United States Government Accountability Office

Report to Congressional Committees

September 2023

F-35 AIRCRAFT

DOD and the Military Services Need to Reassess the Future Sustainment Strategy

Accessible Version

GAO-23-105341

GAO Highlights

Highlights of GAO-23-105341, a report to congressional committees

September 2023

F-35 AIRCRAFT

DOD and the Military Services Need to Reassess the Future Sustainment Strategy

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 450 of the aircraft fielded. DOD plans to procure nearly 2,500 F-35s at an estimated life cycle cost of the program exceeding $1.7 trillion. Of this amount, $1.3 trillion are associated with operating and sustaining the aircraft.

The National Defense Authorization Act for Fiscal Year 2022 included a provision for GAO to review F-35 sustainment efforts. This report, among other things, assesses the extent to which (1) challenges exist with F-35 depot and organizational-level maintenance, and (2) DOD has determined its desired mix of government and contractor sustainment support for the future.

GAO reviewed F-35 program documentation, reviewed readiness and performance data, visited two F-35 depots and three operational installations, conducted a survey of all 15 F-35 installations, and interviewed officials.

What GAO Recommends

GAO is making seven recommendations to DOD, including reassessing F-35 sustainment elements to determine government and contractor responsibility and any required technical data, and making final decisions on changes to F-35 sustainment to address performance and affordability. DOD concurred with all of GAO's recommendations.

View GAO-23-105341. For more information, contact Diana Maurer at (202) 512-9627 or maurerd@gao.gov.

What GAO Found

Maintenance challenges negatively affect F-35 aircraft readiness. The F-35 fleet mission capable rate—the percentage of time the aircraft can perform one of its tasked missions—was about 55 percent in March 2023, far below program goals. This performance was due in part to challenges with depot and organizational maintenance (see fig.). The program was behind schedule in establishing depot maintenance activities to conduct repairs. As a result, component repair times remained slow with over 10,000 waiting to be repaired—above desired levels. At the same time, organizational-level maintenance has been affected by a number of issues, including a lack of technical data and training.

F-35 Maintenance Challenges Negatively Affecting Aircraft Readiness

Source: GAO analysis of Department of Defense information; U.S. Air Force/R. Nial Bradshaw. | GAO-23-105341

Accessible Text for F-35 Maintenance Challenges Negatively Affecting Aircraft Readiness

Heavy reliance on contractors

U.S. government has limited decision-making ability and influence over depot maintenance

Inadequate training

Maintenance-related training for the F-35 program is largely inadequate

Lack of technical data

A lack of access to technical data for repairs delays the maintenance process at the organizational and depot levels

Funding prioritization

Adjustments in funding priorities have prevented the construction of an adequate depot repair capacity

Lack of support equipment

F-35 support equipment is too frequently unavailable on flight lines

Lack of spare parts

A lack of spare parts at installations and on deployments is causing maintenance delays

Source: GAO analysis of Department of Defense information; U.S. Air Force/R. Nial Bradshaw. | GAO-23-105341

The Department of Defense (DOD) relies heavily on its contractor to lead and manage F-35 sustainment (see fig.). However, as DOD seeks expanded government control, it has neither (1) determined the desired mix of government and contractor roles, nor (2) identified and obtained the technical data needed to support its desired mix. The military services must take over management of F-35 sustainment by October 2027 and have an opportunity to make adjustments—specifically to the contractor-managed elements. Reassessing its approach could help DOD address its maintenance challenges and reduce costs.

Responsibility for the 12 F-35 Sustainment Elements

Prime contractor responsibility	Government responsibility
• Information technology (IT) systems continuous support • Maintenance planning and management • Supply support • Support equipment • Sustaining engineering • Technical data • Training and training support	• Design interface • Facilities and infrastructure • Packaging, handling, storage, and transportation (PHS&T) • Personnel • Product support management

Source: GAO analysis of Department of Defense data. | GAO-23-105341

Accessible Text for Responsibility for the 12 F-35 Sustainment Elements

Prime contractor responsibility

- Information technology (IT) systems continuous support
- Maintenance planning and management
- Supply support
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Government responsibility

- Design interface
- Facilities and infrastructure
- Packaging, handling, storage, and transportation (PHS&T)
- Personnel
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Source: GAO analysis of Department of Defense data. | GAO-23-105341

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Abbreviations

DOD	Department of Defense
F-35	F-35 Lightning II aircraft

U.S. GOVERNMENT ACCOUNTABILITY OFFICE
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September 21, 2023

The Honorable Jack Reed
Chairman
The Honorable Roger Wicker
Ranking Member
Committee on Armed Services
United States Senate

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

The F-35 Lightning II aircraft (F-35) has the most advanced capabilities of the Department of Defense's (DOD) fighter aircraft, and represents a growing portion of its tactical fighter aviation fleet. DOD operates and sustains about 450 F-35s and plans to buy about 2,000 more aircraft by the mid-2040s. DOD's sustainment strategy for the F-35 includes two levels of maintenance—the organizational level, generally performed by an operating unit to support day-to-day sustainment, and the depot level, for the most complex repairs and overhauls. DOD has estimated overall costs for the program at more than $1.7 trillion over its life cycle, with the majority of the costs, about $1.3 trillion, associated with sustaining the aircraft.[1]

We have previously reported that

- estimated costs to sustain the F-35 aircraft have grown since 2012, exceeding original estimates by hundreds of millions of dollars;[2]

[1]The $1.7 trillion reflects then-year dollars. Then-year dollars include the effects of inflation or escalation. DOD's Office of Cost Assessment & Program Evaluation updated its most recent official sustainment cost estimate for the F-35 program in June 2020.

[2]GAO, *F-35 Sustainment: DOD Needs to Cut Billions in Estimated Costs to Achieve Affordability*, GAO-21-439 (Washington, D.C.: July 7, 2021).

- F-35 aircraft did not meet warfighter-required mission capable rates—the percentage of total time when an aircraft possessed by a squadron can fly and perform at least one of its missions—due to challenges with spare parts availability during fiscal years 2019 through 2021 and maintenance issues;[3]
- DOD's F-35 engine sustainment strategy does not meet the desired outcomes of the military services;[4] and
- DOD is trying to determine what options the F-35 program has to reduce its reliance on the contractor for sustaining the aircraft and expand organic (i.e., government owned and operated) sustainment.[5]

We have made dozens of recommendations to improve the performance, affordability, and management of F-35 sustainment. DOD has generally concurred with our recommendations and taken some actions to implement them. Appendix I provides a brief overview of sustainment-related F-35 recommendations.

The National Defense Authorization Act for Fiscal Year 2022 included a provision for us to conduct an annual review of the sustainment efforts of the Department of Defense with respect to the F-35 aircraft program.[6] This report assesses the extent to which DOD has (1) established F-35 depot maintenance activities and what challenges, if any, are facing their efforts; (2) made improvements to F-35 organizational-level maintenance activities and what challenges remain; and (3) determined its desired mix of contractor and organic support to meet future F-35 sustainment needs.

To address these objectives, we

- reviewed key F-35 sustainment documents;

[3]GAO, *F-35 Sustainment: DOD Faces Several Uncertainties and Has Not Met Key Objectives*, GAO-22-105995 (Washington, D.C.: April 28, 2022).

[4]GAO, *F-35 Aircraft: DOD Should Assess and Update Its Engine Sustainment Strategy to Support Desired Outcomes,* GAO-22-104678 (Washington, D.C.: July 19, 2022).

[5]GAO-22-105995.

[6]Pub. L. No. 117-81, § 357 (2021). In addition, House Report 116-120, accompanying a bill for the National Defense Authorization Act for Fiscal Year 2020, included a provision for us to review F-35 sustainment challenges. House Report 117-118, accompanying a bill for the National Defense Authorization Act for Fiscal Year 2022, also included a provision for us to review matters related to F-35 maintenance capability. This report addresses all three provisions.

- visited two depot maintenance facilities—Ogden Air Logistics Complex at Hill Air Force Base, Utah and the Fleet Readiness Center East at Marine Corps Air Station Cherry Point, North Carolina—and three installations that are home stations for F-35 squadrons—Hill Air Force Base, Utah; Naval Air Station Lemoore, California; and Marine Corps Air Station Yuma, Arizona;
- conducted a survey from April 2022 through June 2022 of all 15 installations hosting an F-35 squadron, as identified by DOD personnel, to collect information and perspectives on F-35 organizational-level maintenance;
- reviewed F-35 performance-related data, including mission capable and non-mission capable rates, from fiscal year 2020 through March 2023;
- interviewed officials from the F-35 Joint Program Office, the Office of the Secretary of Defense for Acquisition and Sustainment, the Office of Cost Assessment and Program Evaluation, the Air Force, the Navy, and the Marine Corps; and
- evaluated the military services' sustainment approach for the F-35 against criteria in the 2021 New Joint Strike Fighter Production, Sustainment, and Follow-On Development Memorandum of Understanding and federal standards for internal control.

See appendix II for additional information on our scope and methodology.

We conducted this performance audit from July 2021 to September 2023 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.

Background

F-35 Program

The F-35 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, the Navy,

and the Marine Corps; seven international partners; and multiple foreign military sales customers.[7]

Figure 1: F-35 Program Participants

Source: GAO analysis of Department of Defense information. | GAO-23-105341

Accessible Data for Figure 1: F-35 Program Participants

Department of Defense

- U.S. Marine Corps
- U.S. Navy
- U.S. Air Force

Partner nations

- Australia

[7]Seven partner nations contribute to F-35 development, production, and sustainment. In addition, as of February 2023, the program had nine 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. Several other countries are at various stages of foreign military sales consideration. This report focuses on U.S. F-35 sustainment efforts and does not evaluate partner nation sustainment.

- Canada
- Denmark
- Italy
- Netherlands
- Norway
- United Kingdom

Foreign military sales

- Belgium
- Finland
- Germany
- Israel
- Japan
- Poland
- Singapore
- South Korea
- Switzerland

Source: GAO analysis of Department of Defense information. | GAO-23-105341

As shown in figure 2, the program has developed and has been delivering three variants of the F-35 aircraft: F-35A, F-35B, and F-35C. DOD is in the process of replacing a variety of its current fighter aircraft with the F-35, including the F-16 Falcon in the Air Force and the AV-8B Harrier and the F/A-18 C/D Hornet in the Marine Corps.

Figure 2: Variants of the F-35 Aircraft

Source: GAO analysis of Department of Defense documents and interviews with officials. Photos (left to right): U.S. Air Force/ Staff Sgt. Andrew Lee, U.S. Navy/Petty Officer 1st Class Jeremy Starr, and U.S. Air Force/Defense Visual Information Distribution Service. | GAO-23-105341

Accessible Data for Figure 2: Variants of the F-35 Aircraft

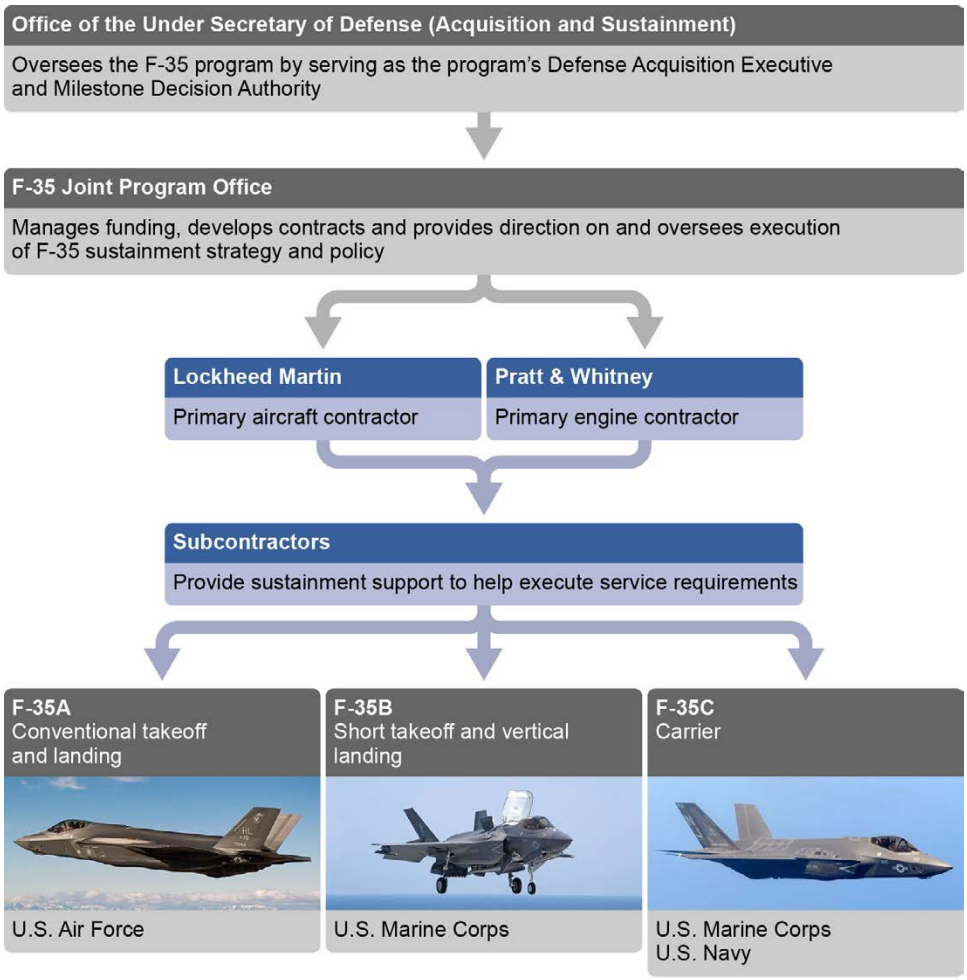
Category	Initial operating capability	Purpose	Variant
F-35A Conventional takeoff and landing	2016	Counter present and future advanced threats through counter air, strike, and surveillance and reconnaissance missions	Air Force variant that supports primarily air-to-ground missions and comprises majority of partner aircraft and foreign military sales
F-35B Short takeoff and vertical landing	2015	Counter present and future advanced threats through counter air, strike, and surveillance and reconnaissance missions	Marine Corps variant that is capable of short takeoff and vertical landing to support expeditionary basing ashore and deployment at sea
F-35C Carrier	2019	Counter present and future advanced threats through counter air, strike, and surveillance and reconnaissance missions	Navy and Marine Corps variant with larger wing span and greater fuel storage to support aircraft carrier operations and expeditionary roles

Source: GAO analysis of Department of Defense documents and interviews with officials. Photos (left to right): U.S. Air Force/

Key Stakeholders in F-35 Sustainment

DOD's sustainment effort for the F-35 aircraft is a large and complex undertaking involving many stakeholders, as shown in figure 3 and described below.

Figure 3: Program Stakeholders for Sustainment of F-35 Aircraft



Source: GAO analysis of Department of Defense information; photos (left to right): U.S. Air Force/Staff Sgt. Andrew Lee, U.S. Navy/Petty Officer 1st Class Jeremy Starr, and U.S. Air Force/Defense Visual Information Distribution Service. | GAO-23-105341

Accessible Text for Figure 3: Program Stakeholders for Sustainment of F-35 Aircraft

- Office of the Under Secretary of Defense (Acquisition and Sustainment) (Oversees the F-35 program by serving as the program's Defense Acquisition Executive and Milestone Decision Authority)
    - F-35 Joint Program Office (Manages funding, develops contracts and provides direction on and oversees execution of F-35 sustainment strategy and policy)
        - Lockheed Martin Primary aircraft contractor
        - Pratt & Whitney Primary engine contractor
            - Subcontractors (Provide sustainment support to help execute service requirements)
                - F-35A Conventional takeoff and landing (U.S. Air Force)
                - F-35B Short takeoff and vertical landing(U.S. Marine Corps)
                - F-35C Carrier (U.S. Marine Corps,U.S. Navy)

Source: GAO analysis of Department of Defense information; photos (left to right): U.S. Air Force/Staff Sgt. Andrew Lee, U.S. Navy/Petty Officer 1st Class Jeremy Starr, and U.S. Air Force/Defense Visual Information Distribution Service. | GAO-23-105341

- The Office of the Undersecretary of Defense (Acquisition and Sustainment) oversees the entire acquisition of the F-35, including sustainment and overall costs of the program.
- 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.
- Lockheed Martin, the prime contractor for the aircraft, maintains the aircraft (i.e., the air vehicle) and conducts the work primarily under annual contracts.
- Pratt & Whitney, the contractor that designs and builds the engines, maintains the engine.
- Lockheed Martin and Pratt & Whitney both rely on subcontractors to manufacture specialized parts for the air vehicle and the propulsion system.

- 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.

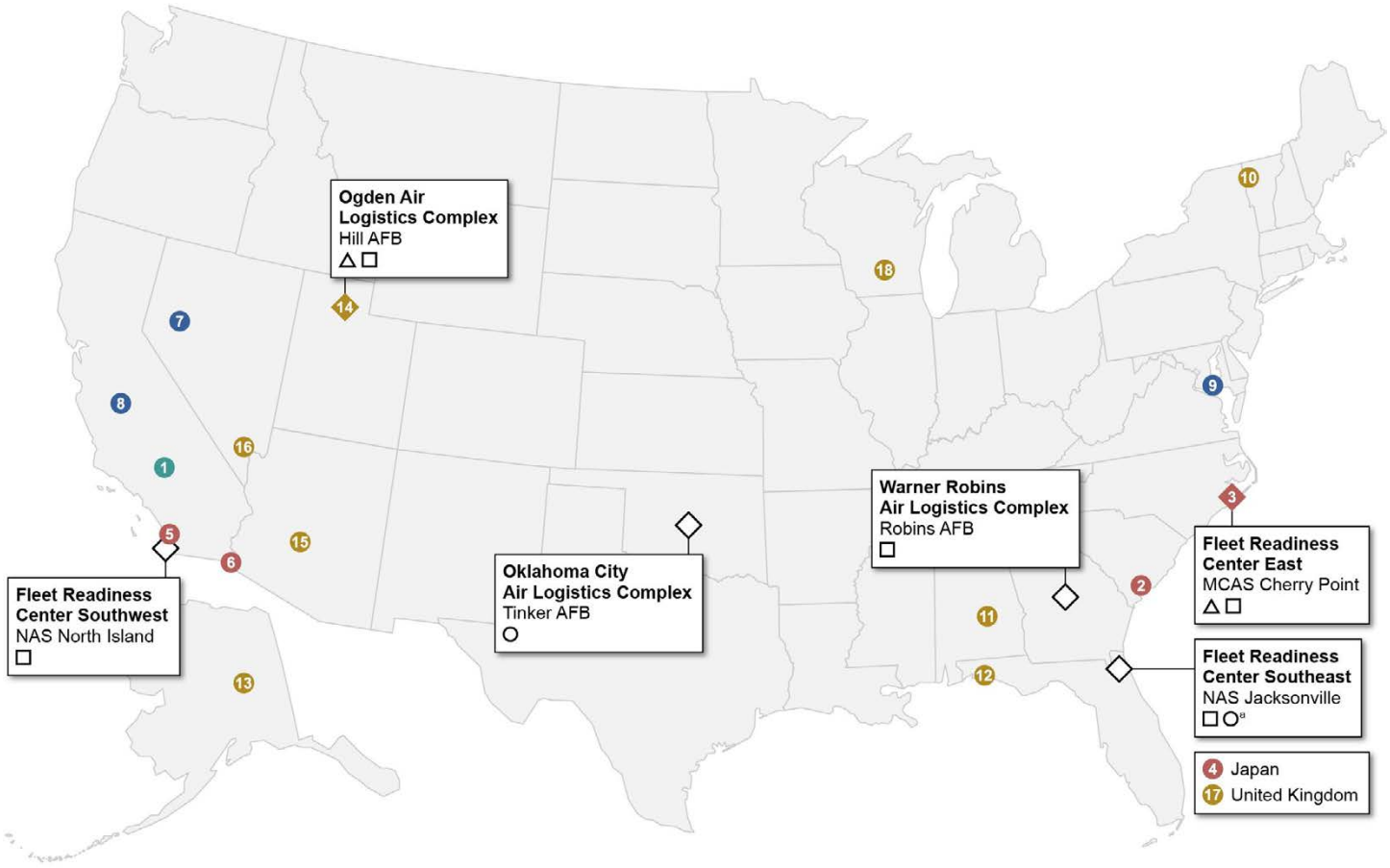
F-35 Maintenance Concept

A combination of contractors, civilian government personnel, and uniformed military personnel conduct aircraft and engine maintenance under the F-35 sustainment strategy's two-level maintenance concept. Under this concept, maintenance is either conducted at the organizational level—the location where the aircraft is stationed or deployed—or at a maintenance depot, which are industrial installations that maintain, overhaul, and repair military weapons systems and equipment. Organizational-level maintenance normally consists of inspecting, servicing, lubricating, and adjusting, as well as the replacing of parts. Depot-level maintenance includes structural repair, engine system overhaul and repair, component repair, and other activities that require specialized skills, facilities, or tooling to conduct the repair.

The program continues to explore the addition of an intermediate-level of maintenance for the Navy and Marine Corps to use both afloat and ashore; however, as of February 2023, there was no intermediate-level maintenance built into the F-35's maintenance concept.[8] Figure 4 shows the locations of F-35 squadrons and depots where organizational-level and depot-level maintenance occur respectively.

[8]Intermediate-level maintenance generally involves material maintenance or repair in direct support of using organizations. Some examples of intermediate-level maintenance include calibration, repair, or replacement of damaged or unserviceable parts, components, or assemblies.

Figure 4: F-35 Squadrons and Depot Locations



Marine Corps, Navy, and Air Force	Marine Corps	Navy	Air Force
1. Edwards AFB, California	2. MCAS Beaufort, South Carolina 3. MCAS Cherry Point, North Carolina 4. MCAS Iwakuni, Japan 5. MCAS Miramar, California 6. MCAS Yuma, Arizona	7. NAS Fallon, Nevada 8. NAS Lemoore, California 9. NAS Patuxent River, Maryland	10. Burlington ANGB, Vermont 11. Dannelly Field ANGB, Alabama 12. Eglin AFB, Florida 13. Eielson AFB, Alaska 14. Hill AFB, Utah 15. Luke AFB, Arizona 16. Nellis AFB, Nevada 17. RAF Lakenheath, United Kingdom 18. Truax Field ANGB, Wisconsin

AFB Air Force Base
ANGB Air National Guard Base
MCAS Marine Corps Air Station
NAS Naval Air Station
RAF Royal Air Force

Source: GAO analysis of Department of Defense and contractor information; Map Resources. | GAO-23-105341

Accessible Data for Figure 4: F-35 Squadrons and Depot Locations

Depot locations

- **Fleet Readiness Center Southwest** NAS North Island (components)
- **Ogden Air Logistics Complex** Hill AFB (air vehicle, components)
- **Oklahoma City Air Logistics Complex** Tinker AFB (propulsion)
- **Warner Robins Air Logistics Complex** Robins AFB (components)
- **Fleet Readiness Center East** MCAS Cherry Point (air vehicle, components)
- **Fleet Readiness Center Southeast** NAS Jacksonville (components, propulsion)
- **Japan** (MCAS Iwakuni, Japan)
- **United Kingdom** (RAF Lakenheath, United Kingdom)

Category	Category member
Marine Corps, Navy, and Air Force	Edwards AFB, California
Marine Corps	MCAS Beaufort, South Carolina
Marine Corps	MCAS Cherry Point, North Carolina
Marine Corps	MCAS Iwakuni, Japan
Marine Corps	MCAS Miramar, California
Marine Corps	MCAS Yuma, Arizona
Navy	NAS Fallon, Nevada
Navy	NAS Lemoore, California
Navy	NAS Patuxent River, Maryland
Air Force	Burlington ANGB, Vermont
Air Forc	Dannelly Field ANGB, Alabama
Air Forc	Eglin AFB, Florida
Air Forc	Eielson AFB, Alaska
Air Forc	Hill AFB, Utah
Air Forc	Luke AFB, Arizona
Air Forc	Nellis AFB, Nevada
Air Forc	RAF Lakenheath, United Kingdom
Air Forc	Truax Field ANGB, Wisconsin

Acronyms

- AFB - Air Force Base
- ANGB - Air National Guard Base
- MCAS - Marine Corps Air Station
- NAS - Naval Air Station
- RAF - Royal Air Force

Source: GAO analysis of Department of Defense and contractor information; Map Resources. | GAO-23-105341

Note: Propulsion repair capability is expected to start at the Fleet Readiness Center Southeast in 2024.

F-35 Depot Standup Has Made Progress but Remains behind Schedule and Faces Several Challenges

The F-35 program has fallen behind schedule in establishing depot maintenance activities for component—or part—repair as well as for modifications to air vehicles. Several challenges have led to these delays. Furthermore, F-35 depot maintenance faces growing risk due to the growing U.S. fleet and increasing demand for depot support.

F-35 Depot Stand Up to Fully Repair Components Will Be Delayed until 2027 and Has Negatively Affected F-35 Readiness

The F-35 program's depot repair capacity has been a key challenge for the program and has been an issue that we have reported on since 2017.[9] In October 2017, we reported that DOD did not have enough capacity to repair F-35 aircraft parts because it was 6 years behind schedule standing up those capabilities at military service depots. DOD—at the time of our review—was nearly 12 years behind schedule standing up those depots. F-35 program plans call for the development of 68 core

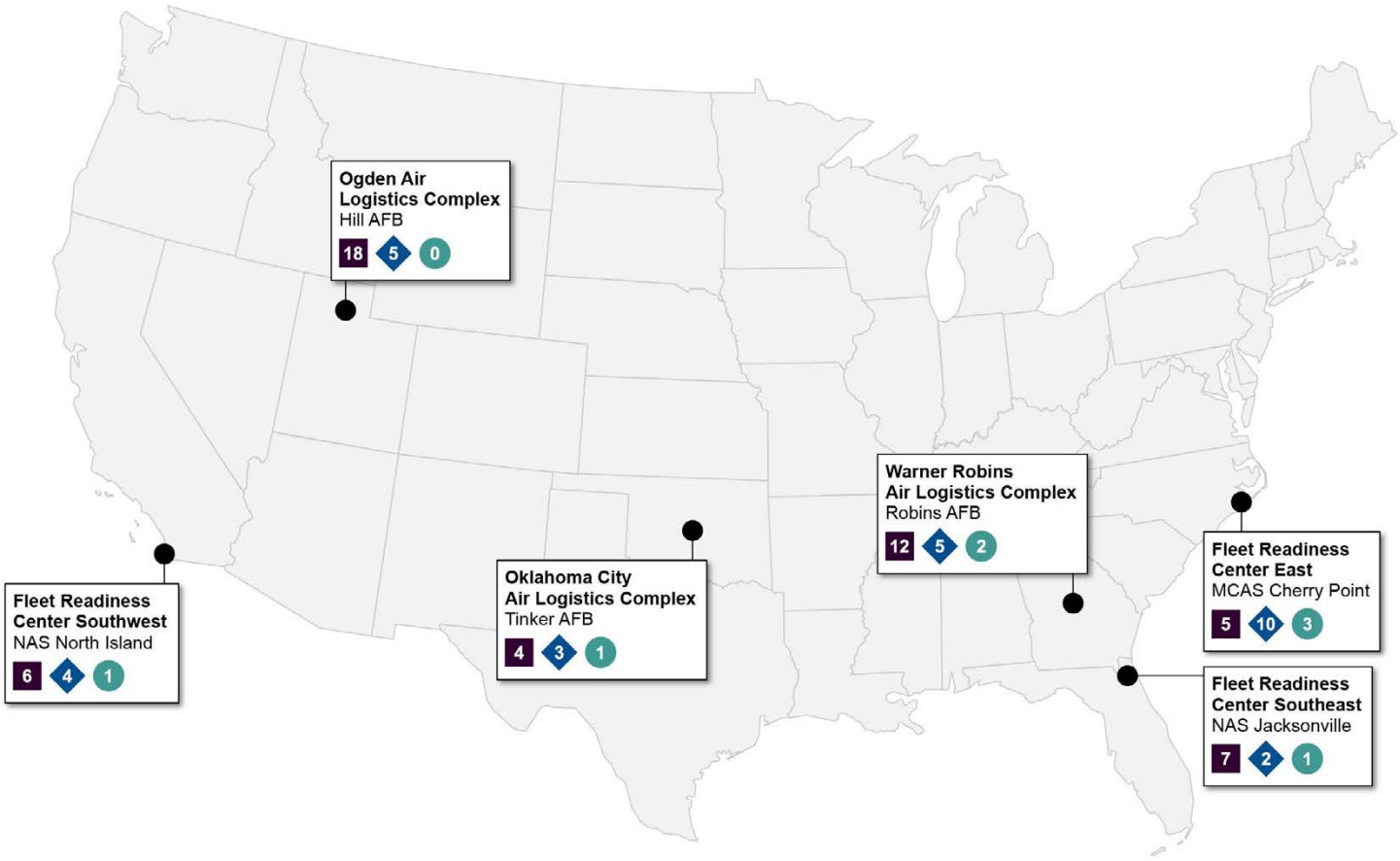
[9]GAO, *F-35 Aircraft Sustainment: DOD Needs to Address Challenges Affecting Readiness and Cost Transparency,* GAO-18-75 (Washington, D.C.: Oct. 26, 2017).

workloads (i.e., components that need repair and are comprised of many individual spare parts) at military service depots that would fulfill the program's depot repair capacity requirements.[10] For example, these components include landing gear, the power thermal management system, and the ejection seat.

As of April 2023, the F-35 program had activated (i.e., had the capability to repair) 44 of the 68 workloads at six different military service depots as shown in figure 5. However, DOD's revised projection is that the program will not establish depot repair capability for all component repairs (68 workloads) until 2027. Of the 44 activated workloads, six were fully activated in calendar year 2022. This was an increase of 12 workloads since 2020 and, according to DOD officials, nine to 11 additional workloads could be activated by the end of calendar year 2023.

[10]Section 2464 of title 10, United States Code, states that it is essential for the national defense that DOD maintain a core logistics capability that is government-owned and government-operated to ensure a ready and controlled source of technical competence and resources necessary to ensure effective and timely response to a mobilization, national defense contingency situations, and other emergency requirements.

Figure 5: F-35 Depot Locations and Workload Status as of February 2023



Source: GAO analysis of Department of Defense and contractor information; Map Resources. | GAO-23-105341

Accessible Data for Figure 5: F-35 Depot Locations and Workload Status as of February 2023

Category	Complete forty-eight total	In work thirty-two total	Planned ten total
Fleet Readiness Center Southwest NAS North Island	6	4	1
Ogden Air Logistics Complex Hill AFB	18	5	0
Oklahoma City Air Logistics Complex Tinker AFB	4	3	1
Warner Robins Air Logistics Complex Robins AFB	12	5	2

Category	Complete forty-eight total	In work thirty-two total	Planned ten total
Fleet Readiness Center East MCAS Cherry Point	5	10	3
Fleet Readiness Center Southeast NAS Jacksonville	7	2	1

Acronyms

- AFB - Air Force Base
- MCAS - Marine Corps Air Station
- NAS - Naval Air Station

Source: GAO analysis of Department of Defense and contractor information; Map Resources. | GAO-23-105341

Delays in standing up the F-35 program's depot repair capacity has had several effects, including slow repair times, a growing backlog of components needing repair, and lower aircraft readiness.

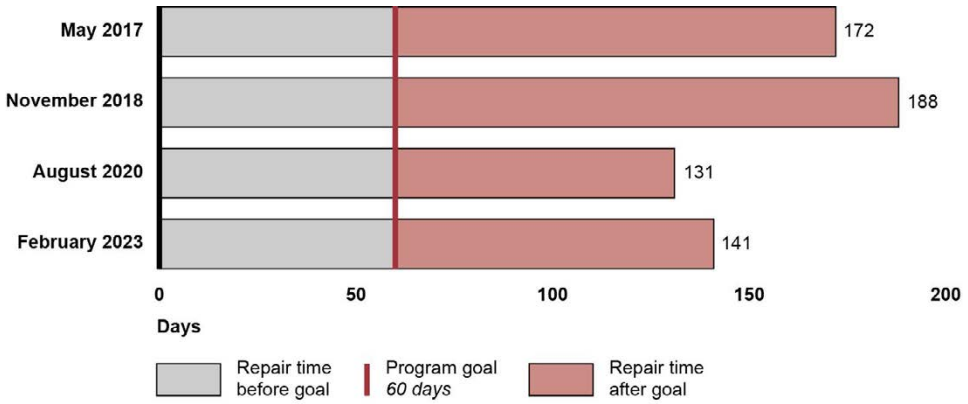
Slow Repair Times for Components

In October 2017, we reported that it took DOD an average of 172 days to repair an F-35 aircraft component, which, at the time was twice that of the program's 60- to 90-day objective.[11] The 172 days reflected the depot repair cycle time (DRCT), which is the time an unserviceable component is received by supply, inducted into the source of repair, repaired, and ready for issue.[12] As reflected in figure 6, DOD improved repair times to 131 days in August 2020. However, its progress has since slowed, with repair times averaging 141 days as of February 2023. The 141-day repair time was 81 days above the F-35 program's top-end goal of 60 days. According to DOD officials, the primary impediment to improving repair times was a lack of repair material for newly activated workloads. However, program officials anticipated having greater repair material starting in the second half of 2023, helping to steadily improve repair times. These officials also told us that they were still years away from achieving the program's goal.

[11]According to program officials, the program repair time goal is 60 to 90 days, depending on the complexity of the repair.

[12]Total DRCT includes, but is not limited to, administration delays, shipping delays, insufficient lay-in material, restocking delays and ALIS data entry.

Figure 6: Average Time for Repair of an F-35 Component Compared to the Program's Goal



Source: GAO analysis of DOD and Lockheed Martin information. | GAO-23-105341

Note: According to program officials, the program's repair time goal is 60 to 90 days depending on the complexity of the repair. We are using 60 days in the graphic to represent the top end of that goal.

Accessible Data for Figure 6: Average Time for Repair of an F-35 Component Compared to the Program's Goal

Date	Repair time before goal	Repair time after goal	Total repair time
May 2017	60	112	172
November 2018	60	128	188
August 2020	60	71	131
February 2023	60	81	141

Source: GAO analysis of DOD and Lockheed Martin information. | GAO-23-105341

Repair turnaround time is a significant component of DRCT. It measures the amount of time it takes to repair the component at either the military service depot or the original equipment manufacturer. According to program officials, military service depots have repaired components more than two times faster than the original equipment manufacturer.[13] As of March 2023, according to these officials, military service depots were repairing components, on average, in 72 days. Nearly half of the military service depots were repairing components at or better than the military services' depot target of a 30-day repair rate. Although the military services' depots were repairing components faster than the original equipment manufacturers, the vast majority of F-35 components were still sent to the original equipment manufacturers for repair. As of March

[13]An original equipment manufacturer is defined as a company that manufactures products that it has designed from purchased components and sells those products under the company's brand name.

2023, DOD was sending 73 percent of all F-35 components back to the original equipment manufacturer due to delays in standing up a full depot repair capability at the military services' depots. The depots, as of March 2023, were repairing about 57 percent of the components that have an activated workload. However, that equates only to just over 27 percent of total F-35 components. According to DOD officials, once the program establishes full depot repair capability, the military services' depots could be fixing nearly 65 percent of the F-35's components.

Growing Backlog of Components for Repair

In prior work, we reported the backlog of F-35 parts awaiting repair. In April 2019, we reported that about 4,300 parts were waiting for repair at depots or with the original equipment manufacturers.[14] In the report, we attributed this backlog mainly to the F-35 program's limited capacity to repair broken components. Since then, DOD has added new F-35s to its fleet, increasing the demand for repairs, while continuing to face delays establishing military service depot repair capacity. As a result, the number of parts waiting for repair increased to over 10,000 as of March 2023. However, according to DOD officials, approximately 70 percent of these parts were expected as part of the F-35's naturally functioning supply chain. Due to this growing list of parts awaiting repair, the F-35 Joint Program Office has purchased new parts instead of repairing the parts it already has in inventory. According to DOD officials, this is a practice that program officials do not believe is a sustainable solution. According to those same officials, this method keeps aircraft flying. However, it has resulted in higher sustainment costs because buying new parts generally costs more than repairing existing parts. These increased costs could further reduce the amount of money that DOD could use to stand up military service depot repair capacity.

Negative Effects of Lack of Repair Capacity on Aircraft Readiness

DOD's delays in standing up depot repair capacity have had and may continue to have a significant effect on readiness.

First, in April 2022, DOD completed an analysis to determine the effects that not having a completed depot repair capacity would have on the F-35 program. The analysis projected that if DOD achieved planned depot capacity, the air vehicle availability rates of the F-35B and F-35C would

[14]GAO, *F-35 Aircraft Sustainment: DOD Needs to Address Substantial Supply Chain Challenges,* GAO-19-321 (Washington, D.C.: Apr. 25, 2019).

be close to 65 percent, while the air vehicle availability rate of the F-35A would be close to 75 percent. The term air vehicle availability refers to the number of aircraft capable of performing at least one mission divided by all aircraft, including those in a depot status or undergoing major repairs.

If DOD does not achieve depot capacity, the analysis projected that the air vehicle availability rate for the F-35C would be below 50 percent, the F-35B would be close to 55 percent, and the F-35A would be about 60 percent—all significantly lower than if depot capacity is achieved. As of March 2023, air vehicle availability for the U.S. F-35 fleet was 51 percent, meaning that this figure will likely remain the same if depot repair capacity is not completed.[15]

Second, DOD officials in November 2022 told us that the lack of depot repair capacity contributes up to a 10 percent reduction in the F-35's mission capable rate, which stood at about 55 percent in March 2023.[16] The term mission capable rate refers to the percentage of time when an aircraft possessed by a squadron can fly and perform at least one of its tasked missions.

In particular, according to Joint Program Office data, six of the top 10 non-mission capable supply components were repaired primarily by the original equipment manufacturer. The term non-mission capable supply components refers to the components that are most frequently responsible for preventing the aircraft from being mission capable. These top 10 non-mission capable supply components are shown in figure 7.

[15]As of March 2023, the air vehicle availability rates for the U.S. fleet were: F-35A 50 percent, F-35B 50.9 percent, and F-35C 57.2 percent. The air vehicle availability goal for the F-35A is 90 percent and the goal for the F-35B and F-35C is 85 percent.

[16]The mission capable rate is determined by subtracting the percentage of time an aircraft is not available due to issues pertaining to supply or maintenance. The mission capable rate objective for the F-35A is 90 percent, while the mission capable rate objective for the F-35B and F-35C is 85 percent. Appendix III includes a comprehensive overview of the full mission capable rates for the program, broken out by variant, aircraft build date, and training and operational squadrons.

Figure 7: Top 10 Non Mission Capable Supply Components, as of April 2023

Source: GAO analysis of Joint Program Office information; Photo: U.S. Air Force/Airman 1st Class Zachary Rufus. | GAO-23-105341

Accessible data for Figure 7: Top 10 Non Mission Capable Supply Components, as of April 2023

Top ten non-mission capable supply components (as of April 2023)
Canopy
Distributed aperture system sensor
Engine[a]
Engine power module
Electro-optical targeting system window cover
Flexible linear shaped charge (not repairable)
Integrated core processor power supply
Nacelle vent fan
Pneumatic power source manifold
Power thermal management system controller

Source: GAO analysis of Joint Program Office information; Photo: U.S. Air Force/Airman 1st Class Zachary Rufus. | GAO-23-105341

[a]After an F-35B crashed in December 2022, program officials stated that they implemented an engine delivery pause while DOD and the contractors could identify the root cause of the accident..

All six of these components, which have been repaired primarily at the original equipment manufacturer, have either a partially activated workload at a military service depot or a workload that was not stood up

or activated at a military service depot.[17] This means that once DOD stands up these workloads, all of these components will be eligible and likely to be repaired at a military service depot. As a result, DOD could repair these components faster, since the depots have generally been repairing components faster than the original equipment manufacturers—as previously described. Generally, an improved military service depot repair capacity would help the U.S. fleet to achieve its goals for the mission capable rate. Further, we have previously reported on the problems faced by the F-35 program in repairing its engine. Specifically, in July 2022, we reported that the program had insufficient depot capacity to repair power modules, but had some plans in place to address this issue.[18] See appendix IV for an update on the status of sustaining the F-35's propulsion system.

Depot Maintenance Needs on the Air Vehicle Are Growing Due to Concurrent Development, Procurement, and Fielding

The current and future need to conduct periodic depot maintenance on F-35 aircraft at military service depots has created additional strain on the already inadequate depot capacity.

Current aircraft modification-based depot maintenance. Depot maintenance on the F-35 aircraft is conducted based on a modification-based approach that is flexible for aircraft operators because it does not require them to commit to sending specific aircraft to depots on specific dates. The need for these aircraft modifications stems from the concurrent development and production of the F-35 aircraft. DOD's F-35 acquisition plan has called for aircraft to be developed, produced, and fielded at the same time. This strategy—known as concurrency—builds aircraft while continuing to refine and test key components. We previously reported that concurrency is a major driver behind the F-35 program's

[17]The flexible linear shaped charge is an explosive and therefore must be replaced with a new part and cannot be repaired by a military service depot or original equipment manufacturer.

[18]GAO-22-104678.

significant cost and schedule growth as the program continues to identify and resolve deficiencies while purchasing aircraft at high rates.[19]

The F-35 program currently operates under low-rate initial production, which is intended to result in completion of manufacturing development to ensure adequate and efficient manufacturing capability and to produce the minimum quantity necessary to provide production for Initial Operational Test and Evaluation, establish an initial production base for the system, and permit an orderly increase in the production rate for the system, sufficient to lead to Full Rate Production upon successful completion of operational testing.[20] Once the program can demonstrate control of the manufacturing process, acceptable performance and reliability, and the establishment of adequate sustainment and support, the program can declare full rate production of the aircraft. However, after over 10 years of producing and developing the F-35, as of April 2023, DOD officials had not established when low rate initial production will end and full rate production will be declared.

Although DOD has not declared full rate production, according to DOD officials, the F-35 program has generally procured aircraft at full rate production levels over the last several years. This has exacerbated sustainment issues for the program, including increasing the risks associated with modification-based depot maintenance. We previously reported that high levels of concurrency make it difficult to sustain already fielded aircraft.[21] Low rate initial production aircraft, according to DOD officials, are delivered in lots that are inherently a different configuration due to nominally increased capabilities that create configuration management problems for the program.

The F-35 program will deliver its 15th lot in 2023, meaning that the aircraft's configurations have varied throughout the last decade. According to the department's Director of Operational Test and Evaluation, aircraft as recent as production Lot 12, have required repairs

[19]GAO, *F-35 Joint Strike Fighter: Cost Growth and Schedule Delays Continue,* GAO-22-105128 (Washington, D.C.: Apr. 25, 2022).

[20]According to DOD officials, although the F-35 program is technically in low rate production and Milestone C, which is the acquisition milestone to transition to higher rate production, the program has been delivering aircraft at high production rates for many years without establishing the expected common design baseline.

[21]GAO-21-439.

and modifications to designs after testing led to significant discoveries, including the need to modify already fielded aircraft.[22] As a result, earlier production lot aircraft will require modification packages to upgrade to modern configurations. For example, as of April 2023, Ogden Air Logistics Complex, an Air Force-operated depot in Ogden, Utah and Fleet Readiness Center East, a Navy operated depot in Cherry Point, North Carolina, were modifying just under 30 aircraft. As the F-35 fleet grows, DOD officials said that the program will need to expand its depot capacity to conduct additional modification-based depot maintenance.

As of April 2022, nearly half of all F-35's in the U.S. fleet in their eighth year of service or older have spent a year or longer undergoing depot-level maintenance upgrades. Depot officials told us they were currently working on at least 14 different versions of the F-35, which makes it difficult to provide depot maintenance in an efficient manner.[23] Those same officials estimated that depot-level upgrades typically require thousands of workload hours per aircraft and an extended stay in the depot for each aircraft. Officials at the program's two air vehicle depots told us there are extensive variations in the workload required for each modification package and they maintain different aircraft configurations because of hardware differences across production lots. This makes scheduling and planning for depot maintenance challenging because the number of hours spent on and the type of work conducted on each F-35 modification package fluctuates considerably. Officials also said the program sometimes makes late modifications to the required repairs, which can contribute to delays because the depot needs to find additional personnel to repair aircraft.

Future aircraft depot maintenance. Over the planned 70-year operational life cycle of the F-35 program, aircraft will continue to need

[22]Department of Defense, Director, Operational Test & Evaluation, *FY 2020 Annual Report* (January 2021).

[23]We previously reported that DOD's acquisition strategy called for high levels of concurrency, or overlap among development, testing and production. In our prior work, we identified these high levels of concurrency as major drivers of the F-35's significant cost and schedule growth, as well as performance shortfalls that the program has experienced since its inception. 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) and *Joint Strike Fighter: DOD Actions Needed to Further Enhance Restructuring and Address Affordability Risks*, GAO-12-437 (Washington, D.C.: June 14, 2012).

periodic depot maintenance to reach their expected service lives.[24] According to DOD officials, after aircraft enter operation and begin flying, they experience stress that can degrade parts or weaken components on the airframe. DOD's decisions on when aircraft visit depots and how much depot maintenance takes place varies across the different aircraft in DOD's inventory. Some other DOD fighter aircraft—such as the Air Force's F-15 and Navy's F/A-18s—use calendar-based maintenance to schedule depot visits at regular intervals.[25] The F-15 receive depot maintenance about once every 6 years. The F/A-18 receive depot maintenance every 4 or 6 years. Also, this construct can be based on flying hours, where aircraft are scheduled for depot maintenance as the aircraft reach a specific flying-hour threshold.

The F-35 program's decision to use modification-based scheduling—as previously described—may be revisited in the future, with potentially long-term implications for the availability and longevity of the fleet. Officials at Fleet Readiness Center East told us the military services were considering adding calendar-based maintenance to their F-35 depot plans within the next 8 years, though they were unsure how it would fit into the existing modification schedule. A modification-based approach could provide more flexibility to the services as the Air Force has experienced with the F-16—another fleet in which depot maintenance has been conducted through a modification approach. However, planned depot maintenance—either based on a time frame or a flying hour requirement—can make forecasting workloads and scheduling a depot workforce more efficient.

The military services could make different decisions on when to perform depot maintenance on the different variants of the F-35. For example, the Navy could determine a different depot maintenance schedule for the F-35B and F-35C variants because these aircraft operate in corrosive maritime environments, with F-35Cs using structurally demanding catapults and tailhook-arrested landings. The Air Force's F-35A variants do not operate under those conditions. According to DOD officials, the military services will have to make these decisions based on their unique operational requirements. Further, deciding to conduct more near-term, costly depot maintenance may result in longer flying aircraft and lower maintenance costs across their life cycle. Ultimately, each service must

[24]Individual F-35 aircraft are expected to be in service for 30 years.

[25]DOD also refers to this type of calendar-based maintenance as programmed depot maintenance or planned maintenance intervals.

decide the best way to sustain their fleet of F-35 aircraft based on competing budgets, priorities, and force structure requirements. However, the military services have not yet made these decisions.

F-35 Program Faces Several Challenges Associated with Depot-Level Maintenance

Three challenges—lack of prioritizing funding, heavy reliance on contractors, and lack of technical data—have affected the department's ability to build depot maintenance capability.

Funding prioritization challenges have historically delayed depot capacity. As we reported in July 2021, the F-35 program deviated from its original strategy to establish an organic military service capability for depot repairs by 2016, due to adjustments in funding priorities earlier in the program's history. Once the program deviated from establishing an organic military service capability for depot repairs by 2016, according to DOD officials, it failed to adequately plan for an alternative repair capacity that would compensate for the decision. As a result, the program's depot repair capacity still remains behind schedule.

When future funding is not adequately planned or prioritized, workloads are not activated and depots cannot provide adequate maintenance on aircraft. For example, Fleet Readiness Center East cannot conduct planned modification-based depot maintenance because the Navy delayed funding for infrastructure improvements through 2025. Officials from Fleet Readiness Center East told us they planned to have enough dock space (i.e., a spot in a hangar that supports depot maintenance activities) to support concurrency-driven modifications. However, the Navy has not prioritized funding for these facilities. As a result, Fleet Readiness Center East did not have sufficient dock space as planned and the F-35 program had to revise its plans. The F-35 program decided that F-35B and F-35C aircraft originally planned for depot maintenance at Fleet Readiness Center East prior to 2027 had to be shifted to Ogden Air Logistics Complex, where plans were in the works to ensure that it can absorb this unexpected depot maintenance workload.

According to F-35 Joint Program Office officials, the most significant reason historically for delays in standing up a depot-repair capability is the lack of funding from the military services as part of the non-annualized sustainment contracts. DOD officials told us the military services have not made it a priority to fund depot activations and have instead prioritized

other areas in their budgets over F-35 depot maintenance. These officials also said this was a common theme for DOD weapon systems, noting that the services tend to prioritize funding for the acquisition of new weapon systems over sustaining current systems. However, according to DOD officials, recognizing this recurring issue in the program, the military services deferred procurement of F-35 aircraft to fully fund known depot requirements in the summer of 2022, with activation contracts planned to be awarded by the end of 2023. Ensuring continued focus on establishing a depot-repair capability is critical to supporting the swiftly growing U.S. fleet throughout the remainder of the 2020s and to meeting program-established objectives, such as mission capable rates.

Heavy reliance on contractors at the depot level. DOD performs depot maintenance in the F-35 program under a Public-Private Partnership. In a Public-Private Partnership, the prime contractor leads depot maintenance, including planning and management. The F-35 program office provides oversight of the contractor. However, the U.S.-government depots act similar to subcontractors and depend on direction from the contractor.[26] The U.S.-government depot provides the facilities and manual labor for the depot maintenance and the prime contractor provides management oversight, guidance, and components and spare parts for their activities. This structure leaves the government, according to DOD officials, with limited decision-making ability to influence critical aspects of depot maintenance.

Providing depot maintenance to F-35 aircraft is a large and complex undertaking that involves many sub-contractors beyond the prime contractor. For example, over 30 original equipment manufacturers are heavily involved in developing F-35-component repair capability at military service depots.[27] The F-35 acquisition strategy indicates that the prime contractor is to sub-contract with each original equipment manufacturer, manage their performance, and report back to the Joint Program Office. Officials within DOD told us the government pays the prime contractor to integrate sub-contractors since this is easier than the Joint Program Office working directly with each manufacturer. However, this method is

[26]DOD's *Product Support Manager Guidebook* describes the Public-Private Partnership as a relationship in which the government entity (such as the depot) acts as a subcontractor. DOD, *Product Support Manager Guidebook* (May 2022). DOD's Public-Private Partnering for Product Support Guidebook characterizes the relationship as being like a subcontractor relationship. DOD, *Public-Private Partnering for Product Support Guidebook* (Oct. 2016).

[27]Lockheed Martin, *F-35 Depot Implementation Plan* (Mar. 2, 2022).

expensive for the program, with the government relying on the prime contractor, who then relies on a variety of subcontractors to provide services to accomplish depot repairs. Ultimately, the government has been unable to perform a full range of depot maintenance without the contractor's participation. Depot officials told us they are in a challenging position—a government entity, but one that must work through and is reliant on the prime contractor and other commercial sub-contractors responsible for maintaining the F-35.

Lack of technical data slows depot maintenance. As we previously reported, a lack of access to technical data prevents government maintainers from performing certain repairs to the F-35.[28] This is true at the depot level as well, with the prime contractor and sub-contractors possessing unique proprietary technical data. Program officials said manufacturers are unwilling to pass proprietary information through the prime contractor to DOD as they may expose information that may reduce their competitiveness as a private sector entity.

Officials at both depot locations we visited said that the lack of technical data and incomplete technical data has delayed depot repair times. For example, according to officials from one depot we visited, components needing repair come with a Depot Component Maintenance Manual. However, these manuals are ambiguous and rarely are detailed enough for depot personnel to make the repair. As a result, depot personnel not only cannot fix the part, but they cannot learn and understand how to fix the part.

Furthermore, disputes between the U.S. government, the prime contractor, and subcontractors over proprietary technical data have delayed the activations of several depot maintenance workloads, pushing some out to the 2028 time frame. For example, according to DOD officials, one of the F-35 program's primary subcontractors has been in contractual discussions with the U.S. government over, among other things, sharing its proprietary technical data. DOD officials told us that the subcontractor is hesitant to share its technical data because of the oversight the prime contractor has over the program and not wanting the technical data to end up in the prime contractor's control. Furthermore, officials we spoke to at Fleet Readiness Center East told us that this particular subcontractor has been difficult to work with because its officials have not been responsive to requests for additional technical

[28]GAO-21-439.

data to assist with component repairs. Without the technical data, according to Fleet Readiness Center East officials, the components remain left in disrepair until the original equipment manufacturer provides the sufficient data for maintenance personnel to move forward with the repair.

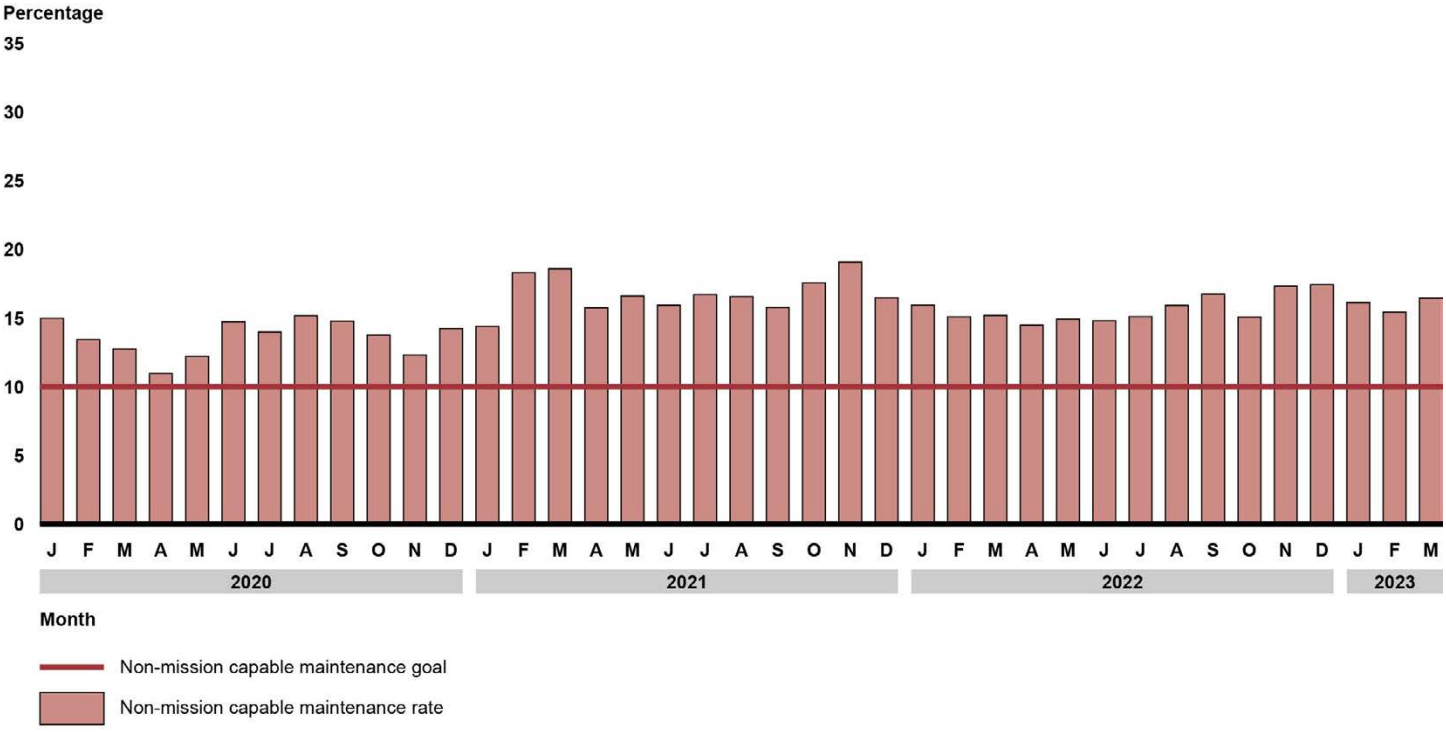
The lack of intellectual property delivery has also been problematic as DOD attempts to stand up a software maintenance repair component to the current depot structure. F-35 aircraft have required over 8 million lines of software code, all of which has been written by its prime contractor and subcontractors. Currently, these same contractors, according to a DOD official, manage and repair the code. According to a cognizant DOD official, the F-35 program has known for more than five years that it wants to take over software sustainment. The official stated that the military services have the capability to sustain software because they have been doing it on other aircraft for years; however, the F-35 program has not acquired the necessary source code to sustain F-35 software and this military service capability remains unused. Standing up a software maintenance repair component to supplement the overall depot structure, according to the F-35 Joint Program Office, is slow due to source code access and intellectual property issues. The F-35 Joint Program Office has labeled software sustainment as a major source of risk to the current sustainment strategy.

These 3 challenges—lack of prioritizing funding, a heavy reliance on contractors, and the government not having sufficient technical data—have hindered the F-35 program's ability to stand up necessary depot repair capabilities, resulted in a lower-than-expected depot repair capability, negatively affected readiness, and increased costs. Below, we describe these sustainment-related challenges and DOD's efforts to address them as they plan for the future of F-35 sustainment.

F-35 Organizational-Level Maintenance Challenges Reduce Aircraft Readiness

Since January 2020, the F-35 fleet has exceeded its non-mission capable maintenance goal of 10 percent by an average of 5 percent, as shown in figure 8. 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 conduct any of their assigned missions because of maintenance.

Figure 8: F-35 Non-Mission Capable Maintenance Rates, January 2020 through March 2023



Source: GAO analysis of Joint Program Office data. | GAO-23-105341

Accessible Data for Figure 8: F-35 Non-Mission Capable Maintenance Rates, January 2020 through March 2023

Month	Non-mission capable maintenance rate	Non-mission capable maintenance goal
January 2020	14.98	10
February 2020	13.43	10
March 2020	12.74	10
April 2020	10.97	10
May 2020	12.2	10
June 2020	14.73	10
July 2020	13.99	10
August 2020	15.18	10
September 2020	14.78	10
October 2020	13.77	10
November 2020	12.32	10
December 2020	14.23	10
January 2021	14.41	10
February 2021	18.3	10

Month	Non-mission capable maintenance rate	Non-mission capable maintenance goal
March 2021	18.58	10
April 2021	15.75	10
May 2021	16.61	10
June 2021	15.94	10
July 2021	16.72	10
August 2021	16.57	10
September 2021	15.79	10
October 2021	17.57	10
November 2021	19.08	10
December 2021	16.48	10
January 2022	15.95	10
February 2022	15.11	10
March 2022	15.2	10
April 2022	14.49	10
May 2022	14.92	10
June 2022	14.8	10
July 2022	15.12	10
August 2022	15.93	10
September 2022	16.75	10
October 2022	15.08	10
November 2022	17.33	10
December 2022	17.44	10
January 2023	16.14	10
February 2023	15.44	10
March 2023	16.46	10

Source: GAO analysis of Joint Program Office data. | GAO-23-105341

During site visits to three F-35 operational installations and a survey of all 15 F-35 installations identified by DOD personnel as of April 2022, maintainers reported a number of challenges they face in maintaining the F-35 at the organizational-level. These challenges include insufficient and unavailable technical data (including part numbers), spare parts, support equipment, and training for maintainers. In general, maintainers at all three locations we visited tied these challenges back to the limited capacity and capability of the military services' maintenance units in conducting organizational maintenance as a result of being reliant on the contractor.

Lack of technical data. Maintainers that we spoke with at all three installations stated that a lack of technical data, or information needed to make specific repairs, prevents them from making certain repairs. The contractor and the original equipment manufacturer of specific components control the technical data necessary to understand, troubleshoot and repair many of the F-35's components, which limits the effectiveness of the services' maintainers. For example, officials at one installation stated that the principal reason why an aircraft would be classified as non-mission capable maintenance is that some repairs are very complex and require intensive troubleshooting that maintainers are not able to do because the procedures are not covered in technical data provided to maintainers.[29] As a result, the unit and squadron needs to request field service representatives (e.g., contractor personnel) to assist in what maintainers told us were routine troubleshooting activities.

Furthermore, maintainers at all three installations we visited said that they had grown frustrated at not being able to make simple repairs to aircraft components that they have historically made on other fighter aircraft fleets. According to maintainers, if they are not able to remove or repair a component due to not having access to the technical data, the unit or squadron must request a contractor to assist. For example, maintainers from one installation told us that on a recent deployment they experienced ejection seat issues that, due to not having access to technical data, required the unit or squadron to helicopter to the ship a contractor representative from the original equipment manufacturer to make the repair.

Faced with maintenance-related issues not covered in the technical data to which they have access, maintainers can either: return the component to the original equipment manufacturer for repair which, as previously described, can have a long turnaround time; or they submit a request to obtain additional guidance from the contractor, which also slows the repair of an aircraft. According to maintainers we spoke to, it can take up to 60 days to receive a response to technical data requests. For more complex problems related to technical data, maintainers say they have had to submit multiple requests that extended 60 days or more.

[29]The Joint-Service Technical Data program and supporting activities are intended to enable sustainment readiness by providing the capability to keep all F-35 air system flight and maintenance procedures updated on a near real-time basis.

Another example of a recurring technical data issue in the program is a lack of access to part numbers. In our survey of F-35 installations, all of the respondents indicated they had to rely to some extent on contractors to get the part numbers of components they need to order. Seven of 14 installations stated that they had to ask the local contractor representative for a part number about half or most of the time.[30] Three of 14 installations stated they always had to ask local contractor representatives for part numbers. Additionally, maintainers at all three installations we visited described access to part numbers as a recurring issue and one that slows down the maintenance process. According to maintainers we spoke to, part numbers reside in a database that is proprietary to the prime contractor. Maintainers do not have access. Not having ready access to part numbers hinders the repair of the aircraft because it delays the ordering and receipt of needed parts. Maintainers at one installation we visited told us that they would not need contractors on the flight line if they simply had access to part numbers. However, since access to part numbers is an issue that can affect readiness of the aircraft, units and squadrons need contractors on a daily basis.

The Joint Program Office has a program, the F-35 Maintenance Value Stream, that includes the Maintenance Plan Change Process designed to improve the maintenance capability of the maintainers in the field, and if successful, could reduce the number of Action Requests and technical data change requests submitted.[31] The Maintenance Plan Change Process continuously reevaluates maintenance plans to seek to optimize unit-level maintenance capability while minimizing cost and attempts to provide maintainers with the necessary support equipment and technical data guidance to do the work. For example, we spoke with maintainers at one installation that can repair specific components of the ejection seat they were previously not able to repair.

According to officials, DOD has completed 144 projects to improve maintainers' ability to conduct aircraft maintenance as of April 2023 and plans to implement another 114 projects in the future. However, the Joint Program Office has encountered recurring issues with implementing these projects. Specifically, according to F-35 Joint Program Office officials, the inability to obtain the requisite technical data—often due to

[30]Only 14 of the 15 installations we surveyed answered this question.

[31]Action Requests are concerns or questions raised by a customer or user about any area of the F-35 system. Action Requests are processed through the F-35 Autonomic Logistics Information System.

the associated cost of procuring such data and extensive delays due to vendor negotiations—prevents many of the planned projects from ever getting started. The program office, according to these same officials, is also trying to improve maintainers' access to part numbers.

In September 2014, we recommended that DOD develop a long-term Intellectual Property (IP) Strategy for the F-35 program to include, but not be limited to, the identification of current levels of technical data rights ownership and all critical technical data needs.[32] Nearly a decade later, DOD has not implemented this recommendation. We continue to believe that an IP Strategy is an important step for the future of F-35 sustainment.

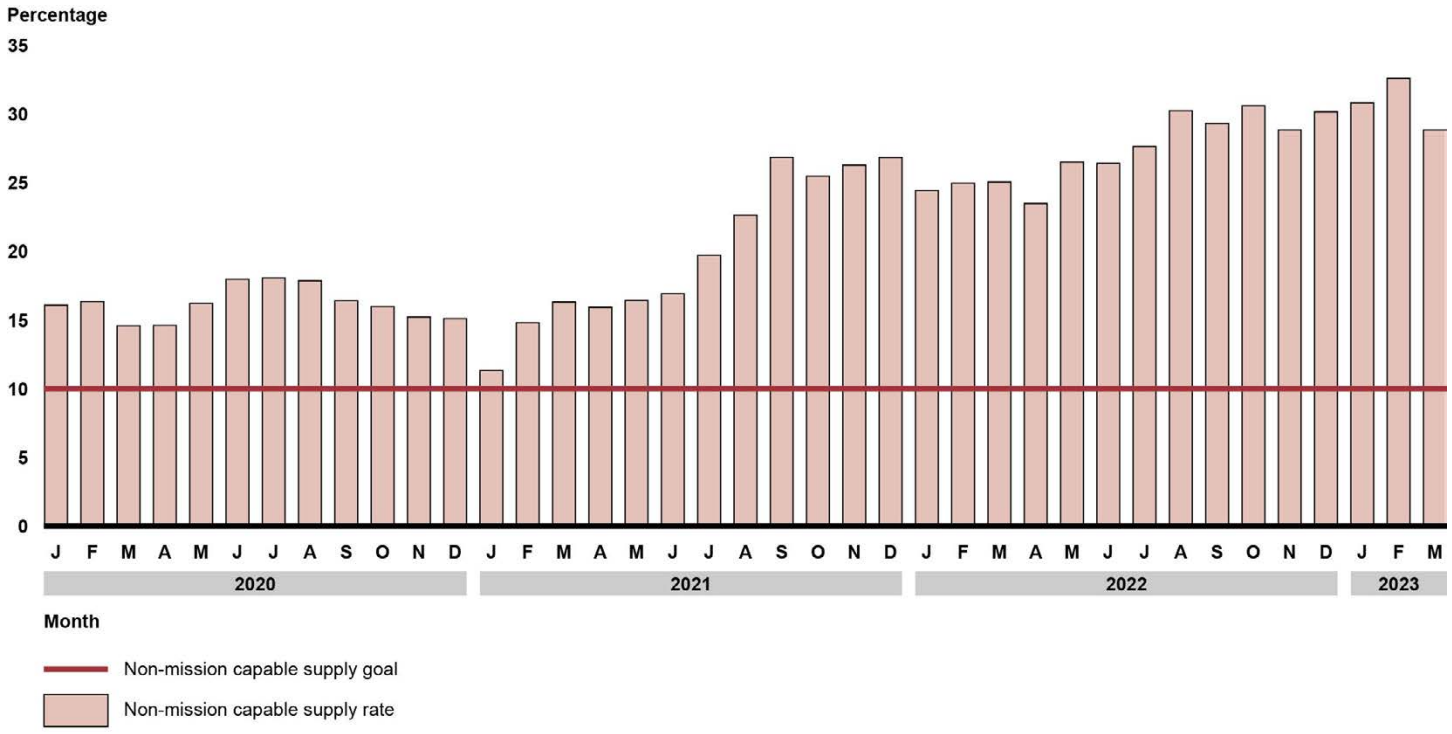
Lack of availability of spare parts. In our survey of F-35 installations, officials at 10 of 15 installations stated that a significant day-to-day maintenance challenge for the F-35 was the availability of spare parts. This challenge is borne out in data from the F-35 Joint Program Office, which shows that during fiscal year 2022, about 27 percent of the time F-35 aircraft at U.S. units were unable to operate due to the lack of a spare part.[33] Specifically, DOD tracks the availability of spare parts and its effects on readiness with the non-mission capable supply rate metric. This rate increased from an average of about 17 percent in fiscal year 2020 to about 27 percent in March 2023 as shown in figure 9. In July 2021, we reported that the prime contractor projected that non-mission capable supply rate in 2022 would settle around 16 percent.[34] Additionally, in that same report, officials from the F-35 Joint Program Office told us that the program planned to fund enough spare parts to achieve approximately 15 percent non-mission capable due to supply for the air vehicle because funding to anything lower than 15 percent was not affordable.

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

[33]In a previous report, we noted that parts shortages increased significantly in 2022. DOD officials attribute recent parts shortage increases to staffing and quality issues throughout the supply chain. Lockheed Martin is evaluating the capacity of its suppliers and focusing on improving delivery of late parts that most affect production. GAO, *F-35 Joint Strike Fighter: More Actions Needed to Explain Cost Growth and Support Engine Modernization Decision*, GAO-23-106047 (Washington, D.C.: May 30, 2023).

[34]GAO-21-439.

Figure 9: F-35 Non-Mission Capable Supply Rate, January 2020 through March 2023



Source: GAO analysis of Joint Program Office data. | GAO-23-105341

Accessible Data for Figure 9: F-35 Non-Mission Capable Supply Rate, January 2020 through March 2023

Month	Non-mission capable supply rate	Non-mission capable supply goal
January 2020	16.09	10
February 2020	16.35	10
March 2020	14.59	10
April 2020	14.62	10
May 2020	16.22	10
June 2020	17.97	10
July 2020	18.08	10
August 2020	17.86	10
September 2020	16.4	10
October 2020	15.99	10
November 2020	15.23	10
December 2020	15.12	10
January 2021	11.33	10
February 2021	14.8	10

Month	Non-mission capable supply rate	Non-mission capable supply goal
March 2021	16.31	10
April 2021	15.94	10
May 2021	16.43	10
June 2021	16.92	10
July 2021	19.72	10
August 2021	22.65	10
September 2021	26.86	10
October 2021	25.48	10
November 2021	26.29	10
December 2021	26.84	10
January 2022	24.43	10
February 2022	24.97	10
March 2022	25.05	10
April 2022	23.48	10
May 2022	26.51	10
June 2022	26.41	10
July 2022	27.64	10
August 2022	30.24	10
September 2022	29.32	10
October 2022	30.6	10
November 2022	28.84	10
December 2022	30.16	10
January 2023	30.81	10
February 2023	32.6	10
March 2023	28.84	10

Source: GAO analysis of Joint Program Office data. | GAO-23-105341

Maintainers we talked to at all three installations told us that the supply chain process, a process managed by the prime contractor, often prevents maintainers from doing their job because of a lack of parts and not knowing when they will be received.

First, maintainers at these locations stated that there were not enough parts on site to support day-to-day maintenance operations on the flight line. From July 2021 through June 2022, installations were able to fill an average of 75 percent of requisitions from the stock of parts and supplies kept at F-35 installations, but had to go off installation to fill 25 percent of the requisitions for parts and supplies. Of the requisitions that were sent off the installation, 14 percent of priority one requisitions and 24 percent

of priority two requisitions were unfilled after 10 days. As a result, maintainers were unable to put the necessary parts in aircraft.[35] At one installation, maintainers told us that issues with spare parts and the supply chain were exacerbated during deployments and can lead to aircraft being grounded for long periods of time. On a recent deployment, maintainers told us that one of their aircraft was grounded for 3 months because it did not have the necessary parts.

Second, traditionally, military services' supply officers can see where parts are and have a realistic idea of when those parts will be received, according to DOD officials. However, they noted that because the F-35 program's prime contractor manages and controls the supply chain, it is not always clear when parts are ordered, tracked, and when they are estimated to arrive.

One example of a problematic part is the F-35's Distributed Aperture System sensor. Maintainers at one installation we visited said that there are workarounds to deal with broken Distributed Aperture System sensors that allow for the aircraft to continue flying. However, broken Distributed Aperture System sensors are a Full Mission Capability degrader. As of May 2023, there were Distributed Aperture System sensors labeled as mission impaired capability awaiting parts, which impacts the utility of the aircraft assigned to those sensors.

The F-35 Joint Program Office was aware of the program's overall spare parts issue and was looking at several ways to fix it, including with performance-based logistics contracts, which they believed would increase access to spare parts. However, officials told us that the investment required to stock sufficient parts and supplies at each installation to meet all readiness demands was not a practical consideration because of cost. We previously reported that problems with the F-35's supply chain, including a lack of spare parts, hindered DOD's ability to meet warfighter performance requirements. We made several

[35]We have previously reported that a lack of repair parts reduces F-35 readiness. In April 2019, we reported that lower-than-desired aircraft performance was due largely to F-35 spare parts shortages and difficulty in managing and moving parts around the world. We made eight recommendations focused on the F-35 supply chain. DOD concurred with all of these recommendations. In July 2021, we reported that DOD had implemented two of the recommendations and that the F-35 program had made improvements in three areas: spare parts availability, customer wait time, and depot-level repair. However, in spite of these improvements the program continues not to meet program objectives in each of those areas. GAO-19-321 and GAO-21-439.

recommendations to address these issues, including that DOD conduct a comprehensive review of the F-35 supply chain and develop a process to modify spares packages. DOD concurred with our recommendations; however, some of these recommendations have not been implemented.[36]

Other DOD officials have told us that recurring issues about parts reliability and maintainability continue to negatively affect the program and increase the demand for parts. The F-35 program has reliability and maintainability goals aimed at ensuring that an aircraft will be available for operations as opposed to being out of service for maintenance. In April 2022, we reported that reliability and maintainability performance had declined.[37] Specifically, we found the program was meeting 11 of its 24 goals as of December 2021.

In recent years, we made a number of recommendations to improve the F-35's reliability and maintainability, and the program has taken some actions to address them. Specifically, in 2018, 2019, and 2020, we made six reliability and maintainability-related recommendations.[38] DOD concurred with all but one of our recommendations and identified actions aimed at addressing them. To date, DOD has implemented four of the six recommendations. As of July 2023, DOD has not, for example, assessed whether its reliability and maintainability goals are still feasible and made revisions, as appropriate. The F-35 Joint Program Office reported that they are still working to identify what, if any, goals need revision. As we previously reported, when programs overpromise a weapon's prospective performance and deliver systems that cannot achieve their requirements, such as reliability and maintainability goals, the warfighter receives less capability than originally promised. It is important for DOD, the F-35 Joint Program Office, and the military services to determine the realistic expectations for the reliability and maintainability of the aircraft and its

[36]GAO-19-321.

[37]These metrics represent a 3-month average and reflect a snapshot in time. Measurable improvements can take time to manifest and metrics can fluctuate substantially from month-to-month. See GAO-22-105128.

[38]GAO, *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); *F-35 Joint Strike Fighter: Action Needed to Improve Reliability and Prepare for Modernization Efforts*, GAO-19-341 (Washington, D.C.: Apr. 29, 2019); and *F-35 Joint Strike Fighter: Actions Needed to Address Manufacturing and Modernization Risks*, GAO-20-339 (Washington, D.C.: May 12, 2020).

parts, so that it can adequately plan sustainment activities as well as understand potential cost implications on sustainment.

Lack of available support equipment on the flight line. Support equipment consists of all equipment (mobile or fixed) that is not inherently part of the primary weapon system but is required to support the operation and maintenance of the aircraft. Maintainers need a variety of support equipment that provides a myriad of different functions including, but not limited to, conditioned cool air (as shown in figure 10), electric power, hydraulic power, and towing to conduct field level maintenance of F-35s. According to maintainers we spoke to at all three installations we visited, the amount of support equipment needed to maintain the F-35 is by far greater than other aircraft platforms in their respective fleets. According to maintainers at one installation, on a short-notice deployment, the squadron required 13 C-17s to transport the support equipment to maintain 12 F-35 aircraft. However, none of the installations we surveyed and no maintainers we spoke to at the three installations we visited said that they always had readily available support equipment on the flight line.

Figure 10: Conditioned Air Cart for the F-35's Power and Thermal Management System

Source: Copyright © Lockheed Martin Corporation. All rights reserved. | GAO-23-105341

For example, maintainers at one installation told us that they had enough support equipment to provide power and air to only two aircraft, and were constantly being forced to borrow support equipment from other squadrons. According to maintainers at another installation, borrowing support equipment from other squadrons has become a normal practice. Maintainers at two of the three installations we visited told us that the issue is exacerbated when squadrons deploy because the deploying contingent will take most of the support equipment from the installation to support the deploying aircraft, leaving the remaining contingent of the squadron scrambling for support equipment to maintain the non-deploying aircraft. Maintainers can contact the Lightning Sustainment Center for assistance, and personnel there will contact other services and program participants to find available equipment. However, DOD officials said there was no pool of support equipment that units could pull from to cover shortages. Rather, the support equipment would need to be taken from other F-35 units across the enterprise.

Furthermore, maintainers at all three installations we visited told us that support equipment was breaking too frequently and, due to the proprietary nature of most of the equipment, they were not able to repair it themselves. As a result, contractor representatives either have to come to the installation to repair the equipment, or the equipment is sent back to the original equipment manufacturer. Like components, support equipment can take original equipment manufacturers months to repair. Maintainers we spoke to at one installation said that they have the capability to repair a lot of the broken support equipment at their installation; however, they are not able to do so. They stated that their inability to repair the equipment is having a negative effect on readiness; however, they could not provide the degree.

The prime contractor is the primary manager of support equipment for the F-35 program. According to program officials, the military services and the F-35 Joint Program Office, in conjunction with several program contractors, are responsible for determining the requirements and related costs for support equipment needs. According to these same officials, similar to depot maintenance funding, support equipment funding—controlled by the services—has been lacking because the primary focus is on acquisition over sustainment. Also, whatever funds are left over from aircraft purchases may or may not end up going toward support equipment. However, these officials said this will not be the case for future aircraft purchases because DOD plans to focus on funding all required support equipment to the appropriate levels.

Inadequate training of F-35 maintainers. F-35 training remains a challenge for the program. We previously reported on training-related issues with the F-35 program, including the inadequacy of maintainers' training on the F-35 Autonomic Logistics Information System (ALIS).[39] Similarly, during this review, maintainers at all three installations we visited told us that the maintenance-specific training for the F-35 was largely inadequate. Maintainers told us they learned how to maintain the aircraft through on-the-job-training. Maintainers at one location added that the initial training they received was mostly classroom based, relied on PowerPoint slides provided by the prime contractor, provided very little hands-on training, and was inadequate for the purposes of learning and understanding the aircraft. Maintainers from all three installations echoed the importance of training for the F-35, including hands-on and simulator training, due to the complex nature and unique features of the aircraft.

Personnel we spoke to from one Field Training Detachment acknowledged that the training they provided was poor and inadequate. The personnel said that because the prime contractor leads and manages training for the overall program, the contractor also controls the types of information that is released to F-35 maintainers. Since so much of the technical data used to maintain the aircraft is proprietary and unavailable to the military services, trainers in the military services cannot develop effective training programs for maintainers. For example, maintainers at one location told us that maintenance manuals for other fighter aircraft, like the F-15 and F-16, contain systems descriptions with a theory of operation that explain in detail how a system operates. This information, they explained, helps maintainers understand the how and why behind repairs and aids in troubleshooting problems that are not addressed in the Joint-Service Technical Data.

However, F-35 maintainers at one location told us that they have access to so little technical information on the aircraft that they do not fully understand the aircraft or how to troubleshoot common problems. As a result, the maintainers frequently rely on contractor personnel for assistance in maintenance tasks they would be otherwise qualified to complete. According to program officials, maintenance-related training for the F-35 is important and something that is steadily improving over time. However, due to the way DOD structured F-35 sustainment, including having limited access to technical data and giving the prime contractor a

[39]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).

significant role with respect to training, DOD is sometimes limited in the improvements it can make.

DOD Does Not Have a Clear Pathway to Transition to More Government Sustainment

DOD designed the F-35 program so that contractors control the majority of sustainment operations. However, in recent years, DOD has expressed a desire to have more governmental control over sustainment activities. For example, in an April 2022 congressional testimony, the Acting Assistant Secretary of Defense for Sustainment stressed the importance of rebalancing government and contractor sustainment responsibilities in the F-35 program. However, DOD faces challenges in achieving a desired approach that is more government-led and -controlled for F-35 sustainment. DOD has also not made key decisions about the future of sustainment for the program.

Contractors Manage and Control the Majority of F-35 Sustainment

When DOD began the F-35 program in the late 1990s, it established a sustainment approach where the prime contractors provided the majority of sustainment, including managing the global logistics supply chain. DOD developed the F-35's sustainment strategy to meet the operational needs of all participants (U.S. and foreign) and, in theory, be supportable and affordable. Under a strategy known as Total System Performance Responsibility, the intention was to leverage industry best practices and reduce government oversight, allowing the contractors to focus on a fully operational system while the government executes core functions such as financial management and security.

With this in mind, according to DOD officials, the prime contractor implemented a common sustainment approach for the air vehicle that included all variants of the F-35 and all countries using the aircraft.[40] At the outset of the program, DOD decided not to procure technical data

[40]According to DOD officials, Pratt & Whitney implemented a similar sustainment approach for the engines installed on the F-35, which are sustained separately from the air vehicle.

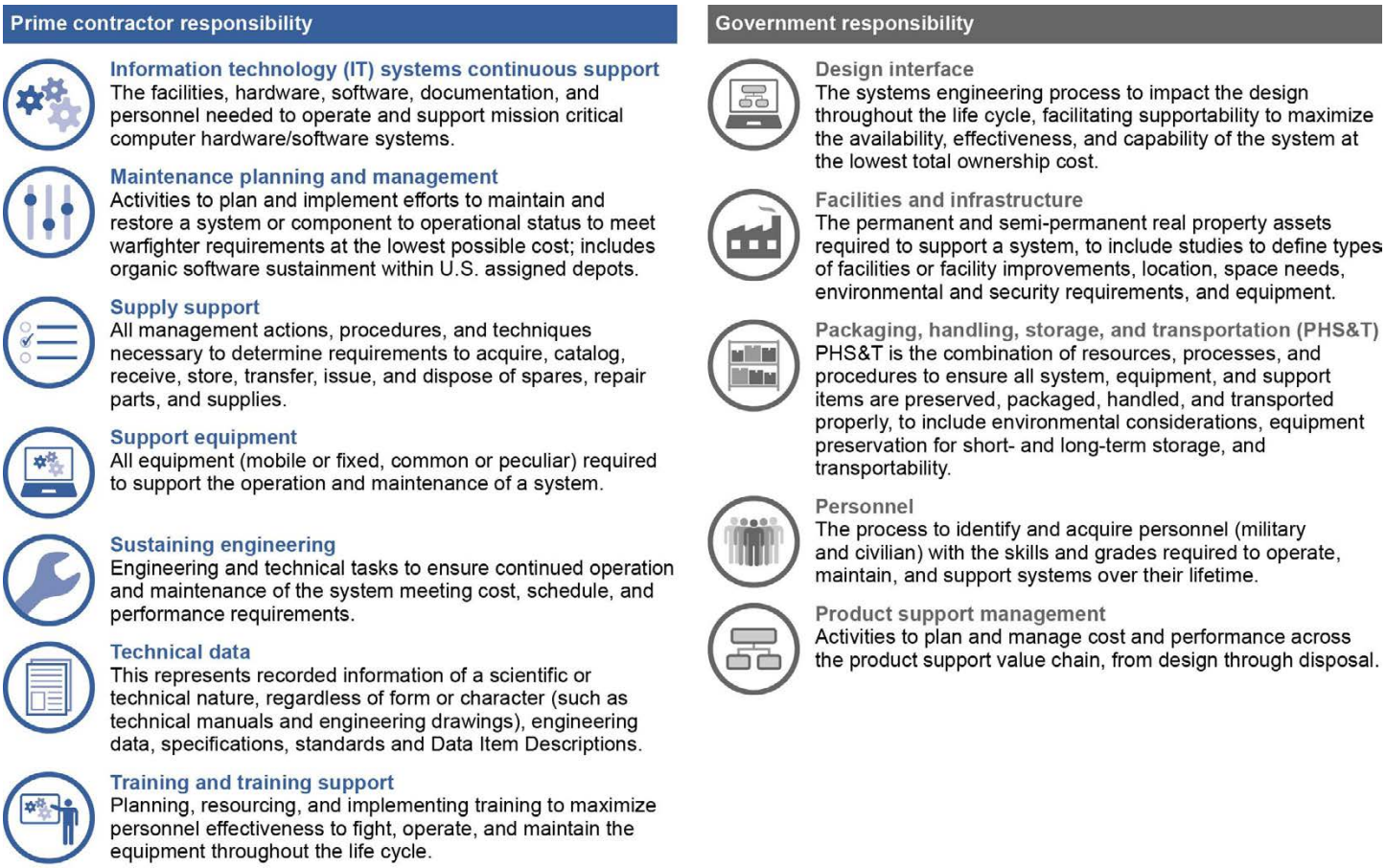
from the prime contractor about the aircraft.[41] As a result, the prime contractor and the program's numerous subcontractors were left with significant control over and involvement in the program's sustainment strategy. According to DOD officials, DOD made these decisions, in part to reduce program costs and put responsibility for sustainment challenges on the contractors. However, DOD's approach also significantly limited its ability to increase government control over sustainment activities.

F-35 sustainment activities have been organized within 12 inter-related elements. The F-35 program relies heavily on contractors, to lead and manage sustainment of seven of the 12 elements, as shown in figure 11. Government civilians or military personnel lead and manage the other five elements. According to DOD officials, the prime contractors and DOD collectively, as part of the Global Support Solution, provide the package of support functions required to field and maintain the readiness and operational capability of the aircraft.[42] DOD refers to these 12 elements as part of Integrated Product Support (IPS) that provides the structure and integrated framework for managing and conducting F-35 sustainment. DOD intends that each Integrated Product Support element will provide U.S. military services the support they need to meet requirements at the lowest cost. DOD expects key program stakeholders to reassess the Integrated Product Support elements throughout the program's life cycle to seek cost and readiness improvements. For the remainder of this report, we will refer to Integrated Product Support elements as sustainment elements.

[41]Technical data packages normally include technical design and manufacturing information sufficient to enable the construction or manufacture of a defense item component modification, or to enable the performance of certain maintenance or production processes. It may include blueprints, drawings, plans, or instructions that can be used or adapted for use in the design, production, manufacture, or maintenance of defense items or technology.

[42]As stated in the F-35 acquisition strategy, the F-35's sustainment posture continues to mature from the original Total System Performance Responsibility strategy to the current strategy, which uses a more government-led approach.

Figure 11: Responsibility for the 12 F-35 Sustainment Elements



Source: GAO analysis of Department of Defense data. | GAO-23-105341

Accessible Data for Figure 11: Responsibility for the 12 F-35 Sustainment Elements

Prime contractor responsibility

- **Information technology (IT) systems continuous support** The facilities, hardware, software, documentation, and personnel needed to operate and support mission critical computer hardware/software systems.

- **Maintenance planning and management** Activities to plan and implement efforts to maintain and restore a system or component to operational status to meet warfighter requirements at the lowest possible cost; includes organic software sustainment within U.S. assigned depots.

- **Supply support** All management actions, procedures, and techniques necessary to determine requirements to acquire, catalog, receive, store, transfer, issue, and dispose of spares, repair parts, and supplies.
- **Support equipment** All equipment (mobile or fixed, common or peculiar) required to support the operation and maintenance of a system.
- **Sustaining engineering** Engineering and technical tasks to ensure continued operation and maintenance of the system meeting cost, schedule, and performance requirements.
- **Technical data** This represents recorded information of a scientific or technical nature, regardless of form or character (such as technical manuals and engineering drawings), engineering data, specifications, standards and Data Item Descriptions.
- **Training and training support** Planning, resourcing, and implementing training to maximize personnel effectiveness to fight, operate, and maintain the equipment throughout the life cycle.

Government responsibility

- **Design interface** The systems engineering process to impact the design throughout the life cycle, facilitating supportability to maximize the availability, effectiveness, and capability of the system at the lowest total ownership cost.
- **Facilities and infrastructure** The permanent and semi-permanent real property assets required to support a system, to include studies to define types of facilities or facility improvements, location, space needs, environmental and security requirements, and equipment.
- **Packaging, handling, storage, and transportation (PHS&T)** PHS&T is the combination of resources, processes, and procedures to ensure all system, equipment, and support items are preserved, packaged, handled, and transported properly, to include environmental considerations, equipment preservation for short- and long-term storage, and transportability.
- **Personnel** The process to identify and acquire personnel (military and civilian) with the skills and grades required to operate, maintain, and support systems over their lifetime.
- **Product support management** Activities to plan and manage cost and performance across the product support value chain, from design through disposal.

Source: GAO analysis of Department of Defense data. | GAO-23-105341

Note: The F-35 Product Support Business Case Analysis report identifies the responsibilities for the government listed in this table as well as the roles of the prime contractor, which DOD officials described as prime contractor responsibilities.

Each sustainment element comprises several different sustainment activities that both public (i.e., military or civilian government) and private (i.e., contractor) entities can perform. Much like the sustainment elements themselves, these sustainment activities—although different—are

inherently interrelated. They all must operate together to make sustainment function and to achieve the program's performance and affordability goals.

Figure 12 shows some of the sustainment activities that fall under the seven contractor-led sustainment elements in the F-35 program. DOD guidance provides for program leadership to determine the government and contractor workload mix for individual sustainment activities, such as those shown in figure 12, depending on what is best suited to meet program goals, requirements, and objectives. DOD typically makes decisions related to the mix of government and contractor sustainment at the beginning of the program, as it did with the F-35 program. This mix has largely remained the same since the beginning of the F-35 program. However, as previously described, DOD is supposed to reassess and change, as necessary, the sustainment elements, including who is responsible for each sustainment activity within each element, throughout the life of the program. These DOD actions are to ensure that the sustainment approach is the most effective regarding performance and cost.

Figure 12: F-35 Sustainment Activities in the Contractor-Led Sustainment Elements

Source: GAO analysis of Department of Defense data. | GAO-23-105341

Accessible Data for Figure 12: F-35 Sustainment Activities in the Contractor-Led Sustainment Elements

Information technology (IT) systems continuous support

- Disaster recovery planning and execution
- Electronic Data Interchange
- IT systems interface
- Software technical data

Maintenance planning and management

- Depot Workload Allocation, Planning, Activation, and Execution
- Level of Repair Analysis – Hardware/Software
- Maintenance execution
- Maintenance Task Analysis

Supply support

- Cataloging
- Initial provisioning
- Inventory management
- Supply Chain Management

Support equipment

- Equipment design
- Support Equipment Integrated Product Support
- Tooling
- Tools requirement determination and management

Sustaining engineering

- Continuous Modernization
- Modification management
- Post-deployment ongoing operational data analyses
- Repair or upgrade vs. disposal or retirement

Technical data

- Data storage and backup

- Engineering data maintenance
- Specifications determination
- Standards management

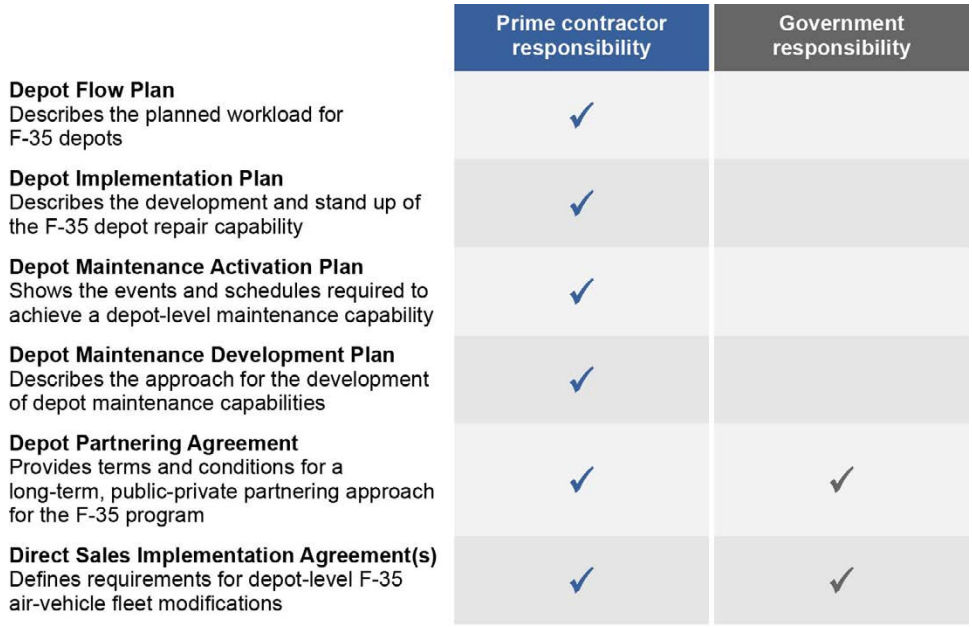
Training and training support

- Computer Based Training/Distance Learning
- Initial, formal, informal, and On the Job Training individual, crew, and unit Sustainment Training
- Operator & maintenance training
- Simulator Sustainment

Source: GAO analysis of Department of Defense data. | GAO-23-105341

According to DOD officials, the seven contractor-led sustainment elements represent a significant portion of sustainment for the F-35 program and are all areas where the U.S. government, including the military services, has limited ability to lead and manage sustainment activities. For example, the depot workload allocation, planning, activation, and execution sustainment activity for the F-35 program is part of the contractor-led Maintenance Planning and Management sustainment element. As shown in figure 13, DOD has six primary planning documents that serve as the foundation for F-35 depot workload planning. The prime contractor primarily developed these documents and is contracted to manage and oversee depot maintenance planning and execution, while the U.S. government, according to DOD officials, provides only manual labor (i.e., the civilians that conduct the maintenance) and facilities in support of the prime contractor. One DOD official at one of the depots we visited told us that he was rarely provided access to depot-related plans because they typically reside with the prime contractor. According to DOD officials, the management and planning of depot-level maintenance activities is a primary example of a sustainment activity that DOD could transition from contractor-led to government-led, giving the government more control over depot workload activations and executions. There are other contractor-led sustainment activities within each of the seven contractor-led sustainment elements that DOD could transfer to government-led, according to DOD officials.

Figure 13: Key F-35 Depot Maintenance Planning Documents and Their Respective Developers



Source: GAO analysis of Department of Defense and contractor information. | GAO-23-105341

Accessible Data for Figure 13: Key F-35 Depot Maintenance Planning Documents and Their Respective Developers

Category	Prime contractor responsibility	Government responsibility
Depot Flow Plan Describes the planned workload for F-35 depots	yes	
Depot Implementation Plan Describes the development and stand up of the F-35 depot repair capability	yes	
Depot Maintenance Activation Plan Shows the events and schedules required to achieve a depot-level maintenance capability	yes	
Depot Maintenance Development Plan Describes the approach for the development of depot maintenance capabilities	yes	
Depot Partnering Agreement Provides terms and conditions for a long-term, public-private partnering approach for the F-35 program	yes	yes

Category	Prime contractor responsibility	Government responsibility
Direct Sales Implementation Agreement(s) Defines requirements for depot-level F-35 air-vehicle fleet modifications	yes	yes

Source: GAO analysis of Department of Defense and contractor information. | GAO-23-105341

DOD Seeks to Gain More Control over F-35 Sustainment

DOD has been actively pursuing changes to its sustainment approach in part to make sustainment more affordable and to provide DOD more ownership and accountability of sustainment activities. According to DOD officials, over the last several years program officials realized that contractor-led sustainment for the F-35 program was unsustainable due to high costs. Several DOD officials we spoke to during the course of our review expressed significant concern over the costs of contractor labor in the F-35 program.

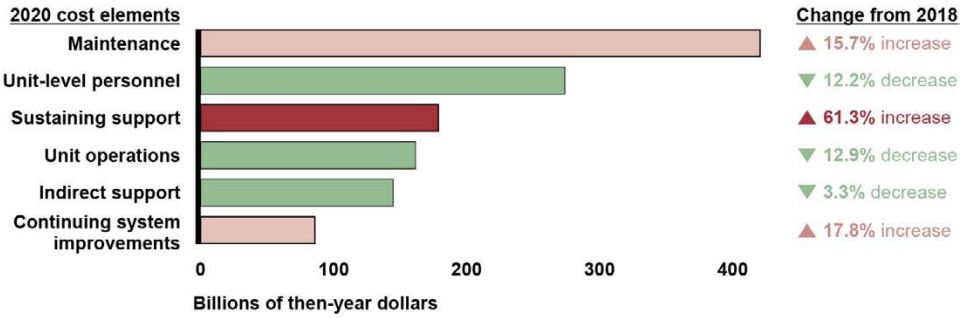
As we reported in July 2021, the military services face a substantial and growing gap between estimated costs and affordability constraints totaling about $6 billion in 2036 alone. The term affordability constraints refers to the cost per tail (aircraft) per year that the services project they can afford. To close this gap, DOD would need to significantly reduce costs associated with the F-35 program or reduce spending on other programs to supplement the rising costs of the F-35 program.[43]

In the July 2021 report, we reviewed the 2020 sustainment cost estimate for the F-35 that was prepared by the Secretary of Defense's Office of Cost Assessment and Program Evaluation, which is the sustainment cost estimate referenced in the program's most recent Selected Acquisition Report.[44] Based on the most recent F-35 life cycle cost estimate, we reported that sustaining support experienced a $68 billion, or 61.3 percent, increase in estimated costs from 2018 to 2020 due, according to DOD officials, to the program's continued reliance on contractor labor. The term sustaining support refers to a sustainment element that captures, among other things, contractor-related support costs to maintain F-35 operations. See figure 14 for more details.

[43]GAO-21-439.

[44]*F-35 Selected Acquisition Report (SAR)*, December 31, 2021.

Figure 14: CAPE's 2020 F-35 Sustainment Cost Estimates and Changes from 2018 to 2020



Source: GAO analysis of Cost Assessment and Program Evaluation (CAPE) F-35 sustainment data. | GAO-23-105341

Accessible Data for Figure 14: CAPE's 2020 F-35 Sustainment Cost Estimates and Changes from 2018 to 2020

2020 cost elements	Billions of then-year dollars	Change from 2018
Maintenance	420.7	15.7% increase
Unit-level personnel	273.9	12.2% decrease
Sustaining support	178.7	61.3% increase
Unit operations	161.6	12.9% decrease
Indirect support	144.8	3.3% decrease
Continuing system improvements	85.9	17.8% increase

Source: GAO analysis of Cost Assessment and Program Evaluation (CAPE) F-35 sustainment data. | GAO-23-105341

DOD officials responsible for the program's life-cycle cost estimate told us that although the majority of contractor support costs were captured in the sustaining support cost element, some contractor-related costs were also part of two elements: maintenance and continued system improvements. These two elements also experienced cost increases. As a result, in part, of rising sustainment costs and affordability issues with the program, the National Defense Authorization Act for Fiscal Year 2022 levied an F-35 quantity purchase limit for each of the military services.[45] That limit, which begins October 2028, is based in part on the military services' respective cost-per-tail-per-year targets. If DOD cannot meet these targets, the services will need to pause further purchases of new F-35s.

Affordability became the primary driver of DOD's desire to transition more aspects of F-35 sustainment to DOD. The F-35 acquisition strategy, updated in October 2018, states that the F-35 program will continue to

[45]Pub. L. No. 117-81, § 141 (2021).

rebalance from predominantly industry to DOD sustainment management. Furthermore, DOD's aforementioned transition to a Global Support Solution supports this rebalance and aims to provide a structure that gives DOD more control over sustainment activities.

As we testified in May 2022, DOD, since adopting the Global Support Solution, has been assessing how it can transition more aspects of sustainment to DOD.[46] For example, DOD, in 2019, designated the Defense Logistics Agency and U.S. Transportation Command as the global providers for warehousing and transportation for the F-35 program. Both organizations have begun to provide the F-35 program with a range of limited organic capabilities for parts storage and distribution. However, officials of the Defense Logistics Agency and U.S. Transportation Command told us the prime contractor has continued to have substantial control over the F-35 supply chain, including in ordering, part procurement, and inventory.

As DOD considers whether to take additional responsibility for the seven sustainment areas that are contractor-led, it has also been working to address sustainment cost concerns and the seven depot-level and organizational-level maintenance challenges that we described earlier in this report. As shown in figure 15, each of the seven sustainment challenges DOD officials identified is tied to at least one of the contractor-led sustainment elements.

[46]GAO-22-105995.

Figure 15: F-35 Depot-Level and Organizational-Level Maintenance Challenges and Their Associated Integrated Product Support Elements

	Information technology (IT) systems continuous support	Maintenance planning and management	Supply support	Support equipment	Sustaining engineering	Technical data	Training and training support
Depot-level challenges							
Funding prioritization Adjustments in funding priorities have prevented the military services from adequately planning for and building a depot repair capacity.		●				●	
Heavy reliance on contractors The U.S. government defers most of the planning and execution of depot maintenance to the contractor, leaving the government with limited decision-making ability and influence.		●				●	
Lack of technical data The lack of access to technical data or incomplete technical data prevents government maintainers from performing certain repairs to the F-35 and can delay repair times.	●	●	●		●	●	
Organizational-level challenges							
Inadequate training Maintenance-related training for the program is largely inadequate, forcing maintainers to learn from on-the-job training.						●	●
Lack of spare parts The lack of spare parts at F-35 installations and on deployment can lead to maintenance delays and negatively affect aircraft readiness.		●	●		●		
Lack of support equipment The necessary amount of support equipment needed to maintain the F-35 is too frequently unavailable on flight lines.		●	●	●	●	●	
Lack of technical data The lack of access to technical data prevents maintainers from making certain repairs, sometimes simple repairs, which can delay the maintenance process.	●	●	●		●	●	

Source: GAO analysis of Department of Defense information. | GAO-23-105341

Accessible Data for Figure 15: F-35 Depot-Level and Organizational-Level Maintenance Challenges and Their Associated Integrated Product Support Elements

Category	Category member	Information technology (IT) systems continuos support	Maintenance planning and management	Supply support	Support equipment	Sustaining engineering	Technical data	Training and training support
Depot-level challenges	**Funding prioritization** Adjustments in funding priorities have prevented the military services from adequately planning for and building a depot repair capacity.		yes				yes	
Depot-level challeng	**Heavy reliance on contractors** The U.S. government defers most of the planning and execution of depot maintenance to the contractor, leaving the government with limited decision-making ability and influence.		yes				yes	
Depot-level challeng	**Lack of technical data** The lack of access to technical data or incomplete technical data prevents government maintainers from performing certain repairs to the F-35 and can delay repair times.	yes	yes	yes		yes	yes	
Organizational-level challenges	**Inadequate training** Maintenance-related training for the program is largely inadequate, forcing maintaine to learn from on-the-job training.						yes	yes

Category	Category member	Information technology (IT) systems continuos support	Maintenance planning and management	Supply support	Support equipment	Sustaining engineering	Technical data	Training and training support
Organizational-level challenges	**Lack of spare parts** The lack of spare parts at F-3 installations and on deployme can lead to maintenance dela and negatively affect aircraft readiness.		yes	yes		yes		
Organizational-level challenges	**Lack of support equipmen**t The necessary amount of support equipment needed to maintain the F-35 is too frequently unavailable on flight lines.		yes	yes	yes	yes	yes	
Organizational-level challenges	**Lack of technical data** The lack of access to technica data prevents maintainers from making certain repairs, sometimes simple repairs, which can delay the maintenance process.	yes	yes	yes		yes	yes	

Source: GAO analysis of Department of Defense information. | GAO-23-105341

DOD officials told us they were reconsidering the division of responsibility between government and contractors in each of the seven sustainment elements to better position DOD to address sustainment-related challenges. For example, DOD could decide to shift the responsibility from contractor to government in the following sustainment activities:

- Inventory Management, falling under the Supply Support sustainment element, could give DOD more transparency over the F-35 program's supply chain;
- Depot Workload Allocation, Planning, Activation, and Execution, falling under the Maintenance Planning and Management sustainment element, as previously mentioned, could give DOD more control over future depot standup; and
- Support Equipment Integrated Product Support, falling under the Support Equipment sustainment element, could give DOD more control over the maintenance and supply of support equipment.

The various sustainment elements are interrelated, so changes in one element may affect other areas. For example, to reassess a challenge with support equipment, DOD could focus solely on the Support Equipment sustainment element. However, the Supply Support sustainment element includes the initial provisioning and replenishment provisioning of support equipment. Also, the Maintenance Planning and Management sustainment element includes establishing maintenance concepts and requirements for the life of the system including support equipment needs. Further, the Technical Data sustainment element includes identifying, planning, validating, resourcing, and implementing management actions to develop and acquire information to effectively catalog and acquire support equipment. Therefore, reassessments of sustainment elements typically require a holistic examination rather than focusing on just one or two elements.

DOD Has Not Made Key Decisions about the Future of F-35 Sustainment

In October 2021, DOD published a business case analysis that evaluated the program's sustainment strategy and explored alternative sustainment solutions to help the department make informed decisions on tradeoffs between traditional government solutions and commercial performance-based logistics. Specifically, the business case analysis evaluated four courses of action with different levels of contractor and government sustainment support, ranging from a wholly contractor-supported solution to a wholly government-supported solution.

Performance-Based Logistics

Performance-based logistics (PBL) is a method of providing support for weapon systems by designating what system performance is required, such as a given level of system availability. Under a PBL contract, DOD sets the desired performance objectives, and places responsibility on the contractor to determine how best to achieve those objectives. The F-35 program has been considering a PBL for several years to improve F-35 sustainment outcomes.

In 2017, we found that DOD may not be well positioned to enter into such a contract because the performance metrics that the DOD was using to incentivize the contractor may not be appropriate. We recommended that the F-35 program not enter into a performance-based logistics contract until DOD had sufficient knowledge of the actual costs of sustainment. Further, the National Defense Authorization Act for Fiscal Year 2022 bars award of any F-35 performance-based logistics contract until the Secretary of Defense certifies that the PBL will either increase readiness or reduce sustainment or operating costs.

Source: GAO analysis. | GAO-23-105341

The business case analysis was done using a “best value analysis” across cost, benefits, and risk, comparing each of the four courses of action. The evaluation recommended that DOD continue to rely on the prime contractor to manage the overall F-35 supply chain through a performance-based logistics contract (see sidebar). Officials we spoke to who conducted the analysis told us that although their recommendation provides, in their opinion, the best value through aircraft production, they could not provide any specific opinions on long-term affordability, maintenance strategies, organic depot stand-up, or depot maintenance philosophies.

Military service officials we spoke to told us that there is no clear consensus within the department on how or whether DOD should implement the findings of the business case analysis. DOD officials told us that as of February 2023, the military services and other program stakeholders, including the foreign partners, had varied views on whether the recommendation from the business case analysis was the best course of action for the program. Specifically, these officials told us that there was disagreement within the department on whether DOD was

ready to enter a performance-based logistics contract with the prime contractor. Furthermore, in a March 2022 report to Congress, the department stated that none of the courses of actions assessed in the business case analysis drove significant cost savings over the life of the program due to their limited scope. The report stated that since the cost savings between all four courses of action were negligible against similar performance benefits across the life cycle of the program, a clear life-cycle sustainment course of action was not agreed upon.

Officials from the Joint Program Office emphasized that the business case analysis was but one data point in evaluating the F-35's future sustainment strategy. They also told us that the recommendation was a prudent course of action and supports a supply chain-related performance-based logistics arrangement. However, as described in the sidebar, the National Defense Authorization Act for Fiscal Year 2022 bars award of any F-35 performance-based logistics contract until the Secretary of Defense certifies that the contract will either increase readiness or reduce sustainment costs.[47] According to DOD officials, the Office of the Under Secretary of Defense for Acquisition and Sustainment was working with the F-35 program's prime contractor to gain access to the data needed to perform the cost and readiness certifications required in the National Defense Authorization Act for Fiscal Year 2022. However, DOD officials we spoke to were unsure if either increased readiness or reduced sustainment costs could occur under a performance-based logistics contract.

Limitations on Contractor Performance of Depot-Level Maintenance

Under 10 U.S.C. § 2466(a), not more than 50 percent of funds made available in a fiscal year to a military department or defense agency for depot-level maintenance and repair may be used to contract for the performance by nonfederal government personnel of such workload for the military departments and defense agencies. Section 2466(b) states that the Secretary of Defense may waive the 50-percent limitation if he or she determines the waiver is necessary for national security and submits to Congress a notice of the waiver and the reasons for the waiver. This is commonly referred to as the 50-**50 rule.**

Source: GAO analysis. | GAO-23-105341

Officials from the Office of the Under Secretary of Defense (Acquisition and Sustainment), the F-35 Program's Defense Acquisition Executive and Milestone Decision Authority, told us that they were hesitant to accept the recommendation in the business case analysis because the scope of the assessment was limited to only the F-35 program and did not consider

[47]Pub. L. No. 117-81, § 356 (2021).

broader departmental concerns.[48] Specifically, these officials told us that they were concerned that implementing the recommendation to maintain contractor-led sustainment could hinder DOD's ability to maintain sufficient organic sustainment capability in the coming years. DOD is generally required to use government personnel to perform at least half of depot-level maintenance (see sidebar). These officials said that DOD already plans to retire several aircraft fleets in the coming years that the services currently sustain organically—using government personnel to manage and carry out depot-level maintenance—that help DOD meet its 50-50 requirement. According to these officials, the planned reductions in future organic sustainment, if combined with keeping F-35 depot-level maintenance contractor-led, would undermine DOD's ability to perform its required level of government-led depot maintenance.

In addition, we previously reported that some DOD officials told us that they were concerned about the operation and financial solvency of the defense-wide and military service-specific working capital funds the military services used to sustain many of the department's weapon systems (see sidebar).[49] DOD uses these funds to provide goods (e.g., spare parts) and services (e.g., depot maintenance) to consumers within the department. According to DOD officials, the F-35 program does not use the working capital funds to support its operations. According to DOD officials, when DOD divests aircraft fleets that are supported through these working capital funds, the department's and military services' working capital funds will likely experience less business over time, which

[48]The Milestone Decision Authority is the overall executive sponsor responsible for any Major Defense Acquisition Program. The Milestone Decision Authority formally initiates each increment of an evolutionary acquisition program as required by DoD Instruction 5000.85, *Major Capability Acquisition* (Aug. 6, 2020) (incorporating Change 1, Nov. 4, 2021). They determine if a program has met its phase exit requirement and can proceed into the next phase during a Milestone review in terms of cost, schedule, and performance. The Under Secretary of Defense for Acquisition and Sustainment is the Milestone Decision Authority for all major Acquisition Category 1 programs unless delegated. The Defense Acquisition Executive is the individual responsible for supervising the Defense Acquisition System. The Defense Acquisition Executive takes precedence on all acquisition matters after the Secretary and Deputy Secretary of Defense.

[49]Working capital funds operate as self-supporting entities that conduct a regular cycle of businesslike activities. Working capital fund operations are funded by reimbursements received from customers for goods or services provided. The ability of working capital funds to operate on a break-even basis depends on accurately projecting workload, estimating costs, and setting rates to recover the full costs of producing goods and services. Working capital fund customers, generally DOD elements, use their appropriated funds to finance orders placed with a working capital fund.

could diminish the organic industrial base.[50] Working capital funds must maintain a positive cash balance throughout the year to prevent buildup of excess cash balances, or to ensure fund solvency, and out-of-cycle rate adjustments may be directed at any time during the fiscal year. This could result in the loss of civilian positions that manage spare-part requirements and broader weapon systems—resulting in a lack of organic capability and over reliance on contractors to manage and conduct sustainment across the department.

Working Capital Fund

Working capital funds operate as self-supporting entities that conduct regular cycles of businesslike activities. Working capital funds are designed to create a cost conscious environment for both customers and providers. Customers derive cost savings by limiting demands to actual requirements, while providers work to reduce or eliminate service costs and assist customers in identifying and modifying behaviors that increase costs. DOD may establish working capital funds to finance inventories of designated supplies and provide working capital for industrial- and commercial-type activities that provide common services within or among DOD components. For example, the Navy and Air Force use working capital funds to finance the provision of goods and services, parts and supplies, transportation, research and development, and depot maintenance by their respective depots.

Source: GAO analysis. | GAO-23-105341

Military Services Face Key Decisions to Address F-35 Sustainment Challenges

The National Defense Authorization Act for Fiscal Year 2022 mandated that sustainment management, planning and execution of the F-35 program will transition from the F-35 Joint Program Office to the Secretary of the Navy and the Secretary of the Air Force by October 1,

[50]For additional information on working capital funds, see GAO, *Defense Management: Defense-Wide Working Capital Fund Agencies Apply Most Key Operating Principles but Should Improve Pricing Transparency*, GAO-20-65 (Washington, D.C.: Nov. 1, 2019) and *Depot Maintenance: DOD Should Adopt a Metric That Provides Quality Information on Funded Unfinished Work*, GAO-19-452 (Washington, D.C.: July 26, 2019).

2027.[51] Throughout our review, DOD officials told us that the military services will take on significantly larger roles in sustainment, including determining the mix of organic and contractor roles within sustainment elements. However, as of February 2023, DOD had not finalized the specific roles and responsibilities of the military services, Joint Program Office, and prime contractors. The decisions the military services make about how they will sustain the F-35 will have significant implications for the entire F-35 program, including international partners.

DOD officials expressed concern about the uncertainty in future approaches to key aspects of F-35 sustainment, and stressed the importance of the services reassessing and then deciding their future strategies for sustaining the F-35 program. However, DOD and the military services face two primary challenges—(1) determining the appropriate mix of government (i.e., organic) and contractor roles and responsibilities and (2) identifying and obtaining the technical data DOD would need to support an increased organic role in sustainment.

DOD and the Military Services Have Not Determined Government and Contractor Roles in Sustainment

According to DOD officials, the military services have been operating under the F-35's original government-and-contractor labor mix since the inception of the program. DOD and the military services have not revisited this mix and have yet to determine if this mix, or a different mix, would best fit into their respective sustainment operations.

As described above, the F-35 Joint Program Office manages a single, centralized sustainment strategy that supports the Air Force, Navy, Marine Corps, and international partners. However, according to DOD officials, each military service operates its fighter aircraft fleets differently and the military services have differing opinions about the current, common sustainment strategy and how well that strategy fits their respective concept of operations. Further, for the F-35 program, each military service is largely expected to use contractors uniformly, according to DOD officials. Also, the Department of the Navy and the Department of the Air Force plan to have vastly different sizes of F-35 fleets, 693 versus

[51]Pub. L. No. 117-81, § 142. According to DOD officials, F-35 stakeholders are determining the make-up of the transition; however, it is certain the military services will be taking over a larger role in F-35 sustainment.

1,763 respectively.[52] According to the official F-35 program charter, despite the considerable fleet size difference, the Department of the Air Force and Navy will equally share costs for common production, sustainment, and follow-on development activities.

Military service officials could not provide us with definitive positions about how they plan to assume responsibility for F-35 sustainment or any potential changes they may make to modify sustainment approaches to better meet service needs. Service officials were well aware of the ongoing discussions within DOD surrounding key sustainment topics such as the business case analysis, assessing the current mix of organic and contractor responsibilities, and the need for the military departments to assume control of service-specific F-35 sustainment strategy. Generally, officials from all three military services were open to and understood the potential benefits of the idea of developing a more organic approach to sustainment for the F-35. However, service officials could not provide details on what that would look like.

Specifically, the military services have not yet determined:

- whether the service or prime contractors should assume prime responsibility for each of the seven sustainment elements that the prime contractors lead;
- what changes, if any, to make in the division of responsibility between the services and prime contractors for sustainment activities within each element; or
- whether any changes in the current sustainment strategy would provide practical, long-term solutions for their various F-35 sustainment challenges.

Some military service officials told us that they were awaiting guidance from either higher military service leadership or leadership from the F-35 Joint Program Office before taking any particular position, while other officials told us that they were still evaluating potential changes to the current sustainment approach.

The 2021 Production Sustainment and Follow-On Development Memorandum of Understanding is an F-35 program document that, among other things, assures the sustainment strategy of the F-35 air

[52]The Navy plans to procure 273 F-35Cs, while the Marine Corps plans to procure 353 F-35Bs and 67 F-35Cs.

system meets the requirements of the participants (e.g., the military services). According to this Memorandum of Understanding, the goal of sustainment for participants is for the F-35 to be supportable and affordable. Participants should identify opportunities for the most cost-effective common sustainment activities that take into account respective capabilities and requirements, the Memorandum of Understanding states. That said, alternative sustainment activities may be pursued by participants (that are unique to them) if common sustainment activities cannot support their respective capabilities and requirements. Furthermore, according to the Standards for Internal Control in the Federal Government, management should identify, analyze, and respond to risks related to achieving the defined objectives.[53] Management designs overall risk responses for the analyzed risks based on the significance of the risk and defined risk tolerance. Based on the selected risk response, management designs the specific actions to respond to the analyzed risks.

As part of the statutory transfer of sustainment functions from the Joint Program Office to the Air Force and the Navy, the Under Secretary of Defense for Acquisition and Sustainment, which serves as the Defense Acquisition Executive and Milestone Decision Authority for the F-35 program, was required to oversee and submit a transition plan no later than October 1, 2022. This transition plan was to be coordinated by the Under Secretary of Defense for Acquisition and Sustainment with the Secretaries of the Navy and Air Force.

In January 2023, the Under Secretary of Defense for Acquisition and Sustainment submitted the mandated plan to Congress. However, the plan focused predominantly on the future vision of a more military service-led sustainment strategy and not on the actual steps to implement this vision. Prior to the submission of the plan, DOD officials told us that the plan itself would cover critical aspects of the future direction of F-35 sustainment. However, the plan does not contain specific decisions about the future of the government and contractor mix for sustainment activities. The plan identified a follow-on Implementation Working Group that will help determine, using the F-35's sustainment elements, the details of all current and future transfers of acquisition and sustainment functions. The Office of the Under Secretary of Defense for Acquisition and Sustainment chairs the working group. Furthermore, since the Under Secretary of

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

Defense for Acquisition and Sustainment serves as the ultimate decision-making authority over the F-35 program, if there are differing opinions about sustainment-related issues among the program stakeholders, it is up to the Under Secretary of Defense for Acquisition and Sustainment to arbitrate and determine a final course of action.

Without DOD and the military services determining whether the government or contractor should assume primary responsibility for each of the seven contractor-led sustainment elements and any changes to the execution of specific sustainment activities within each element, the Air Force and Navy run the risk of not being prepared to manage the sustainment of their respective aircraft, including improving the performance and affordability of their fleets. Additionally, without DOD and the military services developing plans to resource any eventual changes, the program risks not being prepared to sustain the aircraft effectively and efficiently in the future.

Insufficient Technical Data to Support Increased Organic Sustainment

DOD's desire to increase the military services' role in sustainment would require additional access to technical data. We previously reported on DOD's challenges with accessing proprietary technical data that could help support organic (i.e., government-operated) sustainment operations, such as maintenance activities.[54] According to Joint Program Office officials, at the start of the F-35 program, DOD determined the F-35's sustainment strategy would not receive a positive return on investment by obtaining the technical data that would allow them to organically manage several key aspects of sustainment. DOD's goal, according to DOD officials, was to leverage industry best practices, and reduce the government's direct involvement in the more significant aspects of sustainment such as cataloguing and provisioning, which is a key aspect of a weapon system's supply chain (see sidebar). Over time and with the increased annual procurement of jets, DOD's decision to not procure technical data has proven to be a challenge for the program, as it has experienced sustainment-related cost estimate growth in a program that remains largely reliant on contractors to sustain the aircraft.

Cataloging and Provisioning

The Secretary of Defense is required to develop a single catalog system and related program of standardizing supplies for DOD to ensure that any item that is purchased or managed by DOD has a unique identifier and to eliminate redundancy in DOD. Within cataloging, data dissemination functions provide logistics information to customers who need it at every level of the supply system. Provisioning is the management process of determining and acquiring the range and quantity of support items necessary to operate and maintain an end item of materiel for an initial period of service. The objective of provisioning data management is timely access to all data required to identify, acquire, and assess support items.

Source: GAO analysis. | GAO-23-105341

[54]GAO-21-439.

In September 2014, we reported on long-term affordability concerns for the F-35 sustainment strategy and the implications of DOD's decision to obtain limited technical data in the F-35 program.[55] We recommended that to promote competition, address affordability, and inform its overarching sustainment strategy, DOD should develop a long-term Intellectual Property (IP) Strategy for the F-35 program to include, but not be limited to, the identification of (1) current levels of technical data rights ownership by the federal government and (2) all critical technical data needs and their associated costs. In May 2020, we made this a priority recommendation. However, as of May 2023, this recommendation remains open and continues to be a missing element in the department's efforts to plan for the future of F-35 sustainment.

In May 2017, the Institute for Defense Analyses published a report reviewing access to intellectual property—which includes technical data—for weapon systems.[56] The report found that although DOD had established a renewed focus on reducing sustainment costs by addressing intellectual property challenges early in the acquisition process, there were several defense systems, including the F-35 program, for which DOD did not acquire necessary intellectual property data and rights for organic depot or competitive sustainment. For example, according to the report, depot maintenance capabilities required by law, like the aforementioned 50-50 requirement, may not be met because of a lack of necessary technical data and software. The use of original equipment manufacturer-based, public-private partnerships, as is the case with the F-35 program, do not ameliorate that deficiency, since in general such partnerships do not provide the government sufficient technical data and rights to perform the full range of depot maintenance without the private partner's participation, according to the report. The report also added that lack of access to intellectual property data with appropriate rights inhibits DOD's ability to use competitive contracting for repair parts, maintenance, and follow-on production, and likely translates into higher long-term sustainment costs.

In January 2020, the F-35 program published its Independent Logistics Assessment Summary that looked at the adequacy of the program's product support strategy prior to entering Milestone C and Full-Rate

[55]GAO-14-778.

[56]Institute for Defense Analyses, *Department of Defense Access to Intellectual Property for Weapon Systems Sustainment* (May 2017).

production.[57] Among many different findings, the report provided several examples of shortcomings centered on technical data. For example, the report stated that the F-35 Joint Program Office lacks the dedicated skilled personnel and resources to properly:

- develop a technical data strategy,
- contract for proper technical data access and delivery,
- account for technical data in the program,
- ensure proper technical data change management, and
- sustain the technical data within the F-35 Joint Program Office once received.

However, the review added that the military services have the dedicated resources focused on acquiring and sustaining technical data with their respective services. Additionally, the review stated that a technical data strategy for the program is needed to avoid having inadequate technical data to support an organic sustainment capability. As we previously described above, DOD's lack of organic sustainment capability has already increased depot maintenance turnaround time and reduced overall system readiness across the military services. Finally, the report stated that the program has yet to identify the data rights required to support organic sustainment. According to the report, data rights need to be assessed because, if not, the program will enter "vendor lock" with limited organic sustainment capability.[58]

DOD officials have acknowledged the significance of obtaining technical data for the government to take on more sustainment-related activities. The F-35 Joint Program Office has a Technical Data Working Group looking at ways to obtain cataloging and provisioning data that could allow DOD to transition to an organically managed sustainment solution. However, according to DOD officials, progress from the initiative has been minimal due to stalled negotiations and legal actions. These same

[57]DOD, *Independent Logistics Assessment Summary for F-35 Lightning I Joint Strike Fighter Program* (Jan. 2020). In general, an Independent Logistics Assessment is an analysis of a program's supportability planning. As we have previously reported, Milestone C is the milestone that gives the program the approval to move into full-rate production of the aircraft.

[58]Generally, the term vendor lock refers to the situation in which customers are dependent on a single manufacturer or supplier for some product (i.e., a good or service), or products, and cannot move to another vendor without substantial costs or inconvenience. This can grant the vendor some extent of monopoly power and can thus be much more profitable for the vendor than in the absence of such dependency.

officials told us that the F-35 Joint Program Office generally lacks the expertise to handle these types of technical data-related challenges, including developing the type of IP Strategy we previously recommended. However, they added that the military services were appropriately built to manage these areas.

As we previously reported, according to DOD acquisition policy, an IP Strategy must be established and maintained for all defense acquisition programs to identify and manage the full spectrum of IP and related issues, such as technical data, from the inception of the program and throughout the life cycle.[59] Furthermore, a February 2022 report by the Office of the Under Secretary of Defense for Acquisition and Sustainment on the State of Competition within the Defense Industrial Base stated that to proactively mitigate against IP-based restrictions on competition, DOD must develop IP Strategies at program inception and ensure those strategies plan for the program's long-term needs to preserve and enable competition. If the government becomes reliant on the contractor and does not obtain the necessary IP, the government will not be able to provide organic support through the program's life cycle.

Identifying and obtaining the appropriate technical data to support decisions to increase the role of DOD and the military services in managing any of the contractor-managed sustainment elements for the F-35 is a fundamental step to determining the future of F-35 sustainment. The two issues—roles and responsibilities across and within the seven contractor-led sustainment elements and sufficient technical data—are interdependent. Without DOD and the military services ensuring that technical data needs—including specific Intellectual Property required, their associated costs, and milestones to acquire the data—are addressed in their assessment of each sustainment element, the future sustainment strategy and approach to F-35 maintenance activities will remain unclear for the military services and the department. As we have reported previously, the lack of an IP strategy makes it challenging for the department to reclaim more government control of sustainment in a program that began with total contractor reliance and little-to-no technical data.

[59]GAO-14-778.

Conclusions

The F-35 aircraft, with its advanced warfighting capabilities, provides DOD a valuable edge in tactical aviation against our adversaries. However, this valuable edge cannot be realized if the aircraft is not in the air due to sustainment-related issues. As of November 2022, there were more than 450 aircraft in the U.S. fleet and all three participating military services are flying an increasing amount of operational missions. Although the program continues to grow and expand its scope of operations, its underlying sustainment strategy remains in question due to rising costs and poor readiness. Several of these issues are tied to the maintenance of the aircraft where, among other things, the program faces a limited depot repair capability, a growing number of components awaiting repair, rising rates of non-mission capable due to supply, a lack of access to technical data to make repairs, inadequate amounts of support equipment, and rates of non-mission capable due to maintenance that remain well above the program's goal. Furthermore, even though DOD knows it wants to transition more of sustainment from the contractor to the government, it has yet to determine a pathway to achieve this goal.

With a statute mandating that all functions relating to management, planning, and execution of sustainment activities for the F-35 program will transition to the military departments by October 2027, this is a critical time for DOD to determine how it wants to sustain the F-35 for decades to come. More importantly, this is a critical time for DOD and the military services to determine adjustments that need to be made to F-35 sustainment to better achieve their desired objectives in an affordable manner. Furthermore, DOD and the military services must also take into account broader departmental necessities—such as ensuring a robust organic sustainment capability for aviation within DOD—as it plots the path forward for F-35 sustainment. To move forward prudently, DOD must assess assumptions (e.g., contractor versus organic roles and responsibilities across the sustainment elements), understand and address underlying challenges that affect the full F-35 sustainment enterprise (e.g., the lack of technical data), and communicate and advocate the resources required to support in a transparent manner. Over the life of the F-35 program, sustainment has only recently been prioritized and difficult decisions regarding sustainment continue to be delayed. DOD and the military services have the opportunity to take a different path and chart an affordable path forward. The preparedness of our military depends upon it.

Recommendations for Executive Action

We are making seven recommendations to DOD.

The Secretary of Defense should ensure that the Under Secretary of Defense for Acquisition and Sustainment, in consultation with the Secretary of the Navy, the Secretary of the Air Force, and the F-35 Joint Program Office, reassesses the approach for the F-35's information technology systems continuous support sustainment element, to determine: (1) whether the government or contractor should assume primary responsibility; (2) what changes, if any, the Navy and Air Force should make to the leadership, responsibility, and oversight of specific sustainment activities; (3) what intellectual property the Navy and Air Force require to support any changes, including all critical technical data needs, their associated costs, and milestones to acquire the data; and (4) any Navy and Air Force resources needed to implement any changes. (Recommendation 1)

The Secretary of Defense should ensure that the Under Secretary of Defense for Acquisition and Sustainment, in consultation with the Secretary of the Navy, the Secretary of the Air Force, and the F-35 Joint Program Office, reassesses the approach for the F-35's maintenance planning and management sustainment element, to determine: (1) whether the government or contractor should assume primary responsibility of the element for the Air Force and Navy, (2) what changes, if any, the Navy and Air Force should make to the leadership, responsibility, and oversight of specific sustainment activities, (3) what intellectual property the Navy and Air Force require to support any changes, including all critical technical data needs, their associated costs, and milestones to acquire the data, and (4) any Navy and Air Force resources needed to implement any changes. (Recommendation 2)

The Secretary of Defense should ensure that the Under Secretary of Defense for Acquisition and Sustainment, in consultation with the Secretary of the Navy, the Secretary of the Air Force, and the F-35 Joint Program Office, reassesses the approach for the F-35's supply support sustainment element, to determine: (1) whether the government or contractor should assume primary responsibility of the element for the Navy and Air Force, (2) what changes, if any, the Navy and Air Force should make to the leadership, responsibility, and oversight of specific sustainment activities, (3) what intellectual property the Navy and Air Force require to support any changes, including all critical technical data

needs, their associated costs, and milestones to acquire the data, and (4) any Navy and Air Force resources needed to implement any changes. (Recommendation 3)

The Secretary of Defense should ensure that the Under Secretary of Defense for Acquisition and Sustainment, in consultation with the Secretary of the Navy, the Secretary of the Air Force, and the F-35 Joint Program Office, reassesses the approach for the F-35's support equipment sustainment element, to determine: (1) whether the government or contractor should assume primary responsibility of the element for the Navy and Air Force, (2) what changes, if any, the Navy and Air Force should make to the leadership, responsibility, and oversight of specific sustainment activities, (3) what intellectual property the Navy and Air Force require to support any changes, including all critical technical data needs, their associated costs, and milestones to acquire the data, and (4) any Navy and Air Force resources needed to implement any changes. (Recommendation 4)

The Secretary of Defense should ensure that the Under Secretary of Defense for Acquisition and Sustainment, in consultation with the Secretary of the Navy, the Secretary of the Air Force, and the F-35 Joint Program Office, reassesses the approach for the F-35's sustaining engineering sustainment element, to determine: (1) whether the government or contractor should assume primary responsibility of the element for the Navy and Air Force, (2) what changes, if any, the Navy and Air Force should make to the leadership, responsibility, and oversight of specific sustainment activities, (3) what intellectual property the Navy and Air Force require to support any changes, including all critical technical data needs, their associated costs, and milestones to acquire the data, and (4) any Navy and Air Force resources needed to implement any changes. (Recommendation 5)

The Secretary of Defense should ensure that the Under Secretary of Defense for Acquisition and Sustainment, in consultation with the Secretary of the Navy, the Secretary of the Air Force, and the F-35 Joint Program Office, reassesses the approach for the F-35's training and training support sustainment element, to determine: (1) whether the government or contractor should assume primary responsibility of the element for the Navy and Air Force, (2) what changes, if any, the Navy and Air Force should make to the leadership, responsibility, and oversight of specific sustainment activities, (3) what intellectual property the Navy and Air Force require to support any changes, including all critical technical data needs, their associated costs, and milestones to acquire

the data, and (4) any Navy and Air Force resources needed to implement any changes. (Recommendation 6)

The Secretary of Defense should ensure that the Under Secretary of Defense for Acquisition and Sustainment, in consultation with the Secretary of the Navy, the Secretary of the Air Force, and the F-35 Joint Program Office, reassesses the approach for the F-35's technical data sustainment element, to determine: (1) whether the government or contractor should assume primary responsibility of the element for the Navy and Air Force, (2) what changes, if any, the Navy and Air Force should make to the leadership, responsibility, and oversight of specific sustainment activities, (3) any critical technical data needs for the Navy and Air Force , their associated costs, and milestones to acquire them, and (4) any Navy and Air Force resources needed to implement any changes. (Recommendation 7)

Agency Comments

We provided a draft of this report to DOD for review and comment. In its written comments, reproduced in appendix V, DOD concurred with our recommendations. Specifically, DOD identified an approach to implementing our recommendations through a working group the department established to support the transition of sustainment management from the F-35 Joint Program Office to the military services. DOD's comments noted that his working group will address, among other things, the division of responsibilities for the F-35 sustainment elements between the government and the contractor. In addition, DOD provided technical comments, which we incorporated as appropriate.

We are sending copies of this report to the appropriate congressional committees; the Secretary of Defense; the Under Secretary of Defense for Acquisition and Sustainment; the F-35 Program Executive Officer; the 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 VI.

Diana Maurer
Director, Defense Capabilities and Management

Appendix I: Prior Recommendations on F-35 Sustainment

We have published a series of reports examining sustainment of the F-35.[1] Since 2014, we have made 36 recommendations designed to improve the department's operation and sustainment of the F-35 program. While the Department of Defense (DOD) concurred with many of these recommendations, as of July 2023, only just over a third have been implemented; 23 of these recommendations remained unimplemented.

DOD has implemented some of our recommendations. For example:

- In 2020, we recommended that DOD develop and implement a strategy for the redesign of the Autonomic Logistics Information System.[2] DOD concurred and, in November 2021, published and submitted to Congress an F-35 Autonomic Logistics Redesign Strategy.
- In 2019, we recommended that DOD conduct a comprehensive review of the F-35 supply chain to determine what additional actions were needed to close the gap between warfighter requirements for aircraft performance and the capabilities that the F-35 supply chain can deliver.[3] DOD concurred, and reported several actions that it took to implement this recommendation, such as adjusting its contracted performance incentives to prioritize the allocation of parts to operational units.

Across our work on F-35 sustainment, we have reported significant challenges faced by DOD in sustaining a growing F-35 fleet. In April 2022, we testified on the status of F-35 sustainment and the department's

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

[2]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).

[3]GAO-19-321.

efforts to address our recommendations.[4] The F-35 continues to not meet its targets for mission capable rates or reliability and maintainability metrics and DOD faces many uncertainties, including engine modernization, F-35 logistics system redesign, and organic (i.e., government-owned and -operated) versus contractor sustainment, as it decides the future of F-35 sustainment.

We have made recommendations that DOD has concurred with to address many of these challenges; however, DOD has not fully implemented 23 of our recommendations. (see table 1) For example,

- In 2022, we reported that the sustainment strategy for the F-35's engine did not meet the desired outcomes of the military services and we made recommendations designed to improve that strategy.[5]
- In 2021, we recommended that DOD assess and document its ability to meet the military services' affordability constraints and develop a program-wide plan for such constraints.[6]

In the House report accompanying a bill for the National Defense Authorization Act for Fiscal Year 2022, the House Committee on Armed Services stated that our recommendations could help DOD improve overall sustainment and affordability of the program and directed DOD to report on its progress implementing our F-35 sustainment-related recommendations by March 1, 2022. According to DOD officials, as of July 2023, DOD had not submitted this report to Congress.

The following table identifies the status of DOD implementation of our recommendations, as described on the GAO webpage.

[4]GAO-22-105995.

[5]GAO-22-104678.

[6]GAO-21-439.

Table 1: Status of Selected Prior Recommendations on F-35 Sustainment

Category	Recommendation	Status
F-35 Aircraft: DOD Should Assess and Update Its Engine Sustainment Strategy to Support Desired Outcomes (GAO-22-104678)	The Secretary of Defense should ensure that the F-35 Joint Program Office, in collaboration with the military services, assesses and updates the F-35 engine sustainment strategy, including its goals and the necessary actions to achieve its goals—such as the required number of spare engines and modules and the levels of maintenance and capacity needed to repair the modules. The assessment and any corresponding decisions and actions should be documented and take into consideration engine sustainment costs and modernization plans.	**(OPEN)** In July 2022, DOD concurred with this recommendation.
F-35 Aircraft: DOD Should Assess and Update Its Engine Sustainment Strategy to Support Desired Outcomes (GAO-22-104678)	The Secretary of Defense should ensure that the F-35 Joint Program Office collaborates with the military services and Pratt & Whitney on developing a shared model for spare part forecasts, reaches agreement with the military services and Pratt & Whitney on a model for spare parts forecasting, and documents that agreement to ensure common understanding of the model.	**(OPEN)** In July 2022, DOD concurred with this recommendation.
F-35 Sustainment: DOD Needs to Cut Billions in Estimated Costs to Achieve Affordability (GAO-21-439)	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.	**(OPEN)** DOD agreed with the substance of the recommendation and was taking actions to address the recommendation. As of February 2023, DOD officials told us that the F-35 Joint Program Office was using specific activities, including Plan of Actions and Milestones, to drive affordability cost-reduction efforts. These activities will also include timelines, resource requirements, assumptions, and risks against the current military service-provided affordability constraints. DOD plans to document all of these efforts in an update to the F-35's Life Cycle Sustainment Plan; however, the completion date of this update was undetermined. Until we are able to review the updated F-35 Life Cycle Sustainment Plan and determine the extent to which DOD has documented its ability to meet the military services' affordability constraints, this recommendation will remain open.

Category	Recommendation	Status
F-35 Sustainment: DOD Needs to Cut Billions in Estimated Costs to Achieve Affordability (GAO-21-439)	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.	**(OPEN)** DOD agreed with the substance of the recommendation. According to DOD officials, as part of the military services' fiscal year 2023 budget requests, the military services provided analyses of their most up-to-date assessments of future aircraft purchases and flying hour plans. DOD officials told us that they planned to work with the military services to collect any analyses completed that may show how changes in requirements can lead to cost reductions. Until we are able to review and assess these analyses, this recommendation will remain open.
F-35 Sustainment: DOD Needs to Cut Billions in Estimated Costs to Achieve Affordability (GAO-21-439)	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.	**(OPEN)** DOD agreed with the substance of the recommendation and was taking actions to address the recommendation. As of February 2023, DOD officials told us that the F-35 Joint Program Office is using specific activities, including Plan of Actions and Milestones, to drive affordability cost reduction efforts. These activities will also include timelines, resource requirements, assumptions, and risks against the current military service-provided affordability constraints. DOD planned to document all of these efforts in an update to the F-35's Life Cycle Sustainment Plan; however, the completion date of this update was undetermined. Until we are able to review and assess the updated F-35 Life Cycle Sustainment Plan and determine the extent to which DOD has developed a program-wide plan for achieving its affordability constraints, this recommendation will remain open.
F-35 Sustainment: DOD Needs to Cut Billions in Estimated Costs to Achieve Affordability (GAO-21-439)	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 to achieve affordability objectives.	**(OPEN)** DOD agreed with the substance of the recommendation. According to DOD officials, the F-35 program will incorporate cost risk-mitigation plans into its overall risk-mitigation strategy once the military services finalize and document their updated steady-state affordability constraints. A completion date for the updated steady-state affordability constraints could not be determined. Until these actions are taken and a risk-management approach has been developed and documented, this recommendation will remain open.
F-35 Sustainment: DOD Needs to Cut Billions in Estimated Costs to Achieve Affordability (GAO-21-439)	**Matter** - 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.	**(OPEN)** As of March 2023, Congress has not required the Department of Defense to report annually on the progress in achieving the service's affordability constraints.

Category	Recommendation	Status
F-35 Sustainment: DOD Needs to Cut Billions in Estimated Costs to Achieve Affordability (GAO-21-439)	Matter - Congress should consider making future F-35 aircraft procurement decisions contingent on DOD's progress in achieving F-35 sustainment affordability constraints.	**(CLOSED – IMPLEMENTED)** In Section 141 of the National Defense Authorization Act for Fiscal Year 2022, Congress took steps to limit the quantity of F-35s procured by the military services beginning in fiscal year 2029 based on their ability to achieve affordability cost targets. These steps meet the intent of our matter for consideration; therefore, we are closing this action.
Weapon System Sustainment: DOD Needs a Strategy for Redesigning the F-35's Central Logistics System (GAO-20-316)	The Secretary of Defense should ensure the Under Secretary of Defense for Acquisition and Sustainment, in consultation with the F-35 Program Executive Officer, develops a program-wide process for measuring, collecting, and tracking information on how the Autonomic Logistics Information System (ALIS) is affecting the performance of the F-35 fleet to include, but not be limited to, its effects on mission capability rates.	**(OPEN)** DOD concurred with this recommendation. As of November 2021, the department provided a report to Congress entitled, F-35 Autonomic Logistics Information System Redesign Strategy. Within this report was a section on tracking the Autonomic Logistics Information System's (ALIS) effect. The section lists a number of metrics and measures that DOD was taking to make sure that each version of ALIS was better than the previous version. The section described improved ALIS software release strategies and more rigorous testing to assure improved performance of the system. However, the section does not provide any specific guidance on how ALIS was affecting the performance of the F-35 fleet. The report states, "although some improvements have been made to collecting performance measures, ALIS still lacks the ability to collect performance measures that affect the performance of the F-35 aircraft fleet. One of the design principles during the evolution from ALIS to ODIN was to implement those performance measures." As of April 2022, the transition date from ALIS to ODIN is undetermined. We will continue to monitor the ALIS to ODIN transition and if DOD develops a method for determining how its central logistics system is affecting the performance of the F-35 fleet.
Weapon System Sustainment: DOD Needs a Strategy for Redesigning the F-35's Central Logistics System (GAO-20-316)	The Secretary of Defense should ensure the Under Secretary of Defense for Acquisition and Sustainment, in consultation with the F-35 Program Executive Officer, develops and implements a strategy for the redesign of the Autonomic Logistics Information System (ALIS). The strategy should be detailed enough to clearly identify and assess the goals, key risks or uncertainties, and costs of re-designing the system.	**(CLOSED - IMPLEMENTED)** DOD concurred with this recommendation. In November 2021, DOD published and subsequently submitted to Congress an F-35 Autonomic Logistics Information System (ALIS) Redesign Strategy. This strategy was completed in response to a congressional requirement that was based on our recommendation. The strategy includes an identification of goals, key risks, and other important aspects of the desired pathway for the redesign. As a result of addressing the recommendation, DOD will be better positioned to effectively plan, coordinate, and implement its efforts to improve ALIS and its performance.

Category	Recommendation	Status
Weapon System Sustainment: DOD Needs a Strategy for Redesigning the F-35's Central Logistics System (GAO-20-316)	**Matter** - Congress should consider legislation requiring the Department of Defense to establish a performance-measurement process for the Autonomic Logistics Information System (ALIS) that includes, but is not limited to, performance metrics and targets that (1) are based on intended behavior of the system in actual operations and (2) tie system performance to user requirements.	**(OPEN)**
F-35 Aircraft Sustainment: DOD Needs to Address Substantial Supply Chain Challenges (GAO-19-321)	The Secretary of Defense should ensure that the Under Secretary of Defense for Acquisition and Sustainment, together with the F-35 Program Executive Officer, the Secretaries of the Air Force and Navy, and the Commandant of the Marine Corps, conducts a comprehensive review of the F-35 supply chain to determine what additional actions are needed to close the gap between warfighter requirements for aircraft performance and the capabilities that the F-35 supply chain can deliver, in light of the U.S. services' affordability constraints. Potential actions could include adjustments to the quantities of parts DOD is planning to procure, or developing a mechanism for providing increased availability of parts to operational units, as a means to mitigate fleet-wide shortages.	**(CLOSED - IMPLEMENTED)** DOD concurred with this recommendation. As of December 2020, DOD had taken a number of actions to review the F-35 supply chain and identify actions needed to close the gap between warfighter requirements for aircraft performance and what the supply chain can deliver. Specifically, following the issuance of its revised Life Cycle Sustainment Plan in January 2019, DOD has developed detailed and iterative plans of action with milestones for key areas of sustainment-including plans for depot repair and the supply chain-that identify the levers that affect desired sustainment outcomes and the actions that must be taken to achieve those outcomes. DOD conducted an analysis to examine the option of increasing the quantities of parts that DOD will procure, but has determined that this would be unjustified without first addressing the other systemic program issues that are being targeted in its plans of action. Instead, DOD has made adjustments to its contracted performance incentives to prioritize the allocation of parts to operational units to achieve its target of 80 percent mission capability. These actions are reflective of DOD working to ensure that parts are going where they are most needed given budgetary and readiness trade-offs, as it continues efforts to improve overall supply chain performance. While DOD still faces challenges, taken together these actions better position DOD to work toward the required sustainment outcomes for the F-35. DOD has met the intent of our recommendation.

Category	Recommendation	Status
F-35 Aircraft Sustainment: DOD Needs to Address Substantial Supply Chain Challenges (GAO-19-321)	The Secretary of Defense should ensure that the Under Secretary of Defense for Acquisition and Sustainment, together with the F-35 Program Executive Officer, the Secretaries of the Air Force and Navy, and the Commandant of the Marine Corps, develops a process to modify the afloat and deployment spares packages, to include reviewing the parts within the packages to ensure that they match deploying aircraft and account for updated parts demand, and aligning any necessary funding needed for the parts updates.	**(OPEN)** DOD concurred with this recommendation. As of February 2022, documentation provided by DOD showed that it had developed an initial process for managing the configurations of the parts within the afloat and deployment spares packages, including issuing a configuration and updated plan. In November 2020, the program completed its pilot and its subsequent focused effort to review its 13 fielded afloat and deployment spares packages to identify needed updates—referred to as the "Catch-Up" Phase. According to program documentation, the process evolved throughout 2020 and lessons learned from that phase were to be incorporated into the process in 2021—which was to be the first iteration of the process as part of the program's regular planning and execution rhythm. In January 2022, DOD officials said that the revisions to policy that formally document this process were nearly complete. These efforts demonstrated significant progress by DOD; we will continue to monitor DOD's progress as it finalizes this process.
F-35 Aircraft Sustainment: DOD Needs to Address Substantial Supply Chain Challenges (GAO-19-321)	The Secretary of Defense should ensure that the Under Secretary of Defense for Acquisition and Sustainment, together with the F-35 Program Executive Officer, the Secretaries of the Air Force and Navy, and the Commandant of the Marine Corps, revises the business rules for the prioritization of scarce F-35 parts across all program participants so as to clearly define the roles and responsibilities of all stakeholders, the process for assigning force activity designations, and the way in which deviations from the business rules will be conducted.	**(CLOSED - IMPLEMENTED)** DOD concurred with this recommendation. In October 2019, the F-35 Joint Program Office issued revised business rules for the prioritization of scarce F-35 parts. These revised business rules include additional detail that further defines the roles and responsibilities of all stakeholders, the process for assigning force activity designations, and how participants can request deviations from the business rules. As a result, the process for allocating scarce F-35 parts will be more transparent and participants can have more confidence in the equity of such decisions. These revised business rules meet the intent of our recommendation.

Category	Recommendation	Status
F-35 Aircraft Sustainment: DOD Needs to Address Substantial Supply Chain Challenges (GAO-19-321)	The Secretary of Defense should ensure that the Under Secretary of Defense for Acquisition and Sustainment, together with the F-35 Program Executive Officer, completes a detailed plan for the establishment of the global network for moving F-35 parts that outlines clear requirements and milestones to reach full operational capability, and that includes mechanisms to identify and mitigate risks to the F-35 global spares pool.	**(OPEN)** DOD concurred with this recommendation. As of February 2022, DOD had taken some actions to address this recommendation, including issuing a program instruction for F-35 Global Asset Management (GAM) that establishes policy and assigns responsibilities for management and execution of global asset management. This program instruction establishes policy and responsibilities, which is an important foundation for developing a plan. Additionally, the F-35 program office has established an approach for transitioning importer/exporter functions, warehousing, and transportation functions from contracted to government solutions, which includes planning efforts such as a high-level transition dashboard and schedule to track progress, working groups and a risk register to identify potential risks, effects, and associated mitigations to implementation. We have requested additional information about the detailed requirements and milestones behind these efforts as the program works to fully establish the network for moving parts and will continue to monitor DOD's progress in this area.
F-35 Aircraft Sustainment: DOD Needs to Address Substantial Supply Chain Challenges (GAO-19-321)	The Secretary of Defense should ensure that the Under Secretary of Defense for Acquisition and Sustainment, together with the F-35 Program Executive Officer, issues a policy consistent with DOD guidance that clearly establishes how DOD will maintain accountability for F-35 parts within the supply chain, and identify the steps needed to implement the policy retrospectively and prospectively—for example, how DOD will obtain the necessary data from the contractor. This policy should provide clarity on how F-35 parts will be categorized, specify how the program will implement DOD regulations, and define prime contractor roles and responsibilities.	**(OPEN)** DOD concurred with this recommendation. As of February 2022, DOD had taken some steps to address this recommendation. In particular, it has issued a program directive that establishes an F-35 Accountable Property Management Framework. This directive clarifies several key aspects of property accountability for the program, including clarifying certain roles and responsibilities and establishing that global-pooled assets, such as spare parts, are to be categorized as government-furnished property. This is a critical first step, but this framework does not provide details on how it will be implemented and DOD also continues to face challenges with establishing accountability for the global spares pool, including with establishing a fully functioning Accountable Property System of Record. DOD stated that it was working to implement a plan to complete internal policy changes to bring the F-35 program fully into alignment with department policy by January 2023. We will continue to monitor DOD's efforts in this area.

Category	Recommendation	Status
F-35 Aircraft Sustainment: DOD Needs to Address Substantial Supply Chain Challenges (GAO-19-321)	The Secretary of Defense should ensure that the Under Secretary of Defense for Acquisition and Sustainment, together with the F-35 Program Executive Officer, develops a methodical approach to consistently obtain comprehensive cost information from the prime contractor for F-35 spare parts within the supply chain.	**(OPEN)** DOD concurred with this recommendation. As of February 2022, DOD officials cited progress in obtaining comprehensive cost information from the prime contractors for parts within the supply chain. For example, DOD officials have said that all contracts for new spares now identify the unit acquisition cost for each spare part, and require contractors to include these unit acquisition costs in the totals listed on Material Inspection and Receiving Reports at the time of delivery. Additionally, DOD stated that the F-35 program receives data on actual spares replenishment and repair costs associated with its sustainment contracts quarterly from the contractors. However, the F-35 program faces continued challenges in this area. For example, the F-35 program has not established a clear methodology for obtaining the fully burdened costs for each asset. The program has been relying on the Material Inspection and Receiving Reports for these costs, but those reports may not consistently include all costs such as transportation. In addition, the program has not established consistent procedures for capturing continuous transaction costs for each asset after initial delivery. We will continue to monitor DOD's progress in this area.
F-35 Aircraft Sustainment: DOD Needs to Address Substantial Supply Chain Challenges (GAO-19-321)	The Secretary of Defense should ensure that the Under Secretary of Defense for Acquisition and Sustainment, together with the Department of Defense Comptroller, the Secretaries of the Air Force and Navy, and the F-35 Program Executive Officer, completes and formalizes a methodology for the U.S. services to use in recording on their financial statements the funds spent on F-35 parts within the global spares pool.	**(OPEN)** DOD concurred with this recommendation. As of December 2021, DOD stated that the Comptroller was developing a white paper to formalize the methodology for the military services to use in recording on their financial statement the funds spent on F-35 parts within the global spares pool. In parallel to the development of the white paper, to ensure that the department is prepared to implement the methodology once it is complete, DOD said that the spares pool data was being incorporated into an Accountable Property System of Record, and the JPO was working to establish accurate cost values for the global spares pool. However, as of February 2022, there were still a number of issues for DOD to address to establish and implement such a methodology, including establishing an accurate inventory of parts on bases around the world, determining how continuing transactions will be tracked, and agreeing with the services on who will be responsible for tracking and reporting assets. We will continue to monitor DOD's progress in this area.

Category	Recommendation	Status
F-35 Aircraft Sustainment: DOD Needs to Address Substantial Supply Chain Challenges (GAO-19-321)	**PRIORITY REC** - The Secretary of Defense should ensure that the Under Secretary of Defense for Acquisition and Sustainment, together with the F-35 Program Executive Officer, the Secretaries of the Air Force and Navy, and the Commandant of the Marine Corps, clearly defines 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.	**(OPEN)** DOD agreed with this recommendation. As of January 2023, DOD officials told us the department has completed a number of steps to document the F-35 program's future supply chain strategy. In January 2023, the department provided a plan on transferring planning, management, and execution of F-35 sustainment (and acquisition) from the F-35 Joint Program Office to the military departments, as required by the National Defense Authorization Act for Fiscal Year 2022. DOD's report emphasizes the importance of (1) the military departments having a greater degree of ownership and accountability in planning, managing, and executing the sustainment functions for the F-35, (2) the military departments leveraging their existing expertise, capability, and capacity in the sustainment of the F-35, and (3) the department normalizing F-35 sustainment through reinforcing departmental best practices and integrating them with established departmental processes. However, DOD's plan provides no additional details regarding the military departments' plans to manage or resource supply support and the F-35 supply chain. To fully implement this recommendation, DOD should clearly define the strategy by which it will manage the F-35 supply chain in the future and update key strategy documents accordingly. This definition should include determining the roles of both the prime contractor and DOD in managing the supply chain and the investments in technical data needed to support DOD-led management. Until DOD implements our recommendation and clearly defines its strategy for managing the F-35 supply chain in the future-to include any additional actions and investments necessary to support that strategy-the F-35 program will lack the certainty and unity of effort needed to meaningfully improve supply chain performance and reduce costs.

Category	Recommendation	Status
Warfighter Support: DOD Needs to Share F-35 Operational Lessons across the Military Services (GAO-18-464R)	The F-35 Program Executive Officer should formally share or make available, through a new or existing communications mechanism, F-35 operational lessons learned across the services.	**(OPEN)** DOD concurred with our recommendation. According to DOD officials, the Air Force, the Marine Corps, and the Navy have robust systems for capturing and sharing F-35 operational lessons learned. Although these systems are accessible by members of the other services, there is a general lack of awareness of how to access systems across military services. As of December 2019, DOD officials stated that they were developing a Lessons Learned Database, which they estimated will be completed during the third quarter of 2020. As of May 2021, DOD officials believed they had made considerable progress in addressing this recommendation; however, no further information was provided to GAO. As of summer 2022, according to Joint Program Office officials, there is internal dispute as to who within DOD should be the operational authority tied to this recommendation. Until the department provides relevant documentation to confirm the implementation of a solution, this recommendation will remain open.

Source: GAO. I GAO-23-105341

Appendix II: Scope and Methodology

To address our first objective, we reviewed and analyzed relevant sustainment and depot-related plans from the Department of Defense (DOD) and the prime contractor. We selected and visited two depot maintenance facilities—Ogden Air Logistics Complex at Hill Air Force Base, Utah, and the Fleet Readiness Center East at Marine Corps Air Station Cherry Point, North Carolina—both of which are the primary air vehicle and component F-35 depots. At each location we interviewed officials, collected relevant documentation, and observed depot operations. We interviewed officials from the F-35 Joint Program Office, the Office of the Under Secretary of Defense for Acquisition and Sustainment, the Defense Contract Management Agency, the Air Force, the Navy, and the Marine Corps to discuss current depot operations and future plans to evolve the existing depot posture. We collected and analyzed performance metrics, such as component repair times and the number of components awaiting repair, to determine the performance of depots in repairing components.

To address our second objective, we reviewed relevant sustainment and organizational level-related maintenance plans from DOD and the prime contractor. We selected and visited three operational F-35 installations—Hill Air Force Base, Utah; Naval Air Station Lemoore, California; and Marine Corps Air Station Yuma, Arizona—that house Air Force, Navy, and Marine Corps squadrons respectively. We chose one operational F-35 installation from each military service to receive maintainer perspective from squadrons that fly aircraft regularly and have supported operational deployments. At each location, we interviewed government and contractor officials, collected relevant documentation, and observed maintenance activities. We also developed and sent an electronic survey in April 2022 to collect organizational-level maintenance-related inputs, data, and flight-line experiences.

Because this was not a sample survey, it has no sampling errors. We surveyed all 15 U.S. F-35 locations that were testing, training, and operational locations and received responses from all 15, resulting in a 100 percent response rate. However, the practical difficulties of conducting any survey may introduce errors, commonly referred to as nonsampling errors. For example, difficulties in interpreting a particular

question, sources of information available to respondents, or entering data into a database or analyzing them can introduce unwanted variability into the survey results. We took steps in developing the questionnaire, collecting the data, and analyzing them to minimize such nonsampling errors. For example, a social science survey specialist designed the questionnaire in collaboration with engagement team staff who had subject matter expertise. Then, we pretested the draft questionnaire with three knowledgeable F35 staff to ensure that the questions were relevant, clearly stated, and easy to understand. An independent survey specialist within our Applied Research and Methods team also reviewed the survey from a technical standpoint. Since this was a Web-based survey, respondents entered their answers directly into the electronic questionnaire, eliminating the need to key data into a database, and minimizing error.

These 15 locations included operational, testing, and training locations. The locations surveyed were: 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. We interviewed officials from the F-35 Joint Program Office, the Office of the Under Secretary of Defense for Acquisition and Sustainment, the Office of Cost Assessment and Program Evaluation, the Air Force, the Navy, and the Marine Corps to discuss current organizational-level maintenance challenges, improvements, and future plans. Finally, we collected and analyzed performance metrics, such as mission capable rates, non-mission capable rates due to supply issues, and non-mission capable rates due to maintenance issues, from 2020 through March 2023 to determine the current state of performance tied to organizational-level maintenance and the supply chain.

For both objective one and objective two, we analyzed data from the F-35 Joint Program Office and Lockheed Martin, the prime contractor for the F-35's air vehicle, on performance of the air vehicle, depot maintenance, and organizational maintenance. We focused on, among other things, depot component repair times and mission capable and non-mission capable rates due to maintenance and supply. We focused on these metrics because they are key sustainment metrics for measuring depot and organizational-level maintenance. We analyzed data from calendar year 2020 through March 2023 to determine any trend information over that period. We found these data to be sufficiently reliable for the

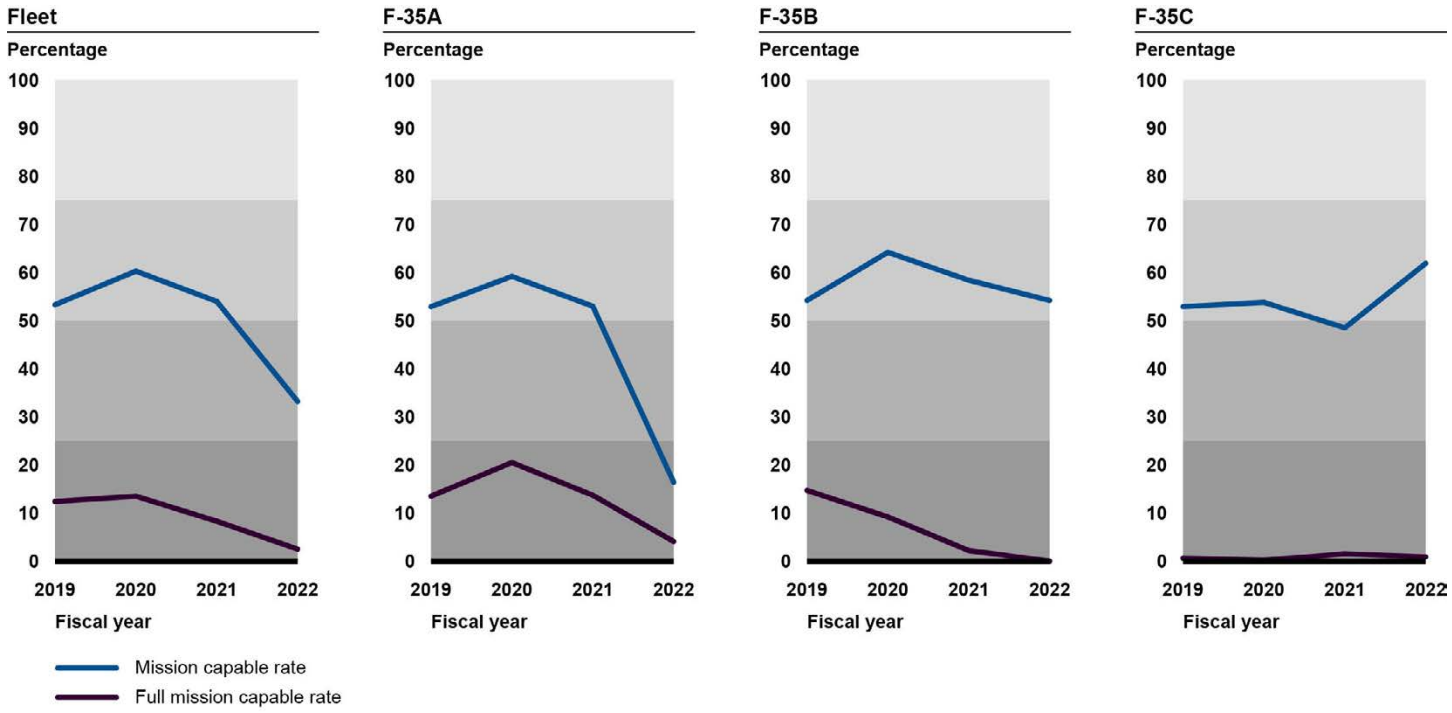
presentation of trends by interviewing officials responsible for and knowledgeable about the collection of the data and by reviewing the data for errors and any anomalies. We discussed trends in the data, including reasons for any changes in the trends, with DOD officials.

To address our third objective, we reviewed relevant planning and sustainment-related F-35 program documents including, but not limited to, the F-35's Life Cycle Sustainment Plan and Global Support Solution. We reviewed key F-35 program documentation related to the roles and responsibilities of government and contractors, including assessing what entities were responsible for producing key sustainment-related documentation for the program. We also reviewed the October 2021 business case analysis that explored alternative sustainment solutions, and interviewed the private-sector officials responsible for conducting the analysis. Using the business case analysis and F-35 program documentation, we identified government and contractor responsibilities associated with the 12 integrated product support elements, or sustainment elements that serve as the foundation of F-35 sustainment. We interviewed officials from the F-35 Joint Program Office, the Office of the Under Secretary of Defense for Acquisition and Sustainment, the Air Force, the Navy, and the Marine Corps to discuss government and contractor roles and responsibilities in sustainment, how the F-35's sustainment approach best fits their respective service moving forward, and what inputs they will have shaping F-35 sustainment moving forward. We evaluated the military services' sustainment approach for the F-35 against criteria in the 2021 Production Sustainment and Follow-On Development Memorandum of Understanding and federal standards for internal control. Additionally, we leveraged an open recommendation we made in 2014 for the F-35 program to develop an Intellectual Property Strategy for the program to follow up on the program's status of completing such a strategy.

Appendix III: U.S. 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 the 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 (figs. 16, 17, 18, and 19); whether the aircraft is being used for training and testing (figs. 20 and 21) or operationally (figs. 22 and 23); and what type of aircraft variant is being flown (figs. 24 and 25). We collected mission capable rate data from calendar year 2019 through calendar year 2022 to determine any trend information over that period. We found these data to be sufficiently reliable for the presentation of trends by interviewing officials responsible for and knowledgeable about the collection of the data and by reviewing the data for errors and anomalies.

Figure 16: Performance of F-35 Aircraft Built between 2008 and 2011, Fiscal Years 2019 through 2022



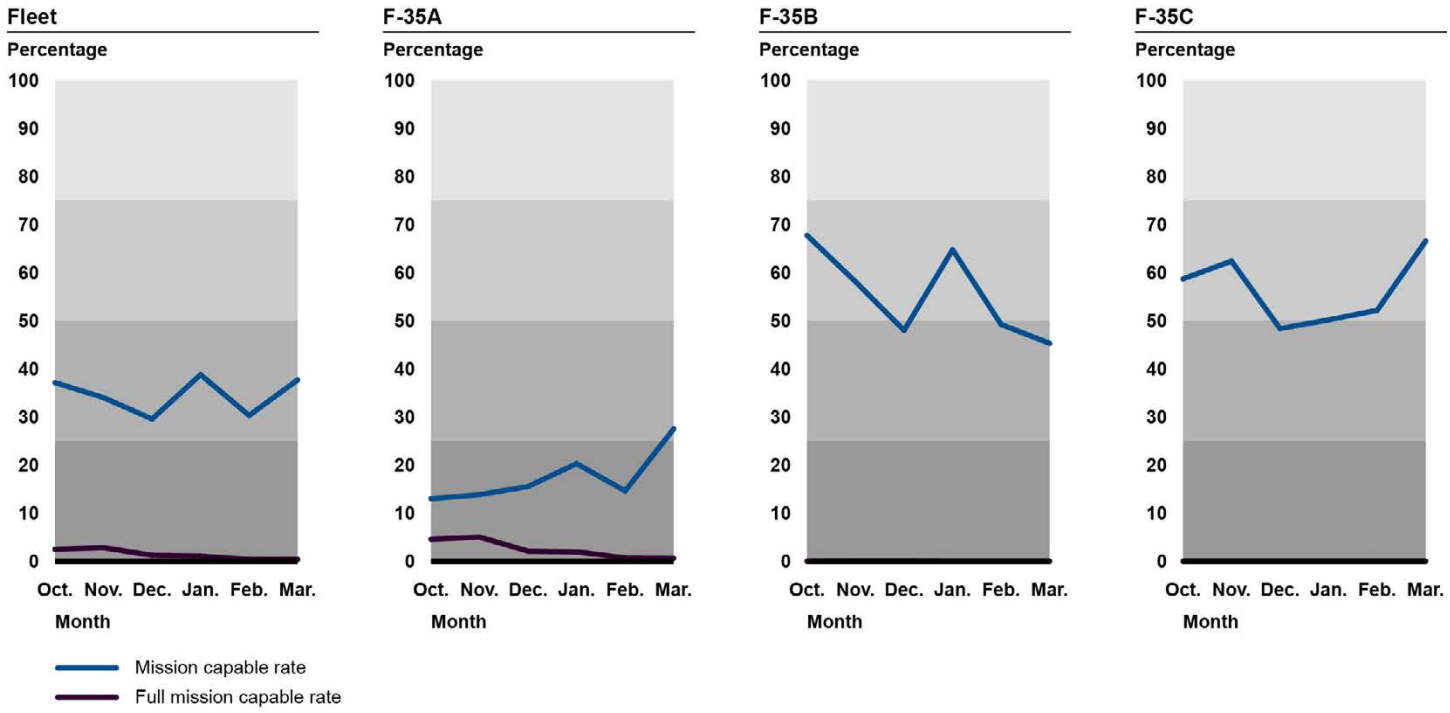
Source: GAO analysis of Department of Defense data. | GAO-23-105341

Accessible Data for Figure 16: Performance of F-35 Aircraft Built between 2008 and 2011, Fiscal Years 2019 through 2022

	Fleet	Fleet	F-35A	F-35A	F-35B	F-35B	F-35C	F-35C
Fiscal year	Full mission capable rate	Mission capable rate	Full mission capable rate	Mission capable rate	Full mission capable rate	Mission capable rate	Full mission capable rate	Mission capable rate
2019	12.4	53.3	13.5	52.9	14.7	54.2	0.6	52.9
2020	13.5	60.3	20.5	59.2	9.2	64.2	0.2	53.8
2021	8.3	54	13.7	53	2.2	58.4	1.5	48.5
2022	2.5	33.2	4.1	16.4	0	54.2	0.9	61.9

Source: GAO analysis of Department of Defense data. | GAO-23-105341

Figure 17: Performance of F-35 Aircraft Built between 2008 and 2011, October 2022 through March 2023



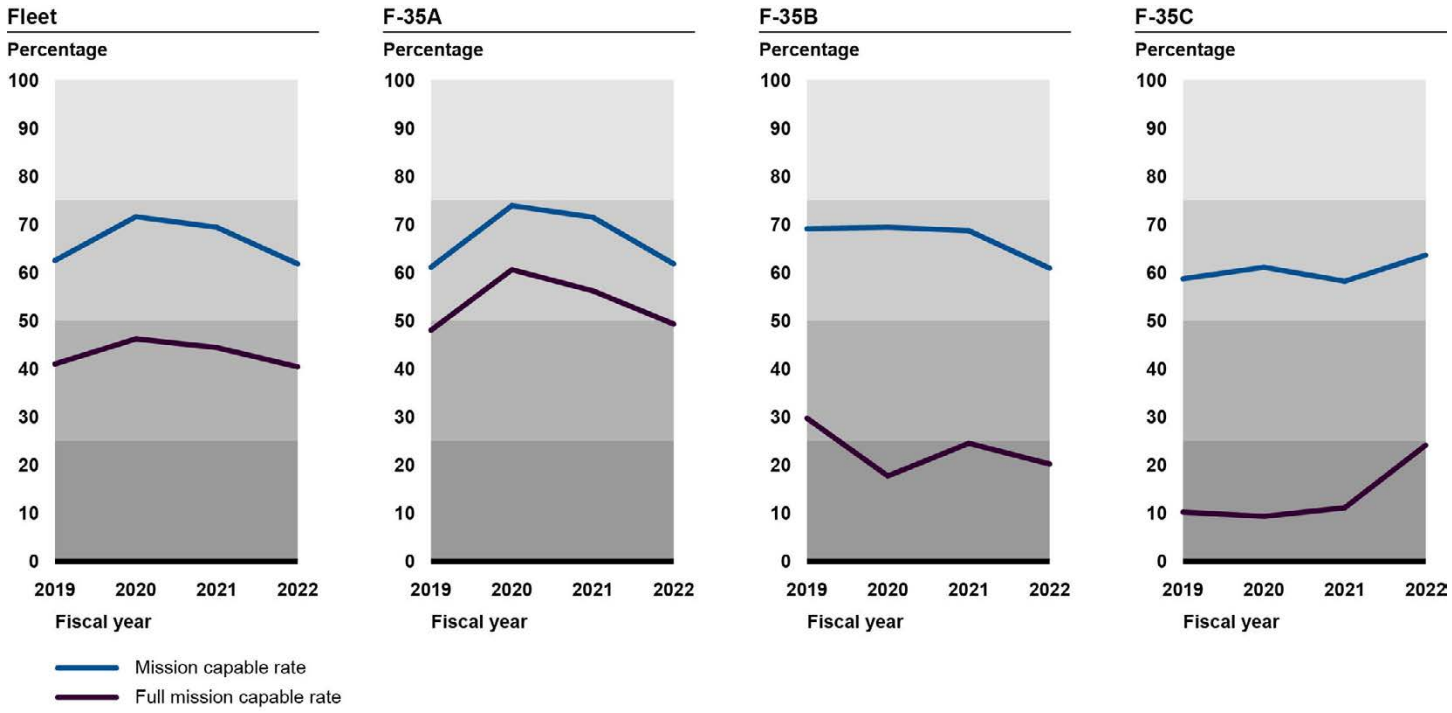
Source: GAO analysis of Department of Defense data. | GAO-23-105341

Accessible Data for Figure 17: Performance of F-35 Aircraft Built between 2008 and 2011, October 2022 through March 2023

	Fleet	Fleet	F-35A	F-35A	F-35B	F-35B	F-35C	F-35C
Month	Full mission capable rate	Mission capable rate	Full mission capable rate	Mission capable rate	Full mission capable rate	Mission capable rate	Full mission capable rate	Mission capable rate
October	2.47	37.12	4.57	12.98	0	67.73	0	58.68
November	2.8	34	5.01	13.81	0.06	58.1	0	62.37
December	1.21	29.55	2.08	15.52	0.08	47.96	0	48.34
January	1.06	38.77	1.94	20.27	0	64.74	0	50.16
February	0.38	30.28	0.68	14.6	0	49.2	0	52.14
March	0.35	37.68	0.61	27.5	0	45.27	0	66.53

Source: GAO analysis of Department of Defense data. | GAO-23-105341

Figure 18: Performance of F-35 Aircraft Built between 2012 and 2023, Fiscal Years 2019 through 2022



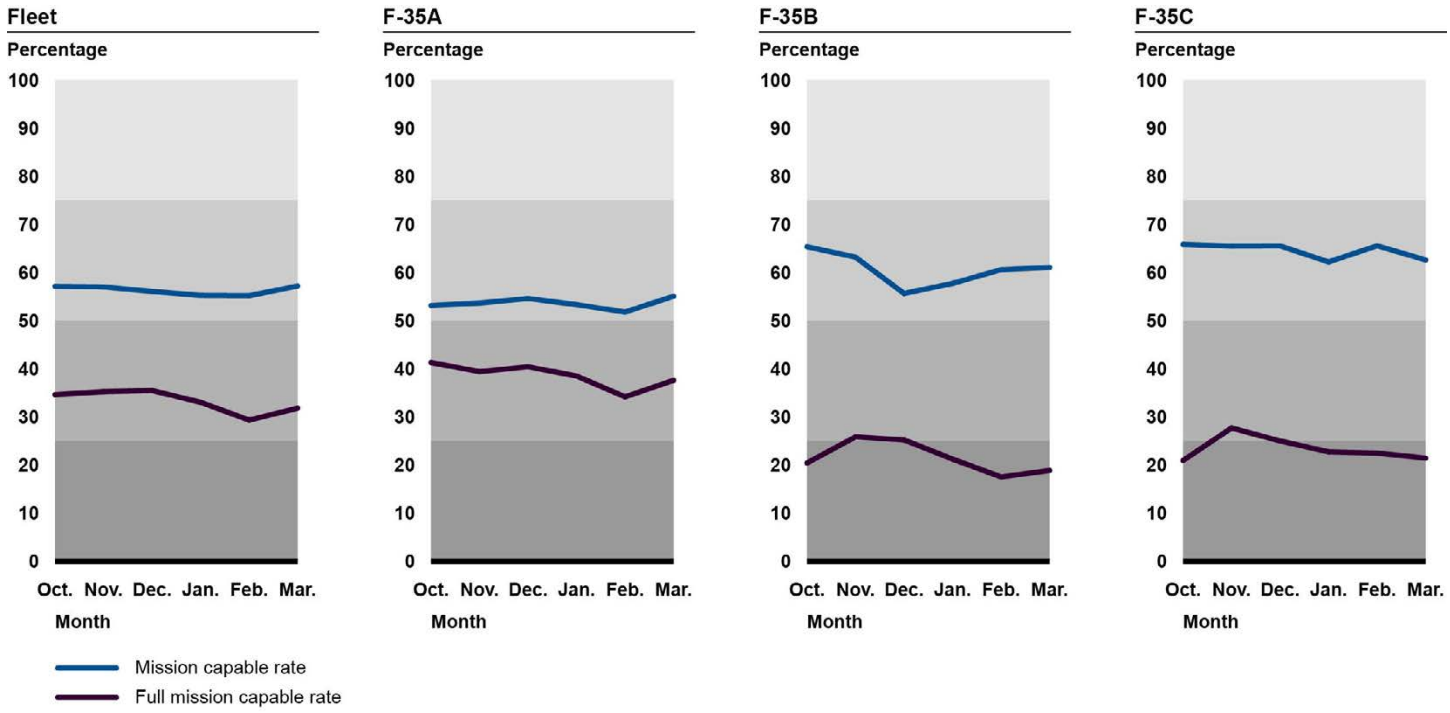
Source: GAO analysis of Department of Defense data. | GAO-23-105341

Accessible Data for Figure 18: Performance of F-35 Aircraft Built between 2012 and 2023, Fiscal Years 2019 through 2022

	Fleet	Fleet	F-35A	F-35A	F-35B	F-35B	F-35C	F-35C
Fiscal year	Full mission capable rate	Mission capable rate	Full mission capable rate	Mission capable rate	Full mission capable rate	Mission capable rate	Full mission capable rate	Mission capable rate
2019	41	62.5	48	61.1	29.7	69.1	10.2	58.7
2020	46.2	71.6	60.6	73.9	17.7	69.4	9.3	61.1
2021	44.4	69.4	56.2	71.5	24.5	68.7	11.1	58.2
2022	40.4	61.8	49.3	61.8	20.2	60.9	24.1	63.6

Source: GAO analysis of Department of Defense data. | GAO-23-105341

Figure 19: Performance of F-35 Aircraft Built between 2012 and 2023, October 2022 through March 2023



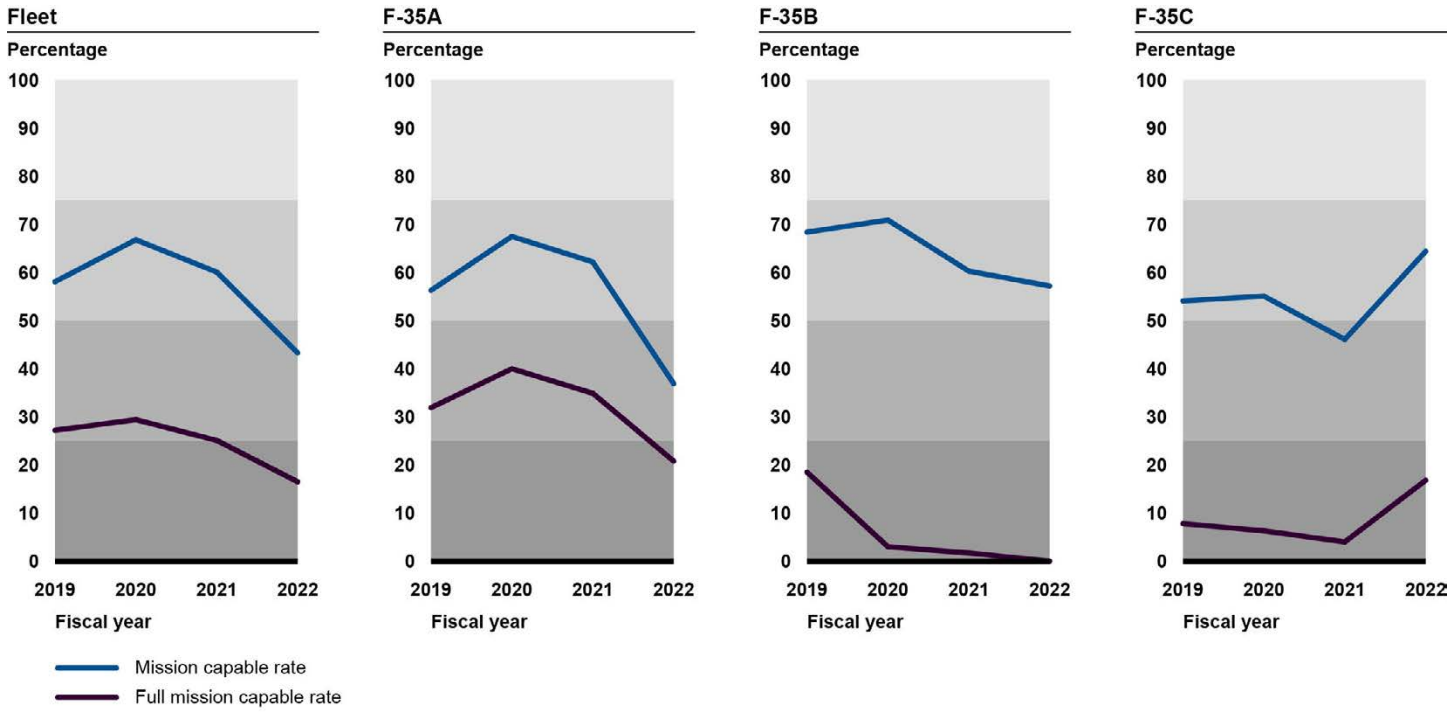
Source: GAO analysis of Department of Defense data. | GAO-23-105341

Accessible Data for Figure 19: Performance of F-35 Aircraft Built between 2012 and 2023, October 2022 through March 2023

	Fleet	Fleet	F-35A	F-35A	F-35B	F-35B	F-35C	F-35C
Month	Full mission capable rate	Mission capable rate	Full mission capable rate	Mission capable rate	Full mission capable rate	Mission capable rate	Full mission capable rate	Mission capable rate
October	34.61	57.13	41.28	53.14	20.41	65.36	20.92	65.84
November	35.24	57.01	39.41	53.66	25.85	63.19	27.68	65.49
December	35.47	56.07	40.41	54.61	25.21	55.65	25	65.54
January	33.03	55.26	38.49	53.32	21.22	57.74	22.72	62.2
February	29.32	55.19	34.16	51.79	17.51	60.61	22.47	65.56
March	31.79	57.2	37.6	55.08	18.85	61.06	21.42	62.61

Source: GAO analysis of Department of Defense data. | GAO-23-105341

Figure 20: Performance of F-35 Training and Testing Aircraft, Fiscal Years 2019 through 2022



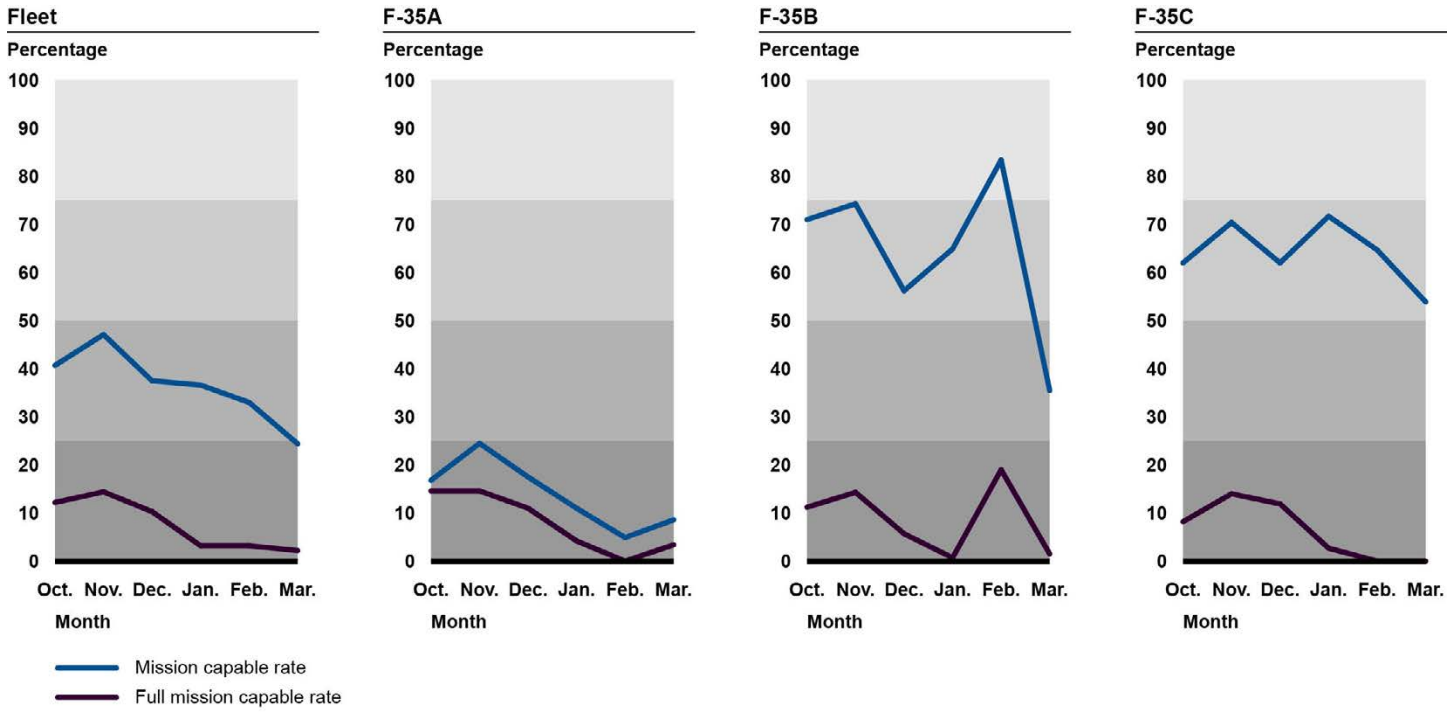
Source: GAO analysis of Department of Defense data. | GAO-23-105341

Accessible Data for Figure 20: Performance of F-35 Training and Testing Aircraft, Fiscal Years 2019 through 2022

	Fleet	Fleet	F-35A	F-35A	F-35B	F-35B	F-35C	F-35C
Fiscal year	Full mission capable rate	Mission capable rate	Full mission capable rate	Mission capable rate	Full mission capable rate	Mission capable rate	Full mission capable rate	Mission capable rate
2019	27.2	58.1	31.9	56.3	18.5	68.4	7.8	54.1
2020	29.4	66.8	40	67.5	3	70.9	6.3	55.1
2021	25.1	60.1	34.9	62.2	1.7	60.3	4	46.1
2022	16.5	43.3	20.8	36.9	0	57.2	16.8	64.4

Source: GAO analysis of Department of Defense data. | GAO-23-105341

Figure 21: Performance of F-35 Training and Testing Aircraft, October 2022 through March 2023



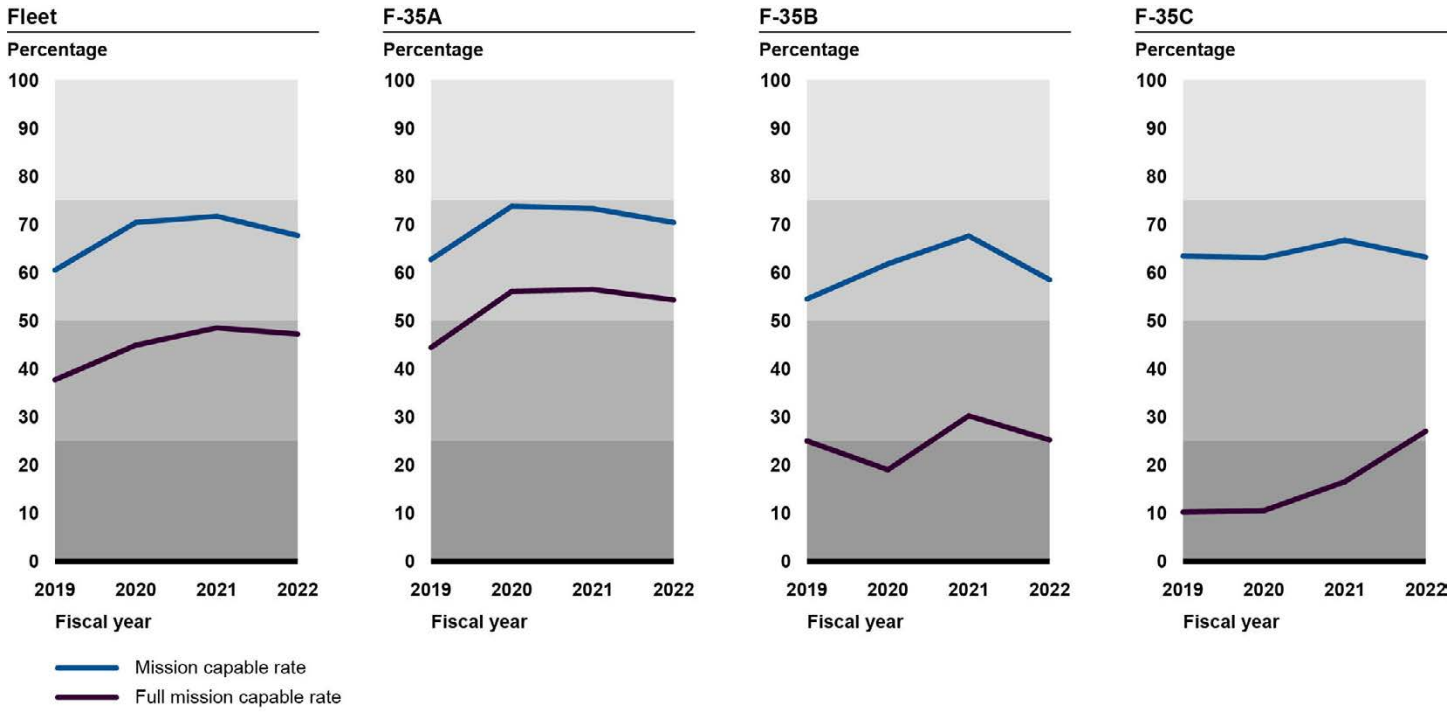
Source: GAO analysis of Department of Defense data. | GAO-23-105341

Accessible Data for Figure 21: Performance of F-35 Training and Testing Aircraft, October 2022 through March 2023

	Fleet	Fleet	F-35A	F-35A	F-35B	F-35B	F-35C	F-35C
Month	Full mission capable rate	Mission capable rate	Full mission capable rate	Mission capable rate	Full mission capable rate	Mission capable rate	Full mission capable rate	Mission capable rate
October	12.2	40.7	14.6	16.8	11.2	71	8.2	62
November	14.4	47.1	14.6	24.5	14.3	74.3	14	70.4
December	10.3	37.5	11	17.5	5.7	56.2	11.9	62
January	3.2	36.6	4.2	11	0.7	64.9	2.7	71.7
February	3.2	33	0	4.9	19	83.4	0	64.7
March	2.2	24.4	3.4	8.6	1.5	35.5	0	53.9

Source: GAO analysis of Department of Defense data.| GAO-23-105341

Figure 22: Performance of F-35 Operational Aircraft, Fiscal Years 2019 through 2022



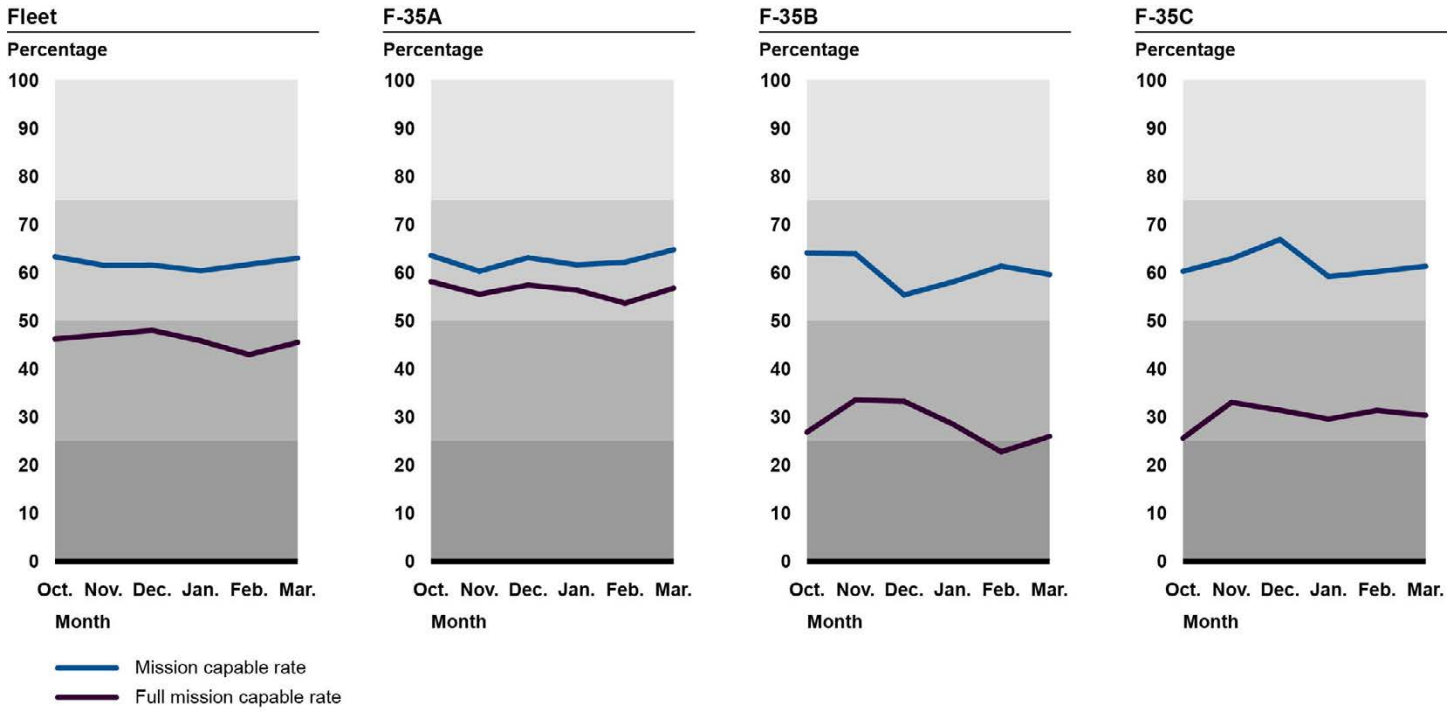
Source: GAO analysis of Department of Defense data. | GAO-23-105341

Accessible Data for Figure 22: Performance of F-35 Operational Aircraft, Fiscal Years 2019 through 2022

	Fleet	Fleet	F-35A	F-35A	F-35B	F-35B	F-35C	F-35C
Fiscal year	Full mission capable rate	Mission capable rate	Full mission capable rate	Mission capable rate	Full mission capable rate	Mission capable rate	Full mission capable rate	Mission capable rate
2019	37.7	60.5	44.4	62.7	25	54.5	10.2	63.4
2020	44.9	70.4	56.1	73.8	19	61.8	10.5	63.1
2021	48.5	71.7	56.5	73.3	30.2	67.6	16.5	66.7
2022	47.2	67.7	54.3	70.4	25.2	58.5	27	63.2

Source: GAO analysis of Department of Defense data. | GAO-23-105341

Figure 23: Performance of F-35 Operational Aircraft, October 2022 through March 2023



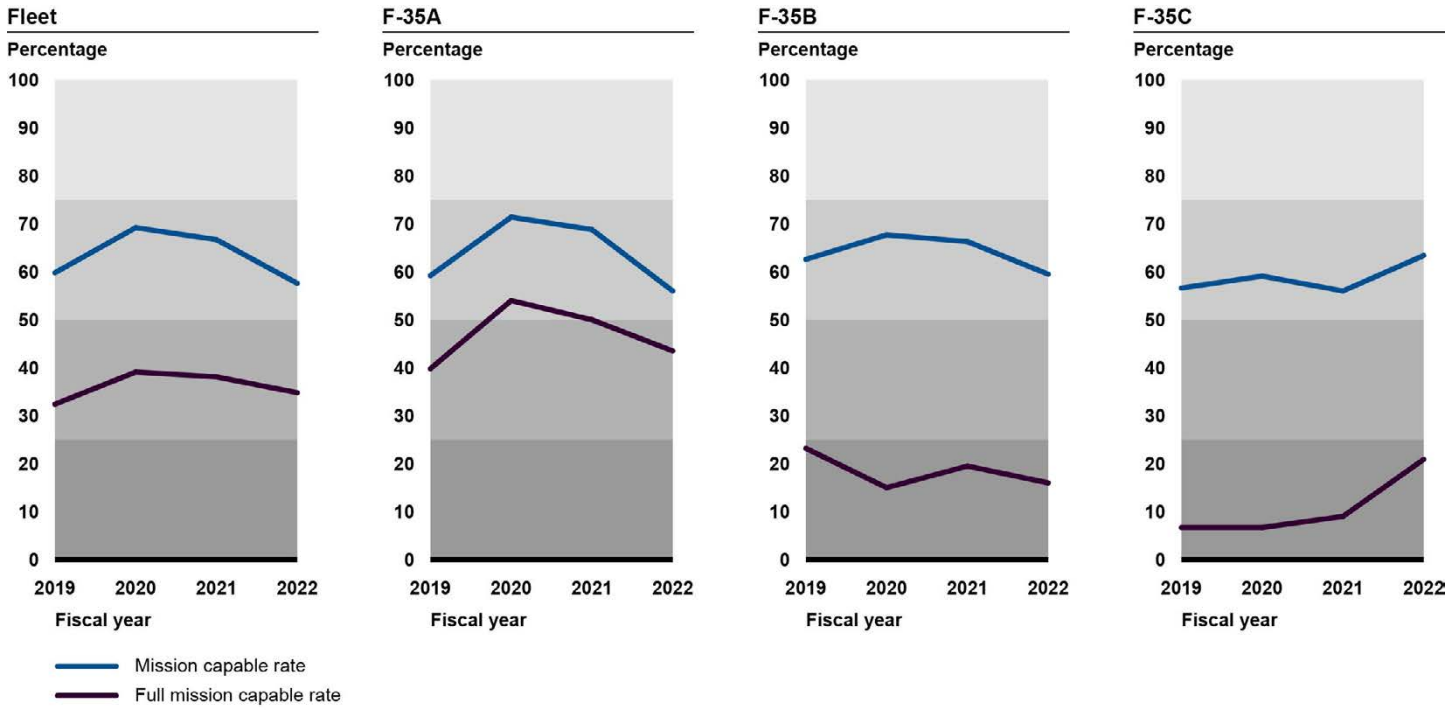
Source: GAO analysis of Department of Defense data. | GAO-23-105341

Accessible Data for Figure 23: Performance of F-35 Operational Aircraft, October 2022 through March 2023

	Fleet	Fleet	F-35A	F-35A	F-35B	F-35B	F-35C	F-35C
Month	Full mission capable rate	Mission capable rate	Full mission capable rate	Mission capable rate	Full mission capable rate	Mission capable rate	Full mission capable rate	Mission capable rate
October	46.2	63.28	58.11	63.54	26.81	64.09	25.57	60.26
November	47.06	61.52	55.49	60.28	33.53	63.88	33.01	62.86
December	47.97	61.56	57.39	63.09	33.22	55.35	31.36	66.86
January	45.81	60.37	56.36	61.6	28.51	58.04	29.54	59.17
February	42.93	61.69	53.64	62.14	22.73	61.34	31.33	60.2
March	45.48	62.99	56.76	64.74	25.94	59.61	30.3	61.31

Source: GAO analysis of Department of Defense data. | GAO-23-105341

Figure 24: Performance of F-35 Aircraft by Variant, Fiscal Years 2019 through 2022



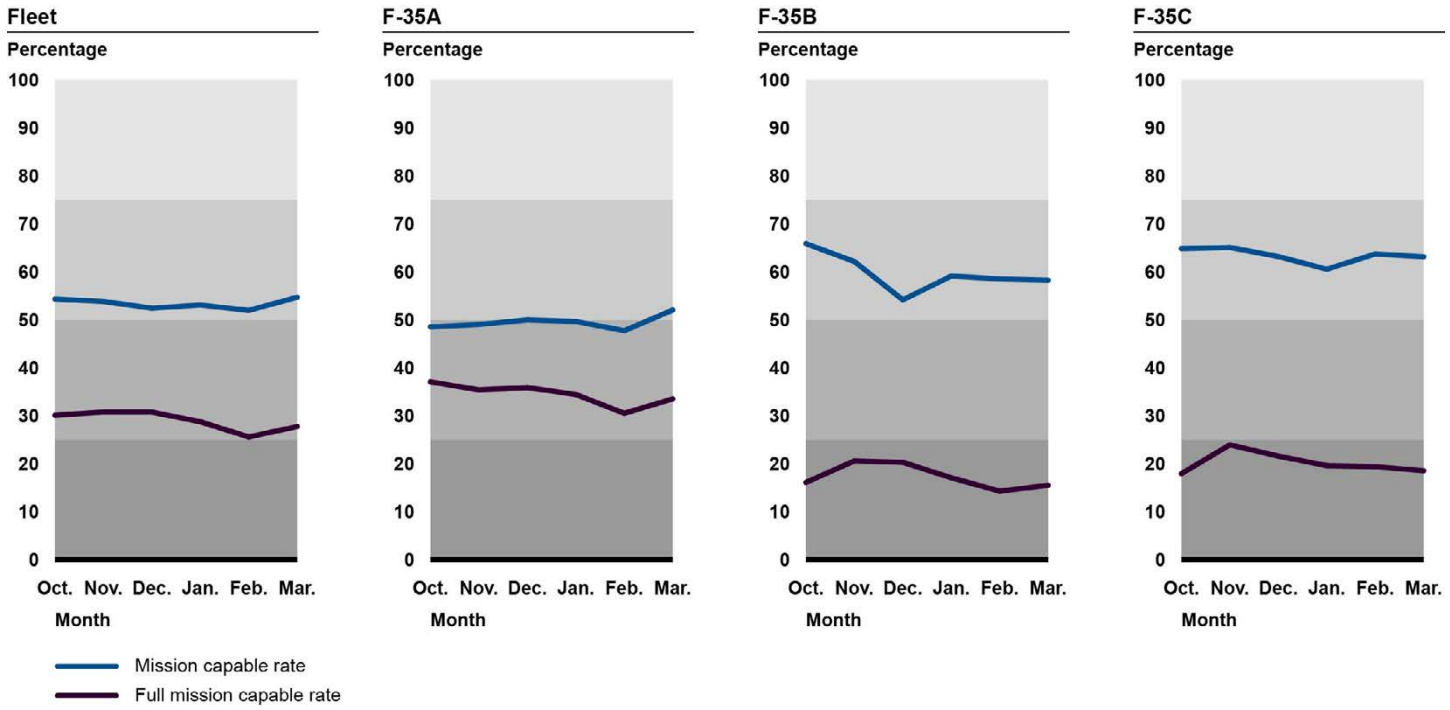
Source: GAO analysis of Department of Defense data. | GAO-23-105341

Accessible Data for Figure 24: Performance of F-35 Aircraft by Variant, Fiscal Years 2019 through 2022

	Fleet	Fleet	F-35A	F-35A	F-35B	F-35B	F-35C	F-35C
Fiscal year	Full mission capable rate	Mission capable rate	Full mission capable rate	Mission capable rate	Full mission capable rate	Mission capable rate	Full mission capable rate	Mission capable rate
2019	32.4	59.8	39.8	59.2	23.2	62.6	6.7	56.6
2020	39.1	69.2	54	71.4	15	67.7	6.7	59.1
2021	38.1	66.7	50	68.8	19.5	66.3	9	56
2022	34.8	57.6	43.5	56	16	59.5	20.9	63.4

Source: GAO analysis of Department of Defense data. | GAO-23-105341

Figure 25: Performance of F-35 Aircraft by Variant, October 2022 through March 2023



Source: GAO analysis of Department of Defense data. | GAO-23-105341

Accessible Data for Figure 25: Performance of F-35 Aircraft by Variant, October 2022 through March 2023

	Fleet	Fleet	F-35A	F-35A	F-35B	F-35B	F-35C	F-35C
Month	Full mission capable rate	Mission capable rate	Full mission capable rate	Mission capable rate	Full mission capable rate	Mission capable rate	Full mission capable rate	Mission capable rate
October	30.1	54.32	37.06	48.52	16.09	65.86	17.93	64.82
November	30.75	53.82	35.4	49.02	20.58	62.15	23.92	65.07
December	30.74	52.41	35.86	49.97	20.3	54.15	21.58	63.18
January	28.75	53.06	34.43	49.65	17.06	59.11	19.6	60.55
February	25.57	51.96	30.5	47.72	14.28	58.5	19.37	63.71
March	27.75	54.69	33.51	52.03	15.5	58.25	18.54	63.14

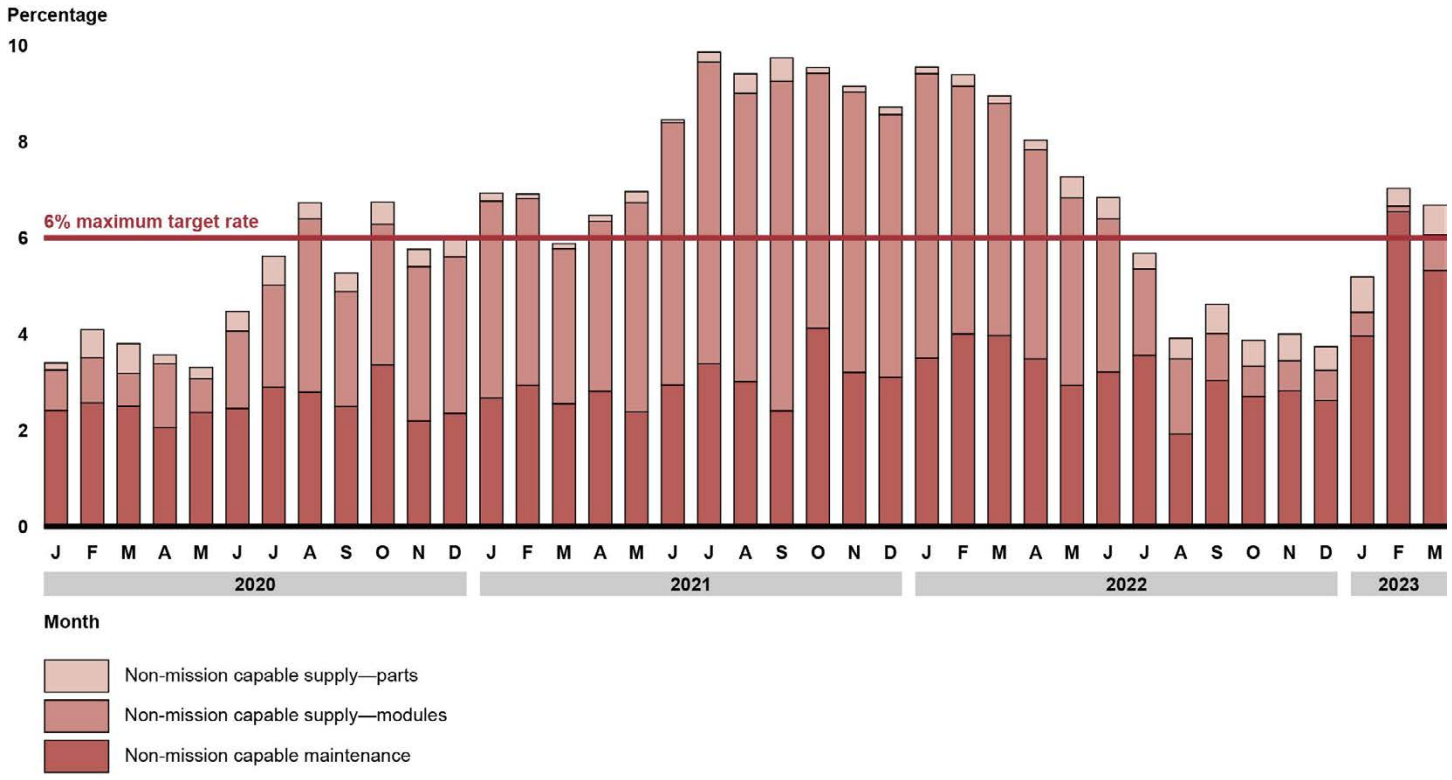
Source: GAO analysis of Department of Defense data. | GAO-23-105341

Appendix IV: Status of F-35 Engine Sustainment Issues

In July 2022, we reported that DOD's engine sustainment strategy did not meet the desired outcomes of the military services. DOD's current strategy, if implemented as planned, allows for 6 percent of its F-35 aircraft to be non-mission capable (i.e., unable to perform assigned missions) due to engine issues. The military services' desired outcomes are similar to their other tactical fighter aircraft, which since 2017, have generally experienced 1 percent or less or aircraft being unable to operate due to engine issues, according to DOD officials. We recommended that DOD assess and make changes to the F-35 engine sustainment strategy and DOD concurred with this recommendation.

We also reported that DOD met its goal of a 6 percent or less non-mission capable rate due to engine issues in only one month from January 2021 to February 2022. According to Joint Program Office data, the non-mission capable rate due to engine issues improved steadily from about 10 percent in January 2022 to about 7 percent in March 2023 as shown in figure 26.

Figure 26: F-35 Fleet Engine-Related Non-Mission Capable Rates, January 2020 through March 2023, Compared with Goal



Source: GAO analysis of Joint Program Office data. | GAO-23-105341

Accessible Data for Figure 26: F-35 Fleet Engine-Related Non-Mission Capable Rates, January 2020 through March 2023, Compared with Goal

Month	Non-mission capable maintenance	Non-mission capable supply—modules	Non-mission capable supply—parts	Maximum target rate
January 2020	2.41	0.84	0.15	6
February 2020	2.57	0.94	0.58	6
March 2020	2.5	0.68	0.62	6
April 2020	2.06	1.32	0.19	6
May 2020	2.37	0.7	0.24	6
June 2020	2.45	1.61	0.41	6
July 2020	2.89	2.13	0.6	6
August 2020	2.79	3.6	0.34	6
September 2020	2.49	2.39	0.39	6
October 2020	3.36	2.92	0.46	6
November 2020	2.19	3.21	0.36	6

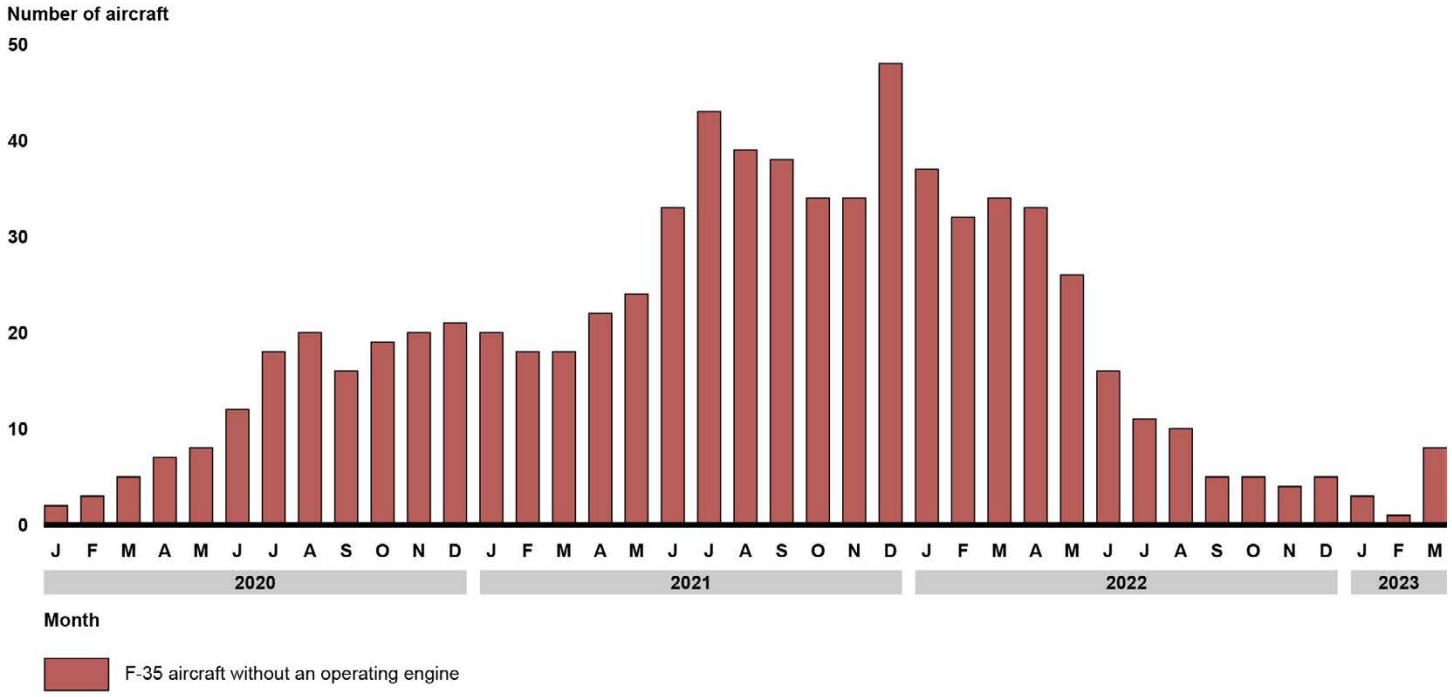
Month	Non-mission capable maintenance	Non-mission capable supply—modules	Non-mission capable supply—parts	Maximum target rate
December 2020	2.35	3.25	0.37	6
January 2021	2.67	4.09	0.17	6
February 2021	2.93	3.89	0.09	6
March 2021	2.55	3.22	0.11	6
April 2021	2.81	3.53	0.13	6
May 2021	2.38	4.35	0.23	6
June 2021	2.94	5.45	0.06	6
July 2021	3.38	6.27	0.21	6
August 2021	3.01	5.99	0.41	6
September 2021	2.4	6.85	0.49	6
October 2021	4.12	5.3	0.12	6
November 2021	3.2	5.83	0.12	6
December 2021	3.1	5.46	0.16	6
January 2022	3.5	5.91	0.14	6
February 2022	4	5.15	0.24	6
March 2022	3.97	4.82	0.16	6
April 2022	3.48	4.35	0.2	6
May 2022	2.93	3.9	0.44	6
June 2022	3.21	3.18	0.45	6
July 2022	3.56	1.79	0.33	6
August 2022	1.92	1.56	0.43	6
September 2022	3.03	0.98	0.61	6
October 2022	2.7	0.63	0.54	6
November 2022	2.82	0.62	0.56	6
December 2022	2.62	0.62	0.5	6
January 2023	3.96	0.49	0.74	6
February 2023	6.54	0.12	0.37	6
March 2023	5.32	0.74	0.62	6

Source: GAO analysis of Joint Program Office data. | GAO-23-105341

DOD improved the non-mission capable rate due to engine issues because it reduced the number of aircraft not having an operating engine. As shown in figure 27, the number of aircraft without an operating engine decreased to eight as of March 2023. For the second half of 2021 and first couple of months of 2022, the program averaged slightly below 40 aircraft without operating engines. According to the F-35 Joint Program Office, DOD achieved this reduction because it increased depot capacity, reducing the amount of time required to repair a power module; procured

additional spare modules and parts; and expanded limits for certain engine parts, resulting in power modules being able to stay on the aircraft for longer periods of time.[1]

Figure 27: F-35 Aircraft without an Operating Engine, January 2020 through March 2023



Source: GAO analysis of Joint Program Office data. | GAO-23-105341

Accessible Data for Figure 27: F-35 Aircraft without an Operating Engine, January 2020 through March 2023

Month	Number of aircraft
January 2020	2
February 2020	3
March 2020	5
April 2020	7
May 2020	8
June 2020	12
July 2020	18
August 2020	20

[1]Under expanded limits, engines are able to safely stay in the aircraft for longer periods of time, resulting in fewer engine removals and fewer required repairs by depots.

Month	Number of aircraft
September 2020	16
October 2020	19
November 2020	20
December 2020	21
January 2021	20
February 2021	18
March 2021	18
April 2021	22
May 2021	24
June 2021	33
July 2021	43
August 2021	39
September 2021	38
October 2021	34
November 2021	34
December 2021	48
January 2022	37
February 2022	32
March 2022	34
April 2022	33
May 2022	26
June 2022	16
July 2022	11
August 2022	10
September 2022	5
October 2022	5
November 2022	4
December 2022	5
January 2023	3
February 2023	1
March 2023	8

Source: GAO analysis of Joint Program Office data. | GAO-23-105341

DOD officials told us that they plan to begin scheduled engine removals for planned maintenance in late 2023. This planned maintenance, as well as planned engine modernization, will increase the engine workload at the depots' and potentially affect their ability to repair engines in the future. The program has actions underway—such as standing up additional depots (e.g., Fleet Readiness Center Southeast in Jacksonville,

Florida)—to meet the engine sustainment needs of the growing F-35 fleet. We will continue to monitor F-35 engine sustainment issues in our future work.

Appendix V: Comments from the Department of Defense

THE UNDER SECRETARY OF DEFENSE
3010 DEFENSE PENTAGON
WASHINGTON, DC 20301-3010

ACQUISITION
AND SUSTAINMENT

SEP 01 2023

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 Government Accountability Office (GAO) Draft Report, GAO-23-105341, "F-35 Aircraft: DOD and the Military Services Need to Reassess the Future Sustainment Strategy" (GAO Code 105341) and concurs with all seven of the GAO recommendations. We have enclosed our responses below.

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. Enclosed is a copy of the Department's official security review.

Sincerely,

William A. LaPlante

Enclosures:
As stated

GAO-23-105341

"F-35 Aircraft: DOD and the Military Services Need to Reassess the Future Sustainment Strategy"

Departmental Comments to the GAO Recommendations

RECOMMENDATION 1: The Secretary of Defense ensure that the Under Secretary of Defense for Acquisition and Sustainment, in consultation with the Secretary of the Navy, the Secretary of the Air Force, and the F-35 Joint Program Office, (JPO) reassess the approach for the F-35's information technology systems continuous support sustainment element, to determine: (1) whether the government or contractor should assume primary responsibility; (2) what changes, if any, the Navy and Air Force should make to the division of organic and contractor responsibility for and oversight of specific sustainment activities; (3) what intellectual property the Navy and Air Force require to support any changes, including all critical technical data needs, their associated costs, and milestones to acquire the data; and (4) any Navy and Air Force resources needed to implement any changes.

DoD RESPONSE: Concur

The Department concurs with this recommendation. The Department's report pursuant to Section 142(b) of the FY 2022 National Defense Authorization Act, delivered to Congress in January 2023, detailed the Department's intent to initiate the transfer of planning, management, and execution of the IT Systems Integrated Product Support (IPS) element to the Services after FY2027, pending schedule and resource assessment. In May 2023, the Department established a Sustainment Implementation Working Group (SUSWG), overseen by the Assistant Secretary of Defense for Sustainment, which includes representatives from the Services, the F-35 JPO, and other key sustainment stakeholders. Within the SUSWG, a dedicated team will be formed to develop plans and identify resources to enable the transfer of the IT Systems IPS element to a Service-led construct, led by Service representatives.

The output of the SUSWG team's efforts will address the four issues cited in the recommendation.

RECOMMENDATION 2: The Secretary of Defense ensure that the Under Secretary of Defense for Acquisition and Sustainment, in consultation with the Secretary of the Navy, the Secretary of the Air Force, and the F-35 Joint Program Office, (JPO) reassess the approach for the F-35's maintenance planning and support sustainment element, to determine: (1) whether the government or contractor should assume primary responsibility of the element for the Air Force and Navy, (2) what changes, if any, the Navy and Air Force should make to the leadership, responsibility, and oversight of specific sustainment activities, (3) what intellectual property the Navy and Air Force require to support any changes, including all critical technical data needs, their associated costs, and milestones to acquire the data, and (4) any Navy and Air Force resources needed to implement any changes.

DoD RESPONSE: Concur

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The output of the SUSWG team's efforts will address the four issues cited in the recommendation.

RECOMMENDATION 3: The Secretary of Defense ensure that the Under Secretary of Defense for Acquisition and Sustainment, in consultation with the Secretary of the Navy, the Secretary of the Air Force, and the F-35 Joint Program Office (JPO), reassess the approach for the F-35's supply support sustainment element, to determine: (1) whether the government or contractor should assume primary responsibility of the element for the Navy and Air Force, (2) what changes, if any, the Navy and Air Force should make to the leadership, responsibility, and oversight of specific sustainment activities, (3) what intellectual property the Navy and Air Force require to support any changes, including all critical technical data needs, their associated costs, and milestones to acquire the data, and (4) any Navy and Air Force resources needed to implement any changes.

DoD RESPONSE: Concur

The Department concurs with this recommendation. The Department's report pursuant to Section 142(b) of the FY2022 National Defense Authorization Act, which was delivered to Congress in January 2023, detailed the Department's intent to initiate transfer of planning, management, and execution of the Supply Support Product Support (IPS) element to the Services by the end of FY2027. In May 2023, the Department established a Sustainment Implementation Working Group (SUSWG), overseen by the Assistant Secretary of Defense for Sustainment, which includes representatives from the Services, the F-35 JPO, and other key sustainment stakeholders. Within the SUSWG, a dedicated team was formed to develop plans and identify resources to enable the transfer of the Supply Support IPS element to a Service-led construct, led by Service representatives.

The output of the SUSWG team's efforts will address the four issues cited in the recommendation.

RECOMMENDATION 4: The Secretary of Defense ensure that the Under Secretary of Defense for Acquisition and Sustainment, in consultation with the Secretary of the Navy, the Secretary of the Air Force, and the F-35 Joint Program Office, (JPO) reassess the approach for the F-35's support equipment sustainment element, to determine: (1) whether the government or contractor should assume primary responsibility of the element for the Navy and Air Force, (2) what changes, if any, the Navy and Air Force should make to the leadership, responsibility, and oversight of specific sustainment activities, (3) what intellectual property the Navy and Air Force

require to support any changes, including all critical technical data needs, their associated costs, and milestones to acquire the data, and (4) any Navy and Air Force resources needed to implement any changes.

DoD RESPONSE: Concur

The Department concurs with this recommendation. The Department's report pursuant to Section 142(b) of the FY2022 National Defense Authorization Act, which was delivered to Congress in January 2023, detailed the Department's intent to initiate transfer of planning, management, and execution of the Support Equipment Integrated Product Support (IPS) element to the Services after FY2027, pending schedule and resource assessment. In May 2023, the Department established a Sustainment Implementation Working Group (SUSWG), overseen by the Assistant Secretary of Defense for Sustainment, which includes representatives from the Services, the F-35 JPO, and other key sustainment stakeholders. Within the SUSWG, a dedicated team has been formed to develop plans and identify resources to enable the transfer of the Support Equipment IPS element to a Service-led construct, led by Service representatives.

The output of the SUSWG team's efforts will address the four issues cited in the recommendation.

RECOMMENDATION 5: The Secretary of Defense ensure that the Under Secretary of Defense for Acquisition and Sustainment, in consultation with the Secretary of the Navy, the Secretary of the Air Force, and the F-35 Joint Program Office, (JPO) reassess the approach for the F-35's sustaining engineering sustainment element, to determine: (1) whether the government or contractor should assume primary responsibility of the element for the Navy and Air Force, (2) what changes, if any, the Navy and Air Force should make to the leadership, responsibility, and oversight of specific sustainment activities, (3) what intellectual property the Navy and Air Force require to support any changes, including all critical technical data needs, their associated costs, and milestones to acquire the data, and (4) any Navy and Air Force resources needed to implement any changes.

DoD RESPONSE: Concur

The Department concurs with this recommendation. The Department's report pursuant to Section 142(b) of the FY2022 National Defense Authorization Act, which was delivered to Congress in January 2023, detailed the Department's intent to evaluate for future transfer planning, management, and execution of the Sustaining Engineering Integrated Product Support (IPS) element to the Services. The Sustaining Engineering IPS element is directly linked to current F-35 production and modernization initiatives; and will be evaluated for transfer once the program reaches steady-state maturity.

RECOMMENDATION 6: The Secretary of Defense ensure that the Under Secretary of Defense for Acquisition and Sustainment, in consultation with the Secretary of the Navy, the Secretary of the Air Force, and the F-35 Joint Program Office, (JPO) reassess the approach for the F-35's training and training support sustainment element, to determine: (1) whether the government or contractor should assume primary responsibility of the element for the Navy and Air Force, (2) what changes, if any, the Navy and Air Force should make to the leadership, responsibility, and oversight of specific sustainment activities, (3) what intellectual property the

Navy and Air Force require to support any changes, including all critical technical data needs, their associated costs, and milestones to acquire the data, and (4) any Navy and Air Force resources needed to implement any changes.

DoD RESPONSE: Concur

The Department concurs with this recommendation. The Department's report pursuant to Section 142(b) of the FY2022 National Defense Authorization Act, which was delivered to Congress in January 2023, detailed the Department's intent to initiate transfer of planning, management, and execution of the Training Integrated Product Support (IPS) element to the Services after FY2027, pending schedule and resource assessment. In May 2023, the Department established a Sustainment Implementation Working Group (SUSWG), overseen by the Assistant Secretary of Defense for Sustainment, which includes representatives from the Services, the F-35 JPO, and other key sustainment stakeholders. Within the SUSWG, a dedicated team has been formed to develop plans and identify resources to enable the transfer of the Training IPS element to a Service-led construct, led by Service representatives.

The output of the SUSWG team's efforts will address the four issues cited in the recommendation.

RECOMMENDATION 7: The Secretary of Defense ensure that the Under Secretary of Defense for Acquisition and Sustainment, in consultation with the Secretary of the Navy, the Secretary of the Air Force, and the F-35 Joint Program Office, (JPO) reassess the approach for the F-35's technical data sustainment element, to determine: (1) whether the government or contractor should assume primary responsibility of the element for the Navy and Air Force, (2) what changes, if any, the Navy and Air Force should make to the leadership, responsibility, and oversight of specific sustainment activities, (3) any critical technical data needs for the Navy and Air Force , their associated costs, and milestones to acquire them, and (4) any Navy and Air Force resources needed to implement any changes.

DoD RESPONSE: Concur

The Department concurs with this recommendation. The Department's report pursuant to Section 142(b) of the FY2022 National Defense Authorization Act, which was delivered to Congress in January 2023, detailed the Department's intent to initiate transfer of planning, management, and execution of the Technical Data Integrated Product Support (IPS) element to the Services by the end of FY2027. In May 2023, the Department established a Sustainment Implementation Working Group (SUSWG), overseen by the Assistant Secretary of Defense for Sustainment, which includes representatives from the Services, the F-35 JPO, and other key sustainment stakeholders. Within the SUSWG, a dedicated team was formed to develop plans and identify resources to enable the transfer of the Technical Data IPS element to a Service-led construct, led by Service representatives.

The output of the SUSWG team's efforts will address the four issues cited in the recommendation.

Accessible Text for Appendix V: Comments from the Department of Defense

SEP 01 2023

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 Government Accountability Office (GAO) Draft Report, GAO-23-105341, “F-35 Aircraft: DOD and the Military Services Need to Reassess the Future Sustainment Strategy” (GAO Code 105341) and concurs with all seven of the GAO recommendations. We have enclosed our responses below.

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. Enclosed is a copy of the Department’s official security review.

Sincerely.

William A. LaPlante

Enclosures:
As stated

GAO-23-105341

“F-35 Aircraft: DOD and the Military Services Need to Reassess the Future Sustainment Strategy”

Departmental Comments to the GAO Recommendations

RECOMMENDATION 1: The Secretary of Defense ensure that the Under Secretary of Defense for Acquisition and Sustainment, in consultation with the Secretary of the Navy, the Secretary of the Air Force, and the F-35 Joint Program Office, (JPO) reassess the approach for the F-35's information technology systems continuous support sustainment element, to determine: (1) whether the government or contractor should assume primary responsibility; (2) what changes, if any, the Navy and Air Force should make to the division of organic and contractor responsibility for and oversight of specific sustainment activities; (3) what intellectual property the Navy and Air Force require to support any changes, including all critical technical data needs, their associated costs, and milestones to acquire the data; and (4) any Navy and Air Force resources needed to implement any changes.

DoD RESPONSE: Concur

The Department concurs with this recommendation. The Department's report pursuant to Section 142(b) of the FY 2022 National Defense Authorization Act, delivered to Congress in January 2023, detailed the Department's intent to initiate the transfer of planning, management, and execution of the IT Systems Integrated Product Support (IPS) element to the Services after FY2027, pending schedule and resource assessment. In May 2023, the Department established a Sustainment Implementation Working Group (SUSWG), overseen by the Assistant Secretary of Defense for Sustainment, which includes representatives from the Services, the F-35 JPO, and other key sustainment stakeholders. Within the SUSWG, a dedicated team will be formed to develop plans and identify resources to enable the transfer of the IT Systems IPS element to a Service-led construct, led by Service representatives.

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Appendix VI: GAO Contact and Staff Acknowledgments

GAO Contact

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

Staff Acknowledgments

In addition to the contact listed above, John Bumgarner (Assistant Director), Jeff Hubbard (Analyst-in-Charge), Leslie Bharadwaja, Vincent Buquicchio, Christopher Gezon, Kevin Keith, Marshal Pennock, Oksana Rezvina, and Terry Richardson made key contributions to this report. Also contributing was Emily E. Wilson.

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