10	10A	Q560	Operation and Maintenance of Hydropower Facilities
I	10	10A	Q580	Operation and Maintenance of the Washington Aqueduct
I	10	10A	Q620	Operation and Maintenance of Recreation Areas
I	10	10A	Q999	Other Civil Works Activities
I	3	3A	R110	Management Headquarters - Research and Development
I	3	3A	R120	Science and Technology

Table 46. CA_Code (continued)

Category	Group	Subgroup	CA_FUNC	Title
I	3	3A	R140	Management and Support to Research and Development
I	3	3A	R999	Other S&T and R&D Management and Support Activities
I	7	7A	S100	Management Headquarters - Installations
I	7	7A	S200	Installation, Base or Facility Management
I	7	7A	S210	Building Management
I	7	7A	S310	Housing Management
I	7	7A	S310E	Housing Management (Berthing BOQ/BEQ)
I	7	7A	S310F	Family Housing Management
I	7	7A	S410	Custodial Services
I	7	7A	S420	Collection and Disposal of Trash and Other Refuse
I	7	7A	S430	Collection and Disposal of Hazardous Material (HAZMAT)
I	7	7A	S435	Pest Management
I	7	7A	S440	Fire Prevention and Protection
I	7	7A	S450	Laundry and Dry Cleaning Operations
I	7	7A	S499	Other Building and Housing Management Services
I	7	7B	S500	Management of Security Operations at Installations/Facilities
I	7	7B	S510	Security Operations at Installations/Facilities
I	7	7B	S520	Support Services to Security Operations at Installations/Facilities
I	7	7B	S520E	Primary Support Services to Security Operations at Installations/Facilities
I	7	7B	S520F	Secondary Support Services to Security Operations at Installations/ Facilities
I	7	7B	S540	Information Security
I	7	7B	S560	Protective Services Operations
I	7	7B	S719	Confinement Facility Operations
I	7	7B	S720	Prison Operations
I	7	7B	S722	Detention of Enemy Prisoners of War, Retained Personnel, Civilian Internees and other Detainees
I	7	7B	S724	Other Security Operations
I	7	7B	S724E	Emergency Operations Centers
I	7	7C	S725	Electrical Plant and Distribution Systems Operation and Maintenance
I	7	7C	S726	Heating Plant and Distribution Systems Operation and Maintenance
I	7	7C	S727	Water Plant and Distribution Systems Operation and Maintenance
I	7	7C	S728	Sewage and Waste Plant and Distribution Systems Operation and Maintenance
I	7	7C	S729	A/C & Cold Storage Plant and Distribution Systems Op. and Maintenance
I	7	7C	S730	Incinerator Plant and Sanitary Fill Operations
I	7	7C	S799	Other Utility Plant and Distribution Systems Operation and Maintenance
I	5	5C	T101	Management Headquarters - Supply
I	5	5C	T110	Retail Supply Operations
I	5	5C	T110E	Consolidated Mail Facility/Fleet Mail Carriers
I	5	5C	T110F	Hazardous Material (HM) Management (HM)
I	5	5C	T120	Wholesale/Depot Supply Operations
I	5	5C	T120E	Logistics Support Center Operations
I	5	5C	T130	Storage and Warehousing
I	5	5C	T140	Supply Cataloging
I	5	5C	T150	Warehousing and Distribution of Publications
I	5	5C	T160	Bulk Liquid Storage

Table 46. CA_Code (continued)

Category	Group	Subgroup	CA_FUNC	Title
I	5	5C	T165	Distribution of Petroleum Oil and Lubricant Products
I	5	5C	T167	Distribution of Liquid, Gaseous and Chemical Products
I	5	5C	T175	Troop Subsistence
I	5	5C	T177	Food Supply
I	5	5C	T180	Military Clothing
I	5	5C	T190	Preparation, Demilitarization and Disposal of Excess and Surplus Inventory
I	5	5C	T199	Other Supply Activities
I	5	5C	T199E	Ordnance Supply
I	5	5D	T701	Management Headquarters - Transportation
I	5	5D	T710	Traffic/Transportation Management Services
I	5	5D	T710E	MSC Operations
I	5	5D	T800	Ocean Terminal Operations
I	5	5D	T810	Air Transportation Services
I	5	5D	T811	Water Transportation Services
I	5	5D	T812	Rail Transportation Services
I	5	5D	T824	Motor Vehicle Transportation Services
I	5	5D	T826	Air Traffic Control
I	5	5D	T899	Other Transportation Services
I	12	12A	U001	Management Headquarters-Military Education and Training
I	12	12A	U050	Military Institutional Education and Training Management
I	12	12A	U060	International Security Program
I	12	12A	U100	Recruit Training
I	12	12A	U150	Multiple Category Training
I	12	12A	U200	Officer-Acquisition (Pre-Commissioning) Training
I	12	12A	U300	Specialized Skill Training
I	12	12A	U400	Flight Training
I	12	12A	U510	Professional Military Education
I	12	12A	U520	Graduate Education (Fully Funded, Full Time)
I	12	12A	U530	Other Full-Time Education Programs
I	12	12A	U540	Off-Duty and Voluntary Education Programs
I	12	12A	U550	Training Development and Support for Military Education & Training
I	12	12A	U599	Other Military Education and Training Activities
I	12	12A	U599E	Bombing Ranges
I	12	12B	U605	Management Headquarters-Civilian Education and Training
I	12	12B	U620	Management of Civilian Institutional Training, Education & Development
I	12	12B	U630	Acquisition Training, Education, and Development
I	12	12B	U640	Civil Works Training, Education, and Development
I	12	12B	U650	Intelligence Training, Education, and Development
I	12	12B	U660	Medical Training, Education, and Development
I	12	12B	U699	Other Civilian Training, Education, and Development
I	12	12C	U710	Management Headquarters-Dependent Education
I	12	12C	U720	Dependent Education Field Management
I	12	12C	U760	Dependent Education - Teacher Instruction
I	12	12C	U770	Dependent Education - Substitute Instruction
I	12	12C	U780	Dependent Education - Aides for Instruction

Table 46. CA_Code (continued)

Category	Group	Subgroup	CA_FUNC	Title
I	12	12C	U799	Other Dependent Education Activities
I	12	12D	UXXX	Transients, Prisoners, Patients, Holdees (TPPH), Students and Trainees
I	2	2A	W100	Management Headquarters - Communications, Computing & Information
I	2	2A	W100E	Management Headquarters – IM/IT Strategic Planning
I	2	2A	W100F	Management Headquarters – IM/IT Workforce Planning
I	2	2A	W100G	Management Headquarters – IM/IT Capital Planning
I	2	2A	W100H	Management Headquarters – Performance Assessments
I	2	2A	W100J	Management Headquarters – Business Process Reengineering
I	2	2A	W100K	Management Headquarters – IT Risk Management
I	2	2A	W100L	Management Headquarters – Knowledge Management
I	2	2A	W100M	Management Headquarters – Information Architecture/ Infrastructures
I	2	2A	W100N	Management Headquarters – IM/IT Project Management
I	2	2A	W100P	Management Headquarters – eBusiness Innovation
I	2	2A	W100Q	Management Headquarters – Other IM/IT Functions
I	2	2B	W210	Telephone Systems
I	2	2B	W220	Telecommunication Centers
I	2	2B	W299	Other Communications Systems
I	2	2C	W310	Computing Services and/or Data Base Management
I	2	2C	W310E	End-User Support
I	2	2C	W310F	Software and Application Development
I	2	2C	W310G	Network Systems
I	2	2C	W310H	Systems Administration
I	2	2C	W310J	Systems Analysis
I	2	2C	W310K	Data Base Management
I	2	2C	W310L	Web Site Development and Maintenance
I	2	2C	W310M	IM/IT Strategic Planning
I	2	2C	W310N	IM/IT Workforce Planning
I	2	2C	W310P	IM/IT Capital Planning
I	2	2C	W310Q	Performance Assessments
I	2	2C	W310R	Business Process Reengineering
I	2	2C	W310S	IT Risk Management
I	2	2C	W310T	Knowledge Management
I	2	2C	W310U	Information Architecture/ Infrastructures
I	2	2C	W310V	IM/IT Project Management
I	2	2C	W310W	eBusiness Innovation
I	2	2C	W399	Other Computing Services
I	2	2D	W410	Information Assurance
I	2	2D	W430	Mapping and Charting
I	2	2D	W440	Meteorological & Geophysical Services
I	2	2D	W499	Other Information Operation Services
I	6	6A	X931	Ordnance
I	6	6A	X932	Products Made from Fabric or Similar Materials
I	6	6A	X933	Container Products and Related Items
I	6	6A	X938	Communications and Electronic Products
I	6	6A	X939	Construction Products

Table 46. CA_Code (continued)

Category	Group	Subgroup	CA_FUNC	Title
I	6	6A	X944	Machined Parts
I	6	6A	X999	Other Products Manufactured and Fabricated
I	1	1A	Y105	Management Headquarters - Defense Direction and Policy Integration
I	1	1A	Y115	Management Headquarters - Joint Staff Direction of the Armed Forces
I	1	1A	Y199	Other Force Management and General Support Activities
I	1	1B	Y210	Management Headquarters - Operation Planning and Control
I	1	1B	Y215	Operation Planning and Control
I	1	1B	Y217	Combat Development Evaluations and Experimentation
I	1	1B	Y220	National Mobilization and Emergency Preparedness Mgmt.
I	1	1C	Y240	Management Headquarters - Manpower Management
I	1	1C	Y245	Manpower Management Operations
I	1	1D	Y310	Management Headquarters-Foreign Military Sales and Security Assistance
I	1	1D	Y315	Foreign Military Sales and Security Assistance Program Management
I	1	1D	Y320	Support Provided Outside the DoD
I	1	1E	Y405	Management Headquarters-Legal Services
I	1	1E	Y415	Legal Services and Support
I	1	1F	Y501	Management Headquarters-Public Affairs
I	1	1F	Y515	Public Affairs Program Activities and Operations
I	1	1G	Y525	Protocol Operations
I	1	1G	Y527	Other Protocol Activities
I	1	1H	Y560	Management Headquarters-Visual Information
I	1	1H	Y570	Visual Information Program Activities and Operations
I	1	1J	Y610	Management Headquarters-Legislative Affairs
I	1	1J	Y620	Legislative Affairs
I	1	1J	Y620E	Legislative Affairs – Healthcare
I	1	1K	Y710	Management Headquarters-Historical Affairs
I	1	1K	Y720	Historical or Heraldry Services
I	1	1K	Y730	Museum Operations
I	1	1L	Y810	Management Headquarters - Administrative Support & Federal Compliance
I	1	1L	Y815	Federal Compliance of Administrative Programs
I	1	1L	Y820	Administrative Management and Correspondence Services
I	1	1L	Y830	Documentation Services
I	1	1L	Y840	Directives and Records Management Services
I	1	1L	Y850	Microfilming and Library Services
I	1	1L	Y860	Printing and Reproduction Services
I	1	1L	Y880	Document Automation and Production Services
I	1	1L	Y899	Other Administrative Support Activities
I	9	9A	Z101	Corps of Engineers Program and Project Management
I	9	9A	Z110	Management of Major Construction of Real Property
I	9	9A	Z120	Real Estate/Real Property Acquisition
I	9	9A	Z135	Title, Outgranting and Disposal of Real Estate/Real Property-National Projects
I	9	9A	Z138	Title, Outgranting and Disposal of Real Estate/Real Property-Local Projects
I	9	9A	Z145	Architect-Engineering-National Projects
I	9	9A	Z148	Architect-Engineering-Local Projects
I	9	9A	Z199	Other Real Prop. Program & Project Management Activities

Table 46. CA_Code (continued)

Category	Group	Subgroup	CA_FUNC	Title
I	9	9B	Z991	Minor Construction, Maintenance & Repair of Family Housing and Structures
I	9	9B	Z992	Minor Constr. M&R of Buildings & Structures Other Than Family Housing
I	9	9B	Z993	Maint. and Repair of Grounds and Surfaced Areas
I	9	9B	Z997	Maint. and Repair of Railroad Facilities
I	9	9B	Z998	Maint. and Repair of Waterways & Waterfront Facilities
I	9	9B	Z999	Maint., Repair, & Minor Construction of Other Real Property

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List of tables

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