United States Government Accountability Office

Report to the Committee on Armed Services, House of Representatives

July 2021

F-35 SUSTAINMENT

DOD Needs to Cut Billions in Estimated Costs to Achieve Affordability

Accessible Version

GAO@100
A Century of Non-Partisan Fact-Based Work

GAO-21-439

GAO@100

Highlights

Highlights of GAO-21-439, a report to the Committee on Armed Services, House of Representatives

Why GAO Did This Study

The F-35 aircraft, with its advanced capabilities, represents a growing portion of DOD's tactical aviation fleet—with about 400 of the aircraft fielded. DOD plans to procure nearly 2,500 F-35s at an estimated life cycle costs of the program exceeding $1.7 trillion—with $1.3 trillion of those costs being associated with operating and sustaining the aircraft.

A House Report accompanying the National Defense Authorization Act for Fiscal Year 2020 included a provision for GAO to review F-35 sustainment efforts. This report, among other things, assesses the extent to which (1) the F-35 has met warfighter-required mission capable rates; and (2) DOD has reduced the F-35's estimated life cycle sustainment costs and made progress in meeting its affordability constraints. GAO reviewed program documentation, analyzed performance and cost data, collected data from F-35 locations, and interviewed officials.

What GAO Recommends

Congress should consider (1) requiring DOD to report annually on progress in achieving the affordability constraints, and (2) making F-35 aircraft procurement decisions contingent on DOD's progress in achieving these constraints. GAO is making four recommendations to DOD, including assessing cost reduction efforts and F-35 program requirements, and developing a plan to afford to sustain the future F-35 fleet. DOD partially concurred stating it will work to meet the intent of the recommendations in an expeditious manner. GAO continues to believe DOD should address the recommendations prior to declaring Milestone C.

View GAO-21-439. For more information, contact Diana Maurer at (202) 512-9627 or maurerd@gao.gov.

July 2021

F-35 SUSTAINMENT

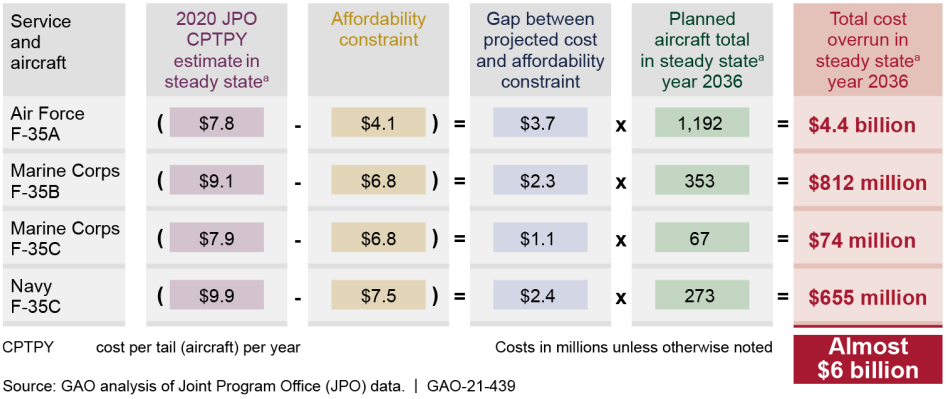
DOD Needs to Cut Billions in Estimated Costs to Achieve Affordability

What GAO Found

F-35 mission capable rates—a measure of the readiness of an aircraft fleet—have recently improved, but still fall short of warfighter requirements. Specifically, from fiscal year 2019 to fiscal year 2020, the U.S. F-35 fleet's average annual (1) mission capable rate—the percentage of time during which the aircraft can fly and perform one of its tasked missions—improved from 59 to 69 percent; and (2) full mission capable rate—the percentage of time during which the aircraft can perform all of its tasked missions—improved from 32 to 39 percent. Both metrics fall below the services' objectives. For example, in fiscal year 2020 the Air Force F-35A full mission capable rate was 54 percent, versus a 72 percent objective.

Since 2012, F-35 estimated sustainment costs over its 66-year life cycle have increased steadily, from $1.11 trillion to $1.27 trillion, despite efforts to reduce costs. The services face a substantial and growing gap between estimated sustainment costs and affordability constraints—i.e., costs per tail (aircraft) per year that the services project they can afford—totaling about $6 billion in 2036 alone (see fig.). The services will collectively be confronted with tens of billions of dollars in sustainment costs that they project as unaffordable during the program.

Gap between F-35 Affordability Constraints and Estimated Sustainment Costs in 2036



Source: GAO analysis of Joint Program Office (JPO) data. | GAO-21-439

Note: Costs are in constant year 2012 dollars, as that was the year when the F-35 program was most recently re-baselined. [a]Steady state years for the F-35 program are defined in each respective service's affordability analysis as: US Air Force/F-35A – 2036-2041; US Marine Corps/F-35B – 2033-2037; US Navy/F-35C – 2036-2043. Steady state refers to the program's peak operating point.

Service and aircraft	2020 JPO CPTPY estimate in steady state	Affordability constraint	Gap between projected cost and affordability constraint	Planned aircraft total in steady state year 2036	Total cost overrun in steady state year 2036
Air Force F-35B	$7.8	$4.1	$3.7	1,192	$4.4 billion
Marine Corps F-35B	$9.1	$6.8	$2.3	353	$812 million
Marine Corps F-35C	$7.9	$6.8	$1.1	67	$74
Navy F-35C	$9.9	$7.5	$2.4	273	$655 million

CPTPY = cost per tail (aircraft) per year. Costs in millions unless otherwise noted. Almost $6 billion.

The Air Force needs to reduce estimated costs per tail per year by $3.7 million (or 47 percent) by 2036 or it will incur $4.4 billion in costs beyond what it currently projects it could afford in that year alone. Cost reductions become increasingly difficult as the program grows and matures. However, GAO found that there is no agreed upon approach to achieve the constraints. The F-35 program estimates that it will declare Milestone C—a decision point for moving into full-rate production of the aircraft—sometime in the 2021-2023 time frame. Without assessing cost-reduction efforts and program requirements (such as number of planned aircraft), and developing a plan prior to declaring Milestone C, the Department of Defense (DOD) may continue to invest resources in a program it ultimately cannot afford. Congress's requiring DOD to report on its progress in achieving affordability constraints and making F-35 procurements contingent on DOD's demonstrated progress would enhance DOD's accountability for taking the necessary and appropriate actions to afford sustaining the F-35 fleet.

Contents

Figures

Abbreviations

ALIS	Autonomic Logistics Information System
CAPE	Cost Assessment and Program Evaluation
DOD	Department of Defense

F-35	F-35 Lightning II aircraft
ICE	Independent Cost Estimate
IOC	Initial Operational Capability
O&S	Operating and Support
ODIN	Operational Data Integrated Network
OUSD (A&S)	Office of the Undersecretary of Defense (Acquisition and Sustainment)
SDD	System Development and Demonstration

441 G St. N.W.
Washington, DC 20548

July 7, 2021

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

The F-35 Lightning II aircraft (F-35) and its advanced capabilities represent a growing portion of the tactical aviation fleet for the Department of Defense (DOD). DOD is in the process of replacing a variety of legacy fighter aircraft—e.g., the A-10 Thunderbolt II and F-16 Falcon in the Air Force, and the AV-8B Harrier and F/A-18C/D Hornet in the Marine Corps—with the F-35.

The F-35 is also DOD's most ambitious and costly weapon system in history, with overall costs for the program estimated by DOD at more than $1.7 trillion over its 66-year life cycle.[1] Current DOD plans call for procuring 2,456 F-35s at an estimated total acquisition cost of just under $400 billion. This leaves the majority of estimated F-35 program costs, approximately $1.3 trillion, associated with the sustainment of the aircraft.[2] These sustainment costs, also referred to as operating and support (O&S) costs, provide for requirements such as the number of hours the aircraft is flown in support of training and operations, operating and maintenance personnel for the aircraft, and supply chain for the delivery of spare parts. For the past decade, DOD has been working to deliver a sustainment strategy that will be both affordable and able to meet the needs of the Air Force, Navy, and Marine Corps (hereinafter referred to as "the services"). This remains an ongoing effort, as DOD continues to support a rapidly expanding fleet.

[1]The $1.7 trillion reflects then-year dollars. Then-year dollars include the effects of inflation or escalation.

[2]Historically, the official sustainment cost estimate for the F-35 program is produced by the Office of the Secretary of Defense Cost Assessment & Program Evaluation (CAPE). This estimate was most recently updated in June 2020.

We have published a series of reports examining sustainment of the F-35. In particular, since 2014 we have reported significant challenges faced by DOD in sustaining a growing F-35 fleet, such as the availability of spare parts.[3] As a result of those challenges, F-35 performance has not met warfighter-required mission capable rates—the percentage of total time when the aircraft can fly and perform at least one of its missions.

Furthermore, we have reported on the program's affordability challenges tied to its uniquely high and growing sustainment-related cost estimates. For example, in 2014 we reported that annual F-35 sustainment costs were estimated to be considerably higher than the combined annual costs of several legacy aircraft, and that DOD had not established sustainment affordability constraints using the services' budgets.[4] Affordability constraints are the amount of financial resources a military service can afford in order to operate and support a system, like the F-35, given future force budgets and portfolio prioritizations.[5] These constraints then provide a threshold, or cap, for sustainment that cannot be exceeded.

We recommended that DOD develop affordability constraints linked to the services' budgets. DOD concurred with the recommendation. In 2017 we reported that F-35 sustainment-related costs had increased despite the department's concerted efforts to reduce costs.[6] Subsequently, in October 2018 DOD released sustainment-related affordability constraints based on service budgets, and it identified the need to substantially reduce the estimated sustainment costs for the program. These constraints serve as the current affordability constraints of the program.

House Report 116-120, accompanying a proposed bill for the National Defense Authorization Act for Fiscal Year 2020, included a provision for us to review DOD's sustainment efforts related to the F-35. This report (1) assesses the extent to which the F-35 has met warfighter-required mission capable rates, (2) provides an update on the status of significant sustainment-related challenges facing the F-35 program, and (3)

[3]*See*, Related GAO Products page at the end of this report for a full list of F-35 related reports.

[4]GAO, *F-35 Sustainment: Need for Affordable Strategy, Greater Attention to Risks, and Improved Cost Estimates*, GAO-14-778 (Washington, D.C.: Sept. 23, 2014).

[5]Office of the Secretary of Defense, *Report to Congress on F-35 Joint Strike Fighter Sustainment Affordability and Transparency* (December 2018).

[6]GAO, F-35 *Aircraft Sustainment: DOD Needs to Address Challenges Affecting Readiness and Cost Transparency*, GAO-18-75 (Washington D.C.: Oct. 26, 2017).

assesses the extent to which DOD has reduced the F-35's estimated life cycle sustainment costs and made progress in meeting its affordability constraints.

To address objective one, we reviewed relevant plans and performance objectives. We collected and analyzed performance metrics, such as mission capable and full mission capable rates, from fiscal years 2015 through 2020 for the U.S. F-35 fleet. We determined that these data were sufficiently reliable for the presentation of trends by reviewing the data for errors and/or anomalies and by interviewing officials responsible for and knowledgeable about the collection of the data. We also obtained views of the F-35 Joint Program Office and the services on the progress that has been made in achieving mission capable and full mission capable rate goals for the F-35.

To address objective two, we used our prior reports from 2017, 2019, and 2020 as a starting point to follow up on sustainment-related challenges for the U.S. F-35 fleet.[7] We also developed and sent a survey comprising 22 open-ended questions and five closed-ended questions to 12 U.S. F-35 locations to collect sustainment-related inputs, data, and flight-line experiences. Of the 12 U.S. F-35 locations, we received responses from 11: Luke Air Force Base, Arizona; Nellis Air Force Base, Nevada; Eglin Air Force Base, Florida; Hill Air Force Base, Utah; Eielson Air Force Base, Alaska; Edwards Air Force Base, California; Naval Air Station Patuxent River, Maryland; Marine Corps Air Station Miramar, California; Marine Corps Air Station Yuma, Arizona; Marine Corps Air Station Iwakuni, Japan; and Marine Corps Air Station Beaufort, South Carolina. These locations included testing, training, and operational locations. We interviewed officials from the F-35 Joint Program Office, the services, the Office of the Under Secretary of Defense for Acquisition and Sustainment, Lockheed Martin (the prime contractor for the F-35 air system), and Pratt & Whitney (the prime contractor for the F-35 engine) to identify any progress made regarding the sustainment-related challenges we had reported in previous years, and any new sustainment-related challenges that might recently have impacted the fleet.

To address objective three, we collected and reviewed each of DOD's three sustainment cost estimates—the Secretary of Defense Cost

[7]GAO, *Weapon System Sustainment: DOD Needs a Strategy for Re-Designing the F-35's Central Logistics System*, GAO-20-316 (Washington, D.C.: Mar. 6, 2020); GAO, *F-35 Aircraft Sustainment: DOD Needs to Address Substantial Supply Chain Challenges*, GAO-19-321 (Washington, D.C.: April 25, 2019); and GAO-18-75.

Assessment and Program Evaluation's (CAPE) Independent Cost Estimate, the F-35 Joint Program Office's Annual Cost Estimate, and the Joint Service Cost Position—completed in 2020. We reviewed these to determine current sustainment-related cost projections, identify deviations from previous cost estimates, and assess any progress made toward achieving the services' affordability constraints.[8] Additionally, we reviewed DOD instructions and guidance regarding cost estimates, "stretch goals," should-costs, and operations and sustainment. We conducted interviews with officials from CAPE, the services, the F-35 Joint Program Office, Lockheed Martin, Pratt & Whitney, and the Boston Consulting Group to determine current and projected sustainment-related costs, sustainment-related cost savings initiatives and achievements, and the extent to which the services are on track to achieve their respective sustainment-related affordability constraints. We referenced DOD guidelines and regulations including DOD Instruction 5000.85, *Major Capability Acquisition*; and the Defense Acquisition University's *A Guide for DOD Program Managers*—to determine affordability considerations and requirements, and the extent to which DOD was managing the affordability of the program.[9]

We conducted this performance audit from March 2020 to July 2021 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 that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

[8]We did not independently evaluate or assess the cost estimates' reliability.

[9]DOD Instruction (DODI) 5000.85, *Major Capability Acquisition* (Aug. 6, 2020); Defense Acquisition University, *A Guide for DOD Program Managers* (December 2014).

Background

F-35 Program

The F-35 Lightning II program is a joint, multinational acquisition program intended to develop and field a family of next-generation strike fighter aircraft. As shown in figure 1, program participants include the Air Force,

Navy, and Marine Corps; seven international partners; and six foreign military sales customers.[10]

Figure 1: F-35 Program Participants

Source: GAO analysis of Department of Defense (DOD) information. | GAO-21-439

The program has developed and is delivering three variants of the F-35 aircraft:

- **F-35A** – A conventional take-off and landing variant that is intended to replace Air Force F-16 fighters and A-10 attack aircraft (and possibly F-15 fighters).[11] The Air Force plans to procure 1,763 F-35As, making that service the largest customer in the F-35 program.
- **F-35B** – A short take-off and vertical landing variant that is intended to replace Marine Corps AV-8B Harrier vertical/short take-off and landing attack aircraft and Marine Corps F/A-18A/B/C/D strike fighters, which are conventional take-off and landing aircraft. The Marine Corps plans to procure 353 F-35Bs.

[10]Seven partner nations contribute to F-35 development, production, and sustainment. In addition, as of February 2021, the program has six foreign military sales customers. In July 2019 DOD decided to remove Turkey from the development program due to its government's decision to procure Russian-made radar systems.

[11]For information on the aircraft that the F-35 is replacing, including their ability to meet mission capable rate goals and associated O&S costs, 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). This is a public version of a more detailed August 2020 sensitive report: GAO, *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.: Aug. 27, 2020).

- **F-35C** – A carrier-suitable variant that is intended to complement the Navy F/A-18E/F, an aircraft the Navy has been procuring since 1997. The Navy plans to procure 273 F-35Cs. Furthermore, to supplement its own aircraft fleet, the Marine Corps plans to procure 67 F-35Cs.

The characteristics of the services' variants are similar in that each is intended to be a multi-role, stealthy strike aircraft, but each service's variant also has unique operating requirements. For example, the Marine Corps requires that the F-35B be capable of operating from aircraft carriers, amphibious ships, and main and austere operating bases alike, requiring the ability to conduct short take-offs and vertical landings (see figure 2).

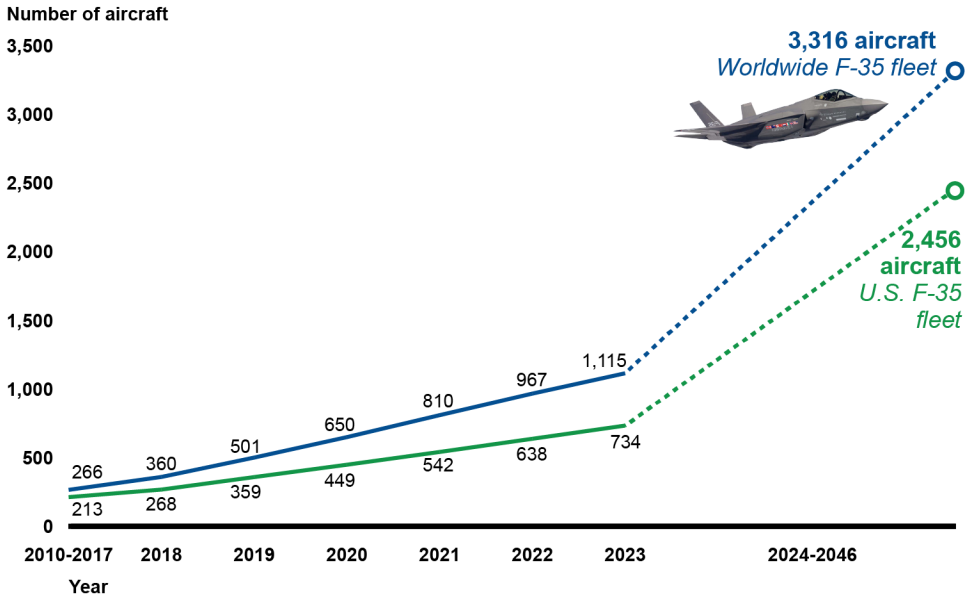
Figure 2: An F-35B Performing a Vertical Landing at Naval Air Station Patuxent

Source: Department of Defense photo by Kyra Helwick. | GAO-21-439

As of November 2020, more than 525 U.S. and international aircraft had been fielded and were operating from various sites worldwide. This represented an increase of more than 270 aircraft relative to August 2017, and 175 more aircraft than were fielded and operating in February 2019. By 2023 the global F-35 fleet is expected to expand, with more than 1,100 aircraft planned across 43 operational sites. In total, the program participants plan to purchase more than 3,300 F-35 aircraft, with the U.S.

services planning to purchase nearly 2,500 of those aircraft. See figure 3 for a timeline of anticipated worldwide fleet growth in the F-35 program.

Figure 3: Timeline of Anticipated Worldwide and U.S. F-35 Fleet Growth



Source: GAO analysis of Department of Defense information; Lockheed Martin (F-35 image). | GAO-21-439

Year	Worldwide F-35 fleet	U.S. F-35 fleet
"2017"	266	213
"2018"	360	268
"2019"	501	359
"2020"	650	449
"2021"	810	542
"2022"	967	638
"2023"	1115	734
"2024"	3316	2456

F-35 Program History and Milestones

In March 2005 we reported that the F-35 program had started development without adequate knowledge of the aircraft's critical technologies or a solid design.[12] Further, we reported that DOD's acquisition strategy called for high levels of concurrency between development and production—an approach that runs counter to best practices for major defense acquisition programs. In our prior work, we identified the F-35 program's lack of adequate technical knowledge and high levels of concurrency as the major drivers of the program's significant cost and schedule growth, and as well as other performance shortfalls.[13]

The high levels of concurrency have also made it difficult to sustain the fielded aircraft. In April 2019 we found that as aircraft, spare parts, and mission software continued to be developed and updated for the program, aircraft in the field had at least 39 different part combinations, thereby posing aircraft sustainment challenges. Furthermore, DOD's training and operational squadrons were flying F-35 aircraft with three different blocks of mission software—2B, 3i, and 3F—with each block providing different capabilities and requiring unique sustainment needs.[14]

Since the F-35 program was begun in 2001 it has been restructured three times with revised cost and delivery schedule estimates. The most recent restructuring was initiated in 2010, when the program's cost estimates exceeded certain thresholds established by statute—a condition known

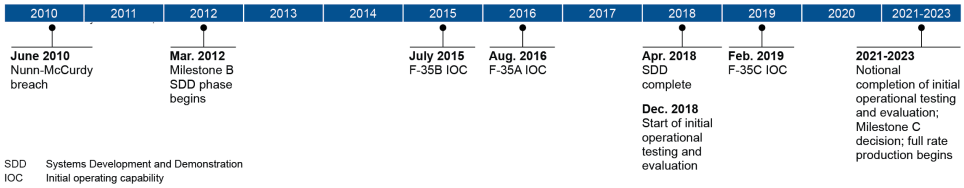
[12]GAO, *Tactical Aircraft: Opportunity to Reduce Risks in the Joint Strike Fighter Program with Different Acquisition Strategy*, GAO-05-271 (Washington, D.C.: Mar. 15, 2005).

[13]GAO-05-271; and GAO, *Joint Strike Fighter: DOD Actions Needed to Further Enhance Restructuring and Address Affordability Risks*, GAO-12-437 (Washington, D.C.: June 14, 2012).

[14]See GAO-19-321. We made several recommendations in that report with which DOD concurred and which will be discussed later in this report.

as a Nunn-McCurdy breach.[15] After the breach, DOD certified to Congress that the program needed to continue, and DOD established a new acquisition program baseline in 2012. This new baseline served as the program's required Milestone B decision, which authorizes a program to enter into the Engineering and Manufacturing Development phase and to commit the required investment resources to support the award of phase contracts. It requires demonstration that all sources of risk have been adequately mitigated to support a commitment to design, development, and production. See figure 4 for completed and planned milestones for the F-35 program.

Figure 4: F-35 Key Dates and Milestones



Source: GAO analysis of Department of Defense information. | GAO-21-439

The F-35A, F-35B, and F-35C were originally scheduled to achieve Initial Operational Capability (IOC) in March 2013, March 2012, and March 2015, respectively; however, all three of those dates were postponed.[16] The Marine Corps declared F-35B IOC on July 31, 2015. The Air Force declared F-35A IOC on August 2, 2016. The Navy declared F-35C IOC on February 28, 2019.

In April 2018 the F-35 program declared System Development and Demonstration (SDD) to be complete after having performed more than

[15]Section 2433 of Title 10 of the United States Code, commonly referred to as Nunn-McCurdy, requires DOD to notify Congress whenever a major defense acquisition program's unit cost experiences cost growth that exceeds certain thresholds. Significant breaches occur when the program acquisition unit cost or procurement unit cost increases by at least 15 percent over the current baseline estimate or at least 30 percent over the original estimate. For critical breaches—when these unit costs increase by at least 25 percent over the current baseline estimate, or at least 50 percent over the original—DOD is required under 10 U.S.C. § 2433a to take additional steps, including conducting an in-depth review of the program. Programs with critical breaches must be terminated unless the Secretary of Defense certifies to certain facts related to the programs and takes other actions, including restructuring of the programs.

[16]Initial Operational Capability is attained when the defined operational organization has been equipped and trained and is determined to be capable of conducting mission operations.

9,200 sorties, accumulated more than 17,000 flight hours, and executed more than 65,000 test points to verify design, durability, software, sensors, weapon capability, and performance of all three variants. However, although the program declared SDD to have been completed, SDD does not actually conclude until the program declares Milestone C. That milestone, which gives the program the approval to move into full-rate production of the aircraft, cannot be declared until DOD has completed several efforts, including Initial Operational Test and Evaluation.

The Initial Operational Test and Evaluation effort provides the most credible means to predict combat performance for the F-35. This effort will likely not be completed until sometime in the late 2021 or 2022 time frame, according to DOD officials. Once all of the requisite factors have been completed and reviewed, the program can declare Milestone C and enter into full-rate production. However, as we reported in March 2021, the F-35 program has not identified an official date for a full-rate production decision.[17] According to DOD officials, it could be sometime in the 2021-2023 time frame.

F-35 Program Stakeholders

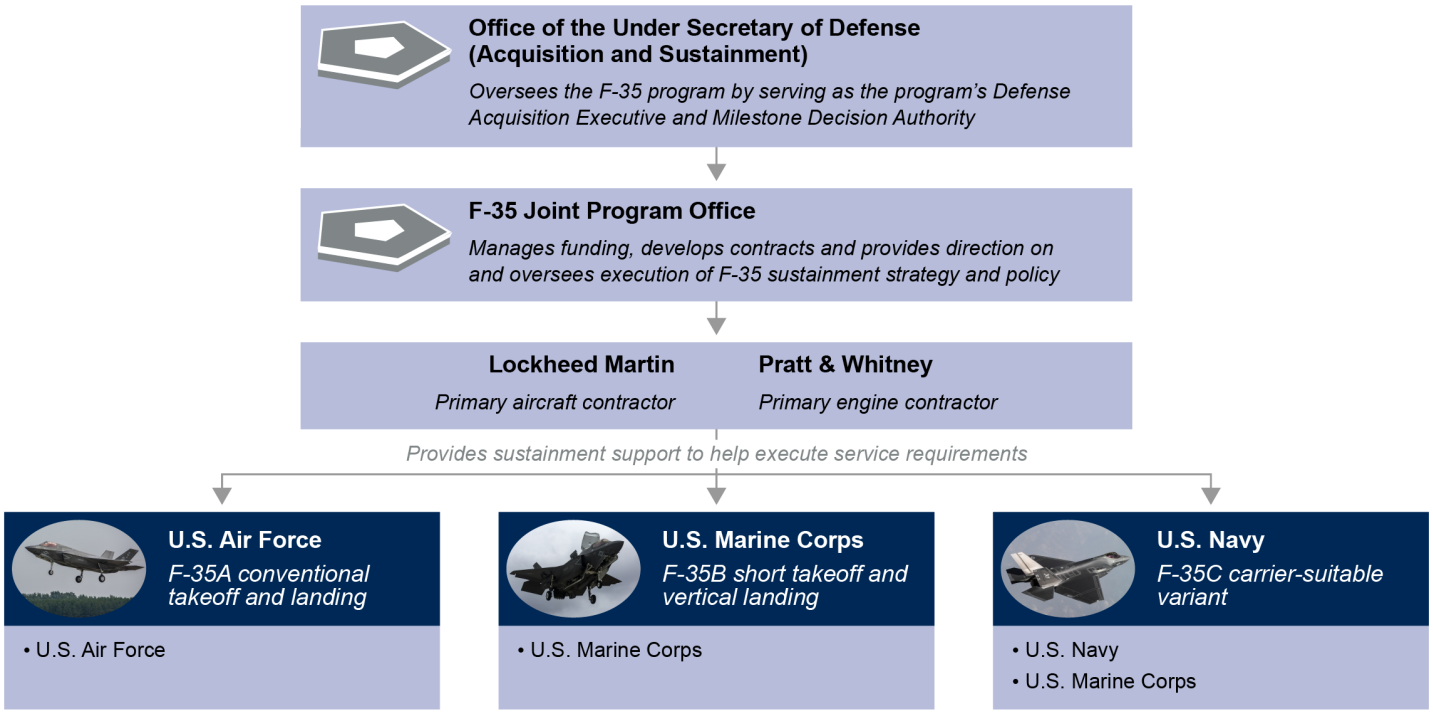
Sustainment for the F-35 aircraft is a large and complex undertaking with many stakeholders, as shown in figure 5 below. Key stakeholders include the following:

- **Office of the Undersecretary of Defense (Acquisition and Sustainment) (OUSD (A&S)):** OUSD (A&S) is the Defense Acquisition Executive and oversees the entire acquisition of the F-35, including sustainment and overall costs of the program. OUSD (A&S) also serves as the Milestone Decision Authority for the program, meaning that if the program is not in good standing, for whatever reason, OUSD (A&S) has the authority to prevent its declaring an acquisition milestone.
- **F-35 Joint Program Office:** The F-35 Joint Program Office manages and oversees the support functions required to field and maintain the readiness and operational capability of the F-35 aircraft across the enterprise.

[17]GAO, *F-35 Joint Strike Fighter: DOD Needs to Update Modernization Schedule and Improve Data on Software Development*, GAO-21-226 (Washington, D.C.: Mar. 18, 2021).

- **Prime Contractor Support:** The F-35 program currently relies heavily on contractors to provide support for its F-35 aircraft. DOD has two primary contractors for the F-35 program: Lockheed Martin for the overall air system and Pratt & Whitney for the engine. Lockheed Martin (hereinafter referred to as the prime contractor) is charged with managing the F-35 supply chain, depot maintenance, and pilot and maintainer training, as well as providing engineering and technical support. Historically, DOD has contracted for sustainment support with the prime contractor through annual contracts. However, according to program officials, in 2021 DOD plans to enter into a multiple year (base year plus option years) sustainment contract for the first time, in an attempt to achieve system level performance outcomes and cost reductions. According to DOD officials, DOD is late in finalizing its planned 2021-2023 sustainment contract with the prime contractor, and the parties are operating under an Undefinitized Contract Action, which allows the prime contractor to continue to perform work without a finalized contract. DOD plans to eventually transition to multiple year, fixed price, performance-based sustainment contracts.
- **Military Services:** The Air Force, Navy, and Marine Corps have each established an F-35 integration office or similar construct focused on how the services will operate and afford the F-35, among other things.

Figure 5: Program Stakeholders for Sustainment of F-35 Aircraft

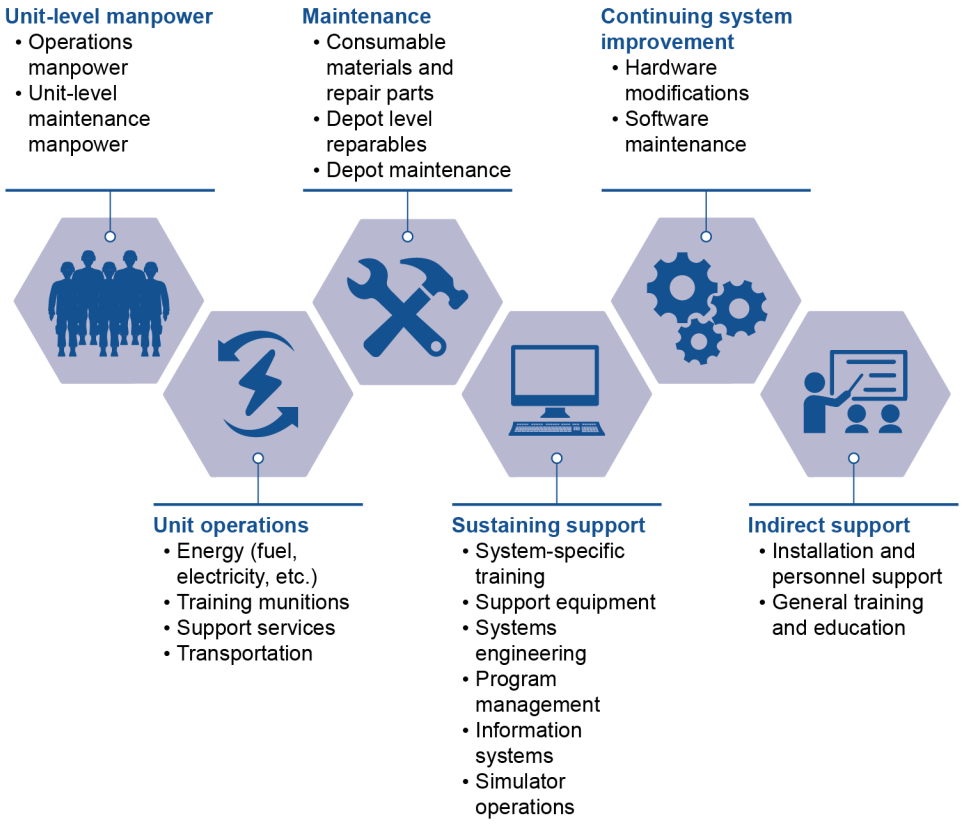


Source: GAO analysis of Department of Defense information; Defense Video and Information Distribution System (photo). | GAO-21-439

F-35 Sustainment Costs and Cost Estimates

Sustainment costs, also referred to as O&S costs, are incurred from the initial system deployment through the end of system operations. These costs, as shown in figure 6, include all costs of operating, maintaining, and supporting the F-35 aircraft.

Figure 6: Sustainment Cost Elements



Source: GAO analysis of Department of Defense and information. | GAO-21-439

Sustainment costs are typically the most significant cost category in a defense program. DOD uses CAPE to develop independent sustainment cost estimates for the program. These estimates serve as the program's official sustainment estimates of record. CAPE cost estimates are generally used to assess the affordability of a program and are required at major acquisition milestones or by special request from DOD leadership.[18]

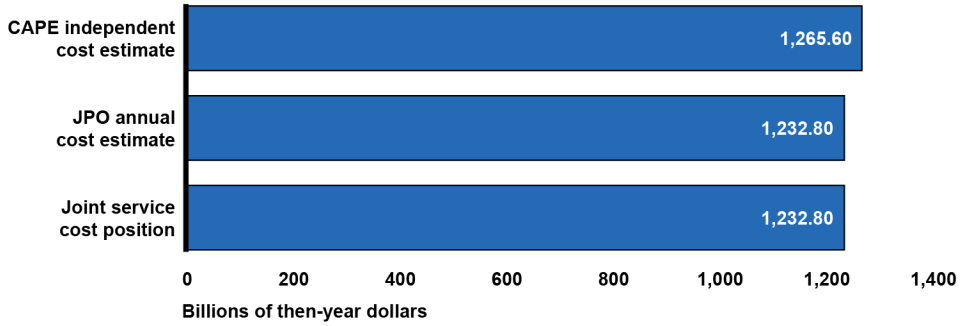
CAPE has provided updates to its F-35 sustainment cost estimate several times since 2012, including 2015, 2018, and 2020. In accordance with statutory requirements in the National Defense Authorization Act for

[18]According to DODI 5000.85, acquisition milestones are decision reviews embedded in DOD's acquisition procedures to carefully assess a program's readiness to proceed to the next acquisition phase and to make a sound investment decision committing DOD's financial resources. DODI 5000.85, *Major Capability Acquisition* (Aug. 6, 2020).

Fiscal Year 2020, CAPE most recently published an Independent Cost Estimate (ICE) in June 2020 for the life cycle costs of the F-35 aircraft program. This ICE included an updated sustainment cost estimate—$1.3 trillion across the program's life cycle.[19] That figure reflects an increase of more than $150 billion since the program re-baselined in 2012.[20]

In addition to the CAPE's ICE, DOD currently issues two other F-35 sustainment-related cost estimates: the F-35 Joint Program Office's Annual Cost Estimate and the service' Joint Service Cost Position. The F-35 Joint Program Office's Annual Cost Estimate is updated and released bi-annually, and it includes total life cycle costs for the program. The service's Joint Service Cost Position requires the services to provide their own F-35 life cycle sustainment costs for their respective programs.[21] Due to extensive communication and shared assumptions among the cost estimators, according to DOD officials, all three estimates were similar in 2020, as shown in figure 7.

Figure 7: F-35 Life Cycle Sustainment Cost Estimates Issued in 2020



Source: Cost Assessment and Program Evaluation (CAPE), Joint Program Office (JPO), and military service data. | GAO-21-439

[19]The CAPE ICE's sustainment cost estimate includes the costs of sustaining F-35 aircraft through the projected end of F-35 program operations in year 2077.

[20]The $1.3 trillion and $150 billion reflect then-year dollars (TY$).

[21]The F-35 program has not historically had a Joint Service Cost Position. Section 167 of Public Law 116-92, the Fiscal Year (FY) 2020 National Defense Authorization Act, directed the Secretary of the Air Force and the Secretary of the Navy to develop a joint service cost estimate for the life cycle costs of the F-35 aircraft program, and to submit the estimate to the congressional defense committees. According to program officials, the Joint Service Cost Position team agreed to adopt the F-35 Joint Program Office's 2020 Annual Cost Estimate (v1.0) as the Joint Service Cost Position.

F-35 Mission Capable Rates Have Improved since 2019 but Still Fall Short of Program Goals

The F-35 Joint Program Office and the services have improved the F-35 mission capable rate—the percentage of time during which the aircraft can fly and perform at least one of its tasked missions—and full mission capable rate—the percentage of time during which the aircraft can perform all of its tasked missions.[22] The U.S. F-35 fleet's average annual mission capable rate increased from 59 percent in fiscal year 2019 to 69 percent in fiscal year 2020. We previously reported that the average mission capable rate for the F-35 fleet between May and November of 2018 was 52 percent.[23] The improvement in the mission capable rate has not been limited to a single F-35 variant. From fiscal year 2019 to fiscal year 2020, the average annual mission capable rates for the U.S. fleet were as follows:

- The F-35A improved from 58.7 percent to 71.4 percent;
- The F-35B improved from 62.3 percent to 67.7 percent;
- The F-35C improved from 56.3 percent to 59.1 percent.

DOD officials stated that improvements in mission capable rates since fiscal year 2018 have been due to an increased focus on achieving higher levels of mission capability. The increased focus stems from a September 2018 memo from the Secretary of Defense directing the services to achieve and maintain 80 percent mission capable rates for critical aviation platforms, including the F-35, by the end of fiscal year 2019.[24] In fiscal

[22]Appendix I includes a more comprehensive overview (fiscal years 2015-2020) of the full mission capable rates for the program, broken out by variant, aircraft build date, and training and operational squadrons.

[23]GAO-19-321. With regard to the mission capable rate, we reported on the entire F-35 fleet, rather than the U.S.-only fleet. The U.S. fleet average mission capable rate was 50 percent from May through November 2018.

[24]Secretary of Defense Memorandum, *NDS Implementation – Mission Capability of Critical Aviation Platforms* (Sept. 17, 2018).

year 2020 DOD abandoned the 80 percent mission capable rate goal for critical aviation platforms.[25]

The F-35 U.S. fleet average annual full mission capable rate improved from 32 percent to 39 percent from fiscal year 2019 to fiscal year 2020. We previously reported that the average full mission capable rate for the F-35 fleet between May and November of 2018 was 27 percent.[26] The improvement to the fleet's full mission capable rate can be attributed almost exclusively to the F-35A. While the F-35A saw a substantial increase in its full mission capable rate, the F-35B and F-35C did not. From fiscal year 2019 to fiscal year 2020, the average annual full mission capable rates for the U.S. fleet were as follows:

- The F-35A improved from 39.6 percent to 54.0 percent;
- The F-35B decreased from 23.3 percent to 15.1 percent;
- The F-35C improved from 6.4 percent to 6.8 percent.

DOD officials attributed the F-35A full mission capable rate increase to the maturity of the fleet as newer, more developed aircraft that reflect lessons learned became integrated with the older aircraft and came to make up a larger percentage of the F-35 fleet. For example, earlier production aircraft built between 2008 and 2011 had a 13 percent full mission capable rate in 2020, while later production aircraft, built after 2011, had a 46 percent full mission capable rate in 2020. According to program officials, as F-35 aircraft continue to fly, program managers discover what is and what is not effective in the design, and they can make adjustments to newer aircraft to avoid recurring problems.

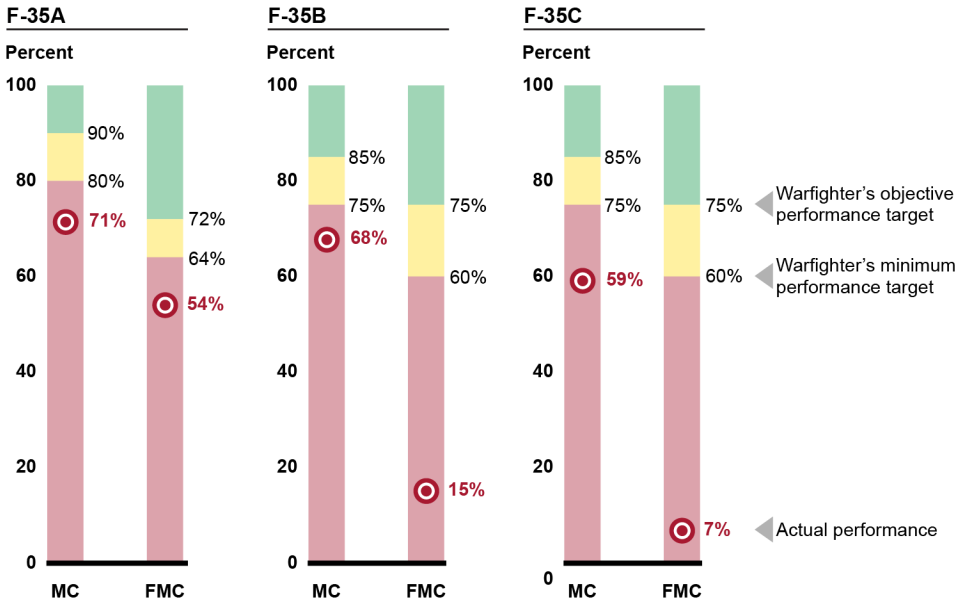
Although there have been improvements in both the mission capable and full mission capable rates for the F-35 fleet, both metrics still fall below the

[25]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. Officials 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.

[26]GAO-19-321. With regard to the full mission capable rates, we reported on the entire F-35 fleet, rather than the U.S.-only fleet. The U.S. fleet average full mission capable rate was also 27 percent from May through November of 2018.

warfighter's minimum and objective performance targets.[27] For example, as shown in figure 8, the mission capable rate for each F-35 variant falls considerably below the warfighter's objective performance target and does not meet the minimum performance target. Similarly, full mission capable rates for each F-35 variant fall well below the warfighter's objective and minimum performance targets.

Figure 8: U.S. F-35 Fleet Mission Capable and Full Mission Capable Rates, Fiscal Year 2020



Mission Capable (MC): This metric assesses only aircraft that are in the possession of F-35 units. It measures the percentage of time during which these aircraft are safe to fly and able to perform at least one tasked mission.

Full Mission Capable (FMC): This metric assesses only aircraft that are in the possession of F-35 units. It measures the percentage of time during which these aircraft are fully capable of accomplishing all tasked missions.

Source: GAO analysis of Department of Defense and Lockheed Martin information. | GAO-21-439

[27]The warfighter's minimum and objective performance targets are the requirements established by the U.S. Air Force for the F-35A, by the U.S. Marine Corps for the F-35B, and by the U.S. Navy for the F-35C in their respective Performance Based Arrangements.

	F-35A		F-35B		F-35C	
	MC	FMC	MC	FMC	MC	FMC
Actual performance	71%	54%	68%	15%	59%	7%
Warfighter's minimum performance target	80%	64%	75%	60%	75%	60%
Warfighter's objective performance target	90%	72%	85%	75%	85%	75%

Note: Appendix I includes a more comprehensive overview (fiscal years 2015-2020) of the mission capable and full mission capable rates for the program, broken out by variant, aircraft build date, and training and operational squadrons.

As the F-35 program continues to mature, the F-35 Joint Program Office and the services plan to place extra emphasis on improving full mission capable rates, which, according to multiple service officials, provide a clearer picture of the aircraft's capabilities and the services' return on investment. According to program officials, DOD is considering placing incentives on the full mission capable rate, rather than the mission capable rate, in future sustainment contracts.[28] According to DOD officials, previous sustainment contracts placed incentives on the program's ability to achieve specific mission capable rates across the enterprise, which measure an aircraft's ability to only complete at least a single mission. While an aircraft's ability to achieve one mission is useful, the F-35 is a multi-mission platform; an inability to conduct all required missions limits the effectiveness of the aircraft. Furthermore, given the F-35's role in the future of tactical aviation—including its enhanced situational awareness and next-generation stealth capabilities—it is also increasingly important that the F-35 has its full capabilities available.

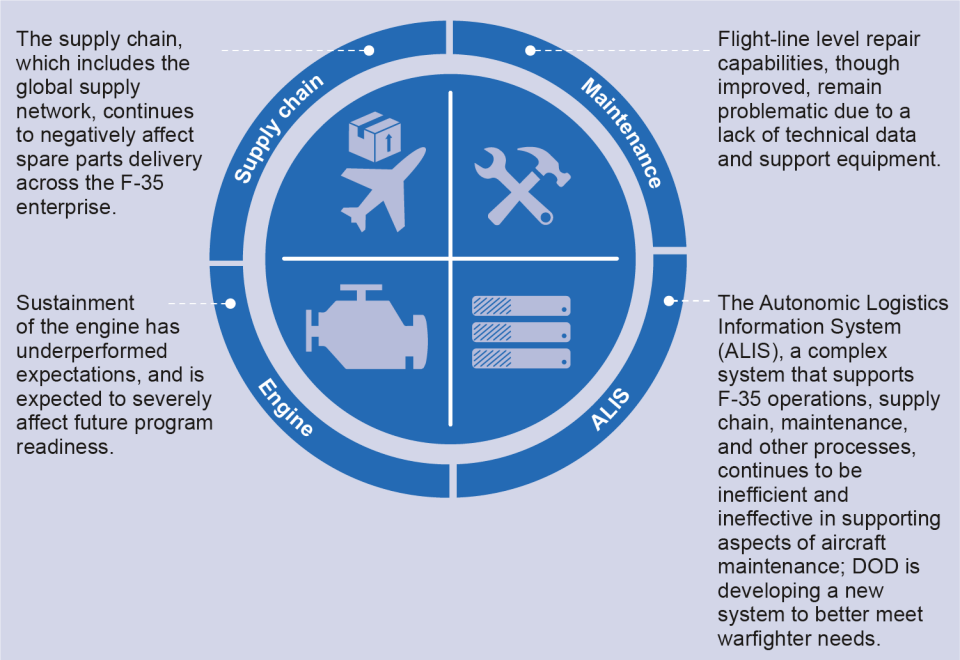
F-35 Has Made Progress in Addressing Some Sustainment Challenges, but Significant Issues Continue to Affect Aircraft Readiness

The F-35 program and the services have made progress in addressing sustainment challenges we reported on in our prior work, leading to

[28]As previously discussed, DOD is currently late in finalizing its planned 2021-2023 sustainment contract with the prime contractor, and the parties are operating under an Undefinitized Contract Action, which allows the prime contractor to continue to perform work without a finalized contract.

improvements in performance.[29] However, our analysis shows that these challenges continue to affect F-35 sustainment operations and aircraft readiness. As described in figure 9, these significant challenges are as follows:(1) the supply chain; (2) maintenance; (3) Autonomic Logistics Information System (ALIS)—a complex system that supports F-35 operations, mission planning, supply-chain management, maintenance, and other processes; and (4) the F-35 engine.

Figure 9: Significant Sustainment Challenges for the F-35 Program



Source: GAO analysis of Department of Defense (DOD) information. | GAO-21-439

The F-35 Supply Chain Has Become More Responsive, but Challenges Remain

Since we reported on the F-35 supply chain in 2019, the F-35 program has made improvements in three areas: spare parts availability, customer wait time, and depot-level repair.[30] However, while the program has made

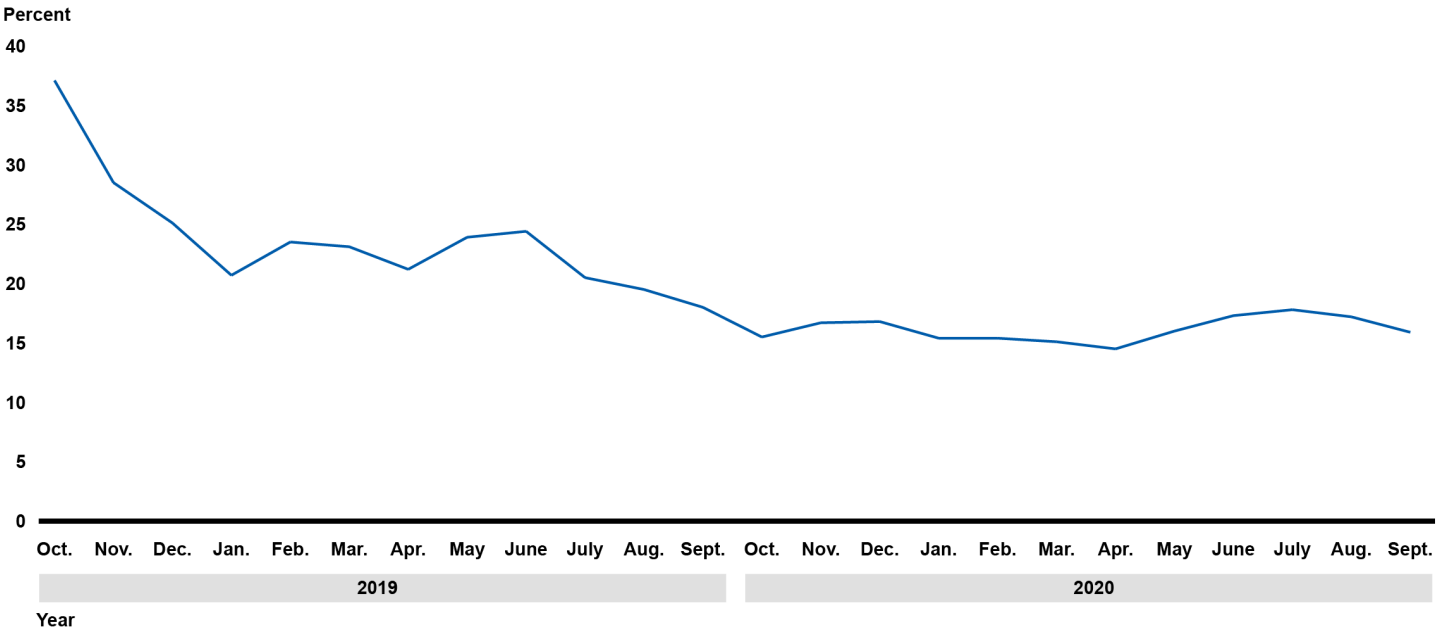
[29]GAO-20-316, GAO-19-321, GAO-18-75, and GAO-14-778.

[30]GAO-19-321.

improvements, it continues not to meet program objectives in each of those areas.

Spare parts availability is measured by non-mission capable due to supply rates—the percentage of time during which aircraft in the possession of F-35 units are unable to fly or conduct any of their tasked missions due to a lack of spare parts—and these rates improved over the course of fiscal years 2019 and 2020. Specifically, the rates improved from an average of 24 percent in fiscal year 2019 to an average of 16 percent in fiscal year 2020, as shown in figure 10. However, F-35 aircraft were still unable to fly due to a lack of spare parts about 15 percent of the time. Furthermore, as previously discussed, the warfighter's objective performance target for the mission capable rate in fiscal year 2020 was 90 percent for the F-35A and 85 percent for the F-35B and F-35C. Given that the mission capable rate is determined by subtracting the percentage of time an aircraft is not available, owing to issues pertaining to supply and maintenance, having a non-mission capable due to supply rate of 15 percent categorically makes it impossible to achieve the F-35A's target.

Figure 10: U.S. F-35 Fleet Non-Mission Capable Due to Supply Rate, Fiscal Years 2019 – 2020

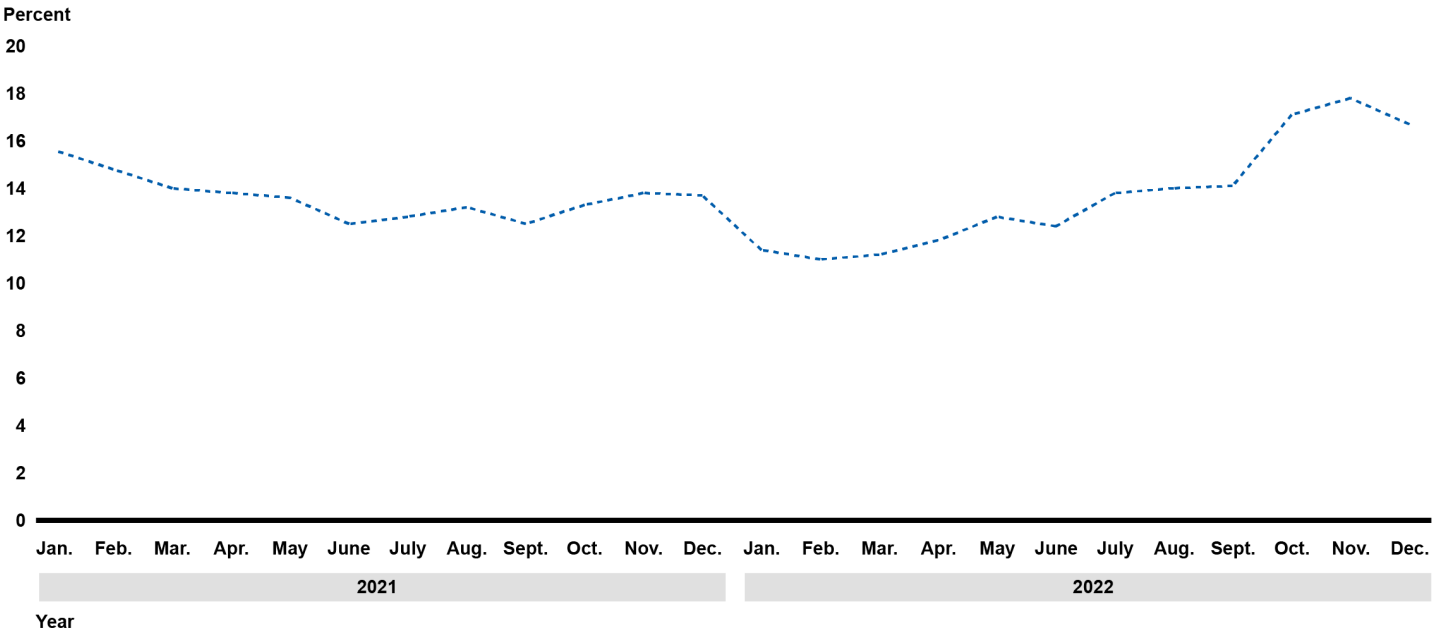


Source: GAO analysis of Lockheed Martin information. | GAO-21-439

Year	Month	Percent
2019	Oct.	37.1
	Nov.	28.5
	Dec.	25.1
	Jan.	20.7
	Feb.	23.5
	Mar.	23.1
	Apr.	21.2
	May	23.9
	June	24.4
	July	20.5
	Aug.	19.5
	Sept.	18
2020	Oct.	15.5
	Nov.	16.7
	Dec.	16.8
	Jan.	15.4
	Feb.	15.4
	Mar.	15.1
	Apr.	14.5
	May	16
	June	17.3
	July	17.8
	Aug.	17.2
	Sept.	15.9

As shown in figure 11, the prime contractor projects that, based on current funding levels, the program's non-mission capable due to supply rate will decrease from 16 percent to 11 percent over the course of 2021 before increasing over the course of 2022 back to approximately 16 percent. The program office stated that the program plans to fund enough spare parts to achieve an approximately 15 percent non-mission capable due to supply rate. According to program officials, funding to achieve a lower non-mission capable due to supply rate was not affordable, and would provide only near-term benefits; therefore, the program has focused on other priorities, such as improving depot repair capacity, as discussed below.

Figure 11: Prime Contractor-Projected U.S. F-35 Fleet Non-Mission Capable Due to Supply Rates, Calendar Years 2021-2022

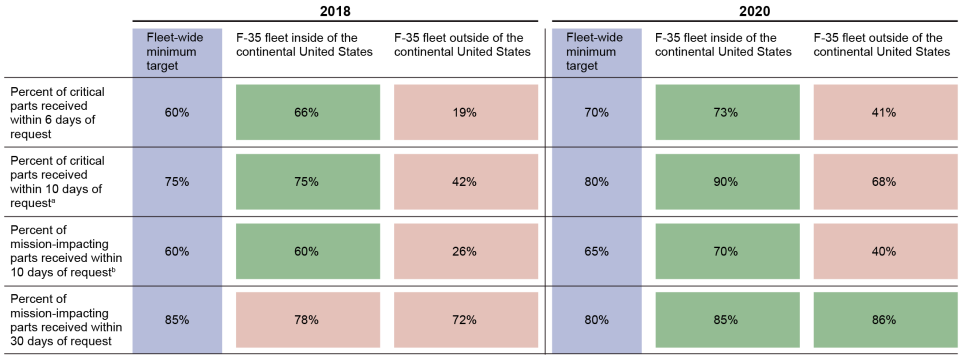


Source: GAO analysis of Lockheed Martin information. | GAO-21-439

Year	Month	Percent
2021	Jan.	15.6
	Feb.	14.8
	Mar.	14
	Apr.	13.8
	May	13.6
	June	12.5
	July	12.8
	Aug.	13.2
	Sept.	12.5
	Oct.	13.3
	Nov.	13.8
	Dec.	13.7
2022	Jan.	11.4
	Feb.	11
	Mar.	11.2
	Apr.	11.8
	May	12.8
	June	12.4
	July	13.8
	Aug.	14
	Sept.	14.1
	Oct.	17.1
	Nov.	17.8
	Dec.	16.7

Additionally, DOD decreased customer wait times for parts and achieved five of its eight customer wait time metrics in fiscal year 2020. As shown in figure 12, this represented an improvement over calendar year 2018, when DOD achieved just three of eight customer wait time metrics. Furthermore, customer wait times for parts inside of the continental United States improved across the board in 2020, with all critical and mission-impacting part targets being met.

Figure 12: Cumulative Customer Wait Times for F-35 Parts, Inside and Outside of the Continental United States, 2018 and 2020



Source: GAO analysis of Department of Defense and Lockheed Martin information. | GAO-21-439

2018 data table

	Fleet-wide minimum target	F-35 fleet inside of the continental United States	F-35 fleet outside of the continental United States
Percent of critical parts received within 6 days of request	60%	66%	19%
Percent of critical parts received within 10 days of request	75%	75%	42%
Percent of mission-impacting parts received within 10 days of request	60%	60%	26%
Percent of mission-impacting parts received within 30 days of request	85%	78%	72%

2020 data table

	Fleet-wide minimum target	F-35 fleet inside of the continental United States	F-35 fleet outside of the continental United States
Percent of critical parts received within 6 days of request	70%	73%	41%
Percent of critical parts received within 10 days of request	80%	90%	68%
Percent of mission-impacting parts received within 10 days of request	65%	70%	40%
Percent of mission-impacting parts received within 30 days of request	80%	85%	86%

[a]For purposes of this table, a critical part is a part that is necessary to repair an aircraft that cannot fly. The program refers to these parts as “Priority 1” parts.

[b]For purposes of this table, mission-impacting parts are those that affect the aircraft’s ability to conduct certain missions but are not necessary for the aircraft to fly. The program refers to these parts as “Priority 2” parts.

Customer wait times for parts outside of the United States remain problematic. In April 2019 we reported that the immaturity of the global supply chain network, including parts shortages throughout the program, contributed to long wait times for both deployed and overseas U.S. and international F-35 squadrons.[31] For example, in 2018 fewer than 20 percent of critical parts outside of the continental United States were received within 6 days of request—well below the fleet-wide minimum target of 60 percent. This metric still remained well below the 60 percent target in 2020; however, it had improved to greater than 40 percent, as shown in figure 12 above. According to program officials, the reason for long customer wait times for aircraft located outside of the United States continues to be the immaturity of the supply chain.

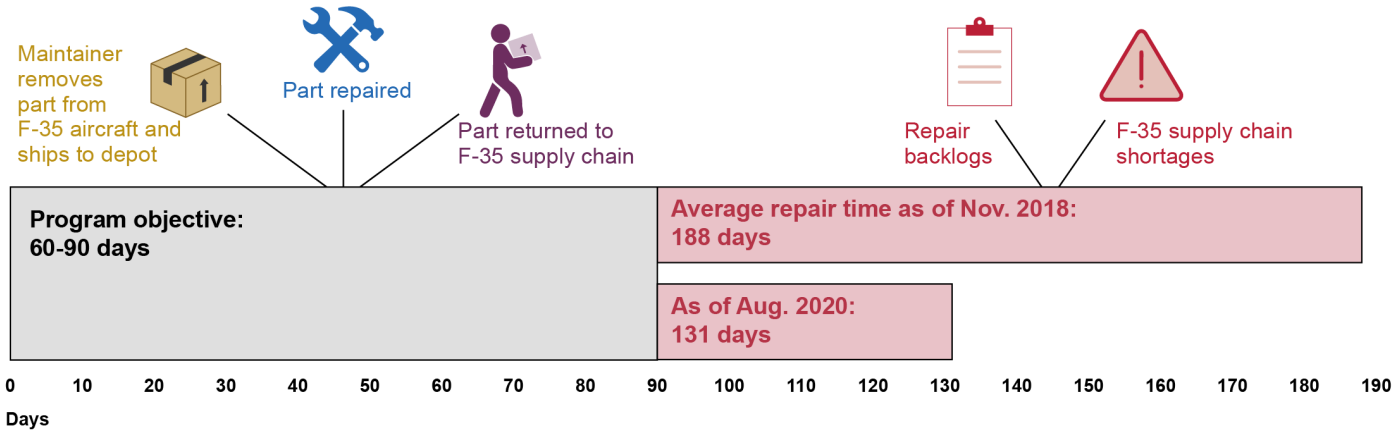
Finally, the inability of the F-35 program to keep up with repair demands has been a recurring issue. According to program officials, the program deviated from its original strategy to establish organic (i.e., government-operated) depot repair capability by 2016, due to adjustments in funding priorities earlier in the program’s history. Program officials stated that once the program deviated from establishing an organic depot repair

[31]GAO-19-321.

capability, it failed to adequately plan for and build a repair capacity that would compensate for the decision. As a result, and as we reported in April 2019, average depot-level repair times were double the program's objective, leading to a significant impact on aircraft readiness.[32]

As shown in figure 13, as of August 2020 average repair times had improved to 131 days from 188 days in November 2018; however, this figure remains well above the program's 60-90 day program objective. According to program officials, part repair times continue to lag because the depots do not yet have the capacity to meet program repair time goals. Program officials told us that while they continue to focus on improving depot maintenance capacity, they are years away from having sufficient capacity to achieve program repair time goals.

Figure 13: 2020 Average Times for Depot-Level Repair of an F-35 Part, as Compared with the Program's Goal



Source: GAO analysis of Lockheed Martin information. | GAO-21-439

All 11 F-35 locations that responded to our survey reported negative effects on the readiness or capabilities of their aircraft as a result of supply chain challenges. Specifically, six of the 11 locations reported that parts failed to arrive on time, or that fewer spare parts arrived than were required. For example,

- six of 11 locations reported that expected delivery dates for spare parts were often delayed for unknown reasons. As a result, locations were unable to plan for both daily flying operations and aircraft maintenance.

[32]GAO-19-321.

- seven of 11 locations reported that delayed arrival times for spare parts needed for maintaining full mission capable status remained a challenge. For example, a part related to the aircraft's sensor system is frequently unavailable in the supply chain, and in high demand from the squadrons. One location reported having waited several months for the part, negatively affecting the squadron's mission capable rates.

We have previously reported on the F-35 supply chain and its associated challenges. For example, in April 2019 we made eight recommendations focused on the F-35 supply chain.[33] DOD concurred with all of these recommendations. As of February 2021, DOD had not fully implemented six of the eight recommendations. In 2019 DOD issued revised business rules for the prioritization of spare parts, addressing one of our recommendations. DOD also improved its planning process and has taken targeted action to improve the supply chain, thereby implementing another recommendation. We continue to believe that it is important for DOD to implement the remaining six recommendations. For example, DOD needs to:

- develop a methodical approach to consistently obtain comprehensive cost information from the prime contractor for F-35 spare parts within the supply chain; and
- clearly define the strategy by which DOD will manage the F-35 supply chain in the future and update key strategy documents accordingly, to include any additional actions and investments necessary to support that strategy.

Implementing these recommendations would allow DOD to provide better supply support for the F-35.

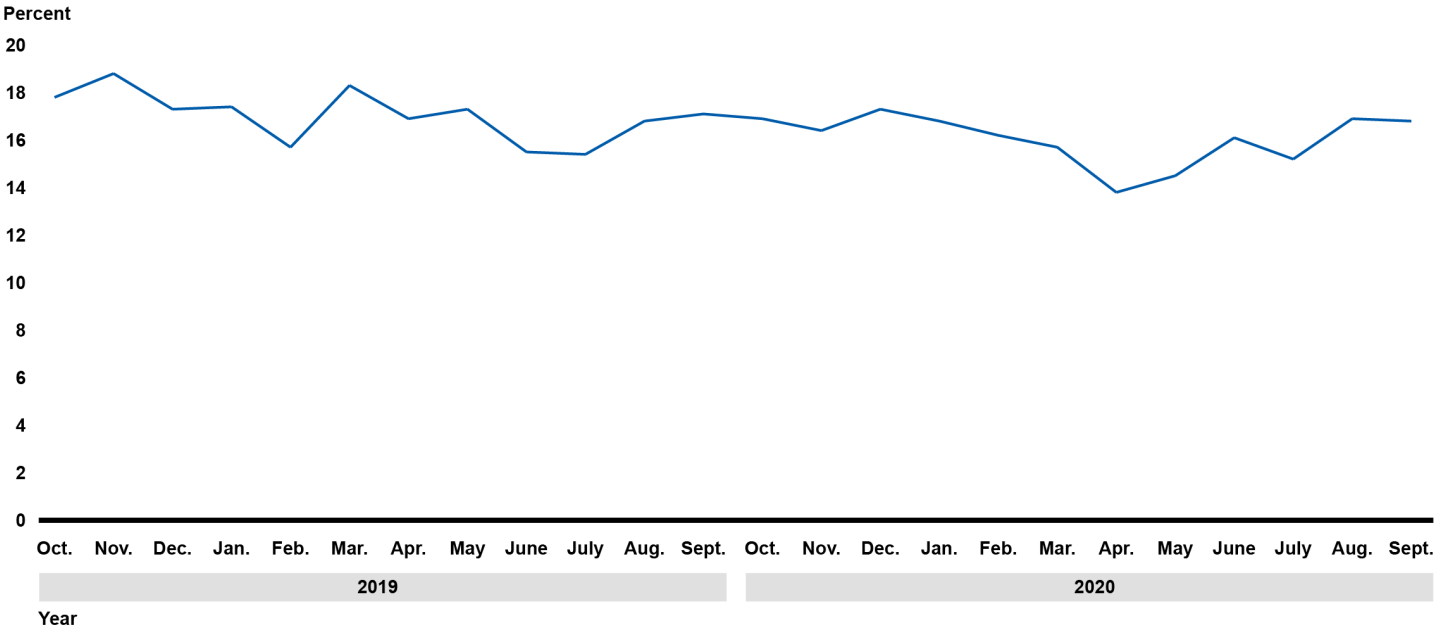
Maintenance Challenges Continue to Affect Aircraft Readiness

The non-mission capable due to maintenance rate fluctuated between a high of approximately 19 percent and a low of 14 percent across fiscal years 2019-2020, as shown in figure 14. The non-mission capable due to maintenance rate is the percentage of time during which aircraft in the possession of F-35 units are unable to fly or conduct any of their tasked missions due to a maintenance requirement. Overall, non-mission capable due to maintenance rate decreased from 17 percent in fiscal year

[33]GAO-19-321.

2019 to 16 percent in fiscal year 2020. However, as previously discussed, the warfighter's objective performance target for the mission capable rate in fiscal year 2020 was 90 percent for the F-35A and 85 percent for the F-35B and F-35C. Given that the mission capable rate is determined by subtracting the percentage of time during which the aircraft is not available due to maintenance and supply issues, a non-mission capable due to maintenance rate of 16 percent makes it impossible to achieve any of the F-35 variants' targets.

Figure 14: U.S. F-35 Fleet Non-Mission Capable Due to Maintenance Rate, Fiscal Years 2019 – 2020



Source: GAO analysis of Lockheed Martin information. | GAO-21-439

Year	Month	Percent
2019	Oct.	17.8
	Nov.	18.8
	Dec.	17.3
	Jan.	17.4
	Feb.	15.7
	Mar.	18.3
	Apr.	16.9
	May	17.3
	June	15.5
	July	15.4
	Aug.	16.8
	Sept.	17.1
2020	Oct.	16.9
	Nov.	16.4
	Dec.	17.3
	Jan.	16.8
	Feb.	16.2
	Mar.	15.7
	Apr.	13.8
	May	14.5
	June	16.1
	July	15.2
	Aug.	16.9
	Sept.	16.8

As we reported in March 2021, although it improved over time, the F-35 program continued to fall short with regard to seven of its 24 reliability and maintainability performance goals, as of June 2020.[34] Reliability and maintainability goals present specific quantitative objectives aimed at ensuring that an aircraft will be available for operations as opposed to out-of-service for maintenance. In January 2020 we reported that a weapon system's reliability directly affects how much DOD must spend to operate and support it over its lifetime.[35] According to leading reliability

[34]GAO-21-226. The program office collects eight reliability and maintainability metrics for each variant.

[35]GAO, *Defense Acquisitions: Senior Leaders Should Emphasize Key Practices to Improve Weapon System Reliability,* GAO-20-151 (Washington, D.C.: Jan 14, 2020).

engineers, the earlier a change is made to a design, the less costly it will be to the program. As we reported, however, the F-35 program deferred key reliability engineering activities intended to improve system designs, until later in development. As a result, the program missed opportunities to identify, understand, and mitigate reliability issues early in the development process that might have reduced sustainment-related costs for the program.

The Director, Operational Test and Evaluation, reported in January 2021 and we reported in March 2021 that as the F-35 continues to mature there have been some improvements in reliability and maintainability metrics.[36] For example, the Director, Operational Test and Evaluation, reported improvements in mean flight hours between critical failures and in mean flight hours between maintenance events. Improvements in these metrics mean that the aircraft are increasingly available for operations and training.

Nonetheless, the Director, Operational Test and Evaluation, reported in January 2021 that some reliability and maintainability metrics have not improved, thus affecting the performance of the aircraft. For example, the mean time to repair metric—i.e., the amount of time needed to repair aircraft and return them to flying status—changed little from 2019 to 2020, and it remains higher than the requirement (i.e., goal) for the system at maturity.[37] The report stated that some repairs have taken more than twice as long as originally intended, placing a heavy maintenance burden on fielded units.

The F-35 Joint Program Office has acknowledged that it will not meet its mean time to repair goals, and it has adjusted those goals. Specifically, the F-35 Joint Program Office and the services changed the F-35A and F-35C mean time to repair goal from 2.5 to 5.0 hours and the F-35B goal from 3.0 to 6.4 hours. Assuming that these new goals are met,

[36]The F-35 Joint Program Office established maturity levels based on flight hours and had generally exceeded those maturity levels as of April 2020. DOD's January 2021 Director, Operational Test and Evaluation Fiscal Year 2020 Annual Report stated that as of April 2020 the F-35 fleet had accumulated 232,885 flight hours, or 116 percent of its targeted maturity value of 200,000 hours. In particular, the F-35A had accumulated 145,452 hours, or 195 percent of its targeted maturity value of 75,000 hours; the F-35B had accumulated 56,529 hours, or 75 percent of its targeted maturity value of 75,000 hours; and the F-35C had accumulated 29,904 hours, or 60 percent of its target value of 50,000 hours.

[37]The mean time to repair metric measures the labor time and cure times for coatings, sealants, paints, and other repair tasks, but it does not include logistics delay times, such as how long it takes to receive shipment of a replacement part.

maintenance actions will consume about twice as much time as originally desired and planned. The Director, Operational Test and Evaluation, stated that this would affect the F-35 program's ability to meet a key performance requirement—the number of sorties (i.e., flights) that a squadron is able to generate. As a result, F-35 aircraft will not be as available for operations and training as originally desired and planned. Figure 15 depicts maintenance being performed on an F-35.

Figure 15: Air Force Personnel Provide F-35 Maintenance at Nellis Air Force Base

Source: U.S. Air Force photo by Tech. Sgt. Alexandre Montes. | GAO-21-439

DOD officials and all 11 F-35 locations that responded to our survey also told us that maintenance challenges are still affecting aircraft performance. In particular, officials and F-35 locations identified two specific challenges, described in detail below: (1) flight line maintainers lack access to technical data to conduct certain maintenance activities; and (2) locations lack support equipment to conduct maintenance efficiently.

Technical data. Technical data, which include the details about how the aircraft should perform and how to maintain its continued performance, constitute an important part of F-35 maintenance. Technical data include item specification, engineering drawings, operating and maintenance

manuals, and other actions needed to support weapon systems.[38] In September 2014 we reported that DOD lacked access to proprietary technical data that could help promote contractor competition or support organic (i.e., government-operated) sustainment operations, such as maintenance activities.[39] We recommended that DOD develop an Intellectual Property strategy to identify the federal government's current levels of technical data rights ownership, and all critical technical data needs and their associated costs. In October 2017 we reported that the program had not identified all critical needs and associated costs and had yet to define the technical data it needs.[40] As of February 2021, DOD was developing but had not yet completed an Intellectual Property strategy for the program. Identifying technical data needs, costs, and ownership of technical data are essential for DOD's effectively maintaining the F-35 and maximizing competition for future product support of the F-35.

Four of the eleven locations we surveyed reported that the amount and quality of technical data for the F-35 available to maintenance personnel has improved in recent years. However, seven of the 11 locations reported that having accessible technical data remains a challenge directly affecting aircraft availability and operations. For example, one location reported that when maintainers find negligible (and fixable) damage to a basic part, they lack the technical data that would allow them to fix the part. Instead, the maintainers have to request the technical data from contractors, which takes time, delays aircraft maintenance, and may prevent the maintainers from acquiring the knowledge needed to maintain the aircraft on their own in the future.

A second location reported that the lack of accessibility to F-35-related technical data prevents repairs that maintainers can currently perform on other aircraft. The location also reported that when maintainers do receive the appropriate authorization to make a repair, the technical data provided are not always helpful or clear—sometimes contradicting other available information for specific maintenance tasks, causing confusion. This lack of access causes maintainers to have to ask for contractor

[38]"Technical data" refers to recorded information (regardless of the form or method of the recording) of a scientific or technical nature (including computer databases and computer software documentation). (See 41 U.S.C. 116). Federal Acquisition Regulation (FAR), 48 C.F.R. § 27.403.

[39]GAO-14-778.

[40]GAO-18-75.

support, thus increasing maintenance time and delaying aircraft readiness.

Support equipment. Service officials and F-35 locations also pointed to a lack of support equipment—equipment items that are required to support the operation and maintenance of the aircraft—as a primary driver of maintenance challenges. According to officials who represented five of 11 locations, maintainers lack sufficient support equipment, such as defueling kits or power tools, thus delaying aircraft maintenance. The maintainers attributed the lack of support equipment both to the program not knowing how much support equipment is needed at individual locations, and to the contractors not producing enough support equipment to fully support ongoing operations. The lack of support equipment leads to delays in the required maintenance and to a decrease in readiness of the aircraft. According to service officials, deployments can exacerbate the lack of support equipment, as aircraft need to deploy with their requisite support equipment. Typically, when all F-35 aircraft are present at a particular location, support equipment can be shared. However, according to service officials, when F-35s deploy, sometimes only a portion of a location's F-35 aircraft are deployed. The deploying squadron will take all of the support equipment necessary to effectively support operations at the forward location. This leaves any F-35 aircraft remaining at the location with less support equipment, which further deprives the location of the ability to maintain aircraft readiness.

DOD and service officials both reported that the Air Force is considering procuring support equipment directly, instead of relying on the program for that equipment. According to service officials, this change would have the potential for cost savings within the program, as the services could work with the supplier directly rather than through the F-35 Joint Program Office or the prime contractor. According to Air Force officials, the service is working through the legal approval process to allow it to procure support equipment in this manner. If successful, according to Air Force officials, there will be an opportunity to expand this approach across the program.

ALIS Challenges Persist as the Program Begins Transition to a New System

ALIS is intended to provide the necessary logistics tools for F-35 program participants to operate and sustain the aircraft. ALIS consists of multiple software applications designed to support different squadron activities,

such as supply chain management, maintenance, training management, and mission planning. However, we have previously identified numerous long-standing issues with ALIS, including that the system is not user friendly and does not provide the sustainment-related capabilities that were promised.[41] In March 2020 we reported that inaccurate and/or missing data in ALIS have at times resulted in the system's signaling that an F-35 aircraft should not be flown—even though the aircraft had no issues that required it to be grounded, and it was ready for flight.[42] Our report also found that ALIS was not intuitive, thus causing standard functions to take more time than expected.

Ten of the 11 F-35 locations we surveyed reported ongoing issues with several of the ALIS-related challenges we have raised in the past, including data related to aircraft parts. Certain F-35 parts have an associated electronic record that is used to track the remaining time before the part must be replaced, among other things.[43] These electronic records reside within ALIS and are supposed to alert maintainers when parts need to be replaced; however, incorrect, missing, or corrupt electronic records within ALIS continue to affect day-to-day operations on the flight lines. This situation has resulted in the unnecessary grounding of "healthy" F-35 aircraft, as well as a culture of otherwise unnecessary manual workarounds to circumvent the electronic records problem at the squadron level.[44]

Maintainers also continue to experience hardware challenges with ALIS. For example, the Standard Operating Units—the squadron-level servers intended to provide all ALIS capabilities to support flying, maintenance, and training at F-35 locations—remain problematic. Maintainers reported that these servers fail to transfer electronic records and/or parts requisitions between aircraft at the squadron level. Additionally, according to squadron officials, the Portable Maintenance Aids—ruggedized laptops

[41]GAO-14-778 and GAO, *F-35 Sustainment: DOD Needs a Plan to Address Risks Related to Its Central Logistics System,* GAO-16-439 (Washington, D.C.: Apr. 14, 2016).

[42]GAO-20-316.

[43]Electronic Equipment Logbooks are electronic files assigned to certain parts that include information such as part history and remaining life (hours). For the purposes of this report, Electronic Equipment Logbooks are referred to as "electronic records."

[44]GAO testified before the House Oversight and Reform Committee on the Autonomic Logistics Information System and the ongoing issue of Electronic Equipment Logbooks in July 2020. *F-35 Sustainment: DOD Needs to Address Key Uncertainties as It Re-Designs the Aircraft's Logistics System,* GAO-20-665T (Washington, D.C.: July 22, 2020).

used by maintainers to perform and document maintenance activities—routinely fail to connect with the servers. Officials at one location reported that they sometimes try three to five Portable Maintenance Aids before they can identify one that will connect with the server, thus leading to wasted labor and time.

Recognizing the ongoing challenges with ALIS, in January 2020 DOD began taking steps to replace it with a future system—the F-35 Operational Data Integrated Network (ODIN). In our March 2020 report we recommended that DOD develop and implement a strategy for the re-design of ALIS to address a myriad of technical and programmatic uncertainties surrounding the development of ODIN.[45] According to DOD officials, they have made some progress in developing ODIN, including a successful trial run of new, smaller, and more efficient server equipment at one F-35 location. In September 2020 the F-35 program published both an ODIN Capability Needs Statement and an ODIN User Agreement, in a step toward developing an overall strategy for ODIN.[46]

However, DOD has not yet finalized its strategy for ODIN, including how and when it will address several of the technical and programmatic uncertainties we raised in March 2020. DOD will continue to rely on ALIS to serve as its primary logistics system while the F-35 Joint Program Office continues to focus on completing the strategy for the development and eventual rollout of ODIN. While the Joint Program Office would like to deliver an initial capability for ODIN in September 2021 and to achieve full operational capacity by September 2023, these dates are ambitious, according to multiple DOD officials with whom we spoke. Furthermore, the F-35 Joint Program Office received 42 percent less research, development, test and evaluation funding for fiscal year 2021 from Congress than it had requested and planned to use in developing ODIN. According to DOD officials, this will likely delay the ALIS-to-ODIN transition and will necessitate the use of more operations and

[45]GAO-20-316.

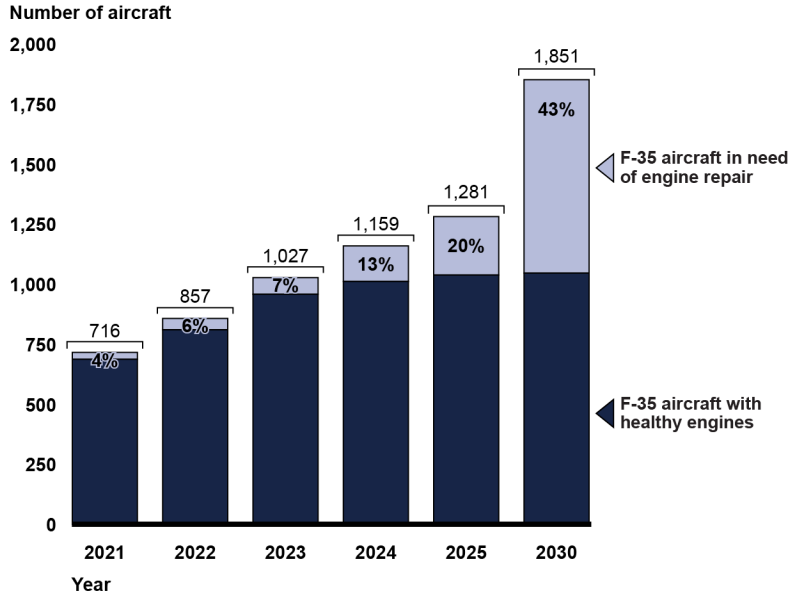
[46]The F-35 program is developing ODIN using an Agile development process to incrementally field capabilities more quickly. According to program officials, the program office is also developing ODIN under DOD's new policy for software development, as opposed to establishing a separate acquisition program for this new effort. While ODIN development is underway, the program is developing other documents that are common for new developmental efforts, such as an acquisition strategy and a cost estimate. See GAO-21-226.

maintenance funding than originally planned to extend the service life of ALIS.

Problems with Engine Sustainment Are Affecting the Program and Could Significantly Affect Future F-35 Mission Capable Rates

According to multiple service and program officials, challenges related to F-35 engine sustainment are currently affecting the program and may pose its greatest sustainment risk over the next 10 years. At the end of 2020, the program had 20 aircraft unable to fly because they needed engine repairs, according to program officials. In January 2021 the F-35 Joint Program Office projected that the program would have a deficit of approximately 800 engines by 2030 without the implementation of considerable mitigation actions, as shown in figure 16. A deficit of this size could lead to 43 percent of the total F-35 fleet's being grounded in 2030.

Figure 16: Projected F-35 Aircraft Needing Engine Repairs



Source: GAO analysis of Joint Program Office data. | GAO-21-439

Year	MC engines	Engine holes
2021	687	29
2022	810	47
2023	958	69
2024	1011	148
2025	1038	243
2030	1046	805

At the end of 2020, two main factors contributed to 20 F-35 aircraft's needing engine repairs. First, F-35 squadrons removed engines for unscheduled maintenance more often than expected, primarily to repair the power module—a key component of the engine that generates thrust for the aircraft to fly.[47] Specifically, in 2020 the F-35 Joint Program Office projected 52 power module removals but it experienced 67. This increased number of power modules needing repair was largely due to a flaw in the turbine coating of the module. For example, in October 2020 one F-35 location reported to us that eight of its aircraft were currently non-mission capable, or unable to perform any of their assigned missions, due to unscheduled engine removals. It projected that another 16-20 aircraft engines—two full squadrons' worth—could require removal in 2021. This number would represent nearly 50 percent of that location's fleet of F-35 aircraft.

Second, the F-35 program was able to repair only 43 percent of removed power modules in 2020, thereby resulting in a backlog of power modules needing repair.[48] The program planned for Oklahoma City Air Logistics Complex—a key source of engine repair—to repair 90 percent of the program's total removed power modules in 2020. However, according to program officials, Oklahoma City Air Logistics Complex was able to repair only 23 percent of what the program had originally forecasted for the site

[47]The engine in the F-35A and F-35C has four modules: fan, power, augmenter, and nozzle. The engine in the F-35B has an additional module—the lift fan. The power module includes a compressor, combustor, and two turbines, and it is considered the hottest part of the engine with the smallest rotational parts and some of the tightest tolerances, according to a DOD official.

[48]The 43 percent represents the total number of repaired power modules in 2020 divided by the total number of removed power modules (in need of repair) in 2020.

in 2020.[49] The F-35 Joint Program Office attributed this to numerous challenges, such as:

- more extensive maintenance being required on the engine module than expected;
- the fact that available technical data did not support the more extensive maintenance being required;
- inefficient maintenance processes and the lack of available support equipment to conduct the more extensive maintenance; and
- a lack of proficiency in the depot workforce.

These challenges resulted in the program's not meeting its goals for engine module repair turnaround time. As of October 2020, the depot had an average repair time of 207 days for a power module—far greater than its turnaround time goal of 122 days. As a result, the officials reported that the program ended 2020 with a backlog of 65 power modules awaiting repair—a number that had decreased by one, to 64, as of mid-February 2021.

In addition, scheduled engine removals are projected to increase the number of power modules needing repair beginning in late fiscal year 2021. Scheduled engine removals are planned periodic maintenance, based on the number of flying hours, requiring an overhaul of the engine power module a well as other maintenance. An increasing number of scheduled engine removals will further strain the capacity of depots, which are currently struggling to handle the workload associated with repairing the engine power module from the unscheduled engine removals. This capacity issue will lead to an increasing number of aircraft's being non-mission capable due to the lack of power modules, as shown previously in figure 16. As a result, the program estimated in January 2021 that if it remained on the current trajectory, there would be a deficit of 47 engines (i.e., 6 percent of aircraft would lack an engine) in 2022; 69 engines (i.e., 7 percent of aircraft would lack an engine) in 2023; and 148 engines (i.e., 13 percent of aircraft would lack an engine) in 2024.

[49]According to program officials, engines are repaired at a heavy maintenance center located at Oklahoma City Air Logistics Complex and other contractor facilities in the repair network. Those other contractor facilities repaired 15 power modules in 2020. The heavy maintenance center at Oklahoma City Air Logistics Complex is a public-private partnership between Pratt & Whitney and the U.S. government.

DOD recognizes that it lacks the capacity to make both unscheduled and scheduled engine power module repairs at the level needed to support the F-35 program. As a result, DOD is taking steps to increase its depot repair capacity for the power module. First, the program has begun taking actions to improve repair turnaround at Oklahoma City Air Logistics Complex, such as establishing a second maintenance shift to conduct repairs and improving the training of the workforce. The program aims to achieve its repair turnaround time goal for power modules of 122 days by January 2022. Second, DOD plans to establish five additional engine depot maintenance facilities in the United States and abroad by the end of 2024, which should increase repair capacity for the power module. The program plans to open a depot repair facility in Jacksonville, Florida, by 2024, and a contractor-managed depot repair facility in West Palm Beach, Florida, by the end of 2023. Third, the program is exploring actions to decrease the demand for power module repairs, such as redesigning hardware to be more durable or reliable and expanding unit level maintenance capability. Officials have identified engine sustainment as a high risk, top priority for the program, and said they know that all stakeholders will need to stay fully engaged to improve the situation.

Mitigating the various challenges entailed in sustaining F-35 engines will likely require the services to spend more for F-35 sustainment than currently planned to avoid the substantial readiness impacts of an 800-engine deficit by 2030. Service officials reported that the power module currently accounts for 30 percent of the costs of spare parts for the F-35 aircraft, and that to improve the repair turnaround times and number of engines being repaired, those costs are likely to increase. Furthermore, accelerating depot standups means that the program will require additional funding in earlier years than were projected. The F-35 Joint Program Office projects that the depot activation in Jacksonville will cost approximately $50 million. According to program officials, the cost of activating the contractor-led depot in West Palm Beach, Florida, is unknown; however, contractor-provided estimates reflect approximately $40 million.

In the near term, capacity challenges at depots will continue to contribute to the number and percentage of non-mission capable aircraft. The program's current goal is for propulsion-related challenges to account for no more than 4 percent of the program's overall non-mission capable due to supply rate. However, projections have the program exceeding that percentage by the end of fiscal year 2021. Achieving the program's 4 percent goal will depend upon the program's ability to address the various challenges sustaining the engine. We have an ongoing review focused on

DOD's plans to address F-35 engine sustainment challenges, and we plan to report on these issues later in 2021. Therefore, in this report, we are not making recommendations concerning F-35 engine sustainment.

F-35 Life Cycle Sustainment Cost Estimates Continue to Rise, and DOD Has Not Made Progress in Meeting Its Affordability Constraints

F-35 life cycle sustainment cost estimates continue to increase. According to our analysis and to DOD officials, DOD does not currently have a pathway to close the substantial gap between estimated operating and support costs for the F-35 and service-established affordability constraints—i.e., operating and support costs the services can afford based on their projected budgets and other priorities. Despite ongoing efforts to reduce F-35 sustainment costs, DOD and the services face significant and difficult choices to achieve affordability constraints. Within DOD there are differing perspectives on the best course of action, and the program lacks a strategic approach for ensuring that the services can afford to operate and support the F-35. As the deployed fleet of F-35 aircraft grows, it will become more difficult to reduce sustainment costs, necessitating urgency in addressing significant concerns about the services' ability to afford the long-term sustainment costs of the F-35 program.

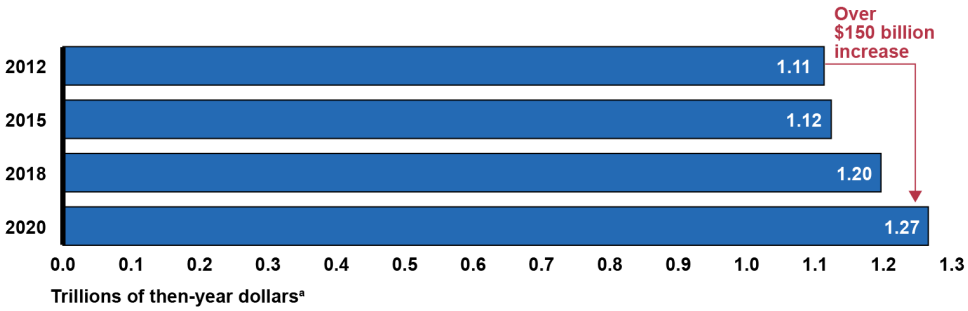
Estimated F-35 Life Cycle Sustainment Costs Have Increased By $150 Billion since 2012

Since 2012, sustainment-related cost estimates for the life cycle of the F-35 program have steadily increased. The F-35 program's latest cost estimate, issued by the Secretary of Defense's CAPE, projects overall sustainment (i.e., operating and support) costs for the F-35 program to be about $1.3 trillion through the program's 66-year life cycle. [50] This

[50]CAPE's 2020 ICE issuance was submitted in accordance with statutory requirements in the National Defense Authorization Act for Fiscal Year 2020. The F-35 program also has two other cost estimates: the F-35 Joint Program Office's Annual Cost Estimate, and the Joint Service Cost Position. These figures, both released in June 2020, estimate total O&S costs for the program. Both estimates produced total O&S costs and cost elements that were very similar to the CAPE O&S estimate.

projection reflects an increase of more than $150 billion since the program re-baselined in 2012, as depicted in figure 17.

Figure 17: Growth in F-35 Life Cycle Sustainment Cost Estimates



Source: GAO analysis of Department of Defense data. | GAO-21-439

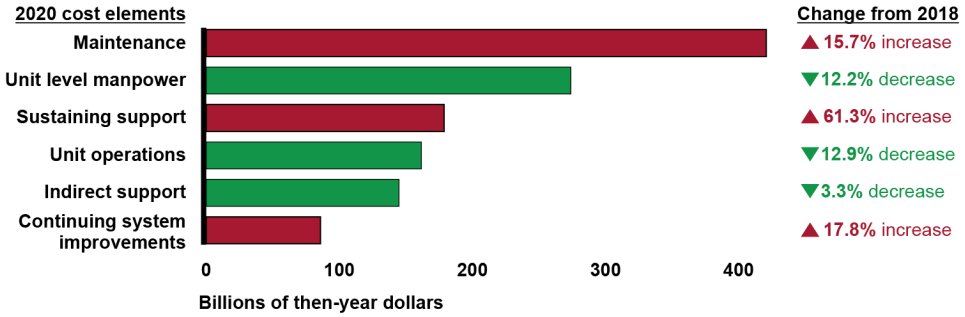
[a]Then-year dollars include the effects of inflation.

Year	Trillions in then-year dollars
2012	1.1133
2015	1.1238
2018	1.1964
2020	1.2656

CAPE's 2020 estimate identified maintenance and unit-level manpower as the top sustainment-related cost elements for the F-35 program, as shown in figure 18.[51] These cost elements make up nearly $695 billion, or 53 percent, of the total sustainment cost estimate. Additionally, sustaining support—an element that captures, among other things, contractor-related support costs to help maintain F-35 operations—experienced the most significant increase, $68 billion, or 61.3 percent, above the last estimate, provided in 2018. This increase, according to CAPE officials, was mainly due to the program's reliance on contractor labor, including ALIS administrators, to help maintain and operate the system.

[51]Unit-Level Manpower includes the costs of all operator, maintenance, and other support manpower at operating units (or at maintenance and support units that are organizationally related and adjacent to the operating units). Maintenance consists of the costs of labor (outside of the scope of unit-level) and materials at all levels of maintenance in support of the primary system.

Figure 18: Secretary of Defense's Cost Assessment and Program Evaluation 2020 F-35 Life Cycle Sustainment Cost Estimate Elements, and Changes between 2018 and 2020 Estimates



Source: GAO analysis of Cost Assessment and Program Evaluation (CAPE) F-35 sustainment data. | GAO-21-439

2020 Cost Elements	Percent Change from 2018
Maintenance	420.7
Unit level manpower	273.9
Sustaining support	178.7
Unit operations	161.6
Indirect support	144.8
Continuing system improvements	85.9

DOD Has Set Affordability Constraints for F-35 Sustainment Costs

According to DOD instruction, acquisition programs establish affordability constraints for sustainment early in the program planning process, prior to Milestone B, which occurred in 2012 for the F-35 program.[52] Affordability constraints are neither cost estimates nor based on the F-35 program's sustainment cost estimates. Instead, they are constraints developed by the services based on assumptions about the total funding available to

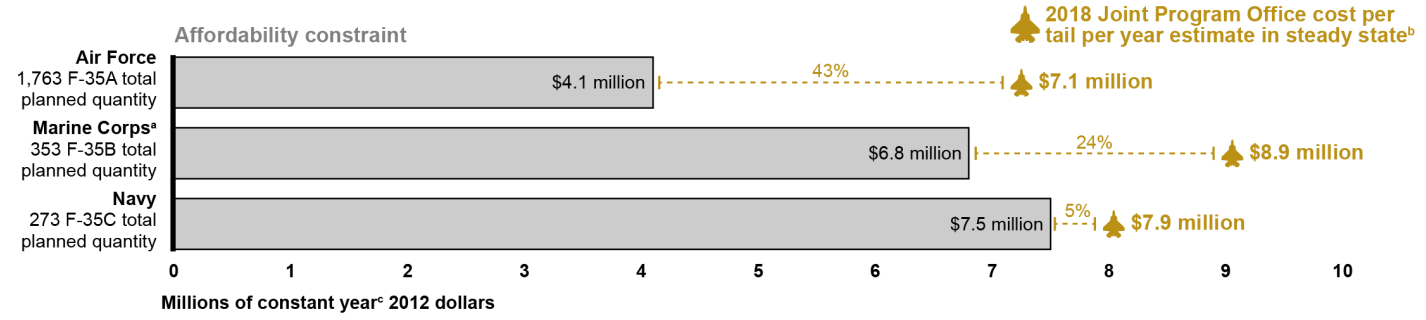
[52]DOD Instruction 5000.85, *Major Capability Acquisition* (Aug. 6, 2020). This instruction requires that "compliance with affordability and program goals" be demonstrated through technical assessments and independent cost estimates for major defense acquisition programs, such as the F-35 Program. The F-35 program refers to affordability goals as "affordability constraints" per submissions to Congress. See Office of the Secretary of Defense, *Report to Congress on F-35 Joint Strike Fighter Sustainment Affordability and Transparency* (December 2018).

them over the life cycle of the given program and projected costs to operate and support other systems in their respective portfolios.

However, we reported in September 2014 that the F-35 Joint Program Office was relying on arbitrary affordability constraints that were not informed by the services or their respective budgets.[53] We recommended that the program issue affordability constraints for sustainment of the program based on the services' respective budgets to guide future sustainment decisions. DOD concurred with the recommendation.

In October 2018 DOD implemented our recommendation when the Undersecretary of Defense for Acquisition and Sustainment issued affordability constraints for each of the services. DOD subsequently submitted to Congress in December 2018 the affordability constraints.[54] The constraints were established in a cost per tail per year metric, as shown in figure 19.[55] The services' goal is to achieve these constraints by the time the F-35 variants reach a steady state in the late 2030s: the F-35A in 2036-2041, F-35B in 2033-2037, and F-35C in 2036-2043.[56]

Figure 19: Differences between Service F-35 Affordability Constraints and 2018 Cost Estimates for Annual Sustainment Costs, per Aircraft, at Program Steady State



Source: GAO analysis of Joint Program Office data. | GAO-21-439

[53]GAO-14-778.

[54]Office of the Secretary of Defense, *Report to Congress on F-35 Joint Strike Fighter Sustainment Affordability and Transparency* (December 2018).

[55]Cost per tail per year is defined as the average annual operating and support cost per aircraft (tail) in a given fleet. It is generally estimated by dividing total operating and support costs of an aircraft fleet by the total number of aircraft.

[56]According to program officials, the steady state period for each service is the period in which it intends to be operating the F-35 at its maximum capabilities.

Branch	Affordability Constraint in Millions
Air Force	4.1
Marine Corps	6.8
Navy	7.5

[a]The Marine Corps plans to procure 67 F-35C aircraft in addition to the 353 F-35B aircraft. These 67 F-35C aircraft have the same $6.8 million affordability constraint associated with them; however, since these aircraft were not specifically referenced in the October 2018 F-35 Lightning II Joint Strike Fighter Acquisition Decision Memorandum, we did not include them in the graphic.

[b]Steady state years for the F-35 program are defined in each respective service's affordability analysis as follows: U.S. Air Force/F-35A – 2036-2041; U.S. Marine Corps/F-35B – 2033-2037; U.S. Navy/F-35C – 2036-2043.

[c]Constant year dollars are expressed as the value of a specific year and do not include escalation or inflation.

To achieve the constraints as shown in figure 19, the Air Force, Marine Corps, and Navy determined that they would need to reduce projected F-35 sustainment costs by 43 percent (or $3.0 million per tail per year), 24 percent (or $2.1 million per tail per year), and 5 percent (or $0.4 million per tail per year), respectively, by the steady state time frame for each variant. These cost reductions are based on the 2018 F-35 Joint Program Office's projected cost per tail per year—$7.1 million for the F-35A, $8.9 million for the F-35B, and $7.9 million for the F-35C—in the respective steady state years.

In 2020 the F-35 Joint Program Office updated its estimated sustainment costs per tail per year. The estimated annual costs for all three F-35 variants increased, thereby furthering the gap between the affordability constraints established in 2018 and the projected sustainment costs at steady state, as shown in figure 20. Based on these estimates, the Air Force, Marine Corps, and Navy collectively face annual multi-billion dollar gaps between the projected costs to sustain their respective F-35 fleets at steady state and their stated affordability goals.[57] Specifically:

- The F-35 Joint Program Office's estimated cost per tail per year for the Air Force increased by $0.7 million above the 2018 estimate—that is, $3.7 million per tail per year higher than its affordability constraint. As the program's largest customer, with a planned procurement of nearly 1,800 F-35A aircraft, the Air Force will need to reduce its annual sustainment costs per aircraft by 47 percent to meet its affordability goals. If not, the Air Force will face a growing, annual gap between actual sustainment costs and its affordability constraint, according to current cost projections. For example, our analysis

[57]We used Total Aircraft Inventory, which does not account for aircraft attrition, to calculate the planned aircraft totals in steady state year 2036.

shows that based on the 2020 cost estimates it will cost the Air Force about $4.4 billion more than it projects it can afford to sustain its planned 1,192 F-35s in 2036.

- The F-35 Joint Program Office's estimated cost per tail per year for the Marine Corps' F-35B aircraft increased by $0.2 million above the 2018 estimate—that is, $2.3 million per tail per year higher than its affordability constraint. The Marine Corps, which plans to procure 353 F-35Bs, will need to reduce its annual sustainment costs per F-35B aircraft by 26 percent to meet its affordability constraint. Further, based on updated 2020 cost per tail per year estimates, the Marine Corps will also need to reduce its annual sustainment costs by 14 percent to meet its affordability constraint for its F-35C aircraft in 2036. If unable to achieve its constraints for the F-35B and F-35C, the Marine Corps will face a growing, annual gap between actual sustainment costs and its affordability constraint, according to current cost projections. For example, our analysis shows that it will cost the Marine Corps about $900 million more than it projects it can afford to sustain its 420 F-35s in 2036.
- The F-35 Joint Program Office's estimated cost per tail per year for the Navy increased by $2.0 million above the 2018 estimate—that is, $2.4 million per tail per year higher than its affordability constraint. The Navy, which plans to procure 273 F-35Cs, will need to reduce its annual sustainment costs per aircraft by 24 percent to meet its affordability constraint. If not, the Navy will face a growing, annual gap between actual sustainment costs and its affordability constraint, according to current cost projections. For example, our analysis shows that based on the 2020 cost estimates it will cost the Navy about $655 million more than it projects it can afford to sustain its 273 F-35s in 2036.

Figure 20: Differences between Service F-35 Affordability Constraints and 2020 Cost Estimates for Annual Sustainment Costs, per Aircraft, at Program Steady State

Service and aircraft	2020 JPO cost per tail per year estimate in steady state[a] (in millions)		Affordability constraint (in millions)		Gap between projected cost and affordability constraint (in millions)		Planned aircraft total in steady state[a] year 2036		Total cost overrun in steady state[a] year 2036
Air Force F-35A	($7.8	-	$4.1)	=	$3.7	x	1,192	=	$4.4 billion
Marine Corps F-35B	($9.1	-	$6.8)	=	$2.3	x	353	=	$812 million
Marine Corps F-35C	($7.9	-	$6.8)	=	$1.1	x	67	=	$74 million
Navy F-35C	($9.9	-	$7.5)	=	$2.4	x	273	=	$655 million
									Almost $6 billion

Source: GAO analysis of Joint Program Office (JPO) data. | GAO-21-439

Note: Costs are in constant year 2012 dollars as that was the year when the F-35 program was most recently re-baselined. “Constant year” dollars are expressed as the value of a specific year and do not include escalation or inflation. We used Total Aircraft Inventory, which does not account for aircraft attrition, to calculate the planned aircraft total in steady state year 2036.

[a]Steady state years for the F-35 program are defined in each respective service’s affordability analysis as follows: U.S. Air Force/F-35A – 2036-2041; U.S. Marine Corps/F-35B – 2033-2037; U.S Navy/F-35C – 2036-2043. We used 2036 for our calculations, as that year fell in each service’s steady state time frame.

The F-35 program has an additional sustainment-related affordability goal called “25 by 25” that seeks to achieve a $25,000 cost per flight hour for all F-35 aircraft by 2025.[58] According to F-35 Joint Program Office estimates, the actual cost per flight hour for all F-35 aircraft in the U.S. fleet in fiscal year 2019 was more than $38,000.[59] DOD officials stated that “25 by 25” is a “stretch goal” based on the current cost per flight hour of the Air Force’s F-16/D aircraft. This stretch goal, according to program officials, is intended to help supplement the program’s established affordability constraints. Stretch goals, or “should-costs,” according to DOD guidance, are a management tool designed to proactively target cost reduction and drive productivity improvement into programs. Should-cost management challenges managers to identify and achieve savings targets below budgeted most-likely costs.[60] These targets are based on

[58]The $25,000 cost per flight hour by 2025 reflects constant year 2012 dollars. Cost per flight hour is calculated by dividing the total annual O&S cost of an aircraft program by the total number of flight hours flown within the same year.

[59]The $38,000 reflects constant year 2012 dollars.

[60]DOD Instruction 5000.85.

real opportunities but are inherently difficult to achieve and may not prove fruitful in achieving cost savings or cost avoidance. Unlike affordability constraints, stretch goals are not always expected to be achieved. In January 2021 program officials reported to congressional committees that the 25 by 25 stretch goal remained a focus for the program.

Officials from OUSD (A&S), CAPE, the F-35 Joint Program Office, and the services do not consider the program's 25 by 25 stretch goal to be feasible. DOD has hired a private consulting firm to help identify opportunities and secure a pathway to achieving the goal, but none of the DOD officials we interviewed said that they believed the goal to be actually achievable. For example, some officials stated that it is impossible for a fifth generation aircraft with low observable—i.e., stealth—technology to cost the same to fly as a fourth generation aircraft that does not possess this technology. Other officials stated that the sustainment-related cost reductions necessary to achieve the 25 by 25 goal are too significant at this stage of the program. CAPE officials documented that the goal is not being based on DOD's cost estimates and is likely unachievable, and stated that it should not be used for programming or budgeting.

DOD Has Pursued Sustainment Cost Reduction Efforts with Limited Results

DOD recognizes the critical need to reduce sustainment costs for the F-35 program, and it has undertaken efforts to do so. However, these efforts have produced limited results. In September 2014 we reported that in 2013 DOD had established a Cost War Room—a collaborative group comprising the services, the F-35 Joint Program Office, and contractor personnel—for the purpose of reducing program sustainment costs. Recently renamed the Affordability War Room, officials from the group told us that their mission is to help set affordability direction and reduce costs in a timely manner through various affordability initiatives. The group helps assess and manage cost reduction initiatives from across the F-35 program, including government and industry. The Affordability War Room has reported identifying $68 billion in life cycle cost avoidance

through varying initiatives since 2013.[61] For example, the F-35 program reported avoiding:

- $568 million in increased costs to the program by contracting a second, more affordable source for a specific countermeasure-related part in 2018;[62]
- $182 million in increased costs to the Air Force by redesigning the F-35A's Ground Data Security Receptacle in 2019;[63] and
- $1.73 billion in increased costs to the program by reducing the hours required for ground maintenance, repair, overhaul, and upgrade scuff and refresh.

Additionally, the F-35 Joint Program Office restructured and created a Directorate of Affordability, which includes the Affordability War Room, to increase attention on reducing total ownership costs of the F-35 and, according to program officials, help achieve the services' respective affordability constraints. According to officials, the Joint Program Office's respective Program Management Offices work in concert with the aforementioned Affordability War Room to help achieve sustainment-related cost savings through various initiatives and contract negotiations.[64]

According to DOD officials, the F-35 Joint Program Office's $68 billion in cost avoidance and renewed focus toward affordability is a positive step. However, CAPE officials stated that their current sustainment estimate does not include all of the $68 billion in reported cost avoidance, in that any cost avoidance based on projected cost initiatives—rather than actual program cost and sustainment data—is not incorporated into their estimate. Furthermore, CAPE officials said they have not independently

[61]Cost avoidance does not result in a tangible benefit that lowers current spending, investment, or debt levels; rather, it is an action that avoids incurring costs in the future.

[62]A countermeasure is a device or technique that has the objective of impairment of the operational effectiveness of enemy activity.

[63]The F-35A's Ground Data Security Receptacle downloads mission data from aircraft after the completion of a mission.

[64]There are five Program Management Offices in the F-35 Joint Program Office. These offices oversee the air vehicle, propulsion systems, combat data systems, training systems and simulation, and maintenance systems. Program Management Offices are responsible for the cost, schedule, and performance of their products to meet the strategic objectives of Capability, Affordability, Availability, Agility, and Deployability, which they manage through their Performance to Plan.

verified the Joint Program Office's $68 billion cost avoidance calculation. According to several DOD officials, even if all of the $68 billion in cost avoidance were achieved, that would represent only a fraction of the cost reductions needed to reduce the program's sustainment costs (and achieve the services' affordability constraints).

F-35 Stakeholders Hold Differing Perspectives, and DOD Lacks a Strategic Approach to Achieving Its Affordability Constraints

According to DOD officials, all stakeholders—the services, the F-35 Joint Program Office, and the contractors—share responsibility for achieving the services' sustainment affordability constraints. OUSD (A&S), which serves as the F-35 program's oversight authority, is also responsible for ensuring that the overall program is affordable from both a production and a sustainment perspective.[65] According to program officials, although the services receive appropriations from Congress to fund the F-35 program and ultimately set the requirements that drive sustainment-related costs for their respective variants, it is imperative for all stakeholders to work together to achieve affordability for the program. However, we found that the stakeholders shared unique and differing perspectives on affordability, as described below.

Air Force: According to Air Force officials, the F-35 program's sustainment costs are already preventing the services from reaching their respective readiness objectives. Specifically, Air Force officials told us that they and the other services are already making difficult choices due to the costs associated with achieving the requirements the F-35 program was supposed to deliver. For example, program objectives for mission capable rates and full mission capable rates are already constrained due to the costs associated with improving the availability of spare parts, according to officials.

Looking to the future, Air Force officials told us that the Air Force will not be able to afford the cost of sustaining the 1,763 aircraft it plans to purchase without making dramatic cuts to sustainment costs of the F-35A. These officials stressed that there is no single solution to address the sheer magnitude of the Air Force's affordability challenge. For

[65]Oversight is a review activity conducted by the Office of the Secretary of Defense, among others, to determine current status, ascertain whether the law or other intentions of Congress are being followed, or serve as a basis for possible future legislation.

example, they stated that even if spare parts for the F-35 came at no cost for the remainder of the program's life cycle, the F-35A's sustainment costs would then be reduced by only 33 percent. This hypothetical situation would still leave the service searching for an additional 14 percent in cost reductions to achieve its affordability constraint. Further, Air Force officials told us that sustainment costs and readiness are inherently linked; therefore, if sustainment costs continue to increase beyond what the Air Force can afford, F-35A readiness rates will be negatively impacted.

According to Air Force officials, the steps taken by the Affordability War Room are prudent, but the results have not been sufficient to significantly improve the affordability of the program. Air Force officials said that since the aircraft has already passed Milestone B, there is little room left for the program to make significant sustainment-related cost reductions; the program has already made definitive design decisions and established a maintenance strategy. In March 2021, Brigadier General David Abba, director of the Air Force's F-35 Integration Office, stated, "The biggest cost challenge that we face in the airplane [F-35] is the life cycle sustainment cost of the jet. We have to find a way to make the aircraft more affordable."

Air Force officials also told us that the service's only available remaining options to meet the affordability constraints are to reduce the total number of F-35A aircraft they plan to purchase, or to reduce the aircraft's planned flying hours. Either of these options, according to the officials, could substantially reduce sustainment costs; however, either option would also require a change to the way in which the aircraft was originally intended to be used by the Air Force. Exercising these options would have implications on the force structure and capabilities of the Air Force.

Marine Corps: Marine Corps officials stated that while they do not currently face affordability challenges, they anticipate that affordability will negatively affect F-35B sustainment in the future. According to these officials, they will likely need to re-examine the service-related requirements for the aircraft going forward but are not focused on doing so now. The officials said that they understand the concerns behind affordability and are aware of the F-35 Joint Program Office's 2020 $9.1 million cost per tail per year estimate for steady state of the F-35B. However, they stated that until the F-35B's cost per tail per year becomes an immediate issue, the Marine Corps will continue to fund reliability and maintainability projects and work with the F-35 Joint Program Office's

Affordability War Room to focus on reducing F-35B-related sustainment costs.

Navy: Navy officials stated that while they are aware of the affordability challenges faced by the overall program, they believe that the F-35 Joint Program Office's current efforts on reducing program sustainment costs should be sufficient to meet the Navy's affordability goal of $7.5 million cost per tail per year. Navy officials added that although program affordability and related cost savings initiatives are important, the service has had to focus its primary attention on the declaration of the F-35C's Initial Operational Capability in February 2019 and preparations for the service's future first operational deployment of F-35Cs onboard an aircraft carrier.[66] Navy officials stated that future cost per tail per year overrun should be resolved through various cost savings initiatives being explored and implemented by the F-35 Joint Program Office's Affordability War Room.

F-35 Joint Program Office: Program office officials told us that for the services to achieve their respective affordability constraints, the F-35 program needs to significantly reduce overall F-35 costs. According to F-35 Joint Program Office officials, the F-35 Joint Program Office holds some responsibility for helping the services achieve their respective affordability goals, and it is doing so by means of a continued pursuit of cost efficiencies through cost savings initiatives and sustainment contract negotiations. However, the program office's ability to achieve cost savings is constrained by its obligation to fulfill the services' program requirements. For example, overall requirements for the program, such as number of aircraft, flight hours per year, and mission capable rate requirements, are set by the services, and the program office must find the most effective and affordable way to meet these requirements. According to program officials, if current requirements remain the same, it may be difficult to realize the cost reductions needed to achieve the services' affordability constraints in the steady state time frame.

OUSD (A&S): OUSD (A&S) officials told us that they are concerned that the current upward trajectory of F-35-related sustainment costs will make it very difficult to achieve the services' affordability constraints. These officials are confident that further cost reductions can be made via the F-35 Joint Program Office's Affordability War Room and by further

[66]Initial Operational Capability is attained when some units and/or organizations in the force structure scheduled to receive a system have received it and have the ability to employ and maintain it.

engagement with industry officials beyond typical contract negotiations. However, they stated that they do not believe these actions will be sufficient to make the program affordable for the services.

OUSD (A&S) officials stated that transitioning the sustainment of the F-35 from a predominantly contractor-managed framework to one managed and conducted by the government (i.e., organic sustainment) could be a primary method for sufficiently reducing sustainment costs to achieve the services' affordability constraints. The current mix of service and contractor personnel, according to these officials, is too expensive, and the government could reduce sustainment costs by utilizing an organic approach to F-35 sustainment. OUSD (A&S) officials stated that the program has not formally assessed or determined whether a transition to organic sustainment—either for the entirety of F-35 sustainment or for portions of F-35 sustainment, such as supply chain management or depot maintenance—would significantly reduce sustainment costs. However, DOD is conducting an ongoing Business Case Analysis examining, among other things, organic versus contractor maintenance and sustainment affordability. This Business Case Analysis is planned to be completed by summer of 2021.

While F-35 program stakeholders agree that sustainment costs are of concern, there is no clear consensus on what should be done to address those concerns. According to some F-35 program stakeholders, the program's ability to meet affordability constraints through ongoing cost reduction efforts is questionable, due to the maturity of the program. Furthermore, according to stakeholders, the affordability constraints are likely to be achieved only by changes to the services' program requirements—i.e., a reduction in the number of aircraft procured and/or the aircraft's planned flying hours.

This situation—projected growth in annual sustainment costs that outpaces the ability of DOD and the services to afford them—has developed over several years. This cost growth has occurred despite warnings that the F-35 program faced a considerable and growing affordability problem, a concern shared by many F-35 stakeholders. Specifically,

- **2014:** We reported that the current sustainment strategy that DOD was developing might not be affordable, and that the assumptions informing cost estimates could be improved. We also noted that the F-35 Program Executive Officer continued to express concerns over the affordability of the program's sustainment approach, stating that "F-35

sustainment costs remain a concern" and that affordability continued to be a top priority for the program.[67]

- **2017:** We reported that the affordability challenges of the current F-35 program had worsened.[68] Specifically, DOD's projected costs to sustain the F-35 fleet over its life cycle had risen since 2012, despite the department's concerted efforts to reduce costs.
- **2018:** DOD established affordability constraints informed by service budget projections and other priorities in late 2018, highlighting the magnitude of the needed cost reductions.[69] As a result, DOD was delayed in bringing a focus on the growing sustainment cost estimates for the F-35 through establishing an objective—the affordability constraints—with which to measure progress and drive decisions.
- **2020:** Projected sustainment costs continued to rise as documented in the 2020 CAPE estimate, despite the F-35 Joint Program Office's efforts to introduce cost-avoidances into the future of the program.

DOD's inability to arrest the increases in F-35 sustainment costs and make progress towards the services' established affordability constraints is due in part to the department's not having a clear, strategic approach across the F-35 program. Specifically, DOD has not:

- assessed its ability to achieve the program's affordability constraints through ongoing cost reduction efforts or any new efforts that might be undertaken (such as assessing options regarding organically sustaining the F-35 or particular aspects of the program);
- assessed the impact of potential changes to the services' F-35 performance requirements (such as any reductions in the number of aircraft purchases or the aircraft's planned flying hours) to achieve affordability;
- made decisions on a realistic approach to achieving its affordability constraints and developed a corresponding program-wide plan—with detailed actions, milestones, and required resources—that coordinates all F-35 stakeholders in achieving reductions in projected sustainment costs; or

[67]GAO-14-778.

[68]GAO-18-75.

[69]Undersecretary of Defense for Acquisition & Sustainment Memorandum, *F-35 Lightning II Joint Strike Fighter Acquisition Decision Memorandum* (Oct. 16, 2018).

- documented a program-encompassing risk-management approach to address challenges that would prevent achievement of affordability objectives or make adjustments based on changes in risk.

DOD Instruction 5000.85, *Major Capability Acquisition*, states that the purpose of key milestone decisions—such as Milestone C—is to carefully assess a program's readiness to proceed to the next phase of the acquisition process and make a sound investment decision committing the department's financial resources. The instruction also states that acquisition, requirements, and budgeting are closely related and must operate simultaneously in close coordination. Furthermore, adjustments may have to be made during a program's life cycle to keep the three processes aligned, to ensure that programs are executable, and to adapt to evolving circumstances. Lastly, the instruction states that sustainment planning and affordability are an integral element of the capability requirements and acquisition process from program inception.

A DOD instruction requires that DOD acquisition programs incorporate strategy in addressing affordability.[70] *A Guide for DOD Program Managers* states that a sound strategy is important for managing weapon system programs, and that a sound strategy requires ends (or goals) with clear articulation of the desired outcome of the strategy; means to achieve the strategy using available resources; identification of targets even with limited knowledge of the program's current state and constraints on the program's future outcome; a plan with a list of steps with milestones and resources used to achieve an objective; and context of any unique elements associated with the program.[71]

Taking program-wide strategic actions to achieve the services' affordability constraints prior to Milestone C declaration would better position DOD and the services to take the necessary steps to arrest the increasing sustainment costs of the F-35 and plot an affordable direction for sustaining the F-35 program. Such an approach would entail assessing cost-savings initiatives, assessing the impact of potential changes in program requirements, developing and documenting a program-wide plan for achieving affordability constraints with detailed actions tied to milestones and resources, and developing and documenting a risk-management approach for addressing potential challenges or making adjustments to achieving affordability objectives. If

[70]DODI 5000.85.

[71]Defense Acquisition University, *A Guide for DOD Program Managers* (December 2014).

the services are unable to reduce the projected sustainment costs and achieve their affordability constraints, DOD and the services will be confronted with tens of billions of dollars in annual F-35 sustainment cost overruns that are currently projected as unaffordable.

Congress directed in the National Defense Authorization Act for Fiscal Year 2020 the Under Secretary of Defense for Acquisition and Sustainment develop and implement a Cost Reduction Plan for achieving significant reductions in the costs to operate, maintain, and sustain the F-35 system.[72] Congress directed that the plan include specific changes in the management and execution of sustainment costs, specific actions that the department should take to reduce costs, and firm, achievable timelines for implementing these actions. While the report was due for issuance in summer 2020, DOD did not submit a full plan to Congress as required. According to DOD officials, DOD was deferring issuance of the plan to a time frame that would be closer to the program's Milestone C decision, which typically reviews the program's full funding.[73] Since Milestone C has been delayed and is not expected until sometime in the 2021-2023 time frame, however, officials stated that they plan to submit the report by May 2021.[74]

DOD is not required to report periodically to Congress on the progress the department has made in implementing any plans to reduce the F-35's sustainment costs and close the gap between these costs and the services' affordability constraints. As previously discussed, the F-35 program's estimated sustainment costs continue to increase, and DOD does not have a strategic approach for reducing these costs and achieving the affordability constraints. Furthermore, as the program grows and matures, sustainment cost reductions become more difficult. Having comprehensive annual reports provided by DOD to Congress on the F-35 program's plans, actions, and progress in achieving the affordability constraints could enhance the accountability of DOD, the services, and the F-35 program in making fiscally responsible decisions over the program's life cycle.

Additionally, such annual reporting could benefit Congress as it makes annual decisions on the number of F-35 aircraft it authorizes DOD to

[72]See Pub. L. No. 116-92, § 165 (2019).

[73]DODI 5000.85.

[74]Milestone C declares that the program has passed specific criteria, including testing and a review of the program's funding, in order to move forward into full-rate production.

procure, as well as on the overall size of the F-35 fleet. Given that $1.3 trillion of the $1.7 trillion life cycle costs for the F-35 are associated with sustainment, and that those sustainment costs are not affordable based on DOD's and the services' own 2020 projections, Congress would benefit from making F-35 procurement decisions contingent on DOD's demonstrating progress in making F-35 sustainment affordable.

If the projected annual sustainment cost overruns—conservatively estimated at tens of billions of dollars when aggregated—are not reversed and brought into alignment with the affordability constraints, over time there will be increasing and significant pressure on DOD's annual budget as the number of the aircraft in the F-35 fleet increases. Decisions made and actions taken in the coming few years could have a significant effect on the affordability and effectiveness of the F-35 program in the long-term. Having DOD report on its progress—including actions taken and planned—to achieve its affordability constraints, as well as having future F-35 procurement decisions be contingent on DOD's progress, would position Congress to ensure that DOD is able to afford sustaining the F-35 aircraft fleet.

Conclusions

The F-35 aircraft, with its advanced warfighting capabilities, provides critical tactical aviation for DOD. As of March 2021, with more than 400 aircraft in the U.S. fleet and all three services flying operational missions, DOD finds itself preparing to declare Milestone C and enter into full-rate production of the F-35. While the F-35's mission capable and full mission capable rates have improved over the past 2 years, these rates remain well below the program's objectives due to several significant and ongoing sustainment challenges.

Since 2012 the program's sustainment cost estimates have increased by more than $150 billion, and they are already preventing the services from reaching their respective readiness objectives. Looking ahead, the gap between projected sustainment costs and what the services say they can afford is on track to widen substantially. As of March 2021, the Air Force, Marine Corps, and Navy would need to cut annual sustainment costs by 47 percent, 24 percent, and 24 percent, respectively, by the mid-2030s to be able to afford to fly and maintain the aircraft they have and plan to continue procuring. Achieving cost reductions of this magnitude—billions of dollars a year, every year—presents a formidable challenge for the program.

Without a cohesive, strategic approach that brings all F-35 stakeholders together to assess the impact of cost-savings initiatives and potential changes in program requirements, and to develop a program-wide plan for achieving affordability constraints, along with a risk-management approach to address potential challenges, DOD may continue to invest resources in a program that the department and the services ultimately cannot afford to sustain. Taking these actions prior to the F-35 program's Milestone C decision—when weapon system programs are supposed to weigh, among other factors, the program's sustainment planning and affordability—will be imperative for DOD and the services in order to ensure that the department can afford its planned F-35 program.

Additionally, Congress's requiring DOD to report on its progress, including actions taken and planned, to achieve its affordability constraints, as well as making F-35 procurements in the future contingent on DOD's progress, would serve to enhance the department's accountability in taking the necessary and appropriate actions to improve the affordability of the F-35 program. Furthermore, such actions would position Congress with the necessary information to make well-informed decisions on the future of the F-35 program in the coming years.

Matters for Congressional Consideration

We are making the following two matters for congressional consideration:

Congress should consider requiring the Under Secretary of Defense for Acquisition and Sustainment, in consultation with the services and the F-35 Joint Program Office, to report annually on progress in achieving the services' affordability constraints, including the actions taken and planned to reduce sustainment costs. (Matter for Consideration 1)

Congress should consider making future F-35 aircraft procurement decisions contingent on DOD's progress in achieving F-35 sustainment affordability constraints. (Matter for Consideration 2)

Recommendations for Executive Action

We are making the following four recommendations to DOD:

The Secretary of Defense should ensure that, prior to the Milestone C decision, the Under Secretary of Defense for Acquisition and

Sustainment, in consultation with the services and the F-35 Joint Program Office, assess and document DOD's ability to meet the services' affordability constraints with existing or planned cost-reduction efforts. (Recommendation 1)

The Secretary of Defense should ensure that, prior to the Milestone C decision, the Under Secretary of Defense for Acquisition and Sustainment, in consultation with the services and the F-35 Joint Program Office, assess and document changes in service-related program requirements (e.g., the number of aircraft purchases and flying hours) to achieve cost-reductions. (Recommendation 2)

The Secretary of Defense should ensure that, prior to the Milestone C decision, the Under Secretary of Defense for Acquisition and Sustainment, in consultation with the services and the F-35 Joint Program Office, develop and document a program-wide plan for achieving affordability constraints with detailed actions tied to milestones and resources. (Recommendation 3)

The Secretary of Defense should ensure that, prior to the Milestone C decision, the Under Secretary of Defense for Acquisition and Sustainment, in consultation with the services and the F-35 Joint Program Office, develop and document a risk-management approach for addressing potential challenges or making adjustments in order to achieve affordability objectives. (Recommendation 4)

Agency Comments and Our Evaluation

We provided a draft of this report to DOD for review and comments. In its written comments, reproduced in appendix II, DOD partially concurred with the four recommendations.

DOD agreed with the substance of each recommendation and identified actions it is currently taking or planning to take to address them. However, for each of the recommendations, DOD stated that it was uncertain whether it could take actions to address it prior to a Milestone C decision for the program, as we recommended. DOD stated that it would not be able to determine this until the department identified a new date for declaring Milestone C. However, the department stated that it would work to meet the intent of all four recommendations.

We are encouraged that DOD agrees with the importance of addressing all of our recommendations and that, in some cases, it has already begun to take actions to do so. However, we still maintain that DOD should address these recommendations before a Milestone C decision. We recognize that the department has not identified a date for a Milestone C decision, the next significant decision point for the F-35 program. However, as we previously discussed in the report, DOD acquisition policy states that prior to declaring Milestone C the program is to weigh, among other factors, the program's sustainment planning and affordability in order to make a sound investment decision committing the department's financial resources.

Given the magnitude of the gap between projected sustainment costs and the services' affordability constraints—billions of dollars a year, every year—we believe that the department, the services, and the F-35 Joint Program Office should not delay critical decisions necessary for ensuring the affordability of the program. Implementing our recommendations before declaring Milestone C and moving into full-rate production will help ensure that DOD can afford to sustain the F-35 program.

DOD also provided technical comments, which we have incorporated as appropriate.

We are sending copies of this report to the appropriate congressional committees; the Secretary of Defense; the Acting Under Secretary of Defense for Acquisition and Sustainment; the F-35 Program Executive Officer; the Acting Secretaries of the Air Force and Navy; and the Commandant of the Marine Corps. In addition, the report is available at no charge on the GAO website at http://www.gao.gov.

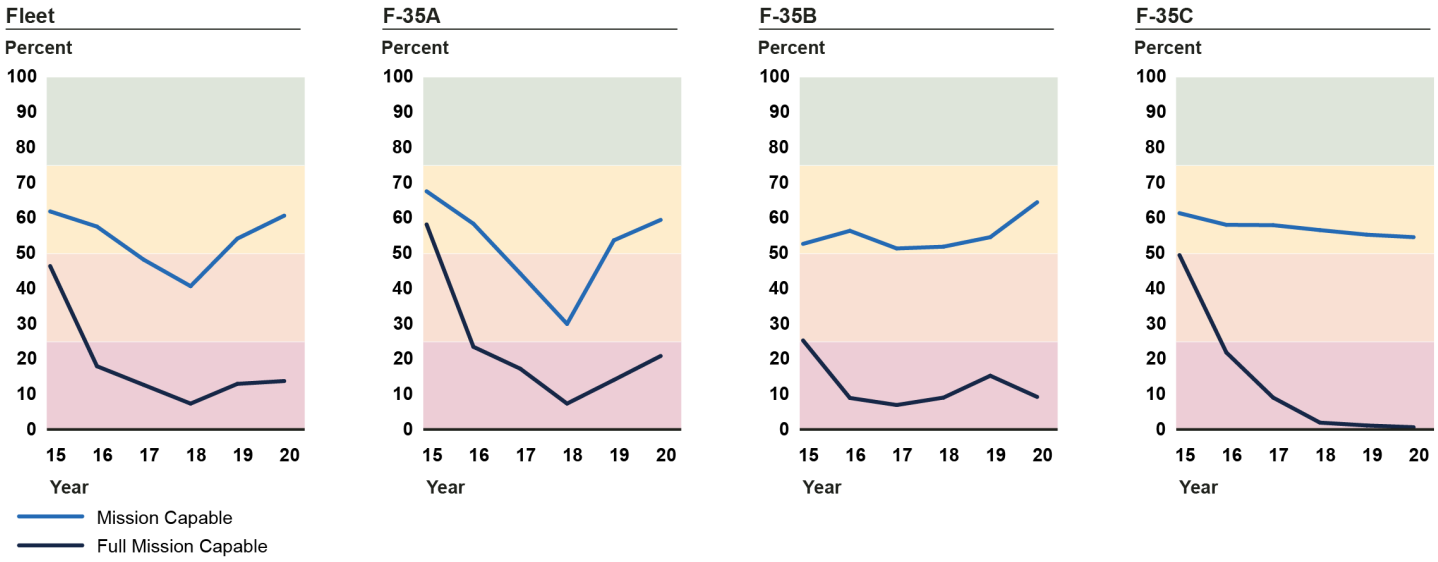
If you or your staff have any questions about this report, please contact me at (202) 512-9627 or maurerd@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. Staff members making key contributions to this report are listed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

Diana Maurer
Director, Defense Capabilities and Management

Appendix I: U.S. F-35 Fleet Mission Capable Rates

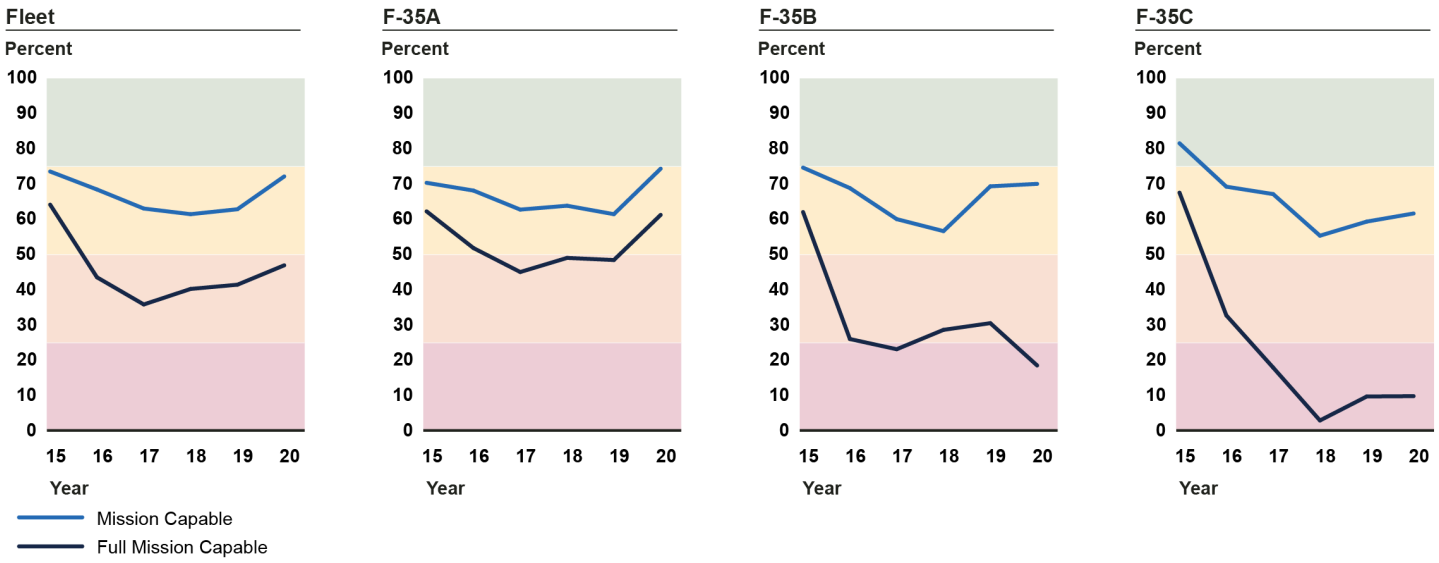
The mission capable rate—the percentage of time during which the aircraft can fly and perform at least one of its tasked missions; and full mission capable rate—the percentage of time during which the aircraft can perform all of its tasked missions are key measures of the health and readiness of a military aircraft fleet. Below we present these rates broken out in several ways, including when the aircraft was built (figures 21 and 22); whether the aircraft is being used for training and testing (figure 23) or operationally (figure 24); and what type of aircraft variant is being flown (figure 25).

Figure 21: F-35 Aircraft Built between 2007 and 2011, Fiscal Years 2015-2020



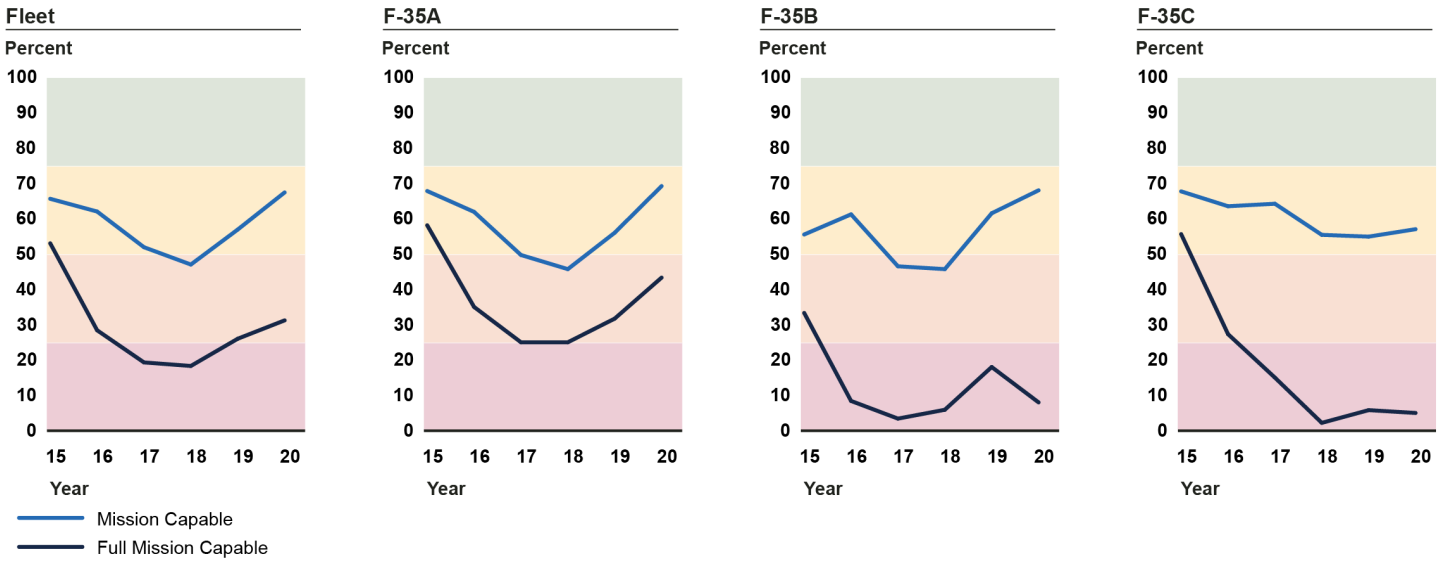
Source: GAO analysis of Lockheed Martin data. | GAO-21-439

Figure 22: F-35 Aircraft Built between 2012 and the Present, Fiscal Years 2015-2020



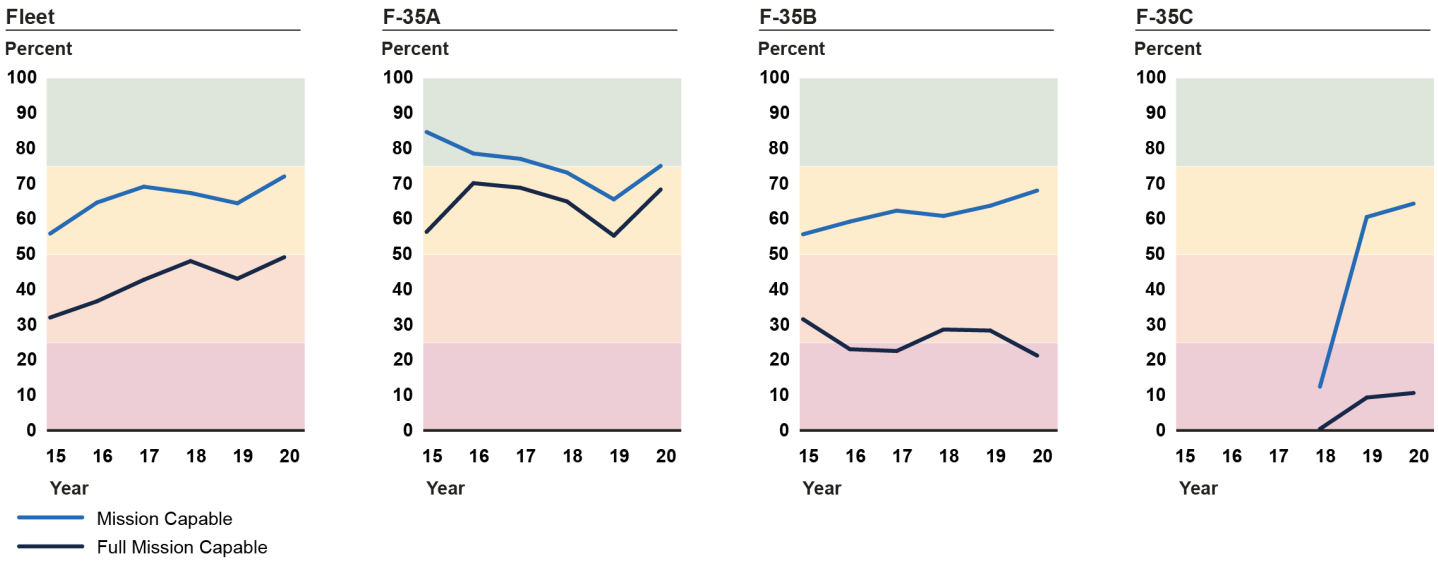
Source: GAO analysis of Lockheed Martin data. | GAO-21-439

Figure 23: F-35 Training and Testing Aircraft, Fiscal Years 2015-2020



Source: GAO analysis of Lockheed Martin data. | GAO-21-439

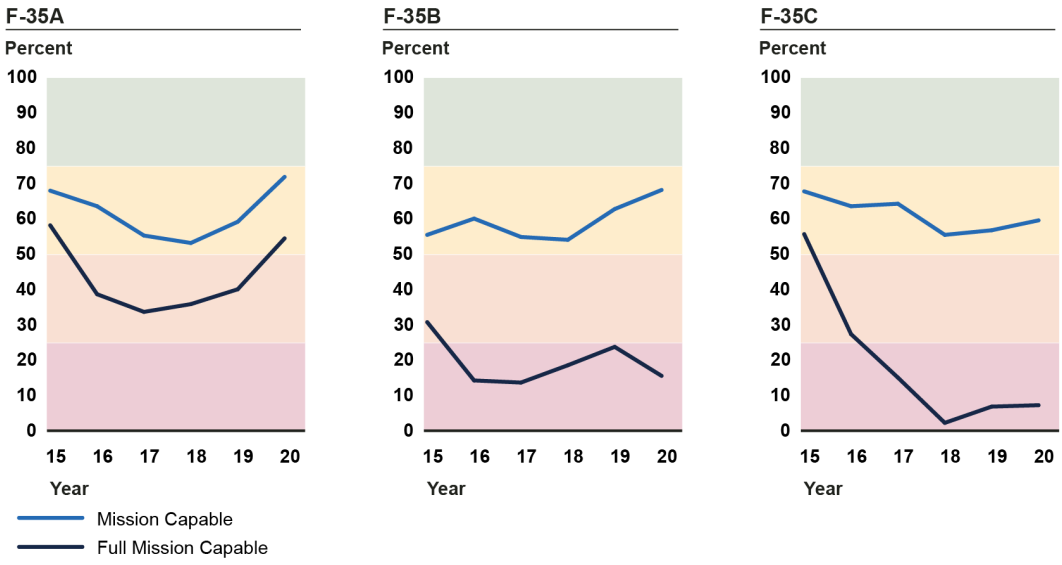
Figure 24: F-35 Operational Aircraft, Fiscal Years 2015-2020



Source: GAO analysis of Lockheed Martin data. | GAO-21-439

Note: Operational aircraft includes those in operational squadrons that are not deployed and those that are deployed outside of the continental United States.

Figure 25: F-35 Aircraft Performance by Variant, Fiscal Years 2015-2020



Source: GAO analysis of Lockheed Martin data. | GAO-21-439

Appendix II: Comments from the Department of Defense

OFFICE OF THE UNDER SECRETARY OF DEFENSE
3000 DEFENSE PENTAGON
WASHINGTON, DC 20301-3000

ACQUISITION AND SUSTAINMENT

June 14, 2021

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

Dear Ms. Maurer:

The Department of Defense (DoD) completed a review of the Government Accountability Office (GAO) Draft Report, GAO-21-439, "F-35 SUSTAINMENT: DoD Needs to Cut Billions in Estimated Costs to Achieve Affordability," (GAO Code 104168), and partially concurs with all four GAO recommendations. We have enclosed our responses (Enclosure 1).

The Department has also completed a security and accuracy review of the Draft Report, and found no "Controlled Unclassified Information" contained therein.

The Department finds that the DRAFT report is UNCLASSIFIED and cleared for open publication, pending the GAO addressing the security and sensitivity concerns provided during the review conducted by the Department's F-35 stakeholders in the final report. Enclosed is a copy of the Department's official security review (Enclosure 2).

Sincerely,

Digitally signed by CUMMINGS.STACY.A.1040597S7
Date: 2021.06.14 17:57:02 -04'00'

Stacy A. Cummings
Principal Deputy Assistant Secretary of Defense (Acquisition)
Performing the Duties of Under Secretary of Defense for Acquisition and Sustainment

Enclosures:
As stated

GAO-21-439

"F-35 SUSTAINMENT: DOD Needs to Cut Billions in Estimated Costs to Achieve Affordability"

Departmental Comments to the GAO Recommendations

RECOMMENDATION 1: The Secretary of Defense should ensure that, prior to the Milestone C decision, the Underecretary of Defense for Acquisition and Sustainment, in conjunction with the services and the F-35 Joint Program Office, assess and document DOD's ability to meet the service's affordability constraints with existing or planned cost-reduction efforts.

DoD RESPONSE: Partially Concur. The Department will leverage the Product Support Business Case Analysis (scheduled for summer 2021 completion) to drive sustainability decision-making through the JSF Executive Steering Board.

The F-35 JPO is currently updating the F-35 Enterprise Affordability Strategy document. The updated strategy spans the entire life cycle and maps each of the five Program Management Office's cost reduction initiatives, timelines, resource requirements, assumptions, and risks against applicable affordability targets and Service provided affordability constraints.

Updates to the Life Cycle Sustainment Plan and the Enterprise Affordability Strategy will include a plan for Service engagement and prioritize activity the Services require of the contractor to enable possible manpower reductions. The joint team has established a project plan (inclusive of site visits) to facilitate this portion of the strategy. This Service-centric activity began in October 2020 and has full engagement and support from Department leadership.

Until the Department determines a new Acquisition Program Baseline (APB) date for the Milestone C decision, the Department is unable to determine if this meets the "prior to the Milestone C decision" criterion. However, we will work to meet the intent of this recommendation in an expeditious manner.

RECOMMENDATION 2: The Secretary of Defense should ensure that, prior to the Milestone C decision, the Undersecretary of Defense for Acquisition and Sustainment, in conjunction with the services and the F-35 Joint Program Office, assess and document changes in service-related program requirements (e.g. the number of aircraft purchases and flying hours) to achieve cost-reductions.

DoD RESPONSE: Partially concur. The Department, in conjunction with the Services and the Program Office, will coordinate to identify potential changes in program requirements, in an effort to drive balanced affordability.

Until the Department determines a new Acquisition Program Baseline (APB) date for the Milestone C decision, the Department is unable to determine if this meets the "prior to the Milestone C decision" criterion. However, we will work to meet the intent of this recommendation in an expeditious manner.

2

Enclosure 1

RECOMMENDATION 3: The Secretary of Defense should ensure that, prior to the Milestone C decision, the Undersecretary of Defense for Acquisition and Sustainment, in conjunction with the services and the F-35 Joint Program Office, develop and document a program-wide plan for achieving affordability constraints with detailed action tied to milestones and resources.

DoD RESPONSE: Partially Concur. The Department will leverage the Product Support Business Case Analysis (scheduled for summer 2021 completion) to drive sustainability decision-making through the JSF Executive Steering Board.

The F-35 JPO is currently updating the F-35 Enterprise Affordability Strategy document. The updated strategy spans the entire life cycle and maps each of the five Program Management Office's cost reduction initiatives, timelines, resource requirements, assumptions, and risks against applicable affordability targets and Service provided affordability constraints.

Updates to the Life Cycle Sustainment Plan and the Enterprise Affordability Strategy will include a plan for Service engagement and prioritize activity the Services require of the contractor to enable possible manpower reductions. The joint team has established a project plan (inclusive of site visits) to facilitate this portion of the strategy. This Service-centric activity began in October 2020 and has full engagement and support from Department leadership.

Until the Department determines a new Acquisition Program Baseline (APB) date for the Milestone C decision, the Department is unable to determine if this meets the "prior to the Milestone C decision" criterion. However, we will work to meet the intent of this recommendation in an expeditious manner.

RECOMMENDATION 4: The Secretary of Defense should ensure that, prior to the Milestone C decision, the Undersecretary of Defense for Acquisition and Sustainment, in conjunction with the services and the F-35 Joint Program Office, develop and document a risk management approach for addressing challenges to achieving affordability objectives.

DoD RESPONSE: Partially concur. The Department has implemented robust risk management practices in response to both statutory mandates and best practices in conjunction with our industry partners. The F-35 JPO will review and revise (as appropriate) the risk mitigation procedures included within the F-35 Joint Risk Management Plan with an eye towards affordability during calendar year 2021.

Until the Department determines a new Acquisition Program Baseline (APB) date for the Milestone C decision, the Department is unable to determine if this meets the "prior to the Milestone C decision" criterion. However, we will work to meet the intent of this recommendation."

DEPARTMENT OF DEFENSE
DEFENSE OFFICE OF PREPUBLICATION AND SECURITY REVIEW
1155 DEFENSE PENTAGON
WASHINGTON, DC 20301-1155

April 15, 2021
Ref: 21-G-0037

MEMORANDUM FOR THE OFFICE OF THE UNDERSECRETARY OF DEFENSE FOR ACQUISITION AND SUSTAINMENT
(ATTN: Mr. Jesse Ellman)

SUBJECT: Security Review of Government Accountability Office (GAO) Draft Report, "F-35 SUSTAINMENT: DOD Needs to Cut Billions in Estimated Costs to Achieve Affordability," GAO-21-439, March 2020

The Department of Defense (DoD) completed its review of the subject report. Based upon subject matter expert review, the report does not contain protected DoD information and is cleared for public release. The stamped report reflecting this release determination is attached for your records. Should you need further assistance, please contact Mr. Doug McComb, at 703-614-4492, or at douglas.mccomb.civ@mail.mil.

MCCOMB.DOUGLAS.GREGORY.1042611324
Digitally signed by MCCOMB.DOUGLAS.GREGORY.1042611324
Date: 2021.04.15 13:15:47 -04'00'

for George R. Sturgis, Jr.
Chief

Attachment:
As stated

Enclosure 2

Agency Comment Letter

Text of Appendix II: Comments from the Department of Defense

June 14, 2021

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

Dear Ms. Maurer:

The Department of Defense (DoD) completed a review of the Government Accountability Office (GAO) Draft Report, GAO-21-439, "F-35 SUSTAINMENT: DoD Needs to Cut Billions in Estimated Costs to Achieve Affordability," (GAO Code 104168), and partially concurs with all four GAO recommendations. We have enclosed our responses (Enclosure 1).

The Department has also completed a security and accuracy review of the Draft Report, and found no "Controlled Unclassified Information" contained therein.

The Department finds that the DRAFT report is UNCLASSIFIED and cleared for open publication, pending the GAO addressing the security and sensitivity concerns provided during the review conducted by the Department's F-35 stakeholders in the final report. Enclosed is a copy of the Department's official security review (Enclosure 2).

Sincerely,

Stacy A. Cummings
Principal Deputy Assistant Secretary of Defense (Acquisition)
Performing the Duties of Under Secretary of Defense for Acquisition and Sustainment

Enclosures:

As stated

"F-35 SUSTAINMENT: DOD Needs to Cut Billions in Estimated Costs to Achieve Affordability"

Departmental Comments to the GAO Recommendations

RECOMMENDATION 1: The Secretary of Defense should ensure that, prior to the Milestone C decision, the Underecretary of Defense for Acquisition and Sustainment, in conjunction with the services and the F-35 Joint Program Office, assess and document DOD's ability to meet the service's affordability constraints with existing or planned cost-reduction efforts.

DoD RESPONSE: Partially Concur. The Department will leverage the Product Support Business Case Analysis (scheduled for summer 2021 completion) to drive sustainability decision-making through the JSF Executive Steering Board.

The F-35 JPO is currently updating the F-35 Enterprise Affordability Strategy document. The updated strategy spans the entire life cycle and maps each of the five Program Management Office's cost reduction initiatives, timelines, resource requirements, assumptions, and risks against applicable affordability targets and Service provided affordability constraints.

Updates to the Life Cycle Sustainment Plan and the Enterprise Affordability Strategy will include a plan for Service engagement and prioritize activity the Services require of the contractor to enable possible manpower reductions. The joint team has established a project plan (inclusive of site visits) to facilitate this portion of the strategy. This Service-centric activity began in October 2020 and has full engagement and support from Department leadership.

Until the Department determines a new Acquisition Program Baseline (APB) date for the Milestone C decision, the Department is unable to determine if this meets the "prior to the Milestone C decision" criterion. However, we will work to meet the intent of this recommendation in an expeditious manner.

RECOMMENDATION 2: The Secretary of Defense should ensure that, prior to the Milestone C decision, the Undersecretary of Defense for Acquisition and Sustainment, in conjunction with the services and the F-35 Joint Program Office, assess and document changes in service-related program requirements (e.g. the number of aircraft purchases and flying hours) to achieve cost- reductions.

DoD RESPONSE: Partially concur. The Department, in conjunction with the Services and the Program Office, will coordinate to identify potential changes in program requirements, in an effort to drive balanced affordability.

Until the Department determines a new Acquisition Program Baseline (APB) date for the Milestone C decision, the Department is unable to determine if this meets the "prior to the Milestone C decision" criterion. However, we will work to meet the intent of this recommendation in an expeditious manner.

RECOMMENDATION 3: The Secretary of Defense should ensure that, prior to the Milestone C decision, the Undersecretary of Defense for Acquisition and Sustainment, in conjunction with the services and the F-35 Joint Program Office, develop and document a program-wide plan for achieving affordability constraints with detailed action tied to milestones and resources.

DoD RESPONSE: Partially Concur. The Department will leverage the Product Support Business Case Analysis (scheduled for summer 2021 completion) to drive sustainability decision-making through the JSF Executive Steering Board.

The F-35 JPO is currently updating the F-35 Enterprise Affordability Strategy document. The updated strategy spans the entire life cycle and maps each of the five Program Management Office's cost reduction initiatives, timelines, resource requirements, assumptions, and risks against applicable affordability targets and Service provided affordability constraints.

Updates to the Life Cycle Sustainment Plan and the Enterprise Affordability Strategy will include a plan for Service engagement and prioritize activity the Services require of the contractor to enable possible manpower reductions. The joint team has established a project plan (inclusive of site visits) to facilitate this portion of the strategy. This Service-centric activity began in October 2020 and has full engagement and support from Department leadership.

Until the Department determines a new Acquisition Program Baseline (APB) date for the Milestone C decision, the Department is unable to determine if this meets the "prior to the Milestone C decision" criterion. However, we will work to meet the intent of this recommendation in an expeditious manner.

RECOMMENDATION 4: The Secretary of Defense should ensure that, prior to the Milestone C decision, the Undersecretary of Defense for Acquisition and Sustainment, in conjunction with the services and the F-35 Joint Program Office, develop and document a risk management approach for addressing challenges to achieving affordability objectives.

DoD RESPONSE: Partially concur. The Department has implemented robust risk management practices in response to both statutory mandates and best practices in conjunction with our industry partners. The F-35 JPO will review and revise (as

appropriate) the risk mitigation procedures included within the F-35 Joint Risk Management Plan with an eye towards affordability during calendar year 2021.

Until the Department determines a new Acquisition Program Baseline (APB) date for the Milestone C decision, the Department is unable to determine if this meets the "prior to the Milestone C decision" criterion. However, we will work to meet the intent of this recommendation."

April 15, 2021 Ref: 21-G-0037

MEMORANDUM FOR THE OFFICE OF THE UNDERSECRETARY OF DEFENSE FOR ACQUISITION AND SUSTAINMENT

(ATTN: Mr. Jesse Ellman)

SUBJECT: Security Review of Government Accountability Office (GAO) Draft Report, "F-35 SUSTAINMENT: DOD Needs to Cut Billions in Estimated Costs to Achieve Affordability," GAO-21-439, March 2020

The Department of Defense (DoD) completed its review of the subject report. Based upon subject matter expert review, the report does not contain protected DoD information and is cleared for public release. The stamped report reflecting this release determination is attached for your records. Should you need further assistance, please contact Mr. Doug McComb, at 703-614-4492, or at douglas.mccomb.civ@mail.mil.

For George R. Sturgis, Jr.
Chief

Attachment:
As stated

Appendix III: GAO Contact and Staff Acknowledgments

GAO Contact

Diana Maurer at (202) 512-9627 or maurerd@gao.gov.

Staff Acknowledgements

In addition to the contact listed above, John Bumgarner and Alissa Czyz (Assistant Directors), Jeff Hubbard (Analyst-in-Charge), Vincent Buquicchio, Juaná Collymore, Ethan Kennedy, William Lamping, Jennifer Leotta, Amie Lesser, Austin J. Lyke, Elizabeth Morris, Terry Richardson, and Cheryl Weissman made key contributions to this report.

Related GAO Products

F-35 Joint Strike Fighter: DOD Needs to Update Modernization Schedule and Improve Data on Software Development. GAO-21-226. Washington, D.C.: March 18, 2021.

F-35 Sustainment: DOD Needs to Address Key Uncertainties as It Re-Designs the Aircraft's Logistics System. GAO-20-665T. Washington, D.C.: July 22, 2020.

Weapon System Sustainment: DOD Needs a Strategy for Re-Designing the F-35's Central Logistics System. GAO-20-316. Washington, D.C.: March 6, 2020

F-35 Aircraft Sustainment: DOD Faces Challenges in Sustaining a Growing Fleet. GAO-20-234T. Washington, D.C.: November 13, 2019.

Space Command and Control: Comprehensive Planning and Oversight Could Help DOD Acquire Critical Capabilities and Address Challenges. GAO-20-146. Washington, D.C.: October 30, 2019.

F-35 Joint Strike Fighter: Action Needed to Improve Reliability and Prepare for Modernization Efforts. GAO-19-341. Washington, D.C.: April 29, 2019.

F-35 Aircraft Sustainment: DOD Needs to Address Substantial Supply Chain Challenges. GAO-19-321. Washington, D.C.: April 25, 2019.

Cloud Computing: Agencies Have Increased Usage and Realized Benefits, but Cost and Savings Data Need to Be Better Tracked. GAO-19-58. Washington, D.C.: April 4, 2019.

DOD Space Acquisitions: Including Users Early and Often in Software Development Could Benefit Programs. GAO-19-136. Washington, D.C.: March 18, 2019.

F-35 Joint Strike Fighter: Development Is Nearly Complete, but Deficiencies Found in Testing Need to Be Resolved. GAO-18-321. Washington D.C.: June 5, 2018.

Warfighter Support: DOD Needs to Share F-35 Operational Lessons Across the Military Services. GAO-18-464R. Washington D.C.: April 25, 2018.

Military Aircraft: F-35 Brings Increased Capabilities, but the Marine Corps Needs to Assess Challenges Associated with Operating in the Pacific. GAO-18-79C. Washington, D.C.: March 28, 2018.

Information Technology Reform: Agencies Need to Improve Certification of Incremental Development. GAO-18-148. Washington, D.C.: November *7, 2017.*

F-35 Aircraft Sustainment: DOD Needs to Address Challenges Affecting Readiness and Cost Transparency. GAO-18-75. Washington D.C.: October 26, 2017.

F-35 Joint Strike Fighter: DOD's Proposed Follow-on Modernization Acquisition Strategy Reflects an Incremental Approach Although Plans Are Not Yet Finalized. GAO-17-690R. Washington, D.C.: August 8, 2017.

F-35 Joint Strike Fighter: DOD Needs to Complete Developmental Testing Before Making Significant New Investments. GAO-17-351. Washington, D.C.: April 24, 2017.

F-35 Joint Strike Fighter: Continued Oversight Needed as Program Plans to Begin Development of New Capabilities. GAO-16-390. Washington, D.C.: April 14, 2016.

F-35 Sustainment: DOD Needs a Plan to Address Risks Related to Its Central Logistics System. GAO-16-439. Washington, D.C.: April 14, 2016.

F-35 Joint Strike Fighter: Preliminary Observations on Program Progress. GAO-16-489T. Washington, D.C.: March 23, 2016.

F-35 Joint Strike Fighter: Assessment Needed to Address Affordability Challenges. GAO-15-364. Washington, D.C.: April 14, 2015.

F-35 Sustainment: Need for Affordable Strategy, Greater Attention to Risks, and Improved Cost Estimates. GAO-14-778. Washington, D.C.: September 23, 2014.

F-35 Joint Strike Fighter: Slower Than Expected Progress in Software Testing May Limit Initial Warfighting Capabilities. GAO-14-468T. Washington, D.C.: March 26, 2014.

F-35 Joint Strike Fighter: Problems Completing Software Testing May Hinder Delivery of Expected Warfighting Capabilities. GAO-14-322. Washington, D.C.: March 24, 2014.

F-35 Joint Strike Fighter: Restructuring Has Improved the Program, but Affordability Challenges and Other Risks Remain. GAO-13-690T. Washington, D.C.: June 19, 2013.

F-35 Joint Strike Fighter: Program Has Improved in Some Areas, but Affordability Challenges and Other Risks Remain. GAO-13-500T. Washington, D.C.: April 17, 2013.

F-35 Joint Strike Fighter: Current Outlook Is Improved, but Long-Term Affordability Is a Major Concern. GAO-13-309. Washington, D.C.: March 11, 2013.

Software Development: Effective Practices and Federal Challenges in Applying Agile Methods. GAO-12-681. Washington, D.C.: July 27, 2012.

Joint Strike Fighter: DOD Actions Needed to Further Enhance Restructuring and Address Affordability Risks. GAO-12-437. Washington, D.C.: June 14, 2012.

Joint Strike Fighter: Restructuring Added Resources and Reduced Risk, but Concurrency Is Still a Major Concern. GAO-12-525T. Washington, D.C.: March 20, 2012.

Joint Strike Fighter: Implications of Program Restructuring and Other Recent Developments on Key Aspects of DOD's Prior Alternate Engine Analyses. GAO-11-903R. Washington, D.C.: September 14, 2011.

Joint Strike Fighter: Restructuring Places Program on Firmer Footing, but Progress Is Still Lagging. GAO-11-677T. Washington, D.C.: May 19, 2011.

Joint Strike Fighter: Restructuring Places Program on Firmer Footing, but Progress Still Lags. GAO-11-325. Washington, D.C.: April 7, 2011.

Joint Strike Fighter: Restructuring Should Improve Outcomes, but Progress Is Still Lagging Overall. GAO-11-450T. Washington, D.C.: March 15, 2011.

GAO's Mission

The Government Accountability Office, the audit, evaluation, and investigative arm of Congress, exists to support Congress in meeting its constitutional responsibilities and to help improve the performance and accountability of the federal government for the American people. GAO examines the use of public funds; evaluates federal programs and policies; and provides analyses, recommendations, and other assistance to help Congress make informed oversight, policy, and funding decisions. GAO's commitment to good government is reflected in its core values of accountability, integrity, and reliability.

Obtaining Copies of GAO Reports and Testimony

The fastest and easiest way to obtain copies of GAO documents at no cost is through our website. Each weekday afternoon, GAO posts on its website newly released reports, testimony, and correspondence. You can also subscribe to GAO's email updates to receive notification of newly posted products.

Order by Phone

The price of each GAO publication reflects GAO's actual cost of production and distribution and depends on the number of pages in the publication and whether the publication is printed in color or black and white. Pricing and ordering information is posted on GAO's website, https://www.gao.gov/ordering.htm.

Place orders by calling (202) 512-6000, toll free (866) 801-7077, or TDD (202) 512-2537.

Orders may be paid for using American Express, Discover Card, MasterCard, Visa, check, or money order. Call for additional information.

Connect with GAO

Connect with GAO on Facebook, Flickr, Twitter, and YouTube.
Subscribe to our RSS Feeds or Email Updates. Listen to our Podcasts.
Visit GAO on the web at https://www.gao.gov.

To Report Fraud, Waste, and Abuse in Federal Programs

Contact FraudNet:

Website: https://www.gao.gov/fraudnet/fraudnet.htm

Automated answering system: (800) 424-5454 or (202) 512-7700

Congressional Relations

Orice Williams Brown, Managing Director, WilliamsO@gao.gov, (202) 512-4400,
U.S. Government Accountability Office, 441 G Street NW, Room 7125,
Washington, DC 20548

Public Affairs

Chuck Young, Managing Director, youngc1@gao.gov, (202) 512-4800
U.S. Government Accountability Office, 441 G Street NW, Room 7149
Washington, DC 20548

Strategic Planning and External Liaison

Stephen J. Sanford, Managing Director, spel@gao.gov, (202) 512-4707
U.S. Government Accountability Office, 441 G Street NW, Room 7814,
Washington, DC 20548