



April 2019

F-35 AIRCRAFT SUSTAINMENT

DOD Needs to Address Substantial Supply Chain Challenges

Accessible Version

GAO Highlights

Highlights of [GAO-19-321](#), a report to congressional requesters

Why GAO Did This Study

DOD's F-35 fighter jet provides key aviation capabilities to support the U.S. National Defense Strategy. The F-35 is also DOD's most costly weapon system, with sustainment costs estimated at more than \$1 trillion over a 60-year life cycle. The F-35's supply chain has a unique design. Rather than owning the spare parts for their aircraft, the Air Force, Navy, and Marine Corps—along with eight international partners and other foreign military sales customers—share a common, global pool of F-35 parts that are managed by the prime contractor.

You asked us to review the F-35 supply chain. This report assesses, among other things, the extent to which (1) F-35 performance is meeting warfighter requirements and any challenges related to the availability of spare parts; (2) DOD can effectively manage and move F-35 spare parts to support aircraft around the world; and (3) DOD can account for F-35 spare parts and their costs within the supply chain. GAO reviewed DOD and contractor documentation, analyzed performance data, and interviewed relevant officials.

What GAO Recommends

GAO is making eight recommendations, including that DOD determine actions to close the gap between warfighter requirements and F-35 supply chain performance; and address challenges with deployments, global parts movement, and spare parts accountability. DOD concurred with all of GAO's recommendations.

View [GAO-19-321](#). For more information, contact Diana Maurer at (202) 512-9627 or maurerd@gao.gov.

April 2019

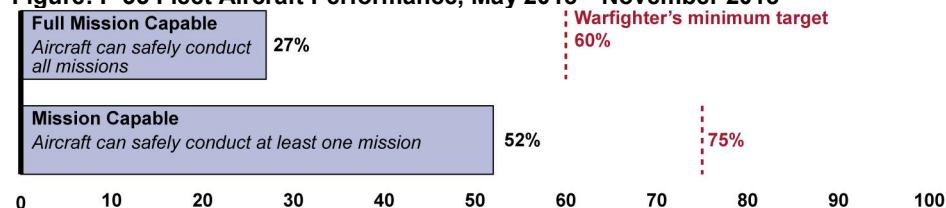
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What GAO Found

F-35 aircraft performance is falling short of warfighter requirements—that is, aircraft cannot perform as many missions or fly as often as required.

Figure: F-35 Fleet Aircraft Performance, May 2018—November 2018



Source: GAO analysis of Department of Defense and Lockheed Martin information. | GAO-19-321

This lower-than-desired aircraft performance is due largely to F-35 spare parts shortages and difficulty in managing and moving parts around the world:

- **Spare parts shortages and limited repair capabilities.** F-35 aircraft were unable to fly nearly 30 percent of the May—November 2018 time period due to spare parts shortages. Also, the Department of Defense (DOD) had a repair backlog of about 4,300 F-35 parts. DOD is taking steps to fix these issues, such as improving the reliability of parts. However, it has not fully determined actions needed to close the gap between warfighter requirements and the performance the F-35 supply chain can deliver.
- **Mismatched parts for deploying aircraft.** DOD purchases certain sets of F-35 parts years ahead of time to support aircraft on deployments, including on ships. But the parts do not fully match the military services' needs because F-35 aircraft have been modified over time. For example, 44 percent of purchased parts were incompatible with aircraft the Marine Corps took on a recent deployment. Without a process to modify the sets of parts for deployments, DOD may be unable to meet the services' operational needs.
- **An immature global network to move F-35 parts.** DOD's networks for moving F-35 parts around the world are immature, and overseas F-35 customers have experienced long wait times for parts needed to repair aircraft. Without a detailed plan for the network, DOD may not be ready to support an expanding fleet.

In addressing these challenges, DOD must grapple with affordability. The Air Force and Marine Corps recently identified the need to reduce their sustainment costs per aircraft per year by 43 and 24 percent, respectively. DOD has spent billions of dollars on F-35 spare parts but does not have records for all the parts it has purchased, where they are, or how much they cost. For example, DOD is not maintaining a database with information on F-35 parts the U.S. owns, and it lacks the necessary data to be able to do so. Without a policy that clearly defines how it will keep track of purchased F-35 parts, DOD will continue to operate with a limited understanding of the F-35 spare parts it owns and how they are being managed. If left unaddressed, these accountability issues will impede DOD's ability to obtain sufficient readiness within affordability constraints.

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Abbreviations

ALIS	Autonomic Logistics Information System
AVA	Air Vehicle Availability
DOD	Department of Defense
F-35	F-35 Lightning II Aircraft
FMC	Full Mission Capable
MC	Mission Capable

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April 25, 2019

Congressional Requesters

The F-35 Lightning II aircraft provides key aviation capabilities to support the U.S. National Defense Strategy. It is also the Department of Defense's (DOD) most costly weapon system, with sustainment costs for the U.S. alone estimated at \$1.12 trillion.¹ The F-35 program is a highly concurrent acquisition program, meaning that aircraft are simultaneously being developed, tested, and fielded. As of February 2019, there were more than 350 U.S. and international F-35 aircraft in operation at 16 sites, with more than 3,300 aircraft expected to be fielded throughout the 60-year life cycle of the program. The F-35's unique supply chain is central to DOD's strategy to sustain this growing fleet. Rather than owning the spare parts for their aircraft, the program is designed so that the Air Force, Navy, and Marine Corps, along with eight international partners and other foreign military sales customers, share a common, global pool of parts (hereinafter referred to as the global spares pool) that is managed by the prime contractor, Lockheed Martin.² Citing less than desirable aircraft performance, in September 2018, the Secretary of Defense directed the military services to achieve and maintain 80 percent mission capability rates³ for their critical aviation platforms, including the F-35 fleet, by the end of fiscal year 2019.⁴

While the construct for the F-35 supply chain was intended to ease the logistical burden on and provide economies of scale for the military services and international partners, we have previously reported that the F-35 program faces affordability, reliability, and sustainment challenges.

¹This estimate is reported in "then year" dollars (that is, dollars that reflect the impact of inflation over time). It was developed by the Office of Cost Assessment and Program Evaluation in March 2016, and was reported in DOD's fiscal year 2019 Selected Acquisition Report for the F-35 program.

²For the purposes of this report, the term "prime contractor" refers to Lockheed Martin, as it is the prime contractor for the aircraft and provides overall system integration. Pratt & Whitney is the contractor for the engine of the F-35.

³An F-35 aircraft is considered mission capable if it is safe to fly and able to perform at least one tasked mission.

⁴Secretary of Defense Memorandum, *NDS Implementation – Mission Capability of Critical Aviation Platforms* (Sept. 17, 2018).

For instance, in 2014, we reported that annual F-35 operating and support costs were estimated to be considerably higher than the combined annual costs of several legacy aircraft, and that while DOD had begun some cost-savings efforts and had established sustainment affordability targets, DOD did not use the military services' budgets to set these targets.⁵ In 2016, we found that DOD faced risks that could affect the F-35's Autonomic Logistics Information System (ALIS)—a complex system supporting operations, mission planning, supply-chain management, maintenance, and other processes.⁶ In 2017, we reported that DOD was experiencing sustainment challenges that were reducing warfighter readiness, including delays of 6 years in standing up repair capabilities for F-35 parts at its depots and significant spare parts shortages that were preventing the F-35 fleet from flying about 20 percent of the time.⁷ We recommended that DOD develop affordability constraints linked to the military services' budgets, develop a plan to address ALIS risks, and revise its sustainment plans, among other things. The department generally concurred with our recommendations, and has taken some actions in response. In particular, in 2018, DOD established affordability constraints based on the military services' future budget projections. These new affordability constraints will require DOD to reduce F-35 sustainment costs per aircraft per year by 43 percent for the Air Force, 24 percent for the Marine Corps, and 5 percent for the Navy.⁸ See the Related GAO Products page at the end of this report for a list of previous F-35 products.

You asked us to review DOD's efforts to establish an effective and accountable F-35 supply chain, to include the F-35's global spares pool.

⁵GAO, *F-35 Sustainment: Need for Affordable Strategy, Greater Attention to Risks, and Improved Cost Estimates*, [GAO-14-778](#) (Washington, D.C.: Sept. 23, 2014).

⁶GAO, *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).

⁷GAO, *F-35 Aircraft Sustainment: DOD Needs to Address Challenges Affecting Readiness and Cost Transparency*, [GAO-18-75](#) (Washington, D.C.: Oct. 26, 2017).

⁸DOD established F-35 variant-specific affordability constraints for steady state F-35 operations and conveyed them to Congress in December 2018. Steady state varies for each service and is the period of time when the number of F-35 aircraft peak in the fleet. For example, the current estimated sustainment costs for the Air Force's F-35A aircraft during its steady state period of 2036 – 2041 are \$7.1 million in base year 2012 dollars, but the Air Force needs to reduce those costs per aircraft per year to \$4.1 million. Office of the Secretary of Defense, *Report to Congress on F-35 Joint Strike Fighter Sustainment Affordability and Transparency* (December 2018).

This report assesses the extent to which (1) F-35 performance is meeting warfighter requirements and any challenges related to the availability of spare parts; (2) DOD can effectively manage and move F-35 spare parts to support aircraft around the world; (3) DOD can account for F-35 spare parts within the supply chain and their associated costs; and (4) actions DOD is taking to address supply chain challenges are consistent with the established F-35 program sustainment strategy.

For each of our objectives, we reviewed relevant F-35 sustainment and supply chain data, plans, program briefs, guidance, and other documentation and collected information by interviewing officials from the Office of the Secretary of Defense for Acquisition and Sustainment, the F-35 Joint Program Office, the U.S. Air Force, the U.S. Navy, the U.S. Marine Corps, and the prime contractor, Lockheed Martin. To interview officials and observe F-35 supply and maintenance operations, we conducted site visits to two F-35 operational locations—Hill Air Force Base, Utah, and Marine Corps Air Station Yuma, Arizona; and one training location—Luke Air Force Base, Arizona. We selected these locations to obtain perspectives from both operational and training units from multiple U.S. military services using different variants of the aircraft, and to gather insights of international partners co-located at these bases, among other factors. Additionally, we interviewed officials from the only overseas-based U.S. F-35 operational squadron—at Marine Corps Air Station Iwakuni, Japan. We used criteria from DOD and service guidance and *Standards for Internal Control in the Federal Government* as bases against which to assess DOD's actions for each of these objectives.⁹

In support of these objectives, we gathered various data related to the F-35 supply chain, such as parts availability, repair, aircraft performance, and customer wait time data. We gathered data for fiscal year 2018 (October 2017—September 2018) and available data from the F-35 program's 2018 sustainment contract period (May—November 2018), in order to provide the most recent information available for F-35 fleet performance and overall supply chain management during our audit timeframes. To determine the reliability of these data, we collected information on how the data were collected, managed, and used through a questionnaire and interviews with relevant DOD officials and the prime contractor. Although we identified some limitations in the way that certain

⁹GAO, *Standards for Internal Control in the Federal Government*, [GAO-14-704G](#) (Washington, D.C.: September 2014).

data—such as data related to aircraft performance, to aircraft that are not mission-capable due to a lack of parts, and to parts cannibalization—were being collected and reported that could potentially result in inaccuracies, we determined that they are sufficiently reliable for our purposes of providing information on the progress and challenges within the program.¹⁰ For a detailed description of our scope and methodology, see appendix I.

We conducted this performance audit from January 2018 to April 2019 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

The F-35 Lighting II program is a joint, multinational acquisition program intended to develop and field a family of next-generation strike fighter aircraft for the U.S. Air Force, Navy, and Marine Corps (hereinafter referred to as the services), eight international partners, and foreign military sales customers (collectively hereinafter referred to as program participants). There are three F-35 variants, and each will be a multi-role, stealthy strike aircraft replacement for or complement to the services' legacy fighter aircraft.

F-35 Milestones and Stakeholders

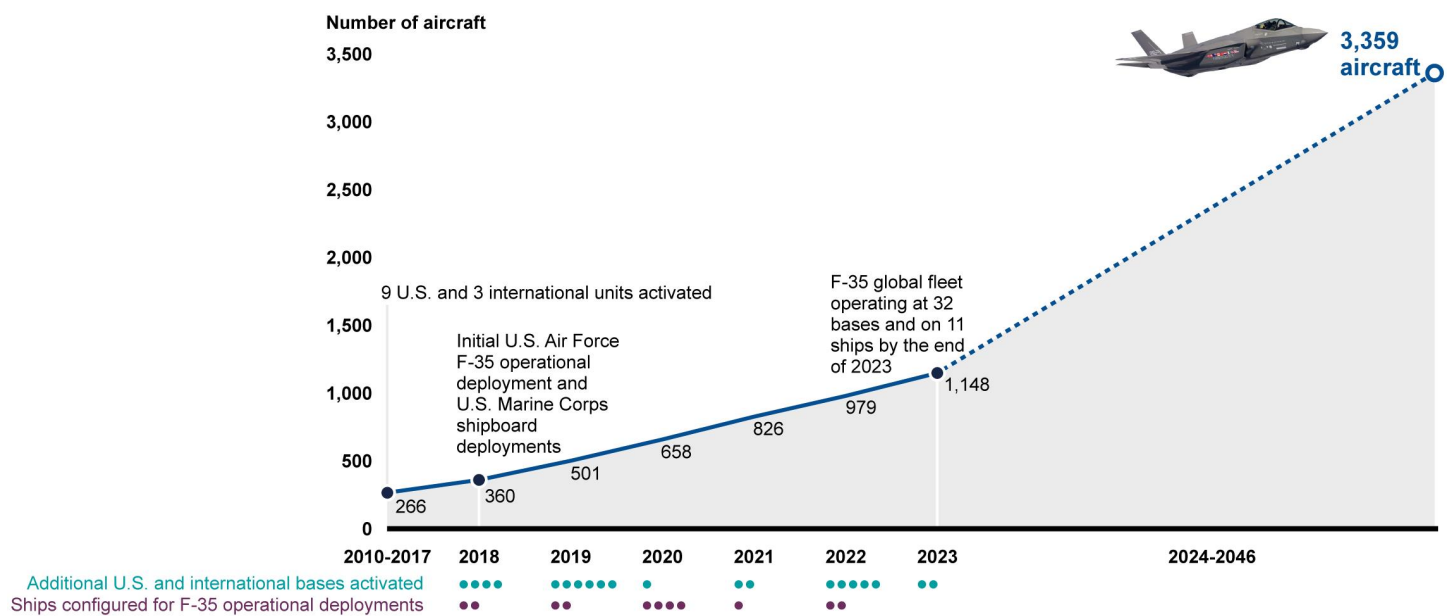
DOD initiated the F-35 program in October 2001, and began operational testing of the aircraft in December 2018. DOD has also, concurrently, been fielding and operating a growing fleet of aircraft as part of low-rate initial production.¹¹ As of February 2019, more than 350 aircraft had been fielded and were operating from 16 bases worldwide. By 2023, the global

¹⁰Cannibalization in this context refers to the practice of removing parts that are necessary for repair of an aircraft from another aircraft, due to the limited supply of parts in the supply chain.

¹¹Low-rate initial production establishes the initial production base for the system or capability increment, provides an efficient ramp-up to full-rate production, and maintains continuity in production pending operational test and evaluation completion.

F-35 fleet is expected to expand to more than 1,100 aircraft across 43 operational sites. In total, the program participants plan to purchase more than 3,300 F-35 aircraft, with the U.S. services planning to purchase nearly 2,500 of those aircraft. See figure 1 for a timeline of anticipated worldwide fleet growth and site activations in the F-35 program.

Figure 1: Timeline of Anticipated Worldwide F-35 Fleet Growth and Site Activations



Source: GAO analysis of Department of Defense information. | GAO-19-321

Note: This figure includes F-35 aircraft purchased or planned to be purchased by international partners and foreign military sales customers. The number of F-35 aircraft and the timeframes in which they are fielded are subject to change.

Sustainment for the growing fleet of F-35 aircraft is a large and complex undertaking with several key stakeholders. The F-35 Joint Program Office, through its Product Support Manager, is responsible for managing and overseeing the support functions required to field and maintain the readiness and operational capability of the F-35 aircraft across the enterprise.¹² As such, it establishes sustainment requirements, manages

¹²The Product Support Manager is the individual responsible for managing the package of support functions required to field and maintain the readiness and operational capability of major weapon systems, subsystems, and components, including all functions related to weapon system readiness, in support of the program manager's life-cycle management responsibilities. 10 U.S.C. § 2337.

funding, develops contracts, and provides direction for and oversees the execution of F-35 sustainment strategy and policy.

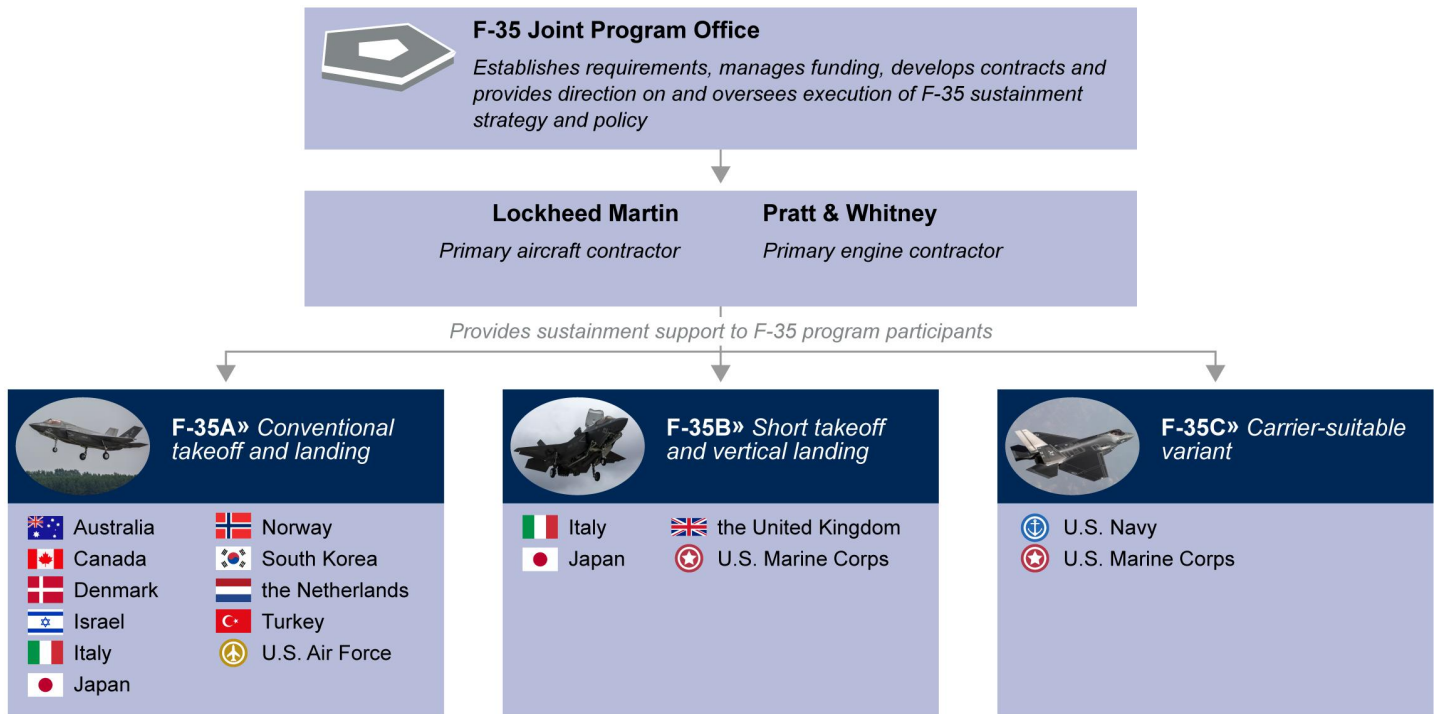
Additionally, in 2016, DOD established a Hybrid Product Support Integrator organization within the Joint Program Office, and it expects to fully implement this organization by the end of 2019.¹³ Once fully implemented, DOD intends for the Hybrid Product Support Integrator to bring together all government and commercial capabilities necessary to execute the F-35 sustainment strategy. The organization is led by a general officer, who is responsible for providing government oversight of all support providers to ensure that they deliver the required levels of performance. In particular, the F-35 program relies heavily on contractors to provide support for its F-35 aircraft. DOD has two primary contractors for the F-35 program: Lockheed Martin for the overall aircraft system and Pratt & Whitney for the engine. As the prime contractor for the overall aircraft system, Lockheed Martin (hereinafter referred to as the prime contractor) is responsible for managing the F-35 supply chain, depot maintenance, and pilot and maintainer training, as well as for providing engineering and technical support. Currently, DOD is contracting for this support with the prime contractor largely through annual contracts, and it plans to transition to multiple-year, fixed-price, performance-based sustainment contracts¹⁴ when the program achieves certain condition-based criteria, including the establishment of critical sustainment capabilities and the government's ability to collect and more fully assess performance and cost data.¹⁵ In addition, the U.S. Air Force, Navy, and Marine Corps have each established an F-35 integration office or similar construct focused on how the services will operate and afford the F-35, among other things. Figure 2 below depicts how these key stakeholders provide support to the F-35 program participants across the three aircraft variants.

¹³A product support integrator is an entity within or outside of the government charged with integrating all sources of product support, both private and public, defined within the scope of a product support arrangement. 10 U.S.C. § 2337.

¹⁴Performance-based logistics is a life-cycle product support strategy whereby outcomes are acquired through performance-based agreements that deliver warfighter requirements and incentivize product support providers to reduce costs through innovation.

¹⁵F-35 Joint Program Office, *F-35 Lightning II Joint Strike Fighter Acquisition Strategy*, Version. 5.0 (October 2018).

Figure 2: Program Stakeholders for Sustainment of F-35 Aircraft



Source: GAO analysis of Department of Defense information; Defense Video and Information Distribution System (photo). | GAO-19-321

Note: Australia, Canada, Denmark, Italy, the Netherlands, Norway, Turkey, and the United Kingdom are international partners. The international partners have contributed funds for system development, and all but Canada have signed agreements to procure aircraft. In addition, Belgium, Israel, Japan, and South Korea have signed on as foreign military sales customers.

The F-35 Global Support Solution and Supply Chain

DOD is planning to meet the sustainment requirements of its F-35 customers by providing a common, global support solution. As part of this common solution, participants share most sources of support, such as spare parts, depot maintenance, and training. At the core of the F-35 global support solution is the F-35 supply chain. At maturity, the F-35 supply chain is intended to be a network of manufacturers, commercial and government part repair depots, and base and regional part warehouses that will be located around the world to provide parts to

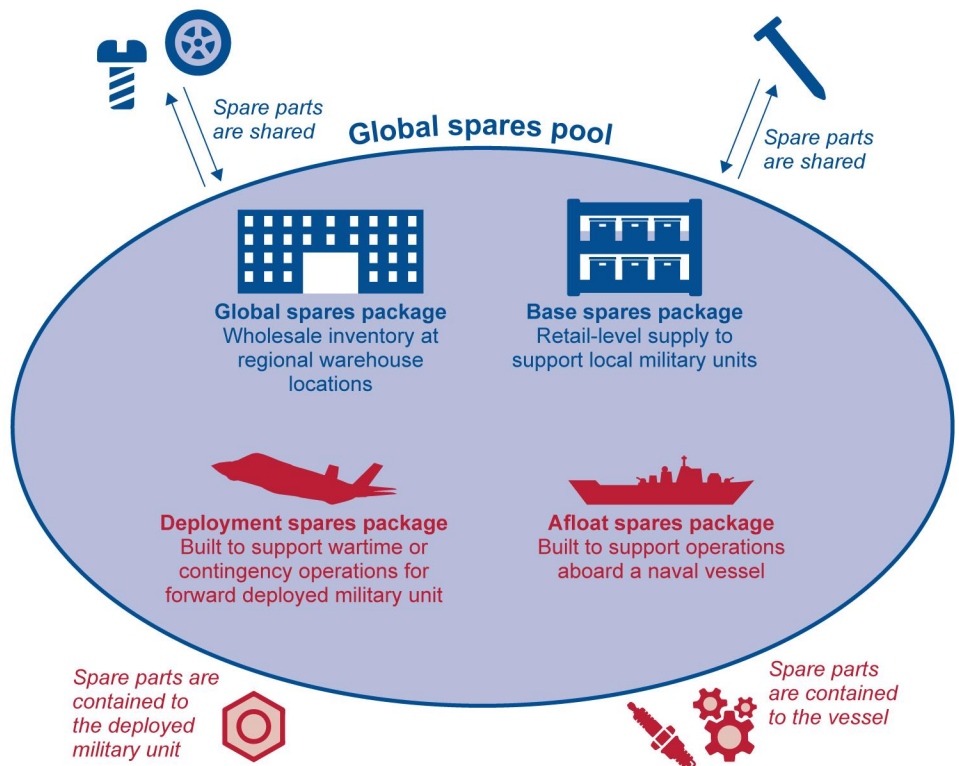
support the operational and training requirements of all F-35 program participants.¹⁶

As a part of the F-35 supply chain, all F-35 program participants—including the U.S. military services, international partners, and foreign military sales customers—share a global pool of F-35 spare parts (formally called the Joint Spares Pool), which we refer to in this report as the F-35 global spares pool. These pooled assets comprise only parts used for F-35 aircraft, such as consumable and repairable spare parts for the airframe, engine system, support equipment, pilot flight equipment, and training devices.¹⁷ The F-35 global spares pool consists of four different packages of parts—the base spares package, the global spares package, the deployment spares package, and the afloat spares package—as described below and in figure 3.

¹⁶Depot-level maintenance includes structural repair, software upgrades, engine system overhaul and repair, component repair, and other activities that require specialized skills, facilities, or tooling to conduct the repairs. While often conducted at a depot facility, depot maintenance is independent of any location or funding source and may be performed in the public or private sectors. DOD is establishing F-35 modification and repair capabilities at six military service depots in the United States and additional repair facilities overseas.

¹⁷Consumable parts are non-repairable items or repair parts that can be discarded more economically than they can be repaired, or that are consumed in use. Repairable parts are items that are expected to be repaired when broken or worn out.

Figure 3: F-35 Global Spares Pool



Source: GAO analysis of Department of Defense information. | GAO-19-321

- Base spares package:** A base spares package is a retail-level supply of parts inventory that is positioned at each F-35 main operating base to support the F-35 aircraft operating from that location. Each base spares package is intended to have a sufficient amount of parts to support the number of aircraft and planned flying hours at the base. While inventory within each base spares package is sized to meet the projected needs of the aircraft at that particular location, parts within the base spare packages are intended to be available for sharing among all global participants, as needed.
- Global spares package:** A global spares package is a wholesale-level supply of parts inventory that is positioned at regional warehouses, original equipment manufacturers, and depot repair facilities. The prime contractor manages this inventory to replenish the stocks of parts in base spares packages and the other packages below, and to meet participants' requirements for parts that are not in their base inventories. If a part is needed for the repair of an aircraft, and the unit does not have the part in its base inventory, the prime contractor sends a part from the global spares package to meet the

unit's requirement. Parts within the global spares package are intended to be available for sharing among all global participants.

- **Deployment spares package:** A deployment spares package is a retail-level supply of parts inventory that is purchased by a program participant to support its wartime or contingency operations. This package is intended to have a sufficient amount of parts to support a program participant's contracted operational requirements for a defined period of time, until the F-35 supply chain is able to ship replenishment parts to the participant's deployed location. For example, a deployment spares package could be sized to provide parts for 12 aircraft to fly a specified number of flight hours over a 20-day period and be fully mission capable 70 percent of the time. The parts in this package are generally reserved for use only by the participant who purchased the package.
- **Afloat spares package:** An afloat spares package is a retail-level supply of parts inventory that is purchased by a program participant to support its F-35 operations aboard a naval vessel. This package is intended to have a sufficient amount of parts to support a program participant's contracted operational requirements for a defined period of time until the F-35 supply chain is able to ship replenishment parts to the participant aboard the ship. For example, an afloat spares package could be sized to provide parts for six aircraft stationed on a ship to fly a specified number of flight hours over a 20-day period, and be fully mission capable 70 percent of the time. The parts in this package are generally reserved for use only by the participant who purchased the package.

All of the parts within the global spares pool are owned by the U.S. government when not installed on a participant's aircraft. The U.S. military services and international participants do not purchase parts directly, but rather purchase access to parts in the shared pool based on how many F-35 aircraft they own and the number of flight hours they plan to fly, among other factors. Accordingly, the F-35 program has developed a series of business rules that are intended to govern how parts within the F-35 global spares pool will be managed and shared, and how the costs of the parts will be allocated across participants. The prime contractor manages the F-35 supply chain and is responsible for allocating parts to F-35 sites and participants based on contracted requirements, such as numbers of aircraft and planned flying hours, and program business rules.

The effective management of the F-35 supply chain requires significant technical data about the F-35 aircraft and parts, such as engineering data, maintenance instructions, and information related to how often the

aircraft experiences failures and how much time it takes to repair those failures.¹⁸ Technical data constitute an important part of a weapon system program, such as the F-35. We have previously reported that identifying technical data needs, costs, and ownership are essential for DOD to effectively consider and maximize competition for future product support of F-35 sustainment, including supply chain management.¹⁹

F-35 Performance Will Likely Continue to Fall Short of Warfighter Requirements, and DOD Faces Challenges Related to the Availability of Spare Parts

F-35 aircraft performance is not meeting warfighter requirements. While DOD is taking various actions to improve F-35 spare parts availability so that aircraft can fly and perform their missions, it will likely continue to struggle to meet warfighter requirements—due to how it is planning for and allocating spare parts.

F-35 Aircraft Performance Is Not Meeting Requirements Due to Spare Parts Shortages and Limited Repair Capabilities

Fleet-Wide F-35 Performance

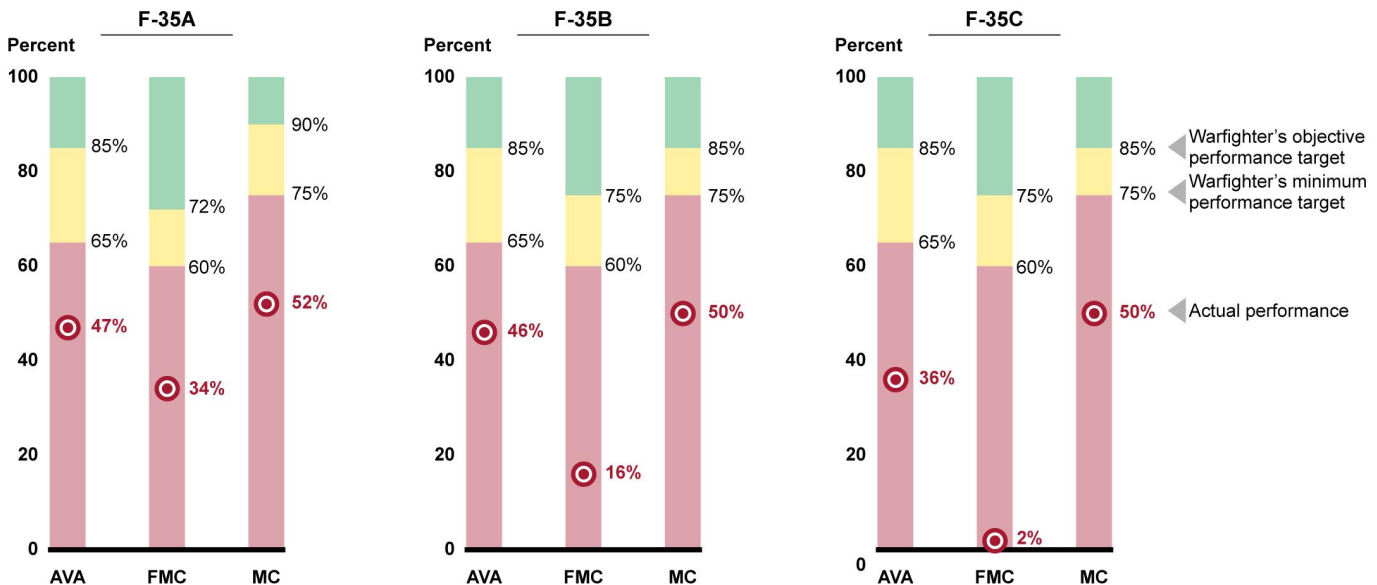
The performance of the F-35 fleet is hindered by lower-than-required aircraft availability and capability rates. Air vehicle availability, or the percentage of total time during which the aircraft can fly and perform at least one mission, was 45.8 percent across the F-35 fleet from May through November 2018, as compared with the warfighter minimum target of 65 percent. Full mission capability, or the percentage of time during which the aircraft can perform all of its tasked missions, was 26.8 percent from May through November 2018, as compared with the warfighter

¹⁸“Technical data” refer to recorded information, regardless of the form or method of the recording, of a scientific or technical nature (including computer software documentation). They could include information in the form of blueprints, drawings, photographs, plans, or instructions.

¹⁹[GAO-14-778](#).

minimum target of 60 percent. However, parts availability and aircraft performance varied by aircraft variant and the age of the aircraft. For instance, fleet-wide rates of full mission capability for the F-35A aircraft were higher than those for the F-35B. Figure 4 below shows aircraft performance data by variant across key program metrics relative to stated U.S. warfighter requirements, referred to within the F-35 program as objective and minimum performance targets. From May through November 2018, fleet-wide F-35 aircraft performance did not meet any of the U.S. warfighter's requirements.

Figure 4: F-35 Aircraft Fleet Performance by Variant, May–November 2018



Air Vehicle Availability (AVA): This metric assesses all aircraft in the fleet, including those in the possession of F-35 units and those at the depots for modifications. It measures the percentage of time during which aircraft are safe to fly, available for use by units, and able to perform at least one tasked mission.

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

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

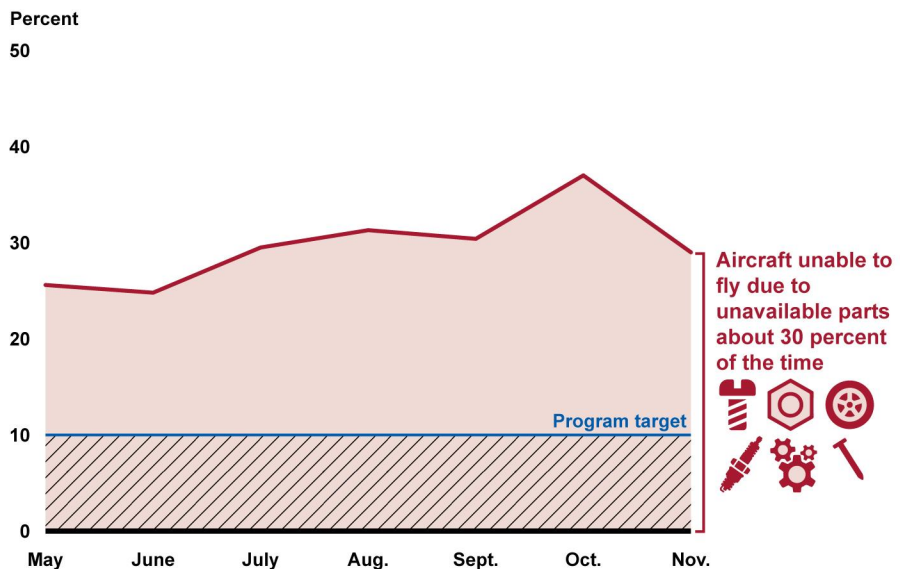
Source: GAO analysis of Department of Defense and Lockheed Martin information. | GAO-19-321

Note: The aircraft performance data presented above include all U.S. and international F-35 aircraft. The warfighter's objective and minimum performance targets shown in the graphic are the 2018 requirements established by the U.S. Air Force for the F-35A, U.S. Marine Corps for the F-35B, and U.S. Navy for the F-35C. The F-35C data include fewer than 30 fielded F-35C aircraft, and the Navy did not declare initial operational capability for this fleet until February 2019. DOD officials said that the Navy was prioritizing modifications to upgrade the capabilities of its F-35C aircraft as the service progressed toward a declaration of initial operational capability instead of pursuing efforts to maximize current aircraft availability and capability rates.

Spare Parts Shortages and DOD Actions for Improvement

Lower-than-required F-35 aircraft performance is attributable in part to spare parts shortages. Specifically, the F-35 supply chain does not have enough spare parts available to keep aircraft flying enough of the time necessary to meet warfighter requirements. According to prime contractor data, from May through November 2018, F-35 aircraft across the fleet were unable to fly 29.7 percent of the time due to spare parts shortages (this metric is hereinafter referred to as the S-rate).²⁰ Figure 5 below shows the percentage of aircraft that were unable to fly from May through November 2018 due to shortages of parts relative to the program's target.²¹

Figure 5: F-35 Aircraft Unable to Fly Due to Parts Shortages, May—November 2018



Source: GAO analysis of Lockheed Martin information. | GAO-19-321

Note: These data include all U.S. and international F-35 aircraft. The data represent the “non-mission capable due to supply” rate, or S-rate. This rate measures the percentage of time during which

²⁰“S-rate” is short for the “non-mission capable due to supply” metric that is tracked in the F-35 program. It measures the percentage of time during which aircraft in possession of F-35 units are unable to fly or conduct any of their tasked missions due to a lack of spare parts.

²¹The program target is the S-rate that DOD and the contractor have stated would be required to achieve the warfighter’s requirements for aircraft performance.

aircraft in possession of F-35 units are unable to fly or conduct any of their tasked missions due to a lack of spare parts. The program target is the S-rate required to achieve warfighter requirements. However, DOD is funding only to an S-rate of 20 percent.

According to prime contractor data, to keep aircraft flying despite parts shortages, from May through November 2018 F-35 squadrons cannibalized (that is, took) parts from other aircraft at rates that were more than six times greater than the services' objective.²² These high rates of cannibalization mask even greater parts shortages, because personnel at F-35 squadrons are pulling parts off of other aircraft that are already unable to fly instead of waiting for new parts to be delivered through the supply chain.

The F-35 program is taking a number of actions to try to increase the availability of spare parts, including steps to increase the capacity of suppliers to produce parts to meet sustainment requirements, improve the timing of spare parts deliveries, and address the reliability of certain parts that are failing more frequently than expected. DOD has identified specific parts shortages that are causing the greatest aircraft capability degradation, and it is developing short-term and long-term mitigation strategies to increase the quantity and reliability of these parts. For instance, DOD found that the special coating on the F-35 canopy that enables the aircraft to maintain its stealth failed more frequently than expected, and that the manufacturer could not produce enough canopies to meet demands. To address these challenges, the program is looking for additional manufacturing sources for the canopy and is considering design changes.

Limited Spare Part Repair Capabilities and DOD Actions for Improvement

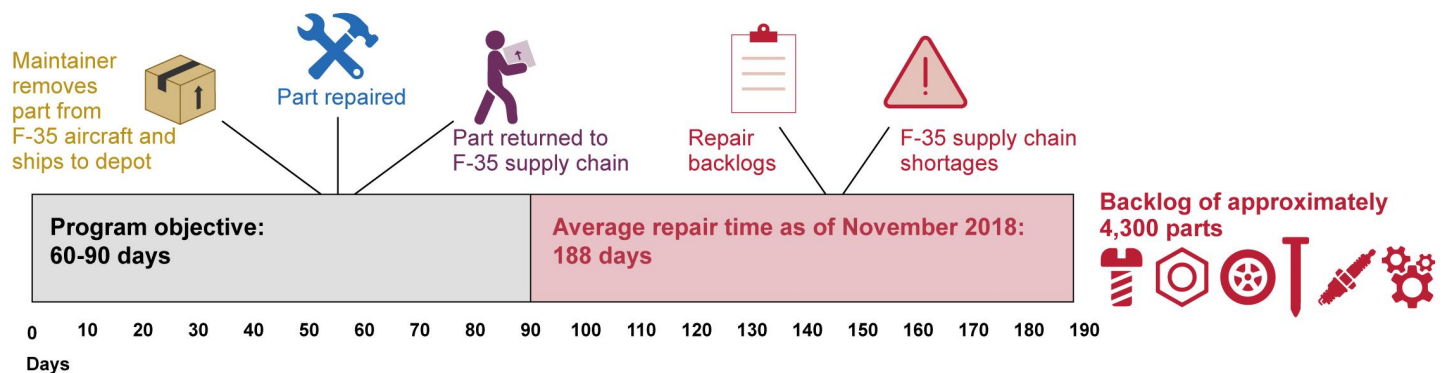
A key contributor to spare parts shortages is the F-35 program's limited capacity to repair broken parts. The average time to repair an F-35 part was more than 6 months, or about 188 days for repairs completed between September and November 2018—more than twice that of the program's objective of 60—90 days.²³ Also, there was a backlog of about

²²The services' objective target is that cannibalizations would occur not more five times per 1,000 flight hours. The threshold target—or minimum acceptable level—is that cannibalizations would occur not more than 10 times per 1,000 flight hours.

²³One of the key factors that the F-35 program uses in its modeling to determine the number of spare parts to purchase is the projected repair times for each part—60, 75, or 90 days, depending on the part.

4,300 spare parts awaiting repair at depots or manufacturers (see figure 6).

Figure 6: Average Time for Depot-level Repair of an F-35 Aircraft Part as Compared with the Program's Objective



Source: GAO analysis of Lockheed Martin information. | GAO-19-321

Note: The program tracks part repair times in 3-month increments. The data in this figure are for repairs that were completed between September and November 2018.

This backlog of parts awaiting repair is largely attributable to delays in the establishment of part repair capabilities at the military depots. The capabilities to repair all parts at the military depots were originally intended to be in place by 2016, but the F-35 program's current plan now projects that the military depots will not have the capability to repair all parts at the expected repair demand rates until 2024.²⁴ According to program officials and documentation, the plan includes the required material and technical instructions to repair parts, and DOD has allocated funding for these efforts in its budget planning. However, as of February 2019, funding decisions had not been finalized.

In the meantime, to address the gap in part repair capabilities at the military depots, the prime contractor has begun incentivizing manufacturers to increase their capacity to repair spare parts by establishing performance-based repair agreements. As of October 2018, according to program documentation, the prime contractor had established seven such agreements, with six more planned by May 2019.

²⁴The F-35 program has identified 68 different repair workloads, or types of part repairs. Repair capabilities for these different workloads are projected to be in place at various dates between 2017 and 2024.

In October 2017, we reported that DOD was experiencing supply chain challenges, largely as the result of sustainment plans that did not fully include key requirements or aligned funding. DOD concurred with our recommendation that it revise its sustainment plans to ensure that they include the key requirements and funding needed to fully implement its sustainment strategy.²⁵ In January 2019, DOD issued an updated Life-Cycle Sustainment Plan for the F-35. The plan includes eight elements that DOD has identified as critical to enabling the program to achieve its aircraft capability and affordability targets by fiscal year 2024, including accelerating supply chain and depot repair capabilities.²⁶

Challenges for Early Production Aircraft

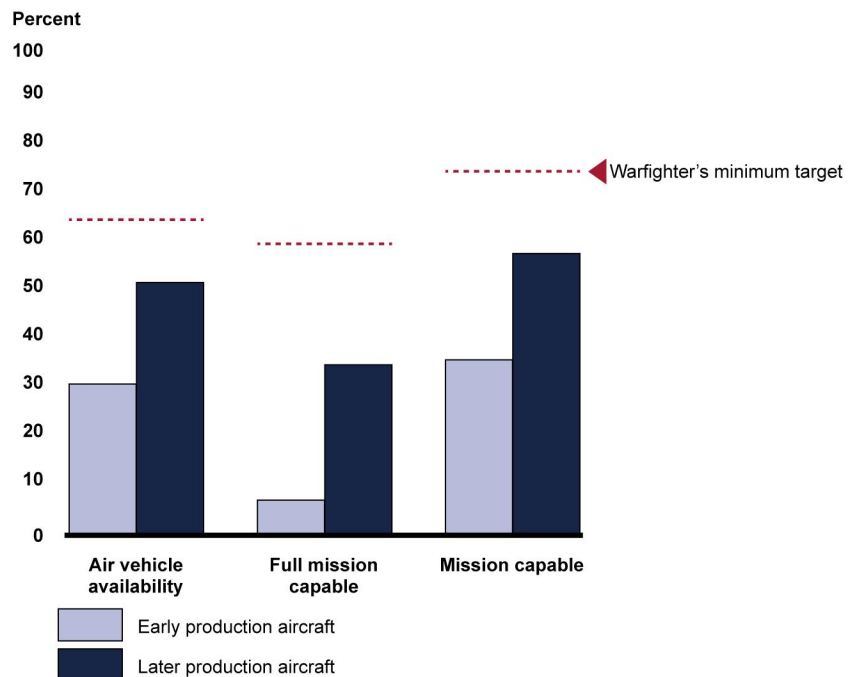
The F-35 program is a highly concurrent program wherein aircraft, spare parts, and mission software continue to be developed and redesigned while fielded aircraft must be sustained.²⁷ As a result, there are at least 39 different part combinations across the fleet. Additionally, DOD's training and operational squadrons are flying F-35 aircraft with three different blocks of mission software—2B, 3i, and 3F—with Block 3F software having the full warfighting capability. According to the program office, DOD spent more than \$15 billion to purchase F-35 aircraft from the earliest lots of production, specifically lots 2 through 5 (hereinafter referred to as “early production aircraft”), but it faces challenges in providing enough spare parts for these aircraft. Early production F-35 aircraft have parts configurations and software that differ from those of later production aircraft, and they have faced more parts reliability issues and parts shortages than later-production aircraft. Figure 7 shows the differences in aircraft performance between early production aircraft and aircraft produced in production lot 6 or later (hereinafter referred to as “later production aircraft”).

²⁵[GAO-18-75](#).

²⁶Office of the Secretary of Defense, *F-35 Lightning II Joint Strike Fighter (JSF) - ACAT ID Life-Cycle Sustainment Plan (LCSP): Supporting Milestone C and Full Rate Production (FRP)*, Jan. 31, 2019.

²⁷As of June 2018, DOD estimated the F-35 program's costs associated with concurrency to be \$1.4 billion.

Figure 7: F-35 Aircraft Performance for Early Production Aircraft and Later Production Aircraft, May—November 2018



Source: GAO analysis of Department of Defense and Lockheed Martin information. | GAO-19-321

Note: Early production aircraft include F-35 aircraft produced in production lots 2–5. Later production aircraft include F-35 aircraft produced in production lots 6 and later.

According to program documentation, DOD plans to upgrade all of its early production aircraft to Block 3F software capability.²⁸ These upgrades were initially scheduled to be completed by the end of 2021, but DOD is taking actions to accelerate these modifications with the plan to complete the upgrades in September 2020. That upgrade is expected to address some of the reliability challenges the older aircraft have experienced. However, program and contractor officials said that these upgrades are not a comprehensive solution, as there will still be many parts that are used on these early production aircraft that are not reliable and are in short supply. Accordingly, DOD is taking action to retrofit some other parts that are not addressed by the modifications. These challenges

²⁸DOD plans to add new capabilities and further modernize the F-35 beyond Block 3F capability in an effort that it refers to as Block 4. We recently reported that DOD requested funding for this modernization effort before establishing a sound business case. 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).

disproportionately affect the U.S. services' training fleets, as the majority of U.S. early production aircraft are currently being used for that mission. For example, the training units at Eglin Air Force Base were unable to fly due to parts shortages about 56 percent of the time from May 2018 through November 2018.

ALIS Challenges

The Autonomic Logistics Information System is an information technology system that is central to the F-35 sustainment strategy. It is intended to provide the necessary logistics tools to F-35 program participants as they operate and sustain the F-35 aircraft. ALIS consists of multiple software applications designed to support different squadron activities, including supply chain management, maintenance, training management, and mission planning. Specifically, for supply chain management, ALIS was intended to automate a range of supply functions—including updating the status of parts, generating supply work orders, and communicating critical data about parts. However, these capabilities are immature, resulting in numerous challenges and the need for maintainers and supply personnel at military installations to perform time-consuming, manual workarounds in order to manage and track parts. One Air Force unit estimated that it is spending the equivalent of more than 45,000 hours per year performing additional tasks and manual workarounds, including for supply-related functions, because ALIS is not functioning as intended. Supply and maintenance personnel we spoke with at various military installations cited challenges associated with ALIS, including the following:

- missing or corrupted electronic spare parts data that are required to install a part on an aircraft, necessitating extensive research and troubleshooting to resolve;
- maintenance and supply systems within ALIS not communicating with each other, resulting in difficulty in electronically tracking aircraft parts as they are physically moved between maintenance and supply locations at the same base; and
- limited automated capabilities, requiring manual and sometimes duplicative steps for receiving, tracking, and managing parts.

We have previously reported on challenges related to ALIS. In April 2016, we reported that DOD did not have a plan to ensure that ALIS was fully

functional as key program milestones approached.²⁹ In October 2017, we reported that DOD faced delays in the development of required ALIS sustainment capabilities and uncertain funding for this development.³⁰ We are currently conducting a separate review of ALIS, assessing how DOD is managing current and future issues related to the system. We plan to complete this review by the end of 2019.

DOD Will Likely Continue to Face Challenges in Achieving F-35 Performance Requirements with its Current Approach to Planning for and Allocating Spare Parts

In September 2018, the Secretary of Defense directed the services to achieve and maintain 80 percent mission capability for the F-35 fleet by the end of fiscal year 2019,³¹ which program and Office of the Secretary of Defense officials have told us will be difficult to accomplish, given the supply and maintenance challenges facing the fleet.³² DOD is pursuing a phased approach to achieving this requirement for the F-35 aircraft. DOD's first priority is to increase the capability of its operational fleet to achieve the 80 percent mission capability target by the end of fiscal year 2019, with the intent to increase the capabilities of its entire F-35 fleet to achieve the target by the end of fiscal year 2020. While DOD has ongoing efforts to increase the availability of spare parts as described above, it is likely to face additional challenges in meeting this requirement as well as the other warfighter aircraft performance requirements, because of the ways in which the program is planning for and allocating parts.

²⁹GAO, *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). We recommended that DOD develop a plan that would prioritize and address ALIS issues prior to the start of full-rate production for the program. DOD implemented this recommendation and continues to evaluate challenges associated with ALIS.

³⁰[GAO-18-75](#).

³¹The Secretary of Defense also directed that the services reduce sustainment costs for their critical aviation platforms—including the F-35 fleet—every year beginning in fiscal year 2019. Secretary of Defense Memorandum, *NDS Implementation – Mission Capability of Critical Aviation Platforms* (Sept. 17, 2018).

³²From May 1 – September 31, 2018, the time during which aircraft in possession of F-35 units were unable to fly or conduct any of their tasked missions due to maintenance problems was about 19 percent—much higher than the program's planned rate of 10 percent. DOD has some ongoing initiatives that are targeted at reducing this rate, but we did not examine those efforts as part of this review.

DOD Is Not Planning for Enough Parts in Its Spare Parts Projections to Meet Warfighters' Performance Requirements

The F-35 program is not planning for the quantity of parts necessary in its spare parts projections to meet warfighter performance requirements. The program's S-rate requirement is used along with a number of other factors in an analytical model to determine the quantity of spare parts to be purchased. Based on this model, DOD is planning to purchase the quantity of parts necessary to achieve a fleet-wide S-rate of 20 percent—meaning the program is buying only enough parts to enable about 80 percent of its aircraft to be mission-capable based on the availability of parts. According to program documentation, the maximum fleet-wide mission capability rates that can be consistently expected when modeling for a 20 percent S-rate is about 70 percent—far lower than the warfighter's requirements. This is the case because the time during which aircraft are unable to fly due to maintenance is also a factor, which the program projects will be about 10 percent. Figure 8 shows the difficulty that DOD will face in meeting the Secretary of Defense's 80 percent mission capability target when planning for an S-rate of 20 percent given the time that is also required for maintenance.

Figure 8: Supply and Maintenance Factors Contributing to Aircraft Mission Capability Rates

Actual Fleet performance, May 2018 through November 2018

52% mission capable



Secretary of Defense target for F-35 fleet performance

80% mission capable



Potential F-35 fleet performance, given supply and maintenance planning factors

70% mission capable



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

 **Non-mission capable due to supply:** Aircraft unable to fly due to lack of parts

 **Non-mission capable due to maintenance:** Aircraft unable to fly due to maintenance issues

Source: GAO analysis of Department of Defense and Lockheed Martin information. | GAO-19-321

According to program and prime contractor documentation, DOD would need to model and fund the spare parts pool to achieve an S-rate of no higher than 10 percent in order to achieve requirements for aircraft performance, such as the mission capability target set by the Secretary of Defense and the services' goals for air vehicle availability. Doing so would significantly increase the costs for spare parts. According to the prime contractor, in order to achieve a fleet-wide S-rate of 10 percent, the U.S. government would need to initially pay hundreds of millions of dollars to buy more parts for already-fielded aircraft. Costs would also increase on an annual basis—above the nearly \$1 billion the U.S. services collectively paid in fiscal year 2018—to buy more parts each year.³³ The current projected costs of F-35 sustainment are not affordable for the services. In 2018, DOD established constraints based on the military services' future budget projections that indicate that DOD needs to reduce F-35 sustainment costs per aircraft per year by 43 percent for the F-35A, 24 percent for the F-35B, and 5 percent for the F-35C in order for the aircraft to be affordable for the services. DOD will be challenged to support this increase in annual costs for spare parts given its need to make significant cost reductions.

Furthermore, as part of DOD's fiscal year 2020 program budget review, DOD conducted modeling and analysis to project how various courses of action—such as increasing purchases of spare parts to compensate for how long it actually takes to repair parts or reducing aircraft production—would affect F-35 fleet performance. DOD's analysis projected that if no additional actions were taken beyond what the U.S. services had already planned for and funded, F-35 aircraft performance would increase for a period of time. However, it would then worsen significantly with the growth of the fleet. Officials from the Office of the Secretary of Defense said that, as a result of this analysis, DOD is considering some additional investments to increase the availability of parts that would result in increased funding requirements for the U.S. services, but that as of January 2019, decisions were not finalized. They further said that their recent modeling and analysis efforts for the fiscal year 2020 program budget review did not formally consider additional investments to lower the planned S-rate to 10 percent as a course of action, but that this misalignment between the quantity of parts that DOD is planning to

³³Specifically, according to program office documentation, \$962.4 million in U.S. funds were budgeted to purchase F-35 initial spare parts for fiscal year 2018.

purchase and what is needed will hinder DOD's ability to meet warfighter performance requirements.

DOD May Have Limited Options to Increase F-35 Spare Parts Availability for Its Operational Fleet

Moreover, DOD may have limited options to increase spare parts availability for its operational fleet because of the way in which the program is currently structured to allocate parts. Within the F-35 program, the U.S. services do not have control over how F-35 parts are allocated, but rather share access to the parts along with the rest of the global fleet. The prime contractor is responsible for allocating parts to meet the requirements of all participants who share in the global spares pool. In response to parts shortages to date, Air Force and Marine Corps officials have said that the program has generally supported big events, such as the 2018 operational deployments of the U.S. services, by shifting parts to those units from the broader global spares pool (see sidebar). According to service officials, decisions to shift parts to different locations to support operational priorities could potentially be made by either a military service that owns those parts or DOD leadership within a legacy program. However, Office of the Secretary of Defense and program officials said that there is no mechanism within the current construct of the F-35's global support strategy for program participants to optimize readiness for certain units by increasing the allocation of parts to those locations, short of deviating from existing program rules or contractual arrangements. As the size of the fleet and number of operational squadrons grow, the F-35 program will face increasing demands on its supply chain and competing operational priorities across participants that will likely make it more difficult for the program and the U.S. services to mitigate fleet-wide shortages of F-35 parts.

Supporting Recent F-35 Shipboard Deployments

The F-35 program was not able to fill the Marine Corps' afloat spares packages (packages of spare parts designed for aircraft stationed on ships) for the first F-35 deployments aboard the U.S.S. *Essex* and U.S.S. *Wasp* in 2018 in time to support those deployments. As a result, the F-35 program pulled spare parts from inventories at Marine Corps Stations Yuma, Arizona, and Iwakuni, Japan. Marine Corps officials stated that these actions reduced F-35 readiness in Iwakuni.



Source: Defense Visual Information Distribution Service. | GAO-19-321

GAO's *Standards for Internal Control in the Federal Government* states that agencies should define objectives clearly to identify risk, including considering external requirements and internal expectations, and to design and implement activities to respond to those risks.³⁴ DOD guidance on performance-based arrangements also states that performance-based logistics arrangements should be structured to deliver outcomes that are tied to warfighter requirements.³⁵

³⁴GAO-14-704G.

³⁵Assistant Secretary of Defense for Logistics and Materiel Readiness, *PBL Guidebook: A Guide to Developing Performance-Based Arrangements* (2016). This guide is intended to provide users with guidance on best practices and processes to enable them to craft effective performance-based logistics arrangements.

Taken together, the current supply chain challenges and the issues related to how the program is planning for and allocating parts expose a significant gap between the F-35 aircraft performance targets the U.S. services need to achieve and what the F-35 supply chain is positioned to deliver within affordability constraints. DOD's updated F-35 Life-Cycle Sustainment Plan identifies a number of actions needed to improve aircraft performance, such as those related to spare parts availability and repair capability. While the identification of such actions is a positive step, the plan also states that those actions do not take into account policy, program structure, or resource constraints, which could make them difficult to implement. Furthermore, DOD's recent modeling efforts have already identified the need for some initial additional investments that could further strain the services' budgets. Without a comprehensive review to determine what additional actions are needed to close the gap between warfighter requirements for aircraft performance and what the F-35 supply chain is capable of delivering, taking into account also the need to reduce the sustainment costs of the F-35, DOD risks that its F-35 fleet may fall short of the capability needed to support its critical national defense missions in the future.

DOD Has Supported Initial U.S. Deployments, but Faces Challenges in Managing and Moving Spare Parts to F-35 Aircraft around the World

DOD's F-35 Supply Chain Has Supported Initial Deployments and U.S. and International F-35 Bases Overseas

DOD's F-35 supply chain has provided spare parts to support the few F-35 deployments that have occurred to date, including the following:

- U.S. Air Force deployment of 12 F-35A aircraft to Japan, November 2017—May 2018;
- U.S. Marine Corps deployment of six F-35B aircraft aboard the U.S.S. *Wasp*, March—April 2018 (see figure 9); and
- U.S. Marine Corps deployment of six F-35B aircraft aboard the U.S.S. *Essex*, July 2018—February 2019.

These units deployed with packages of parts to support the first 20 days of their deployment (that is, deployment and afloat spares packages), and

then received replenishment parts from the broader global spares pool once their packages of parts were depleted. DOD officials generally characterized these deployments as operational successes and significant milestones for the F-35 program. In addition to these early deployments, the F-35 supply chain is also providing parts to activated U.S. and international F-35 bases in six different countries outside of the United States.

Figure 9: U.S. Marine Corps F-35B Conducting Flight Operations aboard the U.S.S. *Wasp*



Source: Department of Defense. | GAO-19-321

DOD Faces Challenges in Managing and Moving Spare Parts to an Expanding F-35 Global Fleet

DOD faces challenges in managing and moving parts to support a deploying and expanding global F-35 fleet. While the initial operational deployments have been successful and the program has established overseas F-35 bases in six different countries, these events have also highlighted several key risks that could hinder future F-35 fleet readiness. These risks are related to (1) the make-up of the afloat and deployment F-35 parts packages, (2) the prioritization process for distributing scarce

parts among global F-35 participants, and (3) the F-35 program's global networks for moving parts.

Spare Parts for Deploying Aircraft Do Not Always Match Military Service Needs

DOD faces challenges in ensuring that the parts in its purchased afloat and deployment spares packages match the needs of deploying operational aircraft. According to Air Force and Marine Corps officials, ensuring that these parts packages are appropriately configured is of significant operational concern because units may be completely reliant on them while deployed to locations that the F-35 supply chain cannot yet readily support.

The afloat and deployment spare parts packages are purchased according to a list of parts planned and paid for by an F-35 program participant at least 2 to 3 years in advance, aligning with the aircraft being purchased at that time and the best projections of what the demand for the parts will be. However, given the immaturity of the F-35 program, continued modifications to parts and aircraft can make such packages out-of-date by the time F-35 units are preparing to deploy.³⁶ For example, Air Force officials told us that the spare parts packages for its November 2017—May 2018 operational F-35 deployment in Japan included parts that were not compatible with the aircraft with which they intended to deploy. Thus, the Air Force had to change its plans and deploy with older aircraft with less advanced capabilities that matched the parts in the package instead of the aircraft that best met their operational requirements. The Marine Corps faced similar challenges with its first shipboard deployments in 2018. Table 1 shows the number of parts and examples of parts in the Marine Corps' afloat spares packages for the U.S.S. *Wasp* and U.S.S. *Essex* deployments that were not initially configured to be compatible with the Marine Corps' deploying aircraft.

³⁶The F-35 program is a highly concurrent program wherein aircraft, parts, and mission software are continuing to be developed and redesigned while fielded aircraft are simultaneously being sustained. As a result, there are at least 39 different part combinations across the more than 350 F-35As, F-35Bs, and F-35Cs that have been fielded.

Table 1: F-35 Spare Parts in the Afloat Spares Packages That Were Not Compatible with the Marine Corps' F-35 Aircraft Deployed Aboard Ships in 2018

	U.S.S. Wasp Afloat Spare Parts Package	U.S.S. Essex Afloat Spare Parts Package
Number and percentage of incompatible parts relative to total parts in the packages	382 out of 886 parts (43%)	339 out of 768 parts (44%)
Examples of types of incompatible parts	Pilot harness, mask, breathing hoses, and other equipment; fire extinguisher; sensor element; batteries; electrical equipment; antennas; multiple types of valves; panel assemblies.	Pilot harness, mask, breathing hoses, and other equipment; fire extinguisher; sensor element; batteries; electrical equipment; antennas; multiple types of valves; panel assemblies.

Source: GAO analysis of Lockheed Martin data. | GAO-19-321

Note: DOD tracks both the range and the depth of parts in these pages. The numbers of parts in the table above pertain to the depth of parts in the packages.

Air Force and Marine Corps officials also said the quantity of parts within their parts packages were not fully reflective of the actual demands for certain parts, based on updated information about the reliability of certain parts and how frequently they needed to be replaced. In other words, the initially built packages did not have enough of the right parts to meet mission requirements. For example, Marine Corps officials said they were able to identify more than a dozen different parts in one of their afloat spares packages prior to deploying that were not provided in sufficient quantities because the program did not account for the actual fleet demand for these parts in its modeling for the afloat spares package. Air Force officials expressed similar concerns and said that they have had difficulty in getting information from the program that would enable the Air Force to assess whether there are enough of the right parts in its deployment spares packages relative to the actual demands for these parts. This is a concern for the Air Force as it prepares for its next F-35 deployment, because officials said that they cannot be sure that the package of parts with which they will deploy will have sufficient parts to support the deployment.

The F-35 program does not have a process in place for changing out the parts within the afloat and deployment spares packages that are put on contract years before a deployment. Such a process is needed to ensure that the packages reflect the actual configurations of the deploying aircraft or updated demand projections for parts. Service and program officials said that such a process would need to include a review of the parts within the packages to ensure that they match deploying aircraft and aligning the funds to pay for any necessary updates or modifications to the parts, which could potentially cost tens of millions of dollars. F-35 program policy recognizes that the program may need to adjust the

configurations or quantity of parts in the packages based on updated information, noting that such actions may necessitate contractual changes, but it does not specify the process for these adjustments. In our discussions with the prime contractor, program office, and military services, officials have lacked clarity regarding who is responsible for reviewing the parts in the package to ensure that they are appropriately configured and for determining whether additional contract actions or funding are needed to update the packages.

In lieu of an established process to refresh these parts, service and contractor officials described an ad hoc and manual effort to review the packages prior to deployment. To address non-matching parts, contractor officials said that the program had to pull parts from the global and base spares packages to make exchanges. Officials said that this cuts into the parts that are available for the other F-35 units that rely on those packages, because the global and base packages are not stocked with the parts to support the deployments. For example, the program used 187 parts from the inventory at Marine Corps Air Station Iwakuni to backfill parts for the U.S.S. *Wasp*. The Marine Corps' squadron in Iwakuni stated that this had a measurable effect on the squadron's readiness to support its operational requirements, as reflected by lower availability of parts within their inventory to support broken aircraft.³⁷ Specifically, during the time of the U.S.S. *Wasp* deployment, only about 46 percent of the critical parts (that is, parts needed to fix aircraft that cannot fly) that the squadron at Iwakuni needed were available in its inventory, and the squadron had to wait an average of about 12 days to receive these parts from off-base. As the F-35 fleet continues to expand and the number of operational deployments increases, military service officials said that these manual workarounds and the singular focus on ensuring that one unit has the appropriate parts to deploy will not be tenable. Program officials said that they have started a working group to look at options for addressing this issue, but they could not provide a timeframe or details about this effort.

DOD guidance for risk management in acquisition programs states that defense programs must anticipate and address risks on a continuing basis, and suggests that programs implement processes that include risk

³⁷Marine Fighter Attack Squadron 121 is based at Marine Corps Air Station Iwakuni. This squadron has 16 aircraft assigned. It deployed six aircraft aboard the U.S.S. *Wasp* while its 10 other aircraft remained at Iwakuni to fulfill other mission requirements.

identification, analysis, mitigation, monitoring, and planning.³⁸ Further, the services have recognized that, to meet operational readiness objectives in a deployed environment, it is critical to have mechanisms ensuring that spare parts packages with which units plan to deploy are built to support the configurations and expected missions of the deploying aircraft, and have established guidance and processes to that effect.³⁹ DOD also has a separate, ongoing initiative to determine whether using risk-based assumptions can produce a more efficient and effective mix of parts within deployment parts packages across a range of weapon systems, including the F-35. While this effort is nascent, it could potentially offer insights for the F-35 program to consider when reviewing the make-up of the F-35 deployment and afloat spares packages. Without a process for DOD to modify the F-35 afloat and deployment spares packages, to include reviewing the parts within the packages to ensure that they match deploying aircraft and accounting for updated parts demand, and without aligning any necessary funding for needed updates, the military services face risk that the parts that they have specifically purchased to meet their operational requirements will not be sufficient to do so.

Uncertainty Exists about How Scarce Spare Parts Will Be Prioritized among All F-35 Customers

Uncertainty exists about how the program will prioritize scarce F-35 spare parts among global participants. The program has developed a set of business rules to govern the prioritization of scarce F-35 parts. The business rules are to differentiate between the relative significance of competing needs and create a structure to be responsive to customer requirements during both peacetime and war.⁴⁰ These rules are critical to ensuring fair and transparent allocation of parts to all program participants, particularly given the significant shortages of spare parts throughout the F-35 program. Under these rules, F-35 units are assigned

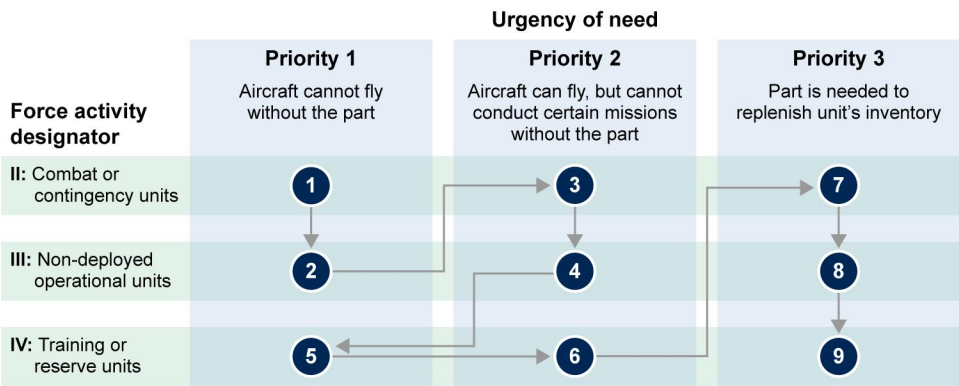
³⁸Department of Defense, *Risk, Issue, and Opportunity Management Guide for Defense Acquisition Programs* (Jan. 9, 2017). This guide describes strategies and processes for risk, issue, and opportunity management that programs should begin early in program development and apply continuously throughout the acquisition life cycle.

³⁹For example, Department of the Navy, NAVSUP Weapon Systems Support Instruction 4441.15L, *Aviation Consolidated Allowance List* (June 26, 2017).

⁴⁰These business rules outline program policy and procedures on the assignment and use of force activity designators for prioritizing critical F-35 scarce resources among all program participants. F-35 Program Instruction 1530.01, *Global Pooling Business Rules* (Mar. 18, 2013).

numerical designations based on the importance of their mission (that is, force activity designators), and their part requests are similarly assigned designations based on how important the part is to aircraft functionality (that is, urgency of need). Under these rules, the force activity designators of each unit and the urgency of need for each part request are combined to create an analysis that is applied to requests for scarce parts to determine which unit should receive the part. For example, according to such an analysis, a deployed F-35 unit that orders a part for an aircraft that cannot fly without that part would have priority over all other units. Conversely, an F-35 training unit that needs a part to replenish the inventory of parts on its shelves would have very low priority for the part relative to that of other units. See figure 10 for a general depiction of the prioritization scheme for F-35 parts.

Figure 10: Prioritization Scheme for the Allocation of Scarce F-35 Parts



Source: GAO analysis of Department of Defense and Lockheed Martin information. | GAO-19-321

Note: The F-35 program does not include a “force activity designator I” in its business rules. This graphic is a general depiction of DOD’s prioritization scheme for the allocation of scarce F-35 parts. It does not capture all potential scenarios.

According to program and contractor officials, the prime contractor has been allocating parts according to these business rules, but these rules are not comprehensive. Officials from the Joint Staff, Office of the Secretary of Defense, program office, and military services cited a number of areas where the rules lack clarity and detail. For example, there is a lack of clarity around how force activity designations will be assigned and by whom. The business rules state that each unit’s force activity designation will be assigned by the participant’s national command authority, but they do not specify the process for doing so; provide for a clear role for the U.S. combatant commanders in the process; or specify the level of U.S. and international leadership required in order to make changes to this designation. In addition, stakeholders

with whom we spoke said that the existing force activity designations do not provide for enough differentiation between types of activities or account for the unit's unique mission requirements when determining how important a part is to aircraft functionality. For example, military units that are engaged in combat operations are assigned the same force activity designations as units that are forward-based to react to potential threats. These officials expressed concern that as the global fleet expands and more units are engaged in operations, this practice could lead to a situation in which too many units are a "priority" at any one time. Stakeholders have also raised questions about whether and how F-35 participants should be charged for increases in their force activity designations, as this matter is not addressed within the current business rules.

Furthermore, the F-35 Product Support Manager has at times waived these business rules to support deployments and other activities, such as aircraft operational tests. For example, the Air Force unit that deployed to Japan in 2017 experienced significant readiness challenges because the business rules had established the replenishment of its spare parts package as a low priority relative to other competing demands for scarce parts. Air Force officials said that this contributed to its aircraft being unable to fly due to shortages of parts more than 30 percent of the time (cumulative over a month). According to Air Force and contractor officials, Air Force leadership then made a number of calls to the program office to request that its replenishment requirements be given higher priority. Subsequently, the F-35 Product Support Manager directed that the contractor deviate from the business rules to place a higher priority on the replenishment of the deployed unit's parts package so that it could get parts faster. Service and program officials said that such deviations may be necessary to meet operational requirements, and that program leadership needs some flexibility in the business rules to make those decisions. According to program officials, the F-35 Product Support Manager has the authority to issue waivers to the business rules, but the business rules do not clearly grant this waiver authority to the Product Support Manager, or address how and when such waivers should occur.

Stakeholders have been raising some of these concerns for several years. For example, the Office of the Secretary Defense and the Joint Staff developed related position papers that identified gaps in the business rules. Officials from these offices said that the papers were sent to the program office in 2014 and early 2017, respectively. In response, the F-35 program established a working group in May 2018 to begin revising the business rules. As of January 2019, program officials said

that the revised business rules were undergoing internal review, but the date for completion was not yet determined due to potentially lengthy timeframes associated with obtaining formal approval through the F-35 governance process. This ongoing effort is promising, but the specific action items that the working group was tasked with incorporating into the business rules do not clearly address some of the areas of concern raised by stakeholders. For example, these action items do not include the issue of deviations from the business rules.

DOD directs its components to comply with DOD's established materiel management guidance, which outlines DOD policy, assigns responsibilities and specifically provides procedures for how parts and materiel should be prioritized for responding to customer supply chain demands for all DOD components, including outlining the application of force activity designators and the role of the combatant commanders.⁴¹ The F-35 program's existing business rules incorporate many aspects of this standard DOD prioritization guidance, but they are not fully aligned with this guidance. For example, DOD's standard process outlines the use of five potential force activity designators, while the F-35 program provides for only three different designations. Additionally, *Standards for Internal Control in the Federal Government* states that agencies should design control activities to achieve objectives and respond to risks, including implementing control activities through policies.⁴² U.S. service and international officials said that, as the fleet and competition for spare parts increases, they are concerned that participants may try to manipulate the system due to the lack of clarity within the existing rules. Without ensuring that the revisions to its business rules for the prioritization of scarce F-35 parts across all program participants define stakeholder roles and responsibilities, the process for assigning and arbitrating force activity designations, and the manner in which deviations from the business rules will be conducted, the F-35 program may face challenges allocating parts to support competing U.S. and international warfighter requirements. Further, F-35 program participants may lack

⁴¹DOD Manual 4140.01, Volume 8, *DOD Supply Chain Materiel Management Procedures: Materiel Data Management and Exchange* (Feb. 10, 2014)(incorporating Change 2, Aug. 31, 2018) implements policy for prioritizing parts and materiel, referred to within DOD as the uniform materiel movement and issue priority system standards. This guidance assigns responsibilities and provides procedures for DOD materiel managers who work within the DOD supply system.

⁴²[GAO-14-704G](#)

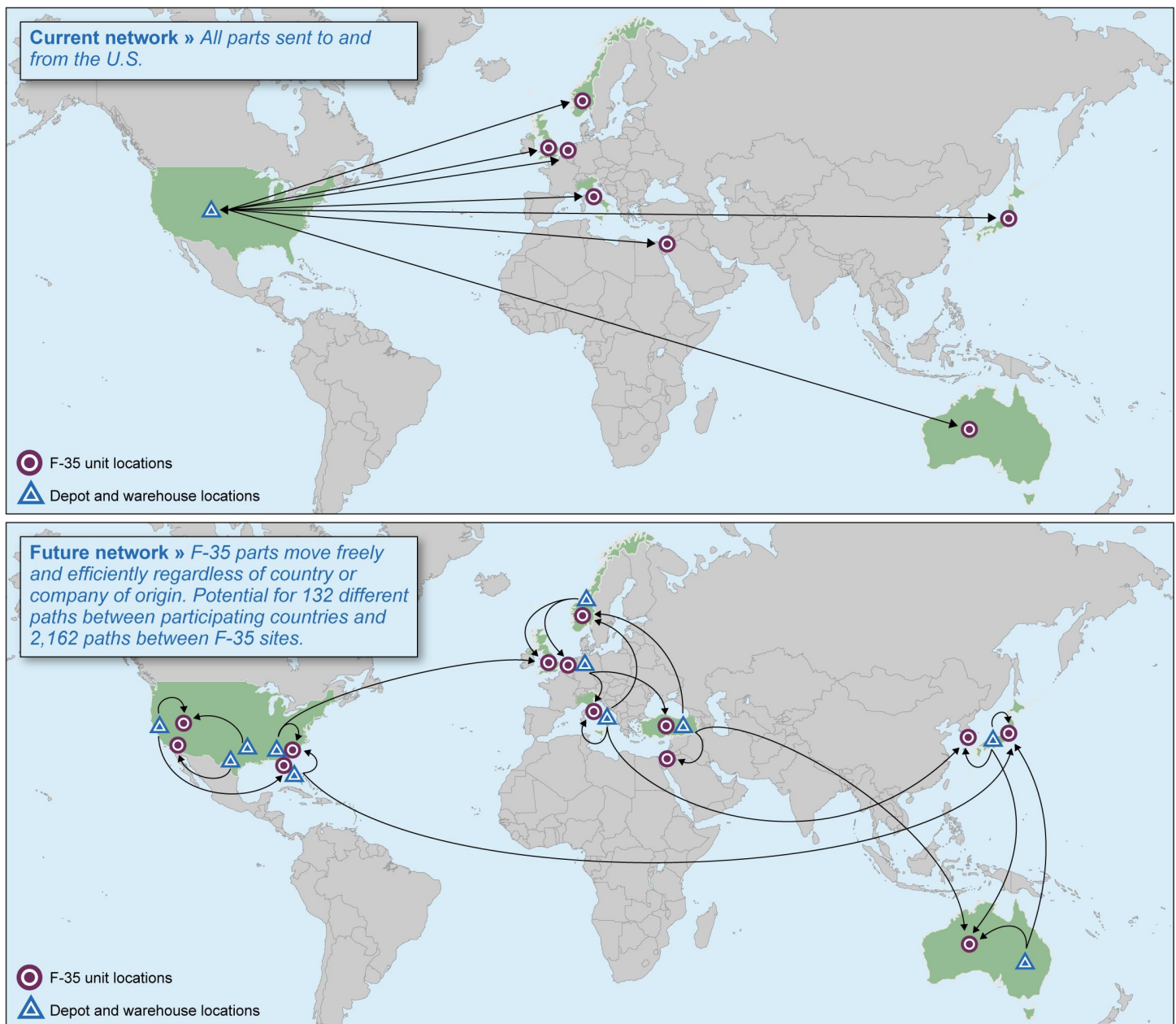
confidence in the equity of decisions regarding scarce parts that affect their operational requirements.

DOD's Networks to Move F-35 Parts around the World Are Immature

DOD is now moving F-35 parts around the world, but its global networks for doing so are immature and there is risk that they will not be fully capable to support an expanding fleet. The F-35 program has a growing number of U.S. and international participant bases outside of the United States and is providing supply support from its global spares pool for an increasing number of operational deployments. For its supply chain construct to work as intended, F-35 parts must be able to move freely and efficiently among U.S. and international program participants, suppliers, and repair facilities, regardless of the country or company of origin. The program has projected that F-35 parts could potentially be moved on 132 different paths between participating countries (for example, Italy to United Kingdom, Italy to Norway) and 2,162 paths between F-35 sites (for example, a warehouse in the Netherlands to a base in Norway). This will require the program to establish strategically located warehouses, synchronize global distribution networks, and navigate a complex web of import and export activities and international weapon control laws.⁴³

However, the envisioned global network is not yet in place. For instance, regional warehouses planned for the Netherlands and Australia are not expected to reach initial operational capability until, at the earliest, late 2019 and 2020, respectively. Furthermore, the program is still working to establish functional shipping networks and locations at which to receive parts. It also does not have mechanisms in place to support the range of required import and export activities. Spare parts are instead being moved under a less efficient system, with the parts originating from and returning to the United States before being delivered to an international program participant. Figure 11 compares a depiction of the program's intent for the future global network for moving F-35 parts with the existing "hub-and-spoke" network.

⁴³See, for example, 22 U.S.C. § 2778, Control of arms exports and imports; International Traffic in Arms Regulations ("ITAR," 22 C.F.R. §§ 120-130).

Figure 11: Current and Future Global Networks for Moving F-35 Parts

Source: GAO analysis of Department of Defense information. | GAO-19-321

The immaturity of the global network has contributed to long wait times for parts for the U.S. and international F-35 squadrons that are deployed or permanently based overseas.⁴⁴ The 2018 F-35 sustainment contract establishes minimum and objective targets for customer wait times across the F-35 fleet. The targets are the same regardless of whether the aircraft are located inside or outside of the United States, thus reflecting the intended global nature of the network. However, customer wait times for parts for units located outside of the continental United States have been significantly higher than those for units located inside of the continental United States, as shown in figure 12. Unless otherwise noted, the data are inclusive of customer wait times for both U.S. and international participants.

Figure 12: Cumulative Customer Wait Times for F-35 Parts Inside and Outside of the Continental United States, January 2018—December 2018^a

	Fleet-wide minimum target	F-35 fleet inside of the continental United States	F-35 fleet outside of the continental United States	Marine Corps Air Station, Iwakuni, Japan ^b	U.S. Air Force Deployment to Kadena Air Base, Japan ^c
Percent of critical parts received within 6 days of request ^d	60%	66%	19%	23%	18%
Percent of critical parts received within 10 days of request ^d	75%	75%	42%	47%	42%
Percent of mission-impacting parts received within 10 days of request ^e	60%	60%	26%	31%	23%
Percent of mission-impacting parts received within 30 days of request	85%	78%	72%	72%	68%

Source: GAO analysis of Department of Defense and Lockheed Martin information. | GAO-19-321

^aUnless otherwise noted, the data in this table are inclusive of customer wait times for both U.S. and international participants.

^bThe U.S. Marine Corps currently has one F-35 squadron permanently based in Iwakuni, Japan.

^cThese data cover the time of the unit's deployment from January through March 2018.

^dFor the purposes of this table, a critical part is a part that is necessary to repair an aircraft that cannot fly. The program refers to these parts as "Priority 1" parts.

^eFor the purposes of this table, mission-impacting parts are those that affect the aircraft's ability to conduct certain missions, but are not necessary for the aircraft to fly. The program refers to these parts as "Priority 2" parts.

⁴⁴Program and contractor officials said that these long wait times are also partially attributable to the parts shortages throughout the program.

Officials from Marine Corps, Air Force, and international F-35 squadrons that were based or deployed overseas in Japan and the United Kingdom described long wait times of up to 17 days—well outside of the 6- and 10-day customer wait-time metric ranges for critical parts—to receive available parts overseas that have degraded their readiness. They cited several reasons for these delays, such as export and import licenses not being in place, delays in customs, inefficient routing or processing of parts, and ineffective commercial freight forwarders. For example, Air Force and contractor officials said that it was initially taking parts up to 14 to 16 days to reach the deployed Air Force unit in Japan using a commercial shipper, which was hurting the unit's readiness. According to DOD and contractor officials, these concerns drove the prime contractor to start shipping parts via military air, which subsequently decreased customer wait times significantly. However, these officials said that the program did not have the appropriate contracting and funding mechanisms in place to utilize military air and had to return to using a different commercial shipper.

The F-35 program's plan for full establishment of the global networks for moving parts is not complete. Program officials and contractor officials told us that planning for this network is 3 to 4 years behind the need because the program was more focused on producing the aircraft than on sustainment. Prime contractor officials also said that they did not realize the complexity of setting up the network, which will require them to establish export and import authorizations in every country and to work through the Department of State to establish export licenses. In addition, the construct necessitates that each of the international participants takes actions within its own government to ensure that the appropriate arrangements are in place, such as obtaining waivers for taxes, tariffs, and duties, or pursuing any necessary changes to its own government's laws. The F-35 program initiated its focused planning for this network in 2018, with the establishment of a working group tasked to develop plans for implementing the network. In January 2019, the F-35 program issued a high-level strategy that provided some limited information on the program's objective and key principles for the network. It also indicated that a forthcoming F-35 program instruction would provide a framework for executing the strategy, but it did not have a timeline or details for the completion of this instruction.

Also in January 2019, DOD selected the U.S. Transportation Command and the Defense Logistics Agency as the entities responsible for the global transportation and distribution networks for F-35 parts—a transition that is expected to occur over the next 12 to 24 months. According to

Department of Defense documentation, existing U.S. Transportation Command and Defense Logistics Agency networks are already in place to support much of the required F-35 global parts movements, particularly for U.S. units and foreign military sales customers. However, these organizations will still be reliant on the F-35 program to establish the necessary licenses and legal frameworks for the movement of parts between partner countries.

The program has established a target date of September 1, 2021 for full operational capability of the network, at which point spare parts are intended to be able to be moved freely throughout the F-35 enterprise. However, the program does not yet have a detailed plan with clear requirements and milestones or an integrated schedule to move the network from initial operational capability to full operational capability.

Program officials stated that they believe this date is achievable, due to the increased emphasis on developing the network among all program participants. However, there are risks to the program's planning effort. Beyond the complexity of the network, the F-35 program office and contractors do not control all elements needed to support the successful implementation of the network. Specifically, each international partner is responsible for establishing the necessary legal framework in its own country to support the network, which can be a lengthy process. Program officials further noted that other international participants have national laws or have made decisions that are not conducive to the free flow of parts throughout the global network. F-35 program policy provides some provisions to address non-conformance by partners—for example, stating that partners will be responsible for any taxes or tariffs charged to the program by their own countries. However, program officials said that the mechanisms to manage any such deviations will be complex to implement and are still being developed.

Our prior work on acquisition management has identified a number of key program management practices that can improve program outcomes if implemented, such as clearly establishing well-defined requirements and developing realistic schedules that include risk analysis.⁴⁵ DOD guidance

⁴⁵GAO, *Homeland Security: DHS Requires More Disciplined Investment Management to Help Meet Mission Needs*, [GAO-12-833](#) (Washington, D.C.: Sept. 18, 2012). This report examining the Department of Homeland Security's major acquisition programs identifies key program and portfolio management practices drawn from GAO's prior reviews of programs at the Department of Homeland Security, Department of Defense, National Aeronautics and Space Administration, and private organizations.

related to managing risk in acquisition programs also states the importance of program managers taking actions to identify, manage, and mitigate programmatic risk, which can either be intrinsic to the program or arise from inadequate planning.⁴⁶

The F-35 program's recent focused efforts in this area are positive steps, but its planning efforts still lack detail about how the network will be fully implemented. Furthermore, the schedule, planning, and risks associated with this delayed global network are not addressed in DOD's recently updated F-35 Life Cycle Sustainment Plan. Without completing a detailed plan for the establishment of the F-35 program's global network for moving parts that outlines clear requirements and milestones to get the network to full operational capability, and includes mechanisms to identify and mitigate risks of delays or gaps in the global network, the program cannot ensure that its supply chain will support U.S. and international program participants as intended. Furthermore, delays or gaps in the establishment of the envisioned global network will likely result in increased costs associated with additional travel segments and delays to the warfighter in receiving spare parts that could hurt the operational readiness of the global F-35 fleet.

DOD Cannot Fully Account for F-35 Spare Parts within the Supply Chain and Their Associated Costs

DOD cannot fully account for F-35 spare parts within the supply chain and their associated costs. Specifically, the department does not have records indicating how many F-35 spare parts it has purchased, or where they are all located. In addition, DOD does not have comprehensive cost information for individual F-35 spare parts, and the military services cannot track the funds that they have spent on F-35 spare parts to the actual parts purchased by the program office on their financial statements and supporting documentation.

Accountability of government property, such as F-35 spare parts, facilitates financial audits by providing the necessary documentation to ensure the accuracy of transactions for government property and

⁴⁶Department of Defense, *Risk, Issue, and Opportunity Management Guide for Defense Acquisition Programs* (Jan. 9, 2017).

contracted services. Congress required the Secretary of Defense to ensure that an external audit be performed on DOD's financial statements for fiscal year 2018, and to submit such audit to Congress no later than March 31, 2019. Congress directed this audit, in part, to help improve the accuracy and reliability of management information on DOD's mission-critical assets—such as F-35 spare parts—and services for which they contract.⁴⁷ Subsequently, DOD completed its first consolidated, department-wide, full financial statement audit in November 2018. The DOD Office of the Inspector General reviewed the department-wide financial statements and identified 20 material weaknesses—that is, serious problems with DOD's internal processes that hamper its ability to reasonably assure that its financial reporting is reliable—including processes related to accountability for government property in the possession of contractors and the accuracy and completeness of financial statements.⁴⁸

DOD Does Not Know How Many F-35 Spare Parts It Has Purchased or Where All of Them Are Located

DOD cannot fully account for its spare parts within the F-35 supply chain, including the quantity of all the spare parts it owns and where they are located. The prime contractor manages the F-35 supply chain and the movement of all F-35 parts across the F-35 enterprise to meet warfighter needs. DOD initially did not intend to own the F-35 parts, but in 2012 the F-35 program's executive steering board issued a decision memorandum declaring the F-35 parts in the global spares pool to be titled to the U.S. government when they are not installed on an aircraft. However, program officials told us that DOD did not develop a corresponding plan to maintain accountability over the parts that it already owned or would purchase in the future. According to program officials, this is due in part to property accountability not being a priority for the program in its effort to field aircraft. This is evidenced by the number of staff within the program office dedicated to this mission; program officials said that until recently there was only one government official at the program office overseeing property accountability for the F-35 system.

⁴⁷10 U.S.C. §§ 240a-240b.

⁴⁸Department of Defense Inspector General, *Independent Auditor's Report on the Department of Defense FY 2018 and FY 2017 Basic Financial Statements*, DODIG-2019-017 (Nov. 15, 2018).

In order to maintain accountability for government property, such as the spare parts within the F-35 supply chain, DOD guidance requires that DOD components establish and maintain a physical inventory control program for assets within the DOD supply chain to serve as a key internal control for providing information to inform inventory financial statements.⁴⁹ Defense Contract Management Agency officials also told us that in order to improve F-35 readiness and decrease costs, DOD must have an understanding of the F-35 spare parts it owns, where those parts are located, and how those parts are being used to support the weapon system. However, the F-35 program has not consistently followed DOD guidance for property accountability. For example:

- As of December 2018, the program office had not populated an accountable property system of record⁵⁰ with data for its F-35 parts.⁵¹ DOD components are required to establish and maintain accountable property systems of record for property that DOD components own and manage. An accountable property system of record is required to contain information such as cost, location, and custodial ownership data for property, including individual parts, that meet certain criteria, and to provide a comprehensive log of transactions that can be audited. Such a system would allow the F-35 program office to have

⁴⁹DOD Manual 4140.01, Volume 11, *DOD Supply Chain Materiel Management Procedures: Inventory Accountability and Special Management and Handling* (Mar. 8, 2017).

⁵⁰DOD guidance requires DOD components to maintain accountability of government property in an accountable property system of record. DOD Instruction 5000.64, *Accountability and Management of DOD Equipment and Other Accountable Property* (Apr. 27, 2017)(incorporating Change 2, Aug. 31, 2018). The inventory accountability instructions prescribed in DOD Instruction 5000.64 apply to DOD equipment and property. DOD Manual 4140.01, Volume 11, requires DOD components to maintain accountability records for secondary items in a DOD component's system of record.

⁵¹The DOD Office of the Inspector General issued a report in March 2019 on its findings from an audit on the management of government-owned property supporting the F-35 program. It found that DOD officials did not account for and manage F-35 program government property and relied upon contractor and subcontractor records as its only sources of data for 3.45 million pieces of property valued at \$2.1 billion. The DOD Office of the Inspector General made several recommendations, including that DOD continuously update data in the accountable property system of record. DOD Office of the Inspector General, *Audit of Management of Government-Owned Property Supporting the F-35 Program*, DODIG-2019-062 (Mar. 13, 2019).

asset visibility for spare parts within the F-35 supply chain.⁵² The program office has identified a database to use as its accountable property system of record, but DOD officials stated that the program office does not have the data necessary to populate it. According to program officials, the prime contractor keeps some of the required data in proprietary databases to which the program office does not have access. In addition, DOD officials told us that the program office is working through some limitations that need to be addressed with the system the program office has chosen to be its accountable property system of record in order to properly maintain data records.

- The program office has not fully identified which spare parts the prime contractor is required to enter into DOD's Item Unique Identification registry (hereinafter referred to as DOD's central registry for government property). In addition to component-specific accountable property systems of record, DOD's central registry for government property is DOD's primary data source for government furnished property, and it is intended to provide department-wide asset visibility for all government property and links with financial and accountability systems in order to maintain accountability over the assets DOD owns.⁵³ DOD guidance states that agencies are to require contractors to report government furnished property in DOD's central registry for government property.⁵⁴ DOD guidance also states that DOD agencies are to identify which assets require unique item-level traceability.⁵⁵

⁵²DOD defines asset visibility as the ability to provide timely and accurate information on the location, quantity, condition, movement, and status of items in its inventory, including assets in transit. Joint Publication 3-35, *Deployment and Redeployment Operations* (Jan. 10, 2018).

⁵³Government furnished property is property in the possession of, or directly acquired by, the government and subsequently furnished to the contractor for performance of a contract. Government furnished property includes, but is not limited to, spare parts and property furnished for repair, maintenance, overhaul, or modification. Federal Acquisition Regulation Clause 52.245-1 "Government Property" (January 2017).

⁵⁴DOD Instruction 4161.02, *Accountability and Management of Government Contract Property* (Apr. 27, 2012)(incorporating Change 2, Aug. 31, 2018).

⁵⁵DOD Instruction 8320.04, *Item Unique Identification (IUID) Standards for Tangible Personal Property* (Sept. 3, 2015)(incorporating Change 2, Aug. 31, 2018). Unique item-level traceability is the requirement to trace life-cycle management events related to acquisition, storage, operation, maintenance, safety, physical security, retirement, and disposal by each individual item. According to this guidance, unique item-level traceability is required for the following items: major end items, depot-level repairables, critical safety items, and items currently serially managed or warrantied, among others. Item unique identification is a technology that allows DOD to assign a unique identifier to an individual item and then use that identifier to manage the item in a variety of logistics processes.

However, the program office has not clearly defined for the prime contractor all F-35 spare parts that should be entered into DOD's central registry. As a result, DOD officials said the prime contractor is not entering in information about all required parts. Moreover, a property accountability official said that the prime contractor is not consistently entering F-35 parts into DOD's central registry when the parts are delivered, because the prime contractor may delay entering information into DOD's central registry until all items associated with a specific contract line item have been delivered to DOD. This official also said that there are some contract line items dating back to the first production lot, which delivered aircraft in 2011, that remain open, and thus there are potentially thousands of F-35 parts that are being used within the global spares pool that have not been entered into the registry, thereby impeding DOD's visibility over these parts.

DOD has not established a program policy that explicitly defines how it will maintain accountability of F-35 spare parts in accordance with DOD guidance. According to program officials, DOD has made some recent progress to address accountability issues, such as taking steps to bring contracts into compliance with property accountability regulations and increasing the number of staff focused on property accountability within the F-35 program office. However, DOD faces continued challenges in accounting for F-35 assets. In the absence of a program policy, the program lacks clarity on how to categorize assets and which property data the contractor is required to provide for those assets, how to implement policies and regulations, and how to define prime contractor roles and responsibilities. For example, F-35 contracts contain Federal Acquisition Regulation clauses that convey requirements for the prime contractor related to the accountability of government furnished property, including specifying the data that the contractor must maintain and provide to DOD. However, DOD officials said that the F-35 program office has not contractually established which items—including spare parts—are government furnished property, which has made it difficult for the program office to hold the contractor accountable for those required functions. As a result, the contractor has disputed which items should be considered as government furnished property, which has implications for how the prime contractor maintains accountability and provides data for F-35 spare parts it manages.

Property accountability officials at the F-35 program office have developed a draft directive that seeks to address the factors currently impeding the program from being compliant with property accountability guidance by clarifying roles and responsibilities within the program office for maintaining accountability of all government furnished property and

pooled assets, including the F-35 spare parts in the supply chain, and defining prime contractor responsibilities for managing these items and providing data to the program office for them. Officials told us, however, that the draft directive is undergoing internal review, and that its timeline for approval and implementation has not been established. Program officials said they are also in the process of developing a program instruction that may provide general procedures for implementing the policies that will be established in the directive.

Furthermore, while the draft program directive defines property accountability goals for the F-35 program, it does not detail the actions the program office will take to achieve these goals. The program office will face challenges that may impede its ability to achieve the goals of the draft directive, both retroactively and prospectively, for the billions of dollars in F-35 spare parts for which it currently cannot fully account. For example, DOD officials said that the costs for the prime contractor to obtain the data required to meet DOD's requirements for property accountability will likely be high, as the prime contractor does not centrally maintain all the data, nor do they maintain the data in a readily usable format for property accountability purposes. The contractor has estimated that more than 450,000 hours of labor could be necessary to provide the data. Program officials also acknowledged that the successful implementation of the draft directive is dependent upon support from program office leadership to ensure that its guidance is followed by both program officials and the prime contractor. However, according to these officials, the program has not historically prioritized property accountability in negotiations with the prime contractor because the program office has been focused on the production and fielding of aircraft and developing contracts to which the prime contractor will agree.

Standards for Internal Control in the Federal Government states that agencies should define objectives to identify risk, and to design and implement control activities to respond to those risks.⁵⁶ These standards also state that without a strong tone at the top to support an internal control system, the entity's risk identification may be incomplete, risk responses may be inappropriate, control activities may not be appropriately designed or implemented, information and communication may falter, and results of monitoring may not be understood or acted upon to remediate deficiencies. DOD's recent efforts related to property

⁵⁶[GAO-14-704G](#).

accountability are positive, but DOD stakeholders have raised concerns about issues related to property accountability within the F-35 program dating back to 2012 that have not been resolved, such as the program's lack of a populated property system of record.

As the fleet expands and the number of spare parts in the supply chain continues to grow, the program office will only continue to face increasing difficulty in obtaining accountability over its F-35 assets if it does not address these challenges. To address the scope of these challenges, DOD will need to establish a unified approach that provides clarity on how to categorize these assets, implement policies and regulations, and define prime contractor roles and responsibilities. Without developing a policy that clearly resolves these issues and defines how the F-35 program will maintain accountability for spare parts within the supply chain that is consistent with DOD guidance—and identifying the steps that it will take to implement it retrospectively and prospectively, such as how the program will obtain the necessary data from the contractor—DOD cannot ensure that it will be able to obtain and maintain comprehensive accountability and visibility over spare parts within the F-35 supply chain. Moreover, without an understanding of the assets it owns and how those assets are being managed by the prime contractor, DOD cannot ensure that the prime contractor is providing sufficient readiness for its most expensive weapon system at a reasonable cost.

DOD Cannot Identify Costs nor Can the Military Services Track the Funds Spent on F-35 Spare Parts

DOD cannot identify individual costs for each F-35 spare part, nor can the military services track the funds that they have spent for the use of F-35 spare parts to the actual parts purchased on their financial statements and related documentation. According to contract administration officials, the ability to track costs and assets is also critical to understanding and improving F-35 fleet performance.

DOD Does Not Have Comprehensive Cost Information for Individual F-35 Spare Parts

DOD does not have comprehensive cost information for individual F-35 spare parts. DOD purchases a high volume of spare parts across several contracts each year. According to program documentation, DOD was appropriated more than \$960 million for F-35 spare parts in fiscal year 2018 alone (see sidebar). DOD does not have a consistent, methodical process to identify and track the costs of individual F-35 spare parts,

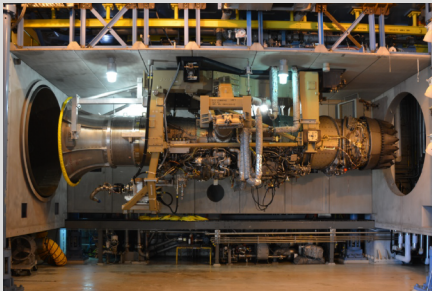
which would typically be done through the purchase contracts for the parts.⁵⁷ However, the F-35 contracts do not identify the individual parts or their costs. Instead, these costs are aggregated under broad contract line items, such that individual pricing for spare parts cannot be determined. For example, the annual sustainment contract for fiscal year 2018

F-35 Spare Parts Purchases

DOD purchases an array of spare parts across several different contracts to support the growing fleet of F-35 aircraft.

For fiscal years 2016 through 2018, DOD spent at least \$1.9 billion on spare parts. Spare parts in the F-35 program fall into different categories:

- An initial set of spare parts that accompany the delivery of new aircraft into the fleet;
- Replenishment spare parts to refill inventory of parts for use in maintenance, overhaul, and repair of aircraft;
- Spare parts for auxiliary systems used within the program, such as training simulators and equipment utilized to support maintenance repairs.



Source: Defense Visual Information Distribution Service. | GAO-19-321

aggregates the costs to repair and replace spare parts for F-35A aircraft under one contract line item totaling \$276 million. The contracts and related documentation do not specify how the money will be distributed among costs for repair or replacement, nor do they specify how many spare parts the contractor will purchase and at what cost.

Program officials said that their system for contract management has limitations that make it difficult to separate individual F-35 parts into their own line items. Since those costs are not being specifically provided in the contracts, program officials said that DOD has relied upon several ad hoc, manual workarounds in an attempt to obtain such data for the thousands of F-35 spare parts it owns, but these efforts are not comprehensive. For example, a program official said that they are obtaining cost information from the inspection and receiving forms accompanying deliveries of F-35 spare parts and then manually entering these cost data into attachments to the sustainment contracts. However, DOD officials said that the inspection and receiving forms for deliveries of F-35 spare parts are often not being entered into the registry until years after the parts are delivered, because such forms are not required until the delivery of all parts purchased under the same contract line item are complete. Furthermore, DOD officials said that this process is not an effective long-term solution for maintaining cost data of the billions of dollars in F-35 spare parts that DOD owns, because data entered in the program's contract management system through manual workarounds do not automatically link to the program office's other data systems. Program officials said that such linkages are necessary to maintain proper

⁵⁷Defense federal acquisition regulations, while providing for exemptions, state that services and supplies, and associated costs, shall be separately identifiable under distinct contract line items. Defense Federal Acquisition Regulation Supplement Clause 204.7103-1, *Uniform Contract Line Item Numbering System – Contract Line Items* (May 30, 2018).

accounting of F-35 spare parts, as cost data constitute one of the required data elements for an accountable property system of record.⁵⁸

Similar to the challenges that DOD faces with property accountability, program officials said that DOD faces significant hurdles in obtaining cost data from the prime contractor for individual F-35 spare parts because the contracts have not been written to require those data from the outset of the program. According to program officials, the program office has attempted to negotiate for cost data for F-35 spare parts, but the attempts have not been successful because of the high price the prime contractor would have charged the government for these data.

DOD guidance states that understanding program costs, such as those for F-35 spare parts, is critical to both achieving desired performance and supporting financial audits. Specifically, DOD guidance states that the government should clearly understand program costs in order to have effective performance-based arrangements.⁵⁹ Along these lines, we have previously reported that DOD's limited understanding of the actual sustainment costs of the F-35 system will hinder its ability to accurately determine how much fleet performance should cost under performance-based contracts, thus putting DOD at risk of overpaying the prime contractor while not receiving the expected level of sustainment support.⁶⁰ Additionally, DOD guidance requires that DOD agencies assign dollar values for spare parts in financial accounting systems.⁶¹

Without a methodical process for consistently obtaining comprehensive cost information from the prime contractor for individual F-35 spare parts, the program office will not be able to maintain financial or property accountability over these parts in accordance with DOD guidance. Furthermore, DOD will continue to face challenges in developing a

⁵⁸Other data elements required by DOD guidance for an accountable property system of record include, but are not limited to, the following: name, part number, serial number, owner, status, and estimated useful life. DOD Instruction 5000.64, *Accountability and Management of DOD Equipment and Other Accountable Property* (Apr. 27, 2017) (incorporating Change 2, Aug. 31, 2018).

⁵⁹Assistant Secretary of Defense for Logistics and Materiel Readiness, *PBL Guidebook: A Guide to Developing Performance-Based Arrangements* (2016).

⁶⁰[GAO-18-75](#).

⁶¹DOD 7000.14-R, *Department of Defense Financial Management Regulations, Volume 4: Accounting Policy* (January 2016).

complete understanding of the costs for the F-35 system, which will impede its ability to effectively negotiate with the prime contractor for sustainment support and to improve readiness of the expanding F-35 fleet.

Military Services Cannot Track the Funds Spent on F-35 Parts

The military services cannot track the funds that they have spent for the purchase of F-35 spare parts to the actual parts on their financial statements and related documentation due to the lack of an established accounting methodology for the parts within the global spares pool. Under this global spares pool construct, the military services and international partners each pay for access to the common pool of spare parts instead of owning the physical parts themselves. However, there is no established accounting methodology for defining how to track funding to the spare parts such that the military services can properly report assets on financial statements. DOD's Financial Management Regulation requires that DOD agencies—such as the military services—account for all spare parts they purchase for accountability and financial reporting purposes.⁶² According to DOD officials, the F-35 program and the DOD Comptroller have been working to develop a policy that provides such guidance since 2015, but it has not yet been finalized and the timeline for completion is unclear.

Specifically, program officials said that they are waiting for the DOD Comptroller to finalize a memorandum that would identify the DOD component responsible for maintaining financial accountability of the F-35 spare parts in the global spares pool. According to DOD officials, the memorandum would include an attachment that defines a methodology for tracking funding contributed by the military services and international partners to F-35 spare parts. A draft of this memorandum has laid out a possible methodology to maintain financial accountability for the spare parts within the global spares pool that includes identifying the program office as the DOD component responsible for financial reporting for F-35 parts, but a program official said that the DOD Comptroller has not yet completed this memorandum because the DOD Comptroller is reconsidering the proposed approach. DOD Comptroller officials said that they are reconsidering the proposed approach based on input received from independent public accountants who performed the services'

⁶²DOD 7000.14-R, *Department of Defense Financial Management Regulations, Volume 4: Accounting Policy* (January 2016).

financial statement audits, to consider having the Department of the Navy or the Air Force, rather than the program office, be the reporting entity for F-35 parts.

Without a DOD Comptroller-approved methodology for the services to account for the funds they have spent on F-35 parts within the global spares pool on their financial statements, DOD will be hindered in its efforts to comply with financial improvement and audit readiness requirements, provide supporting details for its financial statement transactions, and render accurate cost information for DOD management, Congress, and others stakeholders to use in assessing and managing program costs and other financial activities associated with the F-35 program. We previously reported that F-35 sustainment costs are not fully transparent to the military services and recommended that DOD should take steps to improve communication with the military services about how the F-35 sustainment costs they are being charged relate to the capabilities received.⁶³ Furthermore, discrete cost information and an ability to account for funds spent would help DOD in its efforts to decrease costs and make one of its most expensive weapon systems more affordable.

DOD Actions to Address Supply Chain Management Challenges Are Not Consistent with the Established F-35 Sustainment Strategy

DOD Actions Related to Supply Chain Management Diverge from the Established F-35 Sustainment Strategy

Challenges related to readiness and costs—including those we have discussed in this report—are driving the Office of the Secretary of Defense and the services to take actions that diverge from the established F-35 sustainment strategy. These actions indicate a potential shift in DOD's intent for F-35 supply chain management and a growing desire for more direct involvement by the military services and access to program information from the prime contractor.

⁶³[GAO-18-75](#).

The current F-35 sustainment strategy—known as the Global Support Solution—establishes that the two primary contractors will provide logistics support, including for supply chain management and support, through system-level, performance-based logistics contracts. The Global Support Solution is intended to be managed by the government-led Hybrid Product Support Integrator, but it is largely executed by the two primary contractors. Under this strategy, the U.S. military services (as well as the international partners) are customers. They submit requirements to the F-35 Joint Program Office and provide funding for those requirements, but military service officials told us that they have limited influence in program management or decision-making and are reliant on the program office for information about system performance and costs. Furthermore, according to Office of the Secretary of Defense and service officials, many of the military services' sustainment organizations that provide supply and maintenance support to other platforms have had almost no role in the planning for and establishment of sustainment capabilities or ongoing sustainment support for the F-35.⁶⁴

In April 2018, in a departure from the strategy and structure of the program and at the direction of the Assistant Secretary of Defense (Logistics and Materiel Readiness), the Defense Logistics Agency and the military services' supply and sustainment organizations initiated planning efforts to develop an option for organic—that is, DOD-managed—supply chain management support that would include increased roles for the services' supply organizations and the Defense Logistics Agency in assuming responsibility for F-35 supply chain management.⁶⁵ In support of this effort, these organizations have begun to develop notional plans to provision an organic supply chain for F-35 aircraft, which includes determining how many parts are required to support the system and how

⁶⁴The Global Support Solution includes a range of product support providers that provide support under agreements or sub-contracts with the primary contractors. Some of these product support providers are DOD and service organizations, such as the military depots. In January 2019, DOD announced that U.S. Transportation Command and the Defense Logistics Agency had been assigned responsibility for the global transportation and distribution networks for F-35 parts.

⁶⁵Assistant Secretary of Defense for Logistics and Materiel Readiness Memorandum, *Provisioning Mapping Event to Support Development of an F-35 Organic Supply Chain Management Option* (May 23, 2018).

Cataloging F-35 Parts

Cataloging is the process of arranging and accounting for items using descriptive details to include naming, classifying, and assigning unique identifiers. This is a fundamental step for effective supply chain management within DOD to standardize assets for procurement, stocking, and distribution.

The Defense Logistics Agency (DLA) has begun limited cataloging efforts for parts from two of the nine production lots of F-35 aircraft currently in use within the fleet.

This effort has also identified the potential for DLA to provide parts to the F-35 program from its existing inventory, including items that have not always been readily available in the F-35 program. Specifically, DLA officials said that DLA's cataloging efforts have shown the following:

- More than 7,300 F-35 consumable items are common to other DOD platforms;
- Of these common items, more than 6,000 are currently available in DLA's stock to potentially support F-35 requirements;
- The F-35 program has had more than 100,000 demands for these common items, 435 of which had impacts on fleet readiness.



Source: GAO. | GAO-19-321

they can be procured.⁶⁶ In addition, the Defense Logistics Agency has begun to catalogue a limited portion of F-35 consumable parts from production lots 6 and 7 into DOD's supply system (see sidebar).

However, officials from the Office of the Secretary of Defense and the Defense Logistics Agency said that this initial cataloguing effort only includes the level of detail necessary to support disposal of the parts, and that more comprehensive cataloguing would require DOD to have access to significantly more technical data than are currently available. Prior to this effort, parts used on F-35 aircraft were not tracked by DOD in its logistics information systems.

Officials from the Office of the Secretary of Defense said that there are multiple reasons behind DOD's recent effort to develop an option for DOD-led, organic supply chain management, including DOD's need to significantly reduce sustainment costs and improve readiness. For example, according to DOD officials, DOD's early cataloguing efforts have identified more than 7,300 F-35 consumable items that are common to other DOD platforms. Defense Logistics Agency officials said that they are actively working with the program office and prime contractor to identify opportunities for the program to leverage the parts that are already on DOD's shelves. In the longer term, identifying common parts could potentially allow DOD to directly procure them at a lower cost rather than through the prime contractor, and thereby provide economies of scale across other aviation platforms. Furthermore, the prime contractor and F-35 Joint Program Office have not been able to deliver the supply chain performance that the services need under the current sustainment strategy and structure, as discussed earlier in this report. According to an official from the Office of the Secretary of Defense, DOD is supposed to have a viable back-up plan for contractor logistics support under performance-based logistics contracts, in case the contractor cannot meet the government's performance requirements. Prior to the ongoing effort, DOD did not have such a plan. Similarly, DOD guidance on performance-based agreements states that robust performance-based

⁶⁶Provisioning is a critical function of DOD supply chain management. Provisioning is the process of determining and acquiring the range and quantity of spares and repair parts, and the support and test equipment required to operate and maintain an end item of material for an initial period of service.

Importance of Technical Data

Technical data include the blueprints, drawings, photographs, plans, instructions, and other documentation required to adequately produce, operate, and sustain weapon systems. Technical data are critical for weapon systems such as F-35 aircraft, as they provide DOD with the information necessary to support the fleet.

DOD is currently in the process of trying to obtain the following types of information from its contractors for the F-35 program:

- Engineering and technical information, such as specifications, reliability data, and demand rates for F-35 parts to support sustainment and procurement of these parts;
- Instruction manuals to facilitate maintenance and repair of F-35 spare parts;
- Property information, such as cost and location data for F-35 parts across the supply chain to meet DOD accountability requirements



Source: Defense Visual Information Distribution Service. | GAO-19-321

logistics solutions include appropriate criteria to cease the arrangement if necessary in order to manage risk.⁶⁷

DOD officials involved in the cataloguing and provisioning efforts described a long-term (5 to 10 years) and phased approach to the potential development of DOD-led supply chain management capabilities for the F-35 that would require major changes to the F-35 program structure and contracts. It would also require DOD to obtain significant amounts of technical data on F-35 parts from the manufacturers of those parts (see sidebar). DOD has submitted a request to the prime contractor for a proposal regarding supplying the data necessary to provision an organic supply chain and to catalogue all F-35 parts into DOD's supply inventory, but as of October 2018, DOD officials said that the prime contractor had not yet provided the costs of these data.

Officials from the Office of the Secretary of Defense told us that DOD had initially planned to negotiate for these data as part of the annual sustainment contract for fiscal year 2019, but that the prime contractor had cautioned that this could delay the awarding of the sustainment contract because of the complexity around the data negotiations. Officials said that there were also questions about the type of funds that should be used for the acquisition of these data (that is, procurement or operations and maintenance), and whether some data would need to be directly procured by DOD from the original equipment manufacturers. The lack of data from the contractor to support competition in the F-35 supply chain and DOD's understanding of the costs and performance of the system has long been a challenge, as we have previously reported. In September 2014, we recommended that DOD develop an Intellectual Property Strategy, to include identification of all critical technical data needs and associated costs.⁶⁸ Further, in October 2017, we recommended that prior to entering into multi-year, fixed-price, performance-based contracts, DOD should ensure that it has sufficient knowledge of the actual costs of sustainment and technical characteristics of the aircraft after baseline development is complete and the system reaches maturity. DOD

⁶⁷Assistant Secretary of Defense for Logistics and Materiel Readiness, *PBL Guidebook: A Guide to Developing Performance-Based Arrangements* (2016).

⁶⁸[GAO-14-778](#).

concurred with both recommendations but has not yet implemented them.⁶⁹

In addition, ongoing dialogue among stakeholders within the Department of Defense demonstrates a growing desire for more direct military service influence and access to information within the F-35 program. In 2018, the Secretary of Defense directed the U.S. military service chiefs to correct the F-35 parts shortages and to be agents of change in pursuing 80 percent mission capability for the F-35 aircraft.⁷⁰ In a September 2018 memorandum responding to the Secretary of Defense's direction to address F-35 parts shortages, the Air Force Chief of Staff, the Chief of Naval Operations, and the Commandant of the Marine Corps raised concerns about the program's inadequate supply chain and repair networks and reported on the funding that the services, as customers, provided to the Joint Program office to improve delivery of spare parts and accelerate depot maintenance capability.⁷¹ Furthermore, officials whom we interviewed from each of the military service headquarters expressed frustration with the current sustainment construct of the F-35 program in which they pay large sums of money for less-than-required readiness outcomes but have minimal influence on actions being taken to improve readiness and limited visibility into supply chain modeling and data to support their operational decisions.

DOD Has Not Determined the Actions and Investments Needed to Support Its Future Strategy for F-35 Supply Chain Management

DOD has not yet determined the actions and investments needed to support the F-35 supply chain in the future, because the department has not charted a clear strategy for F-35 supply chain management. There is a tension between two distinct sustainment concepts—the official contractor logistics support construct and DOD's current effort to have greater involvement in supply chain management—and F-35 program

⁶⁹[GAO-18-75](#).

⁷⁰Office of the Secretary of Defense Tasker, *F-35 Spare Shortage* (July 16, 2018); Secretary of Defense Memorandum, *NDS Implementation – Mission Capability of Critical Aviation Platforms* (Sept. 17, 2018).

⁷¹Chief of Staff of the Air Force, Chief of Naval Operations, and Commandant of the Marine Corps Info Memorandum, *F-35 Parts Shortage* (September 2018).

officials said that the program is caught between the two. In October 2018 DOD issued an updated F-35 Acquisition Strategy, but it did not clearly outline a shift in supply chain management. The new strategy includes references to the potential for increased organic support of the supply chain in the future—but does not provide details about the actions or timelines necessary to support this—while also reaffirming the current sustainment strategy of contractor logistics support for supply chain management. In addition, while the new strategy states the intent to support supply chain cataloguing and provisioning efforts, it does not provide detailed information regarding the investments in technical data necessary to support these efforts. In January 2019, DOD issued an updated F-35 Life-Cycle Sustainment Plan, which highlighted the absence of the technical data to support provisioning and cataloguing as a gap. The plan stated the intent to have all cataloguing and provisioning data available to the services by the end of fiscal year 2024. However, the plan did not provide details regarding how the data were to be procured or address DOD’s future strategy for supply chain management.

According to F-35 program, Office of the Secretary of Defense, and Air Force officials, DOD has to provide clear and consistent direction regarding its intent for F-35 supply chain management in order to guide investments in technical data, negotiations with industry, and program actions. In particular, F-35 program officials said that DOD’s mixed messages about supply chain management have led to inefficiency as the F-35 program tries to support both the formal, current strategy and initiatives driven by the informal shift toward more DOD involvement in F-35 supply chain management. According to program officials, the Product Support Manager organization at the F-35 Joint Program Office was structured for management of a program in which the primary contractors would be providing comprehensive contractor logistics support for the life of the program, and it has not grown in size as the fleet has grown. Furthermore, many of the positions at the program office that are critical to establishing and managing sustainment and supply chain capabilities are unfilled, even as the program office is taking on new responsibilities as Hybrid Product Support Integrator. For example, as of September 2018,

- Of the 16 positions on the product support maintenance team, which includes depot planning, three were vacant.
- Of the seven positions on the product support supply chain management team, two were vacant. As of January 2019 program

officials said that the number of vacancies had grown to four of seven positions.⁷²

- Of the 42 positions in the directorate of sustainment strategy, 11 were vacant, including the lead roles for strategic planning and risk management and scheduling for the global support solution.

In other cases, the numbers of staff dedicated to complex planning efforts are limited or have experienced frequent turnover. For example, officials said that there are only two officials within the program office dedicated to planning for the establishment of the program's delayed global networks for moving parts, and the lead role had changed four times in a year.

Moreover, program officials said that they are inundated with requests for data and information from the Office of the Secretary of Defense and the U.S. military services, which they partially attributed to the informal shift in the program's strategic intent for sustainment, and to scrutiny related to sustainment performance failures. Officials said that the time spent in responding to requests for data is hindering their ability to focus on long-term actions to improve sustainment performance.

The lack of clarity about the future F-35 sustainment strategy could also increase the risk perceived by industry, thus driving up tensions and potential costs in contract negotiations. Program officials said that the increasing technical data requests sent to the prime contractors to support DOD's provisioning and cataloguing efforts signal to industry a potential change from the acquisition strategy of contractor logistics support for supply chain management. According to Hybrid Product Support Integrator officials, mixed messages about the F-35 program's future supply chain strategy could make manufacturers reluctant to invest in increasing their capacity to produce new parts and to repair parts, if they do not have confidence in the scope of future business to warrant such investments.

Many options for F-35 supply chain management are available to DOD on a spectrum ranging from full contractor logistics support to DOD-led supply chain management or a blend thereof, depending on the aircraft system or subsystem. DOD guidance for program managers states that a sound program strategy requires understanding and clarity of the program's desired outcomes, and the plans and resources necessary to

⁷²Program officials said that an additional two out of 10 positions on the supply chain management team within the Hybrid Product Support Integrator were vacant.

achieve those outcomes.⁷³ Furthermore, federal internal control standards demonstrate the necessity of programs defining a clear strategy in order to support program actions. Specifically, the standards state that management should define objectives clearly so that they are understood at all levels of the organization, to include defining what is to be achieved, who is to achieve it, how it will be achieved, and timeframes for achievement.⁷⁴

Without clearly defining its strategy for how it will manage the F-35 supply chain in the future and updating key strategy documents accordingly, DOD will continue to face uncertainty about how F-35 sustainment support will be provided over the system's life cycle and the actions and investments needed to ensure that support. Such uncertainty could further hinder the program's efforts to improve supply chain performance and reduce costs.

⁷³Defense Acquisition University, *A Guide for DOD Program Managers* (December 2014). This guide is written for DOD acquisition program managers, with the intent of providing them with the foundational principles necessary to run efficient and effective programs.

⁷⁴[GAO-14-704G](#).

Conclusions

The F-35 aircraft, with its advanced warfighting capabilities, is a critical component of the National Defense Strategy. However, DOD will need to overcome substantial supply chain challenges for the aircraft to perform its expected role. Current F-35 performance continues to fall short of warfighter requirements, largely due to spare parts shortages and delays in the development of key repair capabilities. Simply purchasing more F-35 parts without other trade-offs may not be a viable long-term solution for DOD, given the steep reductions in sustainment costs that the military services have recognized are needed to make the aircraft affordable. These complex problems necessitate a comprehensive review by DOD to determine what actions should be taken to close the gap between warfighter requirements and the capabilities that the F-35 supply chain can deliver. Absent such actions, DOD risks that the F-35 will not be able to conduct the full range of intended missions.

The military services are integrating the F-35 into their operations with recent deployments and the establishment of F-35 bases overseas, but these events have also highlighted key risks for DOD in how it is managing and moving aircraft parts around the world. If not addressed, these risks could hinder the readiness of the global fleet. To date, DOD has been able to mitigate some of these risks by placing singular focus on ensuring the success of early F-35 deployments, but this will not be possible with the rapid expansion of the fleet in the next few years. Specifically, without a process and funding to make changes to the spare parts within their afloat and deployment spares packages to ensure that these match their needs, the military services risk not meeting operational requirements during future deployments. Fleet-wide spare parts shortages are also putting the F-35 program's process for prioritizing scarce F-35 parts to the test. Absent comprehensive business rules, the F-35 program could face challenges in transparently allocating parts to support competing U.S. and international requirements. Further, because the F-35 program did not fully recognize the complexity of establishing a global network for moving F-35 parts, this network is now several years behind schedule. Without a detailed plan that includes clear requirements and milestones to fully establish the network, as well as mechanisms to identify and mitigate the risk posed by any gaps or delays, DOD cannot ensure that it will be able to take the network from concept to reality so that F-35 participants do not experience long wait-times for parts in order to fly their aircraft.

Moreover, in its rush to field aircraft and its heavy reliance on the prime contractor, DOD has not focused on property and financial accountability of F-35 spare parts. Simply put, DOD does not have records of all the F-35 spare parts it has purchased; where those parts are located; and how much the military services paid for them. Until DOD establishes a policy that clearly defines how the F-35 program will maintain accountability for spare parts within the supply chain and lays out the steps that it will take to implement that policy, DOD will continue to lack critical visibility of F-35 assets, which is necessary to hold the prime contractor accountable for providing sufficient readiness at a reasonable cost. Additionally, without a process to consistently obtain comprehensive cost information from the prime contractor for F-35 spare parts, DOD will not have a full picture of F-35 costs, which could impede its ability to effectively negotiate with the prime contractor for sustainment support and to improve readiness of the expanding F-35 fleet. Further, absent a DOD Comptroller-approved methodology for the military services to record on their financial statements the funds spent on F-35 parts, DOD will be hindered in its efforts to comply with financial improvement and audit readiness requirements. As a result, DOD will not be able to assure the taxpayer that it fully understands how funds have been spent on this costly weapon system.

Finally, from the start of the F-35 program, the U.S. military services have been largely reliant on the prime contractor to manage the F-35 supply chain and to support their operations, with oversight from the program office. However, the Office of the Secretary of Defense and the services have grown dissatisfied with the program's inability to meet their readiness requirements and reduce costs, and they have begun to take actions that indicate the potential for a significant shift in DOD's F-35 sustainment strategy that would have far-reaching implications for the program. This shift, if fully implemented, would give more control of the supply chain to the federal government, but it also would run counter to the way in which agreements with industry and international participants have been constructed. Until DOD 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 necessary to meaningfully improve supply chain performance and reduce costs.

Recommendations for Executive Action

We are making the following eight recommendations to DOD.

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. (Recommendation 1)

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. (Recommendation 2)

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. (Recommendation 3)

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. (Recommendation 4)

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. (Recommendation 5)

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. (Recommendation 6)

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. (Recommendation 7)

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. (Recommendation 8)

Agency Comments and Our Evaluation

We provided a draft of this report to DOD for review and comment. In its written comments, reproduced in appendix II, DOD concurred with our recommendations and identified actions that it was taking or planned in response.

We are providing copies of this report to appropriate congressional defense committees; the Acting 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 III.

A handwritten signature in black ink that reads "Diana Maurer". The signature is written in a cursive style with a large, stylized 'D' and 'M'.

Diana Maurer, Director
Defense Capabilities and Management

List of Requesters

The Honorable James M. Inhofe
Chairman
Committee on Armed Services
United States Senate

The Honorable Dan Sullivan
Chairman
The Honorable Tim Kaine
Ranking Member
Subcommittee on Readiness and Management Support
Committee on Armed Services
United States Senate

The Honorable John Garamendi
Chairman
The Honorable Doug Lamborn
Ranking Member
Subcommittee on Readiness
Committee on Armed Services
House of Representatives

The Honorable Joe Wilson
House of Representatives

Appendix I: Scope and Methodology

For each of our objectives, we reviewed relevant F-35 sustainment and supply chain plans, program briefs, guidance, and other documentation and collected information by interviewing officials from the Office of the Secretary of Defense for Acquisition and Sustainment, the F-35 Joint Program Office, the U.S. Air Force, the U.S. Navy, the U.S. Marine Corps, and the prime contractor, Lockheed Martin. To interview officials and observe F-35 supply and maintenance operations, we conducted site visits to two F-35 operational locations—Hill Air Force Base, Utah, and Marine Corps Air Station Yuma, Arizona; and one training location—Luke Air Force Base, Arizona. We selected these locations to obtain perspectives from both operational and training units from multiple U.S. military services using different variants of the aircraft, and to gather insights of international partners co-located at these bases, among other factors. Additionally, we interviewed officials from the only overseas-based U.S. F-35 operational squadron at Marine Corps Air Station Iwakuni, Japan, by phone. A complete listing of organizations we contacted for this review is provided later in this appendix.

In support of our objectives, we gathered various data related to the F-35 supply chain, such as parts availability, repair, aircraft performance, and customer wait time data. We gathered data for fiscal year 2018 (October 2017 – September 2018) and available data from the F-35 program's 2018 sustainment contract period (May – November 2018) in order to provide the most recent information for F-35 fleet performance and overall supply chain management available during our audit timeframes. To determine the reliability of these data, we collected information on how the data were collected, managed, and used through a questionnaire and interviews with relevant DOD officials and the prime contractor. Although we identified some limitations in the way that certain data are being collected and reported—such as data related to aircraft performance, aircraft that are not mission capable due to a lack of parts, and parts cannibalization that could potentially result in inaccuracies—we determined that they are sufficiently reliable for the way in which we reported them and our purposes of providing information on the progress

and challenges within the program.¹ Specifically, the parts cannibalization rates that we discuss are sufficiently reliable to discuss generally in comparison to program objectives. All other supply chain and performance data presented in our report are sufficiently reliable to present as specific data points.

To assess the extent to which F-35 performance is meeting warfighter requirements and any challenges with spare parts availability, we reviewed DOD and contractor sustainment and supply chain plans, briefings, and reports, and interviewed Office of the Secretary of Defense, U.S. service, program office, and prime contractor officials to determine the degree to which the supply chain is currently able to provide parts to meet the U.S. services' requirements. In addition, we obtained data related to F-35 parts availability and aircraft performance data for May through November 2018 and compared these to the program's target and the U.S. services' requirements for these metrics to identify any gaps between requirements and actual performance. We also obtained data related to 3-month average part repair times and part repair backlogs as of November 2018—the most currently available data at the time of our review. In order to assess the extent to which the supply chain is positioned to meet future warfighter requirements, we examined program plans, briefs, and other related documentation, and we interviewed Office of the Secretary of Defense, U.S. service, program office, and prime contractor officials to identify the actions that DOD is taking to increase the availability of F-35 spare parts, DOD's projections for when these actions will result in improvements in F-35 aircraft performance, and ongoing areas of challenge that could create risk for the program in meeting future warfighter requirements. Finally, we used principles from the *Standards for Internal Control in the Federal Government*² and DOD guidance for performance-based arrangements related to how programs should be structured to meet requirements and respond to risk as a basis to determine whether DOD needs to take further actions to ensure that

¹Cannibalization in this context refers to the practice of removing parts that are necessary for repair of an aircraft from another aircraft, due to the limited supply of parts in the supply chain.

²[GAO-14-704G](#).

the F-35 supply chain is positioned to meet future warfighter requirements.³

To assess the extent to which DOD can effectively manage and move F-35 parts to support aircraft around the world, we reviewed military service and program briefings and data related to DOD's fiscal year 2018 F-35 operational deployments, and we interviewed service, program office, and contractor officials about how the F-35 supply chain and its global spares pool were able to support these deployments, including the extent to which the packages of parts that the military services purchased to support these deployments were built to meet their requirements. We reviewed DOD guidance related to managing risk in acquisition programs⁴ and the Navy's process and guidance for ensuring that the packages of parts for legacy aircraft are built to meet the requirements of deploying aircraft, and we assessed the F-35 program's processes for identifying and addressing risks related to the sufficiency of its deployment parts packages against these criteria.⁵

We also reviewed the F-35 program's business rules for allocating and prioritizing scarce F-35 assets and related documentation, and we interviewed officials from the Joint Staff, Office of the Secretary of Defense, the services, the program office, and the prime contractor to understand how the business rules are being applied and to identify any related F-35 program participant perspectives about or gaps in the rules. We also reviewed DOD guidance related to prioritizing materiel and parts to identify standard DOD policies for legacy aircraft,⁶ and *Standards for*

³Assistant Secretary of Defense for Logistics and Materiel Readiness, *PBL Guidebook: A Guide to Developing Performance-Based Arrangements* (2016). This guide is intended to provide users with guidance on best practices and processes to enable them to craft effective performance-based logistics arrangements.

⁴*Department of Defense Risk, Issue, and Opportunity Management Guide for Defense Acquisition Programs* (Jan. 9, 2017). This guide describes strategies and processes for risk, issue, and opportunity management that programs should begin early in program development and apply continuously throughout the acquisition life cycle.

⁵For example, Department of the Navy, NAVSUP Weapons Systems Support Instruction 4441.15L *Aviation Consolidated Allowance List* (June 26, 2017).

⁶DOD Manual 4140.01, Volume 8, *DoD Supply Chain Materiel Management Procedures: Materiel Data Management and Exchange* (Feb. 10, 2014)(incorporating Change 2, Aug. 31, 2018) implements policy for prioritizing parts and materiel, referred to within DOD as the uniform materiel movement and issue priority system standards. This guidance assigns responsibilities and provides procedures for DOD materiel managers who work within the DOD supply system.

Internal Control in the Federal Government, and we used these as a basis to assess whether the F-35 program's business rules for allocating scarce F-35 parts are sufficiently clear and comprehensive.⁷

In addition, we reviewed available plans, briefs, and other documentation to understand the F-35 program's envisioned global network for moving F-35 parts, the current state of the network, and the program's projections for full implementation of the network. Further, we obtained data from December 2017 through November 2018 related to customer wait times for parts to determine whether program participants located outside of the continental United States are waiting longer for parts than those located inside of the continental United States. We also interviewed officials from the program office, prime contractor, Office of the Secretary of Defense, the services, and U.S. Transportation Command to discuss the progress being made and challenges the program faces in developing the global network to move F-35 spare parts. Finally, we assessed DOD's plans for establishing its global network for moving parts against key acquisition program management practices that can improve program outcomes if implemented⁸ and DOD guidance related to managing risk in acquisition programs.⁹

To assess the extent to which DOD can account for F-35 spare parts within the supply chain and their associated costs, we reviewed program briefs, DOD guidance and the Federal Acquisition Regulation, and sustainment contracts and related documentation, and we interviewed program and contractor officials to determine how the program office is maintaining accountability for F-35 spare parts, to include roles and responsibilities for property accountability and any associated challenges. In addition, we reviewed draft guidance and program briefs and documentation, as well as interviewed officials from the program office, to identify the actions the program is taking to improve its ability to maintain accountability of parts in the F-35 program. We compared these efforts

⁷[GAO-14-704G](#).

⁸GAO, *Homeland Security: DHS Requires More Disciplined Investment Management to Help Meet Mission Needs*, [GAO-12-833](#) (Washington, D.C.: Sept. 18, 2012). This report examining the Department of Homeland Security's major acquisition programs identifies key program and portfolio management practices drawn from GAO's prior reviews of programs at the Department of Homeland Security, Department of Defense, National Aeronautics and Space Administration, and private organizations.

⁹*Department of Defense Risk, Issue, and Opportunity Management Guide for Defense Acquisition Programs* (Jan. 9, 2017).

against criteria in DOD guidance for property accountability¹⁰ and *Standards for Internal Control in the Federal Government* to assess whether the program's current efforts to obtain and maintain accountability for F-35 spare parts are sufficient to bring the program into alignment with DOD guidance, and whether any additional actions are needed.¹¹

To assess the extent to which DOD is maintaining accountability over costs associated with F-35 spare parts, we reviewed program plans and documentation related to the construct of the global spares pool. We also reviewed sustainment contracts and supplemental contract documentation, and we interviewed officials from the program office, Office of the Secretary of Defense, and Defense Contract Management Agency to determine what information DOD has been able to obtain about the quantity and cost of F-35 spare parts and the approaches that DOD uses to collect such information. Additionally, we identified criteria within DOD guidance for performance-based arrangements¹² and the DOD Financial Management Regulation to serve as a basis to assess whether the program office's approach for obtaining cost information is sufficient to support program and financial management requirements.¹³ We also reviewed DOD and program office documentation and spoke with officials from the program office and the Office of the Under Secretary of Defense (Comptroller) to determine the extent to which the program office has developed a methodology to track the funds paid by the U.S. military services for F-35 parts to the actual parts within the global spares pool. Finally, we used the DOD Financial Management Regulation as a basis to assess whether the program has the ability to

¹⁰DOD Manual 4140.01, Volume 11, *DOD Supply Chain Materiel Management Procedures: Inventory Accountability and Special Management and Handling* (March 8, 2017). DOD Instruction 5000.64, *Accountability and Management of DOD Equipment and Other Accountable Property*, (Apr. 27, 2017)(incorporating Change 2, Aug. 31, 2018). This guidance collectively provides guidelines for maintaining accountability of government owned property.

¹¹[GAO-14-704G](#).

¹²Assistant Secretary of Defense for Logistics and Materiel Readiness, *PBL Guidebook: A Guide to Developing Performance-Based Arrangements* (2016).

¹³DOD 7000.14-R, *Department of Defense Financial Management Regulations, Volume 4: Accounting Policy* (January 2016).

adequately track funds paid by the U.S. military services for F-35 spare parts to the actual parts within the global pool to support financial audits.¹⁴

To assess the extent to which actions DOD is taking to address supply chain challenges are consistent with the established F-35 program sustainment strategy, we reviewed key F-35 program strategy, planning, and structure documents—such as the 2016 and 2018 F-35 Acquisition Strategies, the Life-Cycle Sustainment Plan, and program office organizational structures—and F-35 sustainment contracts to determine the program's formal strategy and structure for F-35 supply chain management. We also reviewed documentation related to DOD's efforts to develop an option for DOD-management of the F-35 supply chain, such as data requests and a memorandum, and we interviewed officials from the Office of the Secretary of Defense for Acquisition and Sustainment, Defense Logistics Agency, military service sustainment commands, the program office, and the prime contractor to understand the extent to which DOD is pursuing a DOD-managed F-35 supply chain, whether these efforts are aligned with the established F-35 program strategy, and the effects of such actions on the program office's ability to execute F-35 sustainment with the prime contractor, Lockheed Martin. In addition, we assessed DOD's efforts to establish a DOD-managed option for supply chain management against principles from DOD planning guidance¹⁵ and *Standards for Internal Control in the Federal Government* for defining objectives and clearly aligning actions and resources to meet those objectives.¹⁶

Department of Defense and Other Organizations with Whom GAO Conducted Interviews

In support of our work, we interviewed officials from the following DOD organizations and other organizations during our review. We selected these organizations based on their oversight, planning, and execution roles related to F-35 sustainment, supply chain management, and operations.

¹⁴DOD 7000.14-R, *Department of Defense Financial Management Regulations, Volume 4: Accounting Policy* (January 2016).

¹⁵Defense Acquisition University, *A Guide for DOD Program Managers* (December 2014). This guide is written for DOD acquisition program managers, with the intent of providing them with the foundational principles necessary to run efficient and effective programs.

¹⁶[GAO-14-704G](#).

DOD Organizations

- Office of the Secretary of Defense, Acquisition and Sustainment
 - Office of the Assistant Secretary of Defense for Sustainment
 - Office of the Deputy Assistant Secretary of Defense for Materiel Readiness
 - Office of the Deputy Assistant Secretary of Defense for Logistics
 - Logistics Reform Team
 - International Cooperation Directorate
 - Defense Pricing and Contracting Directorate
- Office of the Under Secretary of Defense (Comptroller)
- Director of Cost Assessment and Program Evaluation
- F-35 Joint Program Office
- Defense Contract Management Agency
 - Defense Contract Management Agency Lockheed Martin Fort Worth
 - Defense Contract Management Agency Aircraft Propulsion Office – Pratt & Whitney
- Joint Staff, Logistics Directorate
- Defense Logistics Agency
- U.S. Transportation Command
- U.S. Air Force
 - Headquarters, Air Force
 - Air Force F-35 Integration Office
 - Air Combat Command
 - Air Education and Training Command
 - Air Force Materiel Command
 - Air Force Sustainment Center
 - Hill Air Force Base
 - 388th Fighter Wing
 - 388th Maintenance Group

- 34th Aircraft Maintenance Unit
- Luke Air Force Base
 - 56th Fighter Wing
 - 56th Maintenance Group
 - 61st Aircraft Maintenance Unit
 - 62nd Aircraft Maintenance Unit
 - 63rd Aircraft Maintenance Unit
- U.S. Navy
 - Office of the Chief of Naval Operations
 - U.S. Navy Joint Strike Fighter Fleet Integration Office
 - U.S. Naval Supply Systems Command, Weapon Systems Support
- U.S. Marine Corps
 - Headquarters Marine Corps, Deputy Commandant for Aviation, Logistics Support Branch
 - Marine Corps Air Station Yuma
 - Marine Aircraft Group 13
 - Marine Aviation Logistics Squadron 13
 - Marine Fighter Attack Squadron 211
 - Marine Corps Air Station Iwakuni
 - Marine Aircraft Group 12
 - Marine Aviation Logistics Squadron 12
 - Marine Fighter Attack Squadron 121

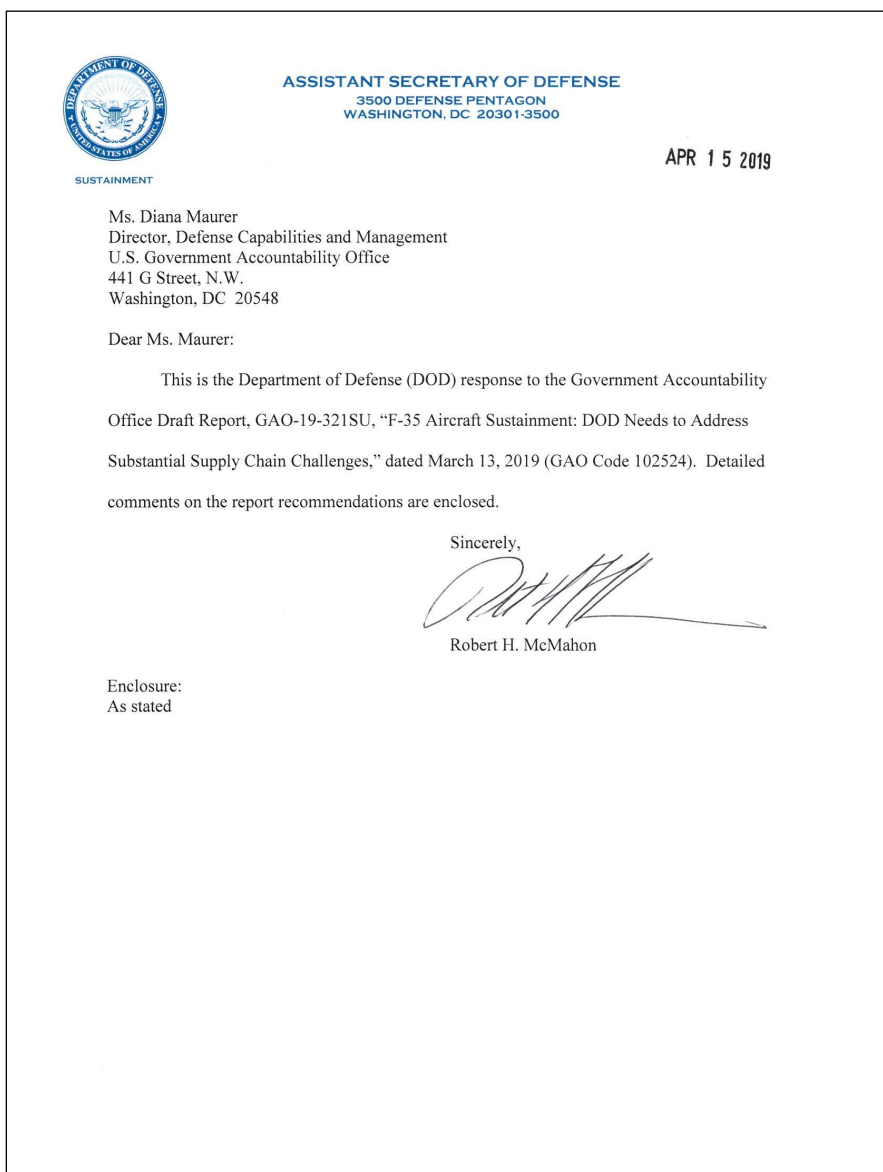
Contractor and Other Organizations

- Lockheed Martin Aeronautics
- Pratt & Whitney
- United Kingdom Ministry of Defence

We conducted this performance audit from January 2018 to April 2019 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.

Appendix II: Comments from the Department of Defense



GAO-19-321SU APRIL 2019 DRAFT REPORT

**“F-35 AIRCRAFT SUSTAINMENT - DOD NEEDS TO ADDRESS SUBSTANTIAL
SUPPLY CHAIN CHALLENGES”**

**DEPARTMENT OF DEFENSE COMMENTS
TO THE GAO RECOMMENDATIONS**

Recommendations for Executive Action

GAO is making the following eight recommendations to DOD.

RECOMMENDATION 1: 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, conduct 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.

DOD RESPONSE: Concur. DOD is addressing the recommendation by incorporating the actions in the recently signed Life Cycle Logistics Plan (LCSP) dated January 31, 2019, which involved a comprehensive review of warfighter gaps and the detailed Program of Actions and Milestones required to close them. Additionally, and in conjunction with the LCSP targeted actions a review occurred while assessing the F-35 Program’s ability to achieve the Secretary of Defense’s mandated readiness requirement of 80 percent mission capable rates for combat coded aircraft (MC80). In devising the plan to achieve MC80 readiness goals, the DOD considered performance against affordability. The availability of critical components will help the F-35 meet the warfighter’s performance requirements and facilitate the iterative adjustments to quantities of parts in the supply chain to ensure requirements can be met across the life of the weapon system.

RECOMMENDATION 2: 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, develop 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.

DOD RESPONSE: Concur. DOD agrees that an agile process to modify spares packages is needed and is currently developing that process, with the assistance of the Services. The initial phase of the plan is scheduled for completion in August 2020 with follow-on tasks based upon Services’ requirements, funding request determinations, demand analysis and subsequent spare parts rebalancing.

RECOMMENDATION 3: 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, ensure that the revisions to the business rules for the prioritization of scarce F-35 parts across all program participants 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.

DOD RESPONSE: Concur. DOD agrees that business rules for the prioritization of scarce F-35 parts need to be revised to clearly define roles and responsibilities, assigning force activity designations, and deviations. Business Rule #34, Management of Scarce Assets, has been rewritten to address these concerns and is being routed through DOD governance process for approval, which includes the Services and Partner Nations. ECD: July 31, 2019

RECOMMENDATION 4: The Secretary of Defense should ensure that the Under Secretary of Defense for Acquisition and Sustainment, together with the F-35 Program Executive Officer, complete 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.

DOD RESPONSE: Concur. On January 31, 2019, the DOD finalized development of the F-35 Program's Global Asset Management (GAM) Strategy that clearly defined the concept of operations for the multi-directional movement of parts throughout the F-35 Enterprise. In order to accomplish a task of this magnitude on December 21, 2018, DOD selected the Defense Logistics Agency and United States Transportation Command to provide supply chain management functions of the F-35 Global Transportation and Distribution and North American Regional Warehousing. The F-35 Program Office met with OSD Office of General Council (OSD/OGC) on March 27, 2019, in an effort to synchronize efforts in relation to international agreements that would optimize the F-35 GAM Strategy. No later than the end of the 4th Quarter of Fiscal Year 2019, the F-35 Program Office will host Partner Nation and FMS customer subject matter experts, OSD OGC, and Department of State for an F-35 Taxes, Tariffs, Duties and Customs (TTD&C) Forum. Partner and FMS Country SMEs will be represented from Ministries of Finance (vs Ministries of Defense) or other Partner Country Agencies which are the decision makers on TTD&C. Initial deliverables will be to account for what each Country is charging (anticipates charging) for TTD&C for F-35 Sustainment Assets, what the TTD&C elements are, and how the TTD&C are assessed. This information will inform development of Courses of Action, timelines and a recommendation regarding GAM for F-35 Product Support Manager approval. ECD: September 30, 2019

RECOMMENDATION 5: The Secretary of Defense should ensure that the Under Secretary of Defense for Acquisition and Sustainment, together with the F-35 Program Executive Officer, issue 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 DOD will implement DOD regulations, and define prime contractor roles and responsibilities.

DOD RESPONSE: Concur. DOD will ensure proper accountability of all parts within the supply chain, per regulatory requirements. This will be achieved by having the contractor provide the required cost and related data and load the information in the Accountable Property System of Record (APSR). The F-35 Program Office will verify contractor data prior to uploading and the DOD will maintain accountability over the APSR once the initial accountable record is established. The APSR will have interfaces that will allow the F-35 Program to have proper accountability of assets per DODI 5000.64, DODM 4140.01 and other applicable regulations, while making sure the contractor is adhering to contractual requirements for the management and reporting of all parts (i.e. GFP and CPE). The APSR will provide the F-35 Program Office with the ability to categorize the assets and maintain visibility throughout the life cycle to include disposition. The F-35 Program Office will develop and publish a Program Instruction that will define roles and responsibilities for all the stakeholders (property owners and custodians) based on DOD regulations.

RECOMMENDATION 6: The Secretary of Defense should ensure that the Under Secretary of Defense for Acquisition and Sustainment, together with the F-35 Program Executive Officer, develop a methodical approach to consistently obtain comprehensive cost information from the prime contractor for F-35 spare parts within the supply chain.

DOD RESPONSE: Concur. The Joint Strike Fighter's Affordability Strategy addresses Price Verification as a goal and DOD is in the process of implementing a Price Verification program. Additionally, the F-35 Program Office has developed a framework for the contractor to provide all data associated with supply chain assets to include cost. ECD: September 30, 2019

RECOMMENDATION 7: 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, complete and formalize 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.

DOD RESPONSE: Concur. The F-35 Program agrees that a formalized, Comptroller-approved methodology must be established for the transparent and accurate reporting of the F-35 global spares pool on the appropriate financial statements. The Department of Defense Comptroller, with collaboration from the Services and the F-35 Program developed the Transfer of Pooled Assets Methodology as a candidate accounting construct under which the F-35 Program would become the single financial reporting entity for F-35 pooled assets, thus removing the need to allocate "shares" of the pool to the Services and participants. Prior to endorsement and implementation of this methodology, the Department of Defense Comptroller is assessing whether the Department of Navy or the U.S. Air Force would provide a more streamlined financial accountability of the F-35 spare parts in the global spares pool. F-35 Program Office's on-going implementation of the Defense Property Accountability System (DPAS) as the F-35 GSP APSR will support the financial statement reporting and auditing. ECD: September 30, 2019

RECOMMENDATION 8: 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 define the strategy by which DOD will manage the F-35 supply chain in the future and update key strategy documents accordingly, to include any additional actions and investments necessary to support that strategy.

DOD RESPONSE: Concur. The F-35 program's recently approved acquisition strategy, dated July 18, 2018, includes strategic sourcing and introduction of competition to be sourced by a world-wide marketplace of providers such as Defense Logistics Agency, Naval Supply Systems Command, Fleet Readiness Center, Air Force Material Command, United States Transportation Command, and other providers. The LCSP will be updated to further define the F-35 supply chain strategy in the future. On December 21, 2018, DOD selected the Defense Logistics Agency and United States Transportation Command to provide supply chain management functions of the F-35 Global Transportation and Distribution and North American Regional Warehousing. This selection is an enabler of the F-35 global sustainment strategy and will facilitate the movement of material around the world through a single integrator.

Appendix III: GAO Contact and Staff Acknowledgments

GAO Contact

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

Staff Acknowledgments

In addition to the contact named above, Alissa Czyz (Assistant Director), Vincent Buquicchio, Kasea Hamar, Amie Lesser, Sean Manzano, Michael Silver, Tristan T. To, and Cheryl Weissman made key contributions to this report.

Appendix IV: Accessible Data

Agency Comment Letter

Text of Appendix II: Comments from the Department of Defense

Page 1

Ms. Diana Maurer

Director, Defense Capabilities and Management

U.S. Government Accountability Office 441 G Street, N.W.

Washington, DC 20548 Dear Ms. Maurer:

This is the Department of Defense (DOD) response to the Government Accountability Office Draft Report, GAO-19-321SU , "F-35 Aircraft Sustainment: DOD Needs to Address Substantial Supply Chain Challenges," dated March 13, 2019 (GAO Code 102524). Detailed comments on the report recommendations are enclosed.

Robert H. McMahon

Enclosure:

As stated

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GAO-19-321SU APRIL 2019 DRAFT REPORT

"F-35 AIRCRAFT SUSTAINMENT - DOD NEEDS TO ADDRESS
SUBSTANTIAL SUPPLY CHAIN CHALLENGES"

DEPARTMENT OF DEFENSE COMMENTS TO THE GAO
RECOMMENDATIONS

Recommendations for Executive Action

GAO is making the following eight recommendations to DOD.

RECOMMENDATION 1:

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, conduct 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.

DOD RESPONSE: Concur.

DOD is addressing the recommendation by incorporating the actions in the recently signed Life Cycle Logistics Plan (LCSP) dated January 31, 2019, which involved a comprehensive review of warfighter gaps and the detailed Program of Actions and Milestones required to close them. Additionally, and in conjunction with the LCSP targeted actions a review occurred while assessing the F-35 Program's ability to achieve the Secretary of Defense's mandated readiness requirement of 80 percent mission capable rates for combat coded aircraft (MC80). In devising the plan to achieve MC80 readiness goals, the DOD considered performance against affordability. The availability of critical components will help the F-35 meet the warfighter's performance requirements and facilitate the iterative adjustments to quantities of parts in the supply chain to ensure requirements can be met across the life of the weapon system.

RECOMMENDATION 2:

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, develop 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.

DOD RESPONSE: Concur.

DOD agrees that an agile process to modify spares packages is needed and is currently developing that process, with the assistance of the Services. The initial phase of the plan is scheduled for completion in August 2020 with follow-on tasks based upon Services' requirements, funding request determinations, demand analysis and subsequent spare parts rebalancing.

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RECOMMENDATION 3:

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, ensure that the revisions to the business rules for the prioritization of scarce F-35 parts across all program participants 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.

DOD RESPONSE: Concur.

DOD agrees that business rules for the prioritization of scarce F-35 parts need to be revised to clearly define roles and responsibilities, assigning force activity designations, and deviations. Business Rule #34, Management of Scarce Assets, has been rewritten to address these concerns and is being routed through DOD governance process for approval, which includes the Services and Partner Nations. ECD: July 31, 2019

RECOMMENDATION 4:

The Secretary of Defense should ensure that the Under Secretary of Defense for Acquisition and Sustainment, together with the F-35 Program Executive Officer, complete 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.

DOD RESPONSE: Concur.

On January 31, 2019, the DOD finalized development of the F-35 Program's Global Asset Management (GAM) Strategy that clearly defined the concept of operations for the multi-directional movement of parts throughout the F-35 Enterprise. In order to accomplish a task of this magnitude on December 21, 2018, DOD selected the Defense Logistics Agency and United States Transportation Command to provide supply chain management functions of the F-35 Global Transportation and Distribution and North American Regional Warehousing. The F-35 Program Office met with OSD Office of General Council (OSD/OGC) on March 27, 2019, in an effort to synchronize efforts in relation to international agreements that would optimize the F-35 GAM Strategy. No later than the end of the 4th Quarter of Fiscal Year 2019, the F-35 Program Office will host Partner Nation and FMS customer subject matter experts, OSD OGC, and Department of State for an F-35 Taxes, Tariffs, Duties and Customs (TTD&C) Forum. Partner and FMS Country SMEs will be represented from Ministries of Finance (vs Ministries of Defense) or other Partner Country Agencies which are the decision makers on TTD&C. Initial deliverables will be to account for what each Country is charging (anticipates charging) for TTD&C for F-35 Sustainment Assets, what the TTD&C elements are, and how the TTD&C are assessed. This information will inform development of Courses of Action, timelines and a recommendation regarding GAM for F-35 Product Support Manager approval. ECD: September 30, 2019

RECOMMENDATION 5:

The Secretary of Defense should ensure that the Under Secretary of Defense for Acquisition and Sustainment, together with the F-35 Program Executive Officer, issue 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

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DOD RESPONSE: Concur.

DOD will ensure proper accountability of all parts within the supply chain, per regulatory requirements. This will be achieved by having the

contractor provide the required cost and related data and load the information in the Accountable Property System of Record (APSR). The F-35 Program Office will verify contractor data prior to uploading and the DOD will maintain accountability over the ASPR once the initial accountable record is established. The APSR will have interfaces that will allow the F-35 Program to have proper accountability of assets per DODI 5000.64, DODM 4140.01 and other applicable regulations, while making sure the contractor is adhering to contractual requirements for the management and reporting of all parts (i.e. GFP and CPE). The APSR will provide the F-35 Program Office with the ability to categorize the assets and maintain visibility throughout the life cycle to include disposition. The F-35 Program Office will develop and publish a Program Instruction that will define roles and responsibilities for all the stakeholders (property owners and custodians) based on DOD regulations.

RECOMMENDATION 6:

The Secretary of Defense should ensure that the Under Secretary of Defense for Acquisition and Sustainment, together with the F-35 Program Executive Officer, develop a methodical approach to consistently obtain comprehensive cost information from the prime contractor for F-35 spare parts within the supply chain.

DOD RESPONSE: Concur.

The Joint Strike Fighter's Affordability Strategy addresses Price Verification as a goal and DOD is in the process of implementing a Price Verification program. Additionally, the F-35 Program Office has developed a framework for the contractor to provide all data associated with supply chain assets to include cost. ECD: September 30, 2019

RECOMMENDATION 7:

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, complete and formalize 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.

DOD RESPONSE: Concur.

The F-35 Program agrees that a formalized, Comptroller-approved methodology must be established for the transparent and accurate reporting of the F-35 global spares pool on the appropriate financial statements. The Department of Defense Comptroller, with collaboration from the Services and the F-35 Program developed the Transfer of Pooled Assets Methodology as a candidate accounting construct under which the F-35 Program would become the single financial reporting entity for F-35 pooled assets, thus removing the need to allocate “shares” of the pool to the Services and participants. Prior to endorsement and implementation of this methodology, the Department of Defense Comptroller is assessing whether the Department of Navy or the U.S. Air Force would provide a more streamlined financial accountability of the F-35 spare parts in the global spares pool. F-35 Program Office’s on-going implementation of the Defense Property Accountability System (DPAS) as the F-35 GSP APSR will support the financial statement reporting and auditing. ECD: September 30, 2019

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RECOMMENDATION 8:

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 define the strategy by which DOD will manage the F-35 supply chain in the future and update key strategy documents accordingly, to include any additional actions and investments necessary to support that strategy.

DOD RESPONSE: Concur.

The F-35 program’s recently approved acquisition strategy, dated July 18, 2018, includes strategic sourcing and introduction of competition to be sourced by a world-wide marketplace of providers such as Defense Logistics Agency, Naval Supply Systems Command, Fleet Readiness Center, Air Force Material Command, United States Transportation Command, and other providers. The LCSP will be updated to further define the F-35 supply chain strategy in the future. On December 21, 2018, DOD selected the Defense Logistics Agency and United States Transportation Command to provide supply chain management functions of the F-35 Global Transportation and Distribution and North American

Regional Warehousing. This selection is an enabler of the F-35 global sustainment strategy and will facilitate the movement of material around the world through a single integrator.

Data Tables

Data Table for highlights figure, Figure: F-35 Fleet Aircraft Performance, May 2018—November 2018

category	Results	Goal
Full Mission Capable	27%	60%
Mission Capable	52%	75%

Data Table for Figure 1: Timeline of Anticipated Worldwide F-35 Fleet Growth and Site Activations

Year	Number of F-35s
2017	266
2018	360
2019	501
2020	658
2021	826
2022	979
2023	1148
2024	3359

Data Table for Figure 4: F-35 Aircraft Fleet Performance by Variant, May—November 2018

Variant	Performance
AVA	47
FMC	34
MC	52
AVA	46
FMC	16
MC	50
AVA	36
FMC	2
MC	50

Data Table for Figure 5: F-35 Aircraft Unable to Fly Due to Parts Shortages, May—November 2018

Month	Aircraft unable to fly	Target
May	25.6	10
June	24.8	10
July	29.5	10
Aug.	31.3	10
Sept.	30.4	10
Oct.	37	10
Nov.	29	10

Data Table for Figure 6: Average Time for Depot-level Repair of an F-35 Aircraft Part as Compared with the Program's Objective

Program objective: 60-90 days

Average repair time: 188 days

Note: Backlog of approximately 4,300 parts

Data Table for Figure 7: F-35 Aircraft Performance for Early Production Aircraft and Later Production Aircraft, May—November 2018

Phase	Early production aircraft	Later production aircraft	Warfighter's minimum target
Air vehicle availability	31	52	65
Full mission capable	7	35	60
Mission capable	36	58	75

Data Table for Figure 8: Supply and Maintenance Factors Contributing to Aircraft Mission Capability Rates

- Actual Fleet Performance. May 2018 through Nov. 2018, 52% mission capable.
- Secretary of Defense target for F-35 fleet performance: 80% mission capable.
- Potential F-35 fleet performance given supply and maintenance planning factors: 70% mission capable

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