



June 2022

AIR FORCE AND NAVY AVIATION

Actions Needed to Address Persistent Sustainment Risks

GAO Highlights

Highlights of [GAO-22-104533](#), a report to the Committee on Armed Services, House of Representatives

Why GAO Did This Study

The Air Force and Navy spend billions of dollars annually to maintain their aircraft. The ability of the Air Force and Navy to complete aircraft maintenance directly affects military readiness, as maintenance delays reduce the time during which aircraft are available for operations and training.

House Report 116-442 included a provision for GAO to examine unit-level aviation maintenance. Among other things, this report assesses (1) trends in mission capability rates and related maintenance metrics for selected aircraft since fiscal year 2015 (2) the extent to which the Air Force and Navy have mitigated sustainment risks.

GAO selected a non-generalizable sample of eight out of 31 Air Force and Navy fixed-wing aircraft and analyzed maintenance and staffing metrics from fiscal years 2015 through 2021; reviewed sustainment reviews and related DOD guidance; and interviewed DOD, military service, and unit officials.

What GAO Recommends

Congress should consider requiring the Air Force and Navy to provide Congress plans to address risks to aircraft availability found in sustainment reviews. GAO is making four recommendations to the Air Force and Navy to prioritize and complete required sustainment reviews in a timelier manner and develop plans to remedy risks to aircraft availability. DOD generally concurred with the recommendations. The Navy did not agree to complete sustainment reviews in a timelier manner, citing resource limitations. GAO believes the Navy should complete these reviews with a greater sense of urgency.

View [GAO-22-104533](#). For more information, contact Diana Maurer at (202) 512-9627 or MaurerD@gao.gov.

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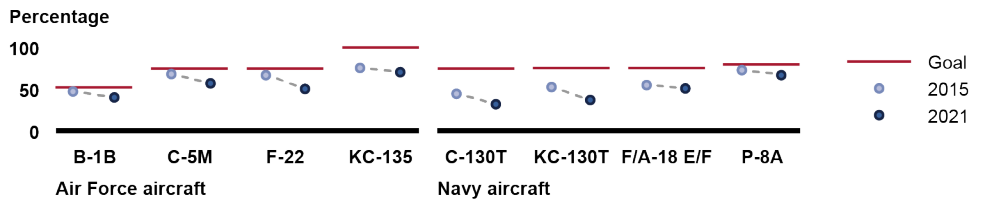
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What GAO Found

Mission capable rates—a metric used to assess the health and readiness of an aircraft fleet—and other related maintenance metrics trends have worsened since fiscal year 2015 for eight selected aircraft (see figure).

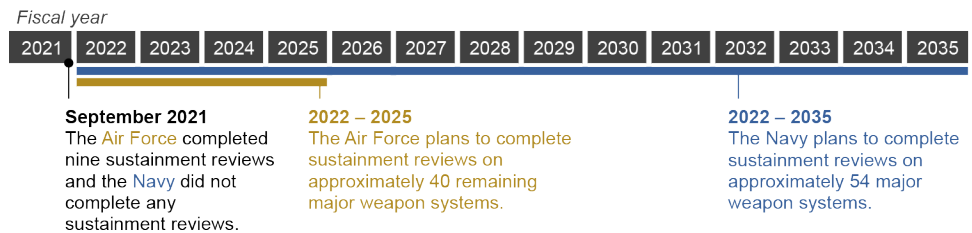
Average Mission Capable Rates, by Percentage, for Selected Air Force and Navy Aircraft, Fiscal Years 2015 and 2021



Source: GAO analysis of Air Force and Navy data. | GAO-22-104533

While the Air Force and Navy have initiatives to address unit-level maintenance challenges, neither service has mitigated persistent fixed-wing aircraft sustainment risks. A statute enacted in 2016 requires the services to conduct sustainment reviews for major weapon systems to assess their product support strategy and performance, among other things. GAO found, however, that the Air Force and Navy have not completed these sustainment reviews for all aircraft (see figure). Both the Air Force and Navy have plans to complete the required sustainment reviews by the end of fiscal years 2025 and 2035, respectively.

Estimated Timeline for Air Force and Navy to Complete Required Sustainment Reviews, as of October 2021



Source: GAO analysis of statutory reporting requirements and Air Force and Navy data. | GAO-22-104533

Without the Air Force and Navy prioritizing the completion of required sustainment reviews and updating their schedules to complete the reviews in a timelier manner, the services are missing opportunities to identify maintenance and other risks to aircraft availability. Further, neither the Air Force nor the Navy have completed mitigation plans to remedy maintenance challenges, risks, or related impacts identified in any sustainment reviews. As a result, the Air Force and Navy cannot fully address unit-level aviation maintenance challenges affecting aircraft availability required for training and operations. If Congress required the Air Force and Navy to submit mitigation plans to Congress related to maintenance challenges and risks to aircraft availability found in sustainment reviews, it would enhance the services' accountability for taking the necessary and appropriate actions to address persistent challenges to aircraft availability.

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Abbreviations

DOD Department of Defense
DECKPLATE Decision Knowledge Programming for Logistics Analysis and Technical Evaluation

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June 15, 2022

The Honorable Adam Smith
Chairman
The Honorable Mike Rogers
Ranking Member
Committee on Armed Services
House of Representatives

The Air Force and Navy spend billions of dollars annually to maintain their aircraft in an effort to ensure that these systems are available to simultaneously support today's military operations and maintain the capability to meet future defense requirements. The ability of the Air Force and Navy to complete aircraft maintenance directly affects military readiness, as maintenance delays reduce the amount of time during which aircraft are available for operations and training. The Air Force and Navy perform aviation maintenance at multiple levels—ranging from the depot-level, for the most complex repairs and overhauls, to the unit-level, generally performed by an operating unit for day-to-day upkeep.

Over the past decade, our work has primarily focused on the challenges experienced at the depots that have contributed to maintenance delays. These include deteriorating equipment and facility condition, difficulty in filling critical personnel skills, aging aircraft, insufficient supply support, and diminishing manufacturing sources and parts obsolescence.¹ In part due to these challenges, we reported in 2018 and 2020 that the Air Force

¹See, for example, GAO, *Military Depots: Actions Needed to Improve Poor Conditions of Facilities and Equipment that Affect Maintenance Timeliness and Efficiency*, [GAO-19-242](#) (Washington, D.C.: Apr. 29, 2019) and GAO, *DOD Depot Workforce: Services Need to Assess the Effectiveness of Their Initiatives to Maintain Critical Skills*, [GAO-19-51](#) (Washington, D.C.: Dec. 14, 2018). A complete listing of related reports is provided in the Related GAO Products pages at the end of this report.

and Navy have struggled to meet fixed-wing aircraft availability goals, hampering unit readiness.²

House Report 116-442, which accompanied a bill for the National Defense Authorization Act for Fiscal Year 2021, included a provision for us to examine Air Force and Navy aviation maintenance completed outside of the depots.³ This report assesses (1) trends in mission capability rates and related maintenance metrics for selected Air Force and Navy aircraft since fiscal year 2015; (2) challenges affecting completion of unit maintenance on selected fixed-wing aircraft; and (3) the extent to which the Air Force and Navy have mitigated sustainment risks for fixed-wing aircraft. We had separate reviews to examine maintenance completed outside of the depots on Navy ships and Army helicopters.⁴

To address these objectives, we used a case study approach to focus on unit-level maintenance and selected a non-generalizable sample of four Air Force and four Navy types of fixed-wing aircraft, out of 31 fixed-wing aircraft.⁵ For the Air Force, we selected the F-22 fighter, the B-1B bomber, the C-5M cargo plane, and the KC-135 air refueler. For the Navy, we selected the F/A-18E/F fighter, the P-8A anti-submarine, the C-130T cargo plane, and the KC-130T air refueler. We selected fiscal years 2015 through 2021, where data were available, to gain insight on

²See GAO, *Weapon System Sustainment: Aircraft Mission Capable Rates Generally Did Not Meet Goals and Cost of Sustaining Selected Weapon Systems Varied Widely*, [GAO-21-101SP](#) (Washington, D.C.: Nov. 19, 2020) and GAO, *Weapon System Sustainment: Selected Air Force and Navy Aircraft Generally Have Not Met Availability Goals, and DOD and Navy Guidance Need to Be Clarified*, [GAO-18-678](#) (Washington, D.C.: Sept. 10, 2018).

³H.R. Rep. No. 116-442, at 89-90 (2020).

⁴GAO, *Navy Ship Maintenance: Actions Needed to Monitor and Address the Performance of Intermediate Maintenance Periods*, [GAO-22-104510](#) (Washington, D.C.: Feb. 8, 2022) and GAO, *Combat Helicopter: Actions Needed to Fully Review Readiness Goals and Address Long-Standing Maintenance Challenges*, [GAO-22-104607SU](#) (Washington, D.C.: Feb. 15, 2022).

⁵We selected these aircraft based on our review of prior GAO work on sustainment of DOD major combat coded aircraft and other factors. GAO, *Weapon System Sustainment: Aircraft Mission Capable Rates Generally Did Not Meet Goals and Cost of Sustaining Selected Weapon Systems Varied Widely*, [GAO-21-101SP](#) (Washington, D.C.: Nov. 19, 2020). We included aircraft mission categories that are service-specific (bomber and anti-submarine) as well as aircraft types that are shared between the services (cargo plane, fighter, and aerial refueler). Additionally, we did not select aircraft that are used solely for training or are used to meet the operational airlift support mission.

historical data trends in maintenance performance and analyzed a variety of maintenance metrics for each aircraft over this time period, including mission capable rates, non-mission capable rates, and maintenance turnaround times. We also analyzed maintenance personnel data over the time period to gain an understanding of staffing at the unit level, by aircraft and by maintenance specialty. To assess the reliability of these data, we reviewed it for completeness and anomalies and asked Air Force and Navy officials to explain any discrepancies or outliers that we encountered. We also received written responses about the reliability of the data. We found the data provided to be sufficiently reliable for the purposes of reporting on maintenance and staffing trends.

Additionally, we reviewed selected aircraft maintenance support documentation, such as completed sustainment reviews, to identify and report risks to aircraft maintenance and sustainment. We also reviewed statutory requirements and Department of Defense (DOD), Air Force, and Navy guidance on the development and implementation of sustainment reviews for major weapons systems.⁶ We compared the progress of Air Force and Navy sustainment reviews for our selected aircraft in meeting statutory and DOD requirements and to the *Standards for Internal Control in the Federal Government*.⁷ Finally, we interviewed officials from the Office of the Deputy Assistant Secretary of Defense for Materiel Readiness, Air Force and Navy headquarters, Air Force Major Commands, Navy Type Commands such as Commander, Naval Air Forces, and aircraft program offices to gain an understanding of trends in maintenance metrics and any challenges, as well as how sustainment risks are mitigated. We also interviewed a random, non-generalizable sample of 15 of 81 maintenance squadrons from our selected aircraft, which included uniformed maintenance personnel, to gain their perspectives on aviation maintenance, including challenges and actions

⁶10 U.S.C. § 2441 (recently renumbered as 10 U.S.C. § 4323); DOD Instruction 5000.85 *Major Capability Acquisition*, app. 3D (Aug. 6, 2020) (subsequently replaced by DOD Instruction 5000.91, *Product Support Management for the Adaptive Acquisition Framework* (Nov. 4, 2021)); Under Secretary of Defense (Acquisition & Sustainment) Memorandum, *Implementation of Sustainment Reviews*, (June 2, 2021); Air Force Instruction 63-101/20-101, *Integrated Life Cycle Management* (June 30, 2020) (incorporating change 1, Nov. 23, 2021); and Secretary of the Navy Instruction (SECNAVINST) 5000.2F, *Defense Acquisition System and Joint Capabilities Integration and Development System Implementation* (Mar. 26, 2019).

⁷GAO, *Standards for Internal Control in the Federal Government*, [GAO-14-704G](#) (Washington, D.C.: Sept. 2014).

to mitigate them. A detailed discussion of our scope and methodology is in appendix I.

We conducted this performance audit from September 2020 to June 2022, in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

DOD Maintenance Capabilities

DOD uses its maintenance capabilities to maintain, overhaul, and repair its military weapon systems, such as aircraft and ships, and equipment. Maintenance varies in complexity, ranging from the depot-level for the most complex repairs and overhauls, to the unit-level for day-to-day upkeep and inspection (see figure 1). This report focuses on aircraft maintenance performed at the unit level.

Figure 1: Levels of Department of Defense Aircraft Maintenance Capabilities



Depot-level maintenance. Includes major overhaul, upgrading, or rebuilding of parts; assemblies and subassemblies; and end items of aircraft, components, and equipment. Also, it includes support to organizational and intermediate-level maintenance.

Performed at large industrial-type facilities, such as at Navy Fleet Readiness Centers or Air Force Air Logistics Complexes.



Intermediate-level maintenance. Includes calibration, repair, or replacement of parts, components, or assemblies, technical assistance; some manufacture of non-available parts; and support to the organizational-level.

Performed by designated maintenance groups located at an air station, on a ship for units at an operating location, or at a centralized intermediate repair facility for quick turn-around of aircraft.



Organizational-level maintenance, also referred to as unit-level maintenance. Includes the inspecting, servicing, lubricating, adjusting, and replacing of parts, minor assemblies, and subassemblies.

Usually performed by the group that operates the aircraft (such as a squadron) on a day-to-day basis in the field, on the flight line, or at the equipment site by maintenance personnel and equipment operators.

Source: GAO analysis of Department of Defense information (text); U.S. Air Force/J. Mather (top photo); U.S. Navy/PO2 M. Dickinson (middle photo); U.S. Navy/PO3 E. Thompson (bottom photo). | GAO-22-104533

Guidance, Roles, and Responsibilities for Sustainment of Fixed-Wing Aircraft

Sustainment of fixed-wing aircraft and other weapon systems comprises the logistics and personnel services required to maintain and prolong operations, and DOD policy states that the Department will conduct comprehensive sustainment planning across the life cycle of the weapon system.⁸ Specifically, DOD guidance requires weapon system program officials to develop and implement sustainment strategies and plans for sustaining weapon systems. These plans can include sustainment metrics linked to performance parameters and key system attributes, which could include aircraft availability, to manage sustainment performance.⁹ Sustainment reviews, which assess matters including

⁸DOD Instruction 5000.91, *Product Support Management for the Adaptive Acquisition Framework* (Nov. 4, 2021).

⁹DOD Instruction 5000.91. The Air Force and the Navy have guidance that implements the DOD guidance, including sustainment-planning requirements for life-cycle sustainment. See Air Force Instruction 63-101/20-101, *Integrated Life Cycle Management* (June 30, 2020) (Incorporating Change 1, Nov. 23, 2021); SECNAVINST 5000.2 F, *Defense Acquisition System and Joint Capabilities Integration and Development System Implementation* (Mar. 26, 2019).

operations and support costs of a weapon system, are conducted in conjunction with revalidation of the product support business case analysis and updating of the life-cycle sustainment plan.

A variety of DOD offices and officials have roles and responsibilities related to sustaining fixed-wing aircraft:

Under Secretary of Defense for Acquisition and Sustainment.

This office is responsible for, among other things, establishing policies for logistics, maintenance, and sustainment support for all elements of DOD, including aircraft.

Assistant Secretary of Defense for Sustainment. This office serves as the principal advisor to the Under Secretary of Defense for Acquisition and Sustainment on logistics and materiel readiness. Among other functions, the Assistant Secretary of Defense for Sustainment establishes policies and procedures on maintenance, materiel readiness, and sustainment support.

Office of the Deputy Assistant Secretary of Defense for Materiel Readiness. This office establishes and maintains maintenance policies and programs to maintain the desired levels of weapon systems and military equipment readiness to accomplish the Department's missions.

Air Force Commands. Air Force Materiel Command develops, acquires, and sustains weapon systems through research, development, testing, evaluation, acquisition, maintenance, and program management of the systems and their components. Air Force Life Cycle Management Center and Air Force Sustainment Center, both within Air Force Materiel Command, provide life-cycle management of weapons systems from inception to retirement.

Navy Commands. Naval Air Systems Command is responsible for providing life-cycle support of naval aviation aircraft, weapons, and systems. This support includes research, design, development, and systems engineering; acquisition; test and evaluation; training facilities and equipment; repair and modification; and in-service engineering and logistics support.

DOD also relies on program managers to lead the development, delivery, and sustainment of individual weapon systems throughout their life cycles. The program managers are responsible for accomplishing a

program's sustainment objectives to meet its users' operational needs. Additionally, the Air Force Sustainment Center and the Navy Supply Systems Command, as well as the Defense Logistics Agency, manage inventories of spare parts. Further, individual weapon systems programs are typically supported by a complex supplier network that can include a prime contractor, subcontractors, and various tiers of parts suppliers.

Information on Selected Air Force and Navy Fixed-Wing Aircraft

The inventories of the selected Air Force and Navy fixed-wing aircraft in our review totaled 1,355 aircraft and approximately \$13.6 billion to operate and support in fiscal year 2020. See figure 2 for a description, inventory, and operation and support costs for each of the eight fixed-wing aircraft selected for our review.

Figure 2: Information on Selected Air Force and Navy Fixed-Wing Aircraft, by Mission Type

	Air Force	Navy
Air refueler	 <p>KC-135 Stratotanker Fleet size: 396 Cost to maintain: \$3.69 billion An aerial refueler and also capable of transporting ambulatory patients using patient support pallets during aeromedical evacuations.</p>	 <p>KC-130T Fleet size: 12 Cost to maintain: \$96.68 million A multi-mission medium-lift tactical tanker/transport aircraft, providing tactical air-to-air refueling, among other functions.</p>
Cargo	 <p>C-5M Super Galaxy Fleet size: 52 Cost to maintain: \$979.44 million A strategic transport aircraft for cargo and personnel.</p>	 <p>C-130T Hercules Fleet size: 18 Cost to maintain: \$159.24 million A multi-mission medium-lift transport aircraft capable of intra-theater and inter-theater airlift operations.</p>
Fighter	 <p>F-22 Raptor Fleet size: 186 Cost to maintain: \$2.33 billion A fighter aircraft that performs both air-to-air and air-to-ground missions.</p>	 <p>F/A-18E/F Super Hornet Fleet size: 530 Cost to maintain: \$3.98 billion A fighter aircraft that performs both air-to-air and air-to-ground missions.</p>
Multi-mission	 <p>B-1B Lancer Fleet size: 62 Cost to maintain: \$1.18 billion A multi-mission long range bomber that carries the largest conventional payload of both guided and unguided weapons in the Air Force inventory.</p>	 <p>P-8A Poseidon Fleet size: 99 Cost to maintain: \$1.21 billion A multi-mission maritime patrol and reconnaissance aircraft.</p>

Source: GAO analysis of Air Force and Navy data (text); U.S. Air Force/Airman E. McClellan (KC-135); U.S. Marine Corps/Lance Corporal R. Ortiz (C-5M); Defense Imagery Management Operations Center/Master Sergeant J. Lock (F-22); U.S. Air Force/Staff Sergeant P. Reft (B-1B); U.S. Marine Corps/Corporal T. Norris (KC-130T); U.S. Marine Corps/Corporal J. Berry (C-130T); U.S. Navy/Petty Officer 2nd Class E. Garst (F/A-18E/F); U.S. Navy/Mass Communication Specialist 3rd Class D. Meshel (P-8A). | GAO-22-104533

Note: The inventories of the selected Air Force and Navy fixed-wing aircraft in our review totaled 1,355 aircraft and approximately \$13.6 billion to operate and support in fiscal year 2020.

Key Sustainment Metrics for Fixed-Wing Aircraft

The Air Force and Navy monitor aircraft readiness using multiple performance metrics. This report provides information on, among other things, metrics that the Air Force and Navy have in common:

- **Mission capable rate:** The percentage of total time when an aircraft can fly and perform at least one mission—one of the key metrics used

by DOD and the military services to assess the health and readiness of their aircraft.¹⁰

- **Not mission capable maintenance rate:** The percentage of total time when an aircraft is not capable of performing any of its assigned missions due to maintenance.
- **Not mission capable supply rate:** The percentage of total time when an aircraft is not capable of performing any of its assigned missions due to the lack of a repair part.

In addition to these metrics, the Air Force measures aircraft availability—the number of aircraft available for flight operations—and the number of not mission capable for both supply and maintenance aircraft that are not in depot and not capable of performing any of their assigned missions due to both maintenance and the lack of a repair part. The Navy measures not mission capable for maintenance and supply separately, among other metrics. The Air Force and Navy also have a range of metrics that measure maintenance performance including how long it takes to perform maintenance and how often parts need to be taken from one aircraft in order to maintain another aircraft.

Mission Capable Rates and Other Maintenance Metrics Trends Have Worsened

Mission Capable Rates Have Declined for All Selected Aircraft

We found that mission capable rates for all eight selected aircraft decreased from fiscal year 2015 to fiscal year 2021 (see table 1).

¹⁰The military services also measure whether systems are fully mission capable (that is, can perform all of their assigned missions). We do not discuss fully mission capable rates in this report.

Table 1: Average Mission Capable Rates, by Percentage, for Selected Air Force and Navy Aircraft, Fiscal Years 2015–2021

	Fiscal year 2021 mission capable goal	Fiscal Year							Change from fiscal year 2015 to 2021
		2015	2016	2017	2018	2019	2020	2021	
Air Force									
B-1B	52	47.5	51.6	52.8	51.8	46.4	52.8	40.7	-6.8
C-5M	75	68.1	69.1	60.9	62.8	63.2	60.5	57.5	-10.6
F-22	75	67.0	60.2	49.0	51.7	50.6	52.0	50.3	-16.7
KC-135	100	75.2	74.3	73.5	73.1	72.3	72.9	71.1	-4.1
Navy									
C-130T	75	43.0	45.1	43.7	22.7	35.7	34.6	32.4	-10.7
KC-130T	75	53.2	52.5	46.3	23.4	32.6	19.6	36.5	-16.7
F/A-18 E/F	75	54.9	55.1	51.9	48.3	48.9	53.0	51.0	-3.9
P-8A	80	73.1	69.5	65.2	62.3	64.6	63.7	67.2	-6.0

Source: GAO analysis of Air Force and Navy data. | GAO-22-104533

The Air Force’s F-22 and the Navy’s KC-130T experienced the sharpest drops in mission capable rates since fiscal year 2015. These downward trends in mission capable rates are not new nor are they specific to our case studies. For example, in August 2020 we reported that average mission capable rates for 18 Air Force and 12 Navy aircraft had fallen since fiscal year 2011.¹¹ Further, six out of 18 Air Force aircraft and six out of 12 Navy aircraft had not met their mission capable goal for any year from fiscal years 2011 through 2019.

The Congressional Budget Office has reported similar findings with data going back to 2001. In January 2022 they found that fleet-wide mission capable rates have declined for both Air Force and Navy aircraft from 2001 through 2019.¹² In particular, the Congressional Budget Office found

¹¹GAO, *Weapon System Sustainment: Aircraft Mission Capable Rates Generally Did Not Meet Goals and Cost of Sustaining Selected Weapons Systems Varied Widely*, GAO-20-67SPSU (Washington, D.C.: Aug. 27, 2020).

¹²Congressional Budget Office, *Availability and Use of Aircraft in the Air Force and Navy* (Washington, D.C.: January 2022). The Congressional Budget Office used a measure they referred to as availability rates, defining aircraft as available if they are identified in service databases as both “mission capable” and “possessed by operators”—that is, not currently undergoing depot-level maintenance or in storage.

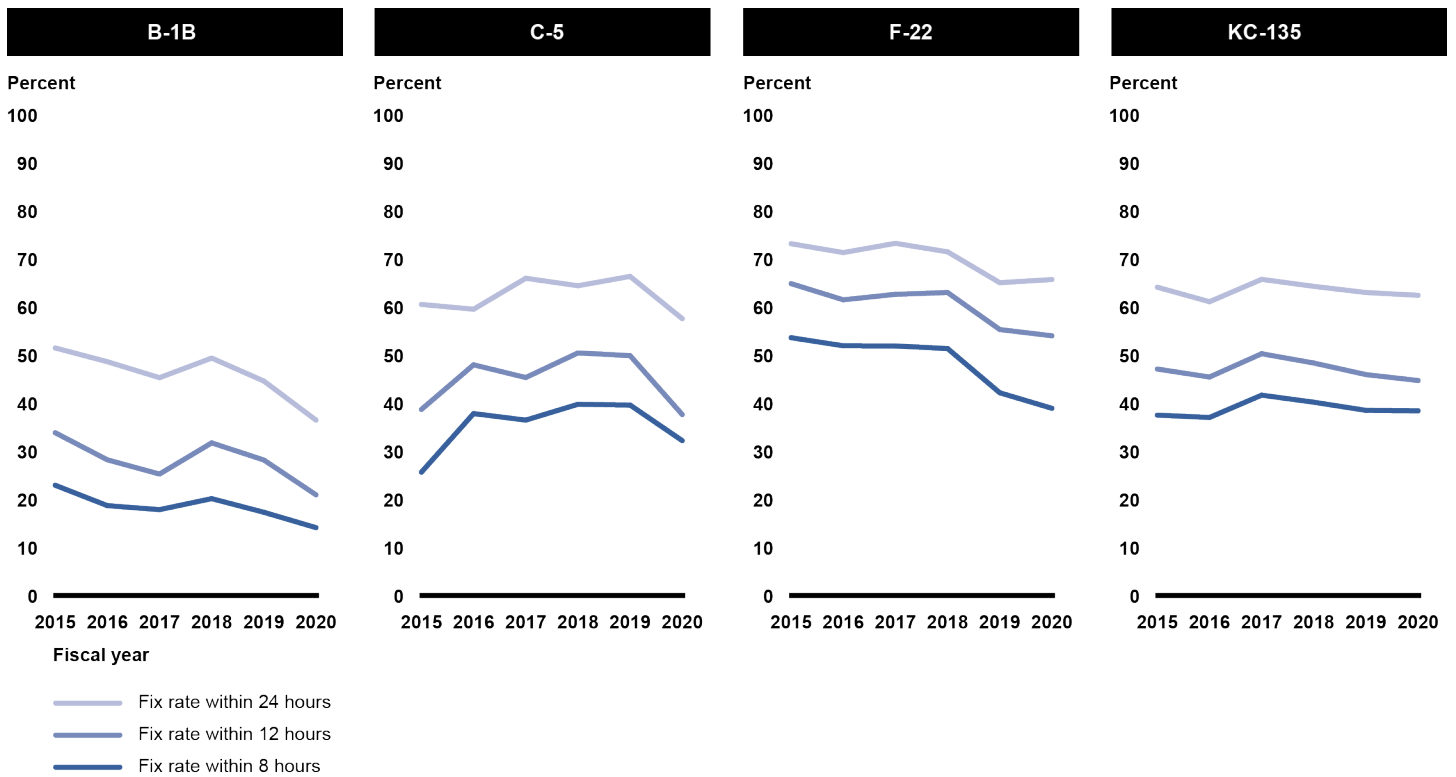
a steep decline in the availability rate for the Navy's fighter and attack aircraft, including the F/A-18.

Unit maintenance personnel we spoke with on this review acknowledged a decline in mission capable rates as a result of delays in completing unit level maintenance. They said fewer mission capable aircraft can limit training and other flying opportunities for squadrons, and forces aircraft that are mission capable to fly more often.

Air Force and Navy Maintenance Metrics are Worsening for Most Selected Aircraft

In addition to mission capable rates, the Air Force and Navy collect a variety of metrics to gain insight into maintenance trends. For example, the Air Force uses a metric referred to as "fix rate" to track the speed of repair and the equipment maintainability of its aircraft. Our analysis of Air Force fix rate data found that their ability to complete maintenance on selected aircraft within an 8-, 12-, or 24-hour window generally decreased from fiscal year 2015 to fiscal year 2020 (see figure 3). This downtrend in the fix rate shows that the Air Force is taking longer to complete aircraft repairs.

Figure 3: Average Air Force 8-, 12-, and 24-Hour Fix Rates for Selected Aircraft, Fiscal Years 2015–2020



Source: GAO analysis of Air Force data. | GAO-22-104533

The Navy also tracks the maintenance turnaround time of its aircraft. It uses the “work-order life” metric to track how long individual work orders have remained open before resolution. Our analysis found that it has taken longer to complete maintenance for three of four selected Navy aircraft from fiscal year 2015 to fiscal year 2020 (see table 2).

Table 2: Average Navy Work-Order Life in Days for Selected Aircraft, Fiscal Years 2015–2020

Aircraft	Fiscal year						Change from fiscal year 2015 to 2020
	2015	2016	2017	2018	2019	2020	
C-130T	227	317	185	433	321	263	36 days
KC-130T	251	204	204	392	379	405	154 days
F/A-18 E/F	275	492	558	470	373	194	-81 days
P-8A	21	25	59	52	57	59	38 days

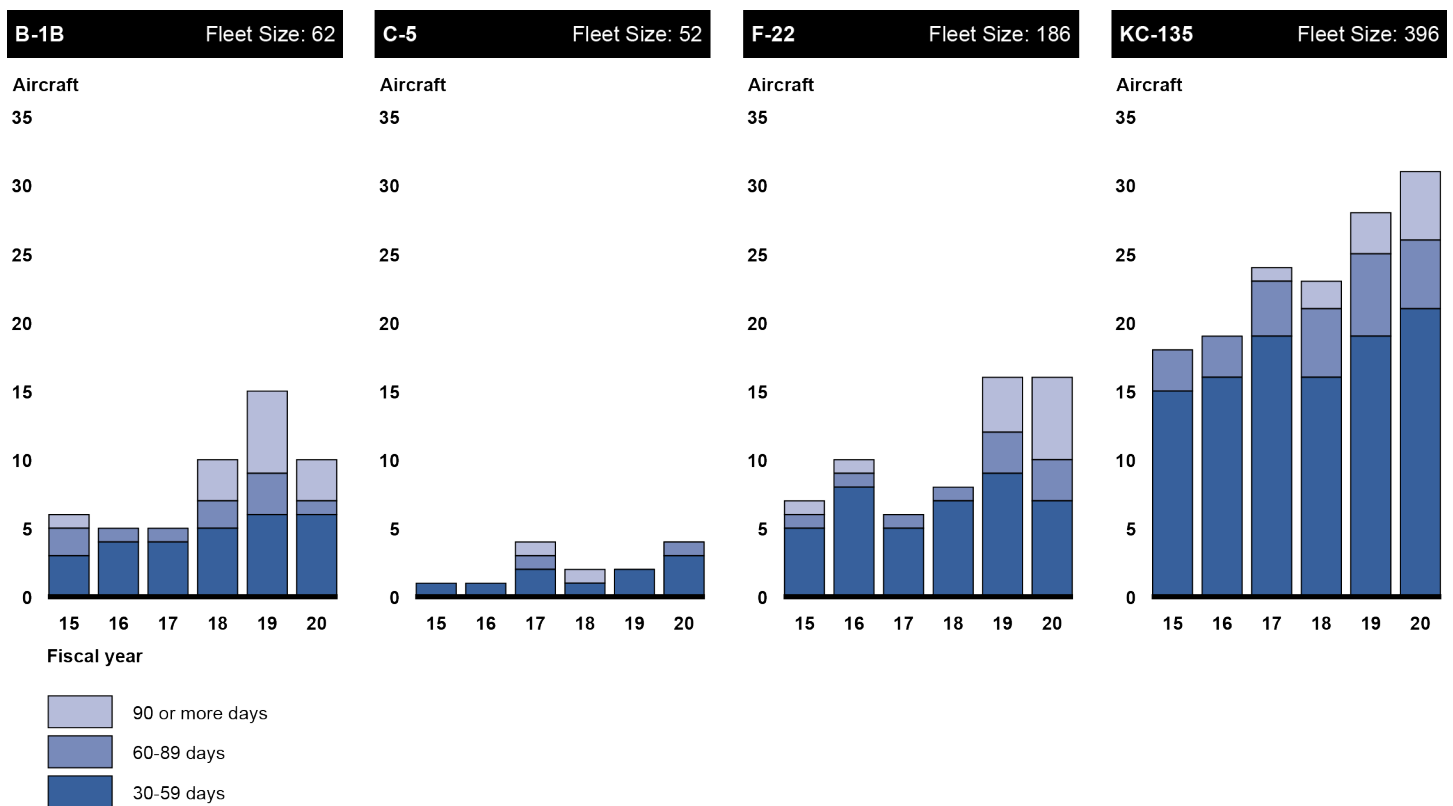
Source: GAO analysis of Navy data. | GAO-22-104533

While any number of issues could affect how long it takes to complete maintenance on their aircraft, unit maintenance personnel we interviewed said longer maintenance periods generally take time away from their other duties, such as providing or receiving necessary training and increases the amount of administrative work they need to do. For example, unit maintenance personnel from one F-22 unit said they spent extended periods of time filling out paperwork requesting waivers and extensions to justify longer maintenance turnaround times.

We also found that the number of long-term grounded aircraft—a metric that tracks aircraft that are not available to fly for long periods of time—generally increased for all four selected Air Force aircraft from fiscal years 2015 through 2020 (see figure 4).¹³

¹³The Air Force tracks aircraft that have been grounded for 30-, 60-, and 90-day or more increments, while the Navy tracks only aircraft that have been grounded for 90 days or more. For the purposes of this report, we will refer to these types of aircraft as “long-term grounded” aircraft.

Figure 4: Average Number of Selected Air Force Long-Term Grounded Aircraft, Fiscal Years 2015–2020



Source: GAO analysis of Air Force data. | GAO-22-104533

As shown in figure 4, long-term grounded aircraft not only generally increased in number across all four of our selected Air Force aircraft, they also remained in long-term grounded status for longer periods of time. More specifically, the number of aircraft grounded for longer periods of time (60-89 days and 90 or more days) generally increased between fiscal years 2015 and 2020 for all four selected Air Force aircraft.

The Navy does not systematically track long-term grounded aircraft so they were unable to provide us complete historical data. Anecdotally, unit maintenance personnel from the Navy reported that they encounter maintenance delays more frequently in recent years, which keeps their aircraft grounded for longer periods of time. Navy unit maintenance personnel also said they sometimes struggle to maintain enough aircraft in a mission capable status to meet monthly goals because of these delays and other challenges.

Unit maintenance personnel from both the Air Force and the Navy told us they use the number of long-term grounded aircraft as an indicator of the success of their maintenance efforts, and they try to have as few aircraft as possible designated in this status. For example, KC-135 unit maintenance personnel we spoke with said they actively rotate parts among their aircraft in an effort to prevent any of them from being designated as a long-term grounded aircraft.

Staffing and Other Interrelated Challenges Affect Unit Maintenance

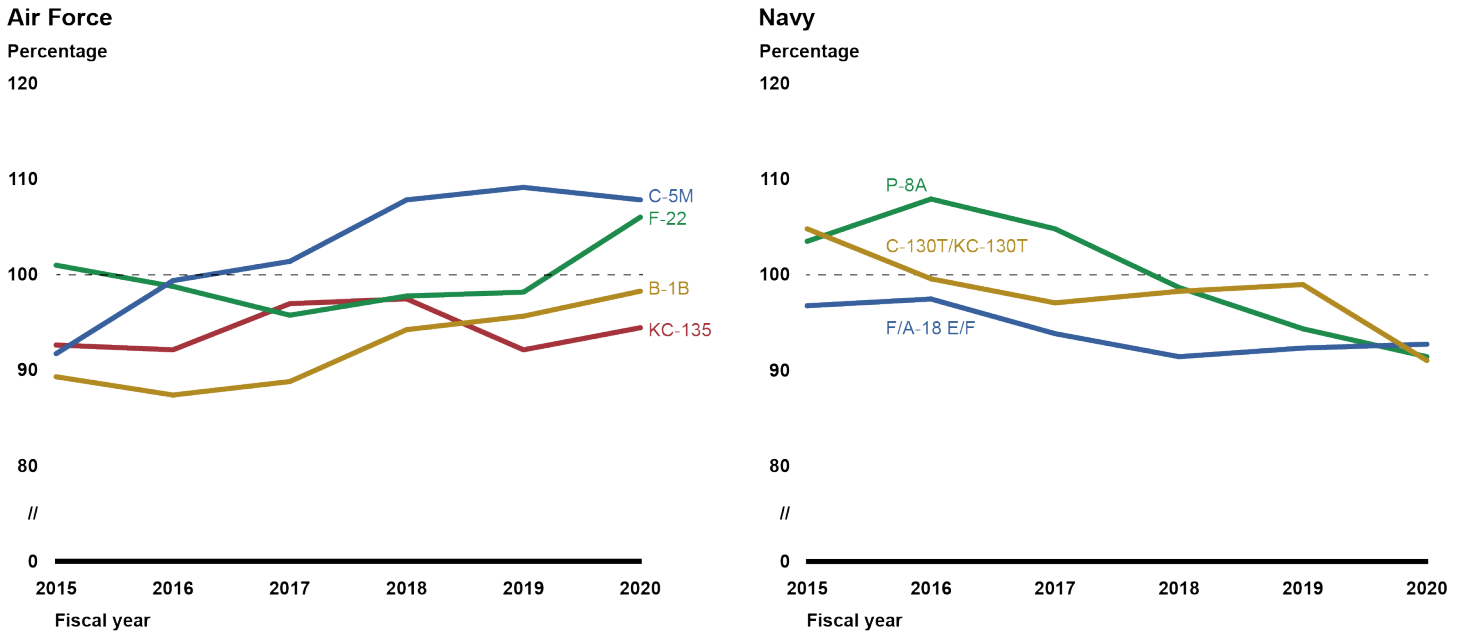
Air Force and Navy aviation units we selected for this review have experienced a variety of challenges that affect their ability to conduct maintenance on their aircraft. The Air Force has worked to address maintainer staffing shortages, while the Navy has experienced a gradual decline in maintainer staffing. Other challenges include supply and parts availability, technical support and access to proprietary data, and access to support equipment and facilities. These challenges are inter-related, vary in severity, and can affect units' ability to have aircraft available for operations and training.

Air Force Addressed Maintainer Staffing Shortages, while Navy Faces Gradual Decline in Maintainer Staffing

Overall unit maintainer trends. In February 2019, we reported that the Air Force faced shortages of experienced maintainers and was taking steps to address staffing shortages.¹⁴ Our analysis of Air Force maintenance personnel data for selected aircraft found that Air Force staffing generally improved from fiscal year 2015 through fiscal year 2020. Although Navy maintainer staffing slightly declined from fiscal year 2015 through fiscal year 2020 for selected aircraft, maintainer staffing remained at high levels (see figure 5).

¹⁴GAO, *Military Personnel: Strategy Needed to Improve Retention of Experienced Air Force Aircraft Maintainers*, [GAO-19-160](#) (Washington, D.C.: Feb. 5, 2019).

Figure 5: Average Percentages of Personnel Assigned to Authorized Maintainer Positions for Selected Air Force and Navy Aircraft, Fiscal Years 2015–2020



Source: GAO analysis of Navy and Air Force data. | GAO-22-104533

Note: According to Navy officials, the Navy tracks the workforce data for the C-130T and KC-130T together because the aircraft are similar and use the same skill sets for maintenance.

Air Force headquarters officials told us the service has worked over the past several years to fill aviation maintainer staffing shortfalls and they are seeing results. Navy headquarters officials told us that the Navy generally has the aviation maintainer personnel it needs, although the challenge lies in getting the right number of qualified and experienced maintainers.¹⁵ Nine out of the 15 maintenance units we met with stated that they experienced maintainer staffing and experience challenges. Unit maintenance personnel from three maintenance units told us that while

¹⁵The Navy tracks its personnel assigned to authorized positions using “fill and fit” rates—fill being the number of sailors used to occupy authorized positions, and fit being the determination as to whether those personnel have the appropriate qualifications and experience. For the purposes of our analysis, we used fill rates to determine the level of staffing to authorized positions unless otherwise noted. For purposes of this report, the term “authorized positions” refers to positions funded to be filled, based on the aviation maintainer workforce data for our selected Air Force and Navy aircraft.

staffing has improved, a lack of experienced maintainers extends the amount of time needed to perform maintenance tasks, leading to maintenance delays (see sidebar).

Selected Units Shared Examples of Lack of Experience Affecting Aircraft Maintenance.

Maintainers from multiple Air Force and Navy selected aircraft units shared examples of a lack of experience affecting aircraft maintenance. Maintainers from one F-22 unit stated that aircraft were held longer for maintenance due to lower experience among its maintainers. Maintainers from one C-5M unit stated that the influx of inexperienced new maintainer personnel created delays caused by training these personnel and affected the unit's ability to support missions until training and qualifications were completed. Maintainers from one C-130T and one KC-130T unit stated that they frequently got new maintainers with no prior experience or qualification with their aircraft. This extends the downtime for maintenance as the personnel need time to become qualified on the aircraft. Also, maintainers from one P-8A unit stated that the lack of experience among replacement personnel affects the ability to troubleshoot maintenance problems and staff maintenance detachments for the aircraft.



Source: GAO analysis of DOD Information. U.S. Air Force/Master Sgt. David Miller (photo). | GAO-22-104533

Unit maintainer occupational specialties. Air Force maintainers are assigned to specific maintenance specialties, such as aircraft electrical and environmental systems, aircraft hydraulics systems, or aerospace propulsion, and, in some cases, are assigned to specific aircraft they are qualified to perform maintenance on. Navy maintainers are assigned to occupational specialties within the aviation occupational community that identify career fields with related aptitude, training, experience, knowledge, and skills, such as aviation machinist's mates and electrician's mates, among others.

Our analysis of Air Force maintenance personnel data for selected aircraft found that staffing generally improved for most Air Force maintainer occupational specialties from fiscal year 2015 through 2020. However, our analysis found two occupational specialties that were persistently below 80 percent staffing to authorized positions for two of the four selected aircraft over this timeframe.¹⁶ Specifically, these were the aircraft fabrication occupational specialty for the B-1B and the aircraft systems occupational specialties for the C-5M.¹⁷

Our analysis of Navy maintenance personnel data for selected aircraft found that the Navy did not have any persistent staffing challenges related to maintainer occupational specialties from fiscal year 2015 through fiscal year 2020 for the aircraft we reviewed.

Unit maintainer skill levels. Air Force maintainer skill levels are 3-level (apprentice), 5-level (journeyman), 7-level (craftsman), and 9-level (superintendents) maintainers, as well as Chief Enlisted Managers. Navy maintainer skill levels are apprentice, journeyman, and master

¹⁶For the purposes of our report, we define a persistent staffing shortage as below 80 percent staffing to authorized positions for a majority—4 or more years—of the selected time frame, fiscal years 2015 through 2020.

¹⁷In addition to the specialties identified above, other specialties were below 80 percent staffing to authorized positions in fiscal year 2020. These included the aircraft metals technology specialty for the C-5M, avionics test station and components and aerospace propulsion specialties for the F-22, and mobility air forces integrated communications/navigation/mission systems specialty for the KC-135.

maintainers.¹⁸ Our analysis of maintenance personnel data for selected aircraft found that Air Force maintainer skill level staffing improved from fiscal year 2015 through fiscal year 2020, while Navy staffing and qualification rates of maintainers by skill level generally worsened over this time period. Table 3 below shows improvements in maintainer skill level staffing for all four Air Force selected aircraft from fiscal year 2015 through fiscal year 2020. As of fiscal year 2020, only the B-1B has a maintainer skill level below 80 percent of authorized positions (chief enlisted managers).

¹⁸Chief Enlisted Managers are Chief Master Sergeant positions that execute managerial duties and responsibilities, including management and direction of personnel resource activities and establishing control procedures to meet work goals and standards. Master maintainers are Chief Petty Officer positions that—depending on paygrade—may supervise and train personnel in tasks normal to an occupational specialty and system and subsystem maintenance, repair, and operations; perform administrative and managerial functions involving enlisted personnel; and assist maintenance officers in planning aircraft and equipment maintenance, including scheduling and forecasting future maintenance requirements based on operational tempo, among others.

Table 3: Air Force Maintainer Skill Level Staffing to Authorized Positions for Selected Aircraft, Fiscal Years 2015–2020

Aircraft	Skill level	2015	2016	2017	2018	2019	2020
B-1B	3-level	◆	◇	◆	◆	◆	◆
	5-level	◆	◆	◆	◆	◆	◆
	7-level	◆	◆	◆	◆	◆	◆
	9-level	◆	◇	◆	◆	◆	◆
	Chief Enlisted Manager	◇	◇	◆	◇	◇	◇
C-5M	3-level	◆	◆	◆	◆	◆	◆
	5-level	◆	◆	◆	◆	◆	◆
	7-level	◆	◆	◆	◆	◆	◆
	9-level	◆	◆	◆	◆	◆	◆
	Chief Enlisted Manager	◆	◆	◆	◆	◆	◆
F-22	3-level	◇	◇	◇	◆	◆	◆
	5-level	◆	◆	◆	◆	◆	◆
	7-level	◆	◆	◆	◆	◆	◆
	9-level	◆	◆	◆	◆	◆	◆
	Chief Enlisted Manager	◆	◆	◆	◆	◆	◆
KC-135	3-level	◆	◇	◆	◆	◆	◆
	5-level	◆	◆	◆	◆	◆	◆
	7-level	◆	◆	◆	◆	◆	◆
	9-level	◆	◆	◆	◆	◆	◆
	Chief Enlisted Manager	◆	◇	◆	◆	◆	◆

Legend:

- ◆ 90 percent or above staffing to authorized positions
- ◆ Between 80 and 89 percent staffing to authorized positions
- ◇ Below 80 percent staffing to authorized positions

Source: GAO analysis of Air Force data. | GAO-22-104533

Our analysis identified some maintainer occupational specialties at specific skill levels that were persistently below 80 percent staffing to authorized positions for each selected aircraft over this timeframe:

- **B-1B (five out of 19 specialties):** Airlift and special mission aircraft maintenance chief enlisted manager, aircraft hydraulic systems craftsman, aircraft metals technology craftsman, aircraft fabrication superintendent, and bomber/special integrated communications/navigation/mission systems journeyman specialties.
- **C-5M (six out of 16 specialties):** Aircraft systems chief enlisted manager, aerospace ground equipment apprentice, nondestructive inspection apprentice, aircraft structural maintenance apprentice,

precision equipment laboratory apprentice, and airlift and special mission aircraft maintenance journeyman specialties.

- **F-22 (three out of 16 specialties):** Aircraft metals technology apprentice, low observable aircraft structural maintenance apprentice, and precision measurement equipment laboratory apprentice specialties.
- **KC-135 (six out of 15 specialties):** Refuel and bomber aircraft maintenance craftsman, aerospace propulsion journeyman, aircraft electrical and environmental systems journeyman, aircraft electrical and environmental systems craftsman, mobility air forces integrated communications/navigation/mission systems craftsman, and mobility air forces integrated instrument and flight control systems craftsman specialties.

Navy staffing and qualification rates of maintainers by skill level generally worsened but remained at high levels from fiscal year 2015 through fiscal year 2020. Table 4 below shows a general decline in maintainer skill level staffing and qualification rates for all Navy selected aircraft from fiscal year 2015 through fiscal year 2020. As of fiscal year 2020, however, only the P-8A has a maintainer skill level below 80 percent of authorized positions (apprentice).

Table 4: Navy Maintainer Skill Level Staffing to Authorized Positions for Selected Aircraft, Fiscal Years 2015–2020

Aircraft	Skill level		2015	2016	2017	2018	2019	2020
C-130T	Apprentice	Staffing	◆	◆	◆	◆	◆	◆
KC-130T	Apprentice	Qualification	◆	◆	◇	◆	◆	◇
	Journeyman	Staffing	◆	◆	◆	◆	◆	◇
	Journeyman	Qualification	◆	◇	◇	◇	◇	◇
	Master	Staffing	◆	◆	◆	◆	◆	◆
	Master	Qualification	◇	◇	◇	◇	◇	◆
	F/A-18E/F	Apprentice	Staffing	◆	◆	◆	◇	◇
	Apprentice	Qualification	◆	◆	◆	◇	◆	◆
	Journeyman	Staffing	◆	◆	◆	◆	◆	◆
	Journeyman	Qualification	◆	◆	◇	◇	◇	◆
	Master	Staffing	◆	◆	◆	◆	◆	◆
	Master	Qualification	◇	◇	◇	◇	◇	◇
P-8A	Apprentice	Staffing	◇	◆	◆	◇	◇	◇
	Apprentice	Qualification	◆	◆	◆	◆	◇	◇
	Journeyman	Staffing	◆	◆	◆	◆	◆	◆
	Journeyman	Qualification	◆	◆	◆	◆	◆	◆
	Master	Staffing	◆	◆	◆	◆	◆	◆
	Master	Qualification	◆	◆	◆	◇	◇	◇

Legend:

- ◆ 90 percent or above staffing to authorized positions
- ◇ Below 90 percent staffing to authorized positions
- ◇ Below 80 percent staffing to authorized positions

Source: GAO analysis of Navy data. | GAO-22-104533

Notes: According to Navy officials, the Navy tracks the workforce data for the C-130T and KC-130T together because the aircraft are similar and use the same skill sets for maintenance.

For the Navy, our analysis found there were no occupational specialties at specific skill levels that were persistently below 80 percent of authorized positions for staffing from fiscal year 2015 through 2020. However, there were three maintainer occupational specialties at specific skill levels that were persistently below 80 percent of authorized positions for qualified maintainers. Specifically, aviation electrician’s mate master maintainers for the C-130T/KC-130T and aviation machinist’s mate

master maintainers, and aviation electrician's mate master maintainers for the F/A-18E/F.¹⁹

Air Force and Navy units we met with shared examples of workforce challenges related to maintainer occupational specialties and skill levels that affect the performance of maintenance activities, such as staffing and experience challenges. For example, officials from one Air Force B-1B unit stated certain specialties that maintain their aircraft—such as airlift and special mission aircraft maintenance and refuel and bomber aircraft maintenance—have been understaffed, particularly at the staff sergeant level (typically 7-level maintainers).²⁰ Officials from this unit also stated that with the influx of new personnel since 2018 that the average years of experience among the unit's maintainers on the B-1B aircraft has dropped from 12.5 years to 3.5 years. Officials from four Navy units told us that a lack of maintainer experience on their specific aircraft prolongs maintenance due to a lack of qualifications.

The National Commission on Military Aviation Safety reported in December 2020 that even when maintenance units are fully staffed, many units do not have enough skilled personnel with the requisite experience and qualification to perform certain maintenance roles.²¹ In addition, the report stated that a decrease in junior maintainer experience is not being offset by more experienced personnel, as experience is declining across the board. To address this, the report recommended, among other things, that the military services implement policies and training for transitioning maintainers among platforms that require and certify proficiency, promote retention, and leverage experience for both legacy and new aircraft.

¹⁹In addition to the specialties identified above, other specialties were below 80 percent staffing assigned or qualified to authorized positions in fiscal year 2020. These included aviation ordnanceman apprentices (assigned) for the F/A-18E/F. For the P-8A these included aviation machinist's mate apprentices (assigned), aviation electrician's mate apprentices (assigned and qualified), aviation structural mechanic apprentices (assigned), aviation structural mechanic—safety equipment master maintainers (qualified), aviation electronics technician apprentices (assigned) and aviation electronics technician master maintainers (qualified).

²⁰Air Force 7-level maintainers typically perform unsupervised flight line and back shop work, train 3- and 5-level maintainers, and conduct supervisory duties.

²¹The National Commission on Military Aviation Safety, *Report to the President and Congress of the United States* (Dec. 1, 2020).

Units Experienced Various and Interrelated Challenges in Completing Aviation Maintenance

Our analysis of Air Force and Navy data and documentation, as well as interviews with maintainers from selected units, identified several other challenges—supply and parts availability, technical support and access to proprietary data, access to support equipment and facilities, and high operational tempo—that unit maintenance personnel experience in conducting maintenance on their aircraft. These challenges are similar to the factors identified in our prior work that affect the ability of maintainers to conduct depot-level maintenance.²² The challenges are inter-related, vary in severity, and can affect units’ ability to have aircraft available for operations and training.

Supply and Parts Availability

We found that supply and parts availability can affect the ability of unit maintenance personnel to conduct maintenance on their aircraft. For example, the average not mission capable supply rate—a metric that measures the total time an aircraft is not capable of performing any of its assigned missions due to a lack of parts—for six of the eight aircraft in our review increased from fiscal year 2015 to fiscal year 2020, as shown in table 5.

Table 5: Average Not Mission Capable Supply Rates, by Percentage, for Selected Air Force and Navy Aircraft, Fiscal Years 2015–2020

Air Force	Fiscal year						Change from fiscal year 2015 to 2020
	2015	2016	2017	2018	2019	2020	
B-1B	10.4	10.2	9.7	8.8	6.8	7.3	-3.1
C-5M	4.0	3.3	7.1	6.4	6.6	6.3	2.3
F-22	5.9	5.6	4.9	5.8	4.8	3.8	-2.1
KC-135	3.9	4.0	4.2	4.8	5.3	5.4	1.5
Navy							
C-130T	6.7	6.3	6.5	14.2	28.7	30.0	23.3
KC-130T	8.1	9.6	5.6	14.8	31.4	38.8	30.7
F/A-18 E/F	7.2	6.4	6.7	12.1	22.0	16.7	9.4
P-8A	8.9	6.8	7.4	10.8	13.6	10.9	2.0

Source: GAO analysis of Air Force and Navy data. | GAO-22-104533

²²See, for example, GAO, *Military Depots: Actions Needed to Improve Poor Conditions of Facilities and Equipment That Affect Maintenance Timeliness and Efficiency*, [GAO-19-242](#) (Washington, D.C.: Apr. 29, 2019) and GAO, *Weapon System Sustainment: Aircraft Mission Capable Rates Generally Did Not Meet Goals and Cost of Sustaining Selected Weapons Systems Varied Widely*, GAO-20-67SPSU (Washington, D.C.: Aug. 27, 2020).

Decrease in C-130T and KC-130T Mission Capable Rate

We previously reported that officials have said one reason for the mission capable rate decrease for the C-130T and KC-130T was that the Navy grounded the fleet in fiscal year 2017 after a fatal accident caused by a propeller malfunction on the aircraft. To expedite the fleet returning to flight, the U.S. Air Force, which is the source of supply for propellers for the family of C-130 aircraft, prioritized propellers needed for Navy and Marine Corps aircraft. This assisted in increasing the mission capable rate at the end of fiscal year 2018 and through fiscal year 2019. From fiscal year 2011 through fiscal year 2019, the rates increased for not mission capable maintenance and not mission capable supply.



Source: GAO analysis of DOD Information. U.S. Air National Guard/S. Tucker (photo). | GAO-22-104533

Of the six aircraft that saw increases in the not mission capable supply metric, the C-130T and KC-130T exhibited the largest increases of 23.3 and 30.7 percentage points respectively from fiscal years 2015 to 2020 (see sidebar). Unit maintenance personnel from all 15 maintenance units we interviewed told us they have experienced challenges in acquiring parts in a timely manner, which can lead to maintenance delays. For example, a C-5M unit had to wait 6 months for six fan components, 7 to 8 months for anti-ice valves, 9 months for five window seals, and 14 months—and counting as of June 2021—for a component that holds the aircraft's critical braking system together. Likewise, maintainers from an F-22 unit said they had to wait 239 days in 2020 for a landing gear component to be built and delivered to the unit.

The long wait times for parts significantly impact units' ability to perform maintenance and can increase the amount of work units have to do. In some cases, units had to delay regularly scheduled maintenance for long periods of time because they did not have the parts and supplies needed to perform the required maintenance operations. Maintainers from one F-22 unit told us that, as a result of parts not being available, they spent a significant amount of time on administrative tasks explaining why maintenance is not being performed, such as requesting waivers and extensions for scheduled maintenance while waiting for parts to arrive, instead of repairing their aircraft or training personnel. According to KC-135 program documentation, the frequent unavailability of three specific types of parts accounted for 2,388 hours of not mission capable supply time in fiscal year 2020—half of the unit's total not mission capable supply time for that year.

To address challenges with supply and parts availability, unit maintenance personnel from all eight of the selected aircraft in our review said they used the workaround of cannibalizing other aircraft for necessary parts.²³ We analyzed Air Force and Navy cannibalization data from fiscal years 2015 through 2020 and found mixed trends for our selected aircraft. Specifically, the number of cannibalizations increased for half of our aircraft and decreased for the other half. Unit maintenance personnel we spoke to told us that cannibalization actions are a common experience. For example, maintainers from an F/A-18 E/F unit said that

²³Cannibalization is the removal of serviceable parts from one item of equipment in order to install them on another item of equipment. DOD guidance states that cannibalization, when properly managed and controlled, may be a cost-effective and mission-enhancing logistics practice. DOD Directive 4151.18, *Maintenance of Military Materiel* (Mar. 31, 2004) (incorporating change 1, Aug. 31, 2018).

cannibalization of aircraft unable to fly for any reason is a routine practice used to fix other aircraft when there are long delays in obtaining parts. These cannibalization actions allow the unit to maintain a set number of mission capable aircraft while waiting for the supply system to produce the parts they need.

Although cannibalizations are common practice and allowable in appropriate circumstances under Air Force and Navy guidance, maintainers stated that frequent cannibalization actions create additional work for the unit, increase the incidence of parts breaking, and provide only short-term fixes to long-term supply problems.²⁴ For example, maintainers from a KC-130T unit said that cannibalizing parts necessitates additional labor and extended time frames to return one of their aircraft to mission capable status. Maintainers from a KC-135 unit stated that they spent a total of approximately 112 hours in cannibalizing two hard-to-acquire parts in fiscal year 2020. In both cases, unit officials said that cannibalization actions require a significant amount of time.

Some parts that maintainers cannibalize are difficult to access or are not designed to be removed, and removing them from one aircraft and installing them in another risks putting both aircraft in non-mission capable status if the part were to break. For example, maintainers from a B-1B unit said that the wing radomes—a part that protects aircraft's antennae from environmental effects—they cannibalize are very fragile and there is a high risk of breaking them every time they are removed from the aircraft. Since this part is no longer being manufactured, B-1B officials said there is a significant risk that an accident could render multiple aircraft non-mission capable for a long period of time.

Frequent cannibalizations may also mask long-term problems maintainers may be facing out in the field. For example, unit maintenance personnel from an F-22 unit said that frequent cannibalizations mask the actual number of parts that are missing across the unit because additional parts are taken from other aircraft instead of being acquired through the supply system. This practice, while enabling the unit to maintain its aircraft in the short-term, does not solve their inability to get new parts in the long-term. Unit maintenance personnel from an F/A-18 E/F squadron said that they

²⁴We previously reported on the adverse effects of cannibalizations. The adverse effects of cannibalizations include higher maintenance costs due to increased workloads, morale and personnel retention problems, and taking expensive aircraft out of service for long periods of time. See GAO, *Military Aircraft: Services Need Strategies to Reduce Cannibalizations*, [GAO-02-86](#) (Washington, D.C.: Nov. 21, 2001).

felt virtually required to cannibalize other aircraft to compensate for the supply system challenges they face obtaining needed parts and to maintain their monthly goal of having five mission capable aircraft. In addition to cannibalizations, maintainers told us that they continually communicate challenges with supply and parts availability in meetings with their respective Wing, Command, and Supply Department, and that they include metrics and top degraders in monthly and quarterly briefings up their chain of command.

Technical Support

Technical Orders and Maintenance

Unit maintenance personnel use technical orders and other publications to access instructions and to check what parts are needed to complete the task at hand. Unit officials said technical orders can be accessed while conducting maintenance on an aircraft through the use of portable electronic devices. For example, hand-held tablets contain electronic technical data and best practices from private industry to assist maintainers working on a weapon system.



Source: GAO analysis of DOD Information. U.S. Air Force/J. Seybert (photo). | GAO-22-104533

We found that selected units' maintenance personnel had various challenges with technical support, including delays in receiving technical support, internet connectivity issues, and challenges with access to proprietary data (see sidebar).²⁵ Unit maintenance personnel from 14 of the 15 maintenance squadrons we interviewed stated that delays in receiving technical support increased the amount of time needed for them to complete maintenance tasks. For example, unit maintenance personnel said they rely on Interactive Electronic Technical Manuals and other digital technical publications to determine repair needs on their aircraft and to provide guidance throughout the maintenance process.²⁶ While unit officials we spoke with generally believed that the Interactive Electronic Technical Manuals and other digital technical manuals were useful, they specified that these manuals must be easily accessible and up-to-date in order to be used effectively. Maintainers from six of the 14 units that spoke of experiencing technical support issues told us they encountered problems with dated Interactive Electronic Technical Manuals and other technical manuals. For example, unit maintenance personnel from one F/A-18 E/F unit said a required inspection that normally took 3 days to complete instead took 2 weeks because the Interactive Electronic Technical Manual the maintainers were relying on

²⁵As described by officials, technical orders, often in digital form, are publications to determine repair capabilities on aircraft and to provide guidance throughout the maintenance process. In this report, technical support can refer to technical orders and manuals, access to proprietary data and onsite engineering support, access to support equipment and appropriate facilities, or internet access. Additionally, in this report proprietary data refers to when the contractor retains ownership of certain intellectual property, such as the source code.

²⁶Interactive Electronic Technical Manuals are the electronic equivalent of paper-based technical manuals and can be accessed on electronic display devices such as laptops and tablets. Unit officials we spoke to further clarified and said the Interactive Electronic Technical Manuals are interactive manuals for different systems in the aircraft. They can read fault codes that come off the aircraft, distinguish which parts of the technical manual a maintainer should reference in a given situation, and interact with different systems in the aircraft to collect maintenance data.

had not been updated and the maintainers did not know how to perform the inspection without it.

Interactive Electronic Technical Manuals and other technical publications also require a stable internet connection in order to access all of their features and receive updates. Six units we spoke with said they had difficulty in accessing their Interactive Electronic Technical Manuals and other technical publications because they lacked stable internet connections in some of their work spaces. For example, maintainers from a C-5M and a KC-135 unit we spoke with said they lacked wireless internet connectivity outside of their offices and could not use the electronic equipment they were provided to access the Interactive Electronic Technical Manuals and other electronic publications unless they went back to their offices, which caused unnecessary maintenance delays. Maintainers from a P-8A unit said that their ability to access an internet connection varied depending on where they were in their deployment cycle, and that maintenance delays occurred more frequently in areas where they did not have a stable internet connection.

Furthermore, units may not have access to all of the data or engineering support they need to perform maintenance on their aircraft. For example, according to officials, two of the selected aircraft in our review—the F-22 and the KC-135—have components whose data are proprietary to the manufacturer or vendor and are not easily accessible by unit maintenance personnel, which can hinder the units from performing maintenance. Maintainers from an F-22 unit, for example, said they did not have access to the inspection data—data collected during routine condition checks of aircraft components for wear or signs of failure—for some parts, such as the auxiliary power unit, due to proprietary data rights being held by the contractor. As a result, maintainers from this unit said they are unable to properly plan and schedule regular maintenance for their aircraft, as the contractors do not share these proprietary data with the unit. Unit officials from a KC-135 unit said that their inability to access proprietary data on some of their aircraft's parts had led to a general decline in maintenance knowledge among the unit's maintenance personnel. These unit officials said their maintainers have the knowledge to access and repair only about 60 percent of the components on their aircraft while contractors repair the remaining 40 percent. Without access to the proprietary data, unit officials said newer maintainers in particular are unable to gain a full understanding of how to maintain their aircraft and miss out on the associated hands-on learning experience.

Air Force Maintenance Squadron Benefits from In-House Engineer

Maintainers from one C-5M unit we interviewed shared the benefits of having an in-house engineer. Specifically, unit maintenance personnel had experienced extended delays in receiving technical support from engineers, which impacted their maintenance turnaround time. According to unit maintenance personnel, after having an in-house structural engineer working in maintenance, structural engineering disposition processing time decreased by 90 percent. The time to fulfill engineering requests decreased from 1 to 2 weeks to 1 to 2 hours. Moreover, between January and April 2021, 13 engineering requests had a mean average of 12 hours each, as compared to the previous average of 53 hours each.



Source: GAO analysis of DOD Information. U.S. Air Force/C. Minoda (photo). | GAO-22-104533

In February 2019, we reported on additional steps DOD is taking to mitigate challenges related to intellectual property, especially software sustainment.²⁷ These steps include the development of policy on the acquisition or licensing of intellectual property, and the establishment of a cadre of intellectual property experts to help support the acquisition workforce on intellectual property matters. In November 2021, we reported that DOD organizations are working to meet their assigned intellectual property responsibilities but have not fully addressed how the intellectual property cadre—DOD’s new group of specialized experts—will fulfill all of its responsibilities.²⁸ In particular, this cadre faces uncertainty in funding and staffing, program support, and sufficient expertise in key areas.

Selected units’ maintenance personnel also cited difficulties in acquiring engineering support as another factor that can lead to maintenance delays. According to unit officials, engineers typically support a unit by reviewing and approving changes to technical orders, maintenance procedures, and repairs while also providing troubleshooting support for maintenance issues that unit maintenance personnel have problems addressing. Maintainers from three of the 15 units we spoke with said that difficulties in acquiring timely engineering support can delay maintenance on their aircraft. For example, maintainers from a B-1B unit said they often turn to engineering support when they find deficiencies in current guidance on how to handle a particular maintenance issue or to receive approval for a particular repair. These types of requests take time to review, and unit maintenance personnel said that this process increases the time it takes for them to complete maintenance on their aircraft.

To address the challenges with technical support, unit maintenance personnel have pursued various solutions. For example, to improve internet connectivity, officials from one unit said they were participating in the Flightline of the Future, which is an initiative aimed at helping to improve aircraft maintenance by introducing more modern technology such as interactive touch screens, newer tablets, and better wireless connection in areas where aircraft maintenance is performed. While unit officials said there are still hurdles to implementing this initiative, such as determining how to get consistent wireless internet connection outside of

²⁷GAO, *Weapon System Sustainment: DOD Needs to Better Capture and Report Software Sustainment Costs*, [GAO-19-173](#) (Washington, D.C.: Feb. 25, 2019).

²⁸GAO, *Defense Acquisitions: DOD Should Take Additional Actions to Improve How it Approaches Intellectual Property*, [GAO-22-104752](#) (Washington, D.C.: Nov. 30, 2021).

Support Equipment and Facilities

the office, they believe it is feasible. In another instance, according to unit maintenance personnel, the C-5M unit managed to secure an in-house engineer that significantly improved their maintenance turnaround times (see sidebar). The units we interviewed also said that they frequently communicate their concerns up the chain of command, and that the program offices and the major and type commands are aware of the challenges they face in receiving timely technical support.

Unit maintenance personnel we spoke with also identified difficulty in accessing support equipment and facilities as a challenge to their maintenance efforts. Nine of the 15 units we spoke with said they encountered problems in acquiring or gaining access to the appropriate support equipment or facilities they needed to perform maintenance on their aircraft. The support equipment they identified varied by aircraft and ranged from forklifts and ladders to equipment designed to test the structural integrity of replacement aircraft parts.

For example, officials from an F/A-18 E/F unit and a joint C-130T/KC-130T unit said that they had to regularly borrow the support equipment they needed from other squadrons, as there was not enough support equipment for each squadron to receive its own. Officials from these units said they had to drive or fly to the nearest base to pick up and deliver the equipment they needed, often causing delays in aircraft maintenance. Maintainers from an F-22 unit said that they lacked the proper support equipment to test or repair parts in the field, which not only forced them to cannibalize parts from other aircraft but also led to maintenance delays as the unit awaited parts being returned by the contractor. The lack of testing ability also means that the unit must first install the repair parts onto the aircraft itself and turn it on, which can lead to unexpected incidents if the part was not repaired properly.

In addition to support equipment, unit maintenance personnel said that they sometimes lack the appropriate facilities in which to perform maintenance, which can cause maintenance delays and other issues. For example, unit maintenance personnel from a B-1B unit said they lacked the proper facilities to handle and dispose of hexavalent chromium, a metallic substance created during the welding process that is a known cause of cancer, produced while the aircraft undergoes corrosion control

maintenance.²⁹ Officials said the lack of an appropriate facility that can house the B-1B while it undergoes this type of maintenance poses a health and workplace safety concern because personnel may potentially be exposed to toxic chemicals.³⁰ Maintainers from a P-8A unit said that they lacked hangar facilities with sufficient space, wash racks, cranes, and other equipment needed to conduct scheduled and unscheduled maintenance while they were deployed overseas. Officials from this unit said they had to reposition their aircraft and then wait for the proper support equipment and facilities to become available before being able to conduct routine maintenance. The units we interviewed also said that they regularly communicate their concerns up the chain of command, and that the program offices and the major and type commands are aware of the challenges they face in receiving timely technical support.³¹

High Operating Tempo

We found that high operating tempo can lead to an increase in the frequency and duration of scheduled maintenance and inspections.³² In September 2016 we found that the military services faced a range of readiness challenges which they attributed to continued demands on their forces and increased frequency and length of deployments.³³ For this review, we analyzed Air Force and Navy data on the number of take-offs, or sorties, performed by selected aircraft. We found mixed operating tempo trends—three of the eight aircraft had an overall increase in the number of sorties from fiscal years 2015 to 2020 and the remaining five aircraft flew fewer sorties over the same period (see table 6). For example, the number of sorties flown by the P-8A increased by 6,696

²⁹According to the Occupational Safety and Health Administration, hexavalent chromium is one of the valence states of the element chromium. It is usually produced by an industrial process. Hexavalent chromium is known to cause cancer. In addition, it targets the respiratory system, kidneys, liver, skin and eyes. Chromium metal is added to alloy steel to increase hardenability and corrosion resistance. A major source of worker exposure to hexavalent chromium occurs during “hot work” such as welding on stainless steel and other alloy steels containing chromium metal.

³⁰Unit maintenance officials noted that the hexavalent chromium issue has been documented in multiple Inspector General inspections since 2015 and that the B-1 program office and Global Strike Command are aware of the problem.

³¹We have ongoing work examining DOD and the services’ depot improvement strategies.

³²Operating tempo refers to the rate at which military units are involved in all military activities, including contingency operations, exercises, and training deployments.

³³GAO, *Military Readiness: DOD’s Readiness Rebuilding Efforts May Be at Risk without a Comprehensive Plan*, [GAO-16-841](#) (Washington, D.C.: Sep. 7, 2016).

from fiscal year 2015 to fiscal year 2020, while the number for the KC-135 decreased by 14,802 over the same period.³⁴

Table 6: Number of Sorties Flown by Selected Aircraft, Fiscal Years 2015-2020

	Fiscal year						Change from fiscal year 2015 to 2020	Percent change from fiscal year 2015 to 2020
	2015	2016	2017	2018	2019	2020		
Air Force								
B-1B	3,363	3,208	2,988	2,566	1,766	1,842	-1,521	-45
C-5M	3,082	3,931	4,763	4,575	4,105	3,673	591	19
F-22	21,189	19,549	19,484	20,473	19,045	18,722	-2,467	-12
KC-135	44,325	40,665	38,371	36,917	33,552	29,523	-14,802	-33
Navy								
C-130T	1,468	1,299	1,379	460	859	1,597	129	9
KC-130T	1,762	2,054	1,467	662	630	556	-1,206	-68
F/A-18 E/F	93,383	95,444	95,026	88,885	90,864	88,094	-5,289	-6
P-8A	3,843	4,820	6,759	8,659	9,424	10,539	6,696	174

Source: GAO analysis of Air Force and Navy data. | GAO-22-104533

³⁴Unit officials said the total number of sorties flown can be affected by a variety of factors including, but not limited to, the size of the aircraft fleet, weather, airfield management, and safety in addition to aircraft readiness.

Air Force and Navy Maintenance Optimization Efforts

The Air Force has begun implementing a new sustainment initiative, referred to as Theory of Constraints, in an effort to increase aircraft availability. Maintainers from one Air Force unit we interviewed shared their success. Specifically, they noted that their aircraft must undergo a periodic inspection established by the program office every 24 months or after 1,800 flight hours, whichever comes first, which typically would take approximately 21 days to complete. As their mission load increased, their aircraft surpassed the 1,800 flight hour threshold more quickly, leading to more frequent 21-day inspections. According to Air Force officials, applying the new initiative reduced the 21-day inspection to 9 days.

Similarly, Navy officials said they began bundling mandatory inspections to create efficiencies, and maintainers from one Navy unit we interviewed shared their success. Specifically, after bundling inspections on their aircraft, the unit reduced the number of mandatory inspections from 22 to 17, and the time between inspections increased from 84 days to 91 days, thereby increasing the time the aircraft was ready to fly.



Source: GAO analysis of DOD Information. U.S. Air National Guard/D. Heaton (photo). | GAO-22-104533

Unit maintenance personnel from five of the 15 units we interviewed said that high operational tempos caused delays in aircraft maintenance in addition to increasing the amount of maintenance needed on their aircraft, as they are flown more. For example, a C-5M unit said that their operational tempo and number of sorties have remained steadily high and are affecting the unit's ability to perform maintenance on the aircraft. Officials from this unit said they are supposed to maintain a 60 percent mission capable rate but are only able to achieve between 20 to 30 percent mission capable because of high operational tempo. In order to sustain this operational tempo, unit officials said they fly their available mission capable aircraft more frequently, but the increased number of flights also puts more strain on those aircraft.

Maintainers from a P-8A unit said that last-minute missions remove aircraft and personnel from the maintenance schedule and detract from the unit's efforts to meet other requirements, such as training and hazardous materials disposal. Unit maintenance personnel said the high operational tempo strains maintenance production and increases workloads for maintainers across the board. To address this challenge, unit maintenance personnel, in coordination with the program office that sets maintenance and inspection requirements, have undertaken efforts to gain efficiencies through maintenance optimization initiatives and maintenance bundling (see sidebar).

Services Have Taken Steps, but Have Not Fully Mitigated Persistent Sustainment Risks

The Air Force and Navy Have Taken Some Steps to Address Unit Maintenance Challenges

We found that the Air Force and Navy have taken some steps to address unit-level maintenance challenges through aviation sustainment strategies and fleet-wide initiatives. Air Force and Navy aviation sustainment strategies identify actions to address unit maintenance challenges as well as recover and maintain readiness levels, as envisioned by the *National Defense Strategy*.³⁵ For example, the Air Force Strategy identifies adopting commercial best practices for scheduled inspections, expanding repair networks, investing in low or first-time demand parts, and utilizing predictive data analytics, among other actions.³⁶ The Navy Strategy identifies actions to reform maintenance at the unit level to align supply to demand, personnel to need, and skill to repair.³⁷

Additionally, the Air Force and Navy have several fleet-wide initiatives to analyze and communicate unit maintenance trends to stakeholders and leadership and improve fleet readiness. The Air Force, through the aircraft availability improvement plan, seeks to increase mission capable rates each fiscal year. The plan is a joint initiative between the program office and major command focused on developing solutions to eliminating or reducing the impact of issues that hamper unit readiness. Moreover,

³⁵In the 2018 *National Defense Strategy* DOD noted that every warfighting domain—land, sea, air, space, and cyberspace—is now contested, as potential adversaries, most notably China and Russia, have developed and enhanced their own capabilities. At the same time, our work has shown that two decades of conflict have degraded U.S. military readiness. To maintain the U.S. military's advantage across all domains in a new security environment characterized by great-power competition, DOD is working to rebuild and restore readiness while also modernizing its forces. See GAO, *Military Readiness: Department of Defense Domain Readiness Varied from Fiscal Year 2017 through Fiscal Year 2019*, [GAO-21-279](#) (Washington, D.C.: Apr. 7, 2021).

³⁶Secretary of the Air Force and Chief of Staff, United States Air Force, *Sustainment Strategy Framework*. We have ongoing work examining predictive maintenance for ground combat systems, ships and submarines, and aircraft.

³⁷Naval Aviation Enterprise, *Naval Aviation Vision 2016-2025*.

the Air Force conducts regular aircraft availability improvement plan briefings to track and analyze unit aircraft maintenance metrics and other briefings to identify top maintenance degraders. For example, health-of-the-fleet briefings identify top mission capability degraders to understand trends, seek to improve scheduling practices, and identify shortfalls.

Likewise, the Navy has several fleet-wide initiatives to improve readiness. We reported in June 2020 on the Navy's implementation of the Naval Sustainment System initiative in 2018 in response to the Secretary of Defense's direction that critical fighter aircraft, such as the F/A-18 E/F, achieve an 80-percent mission capable goal.³⁸ Among other things, this led to the service implementing private industry best practices and employing new strategies such as "swarming," which refers to many maintainers working on a particular aircraft at the same time to expedite completion. The Navy also implemented the Maintenance Operations Center in 2018 as a pilot program to help coordinate actions to address unit maintenance challenges. According to Navy officials, aircraft readiness stakeholders, including Navy supply, maintenance, engineering, and industry partners, are brought together daily in an attempt to expedite information sharing and problem solving, such as tracking needed parts for grounded aircraft. Moreover, the Navy has monthly briefings to track and analyze maintenance issues affecting unit readiness, including the top maintenance degraders.

Air Force and Navy Have Not Completed Required Sustainment Reviews

We found that the Air Force and Navy had not completed required sustainment reviews for the selected aircraft in our review. In 2016, the National Defense Authorization Act for Fiscal Year 2017 included a provision requiring the military departments to conduct sustainment reviews for major weapon systems to assess their product support

³⁸See GAO, *Military Depots: The Navy Needs Improved Planning to Address Persistent Aircraft Maintenance Delays While Air Force Maintenance Has Generally Been Timely*, [GAO-20-390](#) (Washington, D.C.: June 23, 2020). We reported in November 2020 ([GAO-21-101SP](#)) that the Office of the Secretary of Defense had determined that the fiscal year 2019 80 percent mission capable goal is not a fiscal year 2020 requirement. An Office of the Secretary of Defense official stated that the department had decided to move away from a goal that narrowly focused on selected aircraft and had expanded to a more holistic view of readiness.

strategy, performance, and operation and support costs.³⁹ In January 2021 the provision was amended to add further reporting requirements related to cost growth and further define which weapon systems are subject to completing a sustainment review.⁴⁰ DOD recognizes regular sustainment reviews as a critical tool to assess and address performance shortcomings and to identify maintenance and other risks to readiness.

As shown in table 7, we found that, as of September 30, 2021, of the four Air Force aircraft selected in our review, two—the B-1B and KC-135—had completed a sustainment review, and two aircraft—the C-5M and F-22—had not yet completed a sustainment review. We found that the Navy had not completed sustainment reviews for any of the four selected Navy aircraft in our review, as shown below, in part because according to Navy officials, two of the aircraft in our review—the C-130T and the KC-130T—do not meet the threshold defined in the law.⁴¹

³⁹National Defense Authorization Act for Fiscal Year 2017, Pub. L. No. 114-328, § 849(c) (2016). The requirement was initially codified as section 2441 of Title 10, U.S. Code. The William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021 recodified the provision, as amended, as section 4323 of Title 10, U.S. Code, effective January 1, 2022. Pub. L. No. 116-283, §§ 1801(d), 1848(c) (2021).

⁴⁰See Pub. L. No. 116-283, § 802(c) (codified as amended at 10 U.S.C. § 4323). As amended, section 4323 requires a sustainment review of each covered system not later than five years after initial operational capability and every five years thereafter throughout the life cycle of the covered system. § 4323(a). DOD issued implementing guidance to the services in June 2021, directing them to maintain a current list of all systems that meet the requirements for sustainment review reporting and to submit a planned schedule of when each sustainment review-eligible program would hold its review.

⁴¹According to Navy officials, this aircraft is classified an Acquisition Category IV, which is not considered a major defense acquisition program. Traditionally, defense acquisition programs are classified into acquisition categories based on the value and type of acquisition. DOD's most costly programs have historically been referred to as major defense acquisition or Acquisition Category I programs. Programs with lower costs are categorized as Acquisition Category II, III, or IV programs. The acquisition category of a program can affect oversight levels and procedures, such as what program information and documents are required and who is designated as the milestone decision authority.

Table 7: Status of Statutory Sustainment Reviews for Selected Air Force and Navy Aircraft, as of September 30, 2021

	Completed sustainment review
Air Force	
B-1B	Yes
C-5M	No
F-22	No
KC-135	Yes
Navy	
C-130T	Not applicable ^a
KC-130T	Not applicable ^a
F/A-18 E/F	No
P-8A	No ^b

Source: GAO analysis of Air Force and Navy program documentation. | GAO-22-104533

^aThe C-130T and KC-130T is listed as not applicable because this aircraft does not meet the statutory threshold, according to Navy officials.

^bThe Navy completed an internal sustainment review on the P-8A in August 2020; however, the completed review was not part of the Navy's submission to Congress in response to section 2441 of Title 10, U.S. Code (subsequently renumbered, as amended, as section 4323).

Air Force explanation for not completing all sustainment reviews.

Air Force officials told us they believed the initial statutory requirement in 2016 for sustainment reviews was triggered only when a program was 5 years past its initial operational capability date. They said that the Air Force did not consider the requirement as applying to older aircraft, but rather interpreted it as applying to newer weapon systems, once a system reached initial operational capability. The statute was amended in 2021 and Air Force officials are now working to complete sustainment reviews on all covered weapon systems regardless of whether they are newer or older. They have identified approximately 40 weapons systems and began completing sustainment reviews in fiscal year 2021. According to these officials, completing the reviews on all 40 weapons systems between January 2021 and the end of fiscal year 2021 was not feasible. Rather, the Air Force completed nine sustainment reviews, to include the B-1B and KC-135, and according to Air Force officials, plan to complete reviews for the C-5M and F-22 in fiscal year 2022.⁴²

⁴²In addition to the selected aircraft in our review, the Air Force completed sustainment reviews on the B-2, B-52, C-130J, E-3, F-15E, F-16, and the MQ-9.

Navy explanation for not completing any sustainment reviews.

Navy officials told us that they had not completed sustainment reviews on any systems to address the statutory requirement as of October 2021. They explained that they had taken steps to begin addressing the statutory requirements including conducting sustainment review pilots in 2018; updating naval guidance in 2019, to include sustainment reviews as part of their life-cycle management process; and conducting additional sustainment review pilots in 2020.⁴³ In September 2021 the Navy issued implementation guidance for the completion of future sustainment reviews, identifying 54 weapons systems that will require sustainment reviews.⁴⁴ According to this guidance, the Navy plans to complete the F/A-18 E/F sustainment review in fiscal year 2022 and the P-8A sustainment review in fiscal year 2023.

Both the Air Force and Navy have plans to complete all required sustainment reviews, as shown in figure 6 below. Air Force officials reported they plan to work through the backlog of the remaining systems between now and the end of fiscal year 2025. Navy officials reported that they anticipate completing sustainment reviews for 54 systems over the next 13 years, between now and fiscal year 2035.⁴⁵

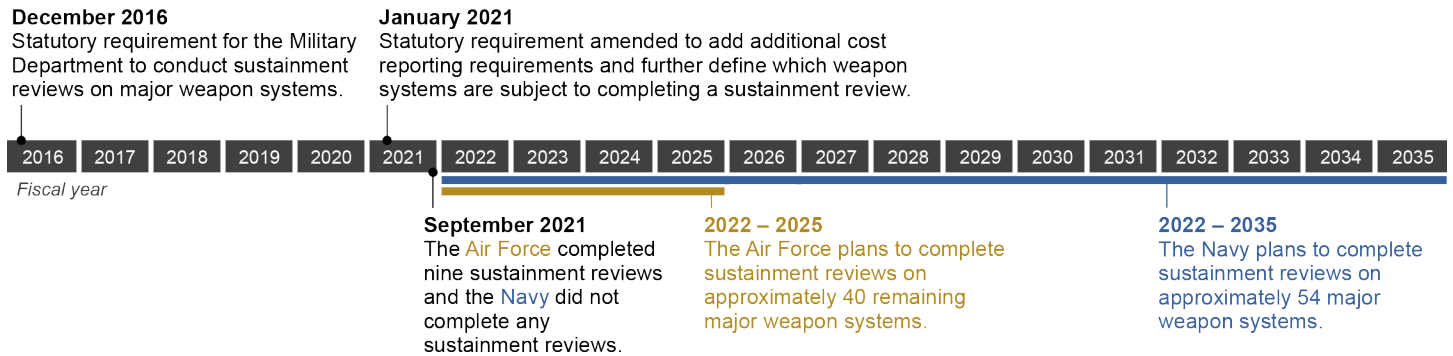
⁴³Regarding updated guidance, Navy officials referenced SECNAVINST 5000.2F, *Defense Acquisition System and Joint Capabilities Integration and Development System Implementation* (Mar. 26, 2019).

⁴⁴Assistant Secretary of the Navy (Research, Development and Acquisition) Memorandum, *Gate 7 Sustainment Reviews* (Sept. 27, 2021).

⁴⁵The Navy's schedule includes fixed-wing aircraft, as well as rotary aircraft, surface ships, and submarines. As a result of amendments in 2021, sustainment reviews are now required every five years; consequently, the services may need to produce multiple sustainment reviews for certain systems over the timeframe they have identified. Specifically, section 4323 now requires a sustainment review not later than five years after initial operational capability and every five years thereafter throughout the weapon system's life cycle. 10 U.S.C. § 4323 (as amended by Pub. L. No. 116-283, § 802(c)(1)).

Figure 6: Estimated Timeline for Air Force and Navy to Complete Required Sustainment Reviews, as of October 2021

Statutory reporting requirements



Service actions

Source: GAO analysis of statutory reporting requirements and Air Force and Navy data. | GAO-22-104533

Note: As a result of amendments in 2021, sustainment reviews are now required every 5 years; consequently, the services may need to produce multiple sustainment reviews for certain systems over the above timeframe.

Mission capable rate and other maintenance metrics have worsened over the last 7 years for the eight systems we reviewed (as discussed above) and the Air Force and Navy have generally not met mission capable rate goals for the last decade across its fixed-wing aircraft (discussed in more detail below). However, the current plans result in the Air Force and Navy conducting its initial required sustainment reviews by the end of fiscal years 2025 and 2035, respectively.⁴⁶

The planned delay in completing the required sustainment reviews is due to the Air Force and Navy not prioritizing the completion of the reviews in a timelier manner. Without the Air Force and Navy prioritizing the completion of required sustainment reviews and updating their planned schedules to complete the reviews in a timelier manner, the services are missing opportunities to identify maintenance and other risks to aircraft availability. Furthermore, DOD and Congress may not be fully informed of the magnitude of unit-level maintenance and other sustainment challenges impeding efforts to reverse the downward decline in outcomes.

⁴⁶As a result of amendments in 2021, sustainment reviews are now required every five years; consequently, the services may need to produce multiple sustainment reviews for certain systems over the timeframe they have identified.

Air Force and Navy Have Not Fully Mitigated Persistent Sustainment Risks

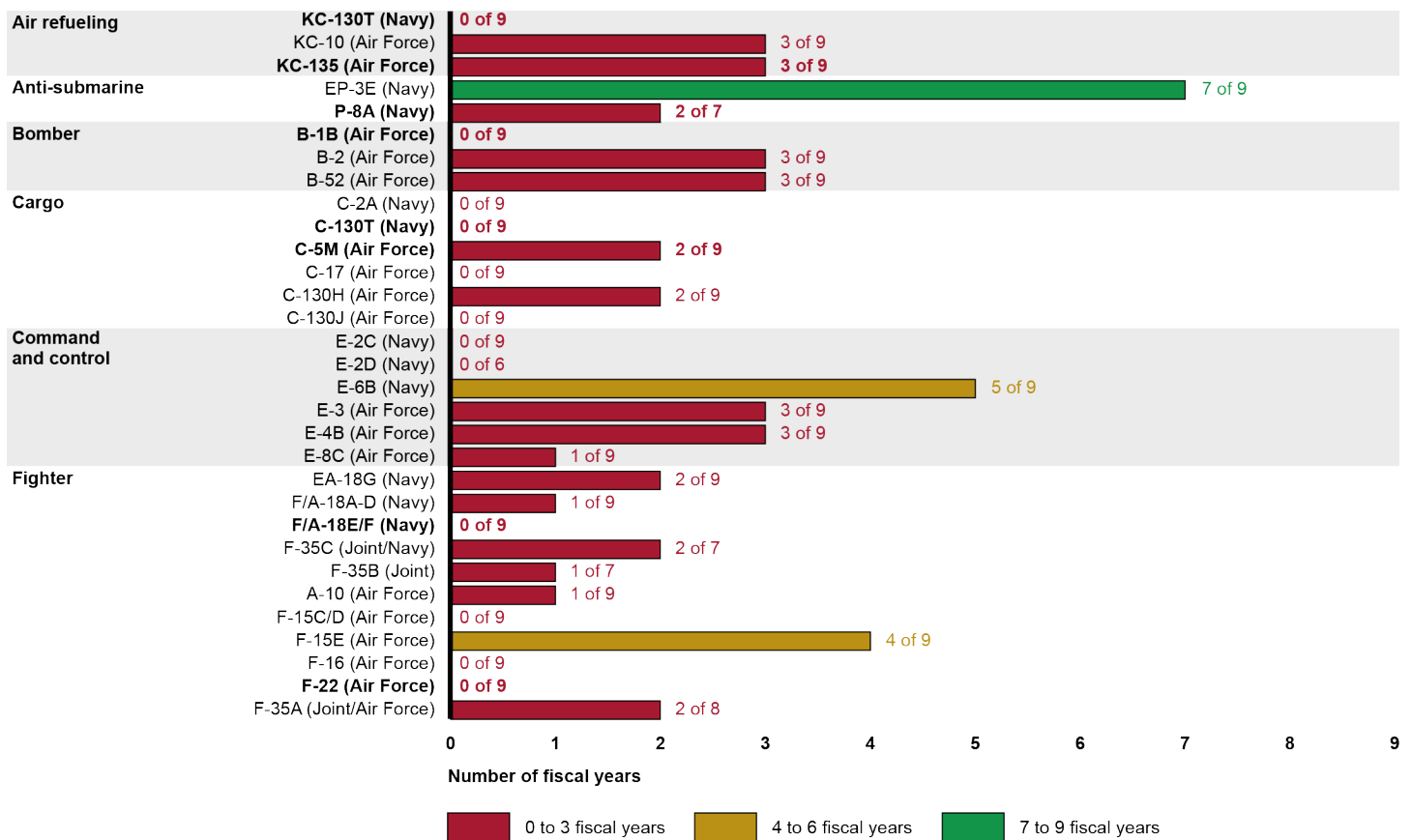
For the two selected aircraft that had completed required sustainment reviews—the B-1B and KC-135—the Air Force identified a range of shortfalls that affected sustainment and readiness. These reviews identified that the Air Force had consistently under-resourced sustainment for these two aircraft. For example, the B-1B sustainment review found, among other things, that continual underfunding of requirements drives degradation of the aircraft; increases risk in readiness, capability, and sustainability; and severely impacts the ability to meet aircrew training and combatant command operational requirements. For example, according to the sustainment review, between fiscal year 2016 and fiscal year 2020, the Air Force funded the B-1B between 48 and 85 percent of the projected operations and support funds required for these fiscal years. Likewise, the KC-135 sustainment review found that the not mission capable supply rate worsened due to under-resourcing sustainment needs. For example, according to the sustainment review, the Air Force funded engines at 82 percent and technical orders at 18 percent of the projected operations and support funds required in fiscal year 2020.

With respect to the Navy, while there was not an official sustainment review submitted to Congress, the P-8A program office conducted an internal Navy sustainment review in August 2020 and identified similar shortfalls affecting sustainment and readiness. For example, according to program documentation, the Navy funded unit readiness support at 37 percent of the projected operations and maintenance funds required in fiscal year 2020, resulting in delays to diagnose aircraft reliability issues. As a result, the average time to close engineering investigations, which help resolve mission and partial mission capable supply and maintenance degraders, increased from approximately 70 days to more than 125 days, thereby negatively impacting aircraft readiness. In another example, the Navy funded P-8A unit maintenance training at 4 percent of the projected operations and maintenance funds required in fiscal year 2020, resulting in ineffective training according to Navy documentation. The program office identified this as a key contributing factor to squadrons' inability to complete required scheduled maintenance inspections, which have exceeded turnaround time objectives by 50 percent.

As discussed earlier in this report, we found that mission capability rates and other maintenance trends had worsened for selected aircraft since fiscal year 2015, and that unit maintenance personnel experienced a variety of interrelated and persistent challenges affecting aircraft availability. This trend, however, is not limited to the eight aircraft we selected for this review. Our prior work has found systemic, fleet-wide aircraft availability challenges facing the Air Force and Navy. For

example, in November 2020 we found that of 31 Air Force and Navy fixed-wing aircraft we reviewed, 12 aircraft did not meet their annual mission capable goals for any year from fiscal year 2011 through fiscal year 2019, and only two met their annual mission capable goals in a majority of those years, as shown in figure 7.

Figure 7: Number of Times Selected Fixed-Wing Aircraft Met Their Annual Mission Capable Goal, Fiscal Years 2011-2019



Source: GAO analysis of Navy, and Air Force data. | GAO-22-104533

Note: This analysis is adapted from our November 2020 report on weapon system sustainment. See GAO, *Weapon System Sustainment Aircraft Mission Capable Rates Generally Did Not Meet Goals and Cost of Sustaining Selected Weapon Systems Varied Widely*, GAO-21-101SP (Washington, D.C.: Nov. 19, 2020). The eight aircraft we selected for this review are bolded.

Likewise, over the past decade, we have issued numerous reports and testified on a variety of interrelated and persistent challenges affecting

aircraft availability.⁴⁷ Our work has shown that Air Force and Navy aircraft mission capable rates have been negatively impacted by aging aircraft, depot maintenance delays, and insufficient supply support. Our work has highlighted that the Air Force and Navy face significant readiness challenges that have developed over more than a decade of conflict, budget uncertainty, and reductions in force structure, and that addressing these challenges will require years of sustained management attention and resources.

DOD and the military services have outlined requirements to address persistent sustainment risks. DOD guidance states that DOD components will conduct sustainment reviews in conjunction with other assessments associated with sustainment strategies and plans.⁴⁸ The guidance further provides that detailed sustainment planning will include sustainment risks, diminishing manufacturing sources and material shortage risk management, and proposed mitigation plans. Further, according to the guidance, such assessments and reviews assist weapon system stakeholders in taking corrective action to prevent degraded materiel readiness, among other things. Air Force and Navy guidance similarly direct that sustainment reviews be conducted. For example, Navy guidance includes among the objectives of such sustainment reviews matters associated with resolving system and mission readiness issues and product support shortfalls, as well as concurrence with key stakeholders regarding sustainment risk assessments and identified mitigations.⁴⁹ Moreover, according to *Standards for Internal Control in the Federal Government*, agencies should define objectives clearly to identify and define risk tolerances, and should design performance measures that

⁴⁷See, for example, GAO, *Navy and Marine Corps: Services Continue Efforts to Rebuild Readiness, but Recovery Will Take Years and Sustained Management Attention*, [GAO-21-225T](#) (Washington, D.C.: Dec. 2, 2020) and GAO, *Air Force Readiness: Actions Needed to Rebuild Readiness and Prepare for the Future*, [GAO-19-120T](#) (Washington, D.C.: Oct. 10, 2018). A complete listing of related reports is provided in the Related GAO Products pages at the end of this report.

⁴⁸DOD Instruction 5000.91. Generally, more detailed life cycle sustainment plans are required for major defense acquisition programs, whereas a tailored life cycle sustainment plan may be used for other systems.

⁴⁹See SECNAVINST 5000.2F, Table E9T1 (listing objectives associated with sustainment reviews).

indicate a level or degree of performance, such as specific milestones for achieving a goal.⁵⁰

The Air Force could not provide us with mitigation plans, including specific milestones, to remedy maintenance challenges, risks, or related impacts to aircraft availability that it had identified in the completed B-1B and KC-135 sustainment reviews. Navy officials directed us to Navy guidance that requires the identification of mitigation plans for critical operations and support cost growth; however, as discussed above, the Navy has not completed sustainment reviews or provided mitigation plans to address persistent sustainment challenges on any of the aircraft in our review. Without developing mitigation plans, with specific milestones, to remedy maintenance challenges, risks, or related impacts identified in completed sustainment reviews, the Air Force and Navy cannot fully address unit-level aviation maintenance challenges affecting aircraft availability required for training and operations.

Moreover, a 2021 amendment to the statutory requirement for sustainment reviews requires a remediation plan to reduce operating and support costs for weapon systems that have experienced critical operating and support cost growth.⁵¹ In so doing, the amendment set a threshold for this requirement and defined cost growth as at least 25 percent higher than the estimate documented in the most recent independent cost estimate, or at least 50 percent higher than the estimate documented in the original baseline estimate for the system. While the Air Force and Navy are generally required by this provision to submit remediation plans to address critical operating and support cost growth found in sustainment reviews, Congress has not required the services to

⁵⁰GAO, *Standards for Internal Control in the Federal Government*, [GAO-14-704G](#) (Washington, D.C.: September 2014).

⁵¹Pub. L. No. 116-283, § 802(c)(3) (presently codified at 10 U.S.C. § 4323(d)). Specifically, the statute requires the secretary of each military department to annually submit to the congressional defense committees the sustainment reviews required for that fiscal year; in the case of covered systems with critical operating and support cost growth, the submission must include a remediation plan to reduce operating and support costs or a certification that such cost growth is necessary to meet national security requirements. Critical operating and support cost growth is defined as growth of at least 25 percent more than the estimate documented in the most recent independent cost estimate; or at least 50 percent more than the estimate documented in the original baseline estimate for the system. 10 U.S.C. § 4323(d), (e)(2).

submit mitigation strategies to address maintenance challenges and risks to aircraft availability found in sustainment reviews.

Our prior work has found that one of the key metrics used by DOD and the military services to assess the health and readiness of an aircraft fleet is its mission capable rate—that is, the percentage of total time when the aircraft can fly and perform at least one mission.⁵² Amending section 4323 of Title 10, U.S. Code to require the Air Force and Navy to submit mitigation plans to Congress related to identified maintenance challenges and risks to aircraft availability found in sustainment reviews based on a specific sustainment threshold would enhance the services' accountability for taking the necessary and appropriate actions to address persistent challenges to aircraft availability. Such thresholds could include aircraft falling below their mission capable rate goal for consecutive years; an aircraft's mission capable rate declining by a specified percentage; or some other sustainment metric or metrics. Doing so would also provide Congress detailed information on the services' plans to address sustainment risks and any related funding needs.

Conclusions

The Air Force and Navy spend billions of dollars annually to ensure the availability of their aircraft and use a variety of metrics, such as mission capable rates, to assess the health and readiness of their aircraft fleet. For the selected aircraft in our review, mission capable rates and other maintenance metrics have worsened since fiscal year 2015. These downward trends in aircraft readiness are not new nor are they specific to our case studies. Over the past decade, we have issued numerous reports finding persistent aircraft availability challenges. Maintainer staffing shortages, supply and parts availability, technical support and access to proprietary data, access to support equipment and facilities, and an increase in the frequency and duration of scheduled maintenance and inspections, among other things, have affected Air Force and Navy units' ability to have aircraft available for operations and training.

While the Air Force and Navy have taken steps to address these challenges, neither service has completed all required sustainment reviews for their aircraft. Without the Air Force and Navy prioritizing the completion of required sustainment reviews and updating their planned schedules to complete them in a timelier manner, the services are missing opportunities to identify maintenance and other risks to aircraft availability and DOD and Congress may not be fully informed of the

⁵²[GAO-21-101SP](#).

magnitude of unit-level maintenance challenges and other sustainment challenges impeding efforts to reverse the downward decline in outcomes. When sustainment reviews are completed, neither the Air Force nor the Navy have completed mitigation plans, including specific milestones, to remedy maintenance challenges, risks, or related impacts identified in completed sustainment reviews. Without developing mitigation plans, with specific milestones, to remedy maintenance challenges, risks, or related impacts identified in completed sustainment reviews, the Air Force and Navy cannot fully address unit-level aviation maintenance challenges affecting aircraft availability required for training and operations.

Finally, while the Air Force and Navy are required to submit remediation plans to address critical operating and support cost growth found in sustainment reviews, the services do not have a similar requirement or threshold to submit mitigation strategies to address maintenance challenges and risks to aircraft availability found in sustainment reviews. Amending section 4323 of Title 10, U.S. Code to require the Air Force and Navy to submit mitigation plans to Congress related to identified maintenance challenges and risks to aircraft availability found in sustainment reviews based on a specific sustainment threshold would enhance the services' accountability for taking the necessary and appropriate actions to address persistent challenges to aircraft availability. Doing so would also provide Congress detailed information on the services' plans to address sustainment risks and any related funding needs.

Matter for Congressional Consideration

Congress should consider amending section 4323 of Title 10, U.S. Code to require the Air Force and Navy to submit to Congress mitigation plans related to identified maintenance challenges and risks to aircraft availability found in sustainment reviews based on a specific sustainment threshold. Such thresholds could include aircraft falling below their mission capable rate goal for consecutive years; an aircraft's mission capable rate declining by a specified percentage; or some other sustainment metric or metrics. (Matter for Congressional Consideration 1)

Recommendations for Executive Action

We are making a total of four recommendations to the departments of the Air Force and the Navy.

The Secretary of the Air Force should prioritize the completion of required sustainment reviews and update its planned schedule to complete the reviews in a timelier manner. (Recommendation 1)

The Secretary of the Navy should prioritize the completion of required sustainment reviews and update its planned schedule to complete the reviews in a timelier manner. (Recommendation 2)

The Secretary of the Air Force should develop mitigation plans, with specific milestones, to remedy maintenance challenges, risks, or related impacts to aircraft availability identified in completed sustainment reviews. (Recommendation 3)

The Secretary of the Navy should develop mitigation plans, with specific milestones, to remedy maintenance challenges, risks, or related impacts to aircraft availability identified in completed sustainment reviews. (Recommendation 4)

Agency Comments and Our Evaluation

We provided a draft of this report to DOD for review and comment. In written comments, reprinted in appendix II, the Air Force concurred with both recommendations while the Navy concurred with one recommendation and partially concurred with another. DOD separately provided technical comments, which we incorporated as appropriate.

The Navy partially concurred with our recommendation that the Secretary of the Navy prioritize the completion of required sustainment reviews and update its planned schedule to complete the reviews in a timelier manner (Recommendation 2). In its response, the Navy stated that it does not concur with accelerating the schedule to conduct sustainment reviews in a timelier manner, stating that the Navy sustainment review schedule balances the workload required for programmatic and cost estimating resources in the aviation, maritime, and Marine Corps' communities on a continuous basis without creating a surge of sustainment reviews in any one year. The Navy also stated that completing the sustainment reviews on an expedited schedule would not increase the rate of additional readiness initiatives already being implemented, but, would create undue cyclical burden on the naval enterprise.

While we acknowledge the need to balance workload, the Navy has yet to complete a single sustainment review. Consequently, it is not clear what time and resources the Navy will need to complete the required reviews. Moreover, the Navy's current schedule shows the Navy completing the initial sustainment reviews for 54 systems over the next 13 years. As a result, the Navy will not complete some weapons system sustainment reviews until fiscal year 2035. Our prior work has found systemic, fleet-wide aircraft availability challenges across the Navy, and this review found mission capability rates for each Navy aircraft selected declined

from fiscal year 2015 to 2021. Taking over a decade to complete initial sustainment reviews for these systems results in missed opportunities to identify maintenance and other risks to aircraft availability that could help reverse the decline in outcomes. We recognize the Navy has other efforts underway to address aviation sustainment challenges. However, we also believe the Navy should complete these statutorily required sustainment reviews with a greater sense of urgency.

In its written comments, the Navy correctly noted that it reports mission capable rate data from multiple data systems that use different approaches for calculating such rates. We have previously reported on two informational technology systems that track mission capable rates, noting these systems use separate approaches, resulting in different outcomes.

- According to Navy officials, starting in fiscal year 2022, its official data source for mission capable rate data will be the Aviation Materiel Supply Readiness Reporting system. This data source measures mission capable rates at a point in time on each day. The Navy compares that data against targets established for fiscal year 2022 and beyond.
- The Navy historically has maintained and reported mission capable rate data, as well as other sustainment data, through its Decision Knowledge Programming for Logistics Analysis and Technical Evaluation (DECKPLATE) system. Navy officials acknowledged DECKPLATE provides a more comprehensive measure of the health of aircraft, systems, and components. DECKPLATE measures mission capable rates based on a percentage of the total time the aircraft is available and provides additional insight into the reasons for an aircraft not being mission capable, such as not mission capable maintenance and supply rates. DECKPLATE data is pulled directly from the maintenance management tools at the unit level.

In our previous reporting and in this report, we used sustainment data from DECKPLATE. Given that this report cites mission capable rates prior to fiscal year 2022, we believe that we used the most appropriate data for the scope and timeframes of this review. Using DECKPLATE data allowed us to examine historical trends prior to the Navy's fiscal year 2022 change to using mission capable rate data from the Aviation Materiel Supply Readiness Reporting system. In our future reviews, we will continue to coordinate with Navy officials on the most appropriate

data sources for determining current readiness as well as the sustainment condition of naval aircraft and will make independent assessments about which source or sources to use in our reports.

We are sending copies of this report to the appropriate congressional committees, the Secretary of Defense, and the Secretaries of the Navy and Air Force. In addition, the report is available at no charge on the GAO website at <http://www.gao.gov>.

If you or your staff has any questions about this report, please contact me at (202) 512-9627 or maurerd@gao.gov. Contact points for our Office of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff that made key contributions to this report are listed in appendix III.

A handwritten signature in black ink that reads "Diana Maurer". The signature is written in a cursive, flowing style.

Diana Maurer
Director, Defense Capabilities and Management

Appendix I: Objectives, Scope, and Methodology

House Report 116-442, which accompanied a bill for the National Defense Authorization Act for Fiscal Year 2021, included a provision for us to examine Air Force and Navy aviation maintenance completed outside of the depots.¹ This report assesses (1) trends in mission capability rates and related maintenance metrics for selected Air Force and Navy aircraft since fiscal year 2015; (2) challenges affecting completion of unit maintenance on selected fixed-wing aircraft; and (3) the extent to which the Air Force and Navy have mitigated sustainment risks for selected fixed-wing aircraft.

To conduct the work for our reporting objectives, we used a case study approach focused on unit-level maintenance and selected a non-generalizable sample of four Air Force and four Navy types of fixed-wing aircraft. For the Air Force, we selected the F-22 fighter, the B-1B bomber, the C-5M cargo plane, and the KC-135 air refueler. For the Navy, we selected the F/A-18E/F fighter, the P-8A anti-submarine, C-130T cargo plane, and the KC-130T air refueler. These aircraft were selected based on our review of prior GAO work on sustainment of Department of Defense (DOD) major combat coded aircraft and other factors.² These factors for selection of the aircraft included aircraft mission categories that are service-specific (bomber and anti-submarine), aircraft types that are shared between the services (cargo, fighter, and aerial refueler), and aircraft mission capable rates compared to mission capable goals. Based on these factors, we chose four aircraft from each service that had the lowest mission capable rate in relation to their mission capable goal in order to understand reasons that influenced this difference at the unit-level. We selected fiscal years 2015 through 2021, where data was available, to gain insight on historical data trends and analyzed a variety of maintenance metrics, including mission capable rates, non-mission capable rates, and maintenance turn-around times.

To assess the trends in mission capability rates and related maintenance metrics for Air Force and Navy selected aircraft since fiscal year 2015, we requested and analyzed data on unit-level maintenance metrics, such as mission capable rates, number of long-term ground aircraft, and maintenance turnaround times, from the Air Force Logistics, Installations,

¹H.R. Rep. No. 116-442, at 89-90 (2020).

²GAO, *Weapon System Sustainment: Aircraft Mission Capable Rates Generally Did Not Meet Goals and Cost of Sustaining Selected Weapon Systems Varied Widely*, [GAO-21-101SP](#) (Washington, D.C.: Nov. 19, 2020) and [GAO-20-67SPU](#) (Washington, D.C.: Aug. 27, 2020). We did not select aircraft that are used solely for training or are used to meet the operational airlift support mission.

and Mission Support-Enterprise View and Navy Decision Knowledge Programming for Logistics Analysis and Technical Evaluation (DECKPLATE) data systems. To assess the reliability of the data, we reviewed the data for completeness and anomalies and asked Air Force and Navy officials to explain any discrepancies or outliers that we encountered. We also asked the Air Force and Navy officials questions about the reliability of the data and received responses from them in writing. We found the data provided to be sufficiently reliable for the purposes of our reporting on historical mission capability and maintenance trends. A data analyst analyzed the maintenance metrics data to identify trends in maintenance metrics for our selected aircraft since fiscal year 2015. We also reviewed Air Force and Navy guidance to understand and identify aircraft maintenance metrics for our analysis.³ In addition, we interviewed knowledgeable Air Force and Navy officials to gain an understanding of the metrics used for measuring the performance of maintenance activities on our selected aircraft and their perspectives on historical trends.

To identify any challenges affecting the completion of unit maintenance, including mitigation efforts, on selected Air Force and Navy fixed-wing aircraft, we reviewed and analyzed documentation and written responses from knowledgeable Air Force and Navy officials, including major command and type command officials, program officials, and unit officials from selected aircraft maintenance units to identify maintenance challenges that are affecting the performance of unit maintenance. We selected units from a list of combat-coded maintenance units for each of our selected aircraft that was provided by cognizant Air Force major commands and Navy type commands. Based on this information, we compiled a list of units and considered factors, such as geographic location and deployment status, to randomly select two units per aircraft to meet with for our review. We selected a non-generalizable sample of 15 units—8 Air Force and 7 Navy units—after identifying that one of the selected Navy units provided maintenance on both the C-130T and KC-130T.

³Air Force Tactics, Techniques, and Procedures 3-4.21V1, *Aircraft Maintenance* (Nov. 26, 2018) (For Official Use Only); Air Force Technical Manual TO 00-20-2, *Maintenance Data Documentation* (Sept. 5, 2019); Office of the Deputy Assistant Secretary of the Navy for Sustainment, *Naval Aviation Sustainment Program Baseline (SPB) Playbook 2020* (June 15, 2020) (For Official Use Only); and Commander, Naval Air Forces Instruction 4790.2D, *The Naval Aviation Maintenance Program (NAMP)* (Feb. 1, 2021).

We obtained written responses to semi-structured questionnaires sent prior to interviews with unit maintenance officials from the selected units. We interviewed unit maintenance officials from the selected units to obtain their perspective on any challenges affecting the performance of unit maintenance and any mitigations to address identified challenges. The unit maintenance officials we interviewed included maintenance officers, enlisted maintenance personnel, and quality assurance personnel. Unit maintenance personnel we interviewed were based on ability to provide responses to our semi-structured questionnaires and personnel who had experience maintaining the selected aircraft. We also interviewed officials from relevant Air Force and Navy aircraft program offices, major commands, type commands, and/or systems commands to obtain their perspective on any challenges unit maintenance personnel may face and what mitigations may be in place to address identified challenges for our selected aircraft.

We also analyzed Air Force and Navy maintainer workforce authorized and assigned personnel data for our selected aircraft to understand how the services are staffing unit maintenance personnel and to identify any workforce trends from fiscal years 2015 through 2020, which was the most recent data available at the time of our analysis. We obtained this data from the Air Force Personnel Center and Navy Personnel Command and analyzed the data to identify the percentage of staff assigned to authorized positions by fiscal year. To assess the reliability of the data, we reviewed the data for completeness and anomalies and asked Air Force and Navy officials to explain any discrepancies or outliers that we encountered. We also asked the Air Force and Navy officials questions about the reliability of the data and received responses from them in writing. We found the data provided to be sufficiently reliable for the purposes of reporting on historical staffing trends.

Our analysis of Navy personnel data included using fill and fit rates to determine personnel assigned to authorized positions.⁴ We also analyzed maintainer personnel data to identify any workforce trends by aggregating data by selected aircraft, by maintainer occupational specialty (Air Force Specialty Code or Navy Rating), and by maintainer skill level (Air Force level 3, 5, 7, 9 and Chief Enlisted Manager or Navy apprentice,

⁴Fill is used as a measure of all personnel assigned versus billets authorized. Fit is used as a measure of personnel with the appropriate skill (Navy Rating) and experience (pay band) versus billets authorized. For the purpose of our report, we refer to billets authorized as authorized or funded positions.

journeyman, and master levels) from fiscal years 2015 through 2020.⁵ For the Navy, we focused our analysis on six specific enlisted maintainer occupational specialties identified in Navy documentation as responsible for unit level aviation maintenance.⁶ In addition, we analyzed the maintainer personnel data to identify what aircraft maintainer workforces, maintainer specialties, and skill levels experienced staffing levels below 80 percent personnel assigned to authorized positions from fiscal year 2015 through 2020. We chose 80 percent as a threshold for staffing based on this level being the lowest reporting standard for staffing both assigned personnel (fill) and qualified and experienced personnel (fit) in Navy guidance.⁷ The Air Force does not have a minimum standard, in general, for staffing its personnel, according to Air Force officials. However, we applied the 80 percent standard for consistency in our analysis. Further, our prior work identified 80 percent as a minimum threshold for staffing personnel who perform maintenance work at DOD depots.⁸

To assess the extent the Air Force and Navy mitigated sustainment risks for selected fixed-wing aircraft, we reviewed selected aircraft sustainment documentation, including aircraft sustainment strategies, service

⁵Air Force maintainer skill levels are as follows: 3 level (apprentice), 5-level (journeyman), 7-level (craftsman), and 9-level (superintendents). Chief Enlisted Managers are Chief Master Sergeant positions that execute managerial duties and responsibilities, including management and direction of personnel resource activities and establishing control procedures to meet work goals and standards. Navy maintainer skill levels include apprentice, journeyman, and master maintainers. Master maintainers are Chief Petty Officer positions that—depending on paygrade—may supervise and train personnel in tasks normal to an occupational specialty and system and subsystem maintenance, repair, and operations; perform administrative and managerial functions involving enlisted personnel; and assist maintenance officers in planning aircraft and equipment maintenance, including scheduling and forecasting future maintenance requirements based on operational tempo, among others.

⁶These specialties are collectively referred to as DEMOT ratings. The acronym refers specifically to six maintainer specialties—Aviation Machinist's Mates (AD), Aviation Electrician's Mate (AE), Aviation Structural Mechanic (AM) and Aviation Structural Mechanic—Safety Equipment (AME), Aviation Ordnanceman (AO), and Aviation Electronics Technicians (AT). Navy Personnel (NAVPERS) Manual 18068F, vol.1, *Manual of Navy Enlisted Manpower and Personnel Classifications and Occupational Standards*, (October 2020).

⁷Commander, U.S. Fleet Forces Command and Commander, U.S. Pacific Fleet Notice 1000, *Sea Duty Manning Target Levels*, (Feb. 12, 2021).

⁸GAO, *DOD Depot Workforce: Services Need to Assess the Effectiveness of Their Initiatives to Maintain Critical Skills*, [GAO-19-51](#) (Washington, D.C.: Dec. 14, 2018).

initiatives, and completed sustainment reviews, to identify and report risks to aircraft maintenance and sustainment. We also reviewed statutory requirements and DOD, Air Force, and Navy guidance on the development and implementation of sustainment reviews for major weapons systems.⁹ We compared the progress of Air Force and Navy sustainment reviews for our selected aircraft in meeting statutory and DOD requirements and to the *Standards for Internal Control in the Federal Government*.¹⁰ Specifically, the risk assessment and information and communication components—the actions managements uses to identify, analyze, and respond to changes and communicate quality information externally—of internal control were significant to this audit. We also interviewed Air Force and Navy officials to gain an understanding of each service’s progress in developing and implementing sustainment reviews in order to meet statutory requirements and any related mitigation plans.

During the course of our review, we interviewed knowledgeable officials from the following DOD, Air Force, and Navy organizations:

- Office of the Deputy Assistant Secretary of Defense for Materiel Readiness
- Deputy Assistant Secretary of the Air Force, Logistics and Product Support (SAF/AQD)
- Headquarters Air Force Aircraft Maintenance Division (A4LM)
- Office of the Chief of Naval Operations, Installations and Logistics (N4) and Aviation Readiness Branch (N832)
- Air Force Materiel Command, including Air Force Sustainment Center and Air Force Life Cycle Management Center

⁹10 U.S.C. § 2441 (recently renumbered as 10 U.S.C. § 4323); DOD Instruction 5000.85, *Major Capability Acquisition*, app. 3D (Aug. 6, 2020) (subsequently replaced by DOD Instruction 5000.91, *Product Support Management for the Adaptive Acquisition Framework* (Nov. 4, 2021)); Under Secretary of Defense (Acquisition & Sustainment) Memorandum, *Implementation of Sustainment Reviews*, (June 2, 2021); Air Force Instruction 63-101/20-101, *Integrated Life Cycle Management* (June 30, 2020) (incorporating change 1, Nov. 23, 2021); and Secretary of the Navy Instruction (SECNAVINST) 5000.2F, *Defense Acquisition System and Joint Capabilities Integration and Development System Implementation* (Mar. 26, 2019).

¹⁰GAO, *Standards for Internal Control in the Federal Government*, [GAO-14-704G](#) (Washington, D.C.: Sept. 2014).

- Naval Air Systems Command and Commander, Fleet Readiness Center
- Air Force Global Strike Command, Air Mobility Command, and Air Combat Command
- Commander, Naval Air Force Pacific and Commander, Naval Air Force Atlantic
- Naval Air Warfare Center Aircraft Division
- Air Force Logistics, Installations, and Mission Support-Enterprise View Team
- Navy Readiness Analysis Team
- Air Force Program Offices for the B-1B, C-5M, F-22, and KC-135 aircraft
- Navy Program Offices for the C-130T/KC-130T, F/A-18E/F, and P-8A aircraft

We also interviewed unit maintenance officials from a random, non-generalizable sample of 15 of 81 maintenance squadrons based on our selected aircraft to gain their perspectives on aviation maintenance, including challenges and actions to mitigate challenges. These units included the following by aircraft

- B-1B: 7th Maintenance Group and 28th Maintenance Group
- C-5M: 60th Maintenance Group and 337th Air Lift Squadron
- F-22: 3rd Maintenance Group and 154th Maintenance Group
- KC-135: 92nd Maintenance Group and 128th Maintenance Group
- C-130T/KC-130T: VR-53 C-130T/KC-130T Fleet Logistics Support, VR-54 C-130T Fleet Logistics Support, and VR-55 KC-130T Fleet Logistics Support squadrons
- F/A-18E/F: Strike Fighter Squadron VFA-103 and Strike Fighter Squadron VFA-41
- P-8A: Patrol and Reconnaissance Squadron VP-8 and Patrol Squadron VP-9

We conducted this performance audit from September 2020 to June 2022, in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe

**Appendix I: Objectives, Scope, and
Methodology**

that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Appendix II: Comments from the Department of Defense



SUSTAINMENT

OFFICE OF THE ASSISTANT SECRETARY OF DEFENSE
3500 DEFENSE PENTAGON
WASHINGTON, DC 20301-3500

May 25, 2022

Ms. Diana Maurer
Director, Defense Capabilities and Management
U.S. Government Accountability Office
441 G Street, NW
Washington, DC 20548

Dear Ms. Maurer:

This is the Department of Defense (DoD) response to the Government Accountability Office (GAO) Draft Report GAO-22-104533SU, "Air Force and Navy Aviation: Actions Needed to Address Persistent Sustainment Risks" dated 16, 2022 (GAO Code 104533). Both the Navy and Air Force have cleared this report for release.

The Department is providing the enclosed official written comments for inclusion in the report. The Air Force concurs with Recommendations 1 and 3 and the Navy partially concurs with Recommendation 2 and concurs with Recommendation 4.

Sincerely,

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Vic S. Ramdass, Ph.D
Deputy Assistant Secretary of Defense
(Materiel Readiness)

Enclosure:
As stated

GAO DRAFT REPORT DATED APRIL 2022
GAO-22-104533SU

“AIR FORCE AND NAVY AVIATION, ACTIONS NEEDED TO ADDRESS
PERSISTENT SUSTAINMENT RISKS”

DEPARTMENT OF DEFENSE COMMENTS
TO THE GAO RECOMMENDATIONS

RECOMMENDATION 1: The Secretary of the Air Force should prioritize the completion of required sustainment reviews and update its planned schedule to complete the reviews in a timelier manner.

DoD RESPONSE: The Department of the Air Force (DAF) concurs with this recommendation. The Air Force completed nine sustainment reviews on some of its largest weapons systems in Fiscal Year (FY) 2021 and timely submitted these reviews to the congressional defense committees. The Air Force initiated another six sustainment reviews in FY 2022 and is on schedule to complete the remainder of its required sustainment reviews by the end of FY 2025. The Air Force will continually seek opportunities to accelerate the remaining required sustainment reviews within available manpower constraints, while taking care to spread out the recurring five-year review cycle into predictable workloads.

RECOMMENDATION 2: The Secretary of the Navy should prioritize the completion of required sustainment reviews and update its planned schedule to complete the reviews in a timelier manner.

DoD RESPONSE: The Department of the Navy (DON) partially concurs with this recommendation. The DON is prioritizing and executing sustainment reviews as delineated in title 10 U.S.C. § 4323, and as promulgated by the Office of the Under Secretary of Defense for Acquisition and Sustainment (OUSD(A&S)) Memorandum “Implementation of Sustainment Reviews,” dated June 2, 2021, and the Assistant Secretary of the Navy for Research, Development, and Acquisition (ASN(RDA)) Memorandum “Gate 7 Sustainment Reviews,” dated September 27, 2021. The DON does not concur with the recommendation to accelerate the schedule to conduct sustainment reviews in a timelier manner. The DON has developed and is implementing the process to prepare for, and conduct, sustainment reviews for 54 covered systems every five years on a continuous basis. The DON sustainment review schedule balances the workload required for programmatic and cost estimating resources in the aviation, maritime, and Marine Corps communities on a continuous basis without creating a surge of sustainment reviews in any one year. Additionally, the DON has developed and implemented readiness initiatives prior to 2018, such as Performance to Plan (P2P) and Navy Sustainment System (NSS), which have yielded significant improvements in aviation readiness. The scope of these initiatives is expanding to all Navy Type/Model/Series (TMS) aircraft as resources permit. The GAO affirms these initiatives in its report. Completing the sustainment reviews on an expedited schedule would not increase the rate of additional readiness initiatives the DON is already implementing, but, rather, would create undue cyclical burden on the Department.

Appendix II: Comments from the Department of Defense

RECOMMENDATION 3: The Secretary of the Air Force should develop mitigation plans, with specific milestones, to remedy maintenance challenges, risks, or related impacts to aircraft availability identified in completed sustainment reviews.

DoD RESPONSE: The DAF concurs with this recommendation. The Air Force agrees that if maintenance challenges, risks, or related impacts to aircraft availability are identified during sustainment reviews, then mitigation plans with specific milestones should be developed to remedy them. Currently, completed sustainment reviews have not identified maintenance challenges requiring new mitigation plans.

RECOMMENDATION 4: The Secretary of the Navy should develop mitigation plans, with specific milestones, to remedy maintenance challenges, risks, or related impacts to aircraft availability identified in completed sustainment reviews.

DoD RESPONSE: The DON concurs with recommendation 4. The DON has implemented several sustainment initiatives to identify and remedy maintenance challenges and risks that impact aircraft availability. The ASN(RDA) has developed a Sustainment Program Baseline (SPB) that identifies the sustainment performance levels, product support agreements, and sustainment cost requirements necessary to achieve the required availability per TMS. The Deputy Assistant Secretary of the Navy for Sustainment (DASN(Sustainment)) and the Program Executive Officers (PEOs) are implementing SPBs across all the covered aviation programs. Additionally, the Commander, Naval Air Systems Command (COMNAVAIRSYSCOM) and the supported PEOs have developed and implemented Naval Sustainment System – Aviation (NSS-A) processes and metrics to measure readiness and drive focused discussions with Commander, Naval Air Forces (CNAF), and supporting commands to identify barriers, expedite resolution, and prioritize resources across the enterprise. This highly collaborative and focused management initiative provides clear accountability, data, and analytical tools to characterize performance gaps, identify barriers to execution, and develop sustainment strategies that are both enduring and accelerate gap closure. At their core, these processes focus leaders on the right challenges and use data to remove barriers. Most importantly, NSS-A underpins the weapon systems’ program managers’ development and “*implementation of sustainment strategies and mitigation plans with specific milestones to remedy maintenance challenges, risks, or related impacts to aircraft availability,*” as recommended by the GAO. Maintenance and supply chain strategies and initiatives implemented as a part of NSS-A have significantly improved readiness on the flight line.

While the Naval Air Systems Command (NAVAIRSYSCOM) and the PEOs concur with this recommendation, the data source that the GAO used to characterize readiness is misleading. The readiness metrics being reported in this GAO report are drawn from DECKPLATE data resources, which provide metrics pulled directly out of the maintenance management tools on at the squadron level and are measured against out-of-date targets, which do not necessarily align to current operational requirements. Initially researched in FY 2021 and implemented in FY 2022, the operational targets have been adjusted to reflect actual flight line needs in terms of number of mission capable aircraft required vice a percentage goal and are reported up line utilizing Aviation Material Supply Readiness Reporting (AMSRR) data. The DON recommends that the GAO evaluate/include AMSRR derived mission capable data into its sustainment evaluation.

**Appendix II: Comments from the Department
of Defense**

The CNAF considers the AMSRR to be the authoritative data source for determining current readiness of naval aviation aircraft/systems. The DON further recommends a follow-on meeting between the GAO, NAVAIR and the CNAF regarding using AMSRR as the authoritative source for data to support GAO readiness assessments.

Appendix III: GAO Contact and Staff Acknowledgments

GAO Contact

Diana Maurer, 202-512-9627 or maurerd@gao.gov

Staff Acknowledgments

In addition to the contact listed above, Chris Watson (Assistant Director), Laura Czohara (Analyst-in-Charge), Aaron Chua, Juliee Conde-Medina, Chad Hinsch, David L. Jones, Felicia Lopez, Michael Pose, Michael Silver, Katharine Moody Wong, and Delia Zee made key contributions to this report.

Related GAO Products

Navy and Marine Corps: Services Continue Efforts to Rebuild Readiness, but Recovery Will Take Years and Sustained Management Attention, [GAO-21-225T](#). Washington, D.C.: December 2, 2020.

Weapon System Sustainment: Aircraft Mission Capable Rates Generally Did Not Meet Goals and Cost of Sustaining Selected Weapon Systems Varied Widely, [GAO-21-101SP](#). Washington, D.C.: November 19, 2020.

Weapon System Sustainment: Aircraft Mission Capable Rates Generally Did Not Meet Goals and Cost of Sustaining Selected Weapon Systems Varied Widely, [GAO-20-67SPSU](#). Washington, D.C.: August 27, 2020.

Military Personnel: Strategy Needed to Improve Retention of Experienced Air Force Aircraft Maintainers, [GAO-19-160](#). Washington, D.C.: February 05, 2019.

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Weapon System Sustainment: Selected Air Force and Navy Aircraft Generally Have Not Met Availability Goals, and DOD and Navy Guidance Need to Be Clarified, [GAO-18-678](#). Washington, D.C.: September 10, 2018.

Weapon System Sustainment: Selected Air Force and Navy Aircraft Generally Have Not Met Availability Goals, and DOD and Navy Guidance Need Clarification, [GAO-18-146SU](#). Washington, D.C.: April 25, 2018.

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