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Identifying Contributions of DOD's Civilian Workforce to Readiness

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Abstract

DOD's total force comprises active and reserve military personnel, government civilians, and contracted services. Each of these types of manpower brings unique and, in some areas, comparable capabilities to execute the work required to support DOD's mission. Fully understanding the scope and magnitude of the contributions of each manpower type to the readiness and lethality of the warfighter is a necessary prerequisite for optimizing the Total Force from an objective, data-driven perspective. This study assists that endeavor by providing visibility into the contributions and roles of DOD's government civilian workforce as enablers of warfighter readiness, lethality, and capability. It provides this visibility through two efforts. First, it develops and applies an analytical construct to identify and categorize, at a high level, how the civilian workforce contributes to DOD's mission. Second, it examines a specific sector of the civilian workforce (aviation depot maintainers) and develops quantitative relationships between the size of that workforce and aircraft readiness metrics.

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Cover image credit: 040213-N-6497N-050 Puget Sound Naval Shipyard, Wash. (Feb. 13, 2004) Puget Sound Naval Shipyard and Intermediate Maintenance Facility (IMF) Commander, Captain Clarke Orzalli, addresses the civilian and military workforce at the Submarine Base Bangor site on Navy-wide transformation initiatives for ship maintenance. IMF performs intermediate and depot level maintenance on the Bangor-based Trident Missile submarine fleet as well as surface ships and aircraft carriers at Bangor, Everett, and Bremerton, Wash., facilities. U.S. Navy photo by Brian Nokell.

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Executive Summary

The Department of Defense's (DOD's) total force comprises active and reserve military personnel, government civilians, and contracted services. Each of these types of manpower brings unique and, in some areas, comparable capabilities to execute the work required to support DOD's mission. Optimizing the workforce "mix" is an ongoing process that has generated a great deal of discussion over the years, especially as leadership guidance has sometimes favored one type over the others.

In assessing the composition of DOD's total force, it is important to understand and recognize the strategic value and contributions of all parts of the department's workforce. Identifying and, where possible, measuring these contributions using analytically based methods will provide the foundation for objective, data-driven assessments. Without this foundation, the department risks workforce decisions that are influenced by opinions and potential misperceptions.

This study builds part of that foundation by providing visibility into the contributions and roles of DOD's government civilian workforce as enablers of warfighter readiness, lethality, and capability. Because of its size and distribution and the many types of work that these civilians perform, a comprehensive, quantitative analysis of all sectors of this workforce was well beyond the scope of this study. As a result, we structure our work along two lines of effort. The first was to examine the entire civilian workforce at a high level with the goals of identifying the areas in which civilians contribute to DOD's mission and determining how many civilians contribute to each area. The second line of effort was to conduct a more in-depth analysis of a specific sector of this workforce to develop quantitative relationships between its size and key military readiness metrics.

How big is DOD's civilian workforce?

Before investigating the contributions of DOD's government civilian workforce, we provide some summary statistics on its size and distribution. In September 2018, this workforce numbered just over 691,000. The Army employs the most civilians, followed by the Department of the Navy (DON), the Air Force, and the DOD agencies. The size of this workforce has changed in the past decade. Overall, it grew by just over 10 percent, but not uniformly across the services. The DON and DOD agencies experienced the largest growth (each over 20 percent). The Air Force was next with a 13 percent increase, whereas the Army's civilian

workforce decreased slightly (by 1.5 percent) during this time. Most of the growth occurred from 2008 to 2011 during the buildup of military forces. In fact, the size of the workforce peaked in 2011 and has since declined slightly.

Another means of measuring the size of the civilian workforce is by comparing it to the size of the military force. We do this using the ratio of civilian to military (active and reserve) personnel. Across the department, this ratio has increased by 17.2 percent over the past 10 years. The DON, which had a ratio of one civilian for every three military personnel in 2018, experienced the largest increase at 24.7 percent. The Air Force was next with a 13.4 percent increase, followed by the Army with a 8.5 percent increase. In the case of the DON, this ratio increased because the size of its civilian workforce increased. The same can be said for the Air Force. The increase in the Army's ratio of civilian to military personnel, however, was because of a reduction in its military personnel.

Identifying contributions across the entire civilian workforce

Identifying all the contributions of DOD's entire civilian workforce is a challenging undertaking. The analysis needs to be at a sufficient level of detail to accurately determine the work that civilians perform and to relate this work to DOD's mission, but at a high enough level to allow us to examine the entire workforce within the scope of this study. To meet these conditions, we developed and applied an analytical construct to identify and categorize the contributions of the civilian workforces in each of the three military departments.

Analytic construct

Whereas past reviews of DOD's civilian workforce have focused on the individual jobs that civilians perform—which are typically aggregated by occupational groups—our construct is different. Instead of identifying contributions based on occupation, we identify them by the missions, functions, and tasks (MFTs) of the organizations in which they work. Because these MFTs are more closely aligned with DOD's mission, this enables a more intuitive connection between the work that civilians perform and DOD's mission.

Our construct consists of four phases. Phase 1 entailed defining the various ways that civilians contribute to DOD's mission (we use the term *contribution categories*). At the highest level, it differentiates between two areas of contributions:

- Conducting (in a non-combat role) and/or directly supporting military or other operations
- Contributing to force readiness

Each of these contribution areas includes multiple subareas. Conducting and/or directly supporting military or other operations has two: military operations and other public (nonmilitary) operations. Contributing to force readiness has three subareas: immediate- and near-term readiness, middle-term readiness, and long-term readiness.

Phase 2 involved developing a set of rules for aligning activities' missions and work functions to the civilian contribution areas defined in Phase 1. Phase 3 consisted of grouping the civilian workforce, at the activity level, by the primary missions/functions the activity performs. Phase 4 entailed using the rules (from Phase 2) to align each activity group (from Phase 3) to the contribution areas (from Phase 1).

Summary of results

Using data in the Defense Civilian Personnel Database (DCPD), we examined the civilian workforces of all three military departments. In 2018, this workforce was spread over 11,600 activities. About half of these activities employed 10 or more civilians. We focused our investigation on these activities, grouping them by their primary functions. We then aligned these activity groups to the contribution areas in our construct. We see the value of analyzing the workforce using this construct as twofold.

First, it shows the wide variety of functions that civilians across DOD support. Although our results reveal that most civilians work at activities that directly support force sustainment, logistics, and maintenance functions, significant numbers work at activities that conduct or directly support other key functions such as training and education, force security, medical services, research and development, communications, and cyberspace operations.

Second, in aligning these functions to our contribution areas, we see that the civilian workforce supports nearly all aspects of DOD's mission. Our results show that most civilians work at activities whose primary functions directly support immediate- and near-term force readiness. Middle-term readiness is the second most supported area. This is not surprising given that most shore support activities (i.e., where most civilians work) focus on the immediate- and near-term readiness of the operating force.

What is a bit surprising is the number of civilians who work at activities that either directly or indirectly participate in conducting military (noncombat functions, that is) and nonmilitary operations. We aligned activities that employ over 150,000 civilians to these contribution areas. Although we identified most of these contributions as indirect versus direct, this still represents a significant contribution.

One important lesson we learned in applying this construct using civilian personnel data at the activity level is that the ability to accurately identify which civilians contribute to which functions depends, in part, on the granularity of the service's organizational structure. A

structure such as the Air Force's that consists of many small, single-function activities gives rise to more accurate results than a structure like the Navy's that has many large organizations that perform multiple and, in some cases, dissimilar functions. One option to address this issue would be to divide these larger organizations into smaller components such as departments or divisions. However, this would require data beyond those in DCDP.

Quantifying relationships between the civilian workforce and readiness

Our second line of effort was to show, quantitatively, relationships between a specific sector of the civilian workforce and readiness metrics in the operational force.[1] We addressed this through a case study that quantifies the readiness produced by civilians working in depot-level maintenance in the Naval aviation depot-level repairable (AVDLR) supply chain. The case study presents a set of linked empirical models to help identify the contributions of civilian depot workers to readiness and relationships between resources and outcomes in the AVDLR supply chain. These linked models allow us to estimate and compare the relative costs and benefits of applying resources that increase the civilian workforce within the AVDLR supply chain. Applying these models to the F/A-18 aircraft group, we find that additional investments in civilian labor are more than twice as efficient in increasing the aircraft mission capable (MC) rate as purchasing new aircraft.

This work represents the type of analyses that are required to properly assess the size and composition of the total force. However, this work is complex and requires comprehensive, detailed data to analyze supply chain operations and to compute readiness metrics. Outside of the maintenance world, the level of data needed to conduct similar types of analyses may not be readily available.

Recommendations

This study does not determine DOD's optimal workforce mix, nor does it analyze the cost-effectiveness of civilians performing certain types of work relative to military personnel or contractors. Rather, it attempts to identify and, where possible, measure the contributions of the current government civilian workforce to DOD's mission. Measuring these contributions,

[1] Another benefit of quantifying the readiness contributions of any workforce—civilians included—is to help make strategic, analytically informed decisions about short-term and longer term investments in the workforce (labor) vice short-term and longer term investments in such things as additional aircraft (capital).

whether at a high level or a more granular level, through sound analytical processes is a critical first step in answering these questions and avoiding actions based on unfounded perceptions.

Given these study objectives, we offer the following recommendations for using this work to help address issues related to the size and mix of DOD's total force:

- Use these findings to assess whether the civilian workforce is positioned to achieve leadership's goals. DOD leadership has issued a directive to maximize warfighting lethality and readiness and to increase the capability and capacity of our military force. We believe the results of our work can be used to assess whether the distribution and contributions of this workforce align with these goals.
- Compare civilian contributions with those of the military and contractor workforces.[2] This work examined only the civilian workforce. The next logical step would be to use this construct to identify contributions of the other manpower types: military personnel and contractors. An investigation of the military workforce should focus on military personnel in nonoperational commands. Results should be used to compare the distribution of personnel by function and contribution area.
- Track changes in the contributions of the civilian workforce over time. Another beneficial application of this construct would be to analyze civilian contributions over time. Results would show if the distribution of civilians by contribution area is changing and, if so, in which areas and functions. In addition, results from this construct would show if these changes align with changes in the contributions of the military or contractor workforce.
- Develop quantitative relationships for other sectors of the civilian workforce. Although the work we presented addresses only a small portion of the civilian workforce, the methods used to map individual maintainer contributions to readiness are applicable to other sectors in the department's supply/maintenance chain.

[2] The lack of quality data may present a challenge in analyzing the contractor workforce.

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Introduction

Background

DOD's total force comprises active and reserve military personnel, government civilians, and contracted services. Each of these types of manpower brings unique and, in some areas, comparable capabilities to execute the work required to support DOD's mission. Optimizing the workforce "mix" is an ongoing process that has generated a great deal of discussion over the years, especially because leadership guidance has sometimes favored one type over the others

In assessing the composition of DOD's total force, it is important to understand and recognize the strategic value and contributions of all parts of the department's workforce. Identifying and, where possible, measuring these contributions using analytically based methods provide the foundation for an objective, data-driven assessment. Without this foundation, the department risks workforce decisions that may be influenced by opinions and potential misperceptions.

Study issues

This study seeks to assist that endeavor by providing visibility into the contributions and roles of DOD's civilian workforce as enablers of warfighter readiness, lethality, and capability. Given the large size and wide distribution of this workforce and the many types of work that civilians perform, we focused our efforts on two tasks:

1. Develop a construct that defines, at a high level, the major civilian contribution areas to warfighting readiness, capability and capacity, and apply this construct to DOD's civilian workforce.
2. Develop, for a specific sector of the civilian workforce, quantitative relationships between the size and composition of that workforce and readiness metrics. Our efforts concentrate on the workforce that conducts depot-level maintenance and repair of aircraft.

Organization of report

The rest of this report contains five sections and four appendixes. The first section examines the size and composition of the civilian workforce, as well as how it is distributed across the services and DOD agencies. The next section describes our construct for analyzing, at a high level, the contributions of this workforce. The third section presents the results of applying this construct to identify contributions of the civilian workforce across the three military departments: Air Force, Army, and Department of the Navy. The fourth section presents a case study that entails a more quantitative analysis of the impact of the civilian workforce on operational readiness metrics. The last section reviews our key findings and recommendations. The appendixes provide amplifying information on each department's civilian workforce and on the analysis underlying the case study.

DOD's Civilian Workforce

Before investigating the contributions of DOD's civilian workforce to military readiness, we first examined the size and composition of this workforce, as well as how it is distributed across the services and DOD agencies and across the major commands/agencies within each service. Our primary data source for this investigation is the Defense Civilian Personnel Database (DCPD). The Defense Manpower Data Center (DMDC) maintains this database, which contains civilian personnel data on appropriated funded civilians.[3,4]

How many civilians does DOD employ, and has the level changed over the past decade?

In September 2018, DOD's civilian workforce numbered just over 690,500. It was spread across the three services and DOD agencies as shown in Table 1. The Department of the Navy (DON) includes civilians employed by the Marine Corps.[5] The totals show that the Army employs the most civilians, followed by the DON, the Air Force, and the DOD agencies.

Table 1. Size of the civilian workforce in each service and across all DOD agencies

Service	Number of civilians in September 2018
Air Force	164,221
Army	234,145
DON	204,815
DOD	87,337
Total	690,518

Source: DCPD data.

[3] We received two DCPD data files from DMDC: one contained data from 2008 to April 2017 and the other contained data from May 2017 to September 2018. Although these data sets differed slightly in their structure and data fields, these differences did not affect our analysis.

[4] DMDC acknowledges that DCPD may not capture all the civilians who work in the intelligence arena.

[5] The Marine Corps was treated as a separate service in DCPD data until 2018, when it was included in the DON.

Table 2 shows how the size of the civilian workforce has changed in the past decade. Overall, it grew by just over 10 percent, but not uniformly across the services. The DON and DOD agencies experienced the largest growth (each over 20 percent). The Air Force was next with a 13 percent increase, whereas the Army's civilian workforce decreased slightly (by 1.5 percent) during this time. Most of the growth occurred from 2009 to 2011 and coincided with the buildup of military personnel. In fact, since peaking in 2011, the civilian workforce (along with the military force) has declined slightly. These more recent civilian declines are limited to the Army (decrease of 30,000) and the Air Force (decrease of 4,000).

Table 2. Civilian workforce levels by service (in thousands)

Service	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Air Force	145	152	162	168	163	160	157	159	162	161	164
Army	238	259	268	264	258	243	236	233	233	231	234
DON	171	179	187	185	184	183	181	192	199	190	205
DOD	71	76	80	84	85	84	88	88	86	89	87
Total	624	666	698	702	689	670	662	672	679	672	691

Source: DCPD data.
Note: Appropriated funded civilians.

Another means of measuring the size of the civilian workforce is by comparing it to the size of the military force. We do this using the ratio of civilian to military personnel. We include both active and reserve personnel in our military totals.

Table 3 shows the yearly ratios from 2008 to 2018 for each service and for DOD as a whole.[6] The ratios for all DOD include the civilians at the DOD agencies. Across the department, the ratio has increased by 17.2 percent over this period. The Navy, which had a ratio of one civilian for every three military personnel in 2018, experienced the largest increase at 24.7 percent. The Air Force was next with a 13.4 percent increase, followed by the Army with an 8.5 percent increase. Changes in this ratio can be caused by changes in the civilian level, changes in the military level, or changes in both. In the case of the Navy, nearly all of its ratio increase was from increases in civilian levels. The same can be said for the Air Force. The increase in the Army's ratio of civilian to military personnel, however, was because of a reduction in military personnel.

[6] The ratio is not applicable to DOD agencies because they do not have military personnel (although military personnel from the service may be assigned to these activities).

Table 3. Ratio of civilian to military personnel

Service	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Air Force	0.29	0.30	0.32	0.33	0.32	0.32	0.32	0.33	0.33	0.32	0.33
Army	0.22	0.23	0.24	0.23	0.23	0.22	0.22	0.22	0.23	0.23	0.23
DON	0.27	0.28	0.29	0.29	0.30	0.29	0.30	0.32	0.33	0.31	0.33
All DOD	0.28	0.29	0.31	0.31	0.31	0.30	0.31	0.32	0.32	0.32	0.33

Source: DCPD and DMDC reports on active duty and reserve military endstrength (DMDC website).

Which commands and agencies employ the most civilians?

We've looked at the total number of government civilians in each service and the total across all DOD agencies. Here, we look at where these civilians work within each service and among the DOD agencies. The DCPD maps each civilian employee to the agency and, where applicable, the administrative subdivision (i.e., subelement) of the agency in which they are employed. Table 4 shows, by service, the agencies that employed the most civilians in 2018. In the Air Force, over one-third of all civilians work at the Air Force Materiel Command. In the Army, the Army Medical Command employs the most civilians, followed by the Army Corps of Engineers and Army National Guard Units. In DON, the two systems commands (Naval Sea Systems Command and Naval Air Systems Command) employ the most civilians (more than 25 percent), followed closely by the two major fleet commands (US Atlantic Fleet Command[7] and US Pacific Fleet Command). The largest DOD agency, in terms of civilians, is the Defense Logistics Agency.

Table 4. Civilian personnel levels in 2018 by service and agency

Service or component	Agency	Number of civilians
Air Force		
	Air Force Materiel Command	59,318
	Air National Guard Units (Title 32)	24,945
	Air Education and Training Command	13,413
	Headquarters, Air Force Reserve	11,521
	Air Combat Command	10,976
	Air Mobility Command	7,186
	Space Command	5,616

[7] US Atlantic Fleet Command is now called US Fleet Forces Command.

Service or component	Agency	Number of civilians
	All others	31,246
	Total	164,221
Army		
	Army Medical Command	38,229
	Army Corps of Engineers	30,613
	Army National Guard Units	30,003
	Army Installation Management Command	21,553
	Army Research, Development and Engineering Command	10,927
	US Army Training and Doctrine Command	10,341
	US Army Reserve Command	8,754
	All others	83,725
	Total	234,145
DON		
	Naval Sea Systems Command	30,534
	Naval Air Systems Command	29,642
	US Atlantic Fleet, Commander in Chief	26,625
	US Pacific Fleet, Commander in Chief	21,938
	Naval Facilities Engineering Command	15,347
	US Marine Corps	15,232
	Naval Medical Command	10,630
	All others	54,867
	Total	204,815
DOD		
	Defense Logistics Agency	22,816
	Defense Finance and Accounting Service	11,830
	Defense Contract Management Agency	11,033
	Defense Commissary Agency	6,429
	Defense Information Systems Agency	5,474
	Defense Contract Audit Agency	4,537
	Military Treatment Facilities under DHA	3,816
	All others	21,402
	Total	87,337

Source: DCPD data.

What type of work do these civilians do?

We now turn to the type of work that these civilians perform. To examine the occupational mix of this workforce, we used two fields in the DCPD that provide information on each civilian's occupation: Civilian Occupation Code and DOD Occupation Code.[8]

Table 5 shows the largest occupation groups across all of DOD based on the civilian occupation code. These eight groups account for more than two-thirds of DOD's civilian workforce. The two largest groups—the general administrative, clerical, and office services group and the engineering and architecture group—represent 30 percent of the total.

Table 5. Occupation groups with most civilians across all DOD

Civilian occupation code and title	2018 Civilians	Percentage
03: General administrative, clerical, and office services group	131,351	17.3%
08: Engineering and architecture group	96,849	12.7%
11: Business and industry group	52,978	7.0%
05: Accounting and budget group	42,934	5.6%
06: Medical, hospital, dental, and public health group	42,497	5.6%
22: Information management group	39,503	5.2%
00: Miscellaneous occupations group	39,312	5.2%
17: Education group	31,148	4.1%
02: Human resources management group	23,118	3.0%
20: Supply group	21,064	2.8%

Source: DCPD data.

In Table 6, we compare the occupational mix across services and DOD agencies. It shows the top occupation groups by percentage of the workforce and their rank in terms of size. (We color-code the top five occupation groups in each service. See color key in table footnotes.) We rank only the top five groups within each service. The general administrative, clerical, and office services group was first or second in all services. The engineering and architecture group was also first or second in all the military services, but not in the top seven in the DOD agencies. Two other groups made the top seven in each service and the DOD agencies: the business and industry group and the information management group.

[8] We used the first two digits of the Civilian Occupation Code, which contains 59 occupational groups. We used the first four digits of the DOD Occupation Code, which segments the workforce into 238 occupational groups.

Table 6. Percentage of civilians by civilian occupation group within each service

Occupation group	Air Force		Army		Navy		DOD agencies	
	% Civ.	Rank	% Civ.	Rank	% Civ.	Rank	% Civ.	Rank
General administrative, clerical, and office services	17.8	1st	19.7	1st	14.8	2nd	15.5	1st
Engineering and architecture	9.9	2nd	10.8	2nd	22.1	1st	3.5	
Business and industry	8.0	3rd	4.5		5.6	4th	13.7	3rd
Accounting and budget	4.5		3.7		3.9		15.4	2nd
Medical, hospital, dental, and public health	2.6		10.8	3rd	3.2		3.0	
Information management	5.1		4.6		5.2	5th	6.7	
Miscellaneous occupations	5.2	4th	5.5	4th	5.8	3rd	3.3	
Education	3.4		3.3		1.9		11.3	4th
Supply	1.9		2.6		1.6		6.7	5th
Transportation/mobile equipment maintenance	0.7		4.8	5th	0.6		0.0	
Aircraft overhaul	5.1	5th	1.3		0.6		0.0	

Source: DCPD.
Notes: Ranking is limited to the top seven groups with the most civilians. Color key follows: 1st – red, 2nd – blue, 3rd – green, 4th – purple, and 5th – brown.

These occupational data show, at an aggregate level, the general types of work that civilians perform throughout DOD. Although this information provides some value in reviewing the civilian workforce, we feel that it is not overly useful in identifying and categorizing the contributions of this workforce to DOD's mission. Consequently, we developed a construct that is based on the missions, functions, and tasks of the organizations in which civilian work instead of the individual jobs they perform. We describe this construct in the next section.

A Construct for Analyzing Contributions of the Civilian Workforce

One of the two primary tasks in this study is to show, at a high level, how the civilian workforce (across all services) contributes to DOD and other public missions. In this section, we describe our four-phase analytical construct for conducting this task:

1. Define the areas in which the civilian workforce contributes to DOD's mission and other public missions.
2. Align DOD work functions to the contribution areas they support.
3. Identify activities that employ large numbers of civilians and group these activities by the primary function(s) they perform.
4. Map these activities, where applicable, to the contribution areas in our framework.

The remainder of this section describes each of these phases in more detail.

Civilian contribution areas

We constructed a framework that defines the various ways that civilians contribute to the mission of DOD and other public missions (we use the term *contribution categories*). At the highest level, it differentiates between two areas of contributions:

- Conducting and/or directly supporting military or other operations
- Contributing to force readiness

The construct further divides these areas into subareas. Conducting and/or directly supporting military or other operations has two subareas: military operations and other public (nonmilitary) operations.[9] Contributing to force readiness has three subareas: immediate- and near-term readiness, middle-term readiness, and long-term readiness.

We expand on each of these areas and subareas in the subsections that follow.

[9] Our initial framework consisted of only the first two categories. In reviewing the missions of activities in the three services, in particular those of the Army Corps of Engineers, we identified a third contribution category: conducting and/or directly supporting (nonmilitary) public mission.

Conducting and/or directly supporting operations

The first contribution area is conducting and/or directly supporting operations. We differentiate this area by whether the operations are military or nonmilitary.

Military operations

This subarea includes civilians who participate in tactical or strategic noncombat operations or perform functions that directly support any military operations. These civilians work at activities that are directly involved in conducting or directly supporting military operations. Examples of the former include civilian mariners who operate the Navy's combat logistic ships that support aircraft carrier battle groups and amphibious ready groups and civilian cyber warriors who conduct defensive cyberspace operations. Examples of the latter include civilians who serve on operational command staffs and those who provide daily weather and oceanographic reports to operational forces.

Nonmilitary operations

Some DOD civilians perform work that contributes directly to nonmilitary operations. A prime example is the Army Corps of Engineers—civilians who provide public engineering services, most notably designing, building, and maintaining locks and dams along US waterways. Other examples of nonmilitary operations include conducting or supporting humanitarian and disaster relief operations.

Contributing to force readiness

The second area is contributing to force readiness. Whereas the definition of the first category is relatively straightforward, the definition of this category is not, mainly because the term *readiness* has multiple meanings. In *Defining Readiness: Background and Issues for Congress,* Russell Rumbaugh identifies two primary uses of this term [1]. One refers to overall military capability and capacity, which he defines in the broad sense as "whether U.S. military forces are able to do what the nation asks of them." The other use has a narrower focus and refers to the ability of current forces to effectively perform their assigned missions (commonly called "operational readiness"). In this usage, readiness is separated from the other components of military capability (i.e., force structure and modernization.)

Because civilians perform work that supports areas under both definitions, we divide the readiness contribution area into three subareas. The first aligns with the operational readiness definition, whereas the other two align more with the warfighting capabilities and capacity definition. The three subareas are (1) immediate- and near-term readiness, (2) middle-term readiness, and (3) long-term readiness.

Immediate- and near-term readiness

These contributions focus on current and near-term (out to three years) capabilities of operational forces. They include efforts to ensure that operational units have sufficient personnel, training, supplies, and ammunition and that the platforms, weapon systems, and equipment are in proper working condition. The principal measures of this readiness are the PESTO (Personnel, Equipment, Supply, Training, and Ordnance) figure of merit (FOM) measures in the Defense Readiness Reporting System (DRRS). Work functions that align to this contribution area include the following:

- Base support
- Real property maintenance and repair
- Intermediate- and depot-level maintenance
- Individual and operational training
- Supply and logistics
- Personnel management
- Security

Middle-term readiness

These contributions affect force capabilities and readiness in the 4-to-7-year horizon and primarily involve introducing new capabilities into the force and sustaining force structure capacity. They focus on improving or redirecting force capabilities and capacities through modernization programs, sustained maintenance, and developing and implementing new strategies and tactics. Work functions that align to this contribution area include the following:

- Depot-level maintenance
- Education
- Acquisition
- Test and evaluation
- Real property maintenance and repair

Long-term readiness

These contributions affect force capabilities and capacities in the 8-to-15-year horizon and involve researching and developing new capabilities, force structure, and operating concepts. They focus on the future capability needs of the force, such as long-range force structure plans, new requirements for ordnance, supply, equipment modernization, ship and aircraft life-extension maintenance, new manning requirements (new skill sets and career paths), and training requirements (new technology and range requirements). Work functions that align to this contribution area include the following:

- Depot level maintenance (modernization, service life extensions)
- Education
- Research and development
- Test and evaluation
- Acquisition

Align work functions to contribution areas

The second phase of our construct was to develop a set of rules for aligning activities' missions and work functions to the civilian contribution areas in our framework. Our approach entailed compiling a comprehensive list of DOD work functions and mapping each function to our framework. We derived an initial list from the DOD function codes. These codes identify the type of work performed within DOD activities. Every civilian manpower authorization (or billet) is assigned a DOD function code in each service's authoritative manpower databases to describe the work performed by the person filling that billet [2]. Because this study focuses on the civilian workforce, we limited this list to those functions performed by activities with large numbers of civilian employees.

One difference between our list of work functions and the DOD function codes is that the latter are used to identify the specific work of individual billets, whereas our approach identifies the primary work of the organization as a whole. For example, our approach aligns comptrollers at a maintenance depot with the depot maintenance function, whereas comptroller billets at this organization would be assigned to a comptroller (vice maintenance) DOD function code.

To align each function to our contribution areas, we compared DOD's definition of each work function with the definitions of our contribution areas.[10] While conducting this task, we found that most functions contribute, at some level, to more than one area in our framework. Consequently, to provide more fidelity in our results, we differentiate areas that are significantly affected by a function from those that are affected but to a lesser extent.[11] As an example, activities that oversee military community and family programs directly affect the immediate and near-term readiness of our force. They also indirectly affect middle-term readiness by influencing personnel retention, which, in turn, affects the composition and experience level of the future force.

[10] Definitions of DOD function codes are provided in [2].

[11] We recognize that these alignments are not always clear-cut and are subjective to a degree. One action to limit this subjectivity was to differentiate between direct and indirect contribution areas.

Table 7 shows the alignment of DOD work functions to the areas in our contribution framework. It lists the DOD work functions, organized by major function group, and shows to which of the five contribution areas that function aligns. We differentiate between direct (D) contributions and indirect (I) contributions in our mapping scheme.

To help interpret this table, we review the intermediate- and depot-level maintenance groups. Reference [3] defines intermediate-level maintenance as maintenance that is the responsibility of and performed by designated maintenance activities for direct support of using organizations. Its phases normally consist of calibration, repair, or replacement of damaged or unserviceable parts, components, or assemblies; the emergency manufacture of nonavailable parts; and providing technical assistance to using organizations. Based on these functions, we align the direct contributions of I-level maintenance to immediate and near-term readiness and the indirect contributions to middle-term readiness.

Depot-level maintenance is performed on materiel requiring major overhaul or a complete rebuild of parts, assemblies, subassemblies, and end items, including the manufacture of parts, modification, testing, and reclamation, as required [4]. Based on these functions, we align the direct contributions of depot-level maintenance to immediate and near-term readiness (by providing mission-capable aircraft back to the operational squadrons), middle-term readiness (major repair and modernization), and long-term readiness (service life extensions and modernization).

Table 7. Alignment of DOD work functions to contribution areas

Mission/function	Operations		Readiness		
	Military	Nonmilitary	Near-term	Middle-term	Long-term
Force management and general support					
Operation planning and control	**D**				
Combat development evaluations			**D**		
Manpower management			**D**	**D**	**I**
Civilian personnel services			**D**	**D**	
Military personnel services			**D**	**D**	**I**
Administrative support			**I**		
Audits, inspections, and investigations			**D**	**I**	
Financial services			**D**	**I**	
Research and development					
Oversight of research and development				**I**	**D**
Research				**I**	**D**
Science and technology				**I**	**D**

Mission/function	Operations		Readiness		
	Military	Nonmilitary	Near-term	Middle-term	Long-term
Systems acquisition, test and evaluation, engineering, and contracting					
Systems acquisition			I	D	D
Test and evaluation				D	D
Procurement and contracting			D	D	I
Engineering			D	D	I
Logistics					
Logistics management			D		
Logistics life cycle sustainment activities			D	I	
Forward logistics	D		D		
Maintenance			D	D	I
Maintenance management			D	I	I
Intermediate maintenance and repair			D	I	
Depot maintenance and repair			D	D	D
Supply operations	I		D		
Transportation services	D		D		
Products manufactured or fabricated					
All functions			D	D	I
Installation/facility management and utility plant operation and maintenance					
Installation/facility management			D	I	
Utility plant operation and maintenance			D	I	
Security/law enforcement					
All functions	I	I	D		
Environment, safety, & natural resource services					
All functions		I	D	I	
Real property project management, maintenance and construction					
Real property project management			D	I	
Real property maintenance, repair and construction			D	I	I
Civil works					
All functions	I	D	I		
Military community and family programs					
All functions			D	I	
Education and training					
Military training			D	I	
Military education			I	D	I

Mission/function	Operations		Readiness		
	Military	Nonmilitary	Near-term	Middle-term	Long-term
Civilian education and training			D	D	I
Health services					
Health services management			D	I	
Medical care	D	D	D		
Research				D	D
Command and control					
Operational command and control	D	I	D		
Information capabilities					
Intelligence	D		D	I	I
Cyberspace operations	D	D	D		
Communications services	D	I	D		
Transmission (radio/satellite) services	D	I	D		
Decision support services (management)			D		

Source: CNA [2].
Notes: D denotes direct contributions, and I denotes indirect contributions.

Identify and group activities by mission/function

The third phase of our construct involves segmenting the civilian workforce, at the activity level, by the primary mission/functions the activity performs.

A key premise underlying our approach is that contributions of the civilian workforce are governed by the organizations in which they work and the missions, functions, and tasks (MFTs) of those organizations. To illustrate, the primary mission of an aviation depot is to maintain and repair aircraft. These organizations employ thousands of civilians. Many perform actual maintenance and repair work functions (e.g., electronic technicians, metal workers, and engineers), whereas others work in supporting roles (e.g., managers, accountants, and administrative personnel). Under our framework, because the primary function of the depot is to maintain and repair aircraft, all civilians employed at the depot, regardless of their occupation, contribute to this function.

Following this logic, the first step in this phase is to determine where (at which organizations) civilians work. Using DCPD, we compiled the number of civilians in FY 2018 assigned to each Unit Identification Code (UIC); UIC uniquely identifies each unit, activity, or organization. We then compiled information about each UIC, including its name, the agency-in-charge/budget

submitting office (BSO), and location. We also researched those organizations that employ large numbers of civilians to learn about their MFTs—primarily from the mission statements on their official websites.[12] Using this information, we identified organizations (i.e., UICs) that perform like functions and grouped them together.

Align activity groups to contribution areas

The last phase of our construct entails mapping each activity group to the contribution areas in our framework. This mapping is based on the primary functions that each activity group performs and our Phase 2 results of aligning DOD work functions to our contribution areas.

In researching the activities in our categories, we discovered that many activities perform multiple functions and that, in some instances, these functions contribute to multiple areas in our framework. We also found that, in some cases, we can differentiate functions as being primary or secondary functions. Primary functions represent the main output of an activity group, whereas secondary functions are other significant outputs that align with other contribution areas. Similar to how we differentiate direct and indirect contributions of specific functions, we also differentiate between the primary (P) and secondary (S) functions of an activity group in our mapping scheme. In short, primary functions represent the main output of an activity group, whereas secondary functions represent other significant outputs that align with other contribution areas.

Align activity groups to DRRS readiness pillars

An extension to our construct that provides more awareness into how the civilian workforce contributes to DOD's missions is to further break down the contributions to readiness by adding another dimension to our framework. The Defense Readiness Reporting System defines six areas of readiness: personnel (P), equipment (E), supply (S), training (T), ordnance (O), and facilities (F). These are known as the readiness pillars. Although DRRS (and these pillars) are used to measure and track near-term (operational) readiness, we believe that identifying these readiness areas, even for those activity groups whose primary contributions are to middle- or long-term readiness, provides more insights into the civilian workforce's contributions to all levels of readiness.

[12] We also used other references that describe the mission and functions of major military organizations (e.g., [5]).

Civilian Workforce Contributions

In this section, we present the results of applying our construct to identify the contributions of the civilian workforce in each of the three military departments. For each department, we first break down the workforce by command structure and, within major commands and agencies, by groups of activities that perform similar missions/functions. Included in these results is the number of 2018 civilians in each group. We then show the results of aligning each command or group to our contribution areas based on its primary mission/functions.

Air Force

Segmenting the Air Force's civilian workforce

In 2018, the number of Air Force activities (i.e., UICs) that employed at least 1 civilian was 6,925, and the number employing at least 10 civilians was 2,932. Using DCPD data, which maps each activity to 1 of 48 agencies, we compiled the numbers of civilians that work in each agency. Table 8 lists the agencies that employ the most civilians. It also gives the size of their 2018 workforce and the percentage of the Air Force's total civilian workforce. In total, these 20 agencies employ roughly 95 percent of all civilians in the Air Force. More than half the civilians work at two agencies: Air Force Material Command (AFMC) and Air National Guard (ANG). Owing to the size of their workforce, we delve deeper into the missions/functions and subordinate organizations of these two agencies.[13]

Table 8. Air Force agencies that employ the most civilians

Agency or command	2018 civilians	Percentage of AF workforce
Air Force Materiel Command	59,318	36%
Air National Guard Units	24,945	15%
Air Education and Training Command	13,413	8%
Headquarters, Air Force Reserve	11,521	7%
Air Combat Command	10,976	7%
Air Mobility Command	7,186	4%
Space Command	5,616	3%
Air Force Global Strike Command	3,810	2%

[13] We examine the workforce and missions/functions of the other large Air Force agencies in Appendix A.

Agency or command	2018 civilians	Percentage of AF workforce
Air Force Civilian Career Training	2,850	2%
Pacific Air Forces	2,748	2%
HQ USAF and Support Elements	1,948	1%
Air Force Elements, US Strategic Command	1,648	1%
Air Force Special Operations Command	1,647	1%
Air Force Installation and Mission Support	1,622	1%
Air Force Personnel Center	1,595	1%
US Air Forces, Europe	1,516	1%
National Air and Space Intelligence Center	1,408	1%
US Air Force Academy	1,219	1%
US Special Operations Command (AF elements)	1,028	1%

Source: DCPD.

Air Force Materiel Command

AFMC's mission is to deliver expeditionary capabilities to the warfighter through development and transition of technology, professional acquisition management, exacting test and evaluation, and sustainment of all Air Force weapon systems [6]. To execute these responsibilities, AFMC oversees six core mission areas, each of which is aligned to a center. These core mission areas follow:

1. **Discovery and development.** Aligned to the Air Force Research Laboratory, this mission area is to discover, develop, and integrate warfighting technologies for air, space, and cyberspace forces.
2. **Test and evaluation.** Aligned to the Air Force Test Center, this mission area directs the developmental test and evaluation of air, space, and cyber systems for military services, other US government agencies, and international partners.
3. **Life-cycle management.** Aligned to the Air Force Life Cycle Management Center, this mission area focuses on providing life-cycle management of all aircraft, engines, munitions, and electronic systems. It also manages information technology systems and networks; command, control, communications, intelligence, surveillance, and reconnaissance systems; armaments; strategic systems; aerial platforms; and various specialized or supporting systems, such as simulators or personal equipment.
4. **Sustainment and logistics.** Aligned to the Air Force Sustainment Center, this mission area provides integrated logistics and sustainment to the warfighter through depot maintenance, supply chain management, and installation support.

5. **Installation and mission.** Aligned to the Air Force Installation and Mission Support Center, this mission area focuses on providing installation and mission support capabilities to 77 Air Force installations, 9 major commands, and 2 direct reporting units. It provides integrated management, resourcing, and combat support operations for airman and family services, base communications, chaplain program, civil engineering, contracting, logistics readiness, public affairs, security forces, and financial.
6. **Nuclear systems management.** Aligned to the Air Force Nuclear Weapons Center, this mission area focuses on acquiring and sustaining effective nuclear weapon systems and providing agile and effective nuclear materiel management [6].

Using information on each activity within AFMC (e.g., activity name and location), we mapped all of them to one of these six centers or to AFMC's headquarters. Table 9 shows the breakdown of civilians by mission area. The majority of civilian work is at activities that support the following three missions: sustainment and logistics, life cycle management, and installation and mission support.

Table 9. Breakout of AFMC civilians by core mission areas

Mission area	2018 civilians	Percentage of AFMC's civilian workforce
Sustainment and logistics	29,112	49.1
Life-cycle management	12,315	20.8
Installation and mission support	8,583	14.5
Discovery and development	4,216	7.1
Test and evaluation	2,826	4.8
Nuclear systems management	1,758	3.0
Unknown	508	0.9

Source: DCDP.

Air National Guard

ANG's federal mission is to maintain well-trained, well-equipped units that are available to mobilize during war and provide assistance during national emergencies (such as natural disasters or civil disturbances). During peacetime, the combat-ready units and support units are assigned to most Air Force major commands to carry out missions compatible with training, mobilization readiness, and humanitarian and contingency operations [7].

ANG consists of flying units and support units. Flying units perform functions such as tactical airlift, air refueling, rescue and recovery, tactical air support, weather flights, strategic airlift, and aeromedical evacuations. The support units, which employ most of the civilians, include

air traffic control units, combat communications squadrons, civil engineering, and communication flights and squadrons. Support units also include weather flights, aircraft control and warning squadrons, a range control squadrons, and an electronic security unit [7]. Table 10 shows a breakdown of ANG's civilian workforce by work function.

Table 10. Air National Guard civilian workforce by work function

Function	2018 civilians	Percentage of ANG's civilian workforce
Maintenance	9,327	37.4%
Squadron/Group/Wing	4,861	19.5%
Support	2,481	9.9%
Logistics	2,251	9.0%
Communications	1,338	5.4%
Civil Engineering	757	3.0%
Security	686	2.8%
Headquarters	642	2.6%
Air Traffic Control	499	2.0%
Special Operations	457	1.8%
Medical	454	1.8%
Comptroller	303	1.8%
Cyber Operations	240	1.2%
Air Operations	197	1.0%

Source: DCPD and CNA.

Unique characteristics of Air Force's organizational structure

Compared with the Army and DON, the Air Force's organizational structure contains more and, on average, smaller (in terms of personnel) activities. Furthermore, the names of many Air Force activities reflect their primary mission/function. These two characteristics enable our construct, when using only data in DCPD, to more precisely identify the missions/functions that civilians perform and to more accurately determine the number of civilians who perform them.

To illustrate, the 55th Mission Support Group at Offutt Air Force Base provides engineering, security, mission support, supply, transportation, contracting, and deployment readiness services. This group consists of the following activities:

- 55th Civil Engineering Squadron
- 55th Contracting Squadron
- 55th Force Support Squadron

- 55th Security Forces Squadron
- 55th Logistics Readiness Flight [8]

Organizing the workforce by this structure enables us to align the civilians in these squadrons to the specific functions they perform. Because this structure is used predominately throughout the Air Force, we are able to use data in DCPD (i.e., the number of civilians by activity) and the name of the activities (which identifies its function) to determine the number of civilians that contribute to each function.

Before aligning these activity groups to our contribution areas, we noticed that, although many of these functions align with a DOD work function, some are new terms that require more explanation. These include the following:

- **Operations support**. These activities dictate policy, train aircrews, and maintain airfields based on the missions of the units they support. They also staff the control tower and supply weather forecasts for bases and aircrews.
- **Force support**. These activities provide airman and family services, community services, force development, manpower and personnel functions, and sustainment services.
- **Civil engineering**. These activities can have wartime and peacetime missions. During military operations, they provide engineering support in forward operating areas, base recovery after attack in contingency environments, rapid runway repair, and response to nuclear, biological, chemical, and conventional attacks. In peacetime, these activities focus on contingency training, base infrastructure support, humanitarian aid, and assisting the citizens in times of natural or man-made disasters. Specific functions include command and control, engineering, emergency management, and operations of electrical systems, power production, mechanical systems, and utility/fuel systems.

Table 11 shows the alignment of these support activities to our contribution areas. These alignments are in conjunction with those for the DOD function codes in Table 7 and served as the basis for aligning the Air Force's civilian workforce to our contribution areas.

Table 11. Alignment of Air Force function descriptions to our contribution areas

Mission/function	Operations		Readiness		
	Military	Nonmilitary	Near-term	Middle-term	Long-term
Force support			**D**	**I**	
Operations support	**I**		**D**	**I**	
Civil engineering		**I**	**D**	**I**	

Source: CNA.
Notes: **D** indicates directly contributes; **I** indicates indirectly contributes.

Contributions of the Air Force's civilian workforce

The ultimate goal of our construct is to show how the civilian workforce contributes to DOD's mission. In this subsection, we present our breakdown of the Air Force's civilian workforce by major command and, within each command, by groups of activities that perform the same (or similar) functions. For each group, we show the size of the civilian workforce and our alignment to the contribution areas they support.

Tables 12 through 15 show these results. As we explained in describing our construct, we use two designators to define these alignments. The first indicates whether the function contributes directly (D) or indirectly (I) to the contribution area. The second indicates whether the contribution is associated with a primary (P) or a secondary (S) function of the activity group. Under this scheme, the strongest alignments are designated D/P, and least significant ones are designated I/S. Alignments designated D/S or I/P fall in between. Because most Air Force activities focus on one primary mission/function, most alignments in these tables are designated as a primary function.

The results show that Air Force civilians support a wide range of functions. The largest, in terms of workforce size, are force sustainment, logistics, and maintenance functions. Overall, most civilians work at activities that directly support immediate- and near-term readiness. The second most supported area is middle-term readiness. Our alignment does reveal that a significant number of civilians (over 22,000) work at activities that directly or indirectly support military and nonmilitary operations

We also applied the extension of our construct to the Air Force's workforce by identifying the specific readiness pillars that each major command supports. Table 16 shows this alignment. The largest number of commands directly support the training, personnel, and equipment pillars.

Table 12. Contributions of the civilian workforce at major Air Force agencies (1 of 4)

Command	Mission/function	2018 civilians	Operations		Readiness		
			Military	Nonmilitary	Near-term	Middle-term	Long-term
Material Command	Sustainment and logistics	29,112			**D/P**	**I/S**	
	Life-cycle management	12,315			**D/P**	**D/P**	**I/S**
	Installation & mission support	8,583			**D/P**	**I/S**	
	Discovery & development	4,216				**I/S**	**D/P**
	Nuclear systems management	4,175			**D/P**	**I/S**	
	Test & evaluation	2,826				**D/P**	**I/S**
	Headquarters	1,758			**I/S**	**I/S**	
Air National Guard Units	Maintenance	9,327			**D/P**	**D/S**	**I/S**
	Squadron/Group/Wing	4,861	**I/S**	**I/S**	**D/P**		
	Support	2,481			**D/P**	**I/S**	
	Logistics	2,251			**D/P**	**I/S**	
	Communications	1,338	**I/P**		**I/P**		
	Civil Engineering	757		**I/S**	**D/P**	**I/S**	
	Security	686	**I/S**		**D/P**		
	Headquarters	642			**I/S**	**I/S**	
	Air Traffic Control	499			**D/P**		
	Special Operations	457	**I/S**		**D/P**		
	Medical	454	**I/S**		**D/P**	**I/S**	
	Comptroller	303			**D/P**	**I/S**	
	Cyber Operations	240	**I/P**	**I/S**	**I/P**		

Source: DCPD and CNA.

Notes: **D** indicates directly contributes; **I** indicates indirectly contributes; **P** indicates primary function; **S** indicates secondary function.

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Table 13. Contributions of the civilian workforce at major Air Force agencies (2 of 4)

Command	Mission/function	2018 civilians	Operations		Readiness		
			Military	Nonmilitary	Near-term	Middle-term	Long-term
Air Education & Training	Training	1,901			**D/P**	**I/P**	
	Civil engineering	1,806		**I/S**	**D/P**	**I/S**	
	Maintenance	1,479			**D/P**	**I/P**	
	Medical	1,222	**I/S**		**D/P**	**I/S**	
	Force support	960			**D/P**	**I/P**	
	Flying training	779			**D/P**	**I/P**	
Air Force Reserves	Maintenance	4,527			**D/P**	**I/P**	
	Airlift	755	**I/S**		**D/P**	**I/S**	
	Operations support	729			**D/P**		
	Force support	722			**D/P**	**I/S**	
	Headquarters	665			**I/S**	**I/S**	
	Civil engineering	625		**I/S**	**D/P**	**I/S**	
Air Combat and Air Mobility Commands	Mission Support	4,616			**D/P**	**I/S**	
	Operations	3,029	**I/S**		**D/P**		
	Headquarters	2,545			**I/S**	**I/S**	
	Medical Group	1,822	**I/S**		**D/P**	**I/S**	
	Maintenance	983			**D/P**	**I/P**	
	Cyber	728	**I/S**		**I/P**		
	Weather	514	**I/S**		**D/P**		
	Test & Evaluation	348			**I/S**	**D/P**	**I/S**

Source: DCPD and CNA.
Notes: **D** indicates directly contributes; **I** indicates indirectly contributes; **P** indicates primary function; **S** indicates secondary function.

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Table 14. Contributions of civilian workforce at Air Force major agencies (3 of 4)

Command	Mission/function	2018 civilians	Operations		Readiness		
			Military	Nonmilitary	Near-term	Middle-term	Long-term
Space Command	Space/missile system	1,379			**D/P**	**D/P**	
	Civil engineer	576		**I/S**	**D/P**	**I/S**	
	Force support	439			**D/P**	**I/S**	
	Space wing	373			**D/P**		
	Communications	384			**I/P**		
	Security	303	**I/S**		**D/P**		
	Cyber	291	**I/S**		**I/P**		
	Logistics	282			**D/P**		
	Contracting	235			**D/P**		
	Medical	176	**I/S**		**D/P**	**I/S**	
Air Force Global Strike Command, Air Force Special Operations Command, US Special Operations (USAF element), Pacific Air Forces, and US Air Forces, Europe	Force support	1,739			**D/P**	**I/S**	
	Civil Engineering	1,517	**I/S**	**I/S**	**D/P**	**I/S**	
	Headquarters	1,167			**I/P**	**I/S**	
	Logistics	652			**D/P**	**I/S**	
	Medical	464	**I/S**		**D/P**	**I/S**	
	Maintenance	372			**D/P**	**I/P**	
	Wing	356			**D/P**		
	Communications	260	**I/P**		**I/P**		
	Operations support	225			**D/P**		
	Security forces	197	**I/S**		**D/P**		
	Contracting	190			**D/P**	**I/S**	

Source: DCPD and CNA. Notes: **D** = directly contributes; **I** = indirectly contributes; **P** = primary function; **S** = secondary function.

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Table 15. Contributions of civilian workforce at Air Force major agencies (4 of 4)

Command	Mission/function	2018 civilians	Operations		Readiness		
			Military	Nonmilitary	Near-term	Middle-term	Long-term
AF Civilian Career Training	Training & education	2,850			**D/P**	**D/P**	**I/S**
HQ USAF and Support Elements	Headquarters	1,948			**I/S**	**I/S**	
US Strategic Command (USAF)	Command	1,289	**D/P**		**I/S**		
	Cyber	210	**D/P**	**I/S**	**D/P**		
AF Installation and Mission Support	Installation & mission support	1,622			**D/P**	**D/P**	
Air Force Personnel Center	Personnel management	1,595			**D/P**	**I/S**	
National Air & Space Intelligence Center	Intelligence	1,408	**D/P**		**D/P**	**I/P**	
US Air Force Academy	Education	1,219			**I/P**	**D/P**	**I/S**

Source: DCPD and CNA.
Notes: **D** indicates directly contributes; **I** indicates indirectly contributes; **P** indicates primary function; **S** indicates secondary function.

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Table 16. Alignment of Air Force major commands to readiness pillars

Activity type	Readiness pillars					
	Personnel (P)	Equipment (E)	Supply (S)	Training (T)	Ordnance (O)	Facilities (F)
Air Force Materiel Command		D			I	
Air National Guard Units	D	D	D	D		D
Air Education and Training Command				D		D
Headquarters, Air Force Reserve	D	I		D		D
Air Combat Command	D	D		D		
Air Mobility Command	D	D		D		
Space Command	D	D		D		
Air Force Global Strike Command						
Air Force Civilian Career Training	D			D		
Pacific Air Forces	D	I	I	D	I	I
HQ USAF and Support Elements	I	I		I		
Air Force Elements, U.S. Strategic Command						
Air Force Special Operations Command	D	I	I	D	I	
AF Installation and Mission Support			I			D
Air Force Personnel Center	D					
US Air Forces, Europe	D	I	I	D	I	I
National Air and Space Intelligence Center	I			I		
US Special Operations Command (AF elements)	I			I		

Source: CNA.
Notes: **D** indicates directly contributes; **I** indicates indirectly contributes.

Army

The Army comprises an active and a reserve component. The reserve component consists of the Army Reserve and the Army National Guard. Within each component, the Army conducts both operational and institutional missions. The operational Army consists of numbered armies, corps, divisions, brigades, and battalions that conduct a full spectrum of operations worldwide. The institutional Army supports the operational Army by providing the infrastructure to raise, train, equip, deploy, and ensure the readiness of all Army forces [9].

Segmenting the Army's civilian workforce

In 2018, there were 3,460 Army activities that employed at least 1 civilian and 1,910 that employed at least 10 civilians. These numbers are about half of the Air Force totals, yet the Army employs more civilians overall. This means that the Army's civilian workforce is concentrated at fewer and, on average, larger activities. Of more concern to our efforts to identify the contributions of this workforce is that the Army has 35 activities that employ over 1,000 civilians and 58 that employ between 500 and 999 civilians.[14] Large activities that conduct multiple functions lessen our ability to accurately determine how many civilians contribute to each function.

Our approach in segmenting the Army's civilian workforce was to follow the Army's organizational structure and identify major commands that employ large numbers of civilians. For some of the larger commands, we also broke out the civilian workforce by the subordinate command in which they are employed. In both cases, we attempted to group activities by the major functions they perform.

Table 17 shows this high-level breakout. We divided the workforce into six categories, five in the active component and one in the reserve component. Over 90 percent of the Army's civilians work in three of these categories: direct reporting units, Army commands, and activities that support the Army National Guard and Reserves.

[14] The Air Force has just one activity that employs over 1,000 civilians and only 22 activities that employ between 500 and 999 civilians.

Table 17. Army major commands and 2018 civilian workforce

Category	Command	2018 civilians
Direct reporting units		88,962
	Medical Command	33,232
	Corps of Engineers	30,613
	Acquisition Support Center	4,754
	Intelligence and Security Command	3,233
	Test and Evaluation Command	3,112
	Civilian Human Resource Agency	2,723
	Human Resources Command	1,571
	Recruiting and Cadet Commands	2,347
	Criminal Investigation Command	864
	Military Academy and War College	1,068
Army commands		84,242
	Materiel Command	61,784
	Futures Command	10,927
	Training and Doctrine Command	10,341
	Forces Command	2,093
National guard/reserves		39,567
	National Guard	30,813
	Reserves	8,754
Army service component commands		9,823
	Cyber Command	4,354
	Special Operations Command (Army)	1,418
	Theater Armies	2,273
	Space and Strategic Defense Command	551
Headquarters		7,790
	Field Offices, Secretary of the Army	2,577
	Chief of Staff of the Army	1,530
	Joint Activities, Secretary of the Army	1,123
	Field Operating Agencies, Army Staff	976
	Chief of the U.S. Army	614
Other		3,761
	Military Entrance Processing Command	1,974
	Joint Activities	1,642
Total		234,145

Source: DCPD.

The largest civilian employer is the Army Materiel Command (AMC). Almost a quarter of all civilians work at activities/commands within this organization. Because of its size, we examined the major subordinate commands within AMC and examined the civilian workforce and the functions they perform at this level.[15]

Army Materiel Command

The AMC, through its subordinate commands, provides technology, acquisition support, and logistics to the Army and our allies [5]. Table 18 lists the six subordinate commands with the most civilian employees.

Table 18. Army Materiel Command component commands

AMC component commands	2018 civilians
Installation Management Command	21,553
Tank-Automotive and Armament Command	8,396
Aviation and Missile Command	7,509
Communications Electronics Command	5,965
Joint Munitions Command	5,544
Sustainment Command	4,625

Source: DCDP.

We list the missions and functions of these commands below:

- The **Army Installation Management Command** (IMCOM) is AMC's largest civilian employer. Nearly all of its over 21,000 civilians work at Army or joint bases within the United States and aboard. The primary mission of these activities is to manage and deliver base support to enable force readiness [10].
- The **Army Tank-Automotive and Armament Command** (TACOM) manages the Army's ground equipment supply chain. Its Integrated Logistics Support Center executes repair parts planning and supply chain management for more than 3,500 weapon systems. TACOM oversees six manufacturing arsenals and maintenance depots across the United States. These activities manufacture, repair, upgrade, and modernized the Army's ground equipment [11].
- The **Army Aviation and Missile Command** (AMCOM) develops and delivers aviation, missile and calibration materiel readiness to the Army. Its primary functions are

[15] We examine the workforce and missions of the other large Army agencies in Appendix B.

sustainment logistics, acquisition support, calibration assistance, contracting, and engineering support [12].

- The **Army Communications Electronics Command** (CECOM) sustains and delivers command, control, communications, computers, cyber, intelligence, surveillance, and reconnaissance (C5ISR) readiness for the army [13].
- The **Army Joint Munitions Command** (JMC) provides the conventional ammunition life-cycle functions of logistics sustainment, readiness and acquisition support. Major activities include the McAlester Army Ammunition Plant and Blue Grass Army Depot [14].
- The **Army Sustainment Command** (ASC) supports combatant command operations by sustaining and supporting joint forces, supporting rotational forces, and augmenting theater combat support service capabilities. Most civilians work at the logistics readiness centers which are located at Army and joint bases and provide logistics support to the service members and units at these bases [15].

Contributions of the Army's civilian workforce

In this subsection, we present our breakdown of the Army's civilian workforce by major command and, within each command, by groups of activities that perform the same (or similar) functions. For each group, we show the size of the civilian workforce and our alignment to the contribution areas they support. Tables 19 through 21 present these results.

Of the civilians who work in the Army's direct reporting units (Table 19), most work in health service activities or in the district offices of the Corps of Engineers. This latter group of almost 25,000 civilians is unique in that one of its primary contribution areas is conducting nonmilitary operations through its civil works program.

In the Army commands (Table 20), the function groups with the most civilians, in decreasing order, are maintenance, real property management, research, and training. In the other commands (Table 21), most civilians work in national guard and reserve activities whose primary functions are maintenance and training.

Overall, the alignment of the Army's civilian workforce is similar to that of the Air Force. The largest number of civilians aligns to immediate- and near-term readiness with middle-term readiness ranking second.

We applied the extension of our construct to the Army's workforce by identifying the specific readiness pillars that each activity group supports. Table 22 shows this alignment. The personnel, equipment, and training pillars are directly supported by the most groups.

Table 19. Contributions of civilian workforce at Army direct reporting units

Command	Mission/function	2018 civilians	Operations		Readiness		
			Military	Nonmilitary	Near-term	Middle-term	Long-term
Medical Command	Health services	33,232	**I/P**		**D/P**	**I/S**	
	Headquarters and support	2,980			**D/P**		
	Medical research	1,439			**I/S**	**D/P**	**D/P**
Corps of Engineers	District offices: civil works	24,781	**D/P**	**D/P**	**D/P**	**I/P**	
	Engineering research	2,088				**I/S**	**D/P**
	Engineering support	1,193			**D/P**	**I/P**	
	Other support	2,085			**D/S**		
Acquisition Support Center	Acquisition - PEO	4,081				**D/P**	**D/P**
	Acquisition support	673				**D/P**	**I/S**
Intelligence & Security Command	Intelligence	3,233	**D/P**		**D/P**	**I/S**	
Test and Evaluation Command	Test and evaluation	3,112			**I/S**	**D/P**	**I/S**
Civilian Human Resource Agency	Personnel management	2,723			**D/P**	**D/P**	**I/S**
Human Resources Command	Personnel management	1,571			**D/P**	**D/P**	**I/S**
Recruiting and Cadet Commands	Recruiting	2,347			**D/P**	**D/P**	
Military Academy & War College	Education	1,068			**I/P**	**D/P**	**I/S**
Criminal Investigation Command	Criminal investigation	864	**I/P**	**I/S**	**I/P**		

Source: DCPD and CNA.

Notes **D** indicates directly contributes; **I** indicates indirectly contributes; **P** indicates primary function; **S** indicates secondary function.

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Table 20. Contributions of civilian workforce at Army commands

Command	Mission/function	2018 civilians	Operations		Force readiness		
			Military	Nonmilitary	Near-term	Middle-term	Long-term
Installation Management Com.	Real property	21,553			**D/P**	**D/P**	**I/P**
Tank-Automotive & Armament	Maintenance	8,396			**D/P**	**I/P**	
Aviation and Missile	Maintenance	7,509			**D/P**	**I/P**	
Communications Electronics	Maintenance	5,965			**D/P**	**I/P**	
Joint Munitions	Maintenance	5,544			**D/P**	**I/S**	
Sustainment	Logistics	4,625			**D/P**	**I/P**	
Surface Deployment and Distribution	Logistics	903	**I/S**		**D/P**		
AMC Headquarters	Management	646			**I/P**		
Chemical Materials Agency	Weapons management	643	**I/S**		**D/P**	**I/S**	
Security Assistance	Security	539	**I/S**		**D/P**		
Army Futures Command	Research	10,927				**I/S**	**D/P**
Army Training & Doctrine Command	Training	10,341			**D/P**	**D/P**	
Army Forces Command	Training/Mission prep	2,093			**D/P**		

Source: DCPD and CNA.
Notes: **D** indicates directly contributes; **I** indicates indirectly contributes; **P** indicates primary function; **S** indicates secondary function.

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Table 21. Contributions of civilian workforce at national guard/reserves, service component commands, headquarters, and other activities

Command	Mission/function	2018 civilians	Operations		Force readiness		
			Military	Nonmilitary	Near-term	Middle-term	Long-term
National Guard	Maintenance, training	21,553			**D/P**	**D/P**	
Reserves	Maintenance, training	8,396			**D/P**		
Cyber Command	Cyberspace operations	4,354	**D/P**	**I/P**	**D/P**		
Special Operations Command (Army)	Mission support	1,418	**I/S**		**D/P**		
Theater Armies	Mission support	2,273	**I/S**		**D/P**		
Field Offices, Sec. of the Army	Various	2,577			**I/P**		
Chief of Staff of the Army	Headquarters	1,530			**I/S**	**I/S**	
Joint Activities, Sec. of the Army	Headquarters	1,123			**I/S**	**I/S**	
Field Operating Agencies, Army Staff	Various	976			**I/S**		
Chief of the U.S. Army	Headquarters	614			**I/S**		
Military Entrance Processing	Recruiting, testing	1,974			**I/S**		
Joint Activities	Headquarters	1,642			**I/S**	**I/S**	

Source: DCPD and CNA.
Notes: **D** indicates directly contributes; **I** indicates indirectly contributes; **P** indicates primary function; **S** indicates secondary function.

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Table 22. Alignment of Army activity groups to readiness pillars

Activity type	Readiness pillars					
	Personnel (P)	Equipment (E)	Supply (S)	Training (T)	Ordnance (O)	Facilities (F)
Medical Command	**D**					
Corps of Engineers	**I**					**D**
Acquisition Support Center		**D**	**D**		**D**	
Intelligence and Security Command	**I**					
Test and Evaluation Command		**D**			**D**	
Civilian Human Resource Agency	**D**			**D**		
Human Resources Command	**D**			**I**		
Recruiting and Cadet Commands	**D**			**D**		
Criminal Investigation Command						
Materiel Command		**D**	**I**		**I**	
Futures Command	**I**	**I**		**I**	**I**	
Training and Doctrine Command	**I**			**D**		
Forces Command	**D**			**I**		
National Guard	**D**	**D**		**D**		
Reserves	**D**	**D**		**D**		
Cyber Command	**I**	**I**				
Special Operations Command (Army)	**I**			**D**		
Theater Armies	**D**		**I**	**D**	**I**	
Military Entrance Processing Command	**D**			**I**		

Source: CNA.
Notes: **D** indicates directly contributes; **I** indicates indirectly contributes.

Department of the Navy

This subsection presents our results for the DON.

Segmenting DON's civilian workforce

In 2018, there were 1,221 DON activities that employed at least 1 civilian and 748 activities that employed at least 10 civilians. These numbers are far less than those for the Air Force and Army, which indicates that, on average, DON activities are larger in terms of the size of their workforce. For comparison, the Navy has 2 activities that employ over 10,000 civilians, 44 activities that employ between 1,000 and 9,999 civilians, and 19 activities that employ between 500 and 999 civilians. Whereas the Air Force, and to a lesser extent the Army, tend to organize activities by specific functions, the Navy tends to combine multiple functions within a single activity.

We segmented the Navy's civilian workforce into the 20 activity types listed in Table 23. This table also contains the number of civilians who work at the activities in each group and the percentage of the Navy's total civilian workforce that each group represents. These 20 groups account for nearly 90 percent of all Navy civilians. Two groups account for over half of the civilian employees: warfare centers and I- and D-level maintenance organizations. Each employs over 50,000 civilians. The next five largest groups (in terms of civilian employees) account for another quarter of the total workforce.

Table 23. DON activity groups that employ the most civilians

Activity type	2018 Civilians	
	Total	Percentage of Navy total
Warfare centers	53,123	27.4%
I- and D-level maintenance	52,469	27.0%
Facilities commands	14,140	7.3%
Base support and security	10,080	5.2%
Hospitals and clinics	9,761	5.0%
Military sealift	6,712	3.5%
Logistics and supply	6,246	3.2%
Research	3,021	1.6%
Educational institutions	2,709	1.4%
Fleet and operational staffs	2,217	1.1%
Systems commands headquarters	2,070	1.1%

Activity type	2018 Civilians	
	Total	Percentage of Navy total
Program executive officers	1,971	1.0%
Criminal investigation	1,895	1.0%
Skills training	1,334	0.7%
Civilian human resources	1,281	0.7%
Meteorology and oceanography	1,171	0.6%
Cyber	1,064	0.5%
Strategic systems programs	1,006	0.5%
Ordnance management	796	0.4%
Computer and telecommunications	703	0.4%

Source: DCPD.

In keeping with our approach, we delved deeper into the two largest groups: warfare centers and maintenance organizations.

Warfare centers

The warfare center group is the largest in terms of the number of civilian employees. Table 24 lists the major organizations in this group by the following warfare areas: aviation, surface, undersea, expeditionary, information, and special operations. The mission of these centers is to identify, develop, deliver, and sustain capabilities in these warfighting areas to support naval, joint, coalition, and other national missions.

Table 24. Warfare centers

UIC	Warfare area	Activity name	Location	FY18 civilians
N00421	Aviation	NAVAIRWARCENAD	Patuxent River, MD	7,749
N68335	Aviation	NAVAIRWARCENAD	Lakehurst, NJ	1,845
N61340	Aviation	NAVAIRWARCEN TRASYSDIV	Orlando, FL	1,230
N60530	Aviation	NAWCWPNDIV	China Lake, CA	4,342
N63126	Aviation	NAWCWPNDIV	Point Mugu, CA	1,704
N64498	Surface	NAVSURFWARCEN	Philadelphia, PA	2,508
N00167	Surface	NAVSURFWARCEN	Bethesda, MD	1,877
N63394	Surface	NAVSURFWARCENDIV	Port Hueneme, CA	2,425
N00164	Surface	NAVSURFWARCENDIV	Crane, IN	3,424
N00178	Surface	NAVSURFWARCENDIV	Dahlgren, VA	3,917
N64267	Surface	NAVSURFWARCENDIV	Corona, CA	1,585
N61331	Surface	NAVSURFWARCENDIV	Panama City, FL	1,447
N63273	Surface	CBTDIRSYSACT	Virginia Beach, VA	605

UIC	Warfare area	Activity name	Location	FY18 civilians
N00174	Surface - EOD	NSWC EOD TECH DIV	Indian Head, MD	2,119
N00253	Undersea	NAVUNSEAWARCENDIV NWCF	Keyport, WA	1,799
N66604	Undersea	NAVUNSEAWARCENDIV NWCF	Newport, RI	3,257
N62583	Expeditionary	NAVFAC EXWC	Port Hueneme, CA	489
N69218	Expeditionary	NFEXWC	Port Hueneme, CA	421
N65236	Information	NAVWARSYSCEN ATLANTIC	Charleston, SC	4,278
N66001	Information	NAVWARSYSCEN PACIFIC	San Diego, CA	4,732
N47898	Special ops.	COMNAVSPECWARDEVGRU	Virginia Beach, VA	454
N68869	Special ops.	COMMANDER NAVSPECWARCEN	Coronado, CA	165

Source: DCPD and Total Force Manpower Management System (TFMMS).

The air warfare centers are split between the aircraft division and the weapons division. The primary missions of these activities are to conduct research, development, test, evaluation, and sustainment for all Navy and Marine Corps aircraft and aircraft systems. NAVAIRWARCENAD also operates a test wing and ranges, facilities, laboratories, and aircraft in support of military operations worldwide. The weapons division (NAWCWPNDIV) has locations at China Lake and Point Mugu in California. Its mission is to conduct weapons research, development, acquisition, test, and evaluation to enhance the Navy's air warfighting capabilities.

The major surface warfare centers are at Philadelphia, Pennsylvania; Bethesda, Maryland; Port Hueneme, California; Crane, Indiana; Dahlgren, Virginia; Corona, California; Panama City, Florida; Virginia Beach, Virginia; and Indian Head, Maryland. These centers and their detachments employ more than 18,000 civilians. Although the work varies among centers, their combined mission is to operate research, development, test and evaluation, engineering, and fleet support centers for offensive and defensive systems associated with surface warfare and related areas of joint, homeland, and national defense systems from the sea.

The two undersea warfare centers (NAVUNSEAWARCEN) are in Keyport, Washington, and Newport, Rhode Island, and employ more than 5,000 civilians. These centers provide research, development, test, and evaluation; engineering, analysis, and assessment; and fleet support capabilities for submarines, underwater systems, and undersea weapon systems in support of undersea warfare. They also provide in-service engineering, maintenance and industrial base support, fleet material readiness, logistics support, contracting, and acquisition support for undersea warfare.

Naval Information Warfare Systems Command (NAVWAR), formerly known as the Space and Naval Warfare Systems Command (SPAWAR), has centers at Charleston, South Carolina, and San Diego, California that employ more than 9,000 civilians. Their mission is to research, develop, test, and evaluate military command, control, communications, computers,

intelligence, surveillance, and reconnaissance (C4ISR) systems to provide information warfighting capabilities in support of naval, joint, coalition, and other national missions.

The Expeditionary Warfare Center (EXWC), in Port Hueneme, California, employs more than 900 civilians. Its mission is to provide research, development, testing and evaluation, and in-service engineering to deliver specialized facility and expeditionary solutions to the warfighter. The special warfare center (SPECWARCEN) and development group are in Coronado, California, and Virginia Beach, Virginia. They employ more than 600 civilians, and their mission is to conduct research, development, testing, and evaluation of commercially procured and modified equipment in support of naval special warfare operational forces.

Maintenance activities

Maintenance activities represent the second largest group, employing more than 52,400 civilians. The two types of maintenance activities are (1) those that maintain and repair ships and submarines and (2) those that maintain and repair aircraft.

Table 25 lists the activities that perform I- and D-level maintenance on ships and submarines. Most civilians work at the naval shipyards (NSYDs), intermediate maintenance facilities (IMFs), and regional maintenance centers (RMCs). Shipyards perform logistic support and work in connection with ship construction, conversion, overhaul, repair, alternation, dry-docking, outfitting, manufacturing research, redevelopment, and test work. The RMCs conduct surface ship maintenance and modernization, providing combat-ready ships from a maintenance and material condition perspective to the fleet.

Table 25. Ship and submarine maintenance activities

UIC	Activity name	Location	FY18 civilians
N4523A	Puget Sound Naval Shipyard and IMF	Bremerton, WA	12,508
N42158	Norfolk Naval Shipyard	Portsmouth, VA	11,009
N39040	Portsmouth Naval Shipyard	Portsmouth, NH	6,031
N32253	Pearl Harbor Naval Shipyard and IMF	Pearl Harbor, HI	5,535
N44466	Trident Refit Facility	Kings Bay, GA	1,695
N50054	Mid-Atlantic RMC	Norfolk, VA	1,220
N55262	Southwest RMC	San Diego, CA	1,155
N4002A	Southeast RMC	Mayport, FL	353
N62758	Ship Repair Facility, Japan	Yokosuka, Japan	331
N45404	Sub Maintenance Eng. Planning Program	Portsmouth, NH	216
N42812	Ship Maintenance Eng. Planning Program	Portsmouth, VA	170
Various	Forward Deployed RMC detachments	Overseas	195

Source: DCPD.

Table 26 lists the activities that perform I- and D-level aviation maintenance. Most civilians work at one of the three major fleet readiness centers at Cherry Point, North Carolina; Jacksonville, Florida; and North Island, California.[16] In addition to the readiness center detachments, we included the commanding activity of these centers and the Naval Air Technical Data and Engineering Service Command (NATEC).

Table 26. Aviation maintenance activities

UIC	Activity name	Location	FY18 civilians
N65923	Fleet Readiness Center East	Cherry Point, NC	3,883
N65886	Fleet Readiness Center Southeast	Jacksonville, FL	3,711
N65888	Fleet Readiness Center Southwest	North Island, CA	3,383
N4274A	Fleet Readiness Center Det. Mid-Atlantic	Virginia Beach, VA	319
N32379	Tech. Data and Eng. Service Command	San Diego, CA	319
Various	Other Fleet Readiness Centers	Various	275
N68520	Commander, Fleet Readiness Center	Patuxent River, MD	135

Source: DCPD and TFMMS.

Contributions of DON's civilian workforce

In this subsection, we present our breakdown of the Navy's civilian workforce by groups of activities that perform the same (or similar) functions. For each group, we show the size of the civilian workforce and our alignment to the contribution areas they support.

Aligning the contributions of DON's civilian workforce is more challenging because of its organization structure. As mentioned, this workforce is spread over fewer activities, many of which are sizable and perform multiple functions. The most notable example is the warfare centers. These activities perform a wide range of functions—from logistic support, to in-service engineering, to test and evaluation, to acquisition and research. Individually, these functions support specific readiness areas, but, combined, they support all three areas. As a result, the alignment of DON's civilian workforce is, to some extent, less informative than that of the other services.

With these limitations in mind, Table 27 shows our alignment of DON's civilian workforce to our contribution areas. Aside from the warfare centers and maintenance activities, which we discussed earlier, the next largest groups of civilians support facilities management and maintenance and base support (including security). Facilities management and maintenance

[16] These readiness centers were formerly known as naval aviation depots.

directly supports immediate- and near-term readiness and middle-term readiness; whereas base support aligns only with immediate- and near-term readiness.

Overall, most DON civilians work at activities that directly support immediate- and near-term readiness. The second most supported area is middle-term readiness, although some of this support is indirect versus direct. The results also reveal that a number of activities employing civilians directly or indirectly support military, and to a lesser extent, nonmilitary operations.

We applied the extension of our construct to the Navy's workforce by identifying the specific readiness pillars that each activity group supports. Table 28 shows this alignment. Similar to the other services, personnel, equipment, and training are the pillars that are supported by the most activity groups.

Table 27. Contributions of DON's civilian workforce

Activity groups	2018 civilians	Operations		Force readiness		
		Military	Nonmilitary	Near-term	Middle-term	Long-term
Warfare centers	53,123			**D/P**	**D/P**	**D/S**
I- and D-level maintenance	52,469			**D/P**	**D/P**	**D/S**
Facilities commands	14,140			**D/P**	**D/P**	**I/P**
Base support and security	10,080	**I/S**		**D/P**		
Hospitals and clinics	9,761	**I/S**		**D/P**	**I/S**	
Military sealift	6,712	**D/P**		**D/P**		
Logistics and supply	6,246			**D/P**	**I/S**	
Research	3,021				**I/P**	**D/P**
Educational institutions	2,709			**I/P**	**D/P**	**I/P**
Fleet and operational staffs	2,217	**I/P**		**D/P**		
Systems commands headquarters	2,070			**D/S**	**D/P**	**I/P**
Program executive officers	1,971			**I/S**	**D/P**	**D/P**
Criminal investigation	1,895	**I/P**	**I/S**	**I/P**		
Skills training	1,334			**D/P**	**D/P**	
Civilian human resources	1,281			**D/P**	**I/P**	
Meteorology and oceanography	1,171	**I/P**		**D/P**		
Cyber	1,064	**D/P**	**I/P**	**D/P**		
Strategic systems programs	1,006			**D/P**	**D/P**	
Ordnance management	796			**D/P**	**I/P**	
Computer and telecommunications	703	**D/P**		**D/P**		

Source: DCPD and CNA.

Notes: **D** indicates directly contributes; **I** indicates indirectly contributes; **P** indicates primary function; **S** indicates secondary function.

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Table 28. Alignment of Navy activity groups to readiness pillars

Activity groups	Readiness pillars					
	Personnel (P)	Equipment (E)	Supply (S)	Training (T)	Ordnance (O)	Facilities (F)
Warfare centers		D		D	I	
I- and D-level maintenance		D				
Facilities commands	I			I		D
Base support & security	I				I	D
Hospitals and clinics	D					
Military sealift			D		D	
Logistics and supply		D	D		D	
Research		D			D	
Educational institutions	D			D		
Fleet and operational staffs	D		I	D		
Systems commands		D	I	D	I	
Program executive officers	I	D		D		
Criminal investigation	I					
Skills training	D			D		
Civilian human resources	D			D		
Meteorology/oceanography				I		
Cyber	I	I				I
Strategic systems programs		I	I	I	D	
Ordnance management					D	
Telecommunications	I	I				I

Source: CNA.
Notes: **D** indicates directly contributes; **I** indicates indirectly contributes.

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Summary

We see the value of the results that are presented in this section as twofold.

First, they show the wide variety of functions that civilians across the three military departments support. Top among these, in terms of workforce size, are force sustainment, logistics, and maintenance functions. But civilians also play key roles in many other functions, such as training and education, research, security, medical, communications, and cyberspace operations.

Second, these results show that by contributing to such a wide variety of functions, the civilian workforce supports all facets of DOD's mission. Most civilians work at activities whose primary functions directly support immediate- and near-term readiness. Middle-term readiness is the second most supported area. This is not surprising given that most shore support activities, which are where most civilians work, focus on immediate- and near-term readiness of the operating force.

What we find surprising is the number of civilians who work at activities that support military and nonmilitary operations. We aligned activities that employ over 150,000 civilians to these contribution areas. Although we identified most of these contributions as indirect, that's still a significant number.

Civilian Contributions to Readiness Through Depot-Level Maintenance: A Case Study

The second of the two primary tasks in this study was to show, quantitatively, a relationship between the civilian workforce and readiness metrics in the operational force. To address this task, we present a case study on quantifying the readiness produced by civilians working in depot-level maintenance in the aviation depot-level repairable (AVDLR) supply chain for the DON. The case study integrates and builds on some results from a study about where investments would provide the most return in the End-to-End AVDLR supply chain [16].

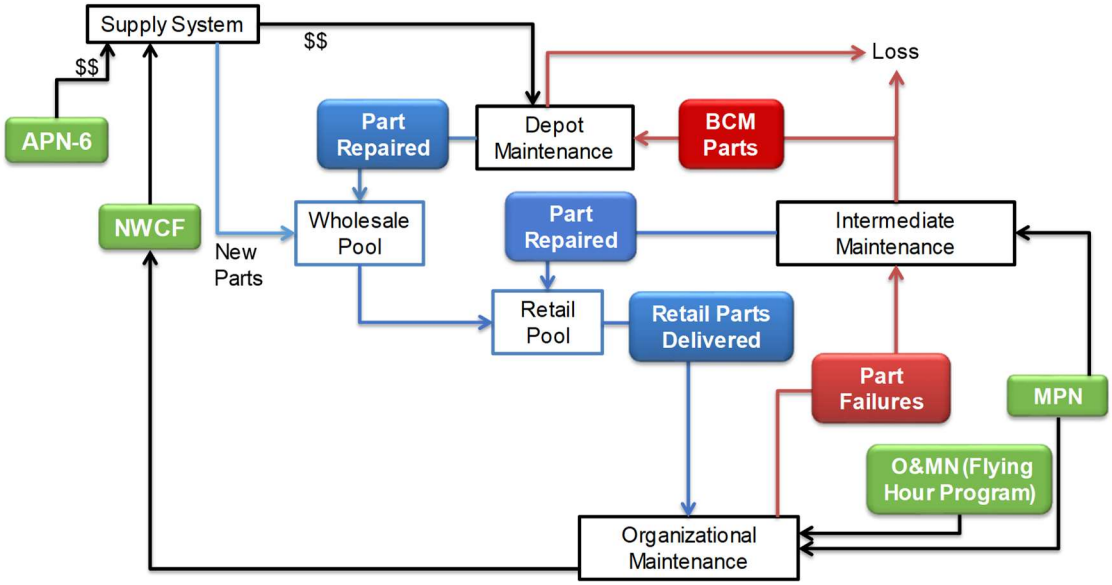
In this section, for background, we provide an overview of what happens to an AVDLR part at a depot. We then present the main results of our case study. The remainder of this section describes in detail how we arrived at these results.

Figure 1 shows the entire supply chain for AVDLR parts. The majority of DOD civilians working in the supply chain work in depot maintenance, a critical node in the supply chain. When a failed part is sent to the depot, the squadron's AVDLR O&M funds are charged and the payment is credited to the Navy Working Capital Fund (NWCF). The charge is intended to cover the cost of a repair (if a carcass (i.e., a nonfunctioning part)_is returned) or replacement (if no carcass is returned). The retail supply activity submits a requisition for a replenishment part from the wholesale pool. If ready-for-issue (RFI) parts are available at the wholesale level, they are issued to the retail site. Depot repairs and replacement procurements replenish the wholesale stocks. The time it takes to replenish wholesale stocks affects the readiness of aircraft. With a lower replenishment time, aircraft are awaiting parts for a shorter period. By mapping civilian labor at depots to replenishment time, we are able to provide an estimate of how much additional labor would increase readiness.

We find that increasing labor at depots would increase readiness cost effectively. To put the results in context, we calculate the readiness produced from buying an additional aircraft, an F/A-18, and compare it with the addition of $10 million worth of labor at the depots. Assume a new F/A-18 costs $60 million to purchase, requires $3 million per year in maintenance and modernization costs, lasts 20 years, and has the average mission-capable (MC) rate over its life in the current fleet (approximately 550 aircraft). Under the further assumption that one additional aircraft will add a proportional number of MC hours (1/550 or 0.0018), we expect an MC rate change per $10 million per year of 0.3. Using our model, we estimate that an additional $10 million in labor at the depots results in an increase of MC rates by 0.8 to 1.1 for

the F/A 18. Thus, investing in depot civilian labor is more efficient because it will provide greater readiness for the same cost as investing in a new aircraft.

Figure 1. The Navy's AVDLR maintenance, supply, and funding process



Source: CNA.

The rest of the case study lays out previous related research, the empirical framework of the various models and how we combined them to derive the foregoing results.

Prior research

This subsection briefly reviews relevant past research that links aviation readiness to DON resources in the maintenance and supply chain.[17]

In practice, "resources to readiness" analyses depend on a chain of causal factors or influences:

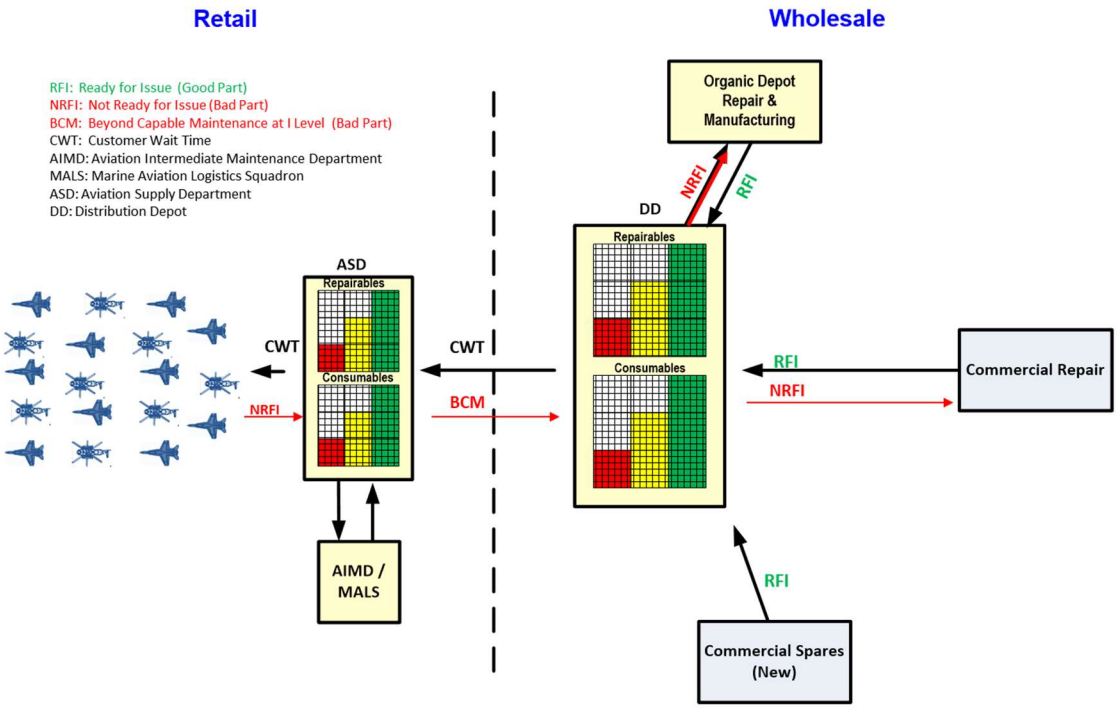
- Backorders that affect the readiness of the DON aviation fleet (i.e., operational availability as measured by fully mission capable (FMC) and mission capable (MC) rates)
- Repair turnaround times (TATs) that affect the extent of backorders
- Resource access that affects observed TATs

[17] For a more complete review of the literature, refer to [16].

Readiness as a function of backorders

Figure 2 illustrates the basic workflow of the DON maintenance and supply chain and provides the context for the analysis of backorders in general and AVDLRs in particular.

Figure 2. Aviation maintenance supply-chain participants



Source: Adapted from "F/A-18E/F Readiness and AREC Briefing" [17, p. 3].

In Figure 2, customer wait time (CWT) and the repair of not-ready-for-issue (NRFI) parts imply distinct types of delay, or TAT, in this system: time spent awaiting and undergoing repairs at organizational-, intermediate-, and depot-level (respectively, O-level, I-level, and D-level) facilities.

Backorders as a function of TAT

Readiness-based sparing (RBS) models combine engineering data on aircraft configuration with availability goals (i.e., FMC and/or MC rates) and assumptions about aircraft utilization, failure rates of parts, and resupply TATs to derive the cost-minimizing set of expected backorders—and, by implication, the optimal set of spare parts allowances.

Several studies have sought to quantify the impact of changes on additional resources by using RBS models to perform sensitivity analyses. Pfaff [18] reports on a sensitivity analysis of the RBS model used for Navy aviation weapon systems. His goal is to identify the factors that have the greatest impact on cost. The effects he identified—in order from largest to smallest in terms of cost across multiple air wings—are availability goal, unit price, wartime flying hours, part failures per flying hour, high-priority order and ship time, number of aircraft, wholesale delay time, rotatable pool factor, intermediate maintenance activity repair time, and mean time to repair. A related Naval Postgraduate School paper by Balafas, Krimizas, and Stage [19] analyzed how the integration of operational availability (A_o) into the acquisition process was connected to life-cycle costs. Focusing on the Light Armored Vehicle equipped with a 25-mm gun system (LAV-25), they find that repair TAT has the largest impact on A_o and readiness risk. Specifically, they find that the most efficient way of reducing life-cycle costs is a combination of TAT improvement and reducing the failure rates of critical components. Further, they argue that keeping a large inventory of spares does not significantly affect A_o or readiness risk but, rather, only increases total life-cycle costs.

The policy implications of these studies are limited to the extent that they do not identify how inputs should be adjusted to accomplish these changes. Policy advice on the broader resource-allocation question requires an understanding of the elements that determine the current status of TAT and other cost drivers, the motivation for this study.

Empirical framework

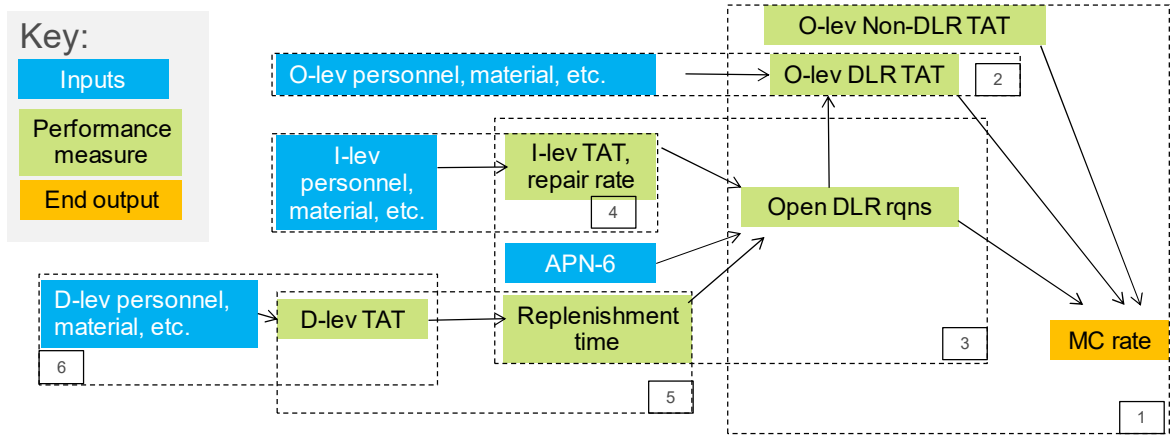
We model and estimate the relationships in the overall AVDLR process depicted in Figure 1 using a set of linked submodels. Each submodel is numbered and enclosed in a dashed rectangle in Figure 3. In this subsection, we provide a brief overview of models needed to perform the case study. In later subsections, we will discuss those models in more detail and provide estimation results.

MC rate equation

The highest level equation (indicated as submodel 1 in the figure) relates the monthly MC rate of squadrons at a site to the daily average AVDLR retail orders open during the month at that site, as well as the average O-level turnaround time on AVDLR-related maintenance actions (primarily remove and replace) open during the month. We allow for nonlinear relationships and interactions. For example, additional TAT days may not affect the MC rate as much when open orders are high as when they are low. We include two controls for the workload volume, for both the number of DLR removals during the month and the number of non-DLR maintenance actions during the month. We control for the squadron's equipment-in-service (EIS) hours, a measure of the number of aircraft supported during the month, as well as other

squadron characteristics (e.g., whether it is carrier based during the month, whether it is a fleet replacement squadron (FRS), and whether it is part of the Forward-Deployed Naval Forces (FDNF)).

Figure 3. Linked submodels in the AVDLR supply chain



Source: CNA.

The purpose of this top-level relationship is to establish a link and conversion from AVDLR-related performance measures to a more readily understandable measure of readiness, the MC rate. It will allow us to estimate changes in MC rates expected from changes in AVDLR chain performance measures.

Because all of the models ultimately feed into the MC rate equation, it would be possible to estimate a single model relating all inputs to the MC rate. However, a separate goal of this study is to estimate the relationships between inputs and performance within each node. These separate estimates can provide insight into how the effects of inputs on MC rates are mediated through the performance of the respective nodes.

Supply node

The performance measure for the supply node (submodel 3 in the diagram) is the daily average retail AVDLR open orders for weapons replaceable assembly (WRA) items removed by the squadron. Fewer AVDLR open orders on average mean that an RFI part is more likely to be on hand when the O-level needs it. We estimate the relationship between open AVDLR orders and three of their key determinants: (1) APN-6 investment to build up inventories at the site, (2) the TAT (and number) of AVDLRs repaired locally by the I-level, and (3) the TAT of replenishment AVDLRs received from the wholesale system. We also include controls for total demands, site-specific effects, and interactions among the determinants.

Wholesale replenishment equation

In submodel 5, we estimate the relationship between organic depot TAT and the average time retail sites spend awaiting replenishment parts. This submodel connects the depot and wholesale level to the retail level. To have a readiness effect, shorter TAT at the depot should improve replenishment time, thereby reducing the average number of open orders at the retail site.

D-level maintenance node

Organic depot-level maintenance (submodel 6) accounts for approximately one-third of all depot-level repairs, with the rest sent for commercial repair. Similar to the I-level model, key D-level performance measures are TAT and repair rate. Inputs are personnel quantity and experience, as well as indicators of parts and support equipment availability.

We discuss these individual models and their estimation in the following subsections. Ultimately, we combine these models to estimate (given the historical baseline allocation of resources) which additional resources are likely to provide the largest readiness return.

Depot-level maintenance

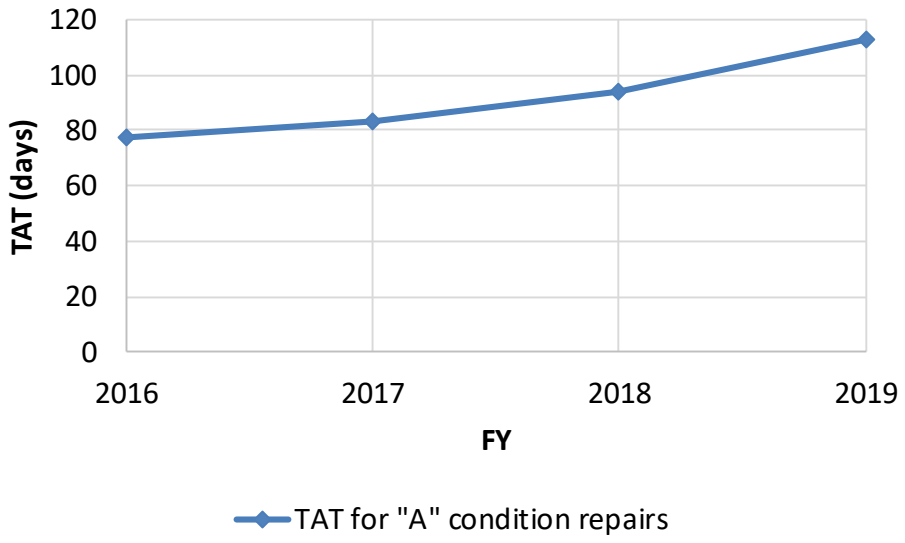
In this subsection, we model and estimate the performance of depot-level maintenance. Approximately one-third of depot maintenance on AVDLR components is performed organically. These results apply primarily to the F18 and EA18 groups, which have a large number of organically repaired components. We were unable to model depot TAT for MH60 AVDLR components because these are mostly commercially repaired under a performance-based logistics (PBL) contract.

Performance measures

Depot-level maintenance can improve AVDLR backlog in two ways: (1) by repairing a greater percentage of the failed components inducted for maintenance and (2) by repairing failed components more quickly (with a lower TAT). We illustrate trends in these performance measures for the F18 and EA18 groups in Figure 4 and Figure 5.[18] For the three years shown, approximately 90 percent of components inducted were repaired to "A" condition.

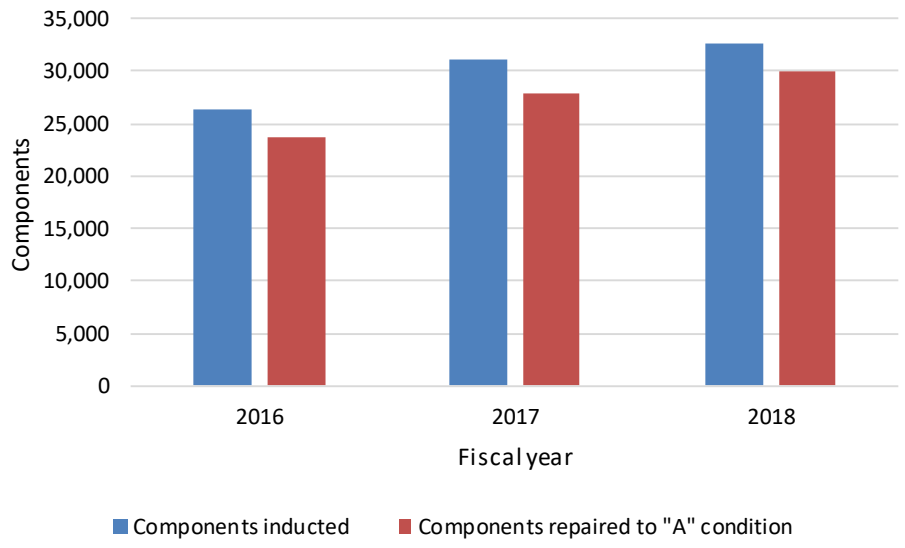
[18] Our dataset is limited to repairs inducted after 2014, so those completed in 2014 and 2015 naturally have shorter TAT. We have trimmed those earlier years from the TAT figure. We also present 2019 TAT in the figure. We were not able to include the 2019 repairs in our analysis because our personnel data went through 2018 only.

Figure 4. Depot TAT for F18 and EA18 component repairs



Source: Commander, Fleet Readiness Centers (COMFRC).

Figure 5. F18 and EA18 component organic depot inductions and repairs



Source: COMFRC.

Inputs

Based on previous research and discussions with subject matter experts, we found that D-level performance depends on the level, experience, and training of personnel and the availability of support equipment, facilities, and parts. We include the following three inputs in the estimation model.

Average daily count of federal wage system personnel at a depot during the time the maintenance action was open[19]

We categorize labor by pay scale. Most production workers are on the federal wage system (FWS) pay scale. Personnel in the WG category are considered apprentice level, WL personnel are journeymen, and WD, WN, and WS are personnel who oversee and facilitate production. We also include the GS personnel at the depot; they include the engineering and management staff.

Average experience of employees at the depot during the time the maintenance action was open

We include overall average months of service for all employees as a measure of the experience level of the staff. We also included indicators for education. Due to lack of historical data availability, however, we were unable to include personnel metrics for training and experience specific to type/model/series (T/M/S).

Parts, equipment or facility availability

We included various delay codes indicating whether the repair experienced a delay and the reason for the delay.

Controls

In addition to inputs, we control for a number of other external factors that may affect TAT.

Fiscal year indicators

The justification is the same as for the I-level. Processes that affect TAT may change over time in ways we are unable to observe. For example, a new policy in a particular fiscal year may require additional quality control on certain repairs, increasing TAT. To capture any such changes that affect all sites equally over time, we include fiscal year indicator variables.

[19] These include the following government wage scale categories: general schedule (GS); for regular schedule federal wage system jobs, nonsupervisory jobs (WG), leader jobs (WL), and wage supervisor jobs (WS); and for production facilitating jobs, nonsupervisory positions (WD) and supervisory positions (WN).

Average number of orders open during the time the maintenance action was open

A maintenance action started during a relatively busy time should have a longer TAT than one opened when the depot is less busy. We account for the workload or level of activity at the depot by calculating the average number of orders open during the time the maintenance action was open.

Maintenance resource intensity

Our measure of resource intensity is the workload labor standard (WLS) for the component repair. This represents the basis for the fixed price that the depot, a working capital fund activity, charges to its customers.

Other workload at the depot

Depots also perform scheduled "deep" maintenance (overhauls) on aircraft. We observe total personnel at the depot, including both those who repair components and those who perform overhauls. We were told that these two groups typically work separately, but occasionally the component repair shops will support overhauls. To account for fluctuations in overall personnel attributable to aircraft overhauls, as well as any competing demand effects, we include the count of overhauls in process during the time the component repair was open.

Site fixed effects

We include an indicator for each of the three depots. The indicator accounts for any site-specific unobserved factors that may affect TAT.

Data

Repair and overhaul data come from COMFRC and consist of all AVDLR depot-level maintenance actions between FY 2014 and FY 2018. We gathered civilian manpower data from 1990 to 2018 using snapshots from the Defense Civilian Personnel Data System (DCPDS). The data consist of the entire work history of all individuals who ever worked at a depot.

Model

We estimate an ordinary least squares (OLS) regression model with squared terms for the inputs and all pairwise interactions among inputs. This specification allows for the marginal effects of an input (on performance) to depend on the level of the input as well as other relevant inputs. For example, a less experienced worker working alone takes more time to complete a repair than one with more experience. However, workers do not work alone, and those with more experience can help train newer and less experienced staff. Our model allows for interactions between staff at varying experience levels to capture experience transfer between

workers. Along with worker ability, parts and support equipment availability are important both singularly and with respect to other inputs. Adding manpower when there is no available support equipment for them to use, or adding support equipment without trained personnel to use it, will each have a smaller effect on TAT than some combination of equipment and manpower.

An observation for us consists of a single repair associated with the aggregate average levels of personnel working at the depot while the repair was open.

Results

D-level TAT

This subsection presents the results of the statistical analysis of depot-level TAT. The interpretation of marginal effects is similar to previous models. A difference here is that we have more categories of labor and more interaction terms in our model. The marginal effects for labor reported in Table 29 represent the mean effect of an additional worker, assuming other variables remain constant at their respective means. For example, adding a worker in the WG pay scale would decrease TAT by 2.5 days. This effect is not constant and would diminish as more workers are added because our model incorporates interactions between working groups along with nonlinear effects.

Table 29. Effect on TAT for a one-unit increase of the variable

Variable	Marginal effect on TAT (days)
Average labor in WG pay scale during repair	-2.5
Average labor in WL pay scale during repair	-5.8
Average labor in WD pay scale during repair	-6.9
Average labor in WN pay scale during repair	-24.2
Average labor in WS pay scale during repair	5.3
Average labor in GS pay scale during repair	2.4
Average labor not in W or GS pay scale during repair	7.8
WLS	0.3
Average months of service for all employed at the depot	20.9
Turnaround time of all completed AVDLR repairs in previous month	0.02
Average number of AVDLR repairs open during repair	-0.4
Average daily labor hours dedicated to aircraft overhaul during repair	11.4
Average number of open aircraft repairs during repair	-1.9
Had material delay (delay code 234)	-0.1
Had engineering/technical delay (delay code 232)	8.1

Variable	Marginal effect on TAT (days)
Had facilities delay (delay code 233)	15.7
No delay	-38.4
Sample size	262,337
R-squared	0.53

Source: CNA.

COMFRC provided indicators of the types of delays experienced by each repair action but was not able to provide the length of each delay by type. We included the various delay indicators in the model. Approximately 95 percent of the repairs in our sample experienced no delay. Applying the estimated effect of having no delay (-38.4 days) to the 5 percent of repairs that experienced a delay, we estimate that eliminating all coded delays would reduce overall depot TAT by 1.9 days.

Probability of repair

We also examined the probability that a component was repaired to "A" condition (versus declared "not repairable"). Over 90 percent of inducted components for the F18 (and approximately 90 percent of all components) are repaired to "A" condition. We found generally negligible estimated effects on this probability from the list of inputs we used for the TAT specification. This suggests that increasing any of these inputs is not likely to change the depot repair rate appreciably.

Linking depot TAT to the larger model

To connect depot TAT to retail AVDLR availability, we estimated a statistical model of the effect of depot TAT on wholesale replenishment time, a performance measure for the wholesale system. Wholesale replenishment time is the average time to deliver parts from the wholesale to the retail level. Later, in our empirical model of the supply node, we will relate wholesale replenishment time to retail AVDLR availability.

Our unit of observation is a supply site day for the F18 group. We focused on depot repairs of components for the E/F version of the F/A-18.[20] The performance measure (dependent variable) is the average time to receipt for replenishment requisitions for organically repaired F18 components during the last 60 days. The explanatory variables include both "supply" and "demand" factors, both of which can influence the availability of wholesale inventory and, consequently, replenishment time.

[20] Specifically, we used SI codes "BB," "G1," and "G2," which identify F/A-18 E/F components.

As supply factors, we include the number of F/A-18 E/F components repaired (to "A" condition) by the depots during the last 90 days and the average TAT for those repairs. If the depots repair more parts at a faster rate, it should result in lower replenishment time. As demand factors, we include the number of items beyond capability of maintenance (BCMs) for organically repaired F18 components during the last 60 days, and the number of replenishment requisitions during the last 60 days. We also include the number of opened jobs at the depot during the last 90 days as a proxy for the wholesale inventory of "A" condition parts. We expect that fewer jobs will be opened if inventories are healthy.

We present the results in Table 30. A 1-day increase in depot TAT is associated with a 0.07-day average increase in wholesale replenishment time.

Table 30. Model of average wholesale replenishment time, last 60 days

Variable	Estimate	t-stat.
Total F 18 EF replenishment requisitions, last 60 days	0.013	11.98**
Total BCMs, last 60 days	-0.02	8.29**
Average depot TAT for F-18 EF repairs, last 90 days	0.07	4.42**
Average depot completed F-18 EF repairs, last 90 days	-0.001	4.93**
Average depot opened F-18 EF jobs, last 90 days	0.0004	2.48*
Sample size	2,349	
R-squared	0.24	

Source: CNA.
*Significant at the 5 percent level.
**Significant at the 1 percent level.

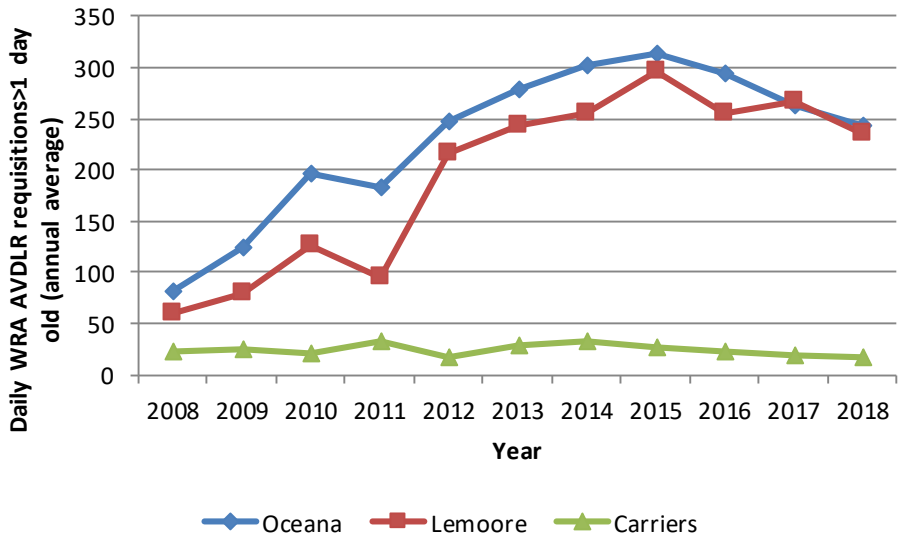
Supply node

In this subsection, we model and estimate input-performance relationships for the supply node. In our empirical framework, the supply node provides squadrons with an adequate supply of RFI parts at the WRA level.

Performance measure

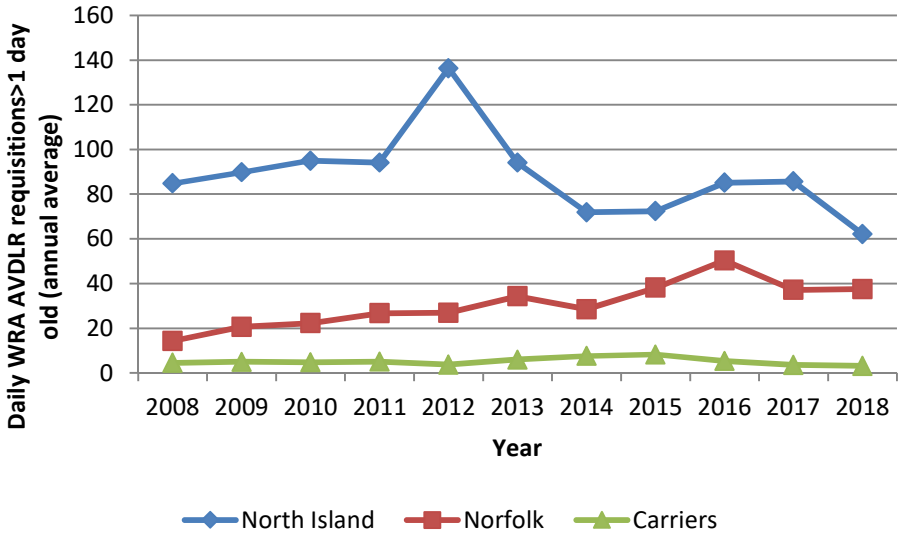
We use the daily number of open retail AVDLR requisitions at a supply site (shore station or aircraft carrier) as a primary performance measure. We define a requisition as open if it has been awaiting issue for at least one day. A larger number of open requisitions on average will mean longer average wait times for AVDLRs. An unfilled order (open requisition) means there is an aircraft awaiting the replacement of a piece of nonfunctioning equipment. In Figure 6 and Figure 7, we present trends in retail backlog for selected retail sites for the F18 and MH60 groups.

Figure 6. Open AVDLR WRA requisitions over time, F18 group



Source: Decision Knowledge Programming for Logistics Analysis and Technical Evaluation (DECKPLATE).

Figure 7. Open AVDLR WRA requisitions over time, MH60 group



Source: DECKPLATE.

Inputs

We have included the following four variables as inputs in our model.

Procurement of additional components to increase allowances (APN-6)

For each AVDLR component, Naval Supply Systems Command (NAVSUP) applies a readiness-based sparing model to estimate the inventory allowance. This model estimates how many additional parts of each component the Navy should keep on hand, given predicted reliability, repair time, and other factors. When required inventories change (e.g., if a part is failing more frequently than originally estimated), one-time additions are funded under the APN-6 appropriation. We observe the number and cost of these APN-6–funded allowance adjustments at each site each day.[21] We expect that more APN-6 spending at a site on a given day (measured as the value of the parts received by the site on that day) will result in lower subsequent AVDLR backlog.

Replenishment time from the wholesale system

Local supply can be affected by the time it takes to receive replenishment parts from the wholesale system. We include average wholesale replenishment time for the preceding 30 days as an input.

I-level TAT

We expect that shorter I-level TAT for AVDLR repairs will result in fewer components in the local repair pipeline and more on the retail shelf ready for issue (RFI). We include average I-level TAT for the preceding 30 days as an input.

I-level RFI repairs

The number of repairs is also an important determinant of how much stock is ready for issue. We expect that more items repaired by the I-level will reduce open orders, all else equal. We include daily total completed I-level repairs as an input.

Controls

New requisitions

The number of open AVDLR requisitions will also depend on new demand, other things equal. We include daily new AVDLR requisitions to control for this demand factor.

[21] We included requisitions in the Aviation Financial Analysis Tool (AFAST) coded with fund code "QZ" that had a project code other than "799." This project code indicates an inventory for a new item, rather than an adjustment to an existing allowance.

Site-specific effects

We also include site-specific fixed effects to account for unobserved factors unique to each site that may affect the level of open requisitions.

Data

Requisition data come from Commander, Naval Air Forces' (CNAF's) Aviation Financial Analysis Tool (AFAST) and consist of all requisitions completed between FY 2007 and FY 2018. The AFAST data include both replenishment requisitions (advice code 5X) and APN-6 requisitions. To calculate the daily backlog of WRA requisitions, we matched supply issue actions to O-level AVDLR removals (both from DECKPLATE). The supply actions identify both the requisition date and issue date, which we used to determine how long a requisition was open. We used DECKPLATE maintenance data to calculate the local repair summary statistics (TAT and number of repairs).

We used data for the full time period (FY 2008 through FY 2018) for the F18 and MH60 groups, but only the June 2015–FY 2018 period for the EA18 group. Squadrons were transitioning from the EA-6B to the EA-18G between 2009 and 2015, and we were unable to reliably separate requisitions associated with each TMS at each site during the transition period. As a result, we estimated the model only for the period following the EA-6B retirement in June 2015.

Model

We report the results from a truncated OLS regression model.[22] The unit of observation is a supply-site day. Our dependent variable is the daily change in open requisitions at the site.

The estimation model includes interactions among the various inputs as well as diminishing returns (squared terms). For example, the effect of APN-6 spending on retail AVDLR backlog may be higher when local I-level repair TAT is higher.

Results

Table 31 presents the change in open retail requisitions associated with small increases in values of the given explanatory variables. Full regression results are available in Appendix D. Most of the estimated parameters have the expected sign (positive or negative). For example, we would expect more APN-6 spending for additional spares to reduce the average number of

[22] We use a truncated OLS estimation to account for the fact that our observed changes in open AVDLRs are constrained to be above the previous day's level. In other words, we do not observe open AVDLR values below zero.

open requisitions at a site. The two statistically significant estimates (for the F18 and MH60) groups have the expected negative sign.

More repairs completed by the I-level also reduce open requisitions for all three groups. Shorter I-level TAT reduces open requisitions for the F18 group, but not for the MH60. Longer wholesale replenishment time increases average open requisitions for the F18 group, but has no statistically significant effect for the other groups.

We also report the marginal effect of the total number of AVDLR requisitions opened. These all have statistically significant and positive effects, as expected.

Table 31. Supply node marginal effects at historical values

Variable	Marginal effect on open AVDLR requisitions (no. of requisitions)		
	F18	MH60	EA18
AVDLR procurement (APN-6) for site (+$1 million)	-4.6	-0.7	n.s.
Wholesale replenishment time (-1 day, sustained for 1 year)	-5.8	n.s.	n.s.
Local AVDLR repairs completed by I-level (+1 percent of annual average)	-6.7	-1.2	-1.3
I-level TAT for completed repairs (in days) (-1 day, sustained for 1 year)	-5.8	1.4	n.s.
AVDLR requisitions opened (+1 percent of annual average)	8.3	2.5	3.0
Sample size	23,771	21,642	3,768
R-squared	0.13	0.13	0.11

Source: CNA analysis of DECKPLATE data.
Note: Marginal effects represent the estimated change in open AVDLR requisitions due to the indicated change in the input variable of interest. All estimated effects are statistically significant at the 1 percent confidence level, except where indicated by "n.s." R-squared is calculated as the squared correlation between actual and predicted open AVDLR requisitions.

MC-rate model

In this subsection, we present estimates for a statistical model relating the key AVDLR supply chain performance measures (O-level AVDLR TAT and open AVDLR requisitions) to monthly squadron MC rates. The purpose of this model is to provide a common metric (MC rate) with which to compare alternatives that may affect different intermediate performance measures within the AVDLR supply chain.

We estimated a fractional logit model, which has the advantage of predicting values between 0 and 1.[23] We include various interactions to capture nonlinear effects. We also include control variables for squadron characteristics. A unit of observation is a squadron-month. We normalize several of the variables by equipment in service (EIS) months, which represents the average number of aircraft a squadron was responsible for during the month.

Full regression results and sample summary statistics are in Appendix D.

In Table 32, we present marginal effects for variables included in the model. The marginal effects represent the change in MC rates associated with unit changes in each of the variables listed. AVDLR-related performance measures are highlighted in boldface. For example, for the F18 group, a one-day increase in the average days to complete a remove-and-replace (RR) maintenance action is associated with a 0.2 percentage point decline in a squadron's MC rate. Similarly, a one-requisition reduction in the average number of open DLR requisitions per EIS month would result in a 4.3 percentage point increase in the MC rate.

Table 32. Marginal effects, monthly MC rates for F18 squadrons

Variable	Estimate	P-stat.
Squadron monthly AVDLR WRA Remove/Replace (RR) TAT (days)	**-0.002**	**7.12****
Squadron monthly consumable RR TAT (days)	-0.002	2.80**
Squadron monthly non- RR TAT (days)	-0.004	7.05**
Squadron open retail AVDLR WRA requisitions per EIS month	**-0.043**	**9.60****
Squadron EIS months	-0.003	2.09*
Squadron month average non-RR jobs open per EIS month	-0.000	2.47*
Squadron month average AVDLR WRA jobs open per EIS month	**-0.000**	**0.42**
Squadron month average daily consumable RR jobs open per EIS mo.	-0.002	6.84**
Squadron has F/A-18 C or D	-0.144	6.47**
Fleet Replacement Squadron	0.134	2.84**
Forward-Deployed Naval Forces	-0.063	4.05**
Carrier-based in month	0.031	5.23**
Operational status: work-up	0.199	4.57**
Operational status: deployed	0.228	5.26**
Operational status: sustain	0.188	4.32**
Sample size	4,711	
R-squared	0.41	

Source: CNA.
Note: R-squared is calculated as the squared correlation between actual and predicted MC rate.
**Significant at the 1 percent level.

[23] We implemented this in Stata using the generalized linear model with a binomial family and log link.

Combining the estimates

In this subsection, we combine the empirical results from the earlier discussions to estimate the effects of various resource changes on MC rates. We use the historical sample as the baseline conditions, though these can be modified for analyses of other scenarios. One caveat to the estimates presented here is that errors or poor data in any one of the submodels will carry through and distort the results of the combined model. Nevertheless, it is useful to illustrate how the estimates from the multiple models can be brought together.

Effects of intermediate nodes

Based on the estimated relationships and the framework in Figure 3, we first calculate a "readiness factor" for how fleet-wide improvements in each of the intermediate nodes affect fleet MC rates. We use the sample average values in Table 33 to calculate estimated effects of percentage changes presented in Table 34.

Table 33. Baseline fleet-wide values for intermediate nodes (sample averages)

Performance measure	F18	MH60	EA18
Depot AVDLR TAT	88 days	n/a	n/a
Depot annual AVDLR repairs (organic only)	29,000	n/a	n/a
Wholesale replenishment time	16.7 days	16.6 days	15.7 days
I-level AVDLR TAT for repairs	9.6 days	14.2 days	8.9 days
I-level annual WRA BCMs (excluding auto-BCMs)	3,500	2,000	300
I-level annual WRA repairs (excluding auto-BCMs)	23,500	4,700	3,000
I-level repair rate	87%	70%	91%
O-level AVDLR TAT	10.6 days	18.2 days	11.5 days
Open AVDLR WRA requisitions, fleet daily average	524	159	170
Open AVDLR WRA requisitions, site daily average	82.7	26.8	50.3
Open AVDLR WRA requisitions, per squadron	14	5	8.9
Open AVDLR WRA requisitions, per EIS month	1.1	0.5	1.3

Source: CNA.
Note: "n/a" indicates not available.

For example, using the results in Table 30, a 10-day improvement in F18 depot TAT will reduce mean replenishment time for organically repaired components by 0.7 day. Accounting for the fact that organically repaired components account for a third of all wholesale replenishments, overall replenishment time will decrease by 0.23 day. Multiplying by the marginal effect of -5.8 in Table 31, this in turn reduces open requisitions at all retail sites by 1.3 items (or 1.5 percent). Applying this percentage decrease to open requisitions per EIS month of 1.1 (and using Table 32) ultimately increases the fleet's MC rate by 0.07 percentage point.

This table is useful for comparing various initiatives intended to influence each node of the AVDLR supply chain.[24] It also illustrates the multiplicative nature of the supply chain. In addition, it can identify performance measures that may not be worth targeting if the potential MC rate gains are very low or nonexistent.

Table 34. Estimated fleetwide MC rate effects of changes in performance measures

Change in performance measure	F18
Depot AVDLR TAT (10-day reduction)	0.07
Depot AVDLR repairs (10 percent increase)	0.2
I-level AVDLR TAT (1-day reduction)	0.3
I-level BCMs (10 percent reduction)	0.6
O-level AVDLR WRA TAT (1-day reduction)	0.2
Open AVDLR WRA requisitions (10 percent reduction)	0.4

Source: CNA.
Notes: Estimates connecting open AVDLR requisitions to MC rates for the EA-18G use those estimated for the F18 group. "n/a" indicates not available.

Effects of inputs

Next, we highlight the potential MC rate changes resulting from selected input changes within various nodes of the AVDLR supply chain. We focus on the F18 group. We have included costs where information is readily available, such as additional APN-6 investments or personnel changes.

In Table 35, we present estimated MC rate gains resulting from F18 depot-level inputs. The values for the change in depot TAT come from Table 29. We multiply these by the estimated effect of a 10-day organic depot TAT reduction on MC rate of 0.07 from Table 34, then divide by 10 days to obtain the change in MC rate shown in the table.

Table 35. Estimated effects of inputs at the depot level (F18 group only)

Change in input	Change in depot TAT	Change in MC rate (percentage points)	Estimated cost, if available	MC rate change per $10M per year
Additional apprentice (WG) at each depot	-2.5 days	0.02	$266,418	0.8
Additional journey (WL) at each depot	-5.8 days	0.04	$355,224	1.1

[24] Because our sample for the MC rate submodel was considerably smaller for the EA-18G than for the other groups, we have assumed that the effect of open AVDLRs on MC rate is the same one estimated in the F18 model.

Change in input	Change in depot TAT	Change in MC rate (percentage points)	Estimated cost, if available	MC rate change per $10M per year
Additional supervisor (WD) at each depot	-7.0 days	0.05	$444,030	1.1

Source: CNA.
Note: We assumed hourly rates of $30 for WG, $40 for WL, and $50 for WD, with a fringe factor of 44 percent.

To put these costs in context, consider the cost to increase fleet MC hours by purchasing a new aircraft. Assume a new F/A-18 costs $60 million to purchase, requires $3 million per year in maintenance and modernization costs, lasts 20 years, and has the same average MC rate over its life as the current fleet (approximately 550 aircraft). Under the further assumption that one additional aircraft will add a proportional number of MC hours (1/550 or 0.0018), we expect an MC rate change per $10 million per year of 0.3. All of the estimates where we were able to calculate costs compare favorably with this benchmark supplying over twice as much readiness, a change of 0.8 to 1.1.

The foregoing breakdown demonstrates that, in comparison to purchasing aircraft, investment in depot civilian labor is efficient. However, analysis of larger spending changes or different baseline spending levels may be influenced by diminishing returns or estimated interdependencies among the nodes. Furthermore, the MC rate model results suggest that there is a maximum potential MC rate gain from improved AVDLR performance. As the baseline number of open retail AVDLR requisitions declines toward zero, further reductions may be increasingly costly to achieve and may yield successively smaller improvements in MC rates. Thus, our estimates of the relationship between amount of labor and MC rates applies to marginal changes in labor around system averages.

Summary

We have presented a set of linked empirical models intended to help identify civilian depot workers' contributions to readiness and relationships between resources and outcomes in the AVDLR supply chain. The linked models allow us to estimate and compare the relative costs and benefits of applying resources that increase the civilian workforce within the AVDLR supply chain. We focus on the F/A-18 aircraft group because it has the largest source of available data, and we find that additional investment in civilian labor is more than twice as efficient as purchasing new aircraft.

Findings and Recommendations

The primary objective of this study was to provide visibility into the contributions and roles of DOD's government civilian workforce as enablers of warfighter readiness, lethality, and capability. Given the large size and wide distribution of this workforce and the many types of work that civilians perform, and to scope this effort within the available resources, we focused on two tasks: (a) examine the entire civilian workforce at a high level to identify the areas in which civilians contribute to DOD's mission and to determine how many civilians contribute to each of these areas and (b) conduct a more in-depth analysis of a specific sector of this workforce to develop quantitative relationships between its size and key military readiness metrics.

Key findings

In the section, we present the key findings from our investigation of each task.

Identifying contributions across the entire civilian workforce

Analytic construct

We believe that one of the most important outputs from this study is a construct for analyzing how the civilian workforce contributes to DOD's mission. Other reviews of this workforce are based on the individual jobs that civilians perform, which are typically aggregated by occupational groups. In these reviews, a comptroller at a depot maintenance activity is grouped with a comptroller at a training activity, and all are likely designated as performing a financial oversight function. Our construct differs in that it is based on the missions, functions, and tasks of the organization—not individual jobs. All employees in the organization contribute to these operational and readiness areas that align with its missions and functions, regardless of their occupation. Furthermore, because organization's MFTs are more closely aligned with DOD's mission, this enables a more intuitive connection between the work that civilians perform and DOD's mission.

Our construct consists of four phases:

1. Define the areas in which the civilian workforce contributes to DOD's mission. Our framework defines five contribution areas: military operations, nonmilitary operations, immediate- and near-term readiness, middle-term readiness, and long-term readiness.
2. Align DOD work functions to the contribution areas they support.

3. Identify activities that employ large numbers of civilians and group these activities by the primary function(s) they perform.
4. Where applicable, align these activity groups to the construct's contribution areas.

One important lesson we learned in applying this construct using civilian personnel data at the activity level is that the ability to accurately identify which civilians contribute to which functions depends, in part, on the granularity of the service's organizational structure. A structure such as the Air Force's that consists of many small, single-function activities lends itself to more accurate results than a structure like the Navy's that has many large organizations that perform multiple and, in some cases, dissimilar functions. One option to address this issue would be to divide these larger organizations into smaller components such as departments or divisions; however, this would require data beyond those in the Defense Civilian Personnel Database (DCPD).

Summary of results

Using data in the DCPD, we examined the civilian workforces of all three military departments. In 2018, this workforce was spread over 11,600 activities. About half of these activities employed 10 or more civilians. We focused our investigation on these activities, grouping them by their primary functions. We then aligned these activity groups to the contribution areas in our construct. We believe the value of analyzing the workforce using this construct is twofold.

First, it shows the wide variety of functions that civilians across DOD support. Although our results reveal that most civilians work at activities that directly support force sustainment, logistics, and maintenance functions, significant numbers work at activities that conduct or directly support other key functions, such as training and education, force security, medical services, communications, and cyberspace operations.

Second, in aligning these functions to our contribution areas, we see that the civilian workforce supports nearly all aspects of DOD's mission. Our results show that most civilians work at activities whose primary functions directly support immediate- and near-term force readiness. Middle-term readiness is the second most supported area. This is not surprising given that most shore support activities—where most civilians work—focus on the immediate- and near-term readiness of the operating force.

A somewhat surprising result is the number of civilians that work at activities that either directly or indirectly participate in conducting military (i.e., noncombat functions) and nonmilitary operations. We aligned activities that employ over 150,000 civilians to these contribution areas. Although we identified most of these contributions as indirect versus direct, this still represents a significant contribution.

Quantifying relationships between the civilian workforce and readiness

The other goal of this study was to develop quantitative relationships between a specific sector of the civilian workforce and readiness metrics in the operational force.[25] We addressed this through a case study that quantifies the readiness produced by civilians working in depot-level maintenance in the aviation depot-level repairable (AVDLR) supply chain. The case study presents a set of linked empirical models to help identify the contributions of civilian depot workers to readiness and relationships between resources and outcomes in the AVDLR supply chain. These linked models allow us to estimate and compare the relative costs and benefits of applying resources that increase the civilian workforce within the AVDLR supply chain. Applying these models to the F/A-18 aircraft group, we find that additional investments in civilian labor are more than twice as efficient in increasing the aircraft mission-capable rate as purchasing new aircraft.

This work represents the type of analysis that is required to properly assess the size and composition of the total force. The methods used to map individual maintainer contributions to readiness are applicable regardless of the service or sector performing the work. Our analysis focused on maintainers because there is a natural way to measure their contribution to readiness. But the same approach will apply to any group within the department's supply/maintenance chain as long as some type of readiness is measured as the end product. The other reason for analyzing maintenance work is the availability of data. Analyzing relationships in other types of work (e.g., training or research) will be more challenging, primarily because of the lack of quality data and quantitative readiness metrics.

Another benefit of quantifying the readiness contributions of any workforce—civilians included—is to help make strategic, analytically informed decisions about short-term and longer term investments in the workforce (labor) vice short-term and longer term investments in such things as additional aircraft (capital).

Recommendations

This study neither determines DOD's optimal workforce mix nor analyzes the cost-effectiveness of civilians performing certain functions relative to military personnel or contractors. Rather, it attempts to identify and, where possible, measure the contributions of the current civilian workforce to DOD's mission. Measuring these contributions through a

[25] Another benefit of quantifying the readiness contributions of any workforce—civilians included—is to help make strategic, analytically informed decisions about short-term and longer term investments in the workforce (labor) vice short-term and longer term investments in such things as additional aircraft (capital).

sound analytical process is a critical first step in answering these questions and avoiding actions based on unfounded perceptions. In addition, a benefit of measuring the contributions of the civilian workforce to readiness is that it allows for cost-benefit comparisons of investments in (civilian) labor vice capital. This study provides an example of one such cost-benefit comparison.

Given these study objectives, we offer recommendations for using this work to address issues related to the size and mix of DOD's total force.

- Use these findings to assess whether the civilian workforce is positioned to achieve leadership's goals. DOD leadership issued a directive to maximize warfighting lethality and readiness and to increase the capability and capacity of our military force. We believe the results of our work can be used to assess whether the distributions and contributions of this workforce align with these goals. The fact that the contribution areas in our construct align with these goals should facilitate such an assessment.
- Compare civilian contributions with those of the military and contractor workforces. Given that our work examined the civilian workforce, the next logical step would be to use this construct to identify contributions of the other manpower types: military personnel and contractors. For military personnel, this investigation should focus on the workforce in nonoperational commands. One option to allow a more equitable comparison would be to restrict this investigation to those activities that also employ government civilians. The results would enable a comparison of civilian to military personnel by function and contribution area that would help answer such questions as (1) Are civilians supporting the same functions and contribution areas as military personnel (or contractors)? and (2) If not, where and how do they differ? We acknowledge that the lack of quality data may present a challenge in analyzing the contractor workforce.
- Track changes in the contributions of the civilian workforce over time. Another useful application of this construct would be to analyze contributions over time. Has the distribution of civilians by contribution area changed, and, if so, in which areas and functions? Do these changes align with changes in the contributions of the military or contractor workforce?
- Develop quantitative relationships for other sectors of the civilian workforce. Although the work we presented addresses only a small portion of the civilian workforce, the methods used to map individual maintainer contributions to readiness are applicable to other sectors in the department's supply/maintenance chain. The only prerequisites are the availability of quality data and quantitative readiness measures of the end product.

Because measuring the contributions of DOD's entire civilian workforce is a sizable undertaking, this work should be viewed more as an initial step than a complete solution. Therefore, we also recommend, as a next step, expanding this work through the following actions:

- Conduct a more thorough examination of DOD's civilian workforce (including the DOD agencies) and use the results to evaluate and, if necessary, modify this construct.
- Explore other data options to segment the workforce of large, multifunction organizations (e.g., the naval warfare centers) to improve the ability to accurately identify which civilians contribute to which areas.

Appendix A: Air Force's Civilian Workforce at Other Activities

In the main body of this report, we examine the civilian workforce at the Air Force's two largest civilian employers: Air Force Material Command and Air National Guard. This appendix provides similar information on the other Air Force commands/agencies that employ significant numbers of Air Force civilians (see table 8).

Air Education and Training Command

The mission of the Air Education and Training Command (AETC) is to recruit, train and educate airmen. It includes Air Force Recruiting Service, two numbered air forces and the Air University [20]. Table 36 breaks down the AETC's civilian workforce by functional area.

Table 36. Major AETC functions and workforce

Functions	2018 civilians
Training	1,901
Civil Engineering	1,806
Maintenance	1,479
Medical	1,222
Force Support	960
Flying Training	779
Logistics	677
Communications	449

Source: DCPD and CNA.

Air Combat and Air Mobility Command

Air Combat Command (ACC) is the primary provider of air combat forces to America's warfighting commanders and is the direct successor to Tactical Air Command. Its mission is to support global implementation of national security strategy by operating fighter, reconnaissance, battle-management and electronic-combat aircraft. It also provides command, control, communications and intelligence systems, and conducts global information operations. ACC also develops strategy, doctrine, concepts, tactics, and procedures for air-, space-, and cyber-power employment [21].

Air Mobility Command's mission is to provide rapid, global mobility and sustainment for America's armed forces. The command also plays a crucial role in providing humanitarian support at home and around the world. The men and women of AMC provide airlift and aerial refueling for all of America's armed forces [22].

Table 37 breaks down the combined civilian workforce of these two commands by functional area.

Table 37. Functions and workforce at the ACC and AMC

Functions	2018 civilians
Medical	1,822
Civil Engineering	1,616
Air Mobility Command	1,369
Air Combat Command	1,095
Force Support	1,070
Intel	1,036
Operations Support	953
Maintenance	771
Cyber	728

Source: DCPD and CNA.

Space Command

The Space Command provides space capabilities for the joint fight through the operational missions of spacelift; position, navigation and timing; satellite communications; missile warning and space control. Its largest subordinate command, the Space and Missile Systems Center, designs and acquires all Air Force and most Department of Defense space systems. It oversees launches, completes on-orbit checkouts and then turns systems over to user agencies. Table 38 breaks down the Space Command's civilian workforce by functional area [23].

Table 38. Major Space Command functions and workforce

Functions	2018 civilians
Space/Missile Systems Center	1,379
Civil Engineer	576
Force Support	439
Space Wing	373
Security	303
Cyber	291
Logistics	282

Source: DCPD and CNA.

Appendix B: Army's Civilian Workforce at Other Activities

The main body of this report reviews the civilian workforce at Army's largest civilian employer: Army Material Command. This appendix provides more information on AMC's subordinate commands and on other Army commands and agencies that employ large numbers of civilians (see Table 17). It breaks down each of these commands by the primary functions they perform and identifies the activities (and number of civilians working at those activities) that conduct each function.

Army Materiel Command

US Army Materiel Command (AMC), through its subordinate commands, provides technology, acquisition support, and logistics to the Army and our allies [5]. Under its command are six large subordinate commands, each of which employs thousands of civilians. We examine the civilian workforce at each of these subordinate commands in the following subsections.

Army Installation Management Command

The Installation Management Command (IMCOM) is AMC's largest civilian employer. Nearly all of its over 21,000 civilians work at Army or joint bases both within the United States and abroad. The primary mission of these activities is to manage and deliver base support to enable force readiness [10].

Army Tank-Automotive and Armament Command

The Army Tank-Automotive and Armament Command (TACOM) manages the Army's ground equipment supply chain. TACOM's Integrated Logistics Support Center executes repair parts planning and supply chain management for more than 3,500 weapon systems. TACOM oversees six of the Army's manufacturing arsenals and maintenance depots across the United States. These activities manufacture, repair, upgrade, and modernize the Army's ground equipment [11]. Table 39 lists these activities along with the size of the civilian workforce and the primary functions they perform.

Table 39. TACOM activities and their civilian workforce and functions

TACOM Activities	2018 civilians	Functions
TACOM headquarters	2,567	Oversight and management
Red River Army Depot	1,891	Life cycle logistics and maintenance
Sierra Army Depot	1,169	Depot maintenance
Rock Island Arsenal	1,015	Weapons manufacturing
Watervliet Arsenal	668	Weapons manufacturing

Source: DCPD and [11].

Army Aviation and Missile Command

Army Aviation and Missile Command (AMCOM) develops and delivers aviation, missile, and calibration materiel readiness to the Army. Its primary functions are sustainment logistics, acquisition support, calibration assistance, contracting, and engineering support [12].

Table 40 shows the subordinate commands and their civilian workforce. AMCOM Logistics Center provides optimized aviation and missile life-cycle logistics across the entire spectrum of supply, maintenance, publications, and technical support to ensure sustainable warfighting readiness. The Corpus Christi Army Depot provides modification, repair, and overhaul of rotary wing components and aircraft to support Army aviation. The Letterkenny Army Depot (LEAD) develops and delivers materiel readiness for air defense forces of the United States [12].

Table 40. AMCOM activities and their civilian workforce and functions

AMCOM activities	2018 civilians	Functions
Corpus Christi Army Depot	2,810	Aviation depot maintenance
AMCOM Logistics Center	2,736	Life cycle logistics
Letterkenny Army Depot	1,420	Air defense depot maintenance

Source: DCPD and [12].

Army Communications Electronics Command

The Army Communications-Electronics Command (CECOM) sustains and delivers command, control, communications, computers, cyber, intelligence, surveillance, and reconnaissance (C5ISR) readiness for American Soldiers [13]. Table 41 shows the subordinate commands and their civilian workforce.

Table 41. CECOM activities and their civilian workforce and functions

CECOM activities	2018 civilians	Functions
Tobyhanna Army Depot	2,536	Depot maintenance
CECOM headquarters	1,326	Oversight
Software Engineering Center	494	Software engineering
Information Systems Engineering Command	279	

Source: DCPD and [13].

Tobyhanna Army Depot provides logistics support for C5ISR systems, including sustainment, overhaul and repair, fabrication and manufacturing, engineering design and development, systems integration, software depot maintenance, technology insertion and modification. Software Engineering Center (SEC) provides life-cycle software engineering support.

Army Joint Munitions Command

The Army Joint Munitions Command (JMC) provides the conventional ammunition life-cycle functions of logistics sustainment, readiness and acquisition support. Table 42 shows the subordinate commands and their civilian workforce. Major activities include the McAlester Army Ammunition Plant and Blue Grass Army Depot [14].

Table 42. JMC activities and their civilian workforce and functions

JMC Activities	2018 civilians	Functions
McAlester Army Ammunition Plant	1,716	Depot maintenance
Blue Grass Army Depot	723	Depot maintenance
Crane Army Ammunition Activity	703	Depot maintenance
Pine Bluff Arsenal	637	Depot maintenance
Army Joint Munitions Command	581	Lifecycle management
Tooele Army Depot	461	Depot maintenance

Source: DCPD and [14].

Army Sustainment Command

The Army Sustainment Command (ASC) supports combatant command operations by sustaining and supporting joint forces, supporting rotational forces, and augmenting theater combat support service capabilities. Table 43 lists the major types of activities employing civilians. Most civilians within the ASC organization work at the logistics readiness centers. These centers are located at Army and Joint bases and provide logistics support to the servicemembers and units that reside at these bases. The center oversees all installation logistics activities, supply, maintenance, transportation and materiel readiness [15].

Table 43. ASC activities and their civilian workforce and functions

ASC activities	2018 civilians	Functions
Logistics Readiness Centers	3,163	Logistics
Army Sustainment Command	680	Headquarters
Army Field Support Battalions	257	
Other	525	

Source: DCPD and [15].

Other Army agencies and commands

Training and Doctrine Command

The Training and Doctrine Command (TRADOC) conducts four primary functions:

- Recruiting and training
- Military and civilian leadership development
- Doctrine development
- Building and integrating formations, capabilities, and materiel

It executes these missions through five subordinate commands and centers:

- Army Center of Military History
- Army Combined Arms Center
- Army Center Initial Military Training
- Army Recruiting Command
- Army Cadet Command

TRADOC also oversees 32 Army schools organized under eight Centers of Excellence, each focused on a separate area of expertise within the Army (e.g., maneuver and signal) [24].

US Army Combat Capabilities Development Command (CCDC)

CCDC is a major subordinate command of the Army Futures Command (AFC), which assesses and integrates the future operational environment, emerging threats, and technologies to develop and deliver concepts, requirements, future force designs and the delivery of modernization solutions. It provides the Army with an organic research and development capability that focuses on six priorities: long-range precision fires, next-generation combat vehicle, future vertical lift platforms, a mobile and expeditionary Army network, air and missile defense capabilities, and soldier lethality [25].

Direct reporting units

Direct Reporting Units (DRUs) can have institutional or operational functions. They provide general support to the Army that is not available elsewhere, and they report to either the Secretary of the Army or a member of their immediate staff.

Table 44 lists the DRUs and the sizes of their civilian workforces. Over three-quarters of the civilians work in the Army Medical Command and the Army Corps of Engineers.

Table 44. Army DRUs

DRUs	2018 civilians
Army Medical Command	38,229
Army Corps of Engineers	30,613
Army Acquisition Support Center	4,754
Army Intelligence and Security Command	3,233
Army Test and Evaluation Command	3,112
Army Civilian Human Resource Agency/ Human Resources Command	2,723
Army Recruiting Command and US Army Cadet Command	2,347
US Military Academy/Army War College	1,068
Army Criminal Investigation Command	864

Source: DCDP.

US Army Medical Command

According to the mission statement of Army medicine, its two primary functions are (1) to provide health services to soldiers (active and retired) and their families and (2) to conduct research [26]. We divided the activities within this command into four groups: health services medical support activities, research activities, headquarter activities, and other. The size of each function in terms of civilian workforce is shown in Table 45.

Table 45. Functional areas within US Army medical command

Functional areas	2018 civilians
Health services	33,232
Support	2,113
Research	1,439
Headquarters	867

Source: DCDP.

Army Corps of Engineers

The second largest DRU in terms of civilian employees is the US Army Corps of Engineers (USACE). USACE provides military and public engineering services and capabilities in support of national interests.

These services align with the following set of missions:

- Civil Works missions: USACE develops and manages the nation's water resources to support commercial navigation, restoration and protection of aquatic ecosystems, manage flood risks, and provide engineering and technical services.
- Military missions: USACE provides engineering, construction, real estate, stability operations, and environmental management products and services for the Army, Air Force, other assigned US government agencies and foreign governments.
- Environmental Program: USACE manages one of the largest federal environmental missions by restoring degraded ecosystems; constructing sustainable facilities; regulating waterways; managing natural resources; and, cleaning up contaminated sites from past military activities.
- Emergency Operations: USACE responds to emergencies and aid in disaster response and recovery.
- Research and development: USACE performs strategic planning, direction, and oversight of research and development for the Corps military and civil works programs, and for the warfighter [27].

Of the over 30,600 civilians at USACE activities, about 25,000, or 81 percent, work at offices in 43 districts that are spread across nine geographic divisions: Great Lakes and Ohio River, Mississippi Valley, North Atlantic, Northwestern, Pacific Ocean, South Atlantic, South Pacific, Southwestern, and Transatlantic [27]. Most of the other civilians work at the activities shown in Table 46.

Table 46. Other USACE organizations

USACE organizations	2018 civilians
Engineer Research and Development Center	2,088
Engineering and Support Center	1,193
Headquarters	600
IT Support	595
Logistics Activity	482
Institute for Water Resources	218
Army Geospatial Center	190
Total	5,366

Source: DCPD.

Appendix C: DON's Civilian Workforce at Other Activities

The main body of this report reviewed the two activity groups in DON that employ the most civilians: warfare centers and maintenance activities. This appendix examines the civilian workforce in DON's other major activities groups. It lists the activities in each group and gives the size of their civilian workforce. It also summarizes their primary missions and functions.

Naval Facility Engineering Command

Naval facility (NAVFAC) engineering activities are located worldwide in regions where DON installations exist. These activities employ over 14,000 civilians, including more than 900 at oversea locations. The primary missions of these organizations are to (1) plan, build, and maintain sustainable facilities, (2) deliver environmental, utility, and other base services, and (3) acquire and manage expeditionary combat force systems and equipment.

Table 47. Naval facilities engineering activities

UIC	Activity name	Location	FY18 Civ.
N40085	NAVFAC Mid-Atlantic	Norfolk, VA	3,827
N62473	NAVFAC Southwest	San Diego, CA	3,181
N69450	NAVFAC Southeast	Jacksonville, FL	1,711
N62478	NAVFAC Hawaii	Pearl Harbor, HI	1,311
N40080	NAVFAC Washington	Washington, DC	1,283
N44255	NAVFAC Northwest	Silverdale, WA	976
N40192	NAVFAC Marianas	Agana, Guam	535
N62470	NAVFAC Atlantic	Norfolk, VA	513
N62742	NAVFAC Pacific	Pearl Harbor, HI	405
N40084	NAVFAC Far East	Yokosuka, Japan	195
N33191	NAVFAC EURAFSWA	Naples, Italy	150
Various	Public works detachments	Various oversea bases	53
Total			14,140

Source: DCPD and TFMMS.

Base support and security

This group comprises a large number of relatively small activities that, in total, employ 7,400 civilians. These activities—which fall under the Commander, Naval Installations Command (CNIC)—are located at all DON bases. They provide base security and support base operations. Table 48 shows the number of civilians in 2018 assigned to each function (security versus base operations) by location (either within the continental US (CONUS) or outside CONUS (OCONUS)).

Table 48. Number of civilians conducting base support and security functions

Location	FY 2018 civilians	
	Security	Base operations
CONUS	2,477	6,587
OCONUS	167	849
Total	2,644	7,436

Source: DCPD and TFMMS.

Medical centers, hospitals, and clinics

Navy medical centers, hospitals, and clinics are located on or near military bases and posts around the world. In total, they employ more than 9,700 civilians. Another 688 civilians work at activities that conduct medical research or provide other types of medical care support. The medical centers, hospitals, and clinics provide inpatient and outpatient medical services to military and retired personnel.

Military sealift

The Military Sealift Command (MSC), which employs more than 6,700 civilians, supports the joint warfighter across the full spectrum of military operations. It provides on-time logistics, strategic sealift, and specialized missions anywhere in the world, under any condition, and at any time. Its civilian mariners operate ships that provide underway replenishment, commercial helicopter services, and other direct fleet support to Navy ships worldwide. It also provides the Navy with towing, rescue and salvage, submarine support, cable laying and repair services, a command and control platform, floating medical facilities and the Navy's expeditionary sea base, and fast transport vessels.

Logistics and supply

This group consists of fleet logistics centers (FLTLOGCTRs) and supply support activities. The FLTLOGCTRs are located in fleet concentration areas and the support activities are in Mechanicsburg, Pennsylvania. In total, they employ more than 6,200 civilians. Table 49 shows the three types of activities and their civilian levels. FLTLOGCTRs provide global logistics capabilities to the Navy, Marine Corps, Coast Guard, and Joint and Allied Forces. These capabilities include full-spectrum logistics support to the fleet, contracting support for both ashore and operational forces, support to regional commanders and Navy installations, and integrated logistics support to industrial customers (NAVSEA and NAVFAC). The mission of Navy Supply Weapon Systems Support activity (NAVSUP WSS) (formerly known as Naval Inventory Control Point) is to provide program and supply support to the Navy, Marine Corps, and Joint and Allied Forces for the weapon systems that keep our naval forces mission ready.

Table 49. Logistics and supply activities

Subcategory	FY18 Civ.
Fleet Logistic Centers	2,889
NAVSUP support	1,073
Weapon systems support	2,284
Total	6,246

Source: DCPD and TFMMS.

Research and development

The Naval Research Lab (NRL) and associated Office of Naval Research (ONR) activities employ more than 3,000 civilians, nearly all in the Washington, DC, area. NRL provides the advanced scientific capabilities required to sustain our country's position as global naval leaders and conducts research that yields immediate and long-range applications to support DOD's missions.

Educational institutions

The educational institutions category consists of the four schools listed in Table 50. Together they employ more than 2,700 civilians.

Table 50. Navy educational institutions

UIC	Activity name	Location	FY18 Civ.
N00124	Navy War College	Newport, RI	467
N00161	Naval Academy	Annapolis, MD	904
N62271	Post Graduate School	Monterey, CA	630
N39721	Naval Acquisition Career Center	Mechanicsburg, PA	708
Total			2,709

Source: DCPD and TFMMS.

Appendix D: Full Estimation Results

This appendix presents full regression results and sample summary statistics.

Depot models

Tables 51 through 54 contain regression results from the depot model.

Table 51. Depot TAT results

Variable	Estimate	t-stat.
Labor in pay scale WG	4.332366	18.30213
Labor in pay scale WL	3.488389	1.757581
Labor in pay scale WD	105.4781	61.09583
Labor in pay scale WN	-533.746	-51.6636
Labor in pay scale WS	-66.8238	-26.9399
Labor in pay scale GS	1.468076	6.731561
Labor in pay scale Other	67.34036	31.74355
(Labor in pay scale Other)2	-0.39824	-42.0363
(Labor in pay scale WG)2	-0.01634	-102.883
(Labor in pay scale WL)2	0.135807	20.78382
(Labor in pay scale WD)2	-1.12497	-105.165
(Labor in pay scale WN)2	-29.3775	-69.464
(Labor in pay scale WS)2	-0.81148	-38.7154
(Labor in pay scale GS)2	-0.00235	-35.9011
WLS (contracted labor hours)	0.250323	76.34678
Average months of service	20.87441	154.4859
Turnaround time from previous month	0.018343	2.543501
Average number of AVDLR repairs open	-0.39983	-26.4337
Depot Jacksonville	-447.864	-45.7432
Depot San Diego	-1513.19	-92.7084
Average daily labor hours for aircraft overhaul	11.35976	56.00261
Average daily repairs open for aircraft overhaul	-1.93962	-68.3428
Percentage of WG with college degrees	311.279	149.7684
Interaction WG:WL	-0.00053	-0.32507
Interaction WG:WD	0.032454	16.06348
Interaction WG:WN	-0.26505	-18.6346
Interaction WG:WS	0.181286	59.17395

Variable	Estimate	t-stat.
Interaction WG:GS	0.010166	52.59158
Interaction WG:Other	-0.01057	-6.41797
Interaction WL:WD	-0.23793	-20.0711
Interaction WL:WN	0.773117	10.56495
Interaction WL:WS	0.547523	35.47747
Interaction WL:GS	-0.03122	-26.1137
Interaction WL:Other	-0.02198	-1.46985
Interaction WD:WN	6.501055	58.15021
Interaction WD:WS	0.354619	14.87815
Interaction WD:GS	0.050946	31.29895
Interaction WD:Other	0.880962	67.48529
Interaction WN:WS	5.430586	36.53116
Interaction WN:GS	-0.06144	-6.14032
Interaction WN:Other	1.825929	18.73565
Interaction WS:GS	-0.0883	-55.1093
Interaction WS:Other	-1.34605	-61.8707
Interaction GS:Other	-0.04553	-33.6206
2015	-269.15	-213.307
2016	-536.567	-285.174
2017	-740.159	-314.272
2018	-991.387	-320.501
Ret.Cond B	-62.1689	-7.98006
Ret.Cond D	10.69029	3.792393
Ret.Cond E	-25.5677	-9.71693
Ret.Cond F	-28.9348	-32.195
Ret.Cond H	-17.9868	-25.4775
Ret.Cond Incomplete/Missing	133.1886	1.926909
Ret.Cond J	-14.7888	-5.10686
Ret.Cond L	-0.93304	-0.03695
Ret.Cond N	21.12396	0.216064
Ret.Cond P	-36.1653	-8.64538
Ret.Cond S	54.55868	0.966349
Federal supply class indicators included (output omitted)		
Delay code indicators included (output omitted)		

Source: CNA.

Table 52. Summary statistics for all AVDLR repairs, depot model

Statistic	N	Mean	S.D.	Min.	Max.
TAT	262,337	137.256	256.137	1	1,986
Labor all	262,337	2,817.166	529.072	1,636.000	3,655.500
Delayed	262,337	0.052	0.222	0	1
Labor GS	262,337	1,438.620	326.657	571.000	2,105.500
Labor WG	262,337	1,082.624	221.953	717.000	1,395.500
Labor WL	262,337	91.937	25.801	31.000	131.000
Labor WD	262,337	120.459	16.571	81.000	161.500
Labor WN	262,337	5.893	1.905	3.000	11.000
Labor WS	262,337	65.194	15.272	43.000	103.000
Labor other	262,337	12.438	18.451	-0.000	60.857
Mean MOS	262,337	172.803	15.329	148.447	220.997
TAT previous month	262,337	138.871	45.826	69.069	368.415
AvgOpenOrders during repair	262,337	62.284	17.313	0.333	360.000
Mean hours AC	262,337	21.006	4.743	7.698	31.185
Mean open AC	262,337	113.302	46.831	18.500	222.500
WLS	262,337	33.924	70.607	0.000	4,500.000
% complete	262,337	0.944	0.229	0	1
% with a college degree	262,337	0.062	0.019	0.035	0.095

Source: CNA.

Table 53. Wholesale replenishment model results

Variable	Estimate	t-stat.
Total F 18 EF replenishment requisitions, last 60 days	0.013	11.98**
Total BCMs, last 60 days	-0.017	8.29**
Average depot TAT for F-18 EF repairs, last 90 days	0.067	4.42**
Average depot completed F-18 EF repairs, last 90 days	-0.001	4.93**
Average depot opened F-18 EF jobs, last 90 days	0.000	2.48*
Site effects included (output omitted)		
Constant	9.555	6.70**

Source: CNA.
*Significant at the 5 percent level.
**Significant at the 1 percent level.

Table 54. Wholesale replenishment model summary statistics

Variable	Mean	S.D.
Time to replenishment, organic depot (days)	14.95	5.07
Total F-18 EF replenishment requisitions, last 60 days	84.89	126.00
Total BCMs, last 60 days	124.94	144.77
Average depot TAT for F-18 EF repairs, last 90 days	88.09	7.05
Average depot completed F-18 EF repairs, last 90 days	7,133.96	750.39
Average depot opened F-18 EF jobs, last 90 days	8,234.37	712.96

Source: CNA.

Supply node models

Tables 55 and 56 contain regression results from the supply model.

Table 55. Supply model results, F18 group OLS

Variable	Estimate	t-stat.
AVDLR procurement (APN-6) for site-day ($M)	-0.222	2.02*
(AVDLR APN-6)^2	-0.002	0.93
Wholesale replenishment time, last 30 days	0.035	4.31**
(Wholesale replenishment time, last 30 days)^2	-0.000	0.09
Carrier x Replenishment time	-0.036	4.35**
Carrier	0.541	1.57
Completed repairs at site	-0.175	32.36**
I-level TAT for completed repairs, last 30 days	0.016	1.90
(I-level TAT for completed repairs, last 30 days)^2	-0.000	4.65**
Carrier x I-level TAT for completed repairs, last 30 days	0.001	0.14
AVDLR APN-6 x I-level TAT	0.013	2.13*
AVDLR APN-6 x Replenishment time	-0.000	0.03
Carrier x AVDLR APN-6	-637.336	46.96**
Site indicators included (output omitted)		
Site indicators x AVDLR APN-6 included (output omitted)		
New AVDLR requisitions	0.193	36.51**
Constant	-0.741	3.56**

Source: CNA.
Note: The dependent variable is the daily change in open WRA AVDLR requisitions at a given supply site or carrier.
**Significant at the 1 percent level.

Table 56. Supply node models summary statistics

Variable	F18		MH60		EA18	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Site open AVDLR requisitions	82.69	101.80	26.78	32.88	50.30	70.64
APN-6 daily site spending ($M)	0.03	0.80	0.04	1.11	0.02	0.56
Wholesale replenishment time, last 30 days	16.68	17.56	16.57	19.97	15.70	9.03
Closed I-level repairs	10.85	13.80	2.01	3.86	1.96	3.73
I-level repairs TAT, last 30 days	8.61	10.63	15.90	22.50	5.30	5.85
New AVDLR requisitions	11.90	14.56	3.17	4.81	3.39	5.39

Source: CNA.

MC-rate models

Tables 57 and 58 contain regression results from the MC-rate model.

Table 57. MC rate results, F18 group fractional logit

Variable	Estimate	P-stat.
Squadron monthly AVDLR RR TAT (days)	-0.009	4.86**
(Squadron monthly AVDLR RR TAT (days))	0.000	4.10**
Squadron monthly consumable RR TAT (days)	-0.011	2.66**
(Squadron monthly consumable RR TAT (days))	0.000	1.79
Squadron monthly non-RR TAT (days)	-0.021	5.76**
(Squadron monthly non-RR TAT (days))^2	0.000	2.53*
Squadron open retail AVDLR requisitions per EIS month (open AVDLRs)	-0.282	5.46**
(Open AVDLRs)	0.062	3.20**
(Open AVDLRs)	-0.005	3.83**
EIS months x open AVDLRs	0.002	0.88
Open AVDLRs x AVDLR RR TAT	-0.000	0.25
Open AVDLRs x consumable RR TAT	0.002	1.25
Open AVDLRs x non-RR jobs open per EIS month	0.000	0.41
Non-RR jobs open per EIS month	0.001	2.73**
Open AVDLRs x (non-RR jobs open per EIS month)	-0.000	0.01
Open AVDLRs x non-RR jobs open per EIS month x EIS months	-0.000	3.33**
Open AVDLRs x AVDLR RR jobs open per EIS month	-0.009	0.76
AVDLR RR jobs open per EIS month	-0.025	3.98**
Open AVDLRs x (AVDLR RR jobs open per EIS month)	0.000	1.00
Open AVDLRs x consumable RR jobs open per EIS month	0.002	0.87
Consumable RR jobs open per EIS month	-0.009	4.21**

Variable	Estimate	P-stat.
Open AVDLRs x (consumable RR jobs open per EIS month)	-0.000	0.22
Open AVDLRs x AVDLR RR jobs open per EIS month x EIS months	0.002	2.51*
Open AVDLRs x consumable RR jobs open per EIS month x EIS months	-0.000	0.85
Squadron has F-18 C or D	-0.615	6.46**
Fleet Replacement Squadron	0.572	2.84**
Forward-Deployed Naval Forces	-0.269	4.05**
Carrier-based in month	0.135	5.23**
Operational status: work-up	0.853	4.56**
Operational status: deployed	0.979	5.26**
Operational status: sustain	0.806	4.32**
Squadron indicators included (output omitted)		
Constant	0.544	2.73**

Source: CNA.
*Significant at the 5 percent level, **Significant at the 1 percent level.

Table 58. MC rate model summary statistics

Variable	F18		MH60		EA18	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
MC Rate	0.57	0.17	0.60	0.18	0.61	0.16
Non-RR TAT (days)	13.48	12.16	8.29	4.22	9.37	5.84
AVDLR RR TAT (days)	14.79	19.29	19.06	21.53	13.92	14.20
Consumable RR TAT (days)	11.04	12.71	9.49	7.15	5.03	5.19
Site open AVDLR WRA requisitions (100s)	1.52	1.14	0.51	0.40	1.01	0.63
Squadron open AVDLR WRA requisitions	13.67	15.00	5.07	5.96	8.93	11.73
EIS Months	13.53	11.51	10.01	4.83	6.74	7.54
Squadron open AVDLRs per EIS month	1.08	1.33	0.51	0.77	1.33	0.86
Non-RR open jobs (100s), daily average	14.96	8.78	20.44	10.36	7.21	5.73
AVDLR RR open jobs, daily average	68.01	49.89	23.72	16.57	21.26	20.56
Consumable RR jobs open in month, daily average	307.52	180.55	340.82	204.21	225.41	139.44
Non-RR jobs per EIS month	130.68	194.32	214.58	168.48	121.66	70.16
AVDLR RR open jobs per EIS month	5.76	7.29	2.51	2.19	3.44	2.01

Variable	F18		MH60		EA18	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Consumable RR open jobs per EIS month	26.56	31.92	36.11	25.32	40.42	27.51
Has F18 C or D	0.18	0.39	0.00	0.00	0.00	0.00
Fleet replacement squadron	0.08	0.27	0.13	0.34	0.06	0.23
Forward-deployed Naval Forces	0.10	0.30	0.06	0.24	0.16	0.37
Carrier-based	0.33	0.47	0.17	0.38	0.19	0.40
Operational status: work-up	0.23	0.42	0.08	0.28	0.09	0.29
Operational status: deployed	0.31	0.46	0.23	0.42	0.26	0.44
Operational status: sustain	0.38	0.48	0.52	0.50	0.57	0.50
Carrier-based	0.10	0.30	0.06	0.25	0.12	0.33

Source: CNA.

Figures

Tables

Abbreviations

AFMC	Air Force Material Command
A_O	operational availability
AIMD	aircraft intermediate maintenance department
AMC	Army Materiel Command
ANG	Air National Guard
AOG	aircraft on ground
APN	Aircraft Procurement, Navy
AVDLR	aviation depot-level repairable
BCM	beyond capability of maintenance
BCM-I	BCM interdiction
BRAC	Base Realignment and Closure
BSO	budget submitting office
C4ISR	command, control, communications, computers, intelligence, surveillance, and reconnaissance
CCPM	Critical Chain Project Management
CNAF	Commander, Naval Air Forces
COMFRC	Commander, Fleet Readiness Centers
COMFLTREADCEN	commanding activity of the fleet readiness center
CWT	customer wait time
D level	depot level
DCPD	Defense Civilian Personnel Database
DECKPLATE	Decision Knowledge Programming for Logistics Analysis and Technical Evaluation
DMDC	Defense Manpower Data Center
DOD	Department of Defense
DON	Department of the Navy

DRRS	Defense Readiness Reporting System
EIS	equipment in service
EXWC	Expeditionary Warfare Center
FDNF	Forward-Deployed Naval Forces
FLTLOGCTR	fleet logistics center
FLTREADCEN	fleet readiness center
FMC	fully mission capable
FOM	figure of merit
FRC	Fleet Readiness Center
FRS	Fleet Replacement Squadron
FWS	federal wage system
HUD	"Heads-Up Display" (weekly briefing)
I level	intermediate level
IMF	intermediate maintenance facility
LIMDU	limited duty
MC	mission capable
MFTs	missions, functions, and tasks
MPN	Military Personnel, Navy
NAE	Naval Aviation Enterprise
NATEC	Naval Air Technical Data and Engineering Service Command
NAVFAC	naval facility
NAVSUP	Naval Supply Systems Command
NAVSUP WSS	Navy Supply Weapon Systems Support
NAVWAR	Naval Information Warfare Systems Command
NEC	Navy Enlisted Classification
NRL	Naval Research Laboratory
NSS	Naval Sustainment System
NSYD	naval shipyard

NWCF	Navy Working Capital Fund
O&MN	Operations and Maintenance, Navy
OLS	ordinary least squares
ONR	Office of Naval Research
OSD	Office of the Secretary of Defense
P2P	performance-to-plan
PBL	performance-based logistics
PESTO	Personnel, Equipment, Supply, Training, and Ordnance
RBS	readiness-based sparing
RFI	ready for issue
RMC	regional maintenance center
ROI	return on investment
SHIPREPFAC	ship repair facility
SPECWARCEN	special warfare center
SRA	shop replaceable assembly
SUBMEPP	submarine maintenance engineering, planning and procurement activity
SURFMEPP	surface maintenance engineering planning program activity
TAT	turnaround time
TFMMS	Total Force Manpower Management System
TRIREFFAC	Trident Submarine Refit Facility
UIC	Unit Identification Code
WLS	workload labor standard
WRA	weapons replaceable assembly
YOS	years of service

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