A Program Name
Name and lead military service for the aircraft.

B Program Essentials and Fiscal Year 2019 Data
Programmatic information, including manufacturer, approach to sustainment, key fiscal year 2019 data, depot maintenance activity and squadron locations, and sustainment challenges and mitigation actions.

C Background
A description of the aircraft and its life cycle.

D Overview
Brief summary of mission capable rates and operating and support (O&S) costs for the aircraft.

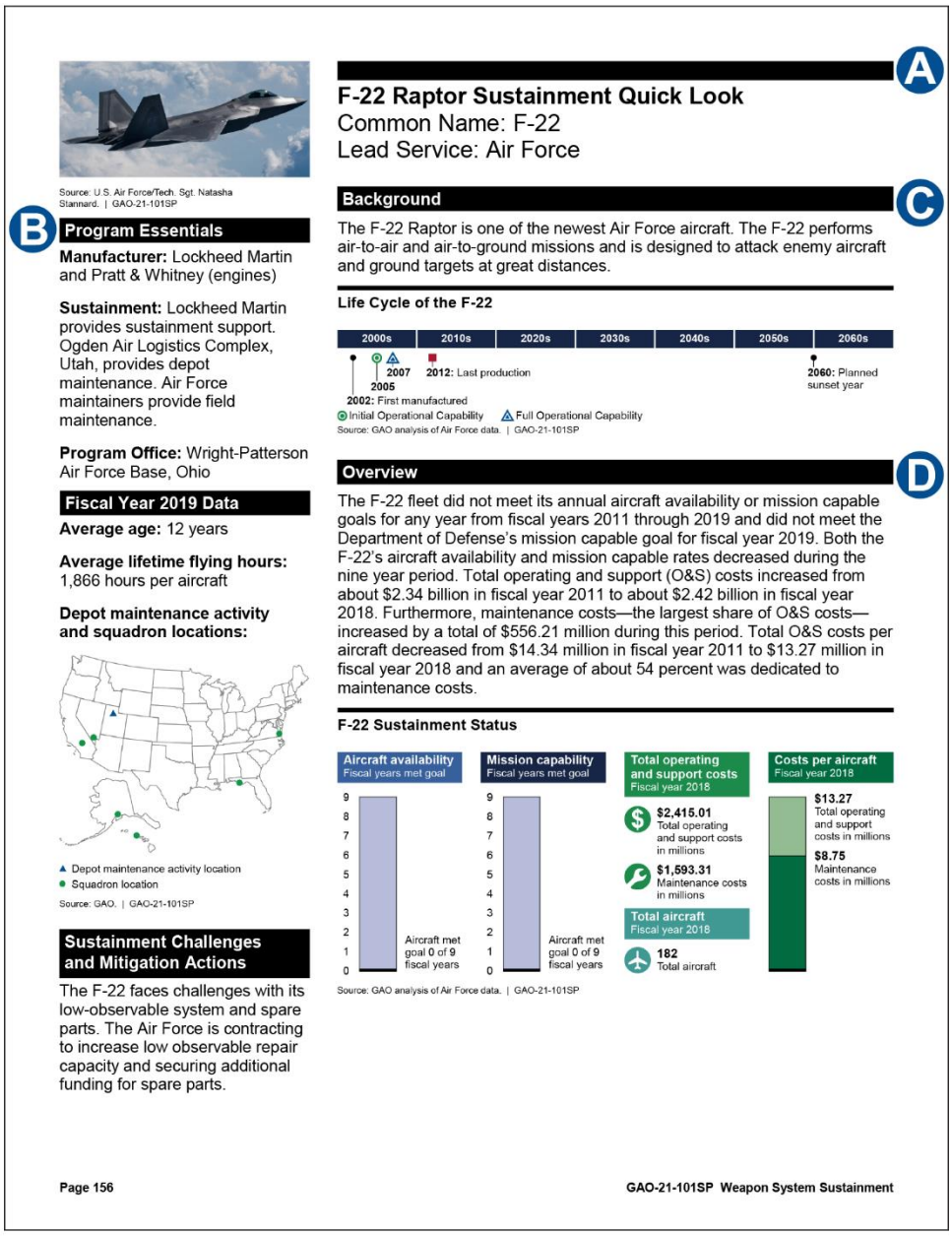
Sustainment Strategy

- Information on the approach used to sustain the aircraft by the military service.

Availability and Condition

- Information on mission capable and not mission capable rate trends for fiscal years 2011 through 2019.

Source: U.S. Air Force/Nicholas Pilch. | GAO-21-101SP



Source: U.S. Air Force/Tech. Sgt. Natasha Stannard. | GAO-21-101SP

F-22 Raptor Sustainment Quick Look
Common Name: F-22
Lead Service: Air Force

Program Essentials

Manufacturer: Lockheed Martin and Pratt & Whitney (engines)

Sustainment: Lockheed Martin provides sustainment support. Ogden Air Logistics Complex, Utah, provides depot maintenance. Air Force maintainers provide field maintenance.

Program Office: Wright-Patterson Air Force Base, Ohio

Fiscal Year 2019 Data

Average age: 12 years

Average lifetime flying hours: 1,866 hours per aircraft

Depot maintenance activity and squadron locations:

▲ Depot maintenance activity location
● Squadron location

Source: GAO. | GAO-21-101SP

Sustainment Challenges and Mitigation Actions

The F-22 faces challenges with its low-observable system and spare parts. The Air Force is contracting to increase low observable repair capacity and securing additional funding for spare parts.

Background

The F-22 Raptor is one of the newest Air Force aircraft. The F-22 performs air-to-air and air-to-ground missions and is designed to attack enemy aircraft and ground targets at great distances.

Life Cycle of the F-22

2000s | 2010s | 2020s | 2030s | 2040s | 2050s | 2060s

2002: First manufactured
2005
2007
2012: Last production
2060: Planned sunset year

Initial Operational Capability ▲ Full Operational Capability

Source: GAO analysis of Air Force data. | GAO-21-101SP

Overview

The F-22 fleet did not meet its annual aircraft availability or mission capable goals for any year from fiscal years 2011 through 2019 and did not meet the Department of Defense's mission capable goal for fiscal year 2019. Both the F-22's aircraft availability and mission capable rates decreased during the nine year period. Total operating and support (O&S) costs increased from about $2.34 billion in fiscal year 2011 to about $2.42 billion in fiscal year 2018. Furthermore, maintenance costs—the largest share of O&S costs—increased by a total of $556.21 million during this period. Total O&S costs per aircraft decreased from $14.34 million in fiscal year 2011 to $13.27 million in fiscal year 2018 and an average of about 54 percent was dedicated to maintenance costs.

F-22 Sustainment Status

Aircraft availability — Fiscal years met goal: Aircraft met goal 0 of 9 fiscal years
Mission capability — Fiscal years met goal: Aircraft met goal 0 of 9 fiscal years
Total operating and support costs — Fiscal year 2018: $2,415.01 Total operating and support costs in millions; $1,593.31 Maintenance costs in millions
Total aircraft — Fiscal year 2018: 182 Total aircraft
Costs per aircraft — Fiscal year 2018: $13.27 Total operating and support costs in millions; $8.75 Maintenance costs in millions

Source: GAO analysis of Air Force data. | GAO-21-101SP

Page 156 GAO-21-101SP Weapon System Sustainment

Operating and Support Costs

- Total O&S costs trends for the aircraft for fiscal years 2011 through 2018.[a]
- O&S cost per aircraft and the size of the inventory for the aircraft.

Challenges and Mitigation Actions

- Descriptive information on the sustainment challenges, such as supply support and maintenance, for the aircraft as well as mitigation actions being taken by the program office.

Program Office Comments

- General comments provided by the cognizant program office.

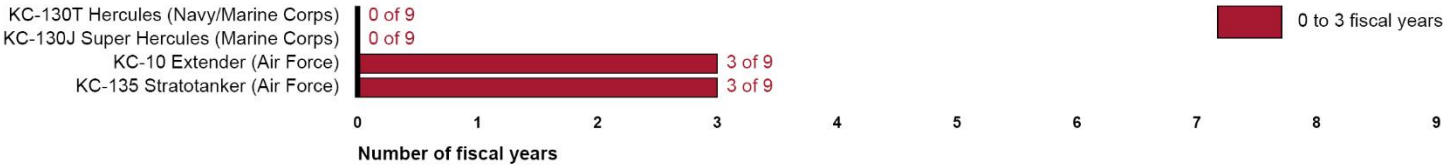
[a]We obtained fiscal year 2018 operating and support (O&S) cost data from the Army, but we learned from the Army that the data were inaccurate. Thus, the costs presented here for the Army aircraft are based on fiscal year 2017 O&S data.

Air refueling aircraft

KC-10 Extender

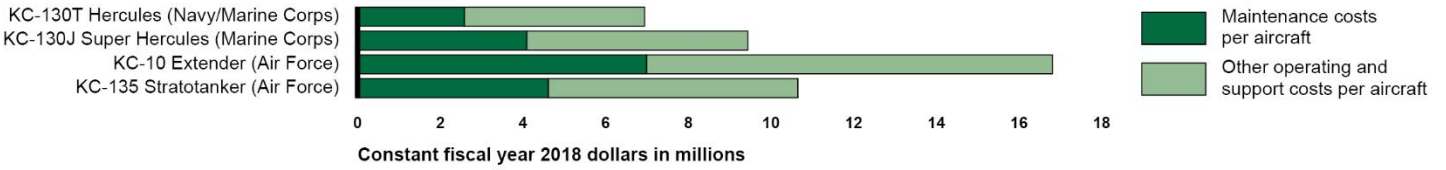
Source: U.S. Air Force/Heide Couch. | GAO-21-101SP

Number of Times Selected Air Refueling Aircraft Met Their Annual Mission Capable Goal, Fiscal Years 2011 through 2019



Source: GAO analysis of Navy and Air Force data. | GAO-21-101SP

Operating and Support Costs per Aircraft for Selected Department of Defense Air Refueling Aircraft, Fiscal Year 2018



Source: GAO analysis of Navy and Air Force data. | GAO-21-101SP

Source: U.S. Marine Corps/Cpl. Timothy Norris. | GAO-21-101SP

KC-130T Sustainment Quick Look

Common Name: KC-130T

Lead Services: Navy and Marine Corps

Program Essentials

Manufacturer: Lockheed Martin

Sustainment: Depot maintenance conducted at Air Logistic Complex at Ogden, Utah and field maintenance conducted by Navy maintainers

Program Office: Program Manager – Air 207, Naval Air Systems Command, Patuxent River, Maryland

Fiscal Year 2019 Data

Average age: 29.68 years

Average lifetime flying hours: 9,193 hours per aircraft

Depot maintenance activity and squadron locations:

▲ Depot maintenance activity location

● Squadron location

Source: GAO. | GAO-21-101SP

Sustainment Challenges and Mitigation Actions

The KC-130T is an aging aircraft with both maintenance and supply challenges. Planned actions to mitigate these challenges include modernization initiatives to upgrade the aircraft and an obsolescence program to procure hardware and software components.

Background

The KC-130T provides tactical transport of troops and cargo, air-to-air refueling, aerial delivery, emergency re-supply into or medical evacuation from unimproved landing zones, emergency evacuation of personnel and key equipment, battlefield illumination, multisensor image reconnaissance and close air support. Lockheed Martin first manufactured the aircraft in 1982 and the Navy and Marine Corps plan on operating it beyond 2060.

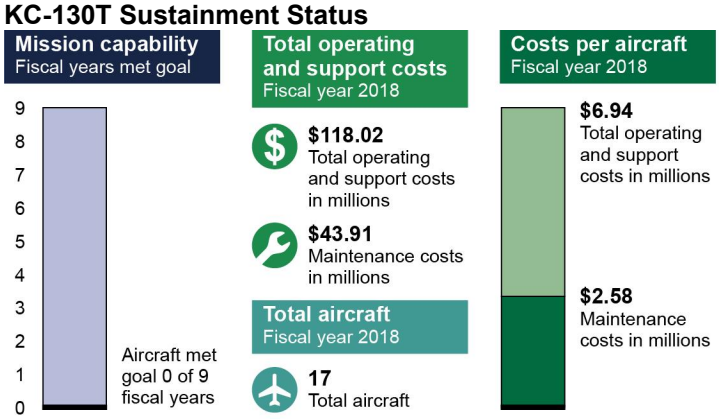
Life Cycle of the KC-130T

Source: GAO analysis of Navy data. | GAO-21-101SP

Overview

The KC-130T fleet did not meet its annual mission capable goals from fiscal years 2011-2019 and its mission capable rate decreased during the time period. According to program officials, the mission capable rate decreased mostly due to issues concerning its propellers, which resulted in a fatal accident in fiscal year 2017. Total operating and support (O&S) costs also decreased from about $154.26 million in fiscal year 2011 to about $118.02 million in fiscal year 2018. Specifically, costs for unit-level manpower, unit operations, and maintenance decreased because, according to officials, of reductions in the KC-130T aircraft inventory. In fiscal year 2018, maintenance costs per aircraft accounted for more than one-third of the total O&S costs per aircraft.

KC-130T Sustainment Status



Source: GAO analysis of Navy data. | GAO-21-101SP

Data table for KC-130T Sustainment Status

Mission capability	Aircraft met goal 0 of 9 fiscal years
Total operating and support costs in millions (FY18)	$118.02
Maintenance costs in millions (FY18)	$43.91
Total aircraft (FY18)	17
Total operating and support costs per aircraft in millions (FY18)	$6.94
Maintenance costs per aircraft in millions	$2.58

Sustainment Strategy

- The KC-130T is a variant of the C-130 airframe. Both systems have similar hardware and software configurations and share costs for development of common capabilities and a common product support infrastructure. Depot maintenance for the KC-130T is conducted at Air Logistics Complex at Ogden, Utah, and Navy and Marine Corps personnel conduct field maintenance on the KC-130T.
- In a statement to Congress, the Navy stated that the KC-130T modernization initiatives include upgrading the propeller system by replacing the legacy four-blade system with an eight-blade, high-thrust composite blade system, among other initiatives. The Navy anticipates that all aircraft will be fully modified by the end of fiscal year 2020. The Navy is also modernizing the KC-130T brake system with carbon brakes designed to provide enhanced safety and maintainability at a reduced weight over the current steel brake assemblies. The Navy's initiatives will reduce maintenance, sustainment, and fuel costs. The Navy plans to complete the installation of the modernized brake system by the end of fiscal year 2020. Additionally, according to officials, they are planning to replace the center wing box beginning in 2025 to extend the service of the aircraft beyond 2060.
- In 2018, the Navy implemented an Avionics Obsolescence Upgrade Program for the C-130T, which, according to program officials, could also benefit the KC-130T. Specifically, Navy and Marine Corps officials told us that obsolete parts from the C-130T modifications will be used to support the KC-130T, as the program office continues to pursue funding for KC-130T modifications. The Navy's Avionics Obsolescence Upgrade program also incorporates multiple aircraft improvements to increase aircrew and passenger safety, such as an improved aircraft avoidance and awareness system and a digital flight data recorder.

Availability and Condition

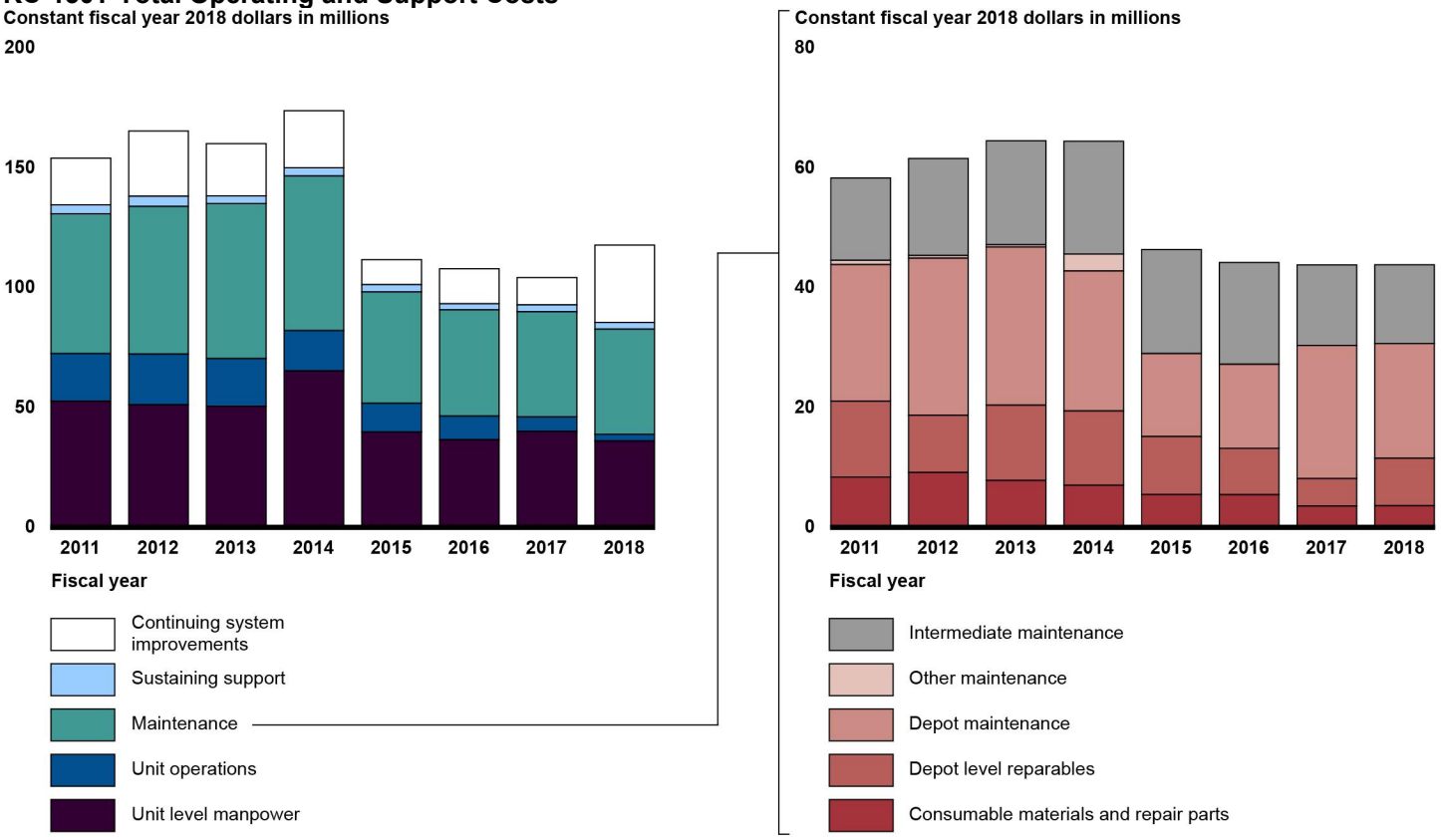
From fiscal year 2011 through fiscal year 2019, the KC-130T fleet fell short of its mission capable goals each year and the mission capable rate decreased during the nine-year time period. According to officials, the Navy grounded the fleet in fiscal year 2017 after a fatal accident caused by a propeller malfunction. To expedite the fleet returning to flight, the Air Force, which is the source of supply for propellers for the family of C-130 aircraft, prioritized propellers needed for Navy and Marine Corps aircraft. This helped to increase the mission capable rate at the end of fiscal year 2018 and through fiscal year 2019.

From fiscal year 2011 through fiscal year 2019, the KC-130T's not mission capable maintenance (NMCM) and not mission capable supply rates generally increased. According to officials, aircraft awaiting delivery of new propellers were a contributing factor to the rate increases after a fiscal year 2017 fatal accident, caused by a propeller malfunction. As new propellers were delivered, the NMCM rate decreased. Specific details on mission capable and not mission capable rates were omitted because the information was deemed by DOD to be sensitive.

Operating and Support Costs

From fiscal year 2011 through fiscal year 2018, the KC-130T's total O&S costs generally decreased from about $154.26 million to about $118.02 million. Maintenance costs, which also decreased during this period, accounted for the largest share of O&S costs, averaging about $53.46 million per year, or 39 percent of total O&S costs. According to officials, these decreases can be attributed to a reduction in aircraft inventory—from 28 in fiscal year 2011 to 17 in fiscal year 2018. Depot maintenance was the most significant category of maintenance costs, averaging about $20.99 million per year, or 39 percent of the total maintenance costs from fiscal years 2011 through 2018. Other maintenance costs accounted for the smallest share of maintenance costs during the same time period, averaging about $1.10 million per year, or 1 percent of the total maintenance costs.

KC-130T Total Operating and Support Costs



Source: GAO analysis of Navy data. | GAO-21-101SP

Data table for KC-130T Total Operating and Support Costs (Constant fiscal year 2018 dollars in millions)

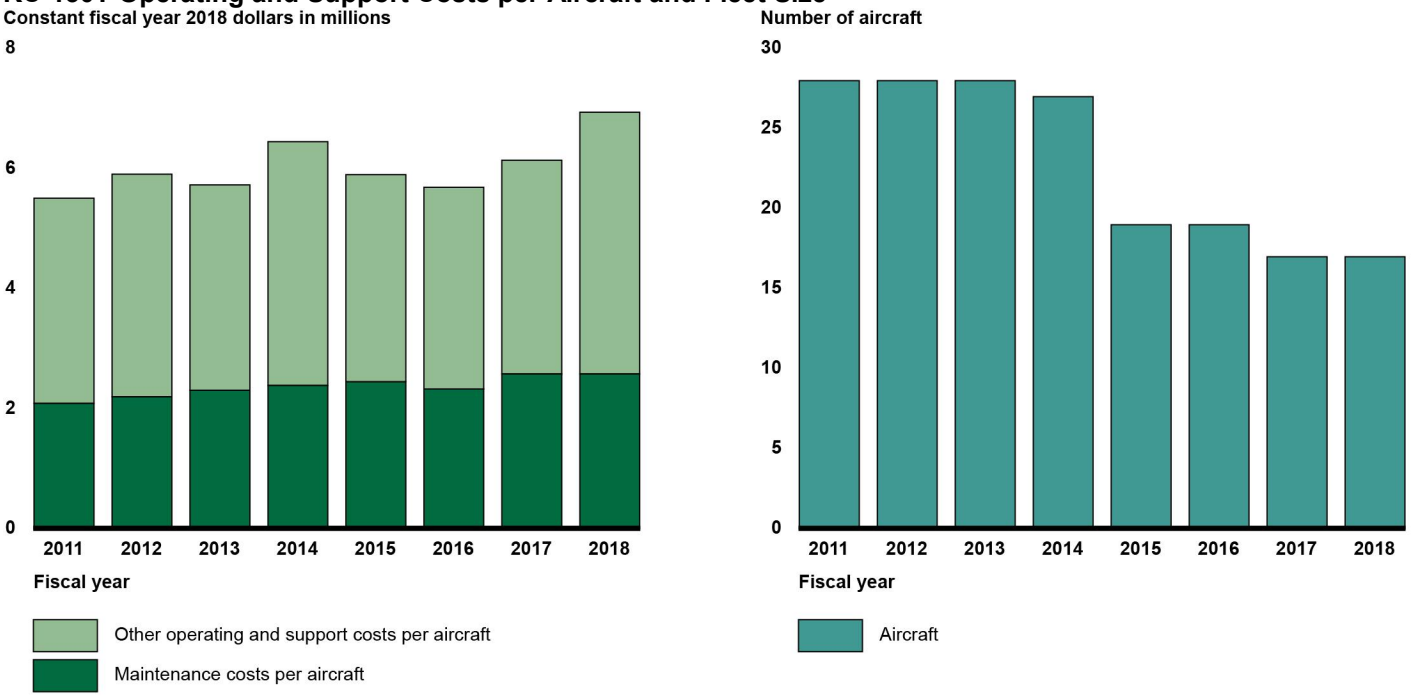
Fiscal year	Unit level manpower	Unit operations	Maintenance	Sustaining support	Continuing system improvements
2011	52.88	19.82	58.39	3.72	19.45
2012	51.41	21.09	61.65	4.26	27.18
2013	50.75	19.94	64.61	3.25	21.81
2014	65.54	16.8	64.52	3.41	23.82
2015	40.02	11.96	46.46	3.1	10.38
2016	36.78	9.9	44.29	2.57	14.58
2017	40.25	6.06	43.88	2.87	11.41
2018	36.29	2.75	43.91	2.79	32.28

Fiscal year	Consumable materials and repair parts	Depot level reparables	Depot maintenance	Other maintenance	Intermediate maintenance
2011	8.47	12.67	22.8	0.72	13.74
2012	9.25	9.55	26.21	0.46	16.18
2013	7.91	12.57	26.39	0.38	17.36
2014	7.12	12.41	23.35	2.82	18.83
2015	5.57	9.69	13.83	0	17.37
2016	5.55	7.73	14.03	0	16.98
2017	3.66	4.58	22.2	0	13.44
2018	3.71	7.91	19.14	0	13.15

From fiscal years 2011 through 2018, the KC-130T's O&S costs per aircraft generally increased from about $5.51 million to about $6.94 million. According to officials, the increase in fiscal year 2018 can be attributed to replacing

the propellers on the aircraft. Maintenance costs per aircraft remained steady, averaging about $2.37 million per year, and accounted for more than one-third of the total cost per aircraft. Additionally, the number of KC-130T aircraft decreased from 28 in fiscal year 2011 to 17 in fiscal year 2018. According to officials, this decrease was because the Navy and Marine Corps are transitioning the aircraft out of service to replace it with the KC-130J.

KC-130T Operating and Support Costs per Aircraft and Fleet Size



Source: GAO analysis of Navy data. | GAO-21-101SP

Data table for KC-130T Operating and Support Costs per Aircraft and Fleet Size (Constant fiscal year 2018 dollars in millions)

Fiscal year	Maintenance costs per aircraft	Other operating and support costs per aircraft
2011	2.09	3.42
2012	2.2	3.71
2013	2.31	3.42
2014	2.39	4.06
2015	2.45	3.45
2016	2.33	3.36
2017	2.58	3.56
2018	2.58	4.36

Fiscal year	Number of aircraft
2011	28
2012	28
2013	28
2014	27
2015	19
2016	19
2017	17
2018	17

Sustainment Challenges and Mitigation Actions

Aging: The Navy and Marine Corps have operated the KC-130T for close to 40 years and, according to officials, have implemented a series of modifications to replace or enhance aging components. The Navy and Marine Corps updated operating techniques to meet mission and training requirements during this time, which has also driven modifications to the aircraft. In its testimony to Congress, the Navy stated it has several planned modernization initiatives to update systems and parts to extend the life of the aircraft, such as modifications to the propeller.

Maintenance: As the KC-130T has aged, it has required additional maintenance for repairs that were not originally planned, such as repairs to the propeller system. Navy and Marine Corps officials told us that maintenance for the aircraft is also taking longer because more parts need to be repaired and replaced. Therefore, the Navy's and Marine Corps' ongoing and planned actions to mitigate these challenges include maintenance initiatives, such as scheduling maintenance for components based on forecasted failure rates for those components, and updating technical publications and training tasks to ensure that training is consistent with the maintenance tasks necessary to support the aircraft. Also, the Navy and Marine Corps are pursuing an automated system that will store interactive electronic technical manuals allowing for quicker updates and provide maintainers with step-by-step instructions on repairing components on the aircraft.

Supply Support: The KC-30T is experiencing some shortages of parts because, according to officials, the size of the fleet causes very low demand, resulting in items not being ordered and available in stock. The Navy and Marine Corps' planned actions to mitigate these challenges include initiatives, such as the Avionics Obsolescence Program, to procure avionics software with associated, commercially-available hardware through existing government contracts, and integrating avionics software and associated components into the aircraft to update these systems and components. Also, according to officials, the Navy and Marine Corps is pursuing an automated system that will capture data from the aircraft and aircrew to allow maintainers to proactively order parts and materials.

Program Office Comments

In commenting on a draft of this assessment, the program office provided technical comments, which we incorporated where appropriate.

Source: U.S. Marine Corps/Lance Cpl. Seth Rosenberg. | GAO-21-101SP

KC-130J Super Hercules Sustainment Quick Look

Common Name: KC-130J

Lead Services: Navy and Marine Corps

Program Essentials

Manufacturer: Lockheed Martin

Sustainment: Depot maintenance conducted at Air Force Logistics Complexes and field maintenance conducted by Navy and Marine Corps maintainers

Program Office: Program Manager – Air 207, Naval Air Systems Command, Patuxent River, Maryland

Fiscal Year 2019 Data

Average age: 11.19 years

Average lifetime flying hours: 5,877 hours per aircraft

Depot maintenance activity and squadron locations:

▲ Depot maintenance activity location

● Squadron location

Source: GAO. | GAO-21-101SP

Sustainment Challenges and Mitigation Actions

The KC-130J faces maintenance and supply support challenges. Planned actions to mitigate these challenges include initiatives focused on maintenance management and updates to the program support package to reflect the supply and equipment needs of the aircraft.

Background

The KC-130J Super Hercules is a multisensor image reconnaissance and close air support platform that supports expeditionary operations by providing air-to-air refueling, rapid ground refueling, logistic support to operating forces, and tactical transportation of personnel and cargo. The KC-130J was first manufactured in 1993 as the latest production variant of the C-130 airframe. The Marine Corps is replacing the KC-130T aircraft with the KC-130J.

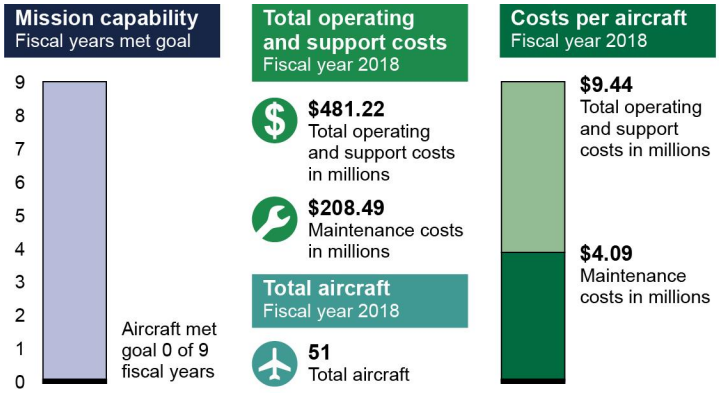
Life Cycle of the KC-130J

Source: GAO analysis of Navy data. | GAO-21-101SP

Overview

The KC-130J fleet's mission capable rate decreased from fiscal years 2011 through 2019 and the fleet did not meet its mission capable goals any year during the time period. The percent of KC-130J aircraft that were not available due to maintenance and supply issues increased during this time period because of additional maintenance needed on the engines and electrical systems of the aircraft, according to officials. Total operating and support (O&S) costs increased, from about $329.07 million in fiscal year 2011 to about $481.22 million in fiscal year 2018. According to officials, maintenance costs went up because of significant price increases when supply contracts were renegotiated as the KC-130J transitioned from contractor logistics support to government-provided (i.e., organic) support. In fiscal year 2018, maintenance costs per aircraft accounted for more than one-third of the total O&S costs per aircraft.

KC-130J Sustainment Status



Source: GAO analysis of Navy data. | GAO-21-101SP

Data table for KC-130J Sustainment Status

Mission capability	Aircraft met goal 0 of 9 fiscal years
Total operating and support costs in millions (FY18)	$481.22
Maintenance costs in millions (FY18)	$208.49
Total aircraft (FY18)	51
Total operating and support costs per aircraft in millions (FY18)	$9.44
Maintenance costs per aircraft in millions	$4.09

Sustainment Strategy

- The KC-130J is a variant of the C-130 airframe developed to replace the KC-130T aircraft. Approximately 80 percent of the KC-130J airframe and components are common with the legacy C-130T and KC-130T. As such, the KC-130J Life-Cycle Sustainment Plan (2019) supports the sustainment strategy of these three weapon systems. This plan provides the Navy and Marine Corps with a roadmap for achieving performance requirements and minimizing life-cycle costs associated with the aircraft.
- Civilian personnel perform depot maintenance of the systems and components on the KC-130J at the Air Force Logistics Complexes in Warner Robins, Georgia, and Ogden, Utah. Fleet maintenance is performed predominantly by Marine Corps military personnel. The Navy entered into a Sustaining Engineering and Logistics Support Services contract with Lockheed Martin for system engineering support.

Availability and Condition

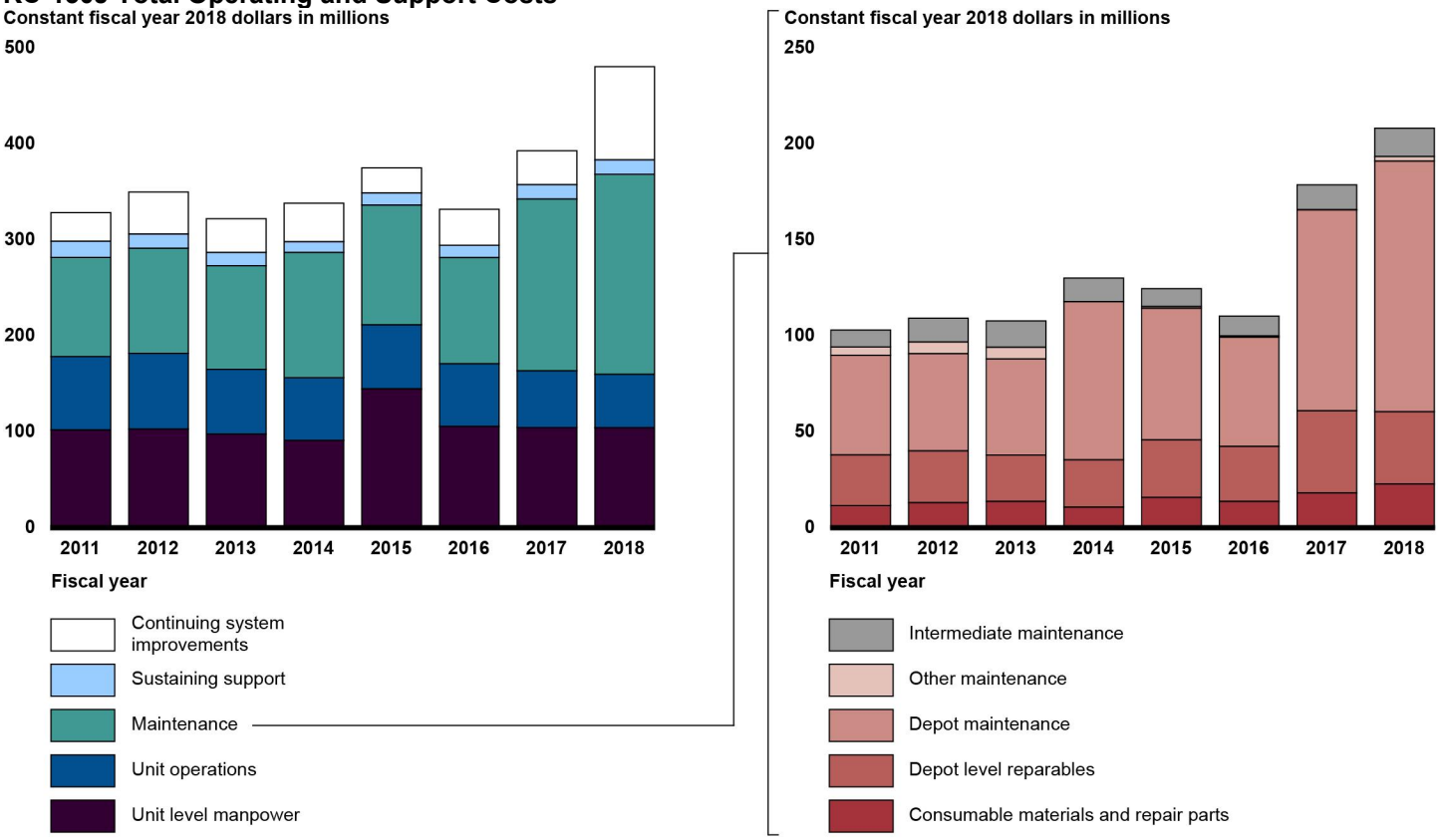
From fiscal years 2011 through 2019, the KC-130J fleet fell short of its mission capable goals each year and the mission capable rate declined during the nine-year period. According to officials, the KC-130J did not meet its mission capable goals because more aircraft were in need of age-related repairs and those repairs took longer to perform.

From fiscal years 2011 through 2019, the KC-130J's not mission capable maintenance (NMCM) and not mission capable supply (NMCS) rates generally increased.. According to officials, the increase in the NMCM rate can be attributed to additional maintenance on the engines and electrical systems of the aircraft. The increase in the NMCS rate was due to the KC-130J reaching its material support date—the point the Navy decided the system would transition from contractor logistics support to government-provided (i.e., organic) supply support. As a result of this transition, the Navy renegotiated a number of the supply contracts, which caused the supply issues that the Navy is in the process of resolving. Specific details on mission capable and not mission capable rates were omitted because the information was deemed by DOD to be sensitive.

Operating and Support Costs

For fiscal years 2011 through 2018, the KC-130J's total O&S costs generally increased from about $329.07 million to about $481.22 million. According to officials, the increase can be attributed to an increase in the number of aircraft—from 43 in fiscal year 2011 to 51 in fiscal year 2018—and the costs of standing up new squadrons for the new aircraft. Maintenance costs, which doubled during this time frame, accounted for the largest share of O&S costs during the time period, averaging about $134.29 million per year, or 37 percent of total O&S costs. According to officials, maintenance costs increased because of significant price increases when the KC-130J reached its materiel support date in 2017—the date it was required to transition from contractor logistics support to organic (government-provided) supply support. As a result of this transition, the Navy renegotiated a number of the supply contracts, resulting in some cost increases. Depot maintenance was the most significant category of maintenance costs, averaging about $74.48 million per year, or 55 percent of the total maintenance costs, from fiscal years 2011 through 2018. According to officials, depot maintenance costs doubled from fiscal year 2016 to fiscal year 2017 for several reasons, including a significant increase in engine repairs, several engines in need of additional repairs, as well as an increased costs for normal repairs and overhauls.

KC-130J Total Operating and Support Costs



Source: GAO analysis of Navy data. | GAO-21-101SP

Data table for KC-130J Total Operating and Support Costs (Constant fiscal year 2018 dollars in millions)

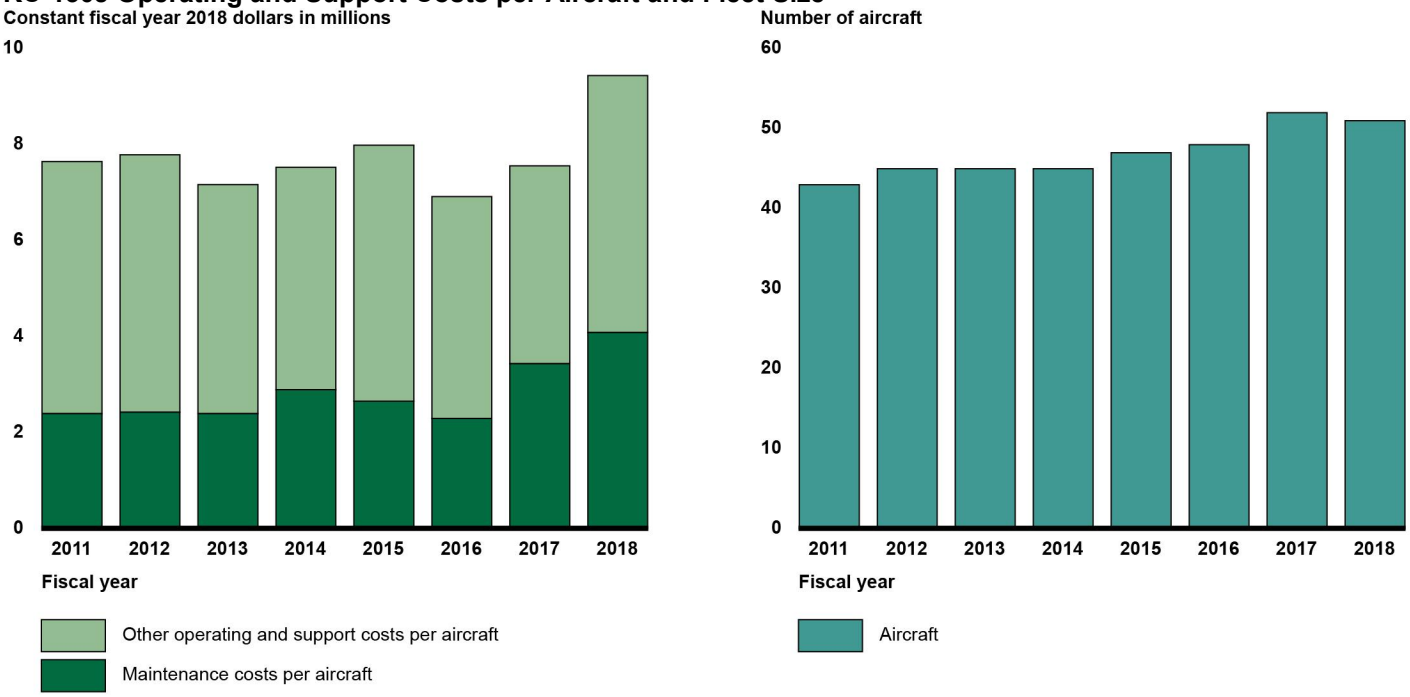
Fiscal year	Unit level manpower	Unit operations	Maintenance	Sustaining support	Continuing system improvements
2011	102.56	76.44	103.33	16.88	29.86
2012	103.4	78.96	109.46	14.76	43.87
2013	98.17	67.46	108.04	13.87	35.2
2014	91.72	65.29	130.43	11.16	40.16
2015	145.28	66.64	124.92	12.61	26.18
2016	106.15	65.32	110.61	12.97	37.41
2017	104.94	59.23	179.02	14.9	35.39
2018	104.78	55.65	208.49	15.1	97.2

Fiscal year	Consumable materials and repair parts	Depot level reparables	Depot maintenance	Other maintenance	Intermediate maintenance
2011	11.86	26.35	51.97	4.32	8.83
2012	13.29	27.02	50.66	6.13	12.36
2013	13.96	24.2	50.05	6.14	13.7
2014	10.97	24.72	82.43	0.01	12.3
2015	16.07	30.02	68.61	0.89	9.34
2016	13.96	28.67	56.94	0.69	10.35
2017	18.43	42.83	104.63	0.1	13.03
2018	23.04	37.74	130.55	2.4	14.76

From fiscal years 2011 through 2018, the KC-130J's O&S costs per aircraft generally increased from about $7.65 million to about $9.44 million. Also, maintenance costs per aircraft almost doubled, from about $2.40 million to about $4.09 million and, on average, accounted for more than one-third of the total costs per aircraft. According to program officials, these increases can be attributed to the increase in costs related to continuing systems

improvements and maintenance for purchasing and installing modification kits to upgrade the transponder and laser systems on the aircraft. Additionally, the number of aircraft increased—from 43 aircraft in fiscal year 2011 to 51 aircraft in fiscal year 2018—because the aircraft is still in production, with an anticipated total inventory of 111 aircraft.

KC-130J Operating and Support Costs per Aircraft and Fleet Size



Source: GAO analysis of Navy data. | GAO-21-101SP

Data table for KC-130J Operating and Support Costs per Aircraft and Fleet Size (Constant fiscal year 2018 dollars in millions)

Fiscal year	Maintenance costs per aircraft	Other operating and support costs per aircraft
2011	2.4	5.25
2012	2.43	5.36
2013	2.4	4.77
2014	2.9	4.63
2015	2.66	5.33
2016	2.3	4.62
2017	3.44	4.12
2018	4.09	5.35

Fiscal year	Number of aircraft
2011	43
2012	45
2013	45
2014	45
2015	47
2016	48
2017	52
2018	51

Sustainment Challenges and Mitigation Actions

Aging: The KC-130J shares similar hardware and software configurations as the C-130 airframe. As such, these aircraft share similar challenges and, according to program officials, have undergone a series of modifications to replace or enhance aging components. Navy and Marine Corps officials told us that they have updated operating techniques to meet mission and training requirements during this time, which has also driven modifications to the

aircraft. Additionally, the Navy and Marine Corps have several planned modernization initiatives to update systems and parts to extend the life of the aircraft, such as modifications to the propeller.

Maintenance: Navy and Marine Corps officials told us that when they procured the KC-130J, the original equipment manufacturer was responsible for sustaining the aircraft. However, when the aircraft transitioned to organic sustainment, the Navy and Marine Corps were unable to obtain the technical data of the aircraft, which would allow the Navy and Marine Corps to update the sustainment strategy of the aircraft as it matures. Also, the lack of the technical data compromises the Navy's and Marine Corps' ability to analyze and resolve sustainment issues related to the KC-130J. According to Navy and Marine Corps officials, current actions to mitigate these challenges include updating technical publications and training tasks to ensure that training is consistent with the maintenance tasks necessary to support the aircraft, and implementing maintenance initiatives to improve the maintenance management to ensure the maintenance conducted addresses the current state of the aircraft. The Navy and Marine Corps are also pursuing an automated system that will store interactive electronic technical manuals allowing for quicker updates, and provide maintainers with step-by-step instructions on repairing components on the aircraft.

Supply Support: Navy and Marine Corps officials told us the KC-130J has experienced supply issues because the Navy and Marine Corps did not update the analysis needed to support the supply requirements of the aircraft when it was procured. As such, demand for parts given military usage has resulted in some shortages, as the Navy did not adequately plan for the parts that the aircraft would need for maintenance and repairs. According to program officials, planned actions to mitigate these challenges include collecting data and developing metrics to focus on necessary critical repair parts and updating the program support package to reflect the supply and equipment needs of the aircraft.

Program Office Comments

In commenting on a draft of this assessment, the program office provided technical comments, which we incorporated where appropriate.

Source: U.S. Air Force/Heide Couch. | GAO-21-101SP

KC-10 Extender Sustainment Quick Look

Common Name: KC-10

Lead Service: Air Force

Program Essentials

Manufacturer: Boeing

Sustainment: Depot maintenance performed by a contractor (HAECO Americas Special Services) and field support by Air Force personnel

Program Office: Tinker Air Force Base, Oklahoma

Fiscal Year 2019 Data

Average age: 34 years

Average lifetime flying hours: 32,482 hours per aircraft

Depot maintenance activity and squadron locations:

▲ Depot maintenance activity location

● Squadron location

Source: GAO. | GAO-21-101SP

Sustainment Challenges and Mitigation Actions

The KC-10 faces maintenance and supply support challenges. Planned actions to mitigate these challenges include replacing and resealing various fuel system components, replacing the engine driven pumps on the aircraft, and overhauling the existing stock of reparable items.

Background

The KC-10 Extender is a tanker and cargo aircraft that can refuel aircraft and transport support personnel and equipment on overseas deployments. The KC-10 is also capable of transporting ambulatory patients during aeromedical evacuations. It was first manufactured in 1981 and was declared fully operational in 1988.

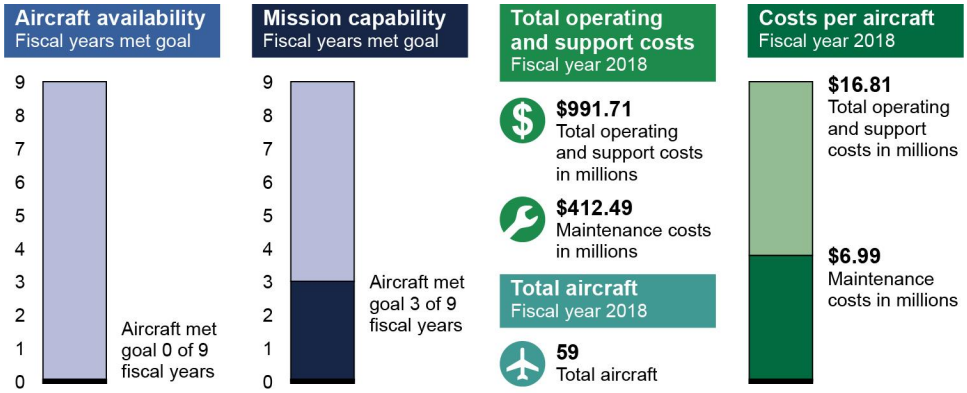
Life Cycle of the KC-10

Source: GAO analysis of Air Force data. | GAO-21-101SP

Overview

The KC-10 fleet did not meet its aircraft availability goals for any year from fiscal year 2011 through fiscal year 2019, but met or exceeded its mission capable goals for 3 of the 9 fiscal years. The KC-10's aircraft availability rate increased slightly and its mission capable rate stayed about the same during the time period. Total operating and support (O&S) costs for the KC-10 fleet decreased from about $1.49 billion in fiscal year 2011, to about $991.71 million in fiscal year 2018 due in part to about a 51 percent decrease in unit operations costs over this period. During this same time period, the annual O&S costs per aircraft decreased from $25.28 million to $16.81 million. Further, in fiscal year 2018, maintenance costs per aircraft accounted for nearly 42 percent of the total O&S costs per aircraft.

KC-10 Sustainment Status



Source: GAO analysis of Air Force data. | GAO-21-101SP

Data table for KC-10 Sustainment Status

Aircraft availability	Aircraft met goal 0 of 9 fiscal years
Mission capability	Aircraft met goal 3 of 9 fiscal years
Total operating and support costs in millions (FY18)	$991.71
Maintenance costs in millions (FY18)	$412.49
Total aircraft (FY18)	59
Total operating and support costs per aircraft in millions (FY18)	$16.81
Maintenance costs per aircraft in millions	$6.99

Sustainment Strategy

- The revised KC-10 life-cycle sustainment plan is expected to be issued in the third quarter of fiscal year 2020, according to program officials. This plan will establish the approaches and guidance to manage and control the life-cycle product support efforts.
- Sustainment of the KC-10 is currently performed through contractor logistics support (CLS) contracts, according to program officials. The KC-10, which retains 88 percent of systems commonality with the Boeing DC-10 aircraft, maintains Federal Aviation Administration certification and uses commercial parts and practices to the maximum extent possible. The airframe CLS contract, according to the KC-10 program office, includes all actions required for sustaining the aircraft subsystems, supply support, logistics integration and support, and aircraft maintenance and modifications. According to officials, the KC-10 engine CLS contract provides all tasks necessary to maintain and support the engine, including parts and logistics, teardown, overhaul, and on-wing support/contract field teams.

Availability and Condition

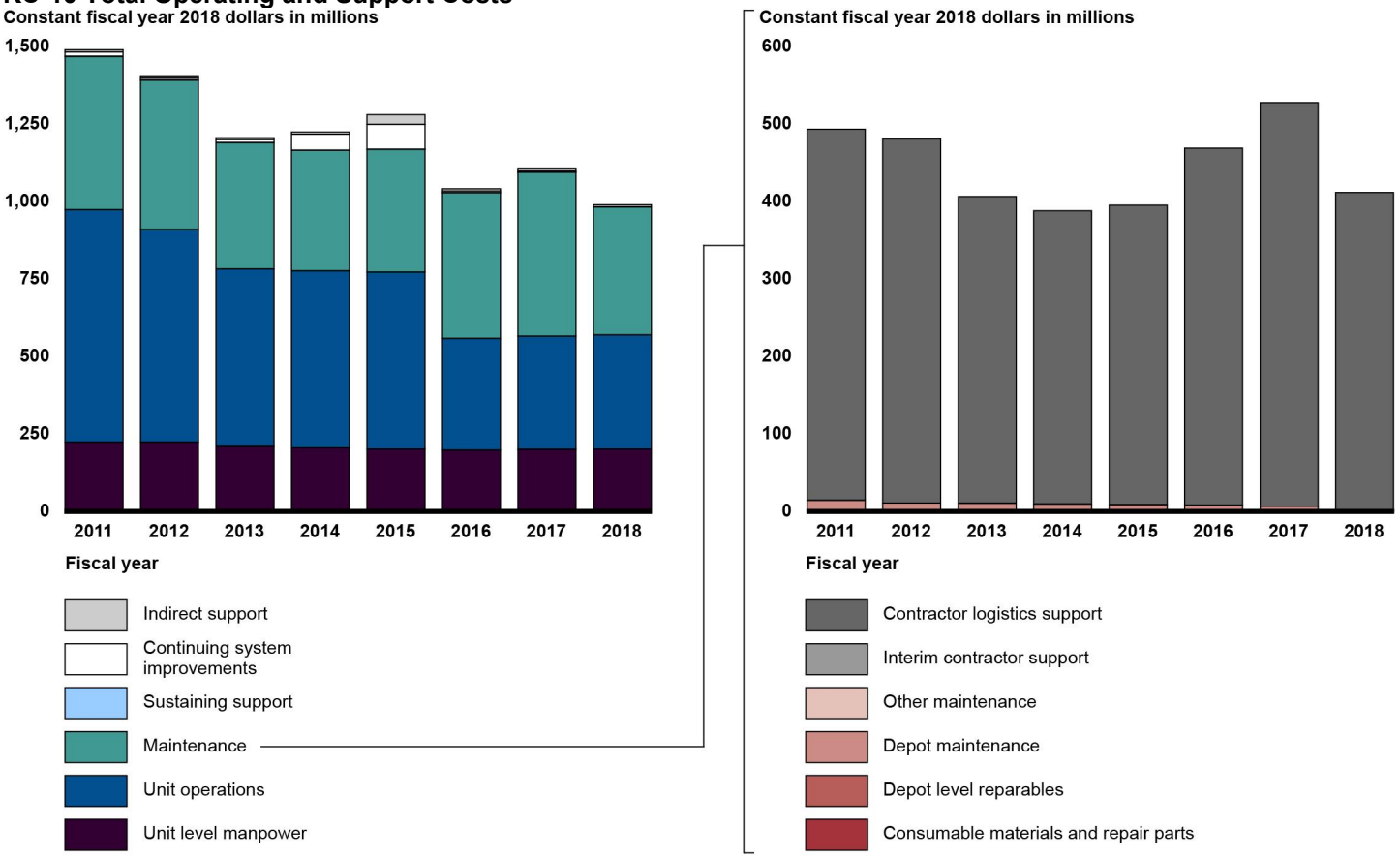
The KC-10 fleet did not meet its aircraft availability goals for any year from fiscal year 2011 through fiscal year 2019, but met or exceeded its mission capable goals for 3 of the 9 fiscal years during that period. The KC-10's aircraft availability rate in fiscal year 2019 was slightly higher than it was in fiscal year 2011, and its mission capable rate was almost the same as it was in fiscal year 2011.Program officials said the KC-10's availability rate was driven by the large amount of time required to perform maintenance on its fuel systems in the field and in depot.

From fiscal year 2011 through fiscal year 2019, the KC-10's not mission capable rates fluctuated. In fiscal year 2019, the not mission capable supply (NMCS) and the not mission capable both (NMCB) maintenance and supply rates were slightly lower than they were in fiscal year 2011, and the not mission capable for maintenance (NMCM) rate was slightly above its fiscal year 2011 level. Program officials stated that maintenance on the KC-10's fuel systems accounted for about a third of the NMCM rate and the fuel system was the highest driver of the NMCS and NMCM rates in fiscal years 2018 and 2019. Specific details on aircraft availability, mission capable and not mission capable rates were omitted because the information was deemed by DOD to be sensitive.

Operating and Support Costs

Total O&S costs for the KC-10 fleet generally decreased from approximately $1.49 billion in fiscal year 2011 to $991.71 million in fiscal year 2018. The largest decreases during these years were in unit operations and maintenance. Program officials stated that they do not manage these costs and therefore were not sure why they decreased. However, according to officials, the KC-10 flight management system modification, which was started in fical year 2015 and completed in fiscal year 2017, caused a substantial increase in continuing system improvements and indirect support costs. Also, officials stated the transition in fiscal year 2017 from one all-encompassing contract to two separate contracts to manage depot and supply chain operations caused an incease in contractor logistics support costs for that year, but later resulted in some cost savings in fiscal year 2018.

KC-10 Total Operating and Support Costs



Source: GAO analysis of Air Force data. | GAO-21-101SP

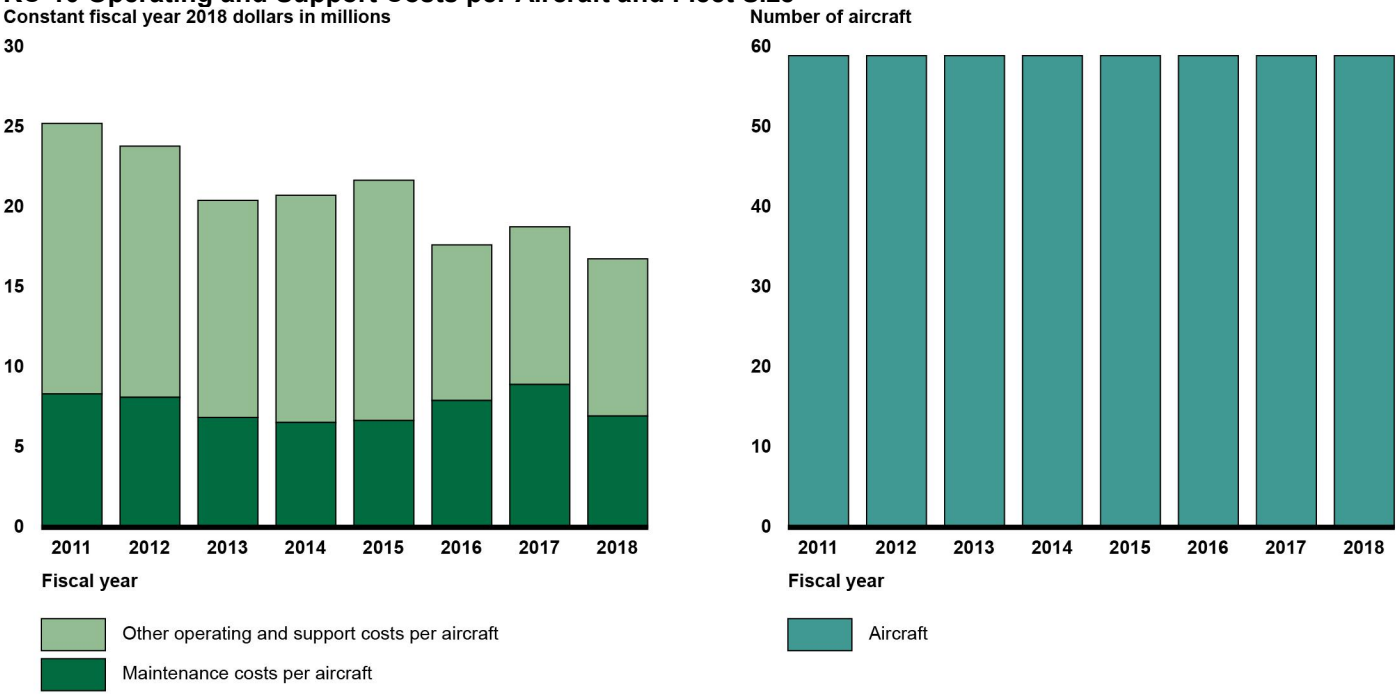
Data table for KC-10 Total Operating and Support Costs (Constant fiscal year 2018 dollars in millions)

Fiscal year	Unit level manpower	Unit operations	Maintenance	Sustaining support	Continuing system improvements	Indirect support
2011	225.64	750.06	493.97	0.9	13.44	7.31
2012	225.6	685.89	481.57	0.7	6.19	7.54
2013	211.4	572.75	407.27	0.74	9.19	6.24
2014	207.04	571.03	388.78	0.84	51.18	7.28
2015	203.04	570.96	396.07	0.91	79.37	31.39
2016	199.36	360.73	469.64	0.15	5.42	7.76
2017	201.97	365.53	528.43	0.11	3.88	9.68
2018	203.14	368.36	412.49	0.13	0.2	7.4

Fiscal year	Consumable materials and repair parts	Depot level reparables	Depot maintenance	Other maintenance	Interim contractor support	Contractor logistics support
2011	1.33	0	13.63	0	0	479.01
2012	0.52	0	10.99	0	0	470.06
2013	0.13	0	11.05	0	0	396.08
2014	0.97	0	9.17	0	0	378.64
2015	1.45	0	8.04	0	0	386.59
2016	0.55	0	8.02	0	0	461.06
2017	0.39	0	7.04	0	0	521
2018	1.35	0.01	0	0	0	411.12

While the total number of aircraft in the KC-10 fleet remained constant from fiscal years 2011 through 2018, the total O&S costs per aircraft generally decreased. Specifically, the annual O&S costs per aircraft decreased from $25.28 million to $16.81 million during this time period. Maintenance costs per aircraft also decreased from $8.37 million to $6.99 million during the same timeframe, with an increase in these costs from fiscal year 2015 through fiscal year 2017, when the O&S costs per aircraft was at its highest of $8.96 million. In addition, the KC-10 mission capable and aircraft availability rates slightly dropped in fiscal year 2018 from early highs, as discussed above.

KC-10 Operating and Support Costs per Aircraft and Fleet Size



Source: GAO analysis of Air Force data. | GAO-21-101SP

Data table for KC-10 Operating and Support Costs per Aircraft and Fleet Size (Constant fiscal year 2018 dollars in millions)

Fiscal year	Maintenance costs per aircraft	Other operating and support costs per aircraft
2011	8.37	16.9
2012	8.16	15.69
2013	6.9	13.56
2014	6.59	14.19
2015	6.71	15.01
2016	7.96	9.72
2017	8.96	9.85
2018	6.99	9.82

Fiscal year	Number of aircraft
2011	59
2012	59
2013	59
2014	59
2015	59
2016	59
2017	59
2018	59

Sustainment Challenges and Mitigation Actions

Maintenance: According to program officials, the KC-10 fuel system is the key factor that affects aircraft availability. To mitigate issues with the fuel system, the program office executed an Aircraft Availability Improvement Program that includes initiatives to improve the fuel system, such as replacing the fuel storage bladders located inside of the fuel tanks and resealing the auxiliary fuel tanks during scheduled depot maintenance. Program officials stated that these initiatives are 83 percent complete—replaced on 49 of the 59 KC-10 aircraft since started in fiscal year 2017. The remaining replacements are scheduled to be completed in fiscal year 2020.

Supply Support: The KC-10 also has supply challenges. For example, according to program officials, in December 2017, when multiple radomes—dome-shaped structures that protect radar equipment—were removed and replaced during scheduled maintenance, the supply system was strained due to an increased need for new radomes. To address this challenge, program officials increased the overall supply of new radomes to help with this higher demand. According to officials, there are challenges associated with the KC-10 contractor logistics support contract, most recently awarded in July 2016 and recompeted every 8 to 10 years. While officials anticipate that the current contractor will have some learning curve challenges in the early years as a new contractor, they expect peak performance in the mid years of the contract before a slight downward turn in performance toward the end of the contract in 2025, due to fewer performance incentives in the later contract years.

Further, program officials stated that about $20 million were taken from the KC-10 program in fiscal year 2019 to help certain fighter aircraft meet the Secretary of Defense's 80 percent mission capable goal for these aircraft, which has caused the KC-10 total not mission capable for supply rates to rise slightly in fiscal year 2019.

Program Office Comments

In commenting on a draft of this assessment, the program office noted that both the engine and airframe CLS contracts have moved through the transition phase into full performance. It also noted that the KC-10 contractors performed well throughout fiscal year 2019, with total not mission capable for supply staying below 5 percent and the war readiness engine metric staying above the six engines required. Officials also stated that in fiscal year 2019, the KC-10 Aircraft Availability Improvement Program initiatives were temporarily suspended because of unscheduled depot work to repair fuel leaks and perform major structural repairs; however, they project improved aircraft availability in fiscal year 2020. In addition, the program office provided technical comments which we incorporated where appropriate.

Source: U.S. Air Force/Senior Airman Alexandria Lee. | GAO-21-101SP

KC-135 Stratotanker Sustainment Quick Look

Common Name: KC-135

Lead Service: Air Force

Program Essentials

Manufacturer: Boeing

Sustainment: Depot maintenance conducted at the Oklahoma Air Logistics Complex, Oklahoma

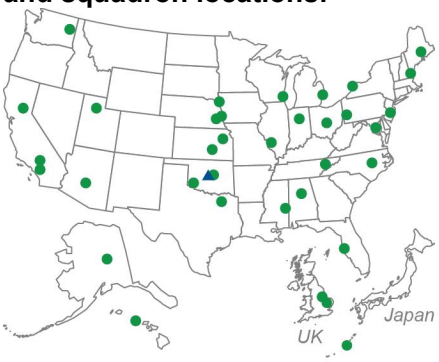
Program Office: Tinker Air Force Base, Oklahoma

Fiscal Year 2019 Data

Average age: 58 years

Average lifetime flying hours: 24,372 hours per aircraft

Depot maintenance activity and squadron locations:



▲ Depot maintenance activity location

● Squadron location

Source: GAO. | GAO-21-101SP

Sustainment Challenges and Mitigation Actions

The KC-135 faces challenges with corrosion and parts obsolescence. Planned actions to mitigate these challenges include executing additional maintenance tasks for known corrosion problem areas, identifying alternative parts, and prioritizing aircraft for repair to support the most critical missions, among others.

Background

The KC-135 Stratotanker was first manufactured in 1954. The aircraft is the Air Force's primary aerial refueling tanker and also provides aerial refueling support to Navy, Marine Corps, and allied nation aircraft. The KC-135 is also capable of transporting litter and ambulatory patients using patient support pallets during aeromedical evacuations.

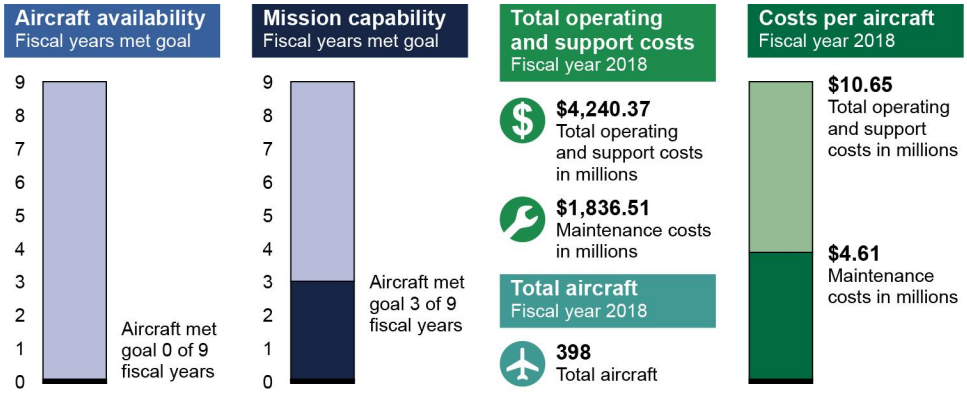
Life Cycle of the KC-135

Source: GAO analysis of Air Force data. | GAO-21-101SP

Overview

The KC-135 fleet did not meet its aircraft availability goals form fiscal years 2011 through 2019, but was above its mission capable goals in 3 of the 9 fiscal years. The KC-135's aircraft availability and mission capable rates decreased during the time period. Total operating and support (O&S) costs for the KC-135 fleet remained fairly consistent—ranging from about $4.13 billion to about $4.63 billion—from fiscal years 2011 through 2018. While maintenance costs steadily increased over this time period and maintenance was the largest cost category in fiscal year 2018, unit operations costs decreased. Depot maintenance costs were the largest driver of the maintenance cost increases. The KC-135 fleet decreased by 18 aircraft from 416 to 398 during the time period; however, total O&S costs per aircraft remained fairly constant. In fiscal year 2018, the O&S costs per aircraft were about $10.65 million, with about $4.61 million per aircraft (or 43 percent) dedicated to maintenance issues.

KC-135 Sustainment Status



Source: GAO analysis of Air Force data. | GAO-21-101SP

Data table for KC-135 Sustainment Status

Aircraft availability	Aircraft met goal 0 of 9 fiscal years
Mission capability	Aircraft met goal 3 of 9 fiscal years
Total operating and support costs in millions (FY18)	$4,240.37
Maintenance costs in millions (FY18)	$1,836.51
Total aircraft (FY18)	398
Total operating and support costs per aircraft in millions (FY18)	$10.65
Maintenance costs per aircraft in millions	$4.61

Sustainment Strategy

- The Air Force issued the KC-135 Life-Cycle Sustainment Plan in August 2017. The plan establishes the methodologies and guidance to manage and control life-cycle product support efforts.
- The Air Force sustains the KC-135 fleet through programmed depot maintenance, which is generally performed on a 5-year cycle.
- Programmed depot maintenance of the KC-135 is conducted by the Air Force at the Oklahoma Air Logistics Complex, Oklahoma. The majority of supply support for the KC-135 is provided by the Air Force Sustainment Center and the Defense Logistics Agency.

Availability and Condition

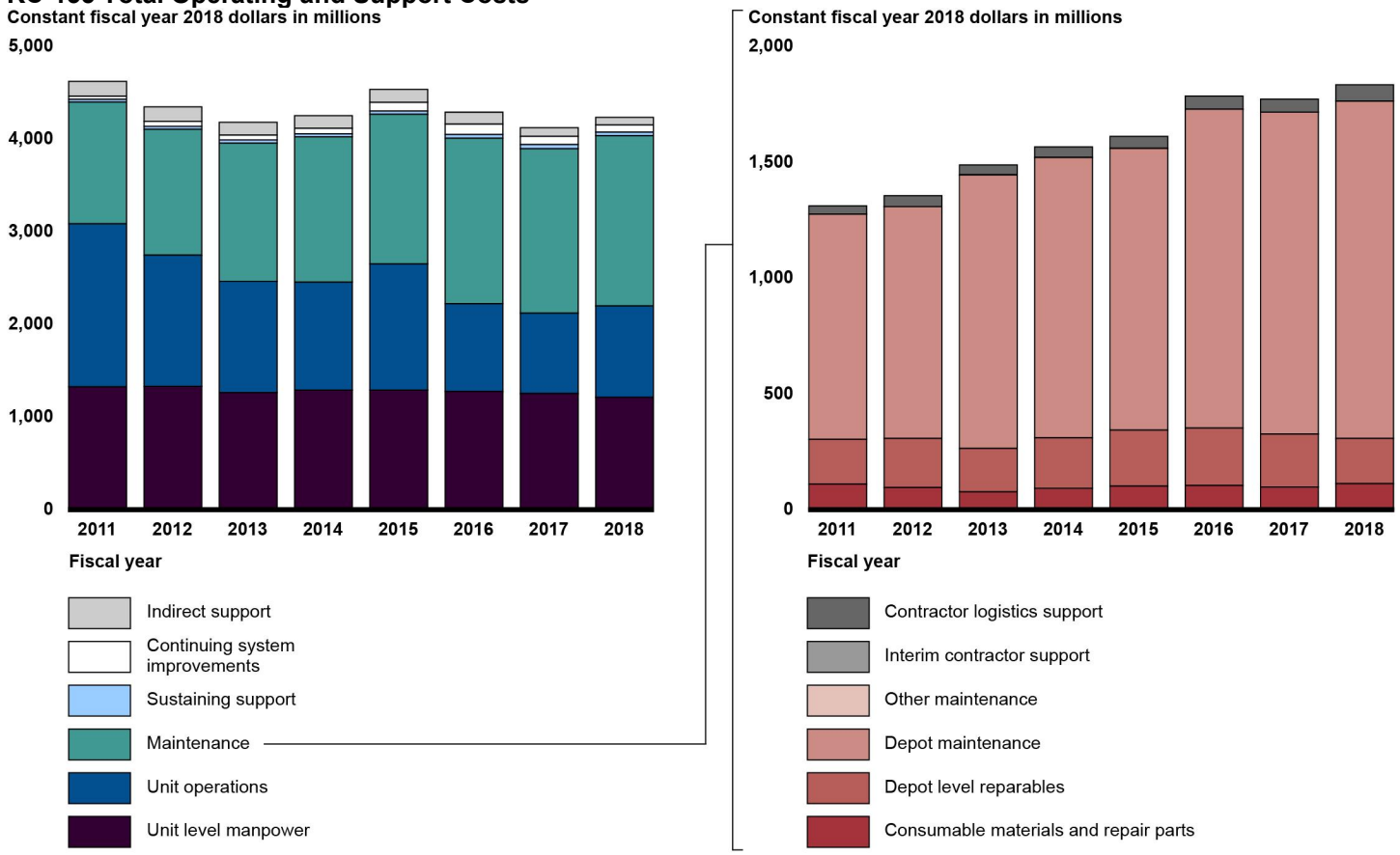
The KC-135 fleet did not meet its aircraft availability goals for any year from fiscal year 2011 through fiscal year 2019. During this time the availability rate only decreased slightly, and the fleet was above its mission capable goals for 3 of the 9 years. According to program officials, the decline in the aircraft availability rate was due to increasing field maintenance downtime as well as depot inductions for a modification to convert the last of the analog cockpit avionics to digital. Additionally, officials stated that increased field maintenance downtime and depot inductions were a part of the reason for the decline in the KC-135 mission capable rate.

From fiscal years 2011 through 2019, the KC-135's rates increased slightly for not mission capable maintenance (NMCM), not mission capable supply, and not mission capable both maintenance and supply. The largest driver of the decrease in the mission capable rate was maintenance. Program officials said that increase in the NMCM rate was primarily due to field maintenance downtime related to several key areas, including fuel leaks, unreliable avionics instruments, and structural corrosion. Program officials also said that an Aircraft Availability Improvement Program was developed for fiscal years 2019 through 2024 that includes 16 initiatives that are expected to improve the aircraft availability and mission capable rates. The KC-135's improvement program includes initiatives to replace fuel bladders, upgrade avionics, and optimize inspection intervals, among other improvements. Specific details on aircraft availability, mission capable and not mission capable rates were omitted because the information was deemed by DOD to be sensitive.

Operating and Support Costs

For fiscal years 2011 through 2018, the total O&S costs for the KC-135 fleet remained fairly constant, ranging from about $4.13 billion to about $4.63 billion. However, maintenance costs increased during the time period while unit operations costs decreased. In fiscal year 2018, maintenance was the largest O&S cost category, and depot maintenance was the largest driver of the increase in maintenance costs over the time period. Program officials stated that depot maintenance costs grew because of increased requirements associated with aging aircraft, which required additional tasks during programmed depot maintenance.

KC-135 Total Operating and Support Costs



Source: GAO analysis of Air Force data. | GAO-21-101SP

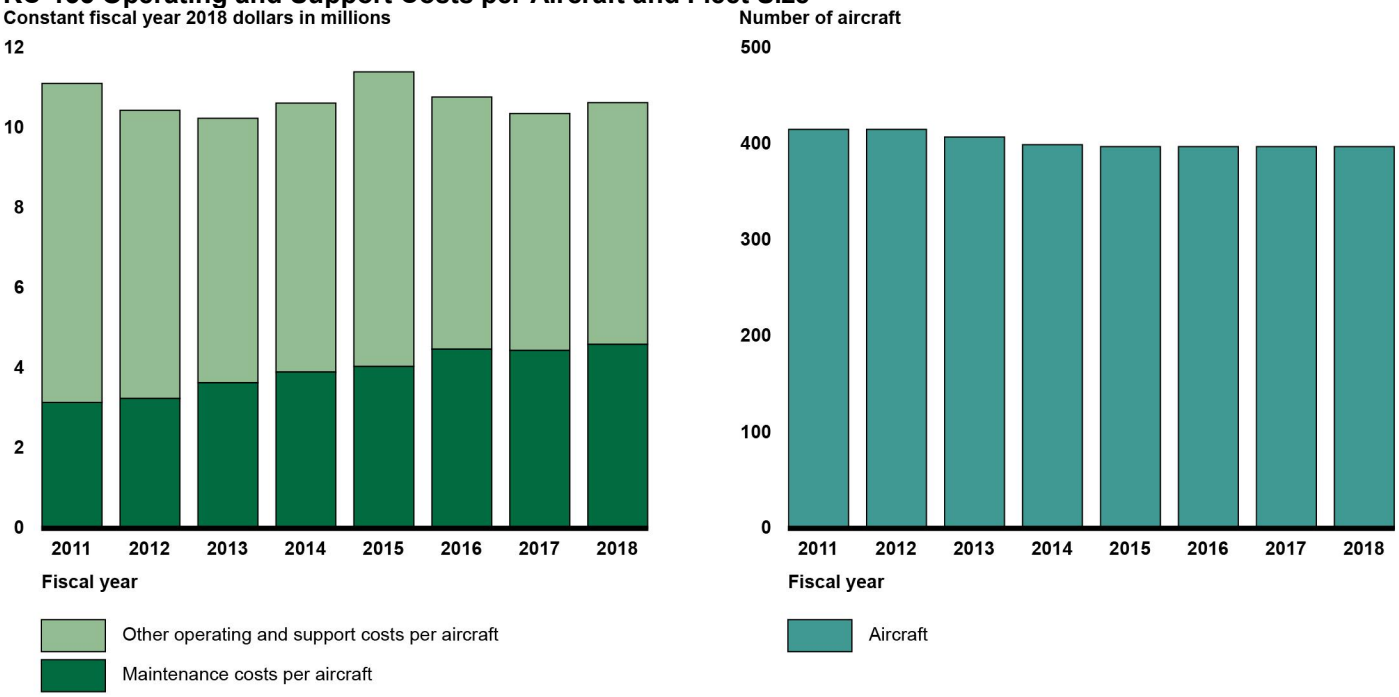
Data table for KC-135 Total Operating and Support Costs (Constant fiscal year 2018 dollars in millions)

Fiscal year	Unit level manpower	Unit operations	Maintenance	Sustaining support	Continuing system improvements	Indirect support
2011	1331.28	1760.62	1313.79	29.77	32.59	160.15
2012	1336.92	1417.03	1357.8	31.49	54.09	156.04
2013	1268.41	1202.35	1490.42	36.08	50.97	138.55
2014	1296.09	1164.77	1568.9	32.57	59.89	136.45
2015	1297.28	1361.57	1614.17	34.68	93.89	140.6
2016	1282.07	945.83	1787.81	38.9	111.34	129.81
2017	1260.42	866.84	1774.42	45.18	87.6	94.47
2018	1218.99	985.97	1836.51	39.09	77.81	82

Fiscal year	Consumable materials and repair parts	Depot level reparables	Depot maintenance	Other maintenance	Interim contractor support	Contractor logistics support
2011	112.91	193.02	971.79	0	0	36.08
2012	98.08	212.02	1000.75	0.07	0	46.89
2013	79.61	187.34	1180.25	1	0	42.23
2014	94.35	218.36	1209.82	0.23	0	46.14
2015	104.28	241.95	1215.88	0.03	0	52.03
2016	106.6	247.78	1376.81	0.01	0	56.62
2017	99.66	228.87	1389.89	0.05	0	55.95
2018	114.38	195.74	1455.6	0	0	70.79

From fiscal years 2011 through 2018, the KC-135 fleet decreased by 18 aircraft, from 416 to 398 aircraft, and total O&S costs per aircraft remained fairly constant. More specifically, the annual O&S costs per aircraft only varied between a low of about $10.26 million and a high of $11.41 million. However, maintenance costs per aircraft climbed steadily, from $3.16 million to $4.61 million during the same timeframe. In addition, the mission capable and aircraft availability rates slightly dropped from earlier highs, as discussed previously.

KC-135 Operating and Support Costs per Aircraft and Fleet Size



Source: GAO analysis of Air Force data. | GAO-21-101SP

Data table for KC-135 Operating and Support Costs per Aircraft and Fleet Size (Constant fiscal year 2018 dollars in millions)

Fiscal year	Maintenance costs per aircraft	Other operating and support costs per aircraft
2011	3.16	7.97
2012	3.26	7.2
2013	3.65	6.61
2014	3.92	6.72
2015	4.06	7.36
2016	4.49	6.3
2017	4.46	5.92
2018	4.61	6.04

Fiscal year	Number of aircraft
2011	416
2012	416
2013	408
2014	400
2015	398
2016	398
2017	398
2018	398

Sustainment Challenges and Mitigation Actions

Maintenance and an Aging Aircraft: According to Air Force officials, as the KC-135 continues to age, the number of maintenance hours related to corrosion has increased, and this has become the largest maintenance challenge. KC-135 program officials stated they have established recurring maintenance tasks to address known problem areas and reduce aircraft downtime. These tasks include maintenance actions varying from minor rework in some areas to complete component replacement in other areas. In addition, officials said that two previously-established programs are part of the KC-135 program office's mitigation efforts: the Aircraft Structural Integrity Program and the Corrosion Prevention and Control Program. The goal of these programs, in conjunction with the KC-135 Structures Working Group, is to continuously monitor the aircraft and to identify and define the requirements for future inspections and maintenance actions.

Supply Support and an Aging Aircraft: Air Force officials also told us that the vast majority of supply support issues stem from decreased asset availability as a result of insufficient organic (i.e., government-owned and operated) and contract repair sources, obsolescence issues, and increased failures directly related to aging of the aircraft. The KC-135 program office stated that it works with the supply chain and engineering organizations to develop mitigation strategies that will minimize the impact to the aircraft. This includes negotiating alternative repair schedules, identifying alternate parts, prioritizing aircraft to ensure the most critical missions are supported first, utilizing assets from the Aerospace Maintenance and Regeneration Group, and allowing reuse of some parts, if appropriate. The combination of these efforts enables the KC-135 to continue to fly missions and minimizes impacts to the fleet, according to program officials.

Program Office Comments

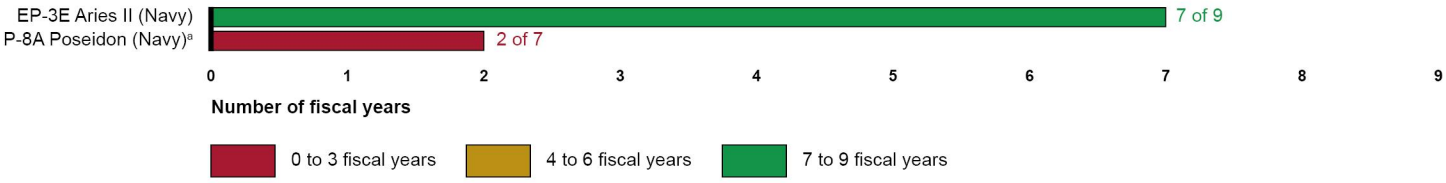
In commenting on a draft of this assessment, the program office provided technical comments, which we incorporated where appropriate. According to program officials, aggressive strategic management continues to keep the KC-135 available as the nation's backbone for air refueling. Further, a robust aircraft availability improvement program has stemmed the aircraft's decreased availability. Program officials forecast that it will increase availability throughout the next decade through a combination of process improvements, sustainment technology advances and continuous materiel product upgrades.

Anti-submarine aircraft

P-8A Poseidon

Source: U.S. Navy/Mass Communication Specialist 1st Class Bryan Niegel. | GAO-21-101SP

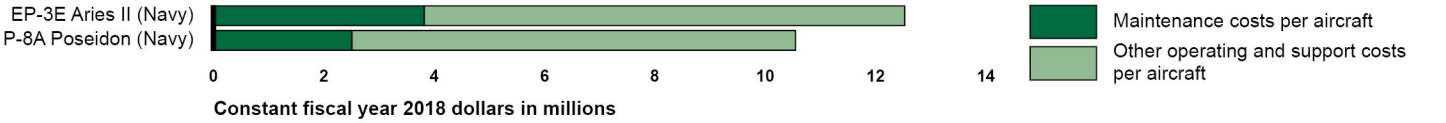
Number of Times Selected Anti-submarine Aircraft Met Their Annual Mission Capable Goal, Fiscal Years 2011 through 2019



Source: GAO analysis of Navy data. | GAO-21-101SP

[a]The Navy did not provide the mission capable goals for all nine years for this aircraft.

Operating and Support Costs per Aircraft for Selected Department of Defense Anti-submarine Aircraft, Fiscal Year 2018



Source: GAO analysis of Navy data. | GAO-21-101SP

Source: U.S. Navy/Mass Communication Specialist 3rd Class Bobby J. Siens. | GAO-21-101SP

EP-3E Aries II Sustainment Quick Look

Common Name: EP-3E

Lead Service: Navy

Program Essentials

Manufacturer: Lockheed Martin

Sustainment: Depot maintenance conducted by contractor support and Navy personnel

Program Office: Program Manager – Air 290, Naval Air Systems Command, Patuxent River, Maryland

Fiscal Year 2019 Data

Average age: 42.19 years

Average lifetime flying hours: 22,405.3 hours

Depot maintenance activity and squadron locations:

▲ Depot maintenance activity location

● Squadron location

Source: GAO. | GAO-21-101SP

Sustainment Challenges and Mitigation Actions

The EP-3E faces challenges related to corrosion, maintenance training, and diminishing supply of needed parts. The program office is increasing corrosion prevention actions at the squadrons, working with the Navy to offer additional training on EP-3 maintenance, and working to address supply shortages.

Background

The EP-3E Aries II is a land-based, multi-intelligence reconnaissance aircraft that was first manufactured in 1969. The EP-3E is the Navy's only land-based reconnaissance aircraft that provides fleet and theater commanders worldwide with near real-time tactical intelligence. The EP-3E uses sensitive receivers and high-gain dish antennas to exploit a wide range of electronic emissions from deep within targeted territory. This information can be used for information dominance, battle space situational awareness, and anti-submarine warfare applications.

Life Cycle of the EP-3E

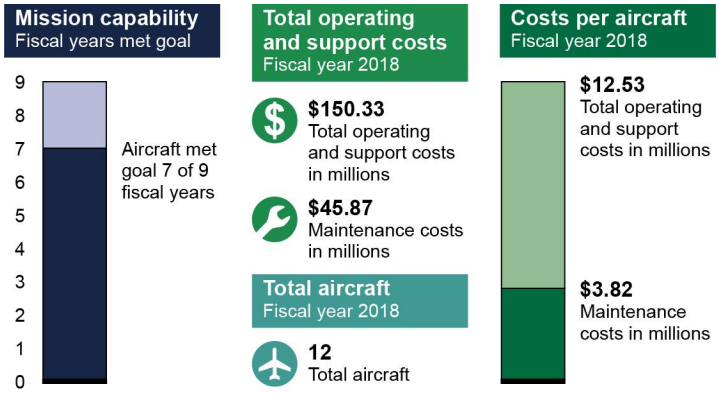
It is unknown when the EP-3 reached initial and full operational capability.

Source: GAO analysis of Navy data. | GAO-21-101SP

Overview

From fiscal years 2011 through 2019, the EP-3E fleet met or exceeded its mission capable goals in 7 of the 9 years and its mission capable rate increased slightly. Total operating and support (O&S) costs were about $150.33 million in fiscal year 2018, with about $45.87 million (31 percent) spent on maintenance. O&S costs have decreased since fiscal year 2011, when these costs were $308.38 million. According to program officials, this decrease was due to avionics upgrades that increased the reliability of the aircraft and therefore reduced costs. Total O&S costs per aircraft was $12.53 million in fiscal year 2018, a decrease from fiscal year 2011.

EP-3E Sustainment Status



Source: GAO analysis of Navy data. | GAO-21-101SP

Data table for EP-3E Sustainment Status

Mission capability	Aircraft met goal 7 of 9 fiscal years
Total operating and support costs in millions (FY18)	$150.33
Maintenance costs in millions (FY18)	$45.87
Total aircraft (FY18)	12
Total operating and support costs per aircraft in millions (FY18)	$12.53
Maintenance costs per aircraft in millions	$3.82

Sustainment Strategy

- The EP-3 has a Life-Cycle Support Plan for the aircraft's Joint Signals Intelligence Airborne Family Modernization Common Configuration Program. The Navy published the plan in 2011 and established and defined acquisitions logistics support functions and requirements for this modernization program.
- The Navy sustains the EP-3E fleet through organizational and depot maintenance. According to program office officials, depot maintenance cycles are determined yearly, based on the previous year's depot sustainment events and analysis of individual aircraft. Programmed depot maintenance is conducted by a combination of contractor support (Lockheed Martin) and Navy personnel at the Fleet Readiness Center Southeast in Jacksonville, Florida or at Lockheed Martin's facility in Greenville, South Carolina.
- The supply chain for the EP-3E is managed by the Naval Supply Systems Command Weapon Systems Support in Philadelphia, Pennsylvania and by the program office.

Availability and Condition

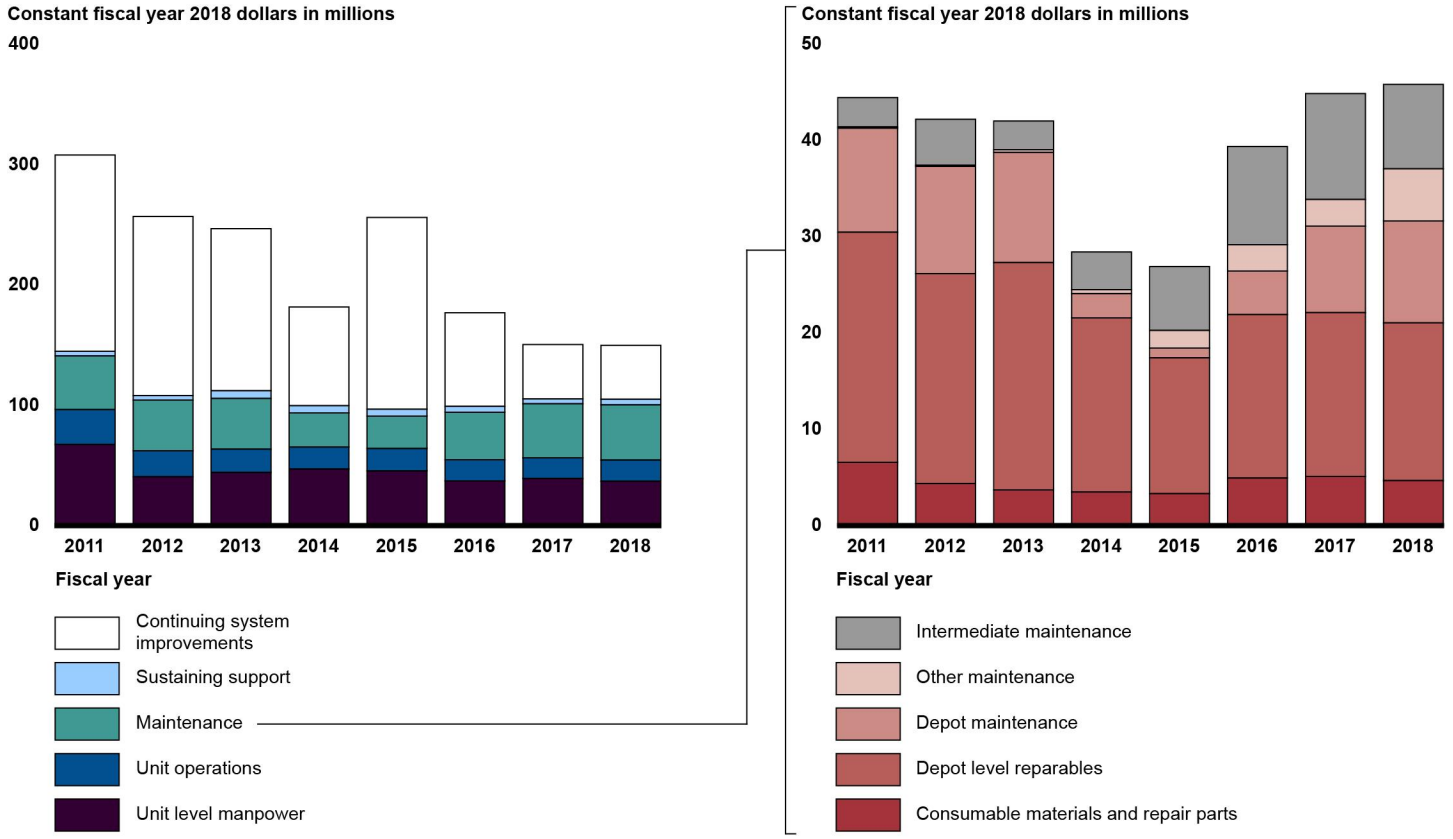
The EP-3E fleet met or exceeded its mission capable goals in 7 of the 9 years from fiscal year 2011 through fiscal year 2019. Over this time period, its mission capable rate increased slightly. According to program officials, this increase in the mission capable rate was partially due to efforts to improve the reliability of the legacy electronic intelligence system, which facilitates the collection of radar and other high frequency signals. The officials explained that the Navy began replacing this system in September 2018 with final completion scheduled in 2020. The mission capable rate also increased because the program office completed several other efforts during fiscal year 2018 to mitigate diminishing manufacturing sources and material shortages, according to the program officials.

From fiscal years 2011 through 2019, the not mission capable maintenance (NMCM) rate decreased slightly and the not mission capable supply rate increased slightly. The NMCM rate was the largest driver of the EP-3E's mission capable rate during the time period. Specific details on mission capable and not mission capable rates were omitted because the information was deemed by DOD to be sensitive.

Operating and Support Costs

From fiscal years 2011 through 2018, the EP-3E's total O&S costs decreased significantly, from $308.38 million in 2011 to $150.33 million in 2018. During that time, the number of aircraft also decreased, from 16 in fiscal year 2011 to 12 in fiscal year 2018, which contributed to the decrease in total O&S costs. However, according to program officials, the decreases in total O&S costs can partially be explained by upgrades to the avionics systems, which resulted in less money spent on continuing system improvements. Maintenance costs varied over this time period, but fiscal year 2011 and 2018 costs were about the same, with $44.51 million spent on maintenance in fiscal year 2011 and $45.87 million spent on maintenance during fiscal year 2018. Since the total O&S costs decreased, maintenance costs increased as a percentage of the total, from 14 percent in fiscal year 2011 to 31 percent in fiscal year 2018.

EP-3E Total Operating and Support Costs



Source: GAO analysis of Navy data. | GAO-21-101SP

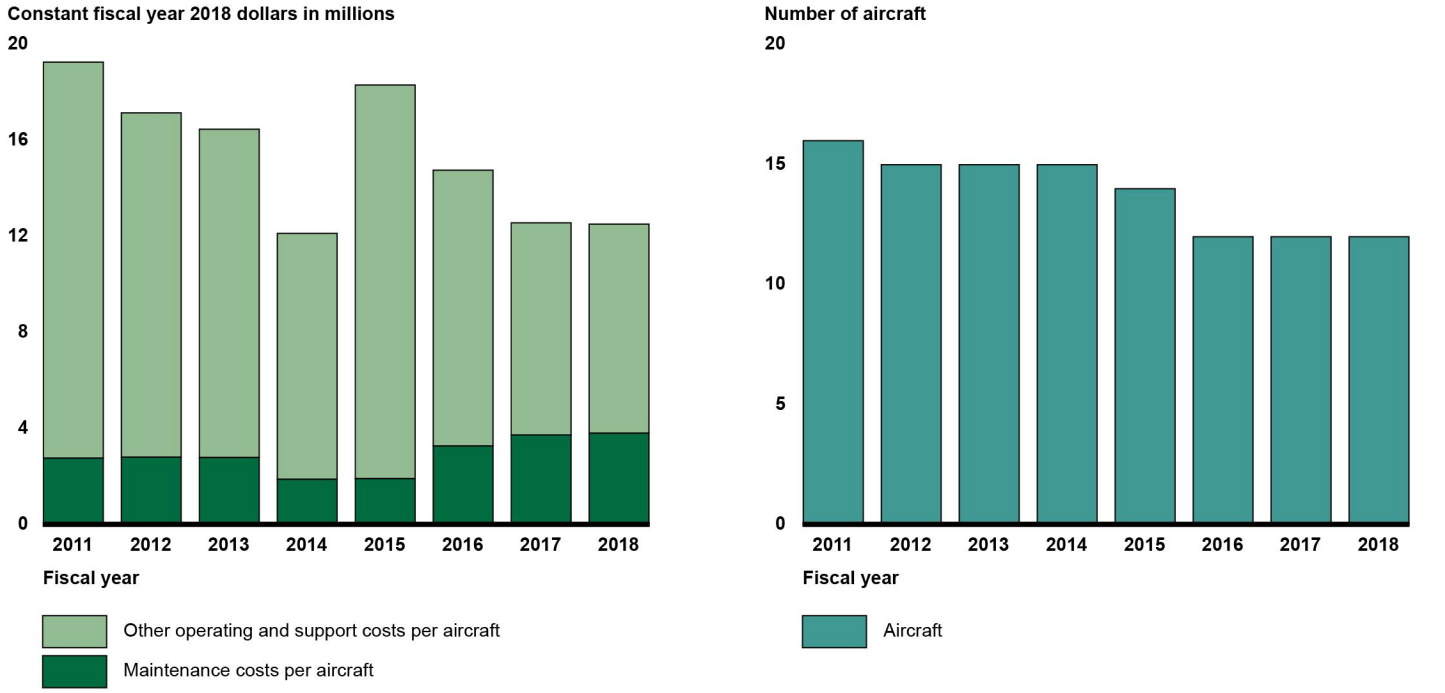
Data table for EP-3E Total Operating and Support Costs (Constant fiscal year 2018 dollars in millions)

Fiscal year	Unit level manpower	Unit operations	Maintenance	Sustaining support	Continuing system improvements
2011	67.89	29.04	44.51	3.91	163.03
2012	41	21.6	42.25	3.63	148.9
2013	44.6	19.43	42.09	6.46	134.57
2014	47.49	18.18	28.47	6.04	81.93
2015	45.8	18.76	26.96	5.64	159.36
2016	37.66	17.52	39.42	5.04	77.65
2017	39.61	17.16	44.94	4.07	45.15
2018	37.33	17.54	45.87	4.74	44.84

Fiscal year	Consumable materials and repair parts	Depot level reparables	Depot maintenance	Other maintenance	Intermediate maintenance
2011	6.64	23.9	10.8	0.13	3.04
2012	4.44	21.79	11.14	0.13	4.76
2013	3.76	23.63	11.43	0.28	2.99
2014	3.55	18.09	2.51	0.42	3.91
2015	3.39	14.09	1.02	1.83	6.63
2016	5	16.99	4.51	2.73	10.21
2017	5.17	17.01	8.99	2.76	11.01
2018	4.73	16.39	10.58	5.41	8.77

From fiscal years 2011 through 2018, the EP-3E's O&S costs per aircraft decreased from $19.27 million to $12.53 million, while the mission capable rate also decreased. However, during this same time period, maintenance costs per aircraft increased from $2.78 million to $3.82 million due to increases in contractor support costs, according to program officials.

EP-3E Operating Support Costs per Aircraft and Fleet Size



Source: GAO analysis of Navy data. | GAO-21-101SP

Data table for EP-3E Operating Support Costs per Aircraft and Fleet Size (Constant fiscal year 2018 dollars in millions)

Fiscal year	Maintenance costs per aircraft	Other operating and support costs per aircraft
2011	2.78	16.49
2012	2.82	14.34
2013	2.81	13.67
2014	1.90	10.24
2015	1.93	16.40
2016	3.29	11.49
2017	3.75	8.83
2018	3.82	8.71

Fiscal year	Number of aircraft
2011	16
2012	15
2013	15
2014	15
2015	14
2016	12
2017	12
2018	12

Sustainment Challenges and Mitigation Actions

Maintenance: Program officials cited several challenges in sustainment of the EP-3E. First, corrosion is a major challenge, which the officials stated is being addressed through increased prevention efforts at the squadron level and additional planned depot sustainment events. Second, program officials cited the need for additional operator and maintenance training and stated that they are working with the Navy's training organizations to provide additional maintenance training courses to improve maintainer efficiency. Finally, program officials stated that sustaining the aircraft's information assurance and communication security systems has been challenging, and that the program office has issued improved instructions to assist with maintenance.

Supply Support: Program officials stated that diminishing manufacturing sources and material shortages for the avionics systems beyond 2021 is a concern, and that they are continuously working to address these shortages. In addition, program officials stated that additional funding may be needed to maintain required readiness levels as the EP-3E ages.

Program Office Comments

In commenting on a draft of this assessment, the program office provided technical comments, which we incorporated where appropriate.

Source: U.S. Navy/Mass Communication Specialist 1st Class Bryan Niegel. | GAO-21-101SP

P-8A Poseidon Sustainment Quick Look

Common Name: P-8A

Lead Service: Navy

Program Essentials

Manufacturer: Boeing

Sustainment: Depot maintenance conducted by AAR and Boeing with field maintenance conducted by Navy personnel

Program Office: Program Manager – Air 290, Naval Air Systems Command, Patuxent River, Maryland

Fiscal Year 2019 Data

Average age: 3.2 years

Average lifetime flying hours: 2,314 hours per aircraft

Depot maintenance activity and squadron locations:

▲ Depot maintenance activity location

● Squadron location

Source: GAO. | GAO-21-101SP

Sustainment Challenges and Mitigation Actions

The main challenge facing the P-8A is the difficulty of sustaining a military aircraft that is based on a commercial design. To address this issue, the Navy and Boeing entered into a technical agreement to obtain needed technical data.

Background

The P-8A Poseidon is a multimission capable aircraft with maritime, patrol, and reconnaissance capabilities that was first manufactured in 2009. The P-8A can operate independently or in conjunction with carrier strike forces and their aircraft, expeditionary strike groups, and other joint and allied assets. The P-8A conducts missions such as maritime and littoral surveillance and reconnaissance; sea control; targeting and strike support; and command, control, and communications tasks.

Life Cycle of the P-8A

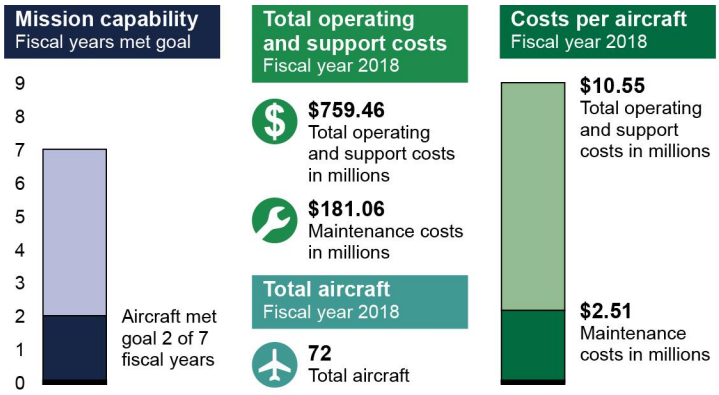
Initial Operational Capability Full Operational Capability

Source: GAO analysis of Navy data. | GAO-21-101SP

Overview

The P-8A fleet met or exceeded its mission capable goals twice from fiscal year 2013—when the Navy declared initial operational capability—through fiscal year 2019. Overall, its mission capable rate decreased during this time period. Total operating and support (O&S) costs increased—from $123.05 million in fiscal year 2013 to $759.46 million in fiscal year 2018—largely because the operating fleet grew from 14 aircraft in 2013 to 72 in 2018. In fiscal year 2018, maintenance accounted for about 24 percent of the total O&S costs and the O&S costs per aircraft was $10.55 million.

P-8A Sustainment Status



Source: GAO analysis of Navy data. | GAO-21-101SP

Data table for P-8A Sustainment Status

Mission capability	Aircraft met goal 2 of 7 fiscal years
Total operating and support costs in millions (FY18)	$759.46
Maintenance costs in millions (FY18)	$181.06
Total aircraft (FY18)	72
Total operating and support costs per aircraft in millions (FY18)	$10.55
Maintenance costs per aircraft in millions	$2.51

Sustainment Strategy

- The Life-Cycle Sustainment Plan for the P-8A was issued in 2013 and is generally focused on full-rate production and acquisition of the P-8A. The plan provides a roadmap toward achieving performance requirements and minimizing life-cycle costs. The Navy is currently upgrading the P-8A's communication, radar, and weapons, which will be incorporated into the existing P-8A architecture.
- According to program officials, sustainment of the fleet is accomplished through programmed depot maintenance, performed on a 4-year recurring cycle by contractor personnel at AAR in Indianapolis, Indiana or Boeing in Atlanta, Georgia. As the fleet grows, the planned number of depot inductions per year increases. For example, program officials told us that eight aircraft are scheduled for depot induction in 2019, while 24 are scheduled for 2024.
- Organizational maintenance support for the P-8A is conducted by Navy personnel, supplemented with a small contingent of Navy field service representatives and technical representatives. The P-8A uses a supply chain managed through Naval Supply Systems Command and the Defense Logistics Agency.

Availability and Condition

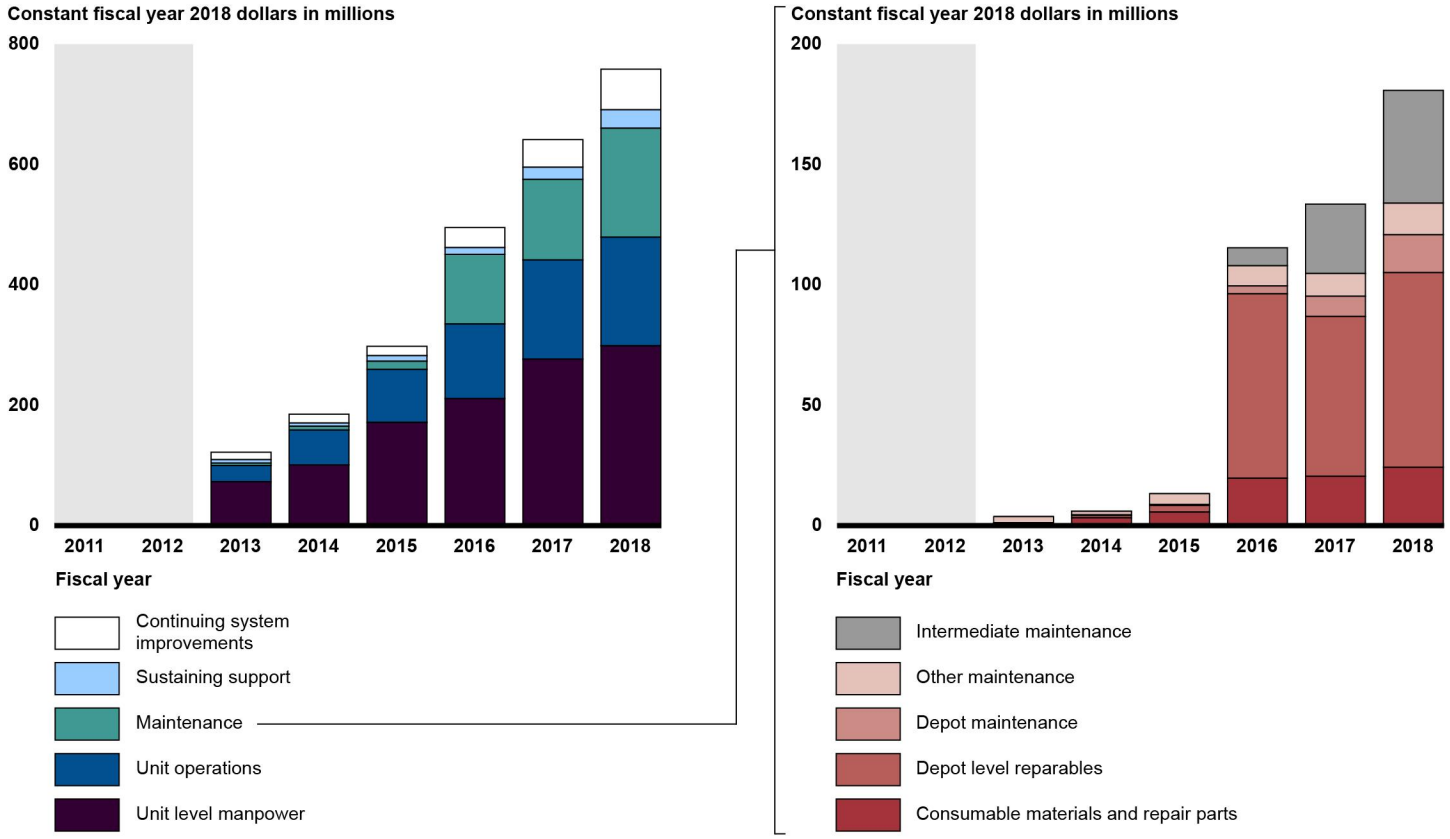
The P-8A fleet met or exceeded its mission capable goals twice from fiscal year 2013—when the Navy declared initial operational capability for the P-8A—through fiscal year 2019. Overall, its mission capable rate decreased during this time period. According to program officials, there were three main not mission capable drivers for the P-8A: conditional inspections, scheduled inspections, and the turret deployment unit. The program officials explained that the scheduled inspections were performed based on the Navy's scheduled maintenance plan. The Navy developed this plan using commercial data because the P-8A was built on a commercial aircraft frame. However, the plan has not been adequate for military usage. As the program matures, the officials said that the scheduled maintenance plan will be updated based on the Navy's P-8A usage data and the inspections should become more efficient. In addition, the Forward Turret Deployment Unit—a structure mounted to the aircraft that contains a rotating camera turret—has had a higher than expected failure rate. The officials told us that they are working to redesign this component to minimize future failures. Further, they stated that the program office has a plan for meeting the P-8A fleet's mission capable goal again by 2021. This plan includes optimizing scheduled maintenance, converting existing technical manuals into interactive electronic technical manuals, and releasing a structural repair manual.

From fiscal year 2013 through fiscal year 2019, the P-8A's rates increased for not mission capable maintenance (NMCM) and not mission capable supply (NMCS). However, the largest driver of the P-8A mission capable rate was maintenance during the time period. The NMCM rate increase was primarily due to scheduled inspections, as discussed above. Program officials also stated that the increase in the size and age of the fleet placed additional demands on the supply system, causing the NMCS rate to rise during the time period. Specific details on mission capable and not mission capable rates were omitted because the information was deemed by DOD to be sensitive.

Operating and Support Costs

Total O&S costs have increased from $123.05 million in fiscal year 2013 to about $759.46 million in fiscal year 2018. During this time period, the number of aircraft increased from 14 to 72. In fiscal year 2018, maintenance represented about 24 percent of the total O&S costs, with the majority of the maintenance costs attributed to depot level reparables. The program office stated that fleet budgets are adequate but that the program is not fully funded for sustainment operations and maintenance, which could hamper readiness efforts and decrease the mission capable rate beginning in fiscal year 2021.

P-8A Total Operating and Support Costs



Source: GAO analysis of Navy data. | GAO-21-101SP

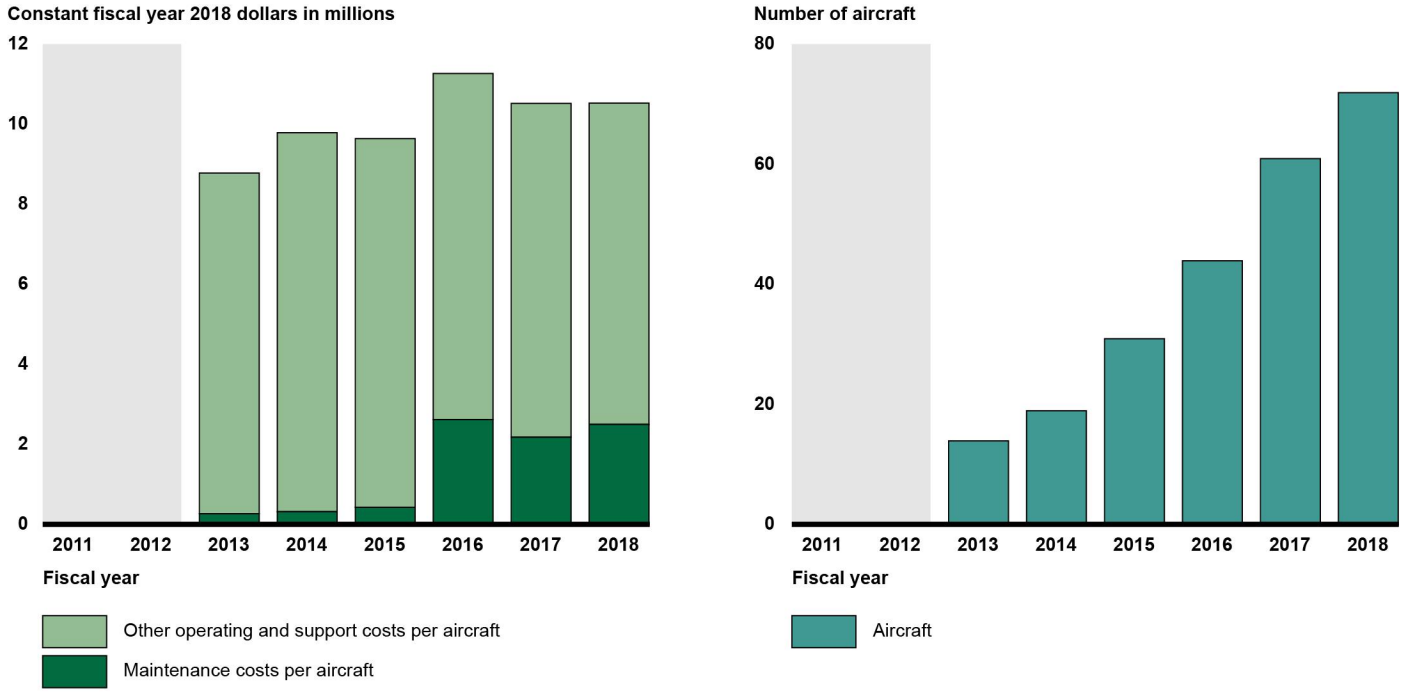
Data table for P-8A Total Operating and Support Costs (Constant fiscal year 2018 dollars in millions)

Fiscal year	Unit level manpower	Unit operations	Maintenance	Sustaining support	Continuing system improvements
2013	73.84	26.95	3.98	5.99	12.29
2014	101.88	57.95	6.26	5.48	14.57
2015	172.43	88.08	13.52	9.39	15.56
2016	212.1	123.98	115.67	11.21	33.27
2017	277.49	164.89	133.79	20.48	45.65
2018	299.61	180.67	181.06	30.71	67.41

Fiscal year	Consumable materials and repair parts	Depot level reparables	Depot maintenance	Other maintenance	Intermediate maintenance
2013	1.17	0.28	0	2.53	0
2014	3.45	0.99	0.31	1.48	0.02
2015	5.88	2.73	0.42	4.49	0
2016	19.94	76.57	3.32	8.38	7.46
2017	20.76	66.37	8.39	9.5	28.78
2018	24.49	80.81	15.75	13.18	46.83

As the P-8A fleet size increased from 14 aircraft in fiscal year 2013 to 72 aircraft in fiscal year 2018, total O&S costs per aircraft increased from $8.79 million to $10.55 million. This increase occurred largely due to the increase in maintenance costs, including consumable materials and repair parts, depot-level reparables, depot maintenance, and intermediate maintenance. During this same time period, the mission capable rate fell from 80 percent in fiscal year 2013 to 63 percent in fiscal year 2018.

P-8A Operating and Support Costs per Aircraft and Fleet Size



Source: GAO analysis of Navy data. | GAO-21-101SP

Data table for P-8A Operating and Support Costs per Aircraft and Fleet Size (Constant fiscal year 2018 dollars in millions)

Fiscal year	Maintenance costs per aircraft	Other operating and support costs per aircraft
2013	0.28	8.51
2014	0.33	9.47
2015	0.44	9.21
2016	2.63	8.65
2017	2.19	8.34
2018	2.51	8.03

Fiscal year	Number of aircraft
2013	14
2014	19
2015	31
2016	44
2017	61
2018	72

Sustainment Challenges and Mitigation Actions

Maintenance: The P-8A is a military aircraft based on a commercial design but, according to the program office, is certified under Navy airworthiness authority and sustained by Navy maintainers. According to the program office, this arrangement is challenging because technical data needed for maintenance has not been readily available to the Navy. To address this issue, the Navy recently entered into a technical data agreement with Boeing to obtain the needed technical data for maintaining the aircraft.

Supply: The Navy has had difficulty procuring parts on the commercial marketplace due to federal and military requirements for the parts that are not common in the commercial industry. In addition, according to the program office, the Navy developed initial spare parts requirements based on engineering estimates for predicted failure rates. As the program has matured, the program office has updated those requirements based on actual fleet usage. Further, the program office stated that it is actively working with Boeing to improve spare parts deliveries for the Forward Turret Deployment Unit given the higher than expected failure rates for associated parts.

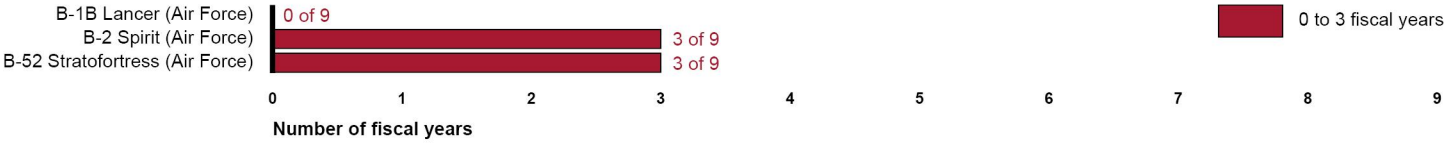
Program Office Comments

In commenting on a draft of this assessment, the program office stated that it continues to reassess the P-8A sustainment posture in order to identify and remove any barriers or constraints and implement opportunities to improve the overall readiness of the program.

Bomber aircraft

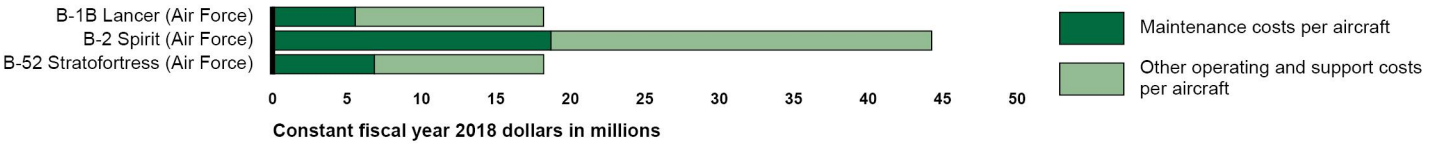
Source: U.S. Air Force/Staff Sgt. Peter Reft. | GAO-21-101SP

Number of Times Selected Bomber Aircraft Met Their Annual Mission Capable Goal, Fiscal Years 2011 through 2019



Source: GAO analysis of Air Force data. | GAO-21-101SP

Operating and Support Costs per Aircraft for Selected Department of Defense Bomber Aircraft, Fiscal Year 2018



Source: GAO analysis of Air Force data. | GAO-21-101SP

Source: U.S. Air Force/Staff Sgt. Peter Reft. | GAO-21-101SP

B-1B Lancer Sustainment Quick Look

Common Name: B-1B

Lead Service: Air Force

Program Essentials

Manufacturer: Boeing

Sustainment: Depot maintenance conducted organically at Oklahoma Air Logistics Center, Oklahoma

Program Office: Tinker Air Force Base, Oklahoma

Fiscal Year 2019 Data

Average age: 31.8 years

Average lifetime flying hours: 9,651.7 hours

Depot maintenance activity and squadron locations:

▲ Depot maintenance activity location

● Squadron location

Source: GAO. | GAO-21-101SP

Sustainment Challenges and Mitigation Actions

The B-1B faces sustainment challenges related to its age, including increased maintenance needs and difficulty finding replacement parts. To address these issues, the Air Force is making modifications to the aircraft to extend its service life and working with the Defense Logistics Agency to improve parts availability.

Background

The B-1B is a multimission weapon system that was first manufactured in 1984. It carries the largest conventional payload of both guided and unguided weapons in the Air Force inventory and can deliver precision and non-precision weapons against adversaries. The B-1B was first used in combat support of operations against Iraq during Operation Desert Fox in December 1998.

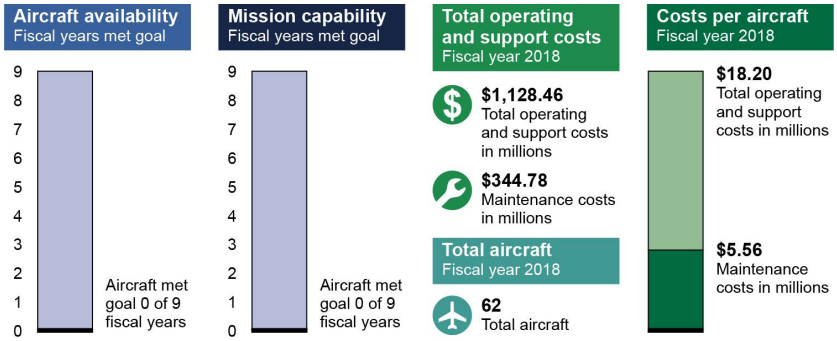
Life Cycle of the B-1B

Source: GAO analysis of Air Force data. | GAO-21-101SP

Overview

From fiscal years 2011 through 2019, the B-1B fleet did not meet any of its annual aircraft availability and mission capable goals and its aircraft availability and mission capable rates decreased. Total operating and support (O&S) costs decreased since fiscal year 2011, from about $1.84 billion to about $1.13 billion in fiscal year 2018. Further, total O&S costs per aircraft decreased during the same time period, from $27.95 million in fiscal year 2011 to $18.20 million in fiscal year 2018. According to officials, there is no one factor that led to decreasing O&S costs. However, a review of the costs shows decreasing costs for unit level operations and maintenance. Further, the B-1B was grounded in 2018 over concerns about ejection seats and in 2019 over concerns about its egress system.

B-1B Sustainment Status



Source: GAO analysis of Air Force data. | GAO-21-101SP

Data table for B-1B Sustainment Status

Aircraft availability	Aircraft met goal 0 of 9 fiscal years
Mission capability	Aircraft met goal 0 of 9 fiscal years
Total operating and support costs in millions (FY18)	$1,128.46
Maintenance costs in millions (FY18)	$344.78
Total aircraft (FY18)	62
Total operating and support costs per aircraft in millions (FY18)	$18.20
Maintenance costs per aircraft in millions	$5.56

Sustainment Strategy

- The Air Force issued the Life-Cycle Sustainment Plan for the B-1B Lancer in October 2018. This plan describes the approach and resources necessary to develop and integrate sustainment requirements into the B-1B's design, development, testing and evaluation, fielding, and operations.
- The Air Force sustains the B-1B fleet through programmed depot maintenance, which is performed on a 5-year cycle. According to the program office, the aircraft also underwent five different modification programs, including upgrades to its fuselage and integrated battle station, from 2011 to 2014.
- Depot maintenance of the B-1B is conducted organically by the Air Force at Oklahoma Air Logistics Complex, Oklahoma. The supply chain for the B-1B is managed by the Air Force's Supply Chain Management Wing.

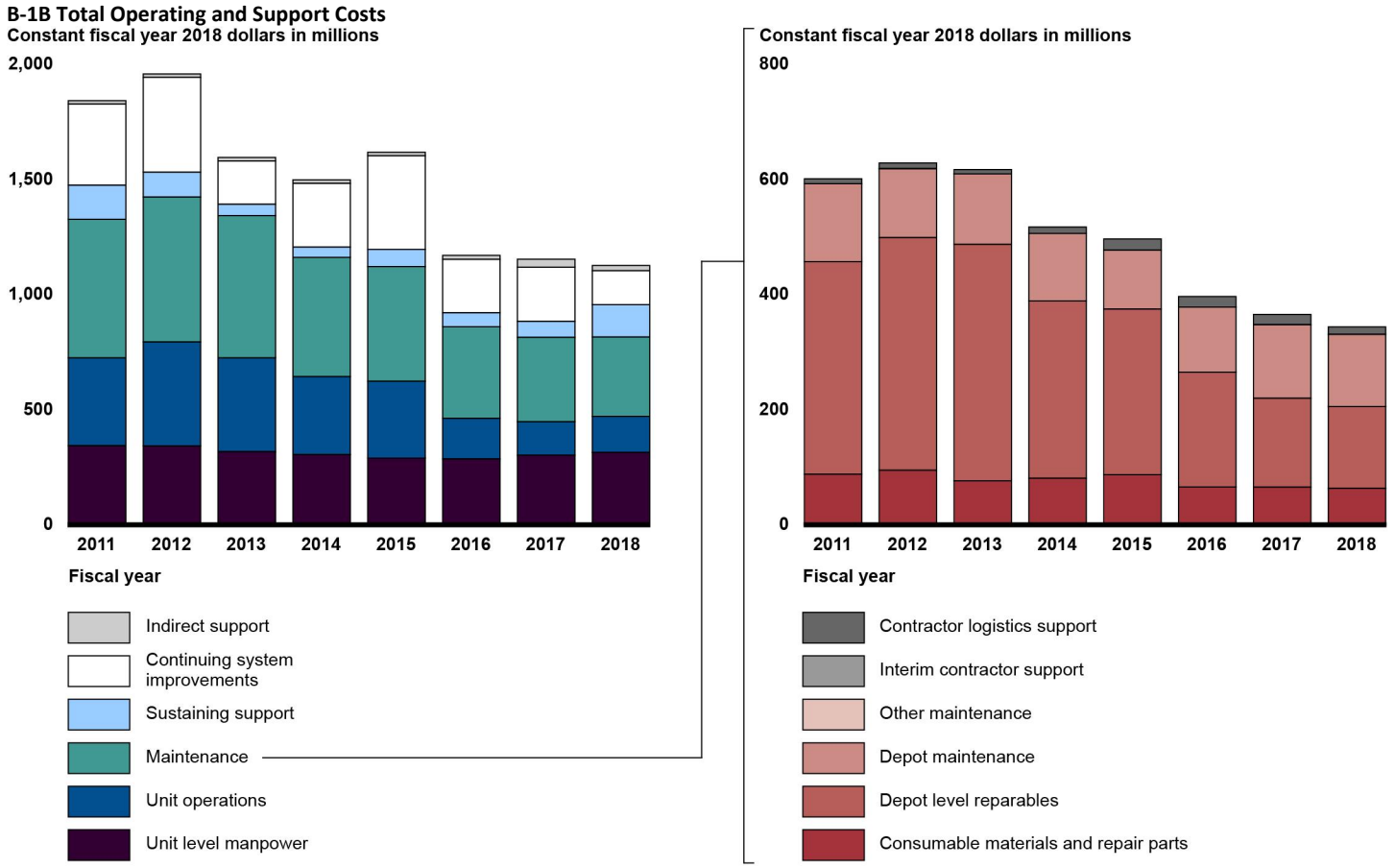
Availability and Condition

The B-1B fleet did not meet any of its annual aircraft availability and mission capable goals from fiscal year 2011 through fiscal year 2019. Both of the rates decreased during this time period. According to program officials, multiple factors contributed to the decline in aircraft availability rates, including several modification programs during 2011 to 2014 and specific inspections, repairs, and replacements conducted from 2013 to 2015. These efforts resulted in the aircraft not being available for operations and training. Program officials also said that an Aircraft Availability Improvement Plan Tiger Team was established in December 2018 to identify ways for improving overall aircraft availability. The Tiger Team is working directly with stakeholders at Barksdale Air Force Base, Louisiana; Dyess Air Force Base, Texas; and Ellsworth Air Force Base, South Dakota to find efficiencies in the B-1B repair processes to improve availability.

The largest driver of the B-2 fleet's lower mission capable rate was maintenance; the not mission capable supply rate and the not mission capable both maintenance and supply rate were both slightly lower in fiscal year 2019 than in fiscal year 2011. Program officials said that the higher not mission capable maintenance rate was primarily due to the age of the aircraft, which requires increased inspections and modifications intended to address safety and performance issues. During these inspections, which can take up to 28 days, the aircraft is not mission capable. Inspections have discovered cracks on certain aircraft antennas and flight control mechanisms that could potentially lead to safety-of-flight issues. According to Air Force officials, the Air Force has been working with local manufacturers to repair these issues. Specific details on mission capable and not mission capable rates were omitted because the information was deemed by DOD to be sensitive.

Operating and Support Costs

Total operating and support costs, along with maintenance costs, decreased from fiscal years 2011 to 2018. Program officials stated that there was no single constant driver that has driven the decrease in O&S total costs and further stated that without sustaining engineering funding, it will be difficult to keep the B-1B at an adversarial competitive advantage through modernization efforts. Maintenance and unit level manpower were the largest cost drivers for the B-1B, with maintenance accounting for about 31 percent of the total cost and unit level manpower accounting for about 28 percent of the total O&S costs in fiscal year 2018. Within maintenance, the Air Force experienced a significant decrease in the costs for depot level reparables for the B-1 fleet. According to program officials, the decrease in depot level reparables costs was due to the decrease in the number of aircraft, from 66 to 62.



Source: GAO analysis of Air Force data. | GAO-21-101SP

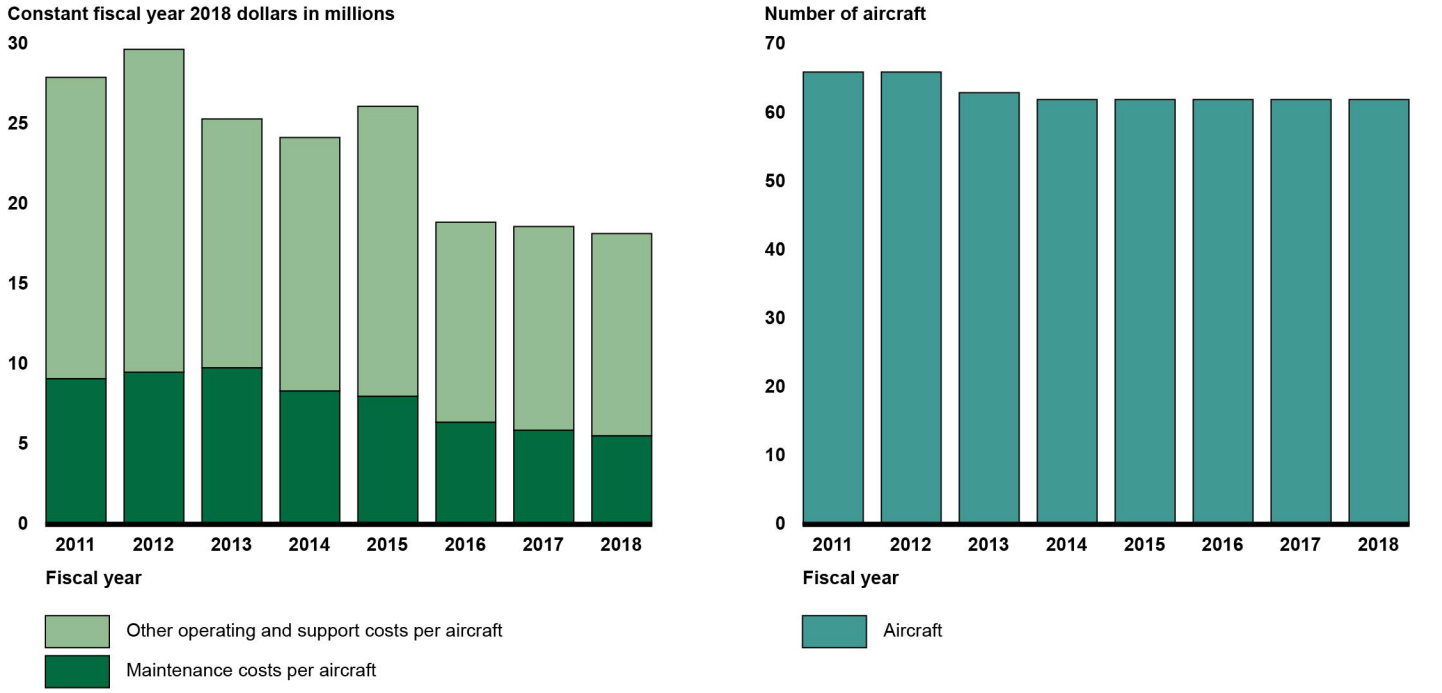
Data table for B-1B Total Operating and Support Costs (Constant fiscal year 2018 dollars in millions)

Fiscal year	Unit level manpower	Unit operations	Maintenance	Sustaining support	Continuing system improvements	Indirect support
2011	346.25	380.95	602.25	147.64	352.99	14.8
2012	344.41	452.13	629.54	107.76	412.12	14.59
2013	319.66	407.34	618.06	49.27	188.44	15.16
2014	307.18	338.49	518.45	44.23	276.86	15.56
2015	292.12	334.04	497.61	74.99	406.28	15.78
2016	288.83	176.11	397.68	60.5	232.43	17.01
2017	304.36	145.63	366.37	69.75	235	34.79
2018	316.91	156.6	344.78	140.29	147.7	22.17

Fiscal year	Consumable materials and repair parts	Depot level reparables	Depot maintenance	Other maintenance	Interim contractor support	Contractor logistics support
2011	88.87	369.21	135.44	0	0	8.73
2012	95.73	404.18	119.56	0.24	0	9.83
2013	77.21	410.95	122.47	0.03	0	7.39
2014	81.93	307.95	117.22	0	0	11.36
2015	88.04	287.71	102.36	0	0	19.49
2016	66.77	199.28	113.15	0	0	18.49
2017	66.34	154.43	127.66	0	0	17.93
2018	64.15	142.29	125.35	0	0	12.99

Total O&S costs per aircraft decreased from fiscal year 2011 to fiscal year 2018. For example, in fiscal year 2011 the total O&S costs per aircraft was $27.95 million and in fiscal year 2018 it was $18.20 million. Maintenance costs per aircraft also decreased, from $9.13 million to $5.56 million, during this time period. In addition, the mission capable and aircraft availability rates slightly dropped, as discussed above.

B-1B Operating and Support Costs per Aircraft and Fleet Size



Source: GAO analysis of Air Force data. | GAO-21-101SP

Data table for B-1B Operating and Support Costs per Aircraft and Fleet Size (Constant fiscal year 2018 dollars in millions)

Fiscal year	Maintenance costs per aircraft	Other operating and support costs per aircraft
2011	9.13	18.83
2012	9.54	20.17
2013	9.81	15.55
2014	8.36	15.84
2015	8.03	18.12
2016	6.41	12.5
2017	5.91	12.73
2018	5.56	12.64

Fiscal year	Number of aircraft
2011	66
2012	66
2013	63
2014	62
2015	62
2016	62
2017	62
2018	62

Sustainment Challenges and Mitigation Actions

Aging: According to the program office, the B-1B current average age is 31.8 years, which exceeds its original structural design life of 30 years. The program office further stated that, over time, Air Force inspections have identified several issues related to the aircraft's age, including structural issues, such as cracks in the wings. According to program officials, the B-1B was continuously deployed to South West Asia from 2011 to 2014 in support of contingency operations, and after returning in 2014, the Secretary of Defense gave a 2-year aircraft stand-down directive to the fleet to focus on sustaining the aging aircraft.

Maintenance: Program officials stated that the Air Force used the B-1B extensively in South West Asia from 2011 to 2014, causing stress on this aging system. In addition, program officials stated that emerging and unplanned requirements found during aircraft structural integrity program inspections increased the maintenance hours necessary to repair the aircraft. For example, during Full Scale Fatigue Testing, structural issues were found on the fuselage. Actions to address these issues include partial rib replacement and replacement of the forward intermediate fuselage substructure and skins (i.e., surface of the aircraft).

Supply: According to program officials, additional maintenance requirements were sometimes difficult to address in the past due to challenges in locating replacement parts for this aging weapon system. To address the shortage in replacement parts, the program office is working with the Air Logistics Complexes and the Defense Logistics Agency to improve parts production and availability.

Program Office Comments

In commentating on a draft of this assessment, the program office provided technical comments, which we incorporated where appropriate.

Source: U.S. Air Force/Master Sgt. Russell Scalf. | GAO-21-101SP

B-2 Spirit Sustainment Quick Look

Common Name: B-2

Lead Service: Air Force

Program Essentials

Manufacturer: Northrop Grumman

Sustainment: Depot maintenance is performed by Air Force personnel, and contractor support and supply are managed by the Air Force

Program Office: Wright-Patterson Air Force Base, Ohio

Fiscal Year 2019 Data

Average age: 25.9 years

Average lifetime flying hours: 7,247 hours per aircraft

Depot maintenance activity and squadron locations:

▲ Depot maintenance activity location

● Squadron location

Source: GAO. | GAO-21-101SP

Sustainment Challenges and Mitigation Actions

The B-2 faces sustainment challenges related to supply of needed parts and maintenance of its low-observable coating. The program office is working to increase the availability of parts and has implemented a program to improve low-observable maintenance.

Background

The B-2 Spirit is a multirole bomber first manufactured in 1988 and capable of delivering both conventional and nuclear munitions. The B-2's low-observable, or stealth, characteristics give it the ability to penetrate an enemy's defenses. The B-2 is currently undergoing a modernization process to include upgrades to its targeting, missile, and antenna systems.

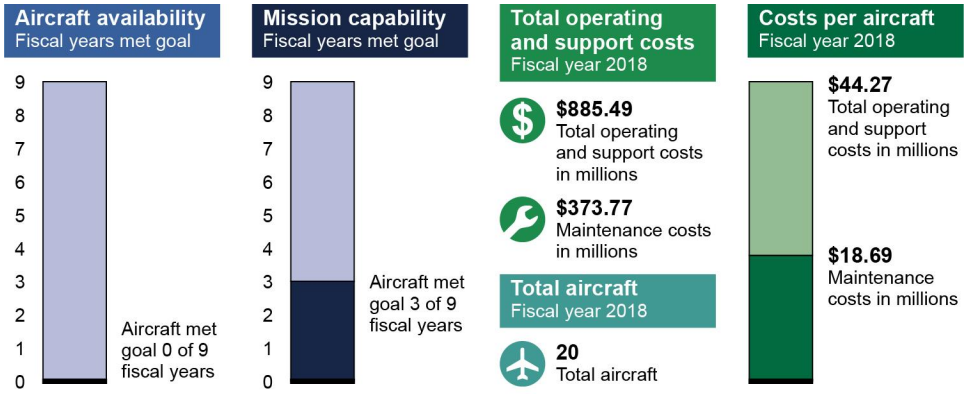
Life Cycle of the B-2

Source: GAO analysis of Air Force data. | GAO-21-101SP

Overview

From fiscal years 2011 through 2019, the B-2 fleet's aircraft availability and mission capable rates increased. The fleet did not meet any of its annual aircraft availability goals and met or exceeded its annual mission capability goals in 3 of the 9 years during this time period. Total operating and support (O&S) costs remained stable over the past several years, averaging around $860 million per year, though costs were above this amount in fiscal years 2012 and 2018. In fiscal year 2018 O&S costs totaled $885.49 million, with about 42 percent, or $373.77 million, spent on maintenance. Total O&S costs per aircraft increased slightly, from $42.97 million in fiscal year 2011 to $44.27 million in fiscal year 2018, and maintenance costs per aircraft also increased slightly during this same time period, from $17.76 million per aircraft to $18.69 million. The B-2 is currently undergoing several upgrades to various systems. The Air Force plans to use the aircraft until at least 2030.

B-2 Sustainment Status



Source: GAO analysis of Air Force data. | GAO-21-101SP

Data table for B-2 Sustainment Status

Aircraft availability	Aircraft met goal 0 of 9 fiscal years
Mission capability	Aircraft met goal 3 of 9 fiscal years
Total operating and support costs in millions (FY18)	$885.49
Maintenance costs in millions (FY18)	$373.77
Total aircraft (FY18)	20
Total operating and support costs per aircraft in millions (FY18)	$44.27
Maintenance costs per aircraft in millions	$18.69

Sustainment Strategy

- The Life Cycle Sustainment Plan for the B-2 (July 2019) describes the program's sustainment strategy as focusing on parts obsolescence management, cybersecurity concerns, and maintaining the low-observable capacity of the aircraft, among other things. The plan also describes the structure and responsibilities for depot maintenance.
- Sustainment of the B-2 fleet is accomplished through programmed depot maintenance, which is performed on a 9-year cycle, with two aircraft entering programmed depot maintenance each fiscal year. The aircraft is also undergoing several modifications, including to its communications, navigation, and weapon systems and the program office is working to conduct these modifications concurrently with programmed depot maintenance.
- Depot maintenance on the B-2 is conducted by Northrop Grumman. The supply chain for the B-2 is managed by the Air Force's Supply Chain Management Wing.

Availability and Condition

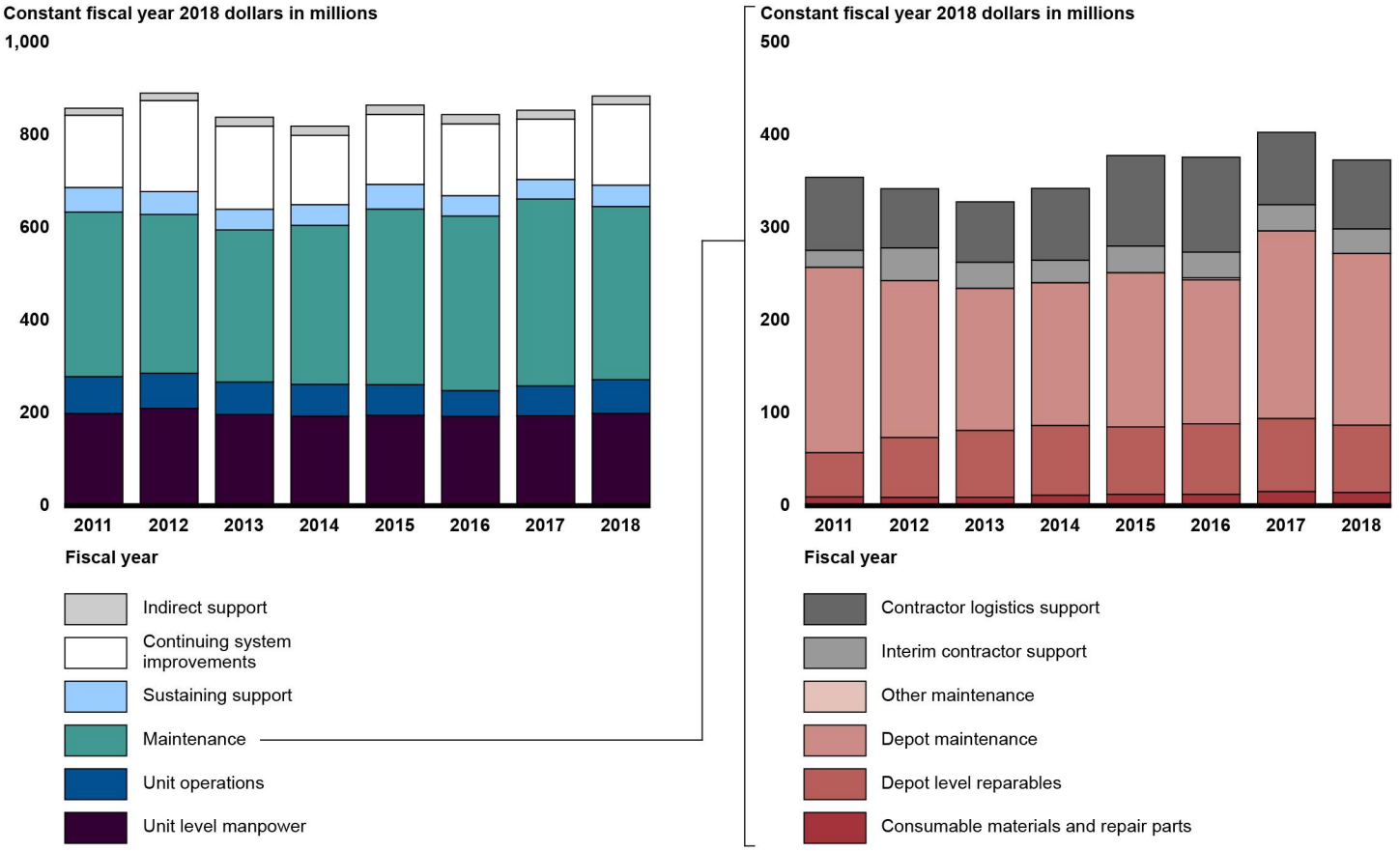
The B-2 fleet's aircraft availability rate increased from fiscal years 2011 through 2019, but the aircraft did not meet any of its annual aircraft availability goals during the time period. The B-2 fleet did not meet any of its availability goals even though the Air Force's Global Strike Command lowered the B-2's aircraft availability goal in fiscal year 2018 to better align with operational plans, according to program officials. The B-2's mission capable rate also increased from fiscal year 2011 to fiscal year 2019, and the fleet met or exceeded its mission capable goals in 3 of the 9 fiscal years during the time period.

The B-2 fleet's not mission capable maintenance and not mission capable supply rates both decreased from fiscal years 2011 through 2019 and contributed to the increase in the mission capable rate. Program office officials attributed the increase in the B-2 fleet's mission capable rate to efforts to improve maintenance of the low-observable coating, the the responsiveness of the supply chain, and a reduction in the programmed depot maintenance cycle time. Specific details on mission capable and not mission capable rates were omitted because the information was deemed by DOD to be sensitive.

Operating and Support Costs

Operating and support costs for the B-2 remained stable—around $860 million a year—from fiscal year 2011 until they increased slightly in fiscal year 2018. Maintenance was the largest cost driver, accounting for about 42 percent of the total cost in fiscal year 2018.

B-2 Total Operating and Support Costs



Source: GAO analysis of Air Force data. | GAO-21-101SP

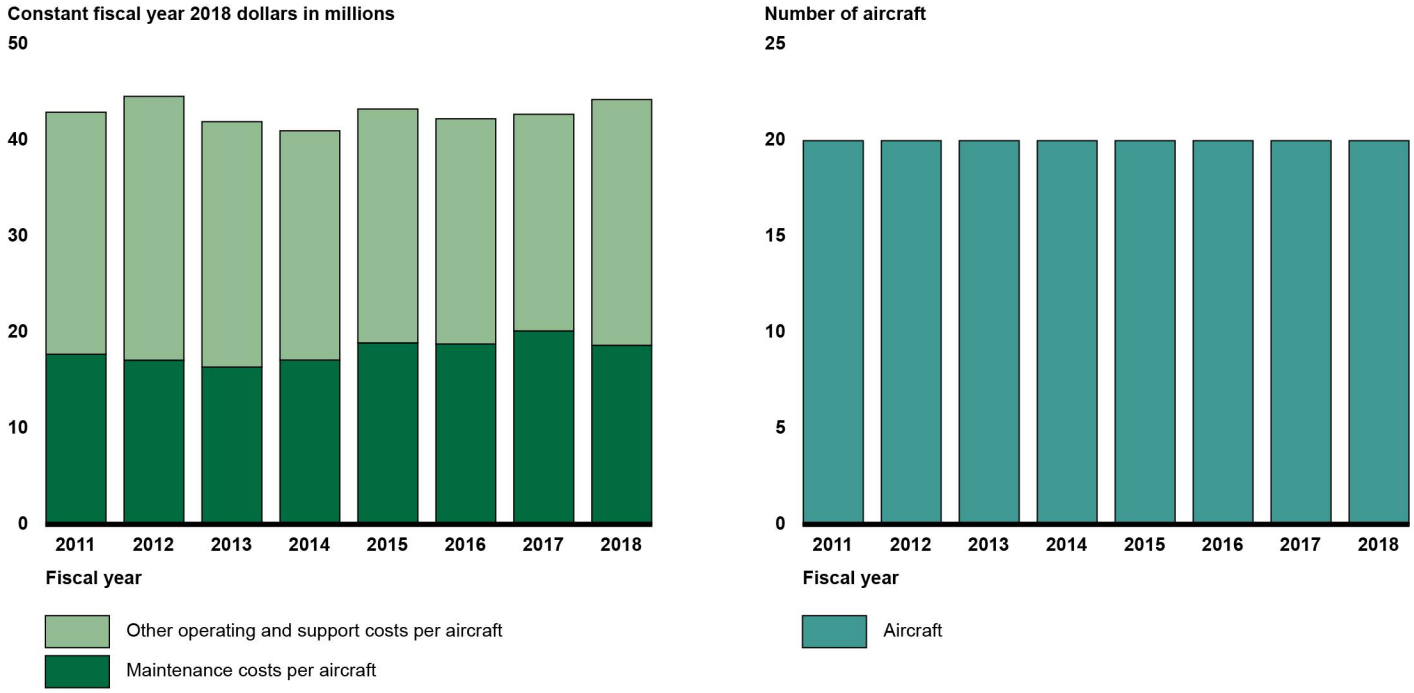
Data table for B-2 Total Operating and Support Costs (Constant fiscal year 2018 dollars in millions)

Fiscal year	Unit level manpower	Unit operations	Maintenance	Sustaining support	Continuing system improvements	Indirect support
2011	199.92	79.77	355.14	53.3	155.75	15.42
2012	211.3	75.76	342.78	49.41	196.46	16.43
2013	198.03	69.95	328.67	44.32	179.48	19.49
2014	194.36	68.6	343.22	44.84	149.56	20.05
2015	196.3	66.15	378.73	53.59	151	20.15
2016	194.09	55.27	376.87	44.15	154.92	20.45
2017	195.42	64.31	403.61	41.85	130.51	19.22
2018	200.21	72.91	373.77	46.1	174.23	18.28

Fiscal year	Consumable materials and repair parts	Depot level reparables	Depot maintenance	Other maintenance	Interim contractor support	Contractor logistics support
2011	9.93	47.97	199.91	0	18.3	79.03
2012	9.46	64.72	169.26	0	35.39	63.95
2013	9.69	72.09	153.45	0	28.02	65.41
2014	11.87	75.35	153.93	0	24.3	77.78
2015	12.83	72.8	166.3	0	28.86	97.94
2016	12.76	76.25	155.27	2.15	27.96	102.49
2017	15.84	78.86	202.4	0.02	28.39	78.09
2018	14.87	72.65	185.27	0.04	26.47	74.46

Total O&S costs per aircraft and maintenance costs per aircraft for the B-2 slightly increased over the 7 year period. Total O&S costs per aircraft rose from $42.97 million in fiscal year 2011 to $44.27 million in fiscal year 2018. Maintenance costs per aircraft increased from $17.76 million per aircraft to $18.69 million during this time period. The number of aircraft in the B-2 fleet remained at 20 since fiscal year 2011.

B-2 Operating and Support Costs per Aircraft and Fleet Size



Source: GAO analysis of Air Force data. | GAO-21-101SP

Data table for B-2 Operating and Support Costs per Aircraft and Fleet Size (Constant fiscal year 2018 dollars in millions)

Fiscal year	Maintenance costs per aircraft	Other operating and support costs per aircraft
2011	17.76	25.21
2012	17.14	27.47
2013	16.43	25.56
2014	17.16	23.87
2015	18.94	24.36
2016	18.84	23.44
2017	20.18	22.57
2018	18.69	25.59

Fiscal year	Number of aircraft
2011	20
2012	20
2013	20
2014	20
2015	20
2016	20
2017	20
2018	20

Sustainment Challenges and Mitigation Actions

Supply: Program office officials told us that they have had difficulty obtaining needed parts from the supply chain because the B-2 is a low-density, high-demand fleet. According to program office officials, because of the low number of aircraft in the B-2 fleet, there is less demand for suppliers to build parts, resulting in decreased parts availability. This parts shortage routinely leads to cannibalization—that is, taking a part from one aircraft and using it on another—of aircraft in depot. While this process fixes an immediate need, it is also inefficient. The B-2 program office has been working with the Air Force's Supply Chain Management Wing to address this issue. Supply chain

improvement efforts include redesigning obsolete hardware to ensure that aging parts are procurable and reparable for the future.

Maintenance: A unique sustainment challenge of the B-2 is the maintenance of the low-observable coating. The program implemented several projects aimed at maintaining the stealth capability of the B-2 by monitoring, maintaining, and enhancing the signature of the aircraft. In addition to these specific sustainment efforts, the program must assess the impact of any modifications to the low-observable coating early in the planning stages.

Program Office Comments

In commenting on a draft of this assessment, the program office provided technical comments, which we incorporated where appropriate.

Source: U.S. Air National Guard/Tech. Sgt. Daniel Gagnon. | GAO-21-101SP

B-52 Stratofortress Sustainment Quick Look

Common Name: B-52

Lead Service: Air Force

Program Essentials

Manufacturer: Boeing

Sustainment: Depot maintenance conducted organically at the designated air logistics complex and contractually for some depot-level repairs at contractor facilities

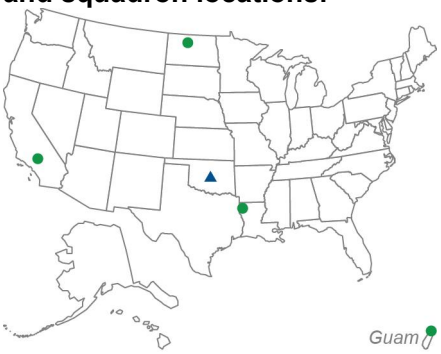
Program Office: Tinker Air Force Base, Oklahoma

Fiscal Year 2019 Data

Average age: 59 years

Average lifetime flying hours: 19,786 hours per aircraft

Depot maintenance activity and squadron locations:



▲ Depot maintenance activity location

● Squadron location

Source: GAO. | GAO-21-101SP

Sustainment Challenges and Mitigation Actions

The B-52 faces sustainment challenges related to its age, and, according to officials, parts are difficult to obtain. Several modification efforts are underway, including a replacement of the engine.

Background

The B-52 Stratofortress is a long-range, heavy bomber that can perform a variety of missions, including strategic attack, close air support, air interdiction, maritime operations, and offensive counter-air missions. It can carry nuclear or precision-guided conventional ordnance with worldwide precision navigation capability. The B-52 has been operating for over 65 years and the Air Force plans to continue operating it into the 2050s, making it one of the longest serving aircraft in the Air Force.

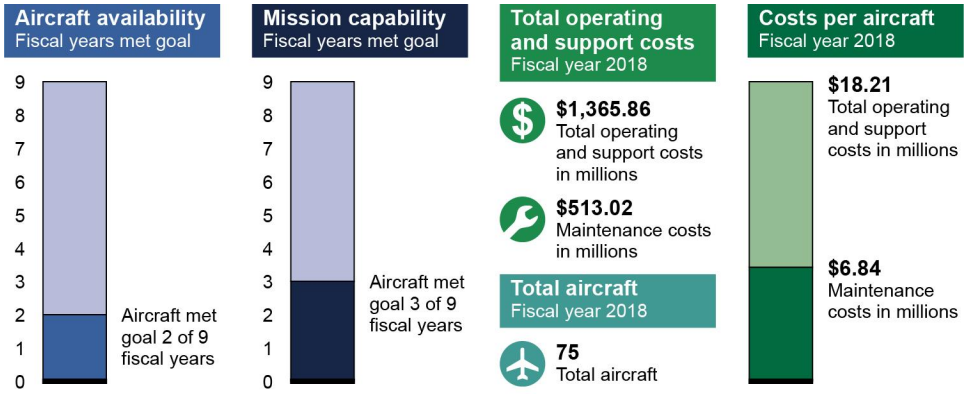
Life Cycle of the B-52

Source: GAO analysis of Air Force data. | GAO-21-101SP

Overview

From fiscal years 2011 through 2019, the B-52 fleet met or exceeded its annual aircraft availability goals in 2 of the 9 years, and met or exceeded its annual mission capable goals in 3 of the 9 years. Both rates decreased during the time period. Total operating and support costs remained relatively stable from fiscal years 2016 through 2018, hovering around $1.3 billion per year. For example, in fiscal year 2018 operating and support (O&S) costs totaled $1.37 billion, with 38 percent, or $513.02 million, spent on maintenance. Total operating and support costs per aircraft increased slightly since fiscal year 2011, from $16.91 million to $18.21 million. Maintenance cost per aircraft also slightly increased, from $5.85 million to $6.84 million. The percentage of costs spent on maintenance increased slightly, from 35 percent in fiscal year 2011 to 38 percent in fiscal year 2018.

B-52 Sustainment Status



Source: GAO analysis of Air Force data. | GAO-21-101SP

Data table for B-52 Sustainment Status

Aircraft availability	Aircraft met goal 2 of 9 fiscal years
Mission capability	Aircraft met goal 3 of 9 fiscal years
Total operating and support costs in millions (FY18)	$1,365.86
Maintenance costs in millions (FY18)	$513.02
Total aircraft (FY18)	75
Total operating and support costs per aircraft in millions (FY18)	$18.21
Maintenance costs per aircraft in millions	$6.84

Sustainment Strategy

- The Air Force accomplishes core sustainment of the fleet through programmed depot maintenance, which it performs on a 4-year cycle, with 17 aircraft entering the program depot maintenance each fiscal year. The B-52 package includes inspections of critical structures and systems, with repairs conducted as needed along with known, incoming defects requiring repair or replacement. The B-52 originally had a planned service life of approximately 20 years. However, the Air Force now plans to sustain the B-52 until at least 2050.
- The B-52H – Weapon System O&S Program Life-Cycle Sustainment Plan, issued in October 2018, describes the approach and resources necessary to develop and integrate sustainment requirements into the weapon system's design, development, testing and evaluation, fielding, and operations. The life-cycle sustainment plan's goal is to ensure that sustainment considerations are integrated into all planning, implementation, management, and oversight activities of the B-52 across its life cycle. The plan also refers to several recent and ongoing modification programs for the B-52, including upgrades to the weapons bay, modernization of the radar system, and replacement of the engine.

Availability and Condition

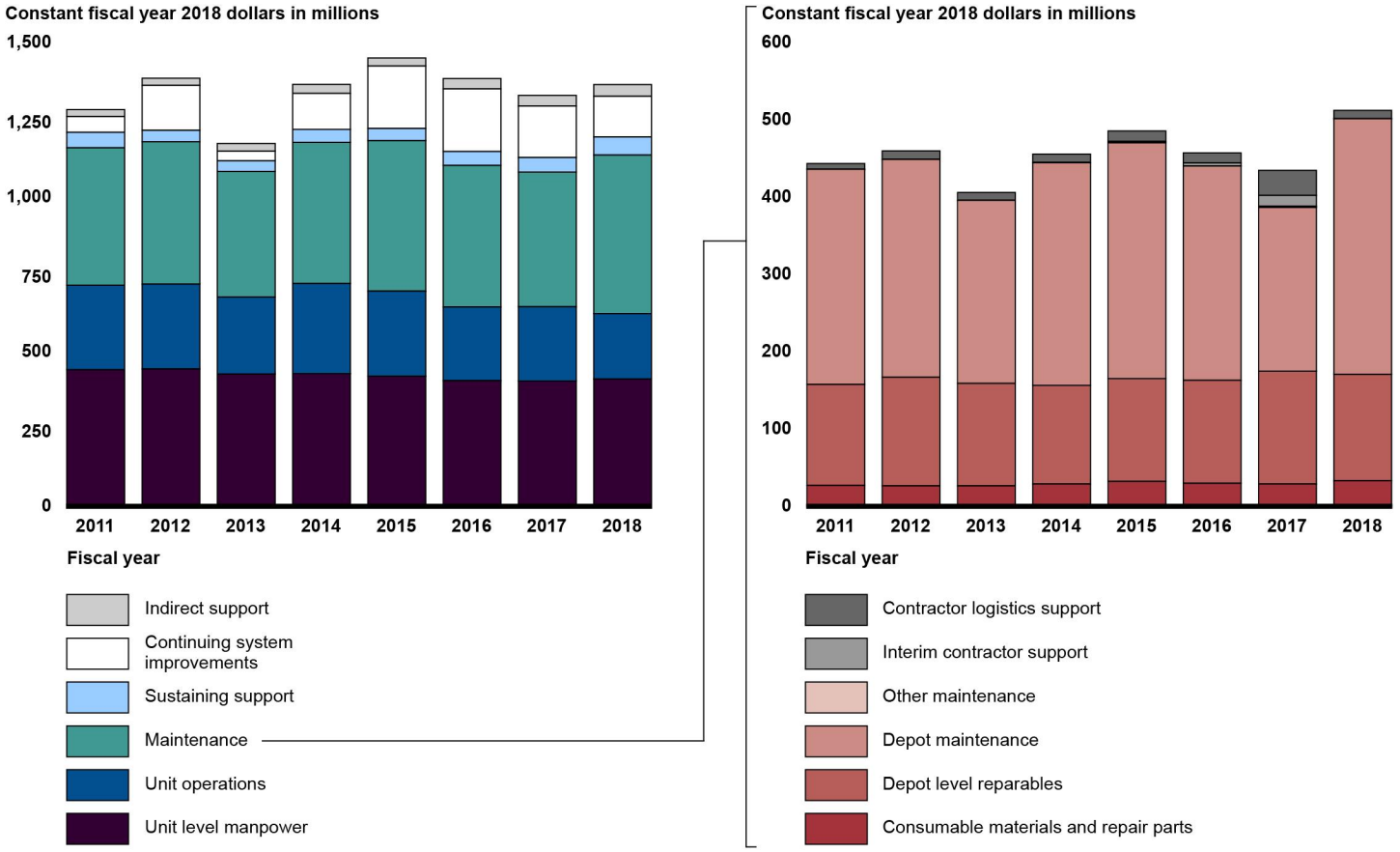
The B-52 fleet met or exceeded its annual aircraft availability goals in 2 of the 9 years, and met or exceeded its mission capable goals in 3 of the 9 years, from fiscal years 2011 through 2019. Additionally, the B-52 fleet was close to meeting its aircraft availability goal in another fiscal year. Both the aircraft availability and mission capable rates decreased during the time period. According to program officials, the decreasing aircraft availability and mission capable rates were related to engine issues and modifications of the aircraft. Further, the aircraft is experiencing structural issues due to its age. The program office is working closely with the Department of Defense and industry experts to address these issues through scheduled maintenance and modifications.

The largest driver of the B-52's mission capable rate from fiscal years 2011 through 2019 was maintenance. The not mission capable maintenance rate increased during the time period, while the rate for not mission capable supply was variable and almost the same in fiscal year 2019 and fiscal year 2011. According to program officials, the B-52's largest maintenance driver was the aircraft's engine. Specific details on mission capable and not mission capable rates were omitted because the information was deemed by DOD to be sensitive.

Operating and Support Costs

Total O&S costs for the B-52 remained relatively steady at around $1.3 billion from fiscal years 2016 through 2019. Maintenance accounted for 38 percent, or $513.02 million, of the total cost in fiscal year 2018.

B-52 Total Operating and Support Costs



Source: GAO analysis of Air Force data. | GAO-21-101SP

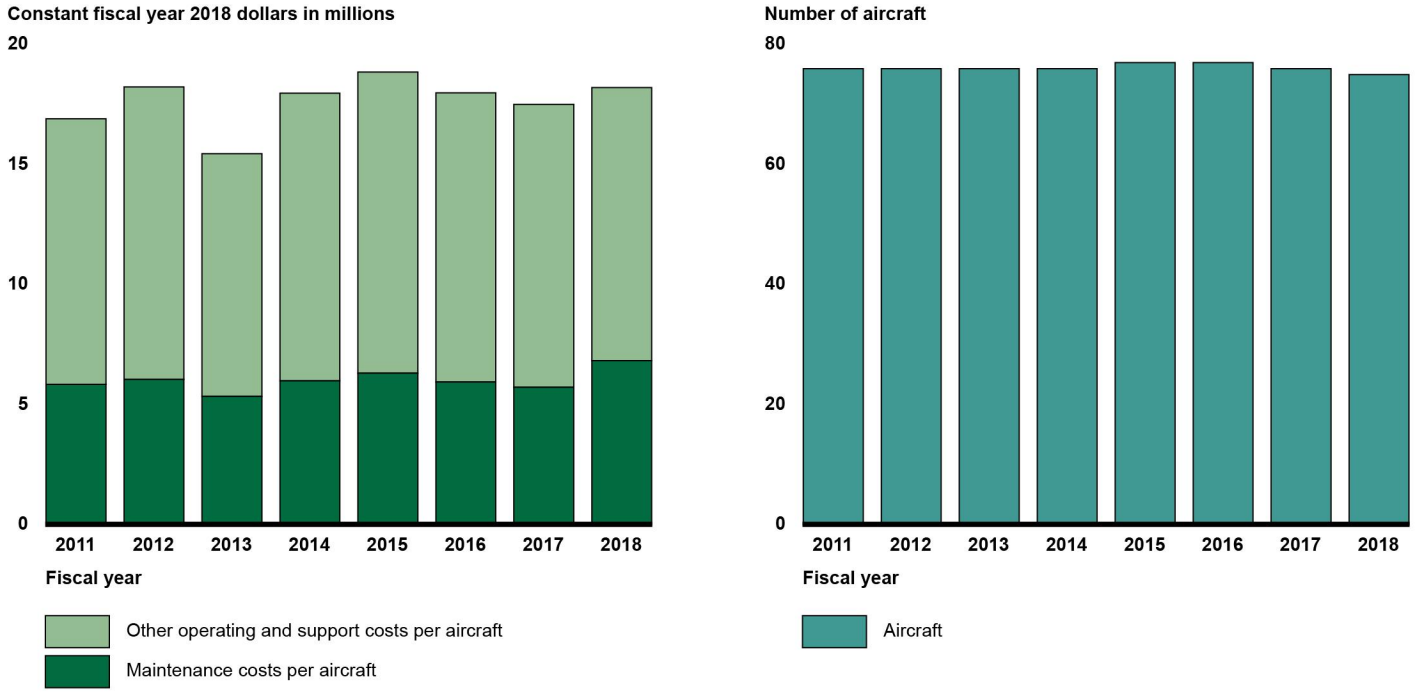
Data table for B-52 Total Operating and Support Costs (Constant fiscal year 2018 dollars in millions)

Fiscal year	Unit level manpower	Unit operations	Maintenance	Sustaining support	Continuing system improvements	Indirect support
2011	443.24	273.98	444.29	49.94	51.25	22.27
2012	446.19	274.24	460.67	36.63	145.58	23.06
2013	429.29	249.09	406.77	34.39	30.99	24.84
2014	431.17	291.43	456.33	42	116.52	29.07
2015	422.52	275.3	486.44	39.74	201.84	26.19
2016	408.35	237.94	458.02	44.98	202.79	33.17
2017	406.76	240.77	435.33	46.91	166.75	34.24
2018	413.42	211.66	513.02	58.24	131.67	37.84

Fiscal year	Consumable materials and repair parts	Depot level reparables	Depot maintenance	Other maintenance	Interim contractor support	Contractor logistics support
2011	27.77	130.61	278.43	0.04	0	7.44
2012	27.26	140.46	281.92	0	0	11.03
2013	27.1	132.62	236.88	0	0	10.17
2014	29.61	127.61	288.04	0.38	0	10.69
2015	32.95	132.96	305.09	1.58	0.14	13.73
2016	30.55	133.2	277.32	0	3.84	13.11
2017	29.62	145.94	211.93	1.46	13.95	32.43
2018	33.89	137.59	330.69	0.05	0	10.8

Costs per aircraft increased slightly since fiscal year 2011. Specifically, in fiscal year 2011 O&S costs per aircraft were $16.91 million, and in fiscal year 2018 they were $18.21 million. Maintenance costs were the largest percentage of overall costs and fluctuated year to year during this time period, resulting in an increase from $5.85 million per aircraft in fiscal year 2011 to $6.84 million per aircraft in fiscal year 2018.

B-52 Operating and Support Costs per Aircraft and Fleet Size



Source: GAO analysis of Air Force data. | GAO-21-101SP

Data table for B-52 Operating and Support Costs per Aircraft and Fleet Size (Constant fiscal year 2018 dollars in millions)

Fiscal year	Maintenance costs per aircraft	Other operating and support costs per aircraft
2011	5.85	11.06
2012	6.06	12.18
2013	5.35	10.11
2014	6	11.98
2015	6.32	12.54
2016	5.95	12.04
2017	5.73	11.78
2018	6.84	11.37

Fiscal year	Number of aircraft
2011	76
2012	76
2013	76
2014	76
2015	77
2016	77
2017	76
2018	75

Sustainment Challenges and Mitigation Actions

Aging and Maintenance: The B-52 is experiencing stress and fatigue in its airframe and components, as the B-52 is one of the oldest systems operating in the Air Force. For example,

- B-52 program officials cited a 40 percent increase in landing gear structural cracks in recent years. Maintainers also identified cracks in the lower segment, a beam providing airframe structural support. Many of these stress and fatigue issues require an engineering solution because manufacturers and vendors are either no longer available or not cost-effective. When these issues are first identified, significant time is required to formulate the correct solution. Over time, the repairs become more routine and efficient. For example, maintainers said that the first repair of the landing gear structure took 90 days but is now taking about 30 days. Also, B-52 program officials plan to continue working with vendors and their engineering support to find solutions for issues such as the beam in the lower segment and to buy spare parts in advance.
- The B-52 communications suite was first designed in the 1940s. Officials said that the upgrade to the new system requires 7,000 work hours for installation per plane and is challenging to complete during programmed depot maintenance.
- The B-52 also has issues with stress and fatigue of its engine. In January 2017 an engine failed in flight. To keep the aircraft flying, Congress and the Air Force have agreed to allocate $1.466 billion in development spending for new engines for the B-52 aircraft, with initial operational capability scheduled for fiscal year 2027.

Supply Support: Department of Defense supply-chain managers sometimes have difficulty finding sources of supply for the B-52 because original manufacturers may not make the parts and obtaining repair parts can sometimes take years. The program office is working on developing a Diminishing Manufacturing Sources and Material Shortages Plan to address parts obsolescence issues.

Program Office Comments

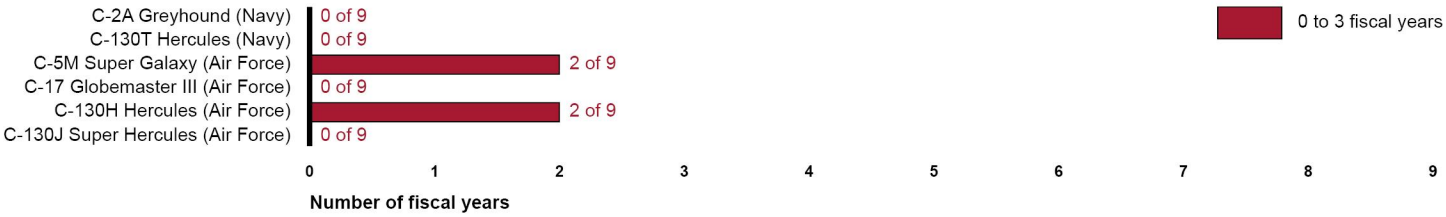
In commenting on a draft of this assessment, the program office provided technical comments, which we incorporated where appropriate.

Cargo aircraft

C-17 Globemaster III

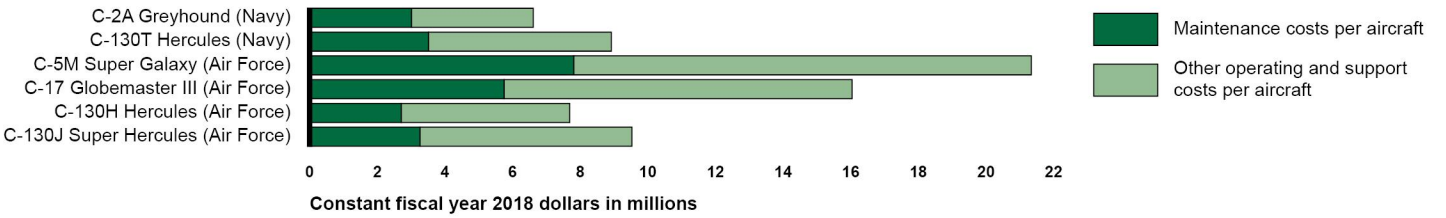
Source: U.S. Air Force/Senior Airman Christopher Quail. | GAO-21-101SP

Number of Times Selected Cargo Aircraft Met Their Annual Mission Capable Goal, Fiscal Years 2011 through 2019



Source: GAO analysis of Navy and Air Force data. | GAO-21-101SP

Operating and Support Costs per Aircraft for Selected Department of Defense Cargo Aircraft, Fiscal Year 2018



Source: GAO analysis of Navy and Air Force data. | GAO-21-101SP

Source: U.S. Navy/Petty Officer 3rd Class Christopher Gaines. | GAO-21-101SP

C-2A Greyhound Logistics Aircraft Sustainment Quick Look

Common Name: C-2A
Lead Service: Navy

Program Essentials

Manufacturer: Grumman Corporation (acquired by Northrop Grumman)
Sustainment: Depot maintenance conducted at Navy Fleet Readiness Centers; and field maintenance conducted by Navy maintainers
Program Office: Program Manager – Air 231, Naval Air Systems Command, Patuxent River, Maryland

Fiscal Year 2019 Data

Average age: 32.2 years
Average lifetime flying hours: 10,677 hours per aircraft
Depot maintenance activity and squadron locations:

▲ Depot maintenance activity location
● Squadron location

Source: GAO. | GAO-21-101SP

Sustainment Challenges and Mitigation Actions

The C-2A is operating beyond its planned service life with maintenance and supply challenges. Actions to mitigate these challenges include moving aircraft to deploying squadrons, and locating other vendors for parts.

Background

The C-2A Greyhound Logistics Aircraft is a twin-engine monoplane cargo aircraft first manufactured in 1965. It is designed to land on aircraft carriers and provide logistics support to Carrier Strike Groups, such as transporting high-priority cargo and passengers.

Life Cycle of the C-2A

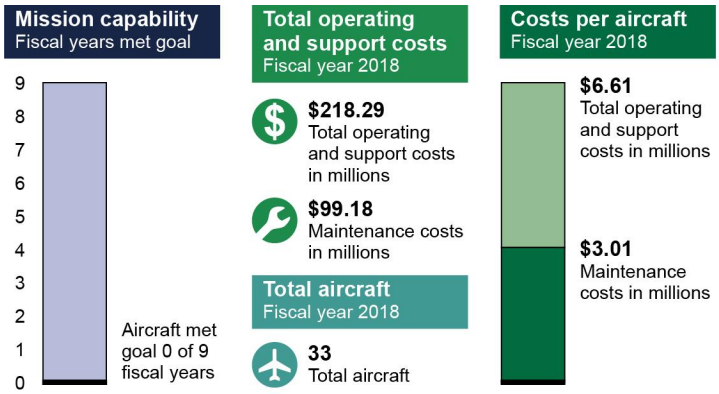
It is unknown when the C-2A Greyhound reached initial and full operational capability.

Source: GAO analysis of Navy data. | GAO-21-101SP

Overview

From fiscal years 2011 through 2019, the C-2A fleet did not meet any of its annual mission capability goals and its mission capable rate decreased. The C-2A's mission capable rate decreased because of unexpected and extensive repairs on landing gears and outer wing panels, according to program officials. Total operating and support (O&S) costs generally decreased from about $239.77 million in fiscal year 2011 to about $218.29 million in fiscal year 2018. Specifically, unit-level manpower, unit operations, and continuing system improvements costs decreased, while maintenance costs fluctuated during the period. In fiscal year 2018, maintenance costs per aircraft accounted for almost half of the total costs per aircraft because, according to officials, of an increase in overall repairs to the aging aircraft.

C-2A Sustainment Status



Source: GAO analysis of Navy data. | GAO-21-101SP

Data table for C-2A Sustainment Status

Mission capability	Aircraft met goal 0 of 9 fiscal years
Total operating and support costs in millions (FY18)	$218.29
Maintenance costs in millions (FY18)	$99.18
Total aircraft (FY18)	33
Total operating and support costs per aircraft in millions (FY18)	$6.61
Maintenance costs per aircraft in millions	$3.01

Sustainment Strategy

- Sustainment planning for the C-2A is focused on providing support for major components, such as the engine, landing gear, and avionics system, among others. According to officials, since the C-2A has a similar airframe to the E-2D Advanced Hawkeye Early Warning and Control Aircraft, they will include an appendix for the C-2A when they update the sustainment strategy for the E-2D for its 5-year update in fiscal year 2020.
- The original C-2A aircraft were overhauled to extend their operational life in 1973 and again from 2004 through 2011. The Navy completed the service life extension program from 2004 through 2011 to increase flight hours from 10,000 to 15,000 and landings from 16,020 to 36,000, among other things.
- The Navy Fleet Readiness Centers maintain the aircraft using planned maintenance intervals, which typically occurs every 24 months. Also, the Naval Supply Systems Command and Defense Logistics Agency provide supply support for the aircraft.

Availability and Condition

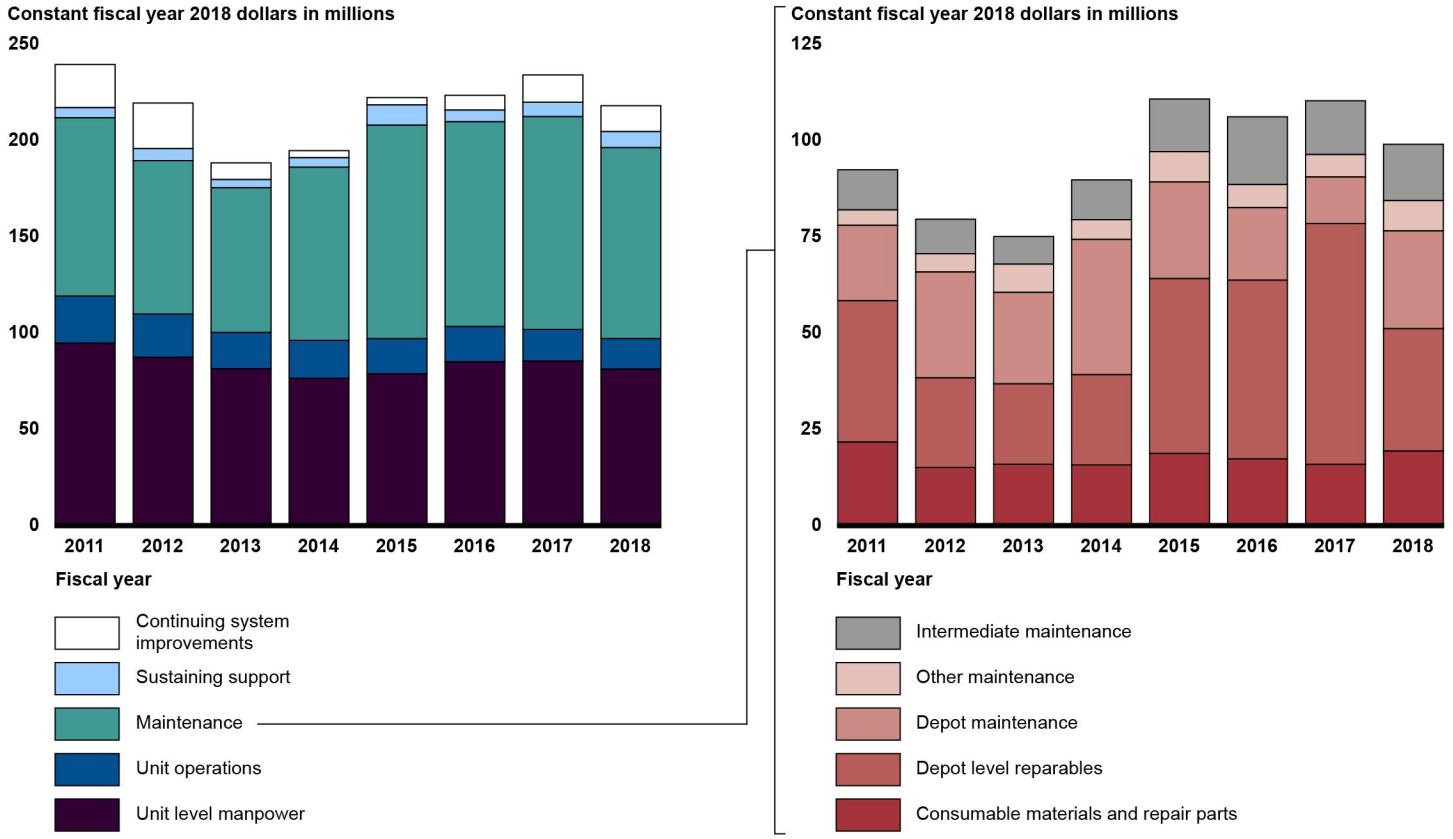
From fiscal year 2011 through fiscal year 2019, the C-2A fleet missed all of its annual mission capable goals and its mission capable rate decreased. According to officials, the Navy did not focus on mission capable rates as a key metric in the past. While the Navy has renewed its focus on improving C-2A mission capability and made some improvements in the C-2A mission capable rate, program officials said that meeting the goal continues to be a challenge. However, they told us that they believe the program will be able to meet the goal beginning in 2021.

From fiscal year 2011 through fiscal year 2019, the rates increased for not mission capable maintenance and not mission capable supply (NMCS). According to officials, the NMCS rate increased because the supply system was not prepared for the immediate increase in demand for parts that resulted from the efforts to reach the mission capable goal. Officials told us that the not mission capable rates can also fluctuate due to unexpected repairs, such as extensive repairs on landing gears and outer wing panels. Specific details on mission capable and not mission capable rates were omitted because the information was deemed by DOD to be sensitive.

Operating and Support Costs

From fiscal year 2011 through fiscal year 2018, the C-2A's total O&S costs fluctuated. Maintenance costs accounted for the largest share of O&S costs over the period, averaging about $95.53 million per year, or 44 percent of total O&S cost, but also fluctuated. According to officials, sustainment costs for the aging C-2A have increased, in part, due to limited sourcing options for parts and the substantial number of obsolescence challenges. Navy officials said they have to work harder to locate new parts once a part is no longer being manufactured, and in some cases require the depot to manufacture parts that would have been purchased, which increases the depot maintenance costs. As such, depot-level reparables was the most significant category of maintenance costs, averaging about $36.31 million per year, or 38 percent of the C-2A's total maintenance costs from fiscal years 2011 through 2018. The other maintenance cost category was the smallest share, averaging about $6.09 million per year, or 6 percent of the total maintenance costs during the same time period.

C-2A Total Operating and Support Costs



Source: GAO analysis of Navy data. | GAO-21-101SP

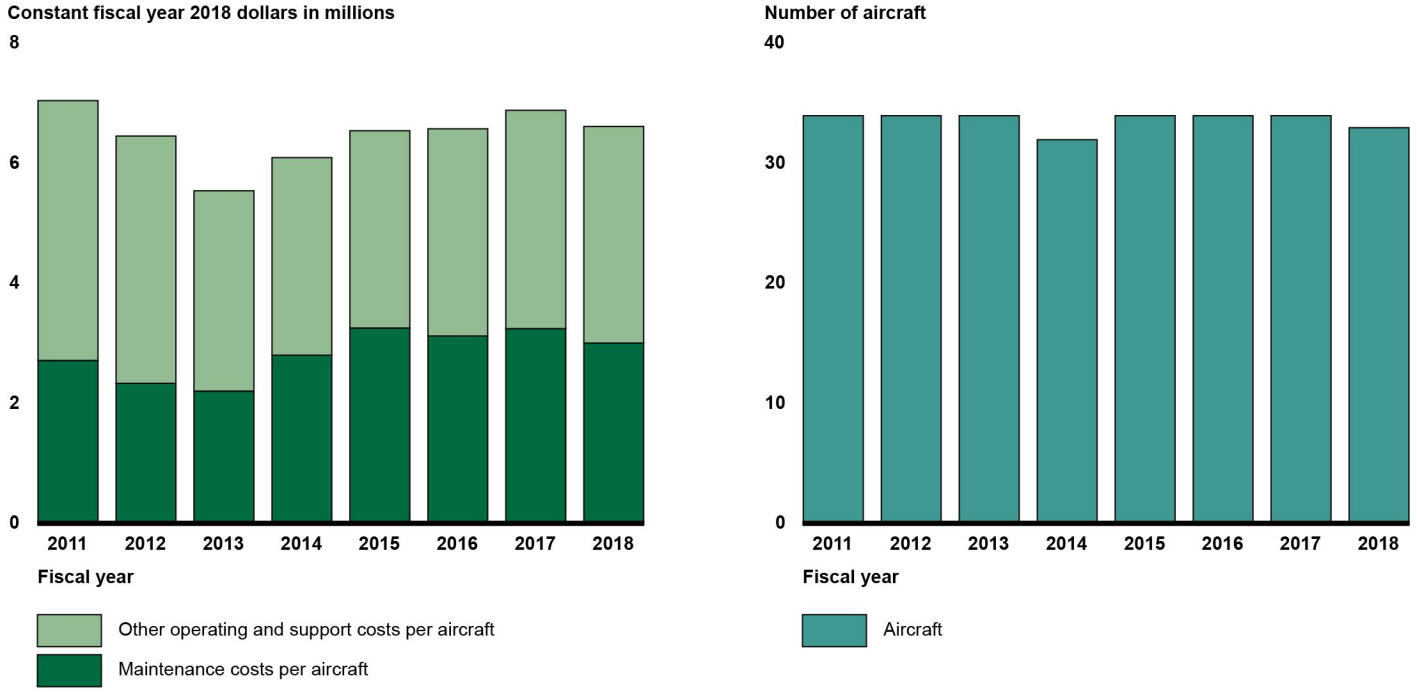
Data table for C-2A Total Operating and Support Costs (Constant fiscal year 2018 dollars in millions)

Fiscal year	Unit level manpower	Unit operations	Maintenance	Sustaining support	Continuing system improvements
2011	95.09	24.39	92.56	5.27	22.46
2012	87.63	22.5	79.7	6.26	23.65
2013	81.84	18.7	75.2	4.27	8.64
2014	76.87	19.62	89.91	4.93	3.7
2015	79.06	18.3	110.92	10.44	3.89
2016	85.34	18.35	106.32	6.11	7.65
2017	85.72	16.46	110.45	7.54	14.16
2018	81.55	15.83	99.18	8.38	13.35

Fiscal year	Consumable materials and repair parts	Depot level reparables	Depot maintenance	Other maintenance	Intermediate maintenance
2011	21.83	36.72	19.59	3.99	10.43
2012	15.25	23.26	27.49	4.76	8.94
2013	16.1	20.87	23.73	7.33	7.19
2014	15.93	23.4	35.14	5.11	10.33
2015	18.88	45.43	25.08	7.84	13.68
2016	17.46	46.4	18.85	6	17.6
2017	16.02	62.58	12.06	5.82	13.97
2018	19.48	31.79	25.39	7.87	14.65

From fiscal year 2011 through fiscal year 2018, the C-2A's O&S costs per aircraft remained steady, averaging about $6.47 million per year. Also, maintenance costs per aircraft, on average, accounted for more than one-third of the total O&S costs per aircraft, averaging about $2.84 million per year during the same time period. According to officials, this was a result of the increase in overall repairs to the aging aircraft and included costly repairs to the flight control surfaces and landing gear, among other maintenance. The number of aircraft remained relatively steady from 34 aircraft in fiscal year 2011 to 33 aircraft in fiscal year 2018.

C-2A Operating and Support Costs per Aircraft



Source: GAO analysis of Navy data. | GAO-21-101SP

Data table for C-2A Operating and Support Costs per Aircraft (Constant fiscal year 2018 dollars in millions)

Fiscal year	Maintenance costs per aircraft	Other operating and support costs per aircraft
2011	2.72	4.33
2012	2.34	4.12
2013	2.21	3.34
2014	2.81	3.29
2015	3.26	3.29
2016	3.13	3.45
2017	3.25	3.64
2018	3.01	3.61

Fiscal year	Number of aircraft
2011	34
2012	34
2013	34
2014	32
2015	34
2016	34
2017	34
2018	33

Sustainment Challenges and Mitigation Actions

Aging: The C-2A has been in operation for close to 50 years, with current aircraft about 29 to 34 years old. The Navy completed a service life extension program for the C-2A from 2004 through 2011 to increase the aircraft's flight hours and landings, among other things. In response to low aircraft inventory, the Navy's ongoing approach to mitigate these challenges includes moving aircraft between squadrons to meet the requirements of deploying missions.

Maintenance: As the C-2A ages, it requires additional maintenance for repairs that were not originally planned, such as repairs for the propeller system and outer wing panels, which are nearing their 7,500 flight hour limit. Also, maintenance for these aircraft is taking longer because more parts need to be repaired and replaced. Additionally, according to Navy officials, there is a shortage of depot and field maintenance personnel due to attrition, inability to find skilled workers, and hiring freezes. The Navy's ongoing and planned actions include: conducting system performance studies to identify maintenance tasks to mitigate potential failures, identifying all parts and components that need to be repaired and replaced during the inspection phase, training depot and field maintainers and other personnel to transition to vacated positions and to be proficient in repairing all parts of the aircraft, and allowing depot and field maintainers to work overtime to keep up with maintenance schedules.

Supply Support: The C-2A is experiencing increased shortages of parts because vendors are no longer producing some of the aircraft's parts. According to Navy officials, there is not enough demand for manufacturers to keep production lines open or to propose redesigns of parts. The Navy's ongoing and planned actions include locating other vendor sources, upgrading hardware and software, reverse engineering (the process of examining an item, such as a spare part, with the intent of replicating its design), and as a last resort, cannibalizing parts (i.e., removing serviceable parts from one aircraft and installing them in another aircraft).

Program Office Comments

In commenting on a draft of this assessment, the program office provided technical comments, which we incorporated where appropriate.

Source: U.S. Air Force/Cynthia Griggs. | GAO-21-101SP

C-130T Hercules Sustainment Quick Look

Common Name: C-130T

Lead Services: Navy and Marine Corps

Program Essentials

Manufacturer: Lockheed Martin

Sustainment: Depot maintenance conducted at Air Logistic Complex at Ogden, Utah, and field maintenance conducted by Navy maintainers

Program Office: Program Manager – Air 207, Naval Air Systems Command, Patuxent River, Maryland

Fiscal Year 2019 Data

Average age: 25.39 years

Average lifetime flying hours: 18,624 hours

Depot maintenance activity and squadron locations:

▲ Depot maintenance activity location

● Squadron location

Source: GAO. | GAO-21-101SP

Sustainment Challenges and Mitigation Actions

challenges. Planned actions to mitigate these challenges include modernization initiatives to upgrade the aircraft and an obsolescence program to procure hardware and software components.

Background

The C-130T Hercules was first manufactured in 1990 and last produced in 1996. The C-130T is a multi-role, long-range land-based tactical aircraft that provides intra-theater logistics support for deployed Navy forces, air-to-air refueling to fleet operating forces, search and rescue, flight demonstration, and transport of personnel and cargo.

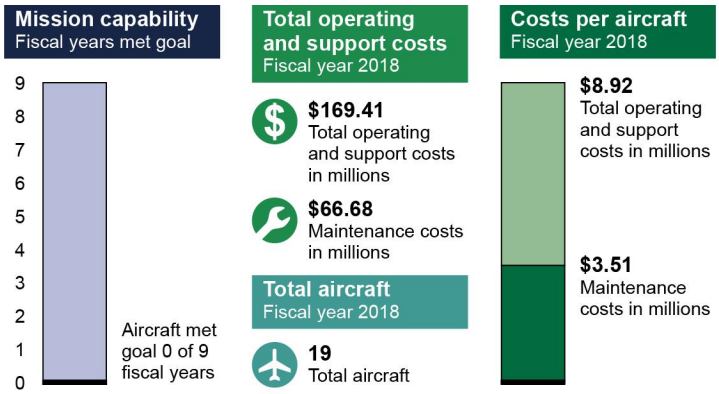
Life Cycle of the C-130T

Source: GAO analysis of Navy data. | GAO-21-101SP

Overview

From fiscal years 2011 through 2019, the C-130T fleet did not meet any of its annual mission capable goals and its mission capable rate decreased during this time period. The C-130T's mission capable rate decreased largely due to a fatal accident in fiscal year 2017 caused by a propeller malfunction on the aircraft. Total operating and support (O&S) costs fluctuated, averaging about $166.48 million per year from fiscal years 2011 through 2018. Specifically, unit-level manpower and unit operations costs decreased over this time period while costs related to maintenance and continuing system improvements increased. According to Navy officials, the cost increases were associated with efforts to modernize the aircraft as well as modifications to replace the propellers on the aircraft. Further, in fiscal year 2018, maintenance costs per aircraft accounted for more than one-third of the total O&S costs per aircraft.

C-130T Sustainment Status



Source: GAO analysis of Navy data. | GAO-21-101SP

Data table for C-130T Sustainment Status

Mission capability	Aircraft met goal 0 of 9 fiscal years
Total operating and support costs in millions (FY18)	$169.41
Maintenance costs in millions (FY18)	$66.68
Total aircraft (FY18)	19
Total operating and support costs per aircraft in millions (FY18)	$8.92
Maintenance costs per aircraft in millions	$3.51

Sustainment Strategy

- The C-130T is a variant of the Air Force's commercially developed C-130 Hercules transport aircraft. As a variant, it shares similar hardware and software configurations, costs for development of common capabilities, and a common product support infrastructure. Depot maintenance for the C-130T is conducted at Air Logistic Complex at Ogden, Utah. Navy and Marine Corps personnel conduct field maintenance on the C-130T.
- In a statement to Congress, the Navy stated that the C-130T modernization initiatives include upgrading the propeller system by replacing the legacy four-blade system with an eight-blade high thrust composite blade system, among other initiatives. The Navy anticipates that all aircraft will be fully modified by fiscal year 2020. The Navy is also modernizing the C-130T brake system with carbon brakes designed to provide enhanced safety and maintainability at a reduced weight over the current steel brake assemblies. The Navy's initiatives will reduce maintenance, sustainment, and fuel costs. The Navy plans to complete installing the modernized brake system by the end of fiscal year 2020.
- In 2018, the Navy implemented an Avionics Obsolescence Upgrade Program for the C-130T to mitigate obsolescence issues (i.e., when a part is not available due to its lack of usefulness or it is no longer current or available for production) by procuring avionics software with associated commercial off-the-shelf hardware and integrating avionics software and associated components into the aircraft. The Navy's Avionics Obsolescence Upgrade Program also incorporates multiple aircraft improvements to increase aircrew and passenger safety, such as improved aircraft avoidance and awareness system and a digital flight data recorder.

Availability and Condition

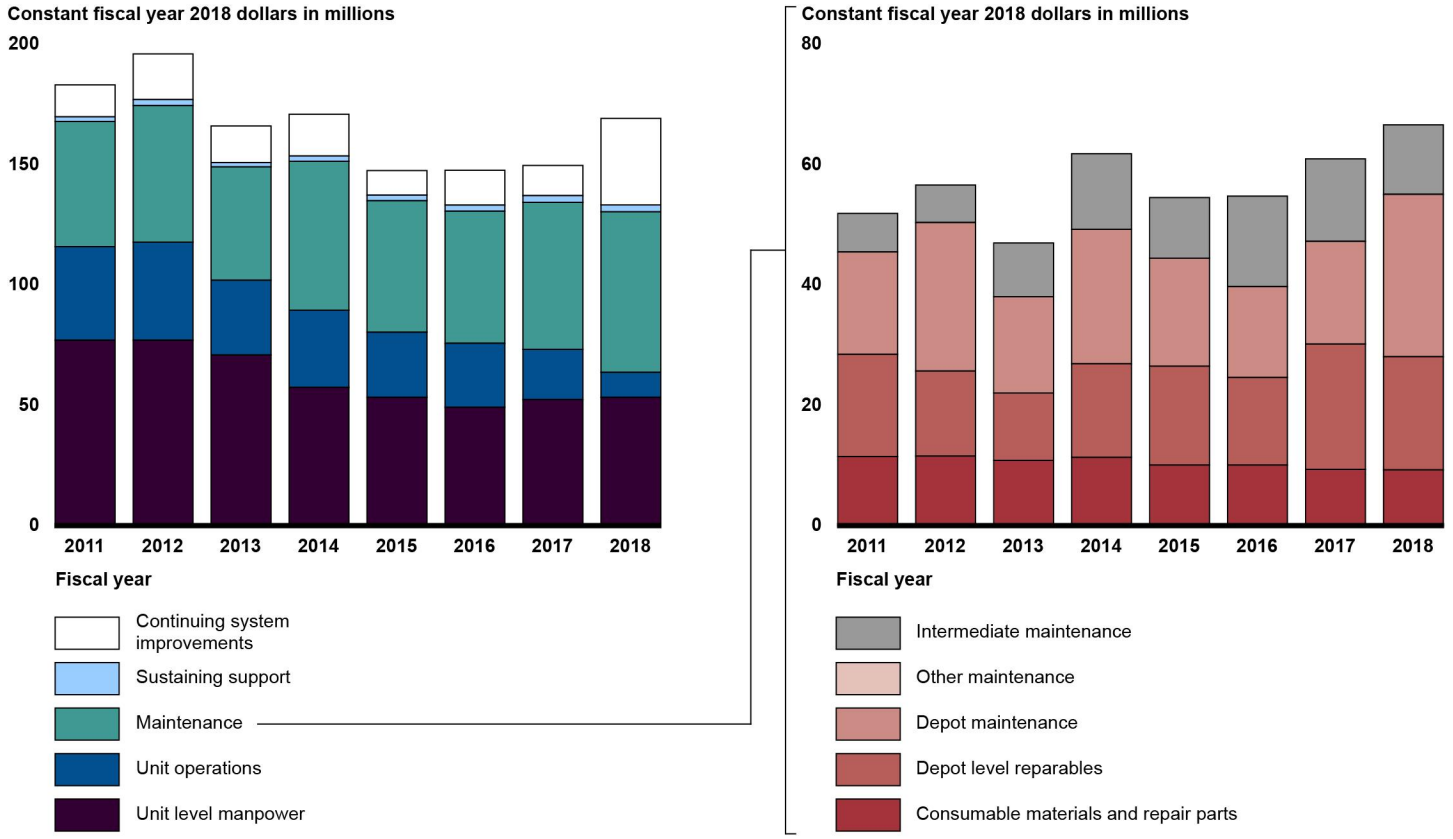
From fiscal year 2011 through fiscal year 2019, the C-130T missed all of its annual mission capable goals, though it was close to meeting its goal one fiscal year, and its mission capable rate decreased during the time period. According to officials, one reason for the mission capable rate decrease was that the Navy grounded the fleet in fiscal year 2017 after a fatal accident caused by a propeller malfunction on the aircraft. To expedite the fleet returning to flight, the U.S. Air Force, which is the source of supply for propellers for the family of C-130 aircraft, prioritized propellers needed for Navy and Marine Corps aircraft. This assisted in increasing the mission capable rate, though it was still below the fiscal year 2011 level in fiscal year 2019.

From fiscal year 2011 through fiscal year 2019, the rates increased for not mission capable maintenance and not mission capable supply. According to officials, the aircraft that were awaiting delivery of new propellers—after the fiscal year 2017 fatal accident caused by a propeller malfunction on the aircraft—were a contributing factor to these rates during this time period. Specific details on mission capable and not mission capable rates were omitted because the information was deemed by DOD to be sensitive.

Operating and Support Costs

From fiscal year 2011 through fiscal year 2018, the C-130T's O&S costs fluctuated averaging about $166.48 million per year. According to officials, O&S costs increased in fiscal years 2017 and 2018 as a result of the modernization and replacement of the aircraft's propellers. Maintenance costs increased during this period and also accounted for the largest share of the C-130T's O&S costs, averaging about $56.85 million per year, or 34 percent of the total O&S costs from fiscal years 2011 through 2018. According to officials, this was a result of costs associated with aviation depot level reparables and depot events for the aircraft. As such, depot maintenance was the most significant category of maintenance costs, averaging about $19.64 million per year from fiscal years 2011 through 2018, or 35 percent of the total maintenance costs during that time period. Intermediate maintenance and consumable materials and repair parts accounted for the smallest shares of the C-130T's maintenance costs, with each category averaging about $10.56 million and $10.59 million per year, respectively, or about 19 percent of the total maintenance costs from fiscal years 2011 through 2018.

C-130T Total Operating and Support Costs



Source: GAO analysis of Navy data. | GAO-21-101SP

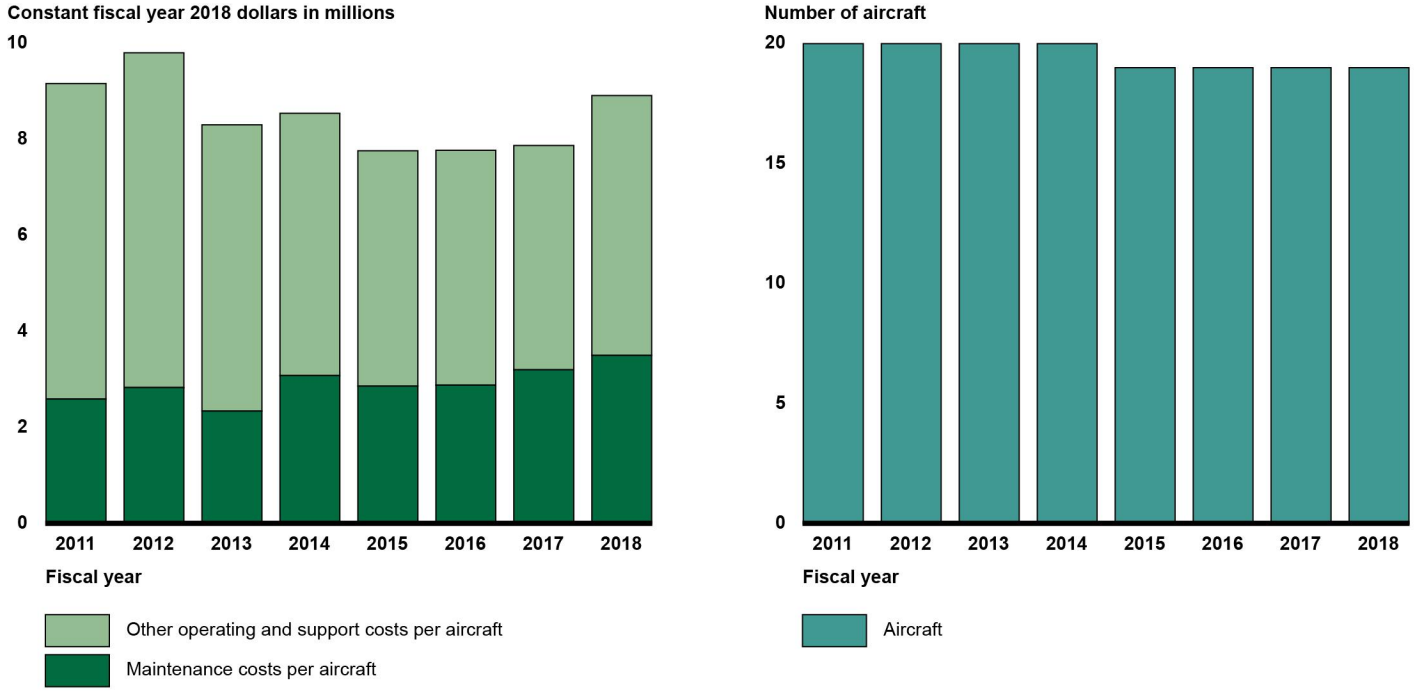
Data table for C-130T Total Operating and Support Costs (Constant fiscal year 2018 dollars in millions)

Fiscal year	Unit level manpower	Unit operations	Maintenance	Sustaining support	Continuing system improvements
2011	77.29	38.86	51.95	1.94	13.31
2012	77.24	40.78	56.7	2.53	18.94
2013	71.13	31.05	47.08	1.8	15.21
2014	57.64	32.09	61.88	2.2	17.34
2015	53.51	27.1	54.61	2.33	10.21
2016	49.41	26.57	54.86	2.59	14.41
2017	52.62	20.85	61.05	2.84	12.51
2018	53.51	10.4	66.68	2.89	35.93

Fiscal year	Consumable materials and repair parts	Depot level reparables	Depot maintenance	Other maintenance	Intermediate maintenance
2011	11.56	17.01	17.01	0	6.38
2012	11.66	14.13	24.67	0	6.24
2013	10.94	11.19	15.99	0	8.95
2014	11.44	15.55	22.33	0	12.56
2015	10.15	16.44	17.95	0	10.07
2016	10.15	14.58	15.09	0	15.04
2017	9.43	20.84	17.06	0	13.72
2018	9.36	18.8	26.98	0	11.54

From fiscal year 2011 through fiscal year 2018, the C-130T's O&S costs per aircraft remained generally steady, averaging about $8.53 million per year. According to officials, the increase in fiscal year 2012 can be attributed to maintenance activities to modernize components on the aircraft. Also, maintenance costs per aircraft, on average, accounted for more than one-third of the total O&S costs per aircraft, averaging about $2.92 million per year. Additionally, the number of aircraft remained relatively steady from 20 aircraft in fiscal year 2011 to 19 aircraft in fiscal year 2018.

C-130T Operating and Support Costs per Aircraft and Fleet Size



Source: GAO analysis of Navy data. | GAO-21-101SP

Data table for C-130T Operating and Support Costs per Aircraft and Fleet Size (Constant fiscal year 2018 dollars in millions)

Fiscal year	Maintenance costs per aircraft	Other operating and support costs per aircraft
2011	2.6	6.57
2012	2.84	6.97
2013	2.35	5.96
2014	3.09	5.46
2015	2.87	4.9
2016	2.89	4.89
2017	3.21	4.67
2018	3.51	5.41

Fiscal year	Number of aircraft
2011	20
2012	20
2013	20
2014	20
2015	19
2016	19
2017	19
2018	19

Sustainment Challenges and Mitigation Actions

Aging: The C-130T has been operating for close to 30 years and, according to program officials, has undergone a series of modifications to replace or enhance aging components. Navy and Marine Corps officials told us that they have updated operating techniques to meet mission and training requirements during this time, which has also driven modifications to the aircraft. In its testimony to Congress, the Navy stated several planned modernization initiatives to update systems and parts to extend the life of the aircraft, such as the propeller modifications.

Maintenance: As the C-130T ages, according to officials, it has required additional maintenance for repairs that were not originally planned, such as repairs to the propeller system. Also, maintenance for the aircraft is taking longer because more parts need to be repaired and replaced. The Navy and Marine Corps' ongoing and planned actions to mitigate these challenges, according to officials, include maintenance initiatives, such as scheduling maintenance for components based on forecasted failure rates for those components, and updating technical publications and training tasks to ensure that training is consistent with the maintenance tasks necessary to support the aircraft. Additionally, the Navy and Marine Corps are pursuing an automated system that will store interactive electronic technical manuals allowing for quicker updates, and providing maintainers with step-by-step instructions on repairing components on the aircraft.

Supply Support: The C-130T is experiencing some shortages of parts because, according to officials, the size of the fleet causes very low and unanticipated demand resulting in items not being ordered and available in stock; which can affect mission capable rates. The Navy and Marine Corps' planned actions to mitigate these challenges include initiatives, such as the Avionics Obsolescence Upgrade Program, to procure avionics software with associated, commercially-available hardware through existing government contracts and integrating avionics software and associated components into the aircraft to update these systems and components. Also, according to officials, the Navy and Marine Corps are pursuing an automated system that will capture data from the aircraft and aircrew to allow maintainers to proactively order parts and materials.

Program Office Comments

In commenting on a draft of this assessment, the program office provided technical comments, which we incorporated where appropriate.

Source: U.S. Air Force/Senior Airman Christopher Quail. | GAO-21-101SP

C-5M Super Galaxy Sustainment Quick Look

Common Name: C-5M

Lead Service: Air Force

Program Essentials

Manufacturer: Lockheed Martin-Georgia Company

Sustainment: Depot maintenance conducted by the Air Force at Warner Robins Air Logistics Complex, Georgia, and field-level maintenance performed by Air Force maintainers

Program Office: Robins Air Force Base, Georgia

Fiscal Year 2019 Data

Average age: 32 years

Average lifetime flying hours: 21,900 hours per aircraft

Depot maintenance activity and squadron locations:

▲ Depot maintenance activity location

● Squadron location

Source: GAO. | GAO-21-101SP

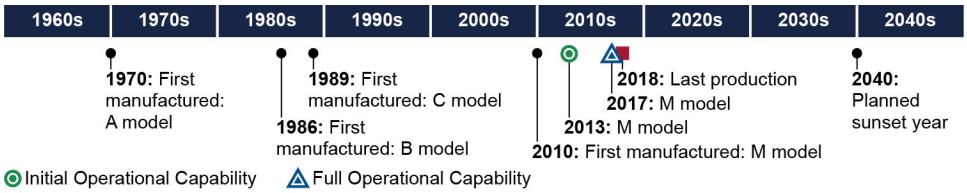
Sustainment Challenges and Mitigation Actions

The C-5M faces issues with corrosion stress cracks and unscheduled maintenance. Repair programs and the implementation of a condition-based maintenance are examples of mitigation actions being taken to address these challenges.

Background

The C-5 was first manufactured in 1970. The C-5M Super Galaxy is a strategic transport aircraft and is the largest aircraft in the Air Force inventory. Its primary mission is to transport cargo and personnel for the Department of Defense. By the end of fiscal year 2018, all remaining legacy C-5 models were modified and redesignated as the C-5M.

Life Cycle of the C-5

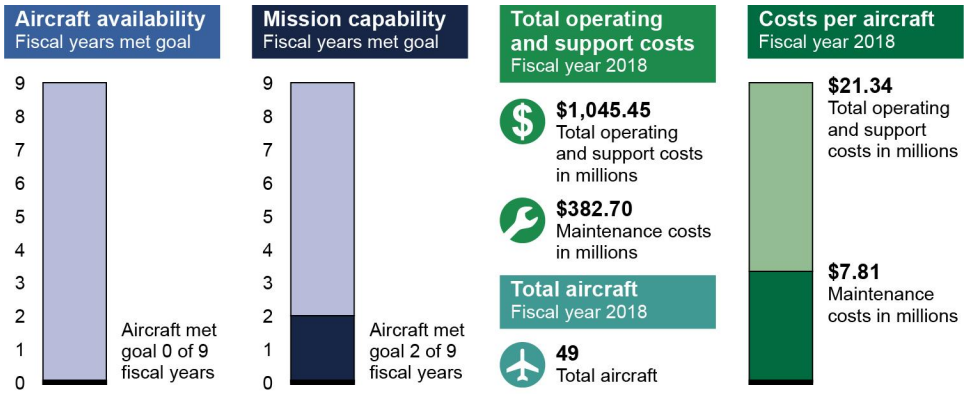


Source: GAO analysis of Air Force data. | GAO-21-101SP

Overview

From fiscal years 2011 through 2019, the C-5 did not meet any of its annual aircraft availability goals, but met or exceeded its mission capable goals in 2 of these 9 fiscal years. The aircraft availability and mission capable rates both increased during the time period. Total operating and support (O&S) costs for the C-5 fleet decreased from about $3.38 billion in fiscal year 2011 to about $1.05 billion in fiscal year 2018, in part because the Air Force retired 59 C-5 aircraft, flew fewer flight hours, and made changes to the fleet structure during this time period. Costs for continuing system improvements decreased the most—from about $998 million to nearly $24 million—during the 8-year period. In fiscal year 2018, maintenance was the largest O&S cost category at almost $383 million. The C-5's O&S costs per aircraft declined from $32.52 million to $21.34 million from fiscal year 2011 to fiscal year 2018.

C-5M Sustainment Status



Source: GAO analysis of Air Force data. | GAO-21-101SP

Data table for C-5M Sustainment Status

Aircraft availability	Aircraft met goal 0 of 9 fiscal years
Mission capability	Aircraft met goal 2 of 9 fiscal years
Total operating and support costs in millions (FY18)	$1,045.45
Maintenance costs in millions (FY18)	$382.70
Total aircraft (FY18)	49
Total operating and support costs per aircraft in millions (FY18)	$21.34
Maintenance costs per aircraft in millions	$7.81

Sustainment Strategy

- The C-5M Super Galaxy Life Cycle Sustainment Plan was issued in April 2019 to document the sustainment strategy and guide sustainment activities.
- Sustainment of the C-5M fleet is accomplished through a maintenance schedule including home station checks, major and minor inspections, and programmed depot maintenance. Programmed depot maintenance is performed on an 8-year cycle. From 2008 through 2018, the entire fleet underwent a modification program to upgrade the aircraft's engines and other components.
- C-5M depot maintenance is conducted at Warner Robins Air Logistics Complex, Georgia. The supply chain for the C-5 is primarily managed by the Air Force's 448th Supply Chain Management Wing and the Defense Logistics Agency, but Lockheed Martin provides supply support for certain avionics items. Field level maintenance is conducted by Air Force active duty and reserve maintainers.

Availability and Condition

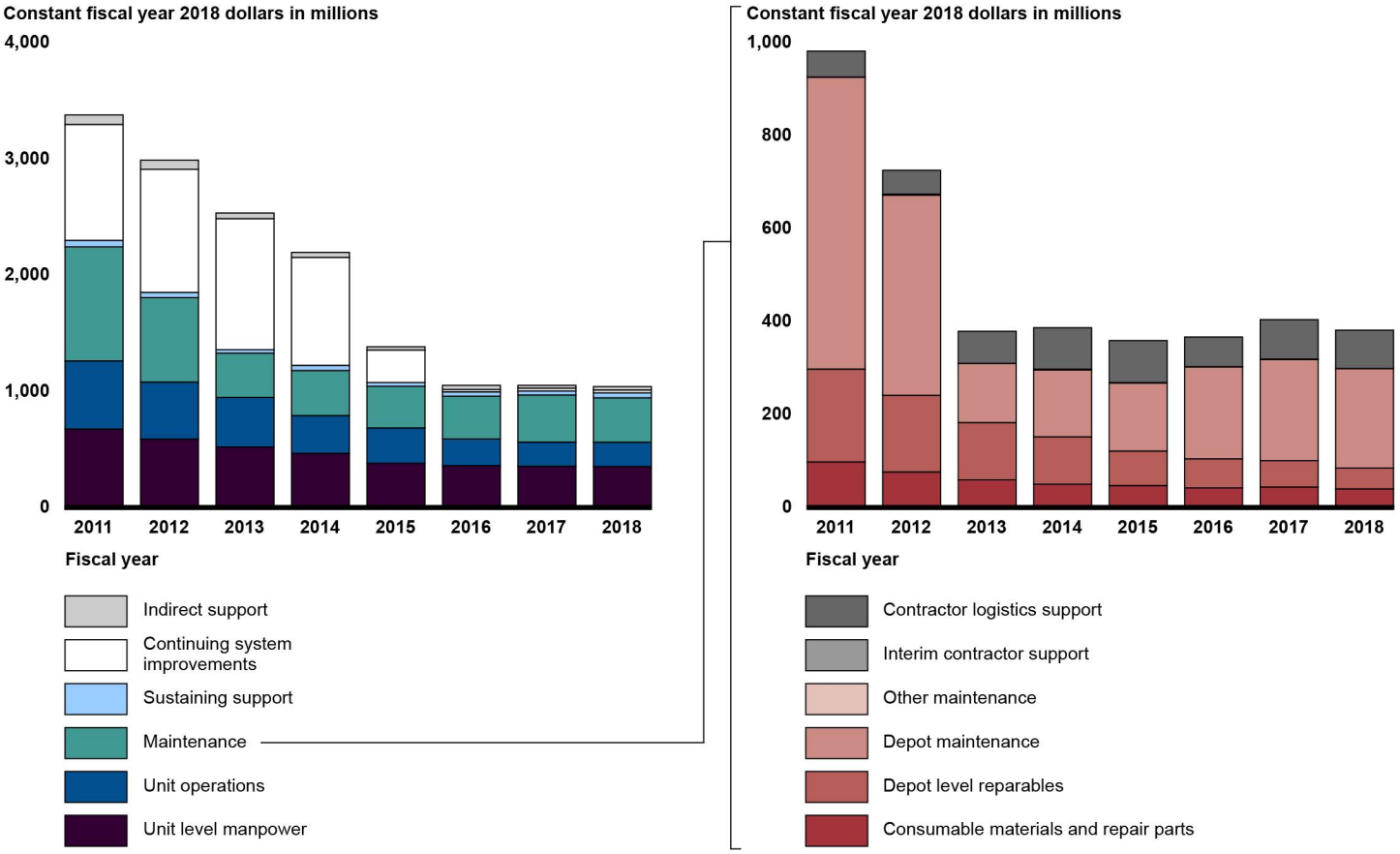
From fiscal years 2011 through 2019, the aircraft availability rate for the C-5 fleet fell short of the goal each year, the mission capable rate exceeded the goals in 2 of the 9 fiscal years, and both of the rates increased slightly. According to officials, many of the factors that influenced the mission capable rate also drove the C-5's aircraft availability trend. In addition, they said that the retirement of low performing C-5A aircraft from fiscal years 2011 through 2017 improved the availability rate during some of those years.

From fiscal year 2011 through 2019, the not mission capable maintenance rate decreased, but the decrease was partially offset by increases in the not mission capable supply rate and the not mission capable both rate. According to Air Force officials, these trends occurred for several reasons, such as reliability improvements from a modification program; landing gear component failures that grounded the fleet during a part of fiscal years 2017 and 2018; and supply delays due to the unexpected demand for—and lengthy process to obtain—several unpriced components provided by a supply-support contractor. Specific details on mission capable and not mission capable rates were omitted because the information was deemed by DOD to be sensitive.

Operating and Support Costs

From fiscal years 2011 through 2018, the C-5's overall O&S costs decreased by about $2.33 billion—from $3.38 billion to $1.05 billion. Continuing system improvements decreased the most, from about $998 million in fiscal year 2011 to about $24 million in fiscal year 2018. Maintenance costs also declined significantly, about $600.2 million, during this timeframe. When comparing fiscal year 2011 to fiscal year 2018, unit operations and unit-level manpower decreased by $378 million and $323 million, respectively. Air Force officials told us that there were several changes to the C-5 fleet during this time period. More specifically, the Air Force retired 59 C-5A aircraft; consolidated the C-5 basing structure from eight main operating bases to four bases with two operating commands, the Air Mobility Command and the Air Force Reserve Command; and converted all Air National Guard C-5 units to C-17 aircraft. As a result, the smaller C-5 fleet flew fewer flight hours and required fewer maintenance actions, which reduced associated supply costs. Finally, the costs for continuing system improvements decreased significantly from fiscal years 2011 to 2018 as less money was spent on modifications to the aircraft to improve safety, reliability, or maintainability, or to otherwise enable the system to meet its basic original operational requirements throughout its life.

C-5 Total Operating and Support Costs



Source: GAO analysis of Air Force data. | GAO-21-101SP

Data table for C-5 Total Operating and Support Costs (Constant fiscal year 2018 dollars in millions)

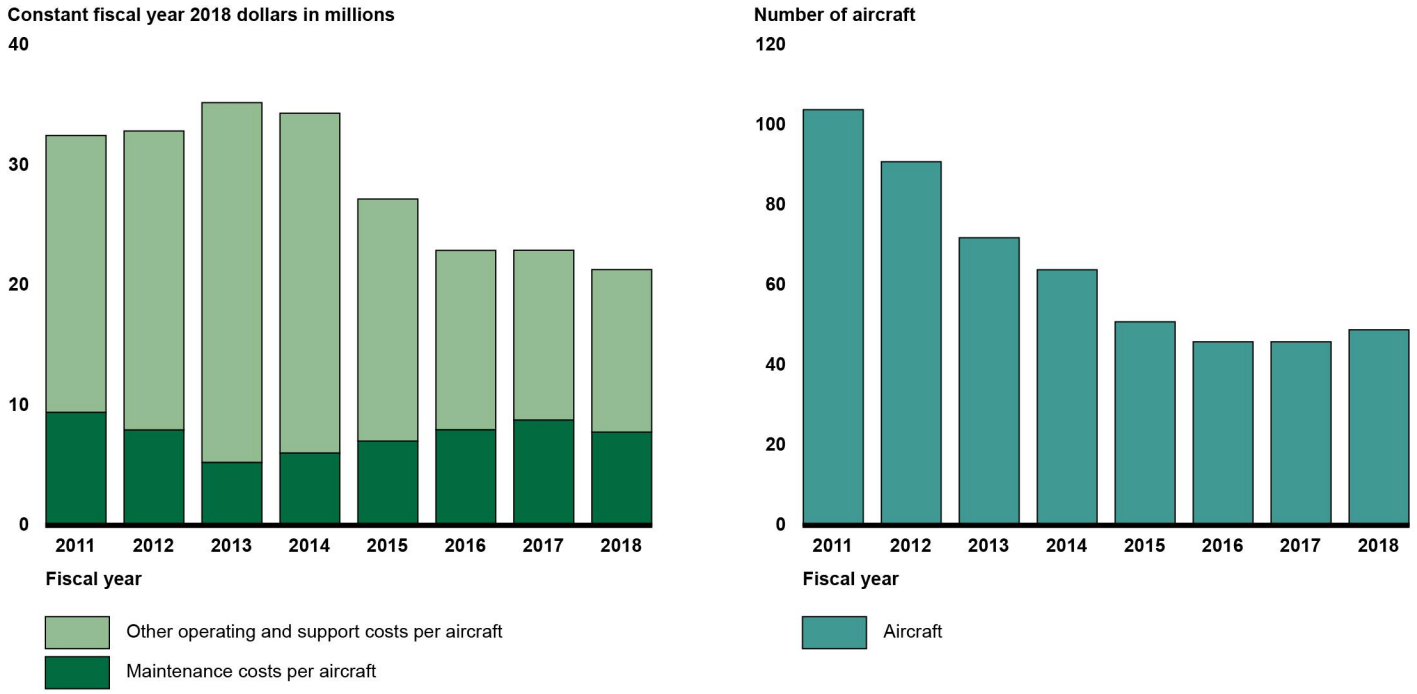
Fiscal year	Unit level manpower	Unit operations	Maintenance	Sustaining support	Continuing system improvements	Indirect support
2011	679.29	586.4	982.9	53.81	998.16	81.66
2012	591.5	491.75	726.77	43.99	1059.96	78.83
2013	524.05	427.59	380.47	30.27	1126.89	48.84
2014	468.81	325.61	387.97	44.62	928.48	44.32
2015	383.63	304.22	360.44	32.17	277.53	30.24
2016	363.7	231.5	368.07	35.72	19.58	37.13
2017	357.98	207.99	405.38	35.76	23.71	25.37
2018	356.23	208.69	382.7	43.57	23.89	30.37

Fiscal year	Consumable materials and repair parts	Depot level reparables	Depot maintenance	Other maintenance	Interim contractor support	Contractor logistics support
2011	99	199.55	628.09	0.82	0	55.43
2012	77.42	164.91	430.82	1.73	0	51.9
2013	60.67	122.89	127.35	0.22	0	69.34
2014	51.32	101.57	144.14	1.42	0	89.53
2015	47.85	74.48	146.42	0.66	0	91.03
2016	43.24	62.49	197.66	0.13	0	64.55
2017	44.95	56.94	217.49	0.56	0	85.44
2018	41	44.83	213.7	0	0	83.17

Note: The figure includes data for C-5A, C-5B, C-5C, and C-5M aircraft.

As a result of the fleet changes noted above and a reduction in the amount of funding for certain modification programs, among other reasons, the total O&S costs per aircraft decreased from $32.52 million in fiscal year 2011 to $21.34 million in fiscal year 2018. Maintenance costs per aircraft also decreased from $9.45 million to $7.81 million during this timeframe. Officials also told us that the C-5 program changed the maintenance concept in 2009 to reduce unscheduled maintenance and extend the maintenance intervals, and that a number of reliability improvements were made to the program as part of ongoing modification programs.

C-5 Operating and Support Costs per Aircraft and Fleet Size Capable Rates



Source: GAO analysis of Air Force data. | GAO-21-101SP

Data table for C-5 Operating and Support Costs per Aircraft and Fleet Size Capable Rates (Constant fiscal year 2018 dollars in millions)

Fiscal year	Maintenance costs per aircraft	Other operating and support costs per aircraft
2011	9.45	23.07
2012	7.99	24.9
2013	5.28	29.97
2014	6.06	28.31
2015	7.07	20.15
2016	8	14.95
2017	8.81	14.15
2018	7.81	13.53

Fiscal year	Number of aircraft
2011	104
2012	91
2013	72
2014	64
2015	51
2016	46
2017	46
2018	49

Note: The figure includes data for all C-5A, C-5B, C-5C, and C-5M aircraft.

Sustainment Challenges and Mitigation Actions

Aging: According to Air Force officials, the C-5 fleet is experiencing stress corrosion cracking. Several major repair programs have been initiated or are planned to mitigate this challenge. For example, officials said that the C-5M Dorsal Complex Repair and Dagger Fitting Replacement program began in fiscal year 2016 to repair a crack on the tail assembly of the aircraft and is expected to be completed in fiscal year 2020. The Pylon Wing Interface program will repair cracks on the pylon to wing interface (the point where the engine attaches). This repair program is planned to begin in fiscal year 2022. Finally, the Air Force officials told us that the Crown Skin Replacement program, which is planned to begin in fiscal year 2024, will replace fuselage skins on two aircraft because the legacy skins are prone to stress corrosion cracking.

Maintenance: Air Force officials told us that the amount of unscheduled maintenance is still a challenge for the C-5 fleet, despite having implemented a commercial maintenance concept to reduce unscheduled maintenance. Therefore, officials said the C-5 program is in the process of implementing another new maintenance concept—condition-based maintenance plus--that converts unscheduled maintenance to scheduled maintenance by identifying components and parts with high failure rates and prescribing the appropriate replacement intervals. Implementation began early in fiscal year 2019. Eight components have been identified and are currently undergoing studies to improve reliability, according to Air Force officials.

Program Office Comments

In commenting on a draft of this assessment, the program office provided technical comments, which we incorporated where appropriate.

Source: U.S. Air Force/Senior Airman Christopher Quail. | GAO-21-101SP

C-17 Globemaster III Sustainment Quick Look

Common Name: C-17

Lead Service: Air Force

Program Essentials

Manufacturer: Boeing

Sustainment: Boeing is responsible for sustainment activities, such as material management and depot maintenance support.

Program Office: Robins Air Force Base, Georgia, and Wright-Patterson Air Force Base, Ohio

Fiscal Year 2019 Data

Average age: 16 years

Average lifetime flying hours: 15,293 hours per aircraft

Depot maintenance activity and squadron locations:

▲ Depot maintenance activity location

● Squadron location

Source: GAO. | GAO-21-101SP

Sustainment Challenges and Mitigation Actions

The C-17 faces challenges with aging and maintenance. Mitigation actions include upgrades and capability improvements and increasing the amount of time between scheduled depot maintenance and field-level maintenance inspections.

Background

The C-17 Globemaster III is a high-wing, four-engine cargo aircraft with a rear loading ramp that was first manufactured in 1987. The C-17 has air-refueling capability and is capable of rapid strategic delivery of troops and all types of cargo to main operating bases and bases in forward deployment areas. The C-17 can perform tactical airlift and airdrop missions and can transport ambulatory patients during aeromedical evacuations, when required.

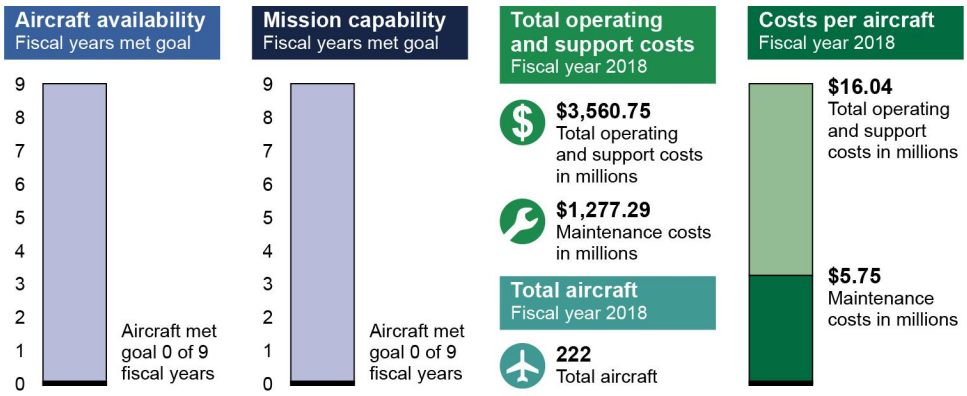
Life Cycle of the C-17

Source: GAO analysis of Air Force data. | GAO-21-101SP

Overview

The C-17 did not meet its annual aircraft availability and mission capable rate goals from fiscal years 2011 through 2019, and both rates decreased slightly during this time period. Total operating and support (O&S) costs for the C-17 fleet decreased from $5.63 billion in fiscal year 2011 to $3.56 billion in fiscal year 2018 primarily due to reduced flying hours, fuel consumption, and fuel prices over this time period, according to program officials. In fiscal year 2018, maintenance was the largest cost category and nearly all of these costs, about $1.28 billion, were contractor support costs. The annual O&S costs per aircraft declined from $27.05 million to $16.04 million as a result of decreased costs and increased aircraft inventory during this period.

C-17 Sustainment Status



Source: GAO analysis of Air Force data. | GAO-21-101SP

C-17 Sustainment Status

Aircraft availability	Aircraft met goal 0 of 9 fiscal years
Mission capability	Aircraft met goal 0 of 9 fiscal years
Total operating and support costs in millions (FY18)	$3,560.75
Maintenance costs in millions (FY18)	$1,277.29
Total aircraft (FY18)	222
Total operating and support costs per aircraft in millions (FY18)	$16.04
Maintenance costs per aircraft in millions	$5.75

Sustainment Strategy

- The C-17 Enterprise Life-Cycle Management Plan and Life-Cycle Sustainment Plan (2014) documents current and future acquisition, sustainment, and integration efforts. It also addresses contractual arrangements and partnership support agreements between Air Force, Boeing, and other sustainment providers.
- Boeing provides life-cycle support for the C-17 under the terms of the Globemaster Integrated Sustainment Program (2013). Under this program, Boeing is responsible for sustainment activities, such as material management and depot-maintenance support.
- Boeing provides oversight of C-17 depot maintenance that is conducted under a public-private partnership at Warner Robins Air Logistics Complex and at its facility in San Antonio. Landing gear overhauls occur at Ogden Air Logistics Complex and contractor facilities. Pratt & Whitney oversees engine overhauls at the Oklahoma City Air Logistics Complex under a public-private partnership, at the Pratt & Whitney Repair Center in Columbus, Georgia, and at the United Airlines Facility in San Francisco, California.

Availability and Condition

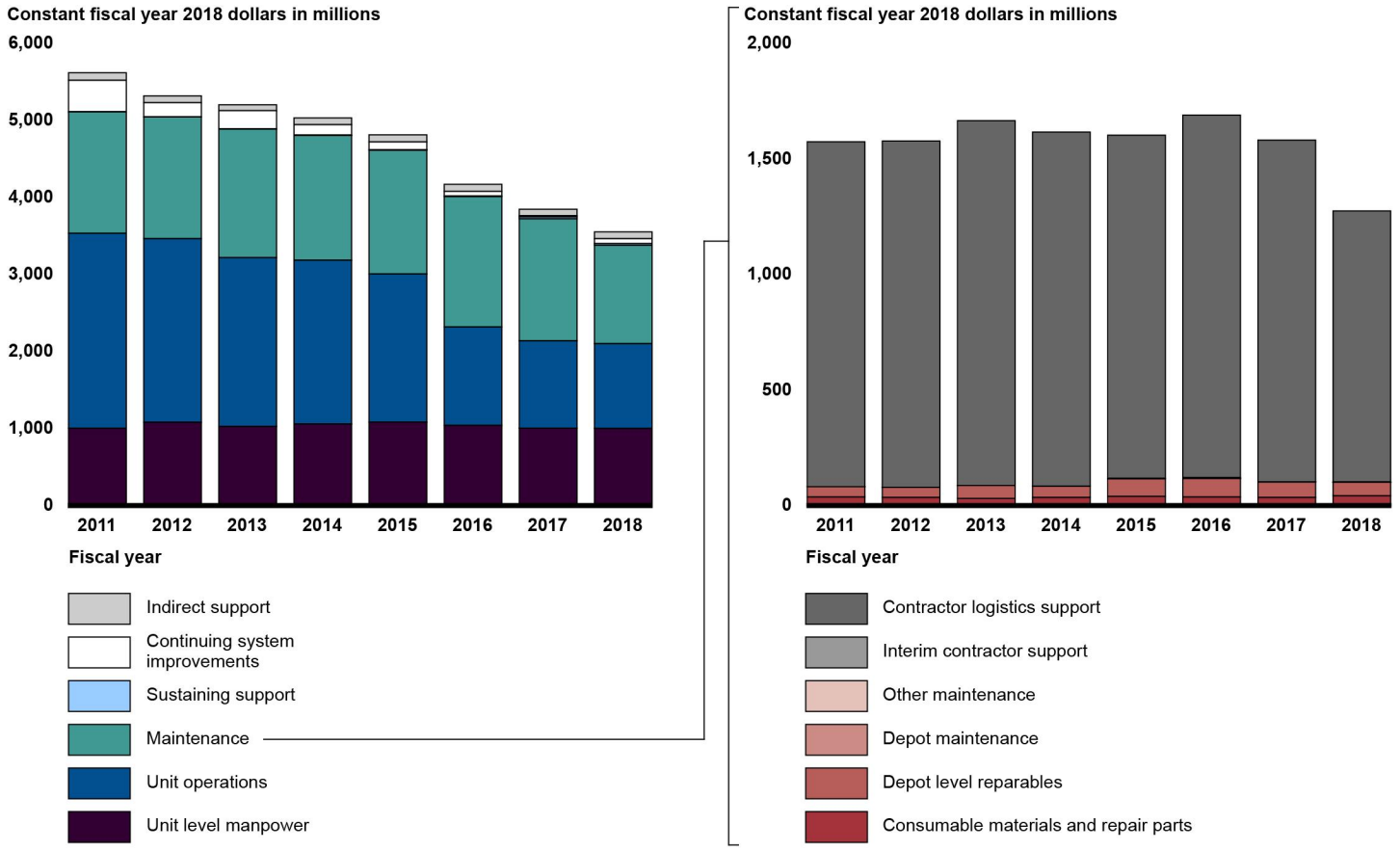
The C-17 fleet did not meet its annual aircraft availability or mission capable goals in fiscal years 2011 through 2019, but the rates were within one percentage point of both goals in two of the fiscal years earlier in the time period, and both of the rates decreased slightly. According to program officials, the number of aircraft undergoing scheduled and unscheduled depot-level maintenance were the primary drivers of the aircraft availability rate that was below the goals. In addition, the officials said that the C-17's aircraft availability and mission capable rates were lower in fiscal year 2019 than in fiscal year 2011 due to an increase in the amount of time needed to complete a scheduled, field-level maintenance inspection; a depot-level upgrade to the latest airplane tracking system used by the Federal Aviation Administration's air traffic control; and supply challenges.

From fiscal year 2011 through 2019, the rates increased slightly for not mission capable maintenance, not mission capable supply, and not mission capable both supply and maintenance. Program officials told us that the amount of time needed to complete regularly-scheduled, field-level maintenance inspections was the largest driver of not mission capable time. Officials explained that, during these years, the C-17 fleet was transitioning aircraft from active Air Force bases to Air National Guard and Air Force Reserve bases. These inspections take an average of 12 days longer to complete at the Guard and Reserve bases because there is typically only one funded maintenance shift, compared to three shifts at active bases. Specific details on mission capable and not mission capable rates were omitted because the information was deemed by DOD to be sensitive.

Operating and Support Costs

From fiscal year 2011 through fiscal year 2018, the C-17's total O&S costs decreased by about $2.06 billion, from $5.63 billion to $3.56 billion. Unit operations costs decreased the most, about $1.43 billion, during this timeframe. According to program officials, unit operations costs decreased because the C-17 fleet executed fewer flying hours and thus used less fuel in fiscal year 2018 than in fiscal year 2011. Further, fuel costs also decreased over this time period. Maintenance costs varied from fiscal years 2011 through 2017, but were above the fiscal year 2011 total of $1.58 billion. However, in fiscal year 2018, maintenance costs dropped to about $1.28 billion, about $300 million below the fiscal year 2011 total. Officials stated that maintenance costs were less in fiscal year 2018 because of reduced contractor support costs for engine depot maintenance as the Air Force began to transition this work to its own maintenance depot. In fiscal year 2018, maintenance was the largest cost category and nearly all of the $1.28 billion were contractor support costs.

C-17 Total Operating and Support Costs



Source: GAO analysis of Air Force data. | GAO-21-101SP

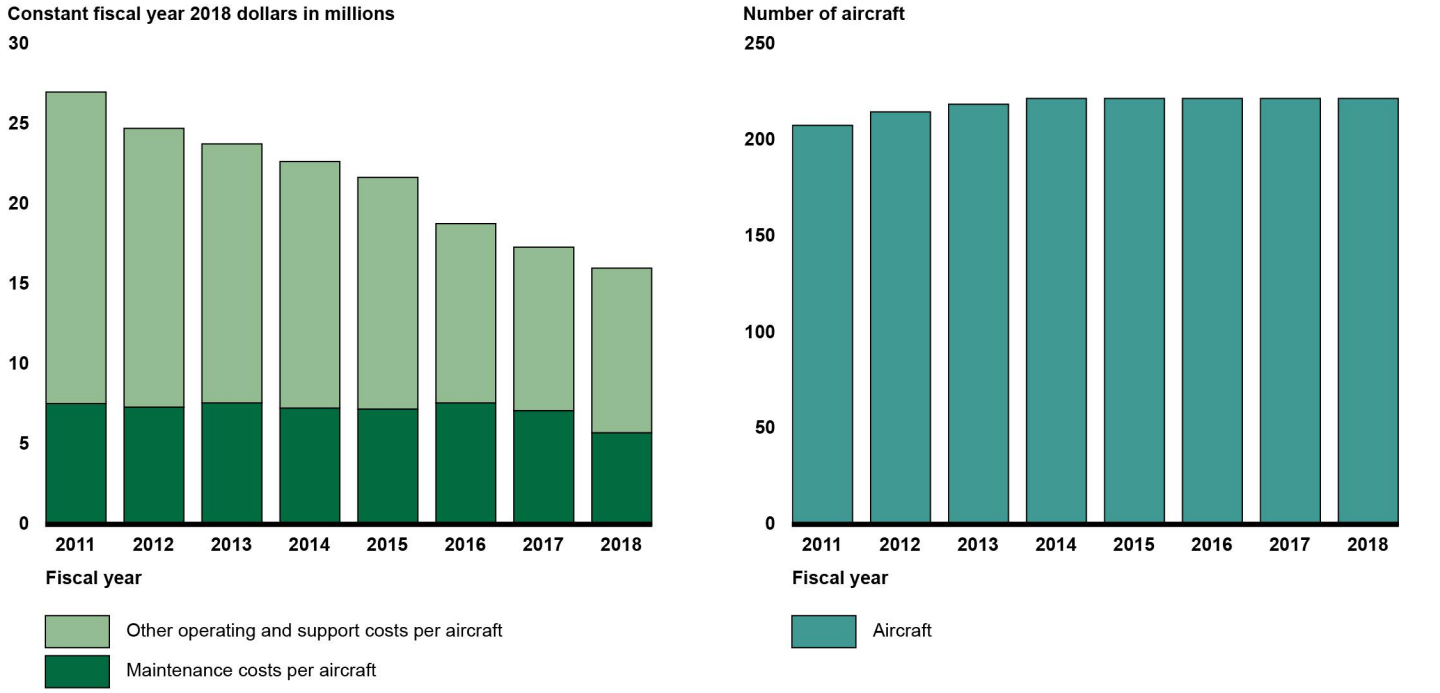
Data table for C-17 Total Operating and Support Costs (Constant fiscal year 2018 dollars in millions)

Fiscal year	Unit level manpower	Unit operations	Maintenance	Sustaining support	Continuing system improvements	Indirect support
2011	1009.13	2532.23	1576.8	0.97	407.82	98.5
2012	1087.77	2383.28	1580.03	3.16	183.19	87.68
2013	1033.11	2192.32	1667.73	5.57	234.69	77.39
2014	1066.47	2126.03	1618.68	6.51	134.54	88.39
2015	1090.89	1922.71	1605.44	9.31	100.03	92.11
2016	1047.62	1277.68	1691.67	9.63	59.21	92.61
2017	1012.05	1133.8	1583.65	23.49	16.5	83.49
2018	1007.01	1102.39	1277.29	20.92	64.99	88.15

Fiscal year	Consumable materials and repair parts	Depot level reparables	Depot maintenance	Other maintenance	Interim contractor support	Contractor logistics support
2011	39.48	44.58	0.13	0	0	1492.62
2012	37.36	44.07	0.15	0	0	1498.45
2013	33.31	56.1	0.2	0	0	1578.12
2014	37.01	49.29	0.53	0	0	1531.85
2015	41.71	76.33	0.36	0	1.54	1485.5
2016	39.31	79.86	0.14	1.45	2.62	1568.3
2017	37.17	66.82	0	1.19	0	1478.47
2018	44.64	58.41	0.66	0.22	0	1173.36

From fiscal years 2011 through 2018, the O&S costs per C-17 aircraft declined from $27.05 million to $16.04 million as a result of decreased O&S costs and an increase in the aircraft inventory during this period. The C-17 inventory increased by 14 aircraft, from 208 to 222, between fiscal years 2011 and 2014 and has remained at 222 aircraft since fiscal year 2014.

C-17 Operating and Support Costs per Aircraft and Fleet Size Capable Rate



Source: GAO analysis of Air Force data. | GAO-21-101SP

Data table for C-17 Operating and Support Costs per Aircraft and Fleet Size Capable Rate (Constant fiscal year 2018 dollars in millions)

Fiscal year	Maintenance costs per aircraft	Other operating and support costs per aircraft
2011	7.58	19.46
2012	7.35	17.42
2013	7.62	16.18
2014	7.29	15.41
2015	7.23	14.48
2016	7.62	11.2
2017	7.13	10.22
2018	5.75	10.29

Fiscal year	Number of aircraft
2011	208
2012	215
2013	219
2014	222
2015	222
2016	222
2017	222
2018	222

Sustainment Challenges and Mitigation Actions

Aging: The C-17 will continue to be modified to meet its requirements. The Air Force's ongoing and planned actions, according to program officials, include establishing specific teams, such as the weapon system integrity program, that are responsible for creating a plan to better sustain the C-17 and increase its service life.

Maintenance: Program officials said the C-17 requires depot modifications to keep it viable, such as upgrading the communications system and other capability modifications, which reduces the amount of time the aircraft is available for training and mission requirements. Officials also said that the Air Force has found increased amounts of corrosion on the aircraft, which requires intensive sheet metal work to repair. To minimize aircraft downtime, the Air Force makes corrosion repairs while the aircraft is undergoing other heavy maintenance or repairs at a designated base. Finally, officials told us that, as part of its Aircraft Availability Improvement Program, the program increased the intervals between the scheduled field-level maintenance inspections from 120 days to 180 days at the beginning of 2018. Additionally, starting in fiscal year 2020, the program plans to extend the amount of time between scheduled depot maintenance inductions from 5 years to 6 years.

Supply Support: Program officials said some vendors were no longer manufacturing parts and expressed concern that this could lead to future parts shortages. The Air Force's ongoing and planned actions, according to program officials, include upgrading aircraft systems before they become obsolete, locating other vendor sources, redesigning parts, and purchasing additional parts to maintain supply sources.

Program Office Comments

In commenting on a draft of this assessment, the program office provided technical comments, which we incorporated where appropriate.

Source: U.S. Air National Guard/Staff Sgt. Jon Alderman. | GAO-21-101SP

C-130H Hercules Sustainment Quick Look

Common Name: C-130H

Lead Service: Air Force

Program Essentials

Manufacturer: Lockheed Martin

Sustainment: Depot maintenance conducted at Warner Robins Air Logistics Complex, Georgia

Program Office: Robins Air Force Base, Georgia, and Wright-Patterson Air Force Base, Dayton, Ohio

Fiscal Year 2019 Data

Average age: 29.4 years

Average lifetime flying hours: 12,744 hours per aircraft

Depot maintenance activity and squadron locations:

▲ Depot maintenance activity location

● Squadron location

Source: GAO. | GAO-21-101SP

Sustainment Challenges and Mitigation Actions

The C-130H faces sustainment challenges such as increasing maintenance requirements and parts obsolescence. Mitigation actions include initiatives to reduce unscheduled maintenance and scheduled maintenance and a program to address diminishing manufacturing sources and material shortages.

Background

The C-130H Hercules was first manufactured in 1965 and the first deliveries to the Air Force began in 1974. Basic and specialized versions of the four-engine turboprop aircraft perform a variety of missions including airlift support, aeromedical, weather reconnaissance, and natural disaster relief.

Life Cycle of the C-130H

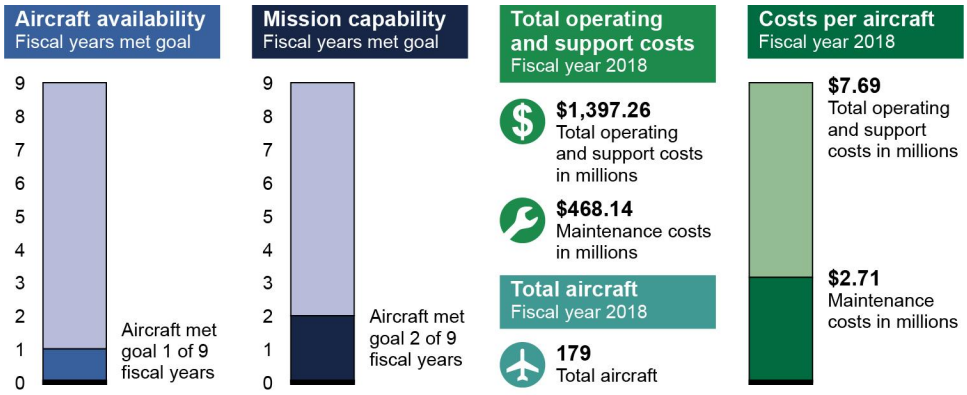
Source: GAO analysis of Air Force data. | GAO-21-101SP

Note: According to program officials, it is unknown when the C-130H reached initial and full operating capability and there is not a projected sunset date for this aircraft.

Overview

From fiscal years 2011 through 2019, the C-130 fleet met its annual aircraft availability and mission capability goals in 1 of the 9 fiscal years, and 2 of the 9 fiscal years, respectively, and both rates decreased during the time period. From fiscal year 2011 through 2018, the size of the C-130H fleet decreased from 268 to 179 due to the retirement of C-130H aircraft and one crash loss. Also, according to Air Force officials, all C-130H aircraft in the active force were moved to Air Force Reserve and Air National Guard units by fiscal year 2015. Operating and support (O&S) costs decreased from about $2.70 billion to $1.38 billion from fiscal years 2011 through 2018 and most of the cost decrease occurred in the unit level manpower, unit operations, and maintenance cost categories. The total O&S costs per aircraft went down from $10.08 million in fiscal year 2011 to $7.69 million in fiscal year 2018.

C-130H Sustainment Status



Source: GAO analysis of Air Force data. | GAO-21-101SP

Data table for C-130H Sustainment Status

Aircraft availability	Aircraft met goal 1 of 9 fiscal years
Mission capability	Aircraft met goal 2 of 9 fiscal years
Total operating and support costs in millions (FY18)	$1,397.26
Maintenance costs in millions (FY18)	$468.14
Total aircraft (FY18)	179
Total operating and support costs per aircraft in millions (FY18)	$7.69
Maintenance costs per aircraft in millions	$2.71

Sustainment Strategy

- The Air Force issued the C-130H Hercules Life-Cycle Management Plan in January 2012 to provide guidance for sustaining and maintaining the C-130H fleet. Air Force officials said they expect to complete the development of a single, updated life-cycle support plan for both the C-130H and C-130J aircraft in fiscal year 2020.
- The Air Force sustains the C-130H fleet through modifications and programmed depot maintenance, which is performed on a 69-month cycle with about 30 aircraft inducted each year.
- Depot maintenance is conducted by the Air Force at Warner Robins Air Logistics Complex, Georgia, and field maintenance is performed by Air Force Reserve Command and Air Force National Guard personnel. According to Air Force officials, spare parts, engines and propellers are all managed and maintained by the Defense Logistics Agency and the Air Force Sustainment Center.

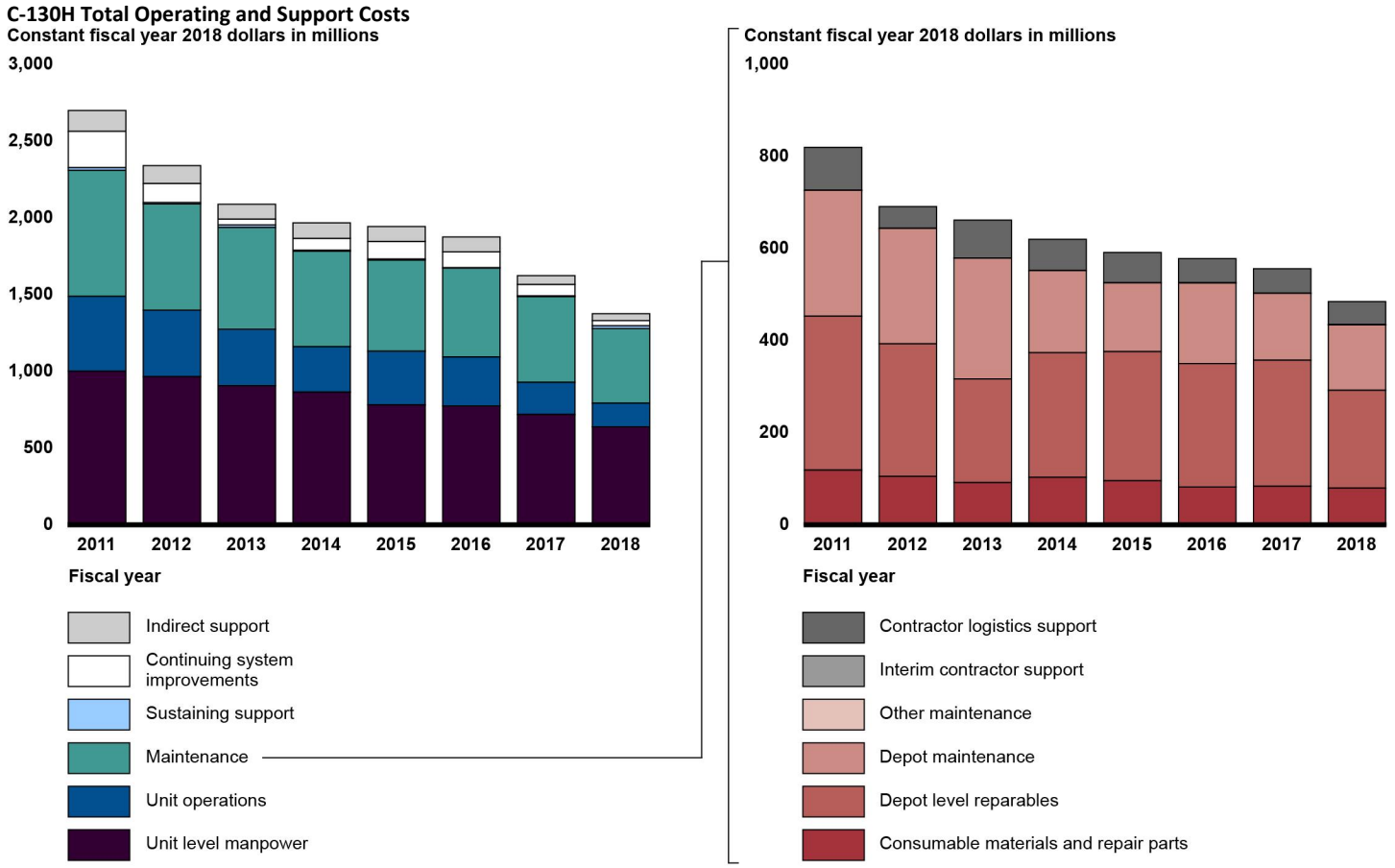
Availability and Condition

From fiscal year 2011 through fiscal year 2019, the C-130H fleet met its aircraft availability goal in 1 of the 9 fiscal years and its mission capable goals in 2 of the 9 fiscal years, and was close to meeting those goals in several other years. Over the period the aircraft availability rate and mission capable rate varied, but generally decreased. Air Force officials said that extended downtime prior to aircraft retirements and for programmed depot maintenance and increased system modifications negatively affected the C-130H fleet's availability rates.

From fiscal year 2011 through 2019, the C-130H's not mission capable maintenance (NMCM) rate varied, and the not mission capable both (NMCB) maintenance and supply rate steadily increased. The not mission capable supply rate varied slightly during the time period. According to officials, increased scheduled maintenance rates, increased parts supportability issues, and force structure changes caused the higher not mission capable rates. With regard to force structure changes and scheduled maintenance rates, officials said that the 61 remaining active duty C-130H aircraft were transferred to Air Force Reserve Command and Air National Guard units during this time period. As a result, the downtime for subsequent field-level maintenance on these aircraft increased because the receiving units were manned only for one maintenance shift per day, while the active duty had three shifts. Additionally, officials said the C-130H unit structure within the Air Force Reserve Command and the Air National Guard changed. Units that did not previously have C-130H aircraft needed time to train and equip their maintainers, which led to higher maintenance rates in certain years. Officials said that the NMCB rate rose higher due to supply issues, such as problems the program faced replacing failed landing gear components. Specific details on mission capable and not mission capable rates were omitted because the information was deemed by DOD to be sensitive.

Operating and Support Costs

From fiscal year 2011 through 2018, the total O&S costs for the C-130H fleet decreased approximately $1.32 billion, from about $2.70 billion to $1.38 billion. About 78 percent of the O&S cost decrease, or about $1.03 billion, occurred in three cost categories. More specifically, unit level manpower decreased by about $362.68 million, unit operations decreased by about $333.27 million, and maintenance costs decreased by about $334.98 million. According to Air Force officials, C-130H's O&S costs decreased largely because the Air Force retired aircraft during the 8-year period. The C-130H fleet size was reduced from 268 aircraft in fiscal year 2011 to 179 aircraft in fiscal year 2018. Officials said that unit operations costs decreased not only as a result of reduced flight hours—the fleet flew almost 50 percent fewer hours in fiscal year 2018 than in fiscal year 2011—but because fuel prices were lower in fiscal year 2018. With respect to unit level manpower, officials told us that costs decreased because there were a smaller number of C-130H personnel and because the program had less military and more civilians, which are less expensive, when comparing fiscal year 2011 to fiscal year 2018.



Source: GAO analysis of Air Force data. | GAO-21-101SP

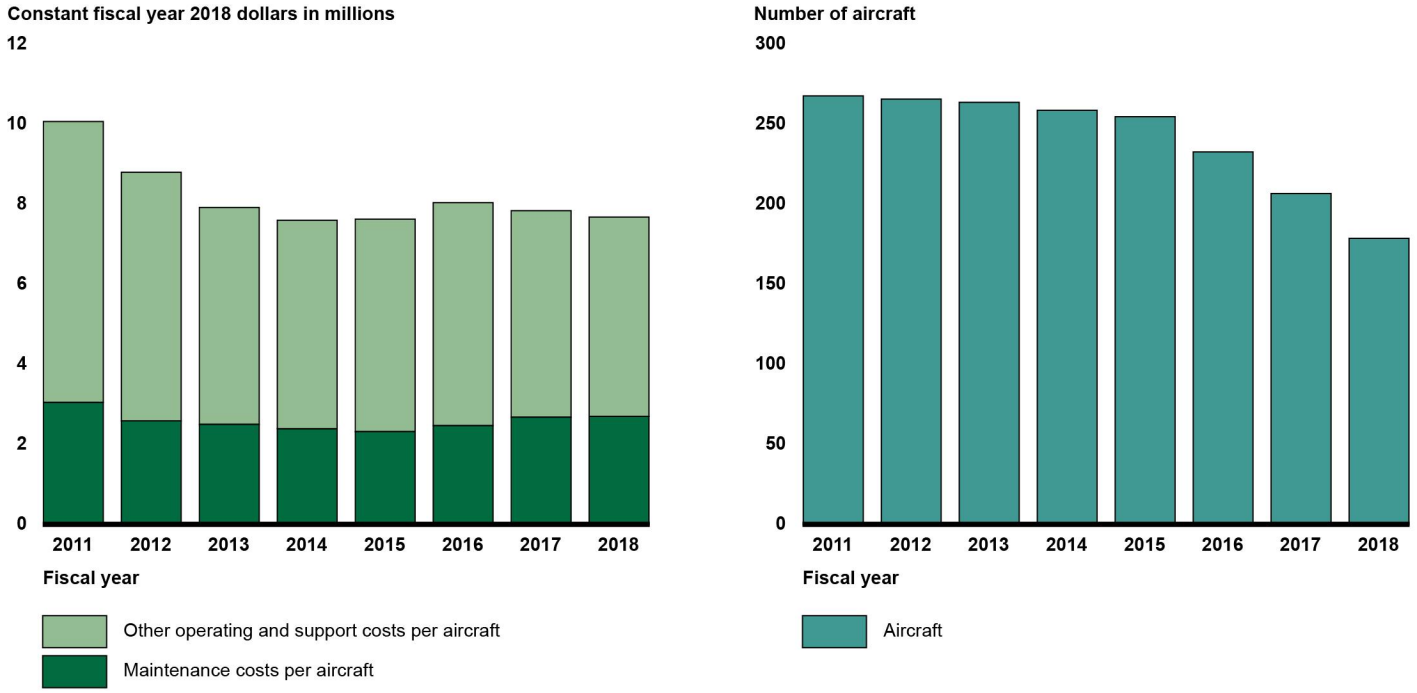
Data table for C-130H Total Operating and Support Costs (Constant fiscal year 2018 dollars in millions)

Fiscal year	Unit level manpower	Unit operations	Maintenance	Sustaining support	Continuing system improvements	Indirect support
2011	1004.17	487.36	821.13	18.58	236.02	135.48
2012	968.49	433.18	692.4	8.47	124.23	117.65
2013	910.14	368.1	662.96	16.15	38.01	96.72
2014	868.37	296.06	621.48	5.68	77.87	101.3
2015	785.22	349.85	592.7	7.29	114.11	97.35
2016	777.51	319.12	579.43	2.95	103.17	97.22
2017	723.13	209.04	557.41	5.64	74.24	57.25
2018	641.49	154.09	486.14	18.67	33.23	45.65

Fiscal year	Consumable materials and repair parts	Depot level reparables	Depot maintenance	Other maintenance	Interim contractor support	Contractor logistics support
2011	119.87	334.47	273.27	0.01	0	93.51
2012	106.28	288.18	250.5	0.18	0	47.26
2013	92.96	225	262.3	0.27	0	82.43
2014	104.34	270.71	178.36	0	0	68.07
2015	97.02	280.18	149.47	0.07	0	65.95
2016	83.4	268.01	174.89	0.7	0	52.44
2017	85.01	273.63	145.29	0.44	0	53.03
2018	81.02	212.38	141.88	0.76	0	50.1

The C-130H's total O&S costs per aircraft decreased from $10.08 million in fiscal year 2011 to $7.69 million in fiscal year 2018.The maintenance costs per aircraft decreased slightly from $3.06 million in 2011 to $2.71 million in 2018. As noted earlier, the C-130H fleet decreased by 89 aircraft and total O&S costs decreased by $1.32 billion during this 8-year period, reducing the overall cost per aircraft.

C-130H Maintenance and Other Operating and Support Costs per Aircraft and Fleet Size



Source: GAO analysis of Air Force data. | GAO-21-101SP

Data table for C-130H Maintenance and Other Operating and Support Costs per Aircraft and Fleet Size (Constant fiscal year 2018 dollars in millions)

Fiscal year	Maintenance costs per aircraft	Other operating and support costs per aircraft
2011	3.06	7.02
2012	2.6	6.21
2013	2.51	5.42
2014	2.4	5.21
2015	2.33	5.31
2016	2.48	5.57
2017	2.69	5.16
2018	2.71	4.98

Fiscal year	Number of aircraft
2011	268
2012	266
2013	264
2014	259
2015	255
2016	233
2017	207
2018	179

Sustainment Challenges and Mitigation Actions

Maintenance: According to Air Force officials, the C-130H fleet is experiencing sustainment challenges that are common to all aging aircraft fleets, such as corrosion, structural fatigue, and parts obsolescence. These issues led to an increase in both field-level and depot-level maintenance, which are being addressed through a series of maintenance and engineering initiatives. Within the maintenance communities, officials explained that technicians, led by the Air Mobility Command, continually evaluate the methods for management of maintenance to reduce the overall downtime. Within the engineering community, continuous analysis is performed to evaluate the effect of flight operations and maintenance activities on the fleet, according to officials. The officials said they are currently implementing condition based maintenance initiatives to provide a predictive parts failure replacement program intended to reduce unscheduled maintenance by converting unscheduled maintenance to scheduled maintenance. They said they are also working on programmed depot maintenance process improvements and regionalizing scheduled maintenance inspections to reduce depot maintenance flow days and aircraft downtime.

Supply Support: Air Force officials said that the sustainment challenges faced by the aging C-130H fleet also resulted in an increase in parts support requirements and a corresponding increase in diminishing manufacturing sources and material shortages. According to officials, the C-130 program office has an active diminishing manufacturing sources and material shortages program that started in 2015 to address both production and sustainment supply-support issues. C-130 personnel at both Robins Air Force Base and Wright-Patterson Air Force Base participate in broader Air Force Material Command parts efforts to identify and resolve these issues for the C-130H fleet.

Program Office Comments

In commenting on a draft of this assessment, the program office provided technical comments, which we incorporated where appropriate.

Source: U.S. Air Force/Airman 1st Class Mercedes Porter. | GAO-21-101SP

C-130J Super Hercules Sustainment Quick Look

Common Name: C-130J

Lead Service: Air Force

Program Essentials

Manufacturer: Lockheed Martin

Sustainment: Depot maintenance conducted at Warner Robins Air Logistics Complex, Georgia

Program Office: Robins Air Force Base, Georgia and Wright-Patterson Air Force Base, Dayton, Ohio

Fiscal Year 2019 Data

Average age: 9.2 years

Average lifetime flying hours: 7,626 hours per aircraft

Depot maintenance activity and squadron locations:

▲ Depot maintenance activity location

● Squadron location

Source: GAO. | GAO-21-101SP

Sustainment Challenges and Mitigation Actions

The C-130J faces increasing maintenance requirements and parts obsolescence. Mitigation actions include initiatives to reduce unscheduled maintenance and scheduled maintenance and a program to address diminishing manufacturing sources and material shortages.

Background

The C-130J Super Hercules was first manufactured in 1998 and deliveries to the Air Force began in 1999. Basic and specialized versions of the four-engine turboprop aircraft perform a variety of missions including airlift support, aeromedical, weather reconnaissance, and natural disaster relief. The C-130J is the latest addition to the C-130 fleet.

Life Cycle of the C-130J

◎ Initial Operational Capability ▲ Full Operational Capability

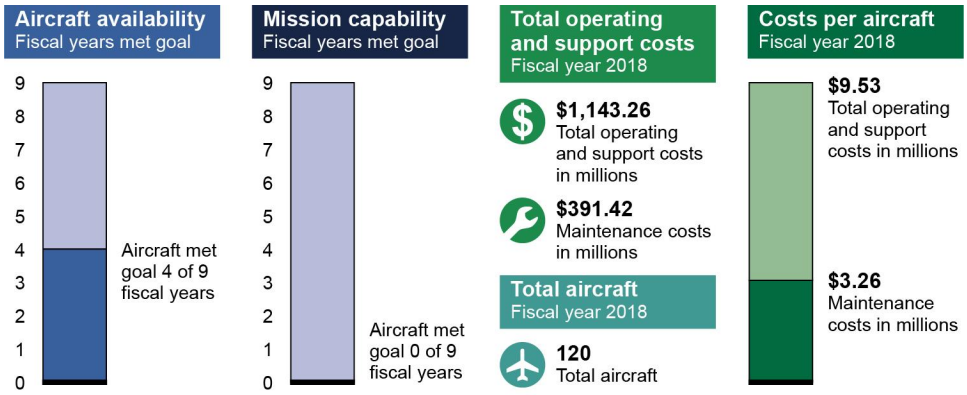
Source: GAO analysis of Air Force data. | GAO-21-101SP

Note: According to program officials there is not a projected sunset date for this aircraft.

Overview

From fiscal years 2011 through 2019, the C-130J fleet met or exceeded its annual aircraft availability goals in 4 of the 9 fiscal years, but did not meet any of its mission capable goals. Both rates decreased slightly during the time period. Total operating and support (O&S) costs for the C-130J fleet increased from about $797.34 million to $1.14 billion from fiscal years 2011 through 2018. Unit level manpower costs and maintenance costs increased the most. Over the 8-year period, the size of the C-130J fleet size increased from 71 to 120 aircraft due to continued procurement and deliveries of aircraft. The total O&S cost per aircraft decreased from $11.23 million in fiscal year 2011 to $9.53 million in fiscal year 2018, while the maintenance costs per aircraft increased from $2.38 to $3.26 million during the same time frame.

C-130J Sustainment Status



Source: GAO analysis of Air Force data. | GAO-21-101SP

Data table for C-130J Sustainment Status

Aircraft availability	Aircraft met goal 4 of 9 fiscal years
Mission capability	Aircraft met goal 0 of 9 fiscal years
Total operating and support costs in millions (FY18)	$1,143.26
Maintenance costs in millions (FY18)	$391.42
Total aircraft (FY18)	120
Total operating and support costs per aircraft in millions (FY18)	$9.53
Maintenance costs per aircraft in millions	$3.26

Sustainment Strategy

- The April 2015 C-130J Life-Cycle Sustainment Plan establishes the sustainment approach for the operations and support phase of the C-130J aircraft. Air Force officials said they expect to complete the development of a single, updated life-cycle sustainment plan for both the C-130H and C-130J aircraft in fiscal year 2020.
- Programmed depot maintenance for the C-130J fleet is conducted by the Air Force at Warner Robins Air Logistics Complex, Georgia. However, engine and propeller maintenance is managed by the Rolls-Royce Company under a performance based logistics contract, according to C-130 program officials. The Air Force Sustainment Center and the Defense Logistics Agency manage the C-130J parts that are common to the C-130H aircraft and other DOD programs. Lockheed Martin Aerospace provides supply support for unique C-130J components under a performance-based logistics contract.
- The Air Force sustains the C-130J fleet through programmed depot maintenance, which is initially performed after 12 years and then on a recurring 6-year cycle, and through modifications, according to officials.

Availability and Condition

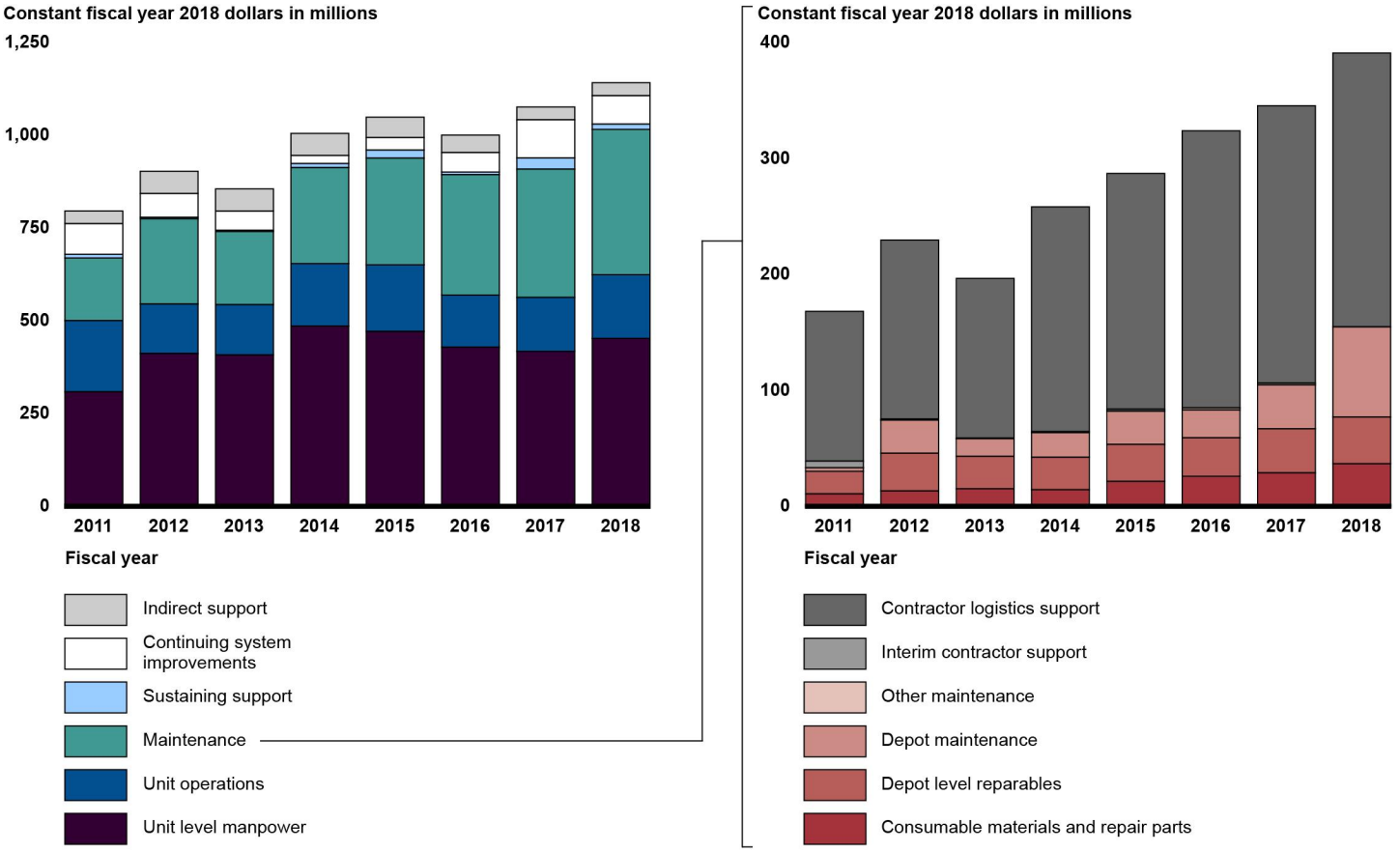
From fiscal years 2011 through 2019, the C-130J fleet met its annual aircraft availability goals in 4 of the 9 fiscal years, but did not meet any of its annual mission capable goals. Both the aircraft availability and the mission capability rates decreased slightly during the time period. According to Air Force officials, the aircraft availability rate decline was largely due to an increase in the amount of time the aircraft spent in depot maintenance. The officials said that depot inductions increased 400 percent overall and the associated downtime increased by 436 percent mostly due to the aircraft's procurement history and programmed depot maintenance schedule. Older aircraft began to require recurring maintenance as newer aircraft continued to receive the initial maintenance.

The C-130J's rates increased slightly for not mission capable maintenance (NMCM) and not mission capable both (NMCB) from fiscal years 2011 through 2019, while it's not mission capable supply (NMCS) rate was about the same at the beginning and the end of the time period. According to Air Force officials, the NMCM rate increases during this period were due, in part, to unit structure changes. C-130H units needed to train and equip their maintainers to work on the C-130J. During training, there were not enough qualified maintainers available to repair C-130J aircraft. Additionally, the officials said that the NMCS and the NMCB increases occurred because the fleet size was increasing and because the levels of spare parts that were available to maintain the aircraft were inadequate due to program funding levels. Specific details on mission capable and not mission capable rates were omitted because the information was deemed by DOD to be sensitive.

Operating and Support Costs

From fiscal year 2011 through 2018, the total O&S costs for the C-130J fleet increased by about $345.92 million, from $797.34 million to $1.14 billion. Most of the increase during this time frame occurred in two cost categories: maintenance and unit-level manpower. Maintenance costs increased by $222.69 million, from $168.73 to $391.42 million, and unit-level manpower costs increased by $144.28 million, from $310.00 to $454.28 million. According to Air Force officials, the increase in C-130J O&S costs was due, in part, to the addition of aircraft to the fleet. The C-130J fleet size increased by 49 aircraft, from 71 aircraft in fiscal year 2011 to 120 aircraft in fiscal year 2018. Further, the officials said that the annual C-130J flight hours increased by about 42 percent during this time frame. A C-130 program official stated that maintenance costs also increased because the number of aircraft that received programmed depot maintenance began to double as older aircraft started to require the recurring maintenance inspection as newer aircraft continued to receive the initial maintenance inspection, among other reasons.

C-130J Total Operating and Support Costs



Source: GAO analysis of Air Force data. | GAO-21-101SP

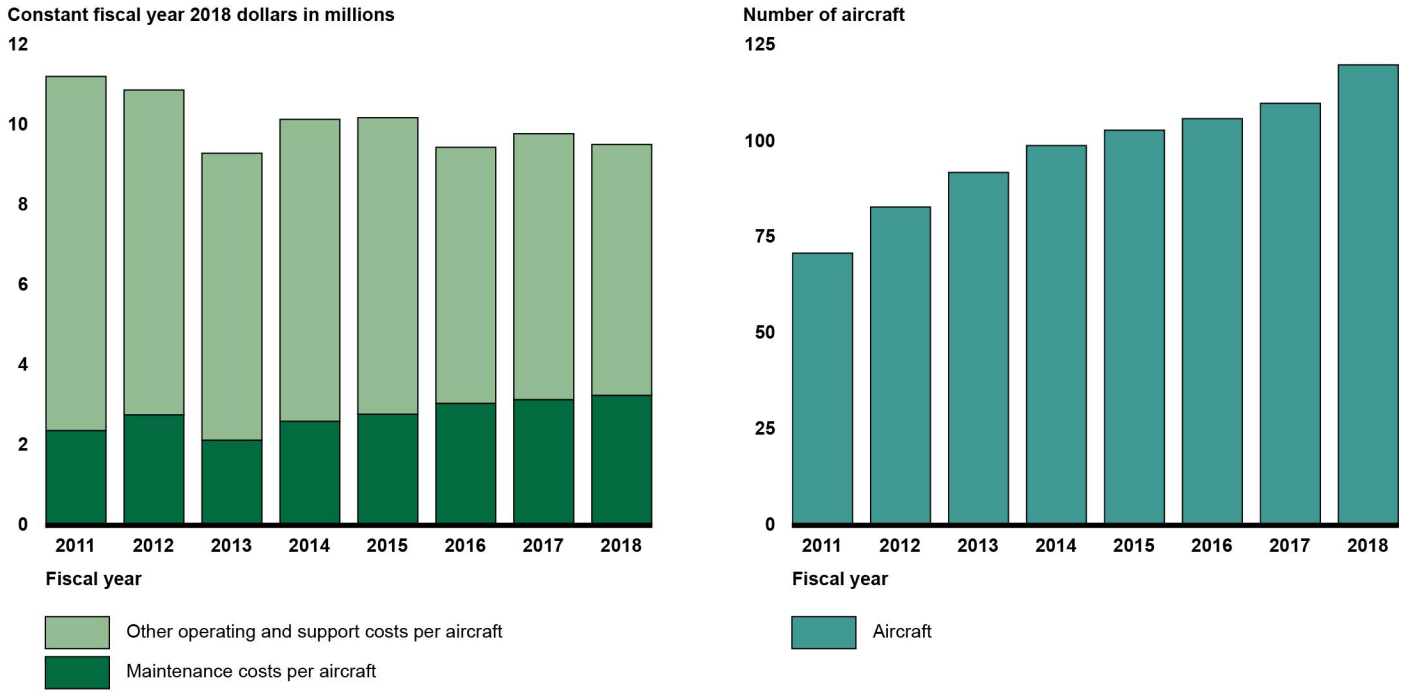
Data table C-130J Total Operating and Support Costs (Constant fiscal year 2018 dollars in millions)

Fiscal year	Unit level manpower	Unit operations	Maintenance	Sustaining support	Continuing system improvements	Indirect support
2011	310	192.19	168.73	9.94	82.53	33.94
2012	413.33	133.18	230.19	3.89	64.01	59.97
2013	409.58	135.5	197.04	3.74	51.19	59.92
2014	487.63	168.33	258.77	10.83	21.47	59.65
2015	472.97	179.55	287.62	21.57	33.66	55.2
2016	430.6	140.38	324.37	6.97	52.7	47.24
2017	419.04	145.52	345.96	29.69	103.01	34.77
2018	454.28	171.67	391.42	14.34	76.62	34.93

Fiscal year	Consumable materials and repair parts	Depot level reparables	Depot maintenance	Other maintenance	Interim contractor support	Contractor logistics support
2011	11.15	19.5	3.05	0.01	5.76	129.25
2012	13.77	32.45	28.62	0.02	0.84	154.48
2013	15.61	27.93	15.32	0.03	0.5	137.64
2014	14.84	27.9	21.26	0	0.96	193.8
2015	21.97	31.85	28.7	0.11	1.6	203.39
2016	26.41	33.25	23.88	1.81	0.01	239.01
2017	29.34	37.95	37.9	1.53	0	239.24
2018	37.19	40.31	77.63	0	0	236.29

The total O&S costs per C-130J aircraft decreased from $11.23 million to $9.53 million from fiscal year 2011 through fiscal year 2018. Maintenance costs per C-130J aircraft increased from $2.38 million to $3.26 million during the same time frame. As noted earlier, the C-130J fleet increased by 49 aircraft and total O&S costs increased by $345.92 million, from fiscal years 2011 through 2018, and the total O&S cost per aircraft decreased. However, the maintenance costs increase of $222.69 million, or 132 percent, during that time frame resulted in higher maintenance costs per C-130J aircraft. Air Force officials attributed the rise in maintenance costs per aircraft to additional maintenance requirements and associated depot maintenance time, noting that the average time for programmed depot maintenance went from 129 days in fiscal year 2011 to 220 days in fiscal year 2018. They cited the replacement of the center wing, the removal of paint, and the modification of an infrared missile countermeasures system as several examples of activities that were added to the basic maintenance work package during the 8-year period.

C-130J Operating and Support Costs per Aircraft and Fleet Size



Source: GAO analysis of Air Force data. | GAO-21-101SP

Data table for C-130J Operating and Support Costs per Aircraft and Fleet Size (Constant fiscal year 2018 dollars in millions)

Fiscal year	Maintenance costs per aircraft	Other operating and support costs per aircraft
2011	2.38	8.85
2012	2.77	8.12
2013	2.14	7.17
2014	2.61	7.55
2015	2.79	7.41
2016	3.06	6.4
2017	3.15	6.65
2018	3.26	6.27

Fiscal year	Number of aircraft
2011	71
2012	83
2013	92
2014	99
2015	103
2016	106
2017	110
2018	120

Sustainment Challenges and Mitigation Actions

Maintenance: According to Air Force officials, the C-130J fleet is experiencing sustainment challenges that are common to all aging aircraft fleets, such as corrosion, structural fatigue, and parts obsolescence. These issues led to an increase in both field-level and depot-level maintenance, which are being addressed through a series of maintenance and engineering initiatives. Within the maintenance communities, officials explained that technicians, led by the Air Mobility Command, continually evaluate the methods for management of maintenance to reduce the overall downtime. Within the engineering community, continuous analysis is performed to evaluate the effect of flight operations and maintenance activities on the fleet, according to officials. The officials said they are currently implementing condition based maintenance initiatives to provide a predictive parts failure replacement program intended to reduce unscheduled maintenance by converting unscheduled maintenance to scheduled maintenance. They said they are also working on programmed depot maintenance process improvements and regionalizing scheduled maintenance inspections to reduce flow days and aircraft downtime.

Supply Support: Air Force officials said that the sustainment challenges faced by the aging C-130H fleet also resulted in an increase in parts support requirements and a corresponding increase in diminishing manufacturing sources and material shortages. According to officials, the C-130 program office has an active diminishing manufacturing sources and material shortages program that was started in 2015 to address both production and sustainment-supply support issues. C-130 personnel at both Robins Air Force Base and Wright-Patterson Air Force Base participate in broader Air Force Material Command parts efforts to identify and resolve these issues for the C-130J fleet.

Program Office Comments

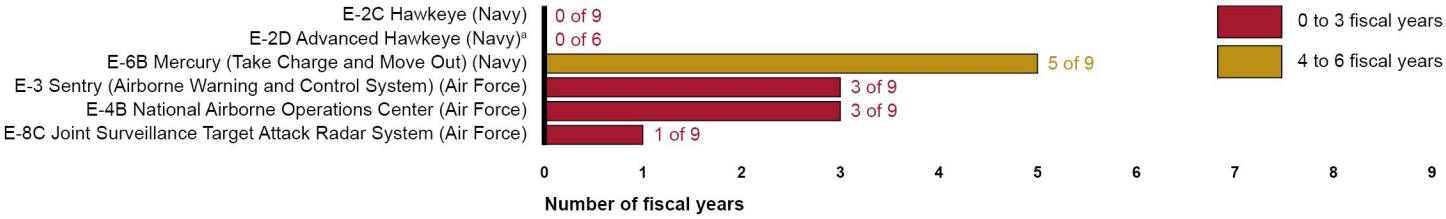
In commenting on a draft of this assessment, the program office provided technical comments, which we incorporated where appropriate.

Command and control aircraft

E-3 Sentry (Airborne Warning and Control System)

Source: U.S. Air Force/Master Sgt. William Greer. | GAO-21-101SP

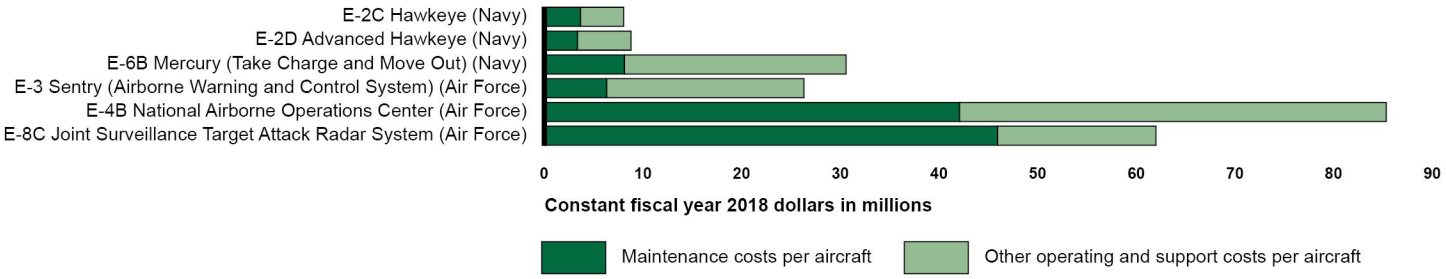
Number of Times Selected Command and Control Aircraft Met Their Annual Mission Capable Goal, Fiscal Years 2011 through 2019



Source: GAO analysis of Navy and Air Force data. | GAO-21-101SP

[a]The Navy did not provide the mission capable goals for all nine years for this aircraft.

Operating and Support Costs per Aircraft for Selected Department of Defense Command and Control Aircraft, Fiscal Year 2018



Source: GAO analysis of Navy and Air Force data. | GAO-21-101SP

Source: U.S. Navy/Mass Communication Specialist 3rd Class Grant G. Grady. | GAO-21-101SP

E-2C Hawkeye Early Warning and Control Aircraft Sustainment Quick Look

Common Name: E-2C

Lead Service: Navy

Program Essentials

Manufacturer: Northrop Grumman Aerospace Corporation

Sustainment: Depot maintenance conducted at Navy Fleet Readiness Centers and field maintenance conducted by Navy maintainers

Program Office: Program Manager–Air 231, Naval Air Systems Command, Patuxent River, Maryland

Fiscal Year 2019 Data

Average age: 17.4 years

Average lifetime flying hours: 6,105 hours per aircraft

Depot maintenance activity and squadron locations:

▲ Depot maintenance activity location

● Squadron location

Source: GAO. | GAO-21-101SP

Sustainment Challenges and Mitigation Actions

The E-2C is operating beyond its planned service life, with maintenance and supply challenges. The Navy's actions to mitigate these challenges include transitioning the fleet to the E-2D aircraft and cannibalizing parts—that is, moving parts from one aircraft to another.

Background

The E-2C Hawkeye Early Warning and Control Aircraft is the Navy's all-weather, carrier-based, tactical battle management, and airborne early warning, command and control aircraft. The E-2C has a planned sunset date of 2026, when the last of its replacement aircraft, the E-2D Advanced Hawkeye Early Warning and Control Aircraft, is delivered.

Life Cycle of the E-2C

It is unknown when Group I was first manufactured and reached full operational capability.

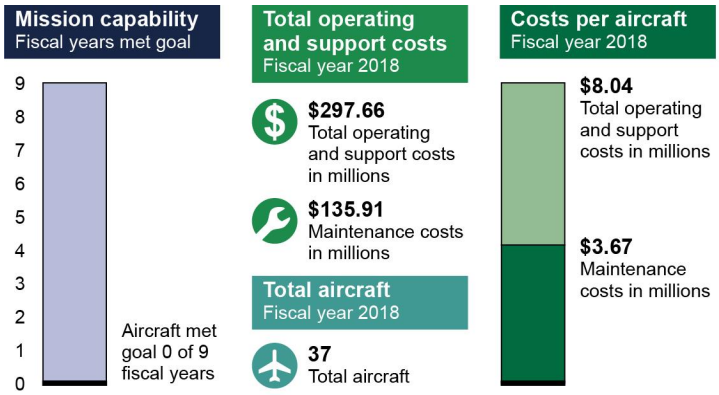
◎ Initial Operational Capability △ Full Operational Capability

Source: GAO analysis of Navy data. | GAO-21-101SP

Overview

The E-2C did not meet any of its annual mission capable goals from fiscal years 2011 through 2019, and the mission capable rate decreased during this time period. According to Navy officials, the E-2C's mission capable rate decrease was due to the fleet's need for additional maintenance as the aircraft ages. Total operating and support (O&S) costs decreased, from about $551.85 million in fiscal year 2011 to about $297.66 million in fiscal year 2018, in part because the E-2C inventory is decreasing as Navy squadrons transition from the E-2C to the E-2D aircraft. During this same time period, the annual O&S costs per aircraft decreased from about $9.51 million to about $8.04 million.

E-2C Sustainment Status



Source: GAO analysis of Navy data. | GAO-21-101SP

Data table for E-2C Sustainment Status

Mission capability	Aircraft met goal 0 of 9 fiscal years
Total operating and support costs in millions (FY18)	$297.66
Maintenance costs in millions (FY18)	$135.91
Total aircraft (FY18)	37
Total operating and support costs per aircraft in millions (FY18)	$8.04
Maintenance costs per aircraft in millions	$3.67

Sustainment Strategy

- The E-2C Hawkeye Post Production Support Plan (2011) documents the sustainment logistics, engineering programs, and financial resources necessary to ensure the platform's continued sustainment and attainment of readiness and safety operations. According to officials, they will include an appendix for the E-2C when they update the sustainment strategy for the E-2D in 2020.
- The E-2C is maintained organically by field maintainers and at Navy Fleet Readiness Centers Southwest and Mid-Atlantic under a planned maintenance interval cycle. Field maintainers perform the initial planned maintenance interval 42 months after initial deployment. The Fleet Readiness Centers then perform the second cycle of planned maintenance 46 months later.

Availability and Condition

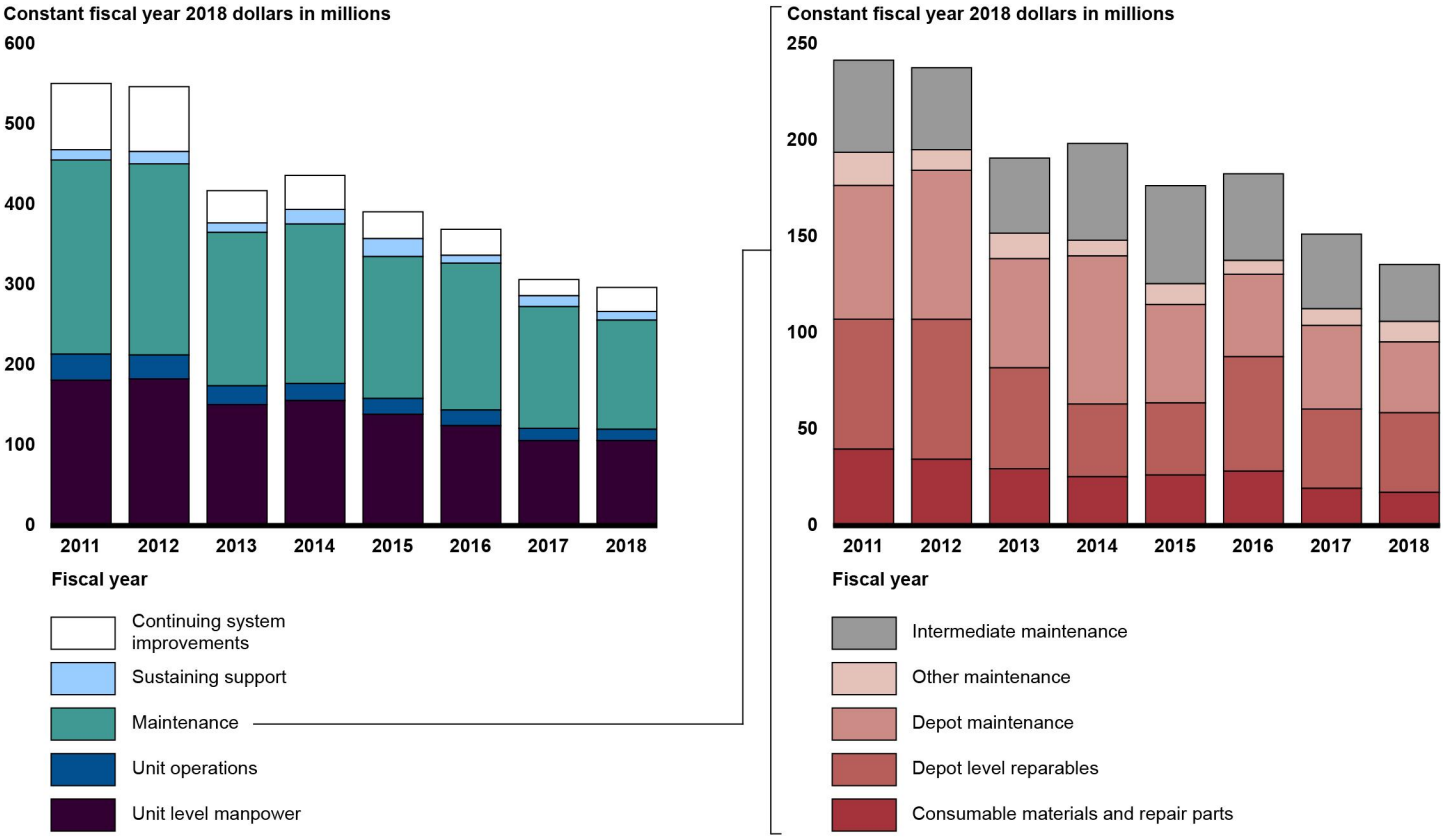
The E-2C fleet did not meet any of its annual mission capable goals from fiscal year 2011 through fiscal year 2019, and its mission capable rate decreased. According to program officials, the funding levels for the E-2C did not support the program's ability to reach the mission capable goals during the time period. Specifically, E-2 program officials told us that the funding levels resulted in the cannibalization of parts (i.e., removing serviceable parts from one aircraft and installing them in another aircraft). However, E-2C officials also stated that the program received additional funding in fiscal years 2017 through 2019 to support increased readiness, and that if this additional funding continues, they expect the program can meet the mission capable goal in fiscal year 2021.

The overall decline in the E-2C's mission capable rate from fiscal years 2011 through 2019 was largely due to maintenance issues, though supply challenges had an impact in the later years. The not mission capable maintenance rate was about the same in fiscal year 2011 and fiscal year 2019, but the rate was higher at times in between these years. The not mission capable supply rate increased from fiscal years 2011 through 2019. According to officials, these trends are a result of the work that the squadrons recently started to make the necessary repairs to the E-2C aircraft, and the supply system was not prepared for the increase in parts demand. Specific details on mission capable and not mission capable rates were omitted because the information was deemed by DOD to be sensitive.

Operating and Support Costs

The E-2C's total O&S costs decreased by about $254.19 million—or 46 percent—from fiscal years 2011 through 2018, in part because the number of aircraft in use also decreased. Specifically, during this time frame, unit level manpower decreased from about $182 million to about $107 million; and maintenance decreased from about $242 million to about $136 million. According to officials, decreases in costs can be attributed to the transition of the fleet from the E-2C to the E-2D. Depot maintenance was the most significant contributor to maintenance costs, averaging about $56.82 million per year, or 30 percent of the total annual maintenance costs from fiscal years 2011 through 2018. The other maintenance cost category was the smallest share, averaging about $10.83 million per year, or 6 percent of the total annual maintenance costs during the same time period.

E-2C Total Operating and Support Costs



Source: GAO analysis of Navy data. | GAO-21-101SP

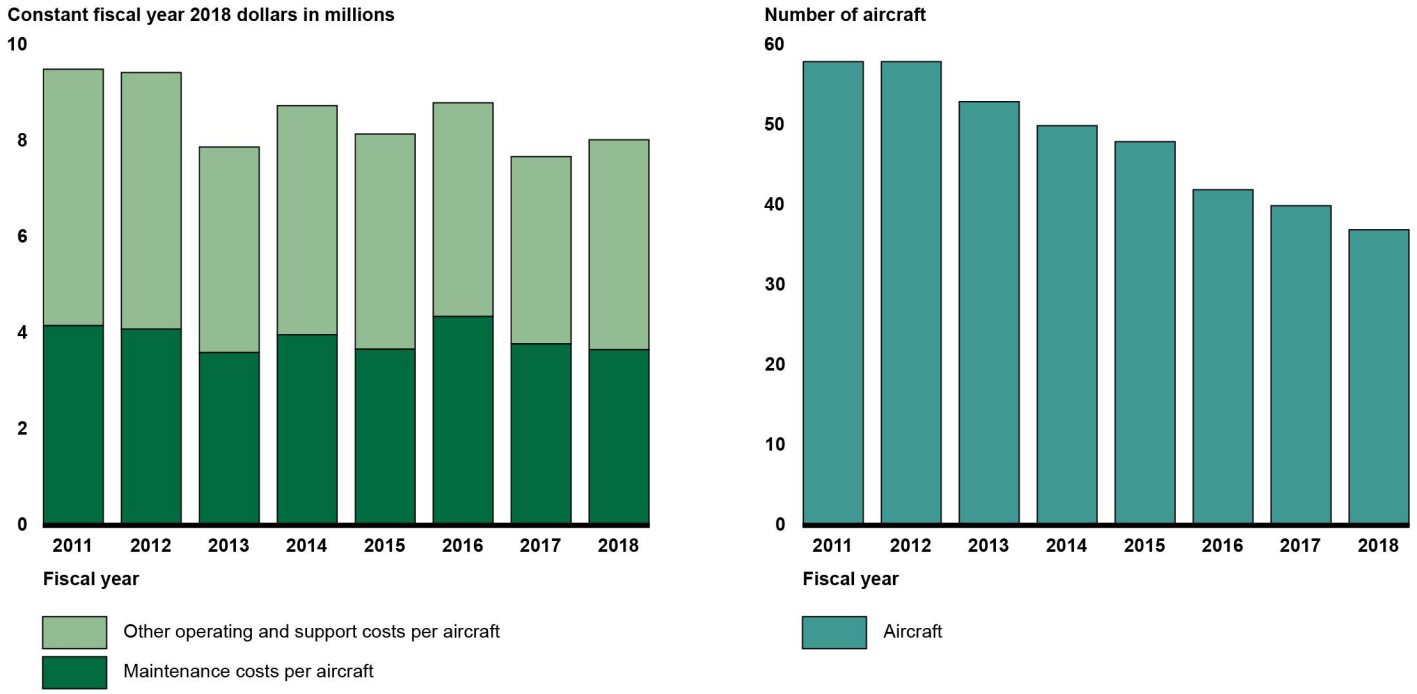
Data table for E-2C Total Operating and Support Costs (Constant fiscal year 2018 dollars in millions)

Fiscal year	Unit level manpower	Unit operations	Maintenance	Sustaining support	Continuing system improvements
2011	181.92	32.41	241.97	12.9	82.65
2012	183.68	29.79	238.06	15.53	80.76
2013	151.56	23.52	191.21	11.7	40.19
2014	156.61	21.23	198.75	18.19	42.36
2015	139.33	19.8	176.83	22.46	33.46
2016	125.44	19.39	183.02	9.67	32.53
2017	106.55	15.48	151.63	13.53	20.28
2018	106.79	14.08	135.91	10.77	30.11

Fiscal year	Consumable materials and repair parts	Depot level reparables	Depot maintenance	Other maintenance	Intermediate maintenance
2011	39.97	67.56	69.39	17.27	47.79
2012	34.78	72.65	77.38	10.72	42.53
2013	29.83	52.38	56.71	13.27	39.01
2014	25.63	37.77	76.93	8.16	50.27
2015	26.59	37.43	51.07	10.79	50.95
2016	28.58	59.42	42.85	7.16	45.01
2017	19.67	41.13	43.48	8.6	38.75
2018	17.55	41.38	36.74	10.67	29.57

From fiscal year 2011 through fiscal year 2018, the E-2C's O&S costs per aircraft generally decreased from about $9.51 million to about $8.04 million, while the mission capable rate also decreased. Maintenance costs per aircraft, on average, accounted for almost half of the total O&S costs per aircraft, averaging about $3.92 million per year. Additionally, the number of aircraft contributing to the costs per aircraft decreased from 58 in fiscal year 2011 to 37 in fiscal year 2018, as the E-2C aircraft transition out of service.

E-2C Operating and Support Costs per Aircraft and Fleet Size



Source: GAO analysis of Navy data. | GAO-21-101SP

Data table for E-2C Operating and Support Costs per Aircraft and Fleet Size (Constant fiscal year 2018 dollars in millions)

Fiscal year	Maintenance costs per aircraft	Other operating and support costs per aircraft
2011	4.17	5.34
2012	4.1	5.34
2013	3.61	4.28
2014	3.98	4.77
2015	3.68	4.48
2016	4.36	4.45
2017	3.79	3.9
2018	3.67	4.37

Fiscal year	Number of aircraft
2011	58
2012	58
2013	53
2014	50
2015	48
2016	42
2017	40
2018	37

Sustainment Challenges and Mitigation Actions

Aging: According to Navy officials, the oldest active E-2C aircraft is about 30 years old and the newest is about 10 years old; thus, there is a wide variance in the age of the aircraft. Navy officials also told us there is high demand for these low-inventory aircraft because of their unique mission capabilities for supporting the Navy's mission. According to officials, the Navy is transitioning its E-2C squadrons to the replacement E-2D aircraft and permanently transitioning the E-2C out of service.

Maintenance: As the E-2C ages, it is requiring additional maintenance for repairs that were not originally planned. Also, according to officials, maintenance for these aircraft is taking longer because more parts have to be repaired and replaced and the Navy faces a shortage of depot and field maintenance personnel, due to attrition and inability to find skilled depot artisans. To address these challenges while the fleet transitions from the E-2C to the E-2D aircraft, officials said that the Navy has several ongoing and planned actions. These include conducting system performance studies to identify maintenance tasks to mitigate potential failures; identifying all parts and components that have to be repaired and replaced during the inspection phase; training depot and field maintainers and other personnel to be proficient in repairing all parts of the aircraft; and allowing depot and field maintainers to work overtime to keep up with maintenance schedules.

Supply Support: The E-2C is experiencing shortages of some parts because vendors are no longer producing these parts. The Navy's ongoing and planned actions, according to officials, include locating another vendor source, upgrading hardware and software, reverse engineering, cannibalizing parts, or waiting until the part is available.

Program Office Comments

The program office reviewed a draft of this assessment and did not have any comments.

Source: U.S. Navy/Mass Communication Specialist Seaman Michael Singley. | GAO-21-101SP

E-2D Advanced Hawkeye Early Warning and Control Aircraft Sustainment Quick Look

Common Name: E-2D

Lead Service: Navy

Program Essentials

Manufacturer: Northrop Grumman Aerospace Corporation

Sustainment: Depot maintenance conducted at Navy Fleet Readiness Centers and field maintenance provided by Navy maintainers

Program Office: Program Manager–Air 231, Naval Air Systems Command, Patuxent River, Maryland

Fiscal Year 2019 Data

Average age: 4.6 years

Average lifetime flying hours: 1,427 hours per aircraft

Depot maintenance activity and squadron locations:

Source: GAO. | GAO-21-101SP

Sustainment Challenges and Mitigation Actions

The E-2D faces maintenance and supply challenges. The Navy's actions to mitigate these challenges include troubleshooting component failures and cannnibalizing parts—that is, moving parts from one aircraft to another.

Background

The E-2D Advanced Hawkeye Early Warning and Control Aircraft is the newest variant of the E-2 aircraft platform, expected to reach full operational capability by 2027. The E-2D aircraft is used to provide advanced warning of approaching enemy surface units and aircraft, among other things.

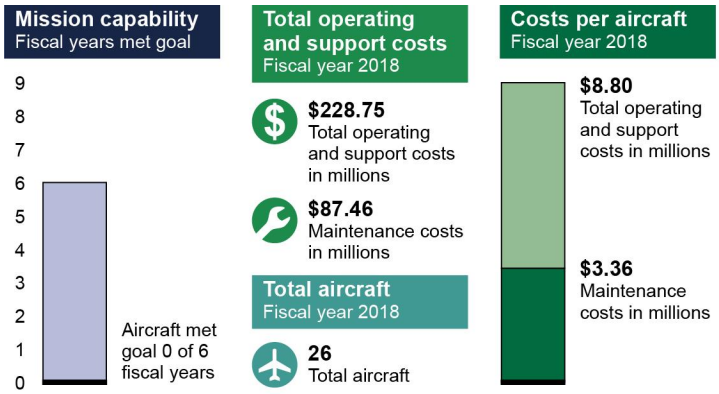
Life Cycle of the E-2D

Source: GAO analysis of Navy data. | GAO-21-101SP

Overview

The E-2D fleet did not meet its annual mission capable goals from fiscal year 2014 through fiscal year 2019, and its mission capable rate decreased during this time period.[1] Total operating and support (O&S) costs consistently increased, from zero in fiscal year 2011 to about $228.75 million in fiscal year 2018. According to officials, the rising O&S costs were largely due to the procurement of additional aircraft. The E-2D fleet increased from three aircraft in fiscal year 2011 to 26 aircraft in fiscal year 2018. In fiscal year 2018, the O&S cost per E-2D aircraft was about $8.8 million, with over a third of the costs dedicated to maintenance needs.

E-2D Sustainment Status



Source: GAO analysis of Navy data. | GAO-21-101SP

Data table for E-2D Sustainment Status

Mission capability	Aircraft met goal 0 of 6 fiscal years
Total operating and support costs in millions (FY18)	$228.75
Maintenance costs in millions (FY18)	$87.46
Total aircraft (FY18)	26
Total operating and support costs per aircraft in millions (FY18)	$8.80
Maintenance costs per aircraft in millions	$3.36

[1]According to Navy officials, mission capable data was not available for the E-2D until fiscal year 2014, when the aircraft entered the fleet.

Sustainment Strategy

- The E-2D Advanced Hawkeye Acquisition Category ID Life-Cycle Sustainment Plan (2012) describes the Navy's approach to sustaining the E-2D aircraft. Also, it describes the overall plan for the management and execution of the product support package by communicating the sustainment strategy to stakeholders in the acquisition, engineering, and logistics communities. Navy officials said they expect to issue an updated life-cycle sustainment plan in 2020.
- Currently, supply support is provided organically by Naval Supply Systems Command and the Defense Logistics Agency; contractor support services are provided by Northrop Grumman Systems Corporation-Aerospace Systems. According to officials, the E-2D's depot maintenance is conducted at the Navy Fleet Readiness Center – Southwest, under a planned maintenance interval cycle of 44 months.

Availability and Condition

From fiscal year 2014 through fiscal year 2019, the E-2D fleet did not meet its annual mission capable goals and its mission capable rate decreased during the time period.[2] According to program officials, prior to fiscal year 2019 the E-2D program did not focus on the fleet-wide mission capable rate as the main metric for the fleet. Under metrics emphasized previously, the E-2D program prioritized resources to units based on training and deployment cycles instead of fleet-wide readiness measures.

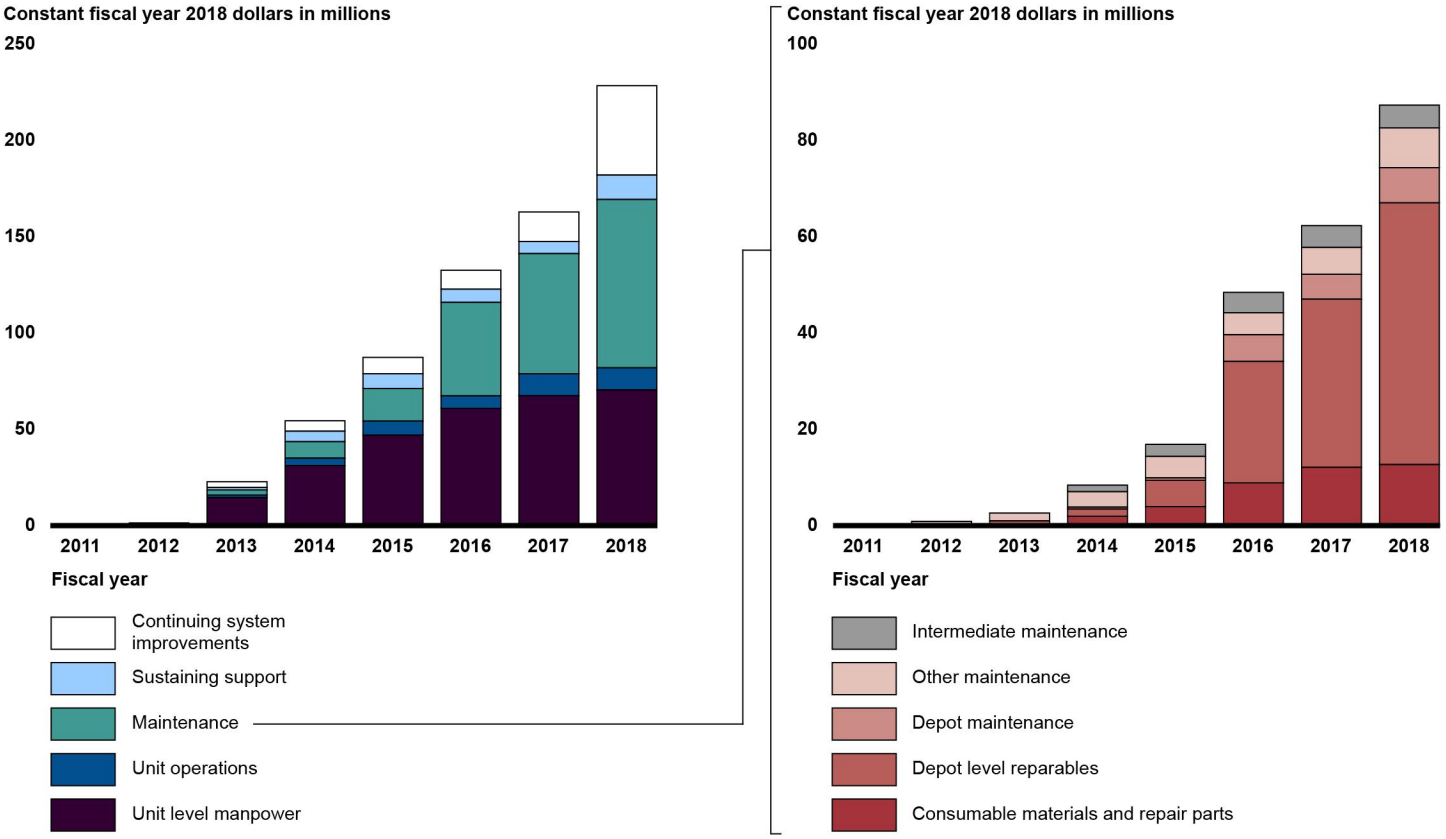
The decrease in the E-2D's mission capable rate from fiscal years 2014 through 2019 was due to an increase in the percent of aircraft that were not mission capable for maintenance (NMCM) and not mission capable for supply (NMCS). The rates increased for NMCM and NMCS by almost the same amount during this time period. According to program officials, the NMCM rate increase was due to an increase in inspections and maintenance needs for the aircraft, while the increase in NMCS was a result of inadequate spares funding for the initial outfitting of the aircraft and the cannibalization of parts from other E-2D aircraft. Specific details on mission capable and not mission capable rates were omitted because the information was deemed by DOD to be sensitive.

Operating and Support Costs

From fiscal year 2011 through 2018, the total O&S costs for the E-2D aircraft increased consistently, from zero to about $228.75 million, with maintenance and unit level manpower costs increasing the most. According to officials, O&S cost growth was mostly due to the procurement of additional aircraft, additional E-2D squadrons, and deployments. Depot-level reparables were the most significant contributor to maintenance costs, averaging about $15.29 million per year during the period.

[2] According to Navy officials, mission capable data was not available for the E-2D until fiscal year 2014, when the aircraft entered the fleet.

E-2D Total Operating and Support Costs



Source: GAO analysis of Navy data. | GAO-21-101SP

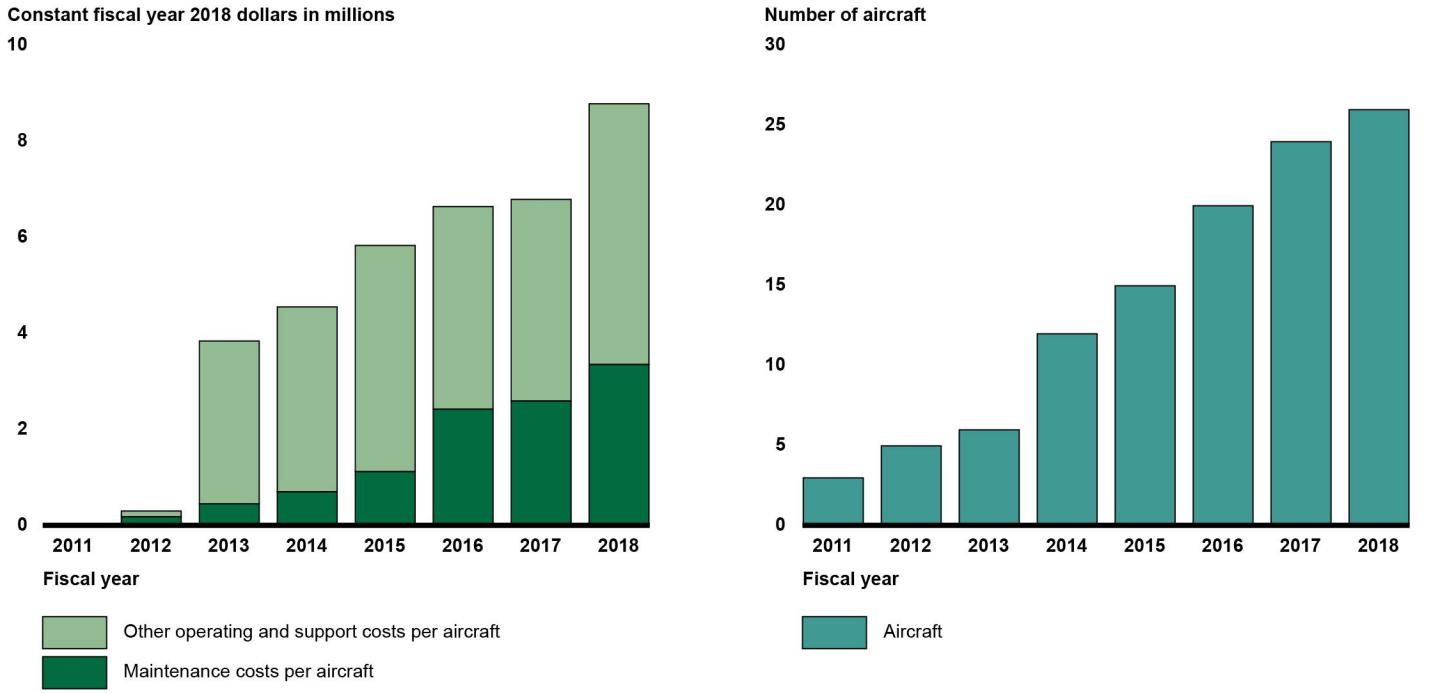
Data table for E-2D Total Operating and Support Costs (Constant fiscal year 2018 dollars in millions)

Fiscal year	Unit level manpower	Unit operations	Maintenance	Sustaining support	Continuing system improvements
2011	0	0	0	0	0
2012	0	0.58	0.96	0	0
2013	14.9	1.23	2.74	1.21	2.99
2014	31.47	3.9	8.52	5.48	5.36
2015	47.22	7.33	16.98	7.66	8.5
2016	61.16	6.47	48.58	6.9	9.77
2017	67.78	11.41	62.43	6.2	15.35
2018	70.78	11.44	87.46	12.69	46.38

Fiscal year	Consumable materials and repair parts	Depot level reparables	Depot maintenance	Other maintenance	Intermediate maintenance
2011	0	0	0	0	0
2012	0.17	0.14	0.01	0.64	0.01
2013	0.42	0.67	0	1.63	0.02
2014	2.08	1.48	0.39	3.21	1.36
2015	4.06	5.46	0.51	4.48	2.48
2016	9	25.22	5.53	4.57	4.26
2017	12.22	34.95	5.16	5.58	4.52
2018	12.79	54.38	7.31	8.25	4.73

From fiscal year 2012 through fiscal year 2018, the E-2D's O&S costs per aircraft increased to about $8.80 million. Maintenance costs per aircraft was 38 percent of the total O&S costs per aircraft in fiscal year 2018. As noted earlier, the E-2D fleet did not incur O&S costs in fiscal year 2011, and total O&S costs increased to about $228.75 million in fiscal year 2018. Additionally, the number of aircraft contributing to the cost per aircraft increased from three in fiscal year 2011 to 26 in fiscal year 2018, with a total expected fleet of 75 aircraft.

E-2D Maintenance and Other Operating and Support Costs per Aircraft and Fleet Size



Source: GAO analysis of Navy data. | GAO-21-101SP

Data table for E-2D Maintenance and Other Operating and Support Costs per Aircraft and Fleet Size (Constant fiscal year 2018 dollars in millions)

Fiscal year	Maintenance costs per aircraft	Other operating and support costs per aircraft
2011	0	0
2012	0.19	0.12
2013	0.46	3.39
2014	0.71	3.85
2015	1.13	4.71
2016	2.43	4.22
2017	2.6	4.2
2018	3.36	5.43

Fiscal year	Number of aircraft
2011	3
2012	5
2013	6
2014	12
2015	15
2016	20
2017	24
2018	26

Sustainment Challenges and Mitigation Actions

Maintenance: According to officials, some components of the E-2D are experiencing faster failure rates than originally planned, resulting in increased maintenance requirements of the aircraft. Officials told us that the avionics system on the E-2D is much heavier than the airframe can support, resulting in additional weight and balance checks as well as airframe maintenance issues. Also, there is high demand for these low-inventory aircraft because of the unique mission capabilities of these aircraft, which has resulted in increased maintenance repairs. Also, there is a shortage of depot and field maintenance personnel due to attrition and inability to find skilled depot artisans. The Navy's ongoing and planned actions, according to officials, include performing weight and balance checks during maintenance repairs, having original equipment manufacturers troubleshoot component failures, identifying all parts and components that need to be repaired and replaced during the inspection phase, moving maintainers around to squadrons as their skill set is needed, and allowing maintainers to work overtime to keep up with maintenance schedules.

Supply Support: E-2D officials said that the aircraft is experiencing some parts shortages because the vendors stopped producing the parts. Even though the E-2D is still in production, in some cases there is not enough demand for manufacturers to keep production lines open in order to continue making spare parts or to propose redesigns of parts. The Navy's ongoing and planned actions, according to officials, include locating another vendor source, hardware and software upgrades, performing maintenance practices to determine whether a part is reusable before ordering a new part, cannibalizing parts (i.e., removing serviceable parts from one aircraft and installing them in another aircraft), or waiting until the part is available.

Program Office Comments

In commenting on a draft of this assessment, the program office provided technical comments, which we incorporated where appropriate.

Source: U.S. Air Force/Josh Plueger. | GAO-21-101SP

E-6B Mercury Sustainment Quick Look

Common Name: E-6B

Lead Service: Navy

Program Essentials

Manufacturer: Boeing

Sustainment: Organizational level maintenance is conducted by Navy personnel, and depot-level maintenance at Oklahoma City Air Logistics Complex, Oklahoma

Program Office: Program Manager – Air 271, Naval Air Systems Command, Patuxent River, Maryland

Fiscal Year 2019 Data

Average age: 26.64 years

Average lifetime flying hours: 24,442 hours per aircraft

Depot maintenance activity and squadron locations:

▲ Depot maintenance activity location

● Squadron location

Source: GAO. | GAO-21-101SP

Sustainment Challenges and Mitigation Actions

The E-6B faces sustainment challenges related to aging, including parts obsolescence and increased maintenance needs. The program office has initiatives to address these issues, including a spare parts initiative.

Background

The E-6B Mercury is used to link the National Command Authority (NCA) with naval ballistic missile forces during times of crisis, often referred to as the Take Charge and Move Out mission. The E-6B was derived from Boeing's commercial 707 and is intended to provide survivable, reliable, and endurable airborne command, control, and communications between the NCA and U.S. strategic and non-strategic forces. The Navy plans to use the aircraft until 2038.

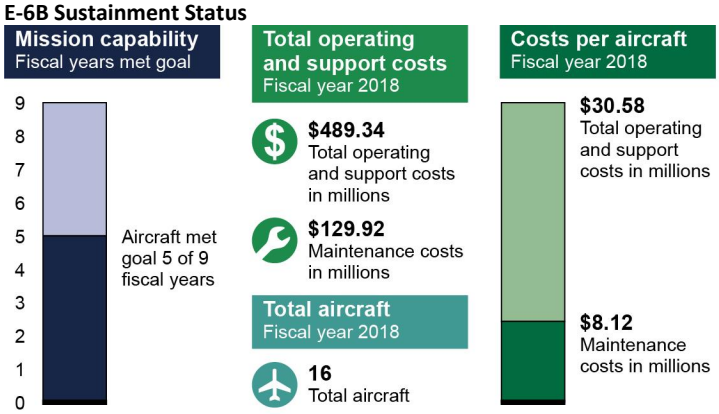
Life Cycle of the E-6B

Source: GAO analysis of Navy data. | GAO-21-101SP

Overview

The E-6B fleet met or exceeded its annual mission capable goals for 5 of the 9 fiscal years from fiscal years 2011 through 2019 and its mission capable rate decreased during this time period. Program officials cited three reasons for not meeting the mission capable goals: parts obsolescence, aging aircraft, and increased maintenance needs. Total operating and support (O&S) costs remained relatively stable over the past 8 years, ranging from $423 to $517 million, with $489 million spent in 2018. However, total O&S costs per aircraft increased during this same time period. Specifically, total O&S costs per aircraft increased from $29.83 million in fiscal year 2011 to $34.95 million in fiscal year 2018. Further, total maintenance costs per aircraft also increased, from $5.42 million in fiscal year 2011 to $9.28 million in fiscal year 2018. Officials stated that increasing the lifespan of the aircraft has created more requirements on maintenance personnel, and total maintenance hours have increased by 9 percent since 2010.

E-6B Sustainment Status



Source: GAO analysis of Navy data. | GAO-21-101SP

Data table for E-6B Sustainment Status

Mission capability	Aircraft met goal 5 of 9 fiscal years
Total operating and support costs in millions (FY18)	$489.34
Maintenance costs in millions (FY18)	$129.92
Total aircraft (FY18)	16
Total operating and support costs per aircraft in millions (FY18)	$30.58
Maintenance costs per aircraft in millions	$8.12

Sustainment Strategy

- The Life-Cycle Sustainment Plan for the E-6B Block I Low Rate Initial Production Program was issued in 2011 and provides general information and a description of the overall logistics support required for the program's equipment. The E-6B Block I Modification program will correct follow-on operational test and evaluation deficiencies, including reliability and maintainability. Improvements will include upgrades to communication systems, aircraft cooling systems, and workstations for crew.

Availability and Condition

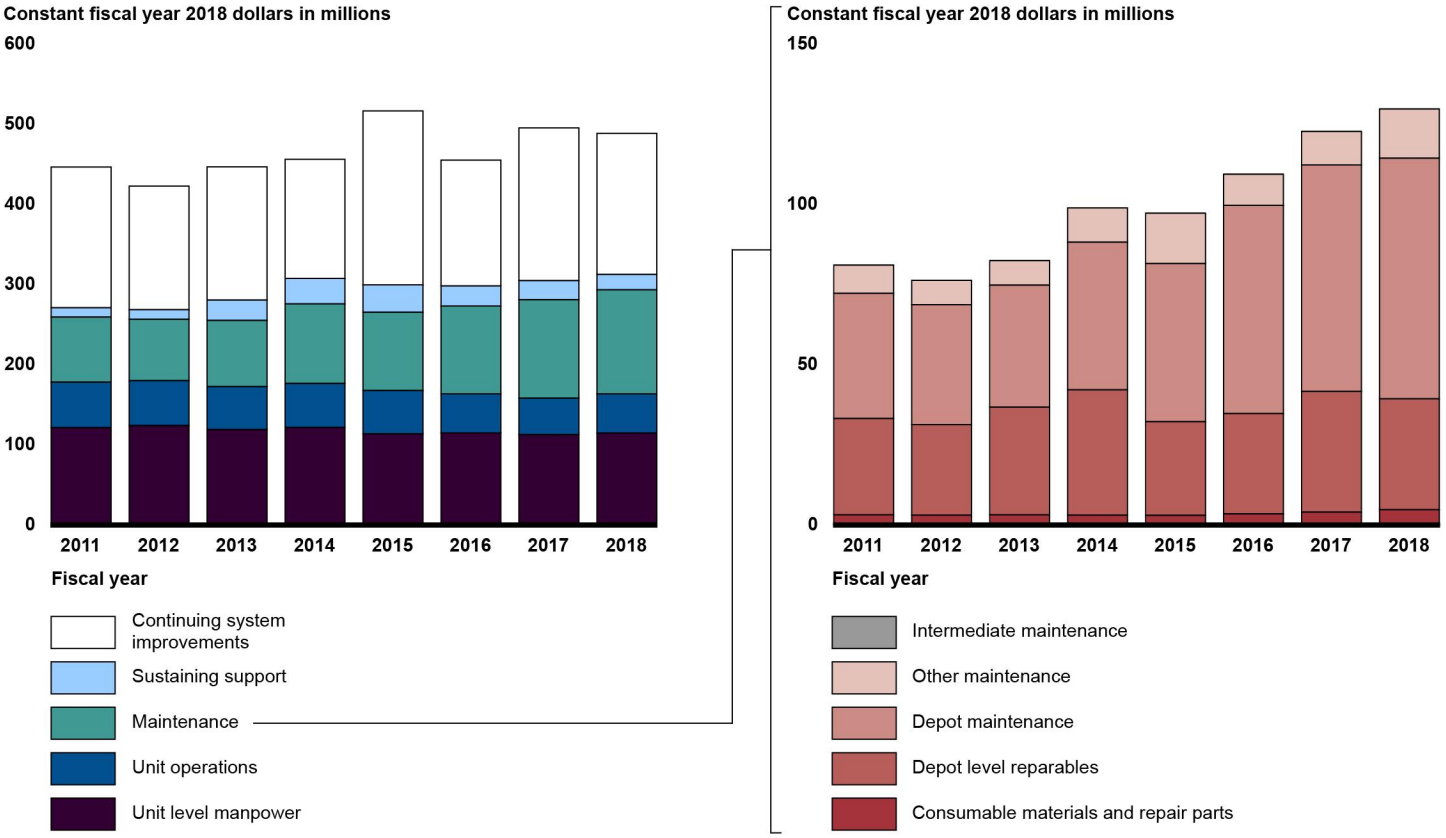
The E-6B fleet met or exceeded its annual mission capable goals for 5 of the 9 fiscal years from fiscal years 2011 through 2019 and its mission capable rate decreased during this time period. Program officials attributed the drop in the mission capable rate to a change in the Navy's method for calculating the mission capable rate, parts obsolescence and diminishing repair and manufacturing sources; aging aircraft; and increased levels of maintenance. Officials stated that parts are becoming physically obsolete and that fewer repair and manufacturer vendors exist or have the equipment to repair or manufacture parts.

From fiscal years 2011 through 2019, the E-6B's rates increased for not mission capable depot, not mission capable maintenance (NMCM), and not mission capable supply. According to officials, the increase in the NMCM rate was due to the increased maintenance requirements of the aging aircraft. Specific details on mission capable and not mission capable rates were omitted because the information was deemed by DOD to be sensitive.

Operating and Support Costs

Total O&S costs for the E-6B increased from $447.45 million in fiscal year 2011 to $489.34 million in fiscal year 2018. Maintenance costs increased significantly, from $81.26 million in fiscal year 2011 to $129.92 million in fiscal year 2018. The largest driver of maintenance costs was depot maintenance, increasing from $39.05 million in fiscal year 2011 to $75.07 million in fiscal year 2018. According to program officials, maintenance has increased to keep up with the needs of an aging aircraft.

E-6B Total Operating and Support Costs



Source: GAO analysis of Navy data. | GAO-21-101SP

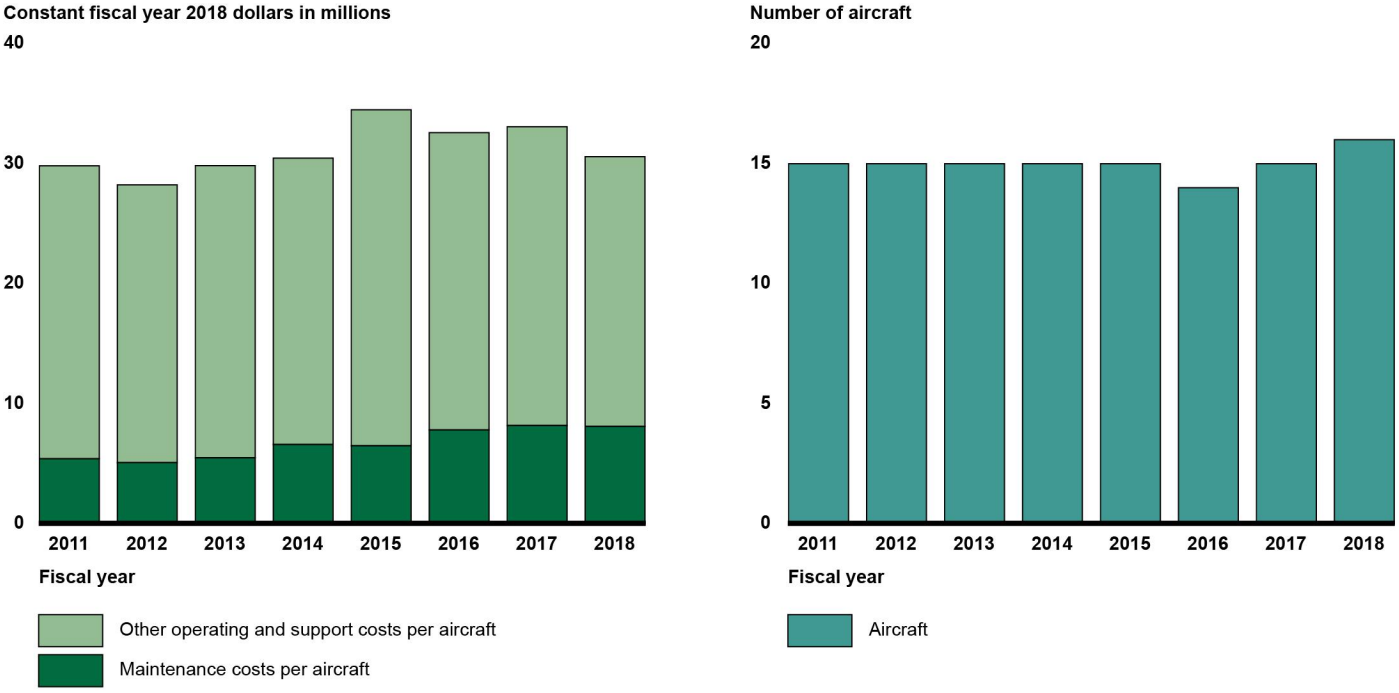
Data table for E-6B Total Operating and Support Costs (Constant fiscal year 2018 dollars in millions)

Fiscal year	Unit level manpower	Unit operations	Maintenance	Sustaining support	Continuing system improvements
2011	122.1	56.83	81.26	11.55	175.7
2012	124.72	56.17	76.5	12.04	154.2
2013	119.72	53.59	82.67	25.5	166.1
2014	122.33	55.08	99.11	31.83	148.63
2015	114.43	54.23	97.46	34.22	216.98
2016	115.58	48.77	109.61	25.12	156.98
2017	113.37	45.56	122.96	23.75	190.56
2018	115.39	48.92	129.92	19.1	176.01

Fiscal year	Consumable materials and repair parts	Depot level reparables	Depot maintenance	Other maintenance	Intermediate maintenance
2011	3.37	30.03	39.05	8.8	0
2012	3.23	28.29	37.4	7.58	0
2013	3.35	33.61	38.02	7.69	0
2014	3.27	39.1	46.02	10.73	0
2015	3.22	29.19	49.36	15.69	0
2016	3.64	31.32	64.94	9.71	0
2017	4.19	37.67	70.65	10.46	0
2018	4.97	34.57	75.07	15.32	0

O&S costs per aircraft for the E-6B increased since fiscal year 2011. Specifically, total O&S costs per aircraft were $29.83 million in fiscal year 2011 and $30.58 million in fiscal year 2018. Further, maintenance costs per aircraft increased from $5.42 million in fiscal year 2011 to $8.12 million in fiscal year 2018. These increases occurred while the number of aircraft remained stable.

E-6B Maintenance and Other Operating and Support Costs per Aircraft and Fleet Size



Source: GAO analysis of Navy data. | GAO-21-101SP

Data table for E-6B Maintenance and Other Operating and Support Costs per Aircraft and Fleet Size (Constant fiscal year 2018 dollars in millions)

Fiscal year	Maintenance costs per aircraft	Other operating and support costs per aircraft
2011	5.42	24.41
2012	5.1	23.14
2013	5.51	24.33
2014	6.61	23.86
2015	6.5	27.99
2016	7.83	24.75
2017	8.2	24.88
2018	8.12	22.46

Fiscal year	Number of aircraft
2011	15
2012	15
2013	15
2014	15
2015	15
2016	14
2017	15
2018	16

Sustainment Challenges and Mitigation Actions

Aging: Program officials told us that the Navy recently increased the lifespan of the E-6B from 27,000 hours to 45,000 hours. The average age of the aircraft in fiscal year 2019 was 26.64 years, with average flying hours of 24,442 per aircraft. The Navy plans for the aircraft to be operating until 2038.

Maintenance: Increasing the service life of the aircraft from 2024 to 2038 has created more requirements on the squadron maintenance personnel. For example, total maintenance work hours conducted on the aircraft have increased by 9 percent since 2010. Mitigation actions include a maintenance work-hour reduction effort that includes examining maintenance requirements and adjusting them based on engineering analysis and failure data. Additionally, the Navy conducted an analysis that showed that hard landing limits could be increased without concern for the safety of the aircraft or the integrity of its landing gear. This will reduce maintenance requirements, such as the number of inspections, and will allow for maintenance personnel to be focused on other issues.

Supply: As the aircraft ages, parts have become more difficult to replace because components are becoming physically obsolete and fewer repair and manufacturer vendors exist or have the equipment to repair or manufacture parts. The program office has undertaken several actions to improve supply, including analyzing the status of parts not currently available in inventory, to identify milestones and track progress so as to return these parts to a healthy inventory status; developing a spare parts requirement tied to the service life extension to 2038 for the aircraft; and ensuring that the contractor for logistics support has adequate personnel to execute increased supply demands.

Program Office Comments

In commenting on a draft of this assessment, the program office provided technical comments, which we incorporated where appropriate.

Source: U.S. Air Force/Master Sgt. William Greer. | GAO-21-101SP

E-3 Sentry Airborne Warning and Control System (AWACS) Sustainment Quick Look

Common Name: AWACS

Lead Service: Air Force

Program Essentials

Manufacturer: Boeing

Sustainment: Depot maintenance conducted at Oklahoma City Air Logistics Complex, Oklahoma, and field maintenance conducted by Air Force maintainers

Program Office: Tinker Air Force Base, Oklahoma, and Hanscom Air Force Base, Massachusetts

Fiscal Year 2019 Data

Average age: 40 years

Average lifetime flying hours: 28,649 hours per aircraft

Depot maintenance activity and squadron locations:

▲ Depot maintenance activity location

● Squadron location

Source: GAO. | GAO-21-101SP

Sustainment Challenges and Mitigation Actions

The E-3 faces sustainment challenges related to supply of needed parts and maintenance of the aging aircraft. The program office is working to increase the availability of parts and has implemented initiatives to modernize the aircraft.

Background

The E-3 Sentry AWACS aircraft was first manufactured in 1971. It is an airborne warning and control system that may be employed alone or in combination with other command and control battle management, intelligence, surveillance, and reconnaissance systems.

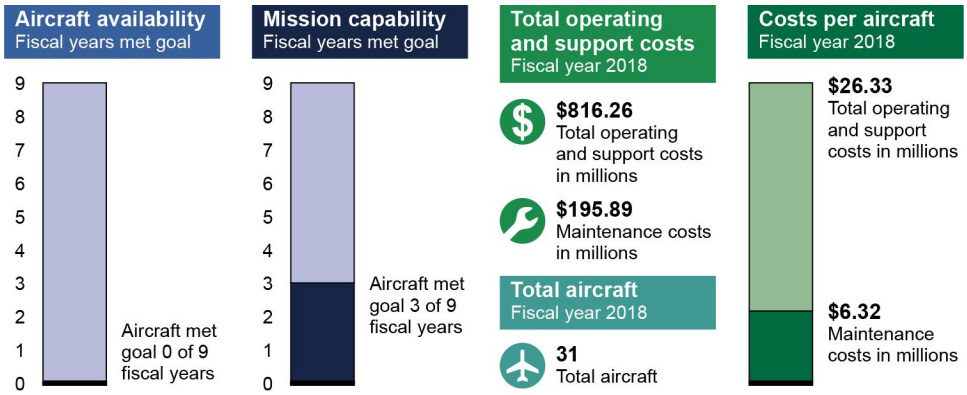
Life Cycle of the E-3

Source: GAO analysis of Air Force data. | GAO-21-101SP

Overview

From fiscal years 2011 through 2019, the E-3 fleet did not meet any of its annual aircraft availability goals, but met or exceeded its mission capable goals during 3 of the 9 fiscal years. The E-3's aircraft availability rate slightly decreased during the time period while its mission capable rate slightly increased. Total operating and support (O&S) costs decreased from about $1.11 billion in fiscal year 2011 to about $816.26 million in fiscal year 2018, due in part to significant decreases in unit operations and continuing system improvement costs. During this same time period, the annual O&S costs per aircraft decreased from $34.54 million to $26.33 million. On average, maintenance costs per aircraft accounted for about 22 percent of the total costs per aircraft.

E-3 Sustainment Status



Source: GAO analysis of Air Force data. | GAO-21-101SP

E-3 Sustainment Status

Aircraft availability	Aircraft met goal 0 of 9 fiscal years
Mission capability	Aircraft met goal 3 of 9 fiscal years
Total operating and support costs in millions (FY18)	$816.26
Maintenance costs in millions (FY18)	$195.89
Total aircraft (FY18)	31
Total operating and support costs per aircraft in millions (FY18)	$26.33
Maintenance costs per aircraft in millions	$6.32

Sustainment Strategy

- The Air Force is implementing the Diminishing Manufacturing Sources Replacement of Avionics for Global Operations and Navigation (DRAGON) program to replace the E-3's aging, predominantly analog, non-sustainable avionics equipment with modern, widely available, and commercially derived digital systems in an effort to enhance operation, safety, and reliability while reducing life-cycle costs. The program is designed to utilize parts currently used by commercial air carriers or existing military aircraft. Program officials expect the cost, schedule, and technical risk—including reliability risk—of the program to be minimal. Planned maintenance, field maintenance, and inspection processes will continue with the infrastructure currently in place.

- The Life-Cycle Sustainment Plan for DRAGON states that the program will initially rely on an interim contractor-support contract with Boeing—for one year, with two one-year options—for item management and depot maintenance of components and support equipment, and will later transition to contractor logistics support. The plan states that once sufficient aircraft have been modified and flown operationally, then those sustainment data can be used to decide whether to maintain the contractor logistics support or, alternatively, to choose a different sustainment approach. Beginning in January 2021, sustainment will transition to Air Force maintainers, contractor logistics support, or a combination of both. Additionally, depot repairs for the E-3 may be performed in-house, by contractor or a public-private partnership, to ensure that the appropriate cost-effective product support is provided.

Availability and Condition

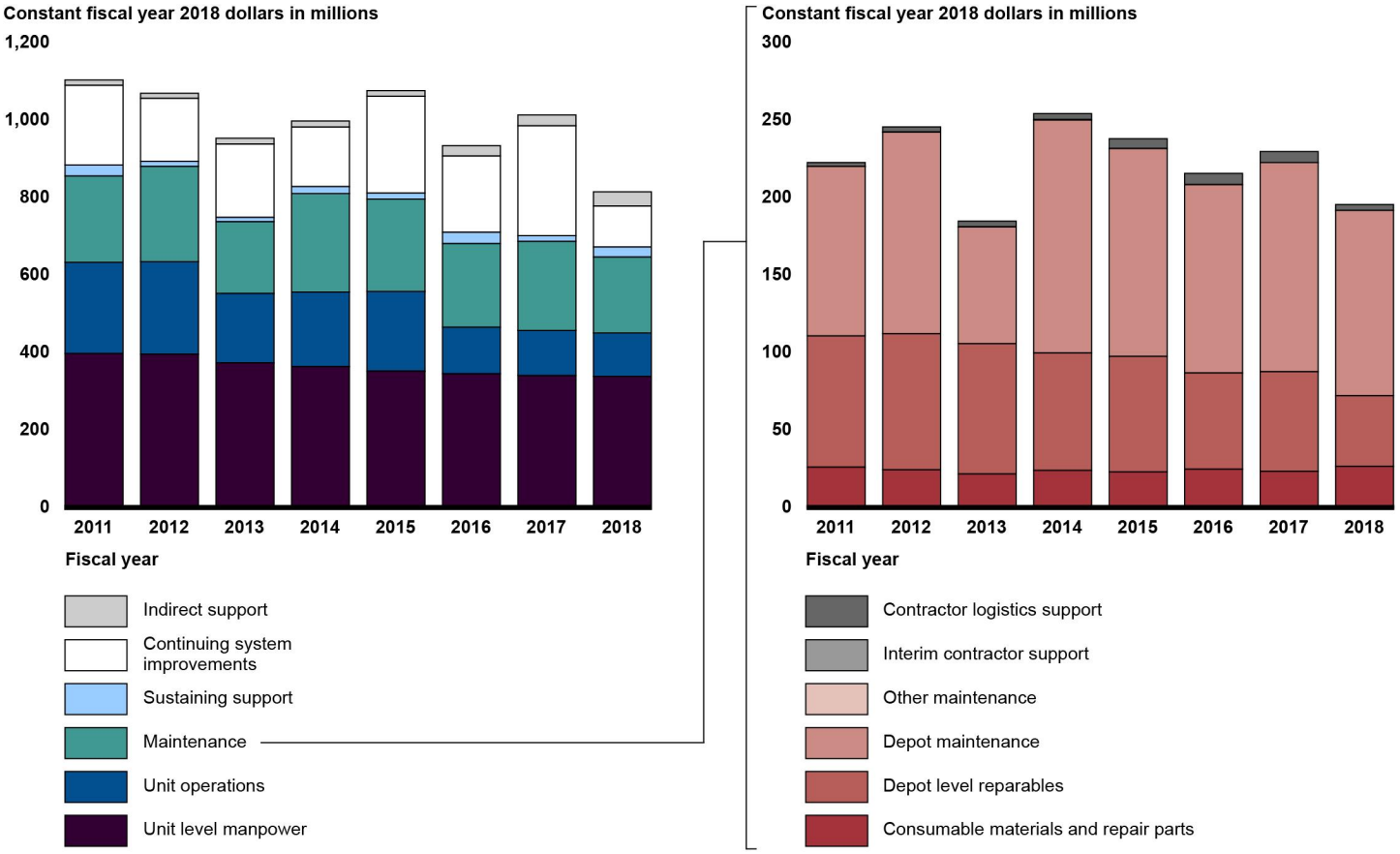
The E-3 fleet did not meet its aircraft availability goals from fiscal years 2011 through 2019, but met its mission capable goals during 3 of the 9 fiscal years. The E-3's aircraft availability rate slightly decreased during the time period while the mission capable rate slightly increased. According to Air Force officials, the primary reason for the drop in aircraft availability was the current and planned modifications for the E-3 fleet. The E-3's mission capable rate was slightly higher in fiscal year 2019 than it was in fiscal year 2011. However, program officials said there were challenges and circumstances during these years affecting mission capability.

From fiscal year 2011 through fiscal year 2019, the E-3 not mission capable maintenance rate slightly increased; while the rate slightly decreased for not mission capable supply. The not mission capable both (NMCB) maintenance and supply rate in fiscal year 2019 was less than one percent below the fiscal year 2011 rate. Program officials stated that these rates were due to an increased number of repairs, over the same period of time, occurring on various aircraft systems (i.e., the fuel system, landing gear, airframe, air conditioning pressurization, and turbofan power plant). Further, officials noted that the degraded reliability of aircraft systems could also have caused an increase in maintenance actions. Specific details on mission capable and not mission capable rates were omitted because the information was deemed by DOD to be sensitive.

Operating and Support Costs

From fiscal year 2011 through fiscal year 2018, the E-3's total O&S costs decreased, from about $1.11 billion to about $816.26 million, due to significant decreases in unit operations and continuing system improvement costs. Maintenance costs constituted the second largest O&S cost category behind unit level manpower and accounted for 22 percent of total O&S costs from fiscal years 2011 through 2018, averaging about $223.66 million per year. Depot maintenance costs fluctuated over this period and were the most significant contributor to maintenance costs, representing 55 percent of the total maintenance costs. According to officials, depot maintenance costs fluctuated based on the number of programmed and unscheduled depot maintenance, the quantity of engines requiring overhaul per year, depot maintenance sales rates, and the software maintenance workload.

E-3 Total Operating and Support Costs



Source: GAO analysis of Air Force data. | GAO-21-101SP

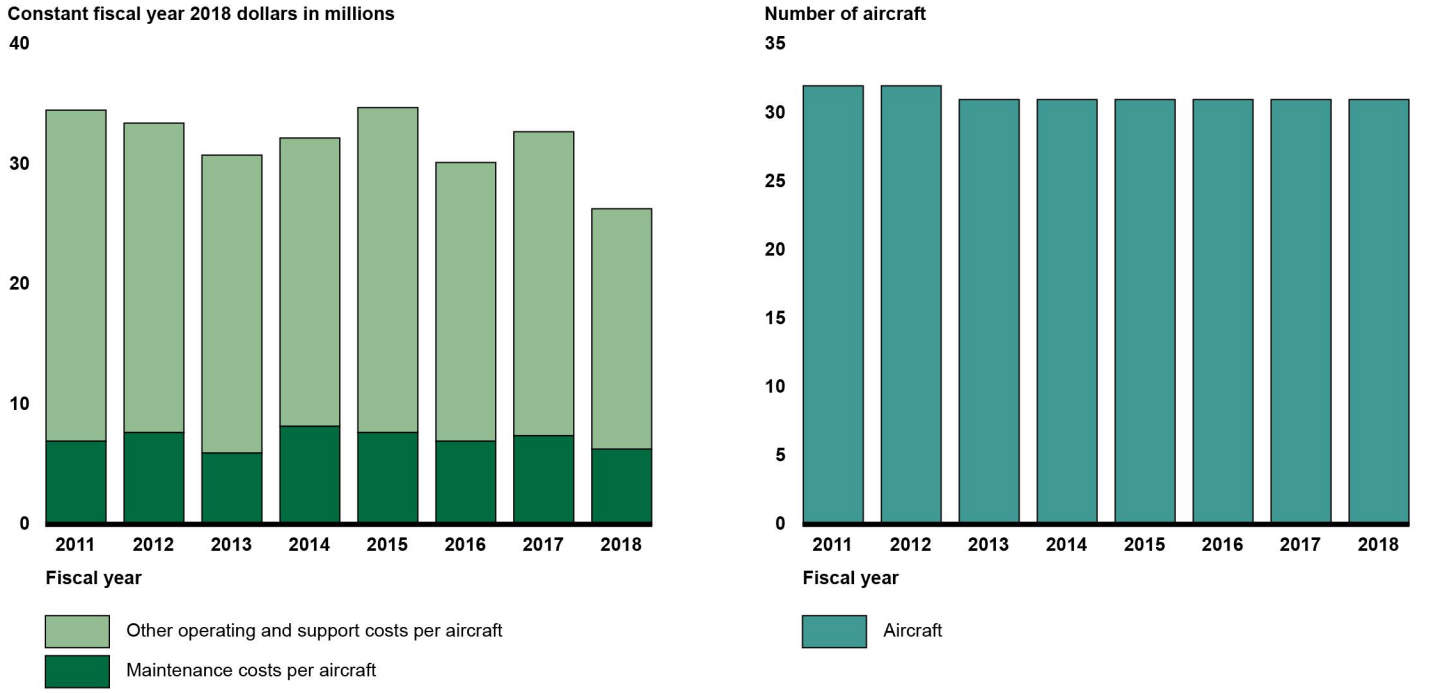
Data table for E-3 Total Operating and Support Costs (Constant fiscal year 2018 dollars in millions)

Fiscal year	Unit level manpower	Unit operations	Maintenance	Sustaining support	Continuing system improvements	Indirect support
2011	399.1	235.3	222.95	28.3	205.49	14.14
2012	397.17	238.77	246.01	13.06	162.41	13.46
2013	374.7	179.19	185.23	11.27	189.21	15.08
2014	365.24	192.23	254.64	17.81	153.58	15.68
2015	353.52	205.77	238.45	15.33	250.12	14.35
2016	346.91	119.95	216.03	29.11	196.71	26.88
2017	342.05	116.15	230.05	15.11	283.36	28.14
2018	339.97	112.13	195.89	26.17	105.46	36.63

Fiscal year	Consumable materials and repair parts	Depot level reparables	Depot maintenance	Other maintenance	Interim contractor support	Contractor logistics support
2011	26.39	84.69	109.42	0.03	0	2.43
2012	24.73	87.77	130.09	0.06	0	3.37
2013	21.97	84.12	75.29	0.13	0	3.71
2014	24.31	75.8	150.29	0.31	0	3.93
2015	23.27	74.66	134.05	0.16	0	6.3
2016	25.12	62.1	121.45	0	0	7.36
2017	23.72	64.3	134.96	0	0	7.08
2018	26.91	45.56	119.6	0	0	3.82

From fiscal year 2011 through fiscal year 2018, the O&S costs per E-3 aircraft generally decreased, from about $34.54 million to about $26.33 million. Maintenance costs per aircraft decreased from about $6.97 million to about $6.32 million (or about 24 percent) of total O&S costs per aircraft during this same time period.

E-3 Operating and Support Costs per Aircraft and Fleet Size



Source: GAO analysis of Air Force data. | GAO-21-101SP

Data table for E-3 Operating and Support Costs per Aircraft and Fleet Size (Constant fiscal year 2018 dollars in millions)

Fiscal year	Maintenance costs per aircraft	Other operating and support costs per aircraft
2011	6.97	27.57
2012	7.69	25.78
2013	5.98	24.82
2014	8.21	24.02
2015	7.69	27.07
2016	6.97	23.21
2017	7.42	25.32
2018	6.32	20.01

Fiscal year	Number of aircraft
2011	32
2012	32
2013	31
2014	31
2015	31
2016	31
2017	31
2018	31

Sustainment Challenges and Mitigation Actions

Aging and Maintenance: According to program officials, the E-3 is prone to corrosion, stress corrosion, and fatigue damage. Program officials stated that the aircraft is inspected for this damage, and repairs are completed when needed. Officials also noted that the systems on the aircraft are aging and require additional maintenance to restore mission capability. Additionally, program officials have found several components for which more detailed overhaul or even new parts are required. Further, program officials stated that depot maintenance of the E-3 airframe (conducted on a 5-year depot cycle), engines, and much of the software is sustained by Air Force maintainers**.**

Supply Support: Diminishing manufacturing sources will continue to be an ongoing sustainment challenge across the E-3 platform. According to program officials, it is common for contractors not to want to restart production of parts for small quantities. Officials stated that they work closely with the supply chain to resolve these issues when they occur. Further, the program officials noted that the E-3 engine suffers from “cold” supply chains; specifically, no commercial vendors have made some parts for several years. As a result, officials stated that the Propulsion Sustainment Division is seeking expanded ability to address this situation through an Integrated Product Team that is working to reinvigorate the industrial base by visiting vendors to encourage open competition for new parts.

Program Office Comments

In commenting on a draft of this assessment, the program office provided technical comments, which we incorporated where appropriate.

Source: U.S. Air Force/Senior Airman Jacob Skovo-Lane. | GAO-21-101SP

E-4B Sustainment Quick Look

Common Name: E-4B

Lead Service: Air Force

Program Essentials

Manufacturer: Boeing

Sustainment: Depot maintenance is conducted by contractor logistics support, with some organizational level maintenance conducted by the Air Force

Program Office: Tinker Air Force Base, Oklahoma

Fiscal Year 2019 Data

Average age: 45 years

Average lifetime flying hours: 18,557 hours per aircraft

Depot maintenance activity and squadron locations:

▲ Depot maintenance activity location

● Squadron location

Source: GAO. | GAO-21-101SP

Sustainment Challenges and Mitigation Actions

The E-4B faces sustainment challenges due to its age, making it more difficult to find replacement parts. In addition, delays in scheduled programmed depot maintenance has reduced operational availability.

Background

The E-4B serves as the National Airborne Operations Center and is a key component of the National Military Command System for the President, the Secretary of Defense, and the Joint Chiefs of Staff. In case of national emergency or destruction of ground command and control centers, the aircraft provides a highly survivable command, control, and communications center to direct U.S. forces, execute emergency war orders, and coordinate actions by civil authorities. The E-4B is a militarized version of the Boeing 747-200 that was declared fully operational in 1985. To provide direct support to the President, the Secretary of Defense, and the Joint Chiefs of Staff, at least one E-4B is always on 24-hour alert, 7 days a week, with a global watch team at one of many selected bases throughout the world.

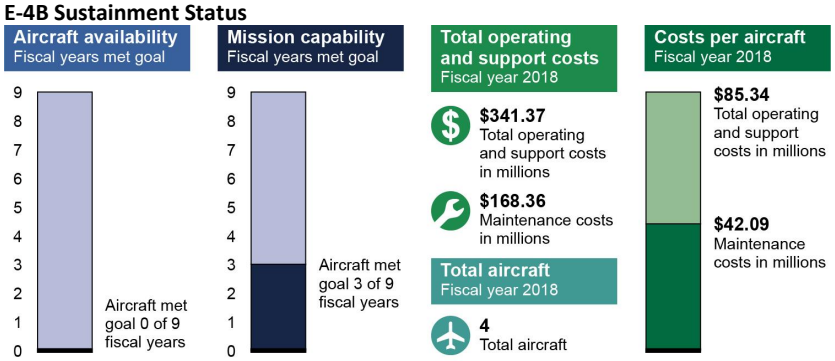
Life Cycle of the E-4B

Source: GAO analysis of Air Force data. | GAO-21-101SP

Overview

From fiscal years 2011 through 2019, the E-4B fleet did not meet any of its annual aircraft availability goals, but met or exceeded its mission capability goal in 3 of the 9 fiscal years. The E-4B's aircraft availability rate was almost the same in fiscal years 2011 and 2019 and its mission capable rate decreased during the time period. Total operating and support (O&S) costs increased since fiscal year 2011, from $298.95 million to about $341.37 million in fiscal year 2018. Maintenance costs also increased during this time period, from $116.02 million in fiscal year 2011 to $168.36 million in fiscal year 2018. According to program officials, these increases were due to the aging of the aircraft. Per aircraft total O&S costs increased from $74.74 million in fiscal year 2011 to $85.34 million in fiscal year 2018.

E-4B Sustainment Status



Source: GAO analysis of Air Force data. | GAO-21-101SP

Data table for E-4B Sustainment Status

Aircraft availability	Aircraft met goal 0 of 9 fiscal years
Mission capability	Aircraft met goal 3 of 9 fiscal years
Total operating and support costs in millions (FY18)	$341.37
Maintenance costs in millions (FY18)	$168.36
Total aircraft (FY18)	4
Total operating and support costs per aircraft in millions (FY18)	$85.34
Maintenance costs per aircraft in millions	$42.09

Sustainment Strategy

- The E-4B's Life-Cycle Sustainment Plan (April 2019) focuses on meeting the needs of the Air Force Global Strike Command as well as additional missions defined by the Chairman of the Joint Chiefs of Staff. The plan includes modifications periodically required to ensure the ability of the aircraft to support these missions.
- Organizational level maintenance for the E-4B is augmented by limited contractor repair capabilities, and depot-level maintenance is performed by Boeing. An integrated supply chain management system with a centralized inventory supports this fleet's requirements through supply points at the main operating base (Offutt Air Force Base, Nebraska) and the depot facility (San Antonio, Texas) for the aircraft.

Availability and Condition

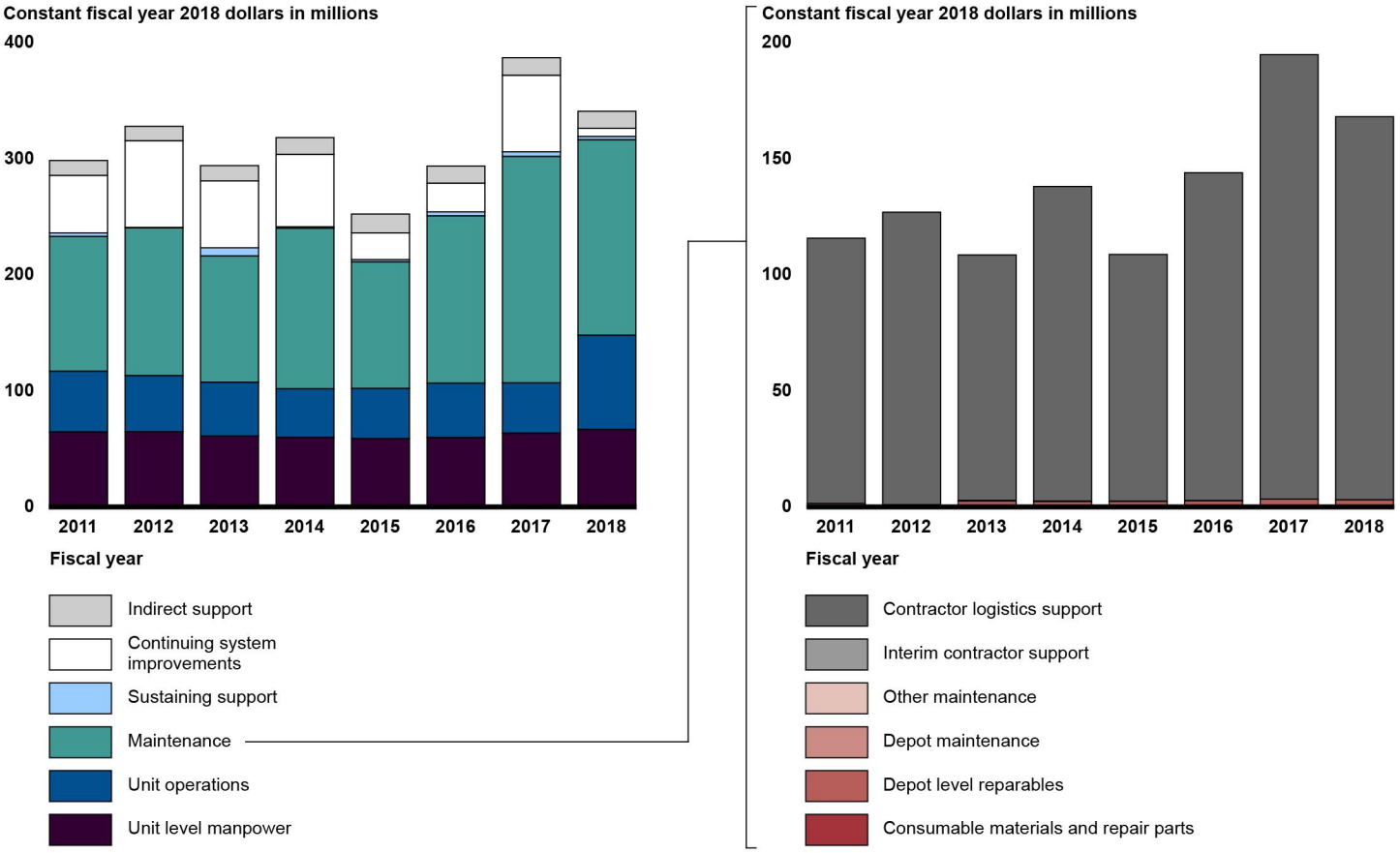
From fiscal years 2011 through 2019, the E-4B fleet did not meet any of its annual aircraft availability goals, but met or exceeded its mission capability goal in 3 of the 9 fiscal years. According to the program office, there are several challenges to meeting the aircraft availability goal, including the small size of the fleet and downtime to conduct modifications on the aircraft. Aircraft availability for the E-4B in fiscal year 2019 was about the same as it was in fiscal year 2011. The E-4B's mission capable rate decreased from fiscal years 2011 through 2019, but fluctuated over the time period.

The primary driver of the E-4B's mission capable rate was maintenance. The E-4B's not mission capable maintenance rate increased from fiscal years 2011 through 2019, but was variable during the time period and the not mission capable both maintenance and supply rate increased. The small size of the fleet contributed to the maintenance issues of the E-4B because one aircraft taken down for maintenance has a proportionally greater effect on the percentage of aircraft available for operations than it would for a larger fleet. Specific details on mission capable and not mission capable rates were omitted because the information was deemed by DOD to be sensitive.

Operating and Support Costs

Total O&S costs for the E-4B rose by about 14 percent from fiscal year 2011 through fiscal year 2018, with maintenance costs accounting for about 49 percent of total O&S costs in fiscal year 2018.

E-4B Total Operating and Support Costs



Source: GAO analysis of Air Force data. | GAO-21-101SP

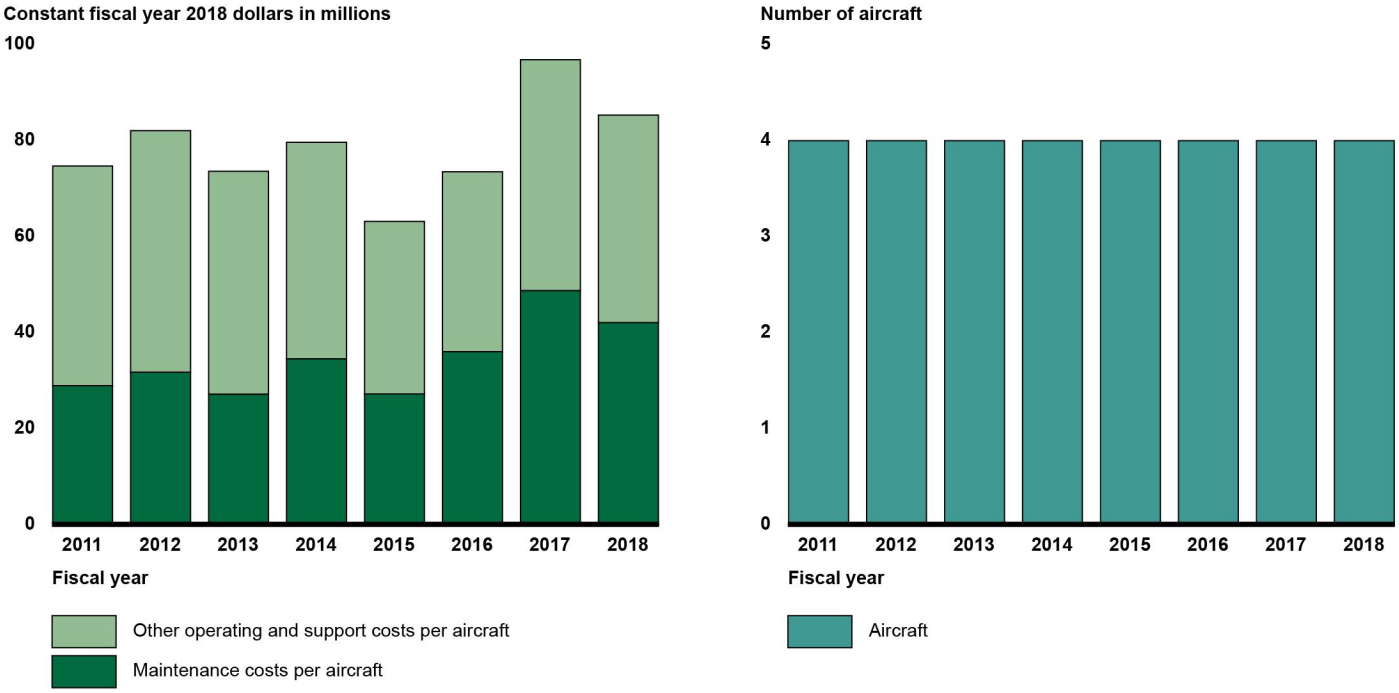
Data table for E-4B Total Operating and Support Costs (Constant fiscal year 2018 dollars in millions)

Fiscal year	Unit level manpower	Unit operations	Maintenance	Sustaining support	Continuing system improvements	Indirect support
2011	65.11	52.28	116.02	3.11	49.5	12.93
2012	65.31	48.31	127.18	0.38	74.7	12.51
2013	61.62	46.27	108.79	7.07	57.59	13.19
2014	60.37	41.91	138.28	1.15	62.42	14.52
2015	59.47	43.09	109.03	1.85	23.07	16.29
2016	60.3	46.74	144.19	3.39	24.66	14.8
2017	63.94	43.41	195.05	4.06	65.74	15.3
2018	67.21	81.2	168.36	2.85	7.08	14.68

Fiscal year	Consumable materials and repair parts	Depot level reparables	Depot maintenance	Other maintenance	Interim contractor support	Contractor logistics support
2011	0.47	1.27	0	0	0	114.29
2012	0.43	0.11	0.59	0	0	126.05
2013	0.64	2.12	0.29	0	0	105.74
2014	0.55	1.98	0.16	0	0	135.59
2015	0.42	2.2	0	0	0	106.41
2016	0.44	2.4	0	0	0	141.35
2017	0.45	3.12	0	0	0	191.49
2018	0.62	2.63	0	0	0	165.11

Per aircraft total O&S costs for the E-4B increased from $74.74 million in fiscal year 2011 to $85.34 million in fiscal year 2018. In addition, per aircraft maintenance costs increased from $29.01 million in fiscal year 2011 to $42.09 million in fiscal year 2018. The number of aircraft during this time period remained steady at four total aircraft.

E-4B Operating and Support Costs per Aircraft and Fleet Size



Source: GAO analysis of Air Force data. | GAO-21-101SP

Data table for E-4B Operating and Support Costs per Aircraft and Fleet Size (Constant fiscal year 2018 dollars in millions)

Fiscal year	Maintenance costs per aircraft	Other operating and support costs per aircraft
2011	29.01	45.73
2012	31.8	50.3
2013	27.2	46.43
2014	34.57	45.09
2015	27.26	35.94
2016	36.05	37.48
2017	48.76	48.11
2018	42.09	43.25

Fiscal year	Number of aircraft
2011	4
2012	4
2013	4
2014	4
2015	4
2016	4
2017	4
2018	4

Sustainment Challenges and Mitigation Actions

Supply: Due to the age of the aircraft, certain parts are getting older and more difficult to replace. For example, according to the program office, flight deck gauge failures are increasing, and the replacement parts are difficult to find. The program office is working to find new manufacturers for these gauges. Further, the program is working to identify additional warehouse space to store large spare parts such as flight controls and airframe panels. In addition, lack of storage for spare parts increases the risk that parts may not be available when needed and could negatively impact aircraft availability. The program office is currently utilizing space in a base supply facility as a temporary solution but is working on agreements with other base tenants to gain more storage space.

Maintenance: According to the program office, for the past 2 years the contractor has not completed programmed depot maintenance within the required time limits, thereby reducing operational availability of the aircraft. Program officials told us that multiple efforts are underway to reduce maintenance downtime. For example, the program is initiating incentivized programmed depot maintenance dates that provide monetary incentives to the contractor for performing work by certain dates. The program office has also developed a 5-year maintenance roadmap that tracks future maintenance packages, acquisitions, and modifications, and it has added mandatory field-level inspection requirements every 200 days. In addition, the program office is working to conduct needed modifications to the aircraft during programmed depot maintenance, including overhauling the landing gear and flight control.

Program Office Comments

In commenting on a draft of this assessment, the program office stated that historically, E-4B sustainment is underfunded and must rely on unfunded requirements and end-of-year funding to remain healthy. Further, costs have risen in previous years due to aircraft age, supplier issues, and natural disaster incidents, and they are expected to continue to rise throughout the Future Years Defense Program. In addition, the program office stated that it is executing several initiatives to improve aircraft availability, including programmed depot maintenance pre-planning and the creation of a systems integration lab.

Source: U.S. Air Force/Greg L. Davis. | GAO-21-101SP

E-8C Joint Surveillance Target Attack Radar System Sustainment Quick Look

Common Name: JSTARS

Lead Service: Air Force

Program Essentials

Manufacturer: Northrop Grumman

Sustainment: Depot maintenance conducted by Northrop Grumman, and field maintenance primarily conducted by the Air Force

Program Office: Robins Air Force Base, Georgia

Fiscal Year 2019 Data

Average age: 51.6 years

Average lifetime flying hours: 60,573 hours per aircraft

Depot maintenance activity and squadron locations:

▲ Depot maintenance activity location

● Squadron location

Source: GAO. | GAO-21-101SP

Sustainment Challenges and Mitigation Actions

The E-8C is an aircraft with significant maintenance and supply challenges. Examples of the Air Force's actions to mitigate these challenges include implementing a new depot maintenance plan and contracting with Boeing to redesign the aircraft's pylons, which are used to hold the aircraft's engines to the wings, according to Air Force officials.

Background

The E-8C Joint Surveillance Target Attack Radar System was built using pre-owned Boeing 707-300 aircraft that were first manufactured in 1967. The joint Air Force and Army system includes airborne radar, operations and control, and communication subsystems, as well as two ground-based subsystems. Its primary mission is to provide theater ground and air commanders with ground surveillance to support attack operations and targeting.

Life Cycle of the E-8C

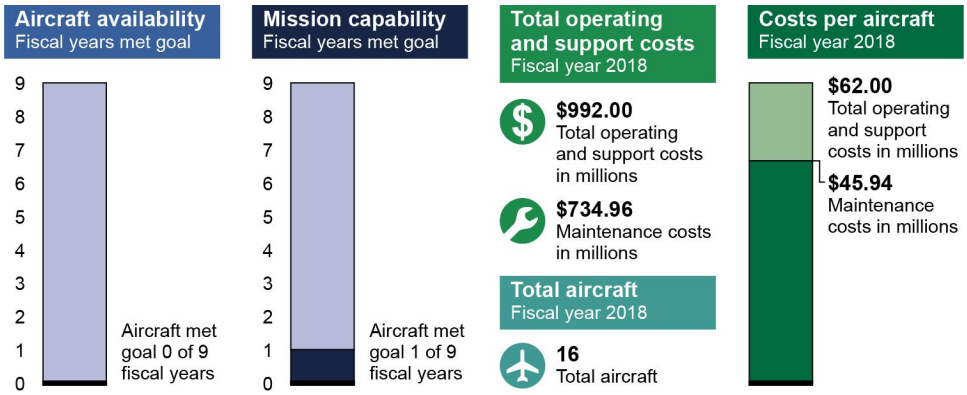
Initial Operational Capability Full Operational Capability

Source: GAO analysis of Air Force data. | GAO-21-101SP

Overview

From fiscal years 2011 through 2019, the E-8C fleet did not meet any of its annual aircraft availability goals and met or exceeded its mission capable goal in 1 of the 9 fiscal years. The E-8C fleet aircraft availability and mission capable rates decreased during the time period. Total operating and support (O&S) costs increased from approximately $722.76 million in fiscal year 2011 to $992 million in fiscal year 2018. All of the O&S cost categories decreased except maintenance, which increased primarily in the contractor logistics support cost category. During this same time frame, Northrop Grumman conducted depot maintenance on the E-8C. The total O&S costs per aircraft also increased from fiscal years 2011 to 2018, from about $42.51 million to $62 million. In fiscal year 2018, nearly three-quarters of the total O&S costs per aircraft, or about $45.94 million, was for aircraft maintenance.

E-8C Sustainment Status



Source: GAO analysis of Air Force data. | GAO-21-101SP

Data table for E-8C Sustainment Status

Aircraft availability	Aircraft met goal 0 of 9 fiscal years
Mission capability	Aircraft met goal 1 of 9 fiscal years
Total operating and support costs in millions (FY18)	$992.00
Maintenance costs in millions (FY18)	$734.96
Total aircraft (FY18)	16
Total operating and support costs per aircraft in millions (FY18)	$62.00
Maintenance costs per aircraft in millions	$45.94

Sustainment Strategy

- The Joint Surveillance Target Attack Radar System Life-Cycle Management *Plan* (2014) documents the sustainment plan for the E-8C. Program officials said they will update the life-cycle management plan prior to October 2022, when the current Total System Support Responsibility contract with Northrop Grumman ends. The current support contract is valued at $7 billion, and $4.4 billion has been obligated through fiscal year 2019, according to program office officials.
- As of May 2020, Northrop Grumman provides depot maintenance and supply chain management of E-8C specific items under the previously mentioned contract. In July 2018 the Air Force inducted an E-8C aircraft at Warner Robins Air Logistics Complex to demonstrate potential cost and schedule efficiencies from performing depot maintenance at an organic, Air Force depot. The complex was approved as a designated source of repair for the E-8C in early 2019, according to Air Force officials; however, the Air Force has not decided on its approach to providing depot maintenance on the E-8C beyond 2022. The Air Force currently repairs and overhauls the E-8C's TF33 engines at Tinker Air Logistics Complex. Field maintenance is performed primarily by active duty Air Force and Air National Guard personnel. The Air Force Sustainment Center and the Defense Logistics Agency provide supply support for items common with other Department of Defense weapon systems.
- Under the current programmed depot maintenance plan that is based on the Boeing 707 commercial maintenance plan, one of four areas of the aircraft is inspected and receives depot maintenance every 24 months, according to Air Force officials. Thus, depot maintenance on the aircraft occurs over a period of about 12 years. Program officials have determined that this plan is inadequate for the E-8C's fleet of aging aircraft and are implementing a new programmed depot maintenance plan with a 6-year depot maintenance cycle. According to the program office officials, the entire aircraft will undergo a nose-to-tail inspection at the 3-year point and a depot maintenance event at the 6-year point.

Availability and Condition

From fiscal year 2011 through fiscal year 2019, the E-8C fleet missed its aircraft availability goals every year and met or exceeded its mission capable goal in 1 of the 9 fiscal years, The E-8C's aircraft availability rate decreased during the time period. Air Force officials said that delays in contracted depot maintenance constituted the largest driver that negatively affected the E-8C fleet's availability rate. For example, the percentage of the E-8C fleet in depot maintenance increased from about 28 percent in fiscal year 2011 to about 37 percent in fiscal year 2019. Air Force officials also explained that the program's use of the commercial maintenance plan (previously discussed) and contractor performance issues have contributed to the increased depot maintenance time and reduced aircraft availability. The E-8C's mission capable rate also decreased percent from fiscal years 2011 through 2019, and the engine was the leading degrader of mission capability due to problems with the thrust reversers, capacity-related maintenance delays, and other maintenance issues.

The E-8C's rates increased for not mission capable maintenance (NMCM), not mission capable supply (NMCS), and not mission capable both (NMCB) maintenance and supply from fiscal years 2011 through 2019. The NMCB rate increased the most, and accounted for almost half of the decrease in the mission capable rate during the time period. Air Force officials stated that the top E-8C NMCM and NMCS rate drivers for fiscal years 2011 through 2019 were the TF33 engine and the fuel system and they also cited flight controls and scheduled inspections as two other major not mission capable drivers. Air Force officials explained that the E-8C's NMCB rate was variable because E-8C aircraft accumulate most of the NMCB time during scheduled inspections. If an aircraft is not mission capable and awaiting parts through the supply system and it becomes due for a scheduled inspection, program officials stated that they have the scheduled inspection performed while the aircraft cannot complete missions due to the lack of the part. Specific details on mission capable and not mission capable rates were omitted because the information was deemed by DOD to be sensitive.

Operating and Support Costs

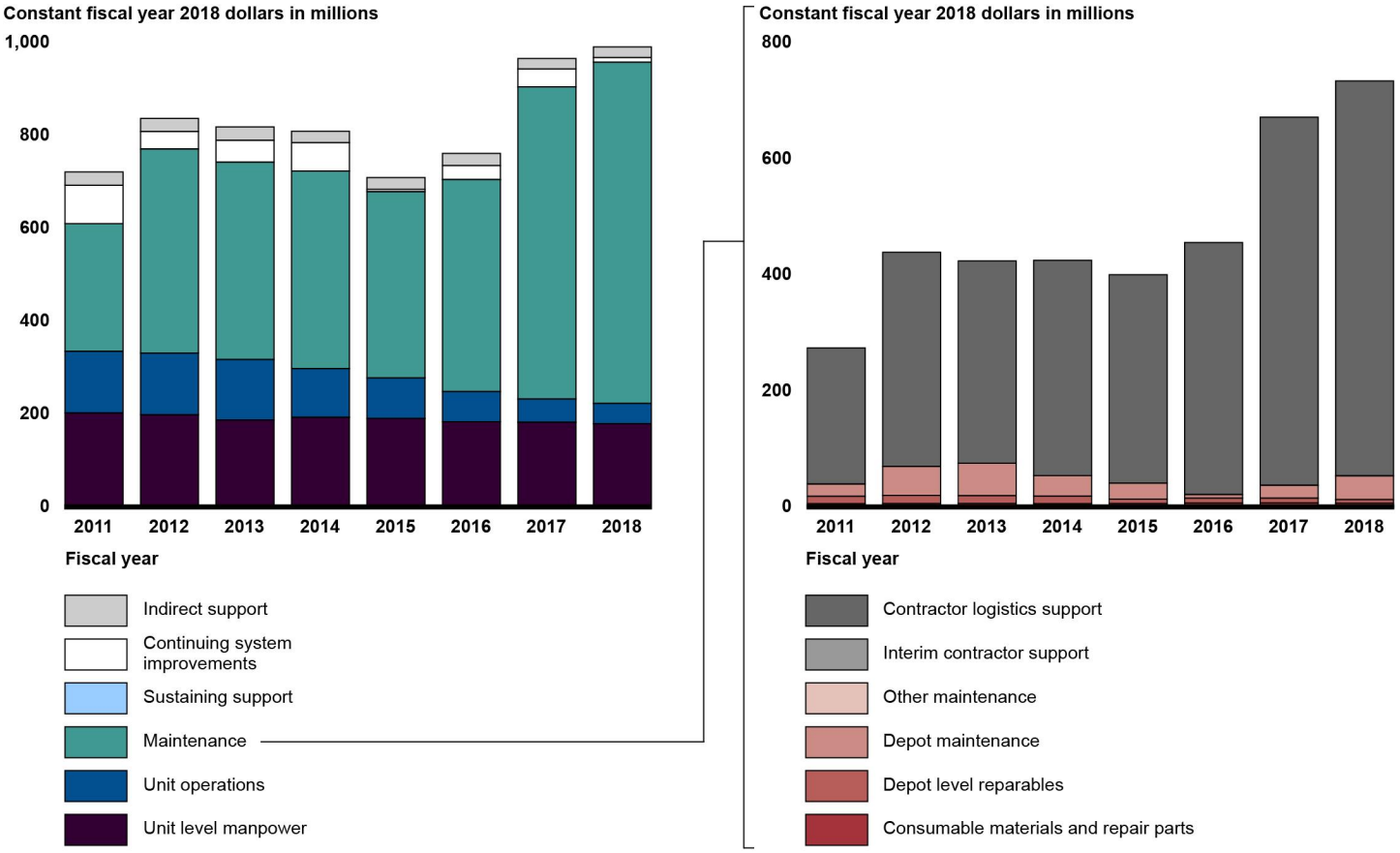
Total O&S costs increased by about $269.23 million, from approximately $722.76 million in fiscal year 2011 to $992 million in fiscal year 2018. All of the O&S cost categories decreased during the time period except maintenance. Maintenance costs increased by $460.05 million, from $274.91 million in fiscal year 2011 to $734.96 million in fiscal year 2018. During that time period, maintenance costs increased primarily in the contractor logistics support category. In fiscal year 2018, contractor logistics support represented $680.45 million of total maintenance costs—about 93 percent. Sustainment of the aircraft is performed through contractor logistics support.

According to Air Force officials, maintenance costs have increased in part due to the age of the aircraft. As a result, the officials said that the program has been required to conduct repairs related to corrosion prevention and mitigation, as well as to perform additional structural repairs that are necessary to keep the aircraft operational. Program officials also said that using a commercial depot maintenance plan (as previously discussed), increasing

numbers of service bulletins, and maintenance quality inefficiencies (that is, corrections to contractor repairs) also contributed to higher maintenance costs in recent years, among other reasons.

The E-8C's costs for unit operations, unit level manpower, continuing systems improvements, and indirect support decreased from fiscal year 2011 through 2018. Air Force officials stated that one reason why unit level manpower costs went down is because the E-8C's operational units have had difficulty filling vacancies, and vacancies have increased faster than units can fill positions. The costs for continuing systems improvements were lower in fiscal year 2018 because that was the last year of funding for the prime mission equipment diminishing manufacturing sources modification, according to Air Force officials.

E-8C Total Operating and Support Costs



Source: GAO analysis of Air Force data. | GAO-21-101SP

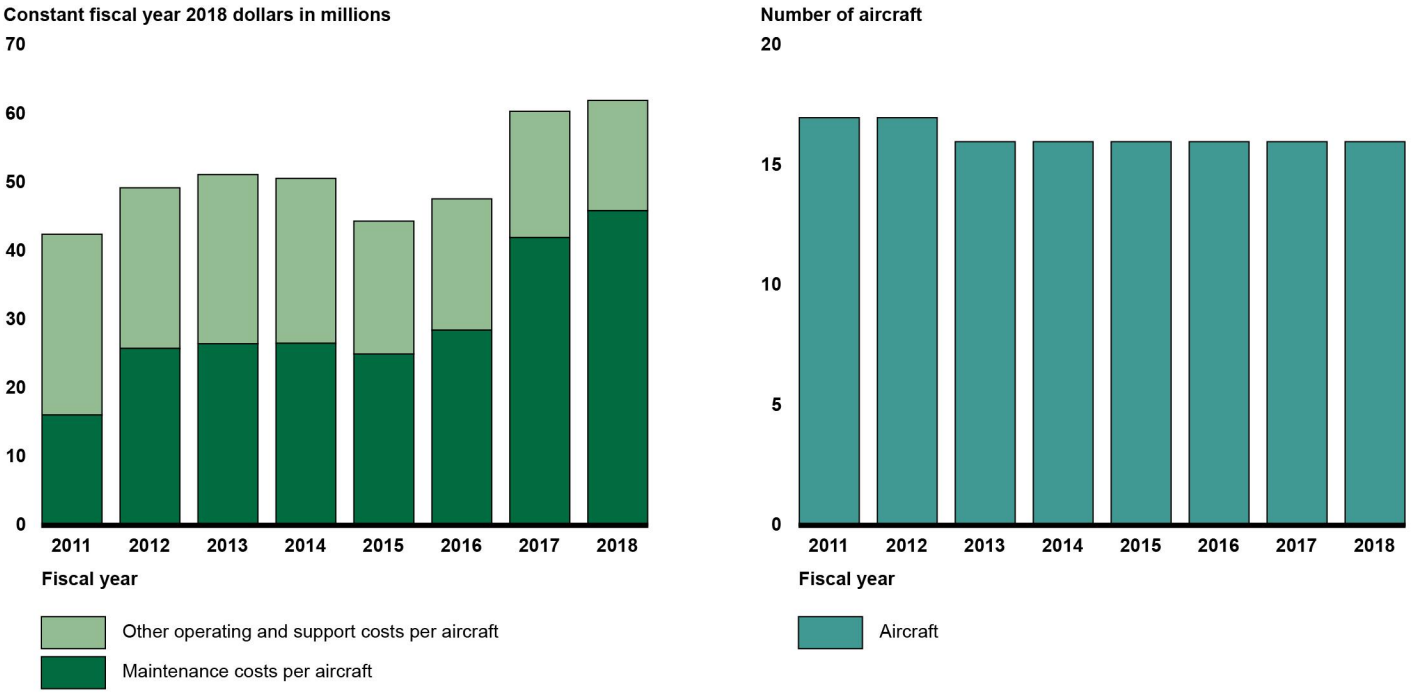
Data table for E-8C Total Operating and Support Costs (Constant fiscal year 2018 dollars in millions)

Fiscal year	Unit level manpower	Unit operations	Maintenance	Sustaining support	Continuing system improvements	Indirect support
2011	203.66	132.82	274.91	0	82.68	28.69
2012	199.68	132.56	439.77	0	37.68	28.25
2013	188.32	130.38	424.81	0	47.19	28.86
2014	194.21	104.69	425.87	0	60.72	24.93
2015	191.75	87.28	400.95	0	5.02	25.76
2016	184.72	64.98	456.54	0.01	30.17	26.24
2017	183.72	49.94	672.49	0	38.04	22.63
2018	180.42	43.5	734.96	0	10.14	22.97

Fiscal year	Consumable materials and repair parts	Depot level reparables	Depot maintenance	Other maintenance	Interim contractor support	Contractor logistics support
2011	6.32	12.74	21.17	0	0	234.68
2012	6.67	14.02	49.99	0	0	369.08
2013	6.79	13.37	56.14	0	0	348.51
2014	6.44	13.03	35.41	0	0	370.99
2015	6.78	7.68	27.3	0	0	359.2
2016	7.45	8.61	6.18	0	0	434.3
2017	7.59	8.31	22.29	0	0	634.29
2018	7.13	6.5	40.89	0	0	680.45

Although the E-8C fleet size remained fairly constant, the total O&S costs per E-8C aircraft increased from about $42.51 million in fiscal year 2011 to about $62 million in fiscal year 2018. During this time period the maintenance costs per aircraft also increased, from $16.17 million to about $45.94 million. The E-8C inventory was comprised of 17 aircraft in fiscal years 2011 and 2012 and 16 aircraft in fiscal years 2013 through 2018, due to the loss of an aircraft in 2013.

E-8C Operating and Support Costs per Aircraft and Fleet Size



Source: GAO analysis of Air Force data. | GAO-21-101SP

Data table for E-8C Operating and Support Costs per Aircraft and Fleet Size (Constant fiscal year 2018 dollars in millions)

Fiscal year	Maintenance costs per aircraft	Other operating and support costs per aircraft
2011	16.17	26.34
2012	25.87	23.42
2013	26.55	24.67
2014	26.62	24.03
2015	25.06	19.36
2016	28.53	19.13
2017	42.03	18.4
2018	45.94	16.07

Fiscal year	Number of aircraft
2011	17
2012	17
2013	16
2014	16
2015	16
2016	16
2017	16
2018	16

Sustainment Challenges and Mitigation Actions

Aging: The E-8C airframe has been in operation commercially since 1967, and corrosion is prevalent with the system. According to Air Force officials, the military use of the E-8C exposes the fleet to more extreme circumstances than commercial use, causing corrosion to be more problematic. Further, program officials stated that the original E-8C Corrosion Prevention and Control Program was based on commercial standards and was ineffective for sustaining a military weapon system. As a result, program officials began rewriting the E-8C's Corrosion Prevention and Control Program in fiscal year 2017 to comply with Air Force standards. The officials stated that they expected to complete the revised corrosion program by the end of fiscal year 2021. To support the revised corrosion program, E-8C program officials stated that they executed an engineering services contract in September 2017 to develop technical data to improve corrosion repair and reduce future corrosion damage with improved processes and materials. These data were used to develop a new paint specification that program officials plan to implement on the first aircraft in 2020. The officials explained that the new paint specification applies an additional protective coating on the leading edges and upper wing surfaces to reduce corrosion damage and improve the integrity of the paint system between the programmed depot maintenance paint intervals.

Maintenance: According to Air Force officials, the E-8C faces extended downtime and reduced aircraft availability as a result of contractor depot maintenance delays. To mitigate this issue, E-8C program officials explained that they have taken the following actions, among others:

- They developed a collaborative maintenance "speed" line at Warner Robins Air Logistics Complex with Northrop Grumman and Boeing to improve repair times for certain structural components in 2018. E-8C program officials explained that the Air Force conducted the staging and preparation work for the repairs and Boeing performed the structural repair work on the aircraft as a subcontractor to Northrop Grumman. Examples of speed line repairs include the body station 360, center wing refurbishment, and wing plank four replacements. According to program officials, three aircraft were completed at this maintenance speed line, before it was shut down due to capacity constraints at Warner Robins Air Logistics Complex. They are working with Northrop Grumman to re-establish the maintenance line at the contractor's facility.
- They started an organic depot maintenance proof-of-concept at Warner Robins Air Logistics Complex, with two maintenance docks. The first E-8C was inducted for programmed depot maintenance in July 2018 to demonstrate potential cost and schedule efficiencies from organic maintenance. The goal was to complete the depot maintenance on one of the four designated areas of the aircraft within 300 flow days (that is, calendar days) at a cost of $14.5 million. According to Air Force officials, the contractor's average was 338 flow days for the depot maintenance on the same area of the aircraft, and in fiscal year 2017 the contractor's average costs across varying depot maintenance events were about $38 million per aircraft. The officials said that as of mid-April 2020, the first aircraft was at 639 flow days and had not yet been completed, but the projected cost of the depot maintenance was only slightly higher than planned at $14.7 million. They told us that maintenance took longer than expected due to challenges associated with the alignment of the pylons to which the engines are attached on the aircraft and major structural repairs to the right wing. According to program officials, the repairs needed to restore the wing's structural integrity require parts that must be manufactured and have long material lead times; therefore, the repairs are not scheduled to be completed until fiscal year 2021. The program office inducted a second E-8C aircraft into depot maintenance at Warner Robins Air Logistics Complex in March 2020, which is discussed in more detail below. However, according to the officials, the two maintenance docks at Warner Robins Air Logistics Complex are not sufficient to transition the depot maintenance for the entire E-8C fleet to the Air Force. To address the capacity issue, program officials said that they requested funding to start the construction of additional depot maintenance docks for the E-8C in fiscal year 2023 at Warner Robins Air Logistics Complex, but the funding had not yet been approved as of May 2020.
- They implemented a standard process in 2018 to develop engineering maintenance requirements and ensure that the requirements are valid and fully supportable before execution. Program officials said that the contractor

did not fully utilize this process, but the process is now being used to record the data from depot maintenance events occurring at Warner Robins Air Logistics Complex. Specifically, the data generated by the aircraft inspections and associated repair activity are recorded and used to continuously review the maintenance requirements, according to the officials. Based on the recorded data, maintenance requirements may be added to address issues that are found or reduced. As a result of the process, program officials said that the maintenance plan will be updated as the needs of the aircraft change, as the weapon system ages.

- They increased the use of additional inspections beginning in fiscal year 2019 to inform decisions about whether to extend the period of time during which an aircraft can fly before the next depot maintenance induction. According to the officials, the government required the contractor to average three aircraft or fewer in the depot per calendar year in order to meet the Air Force's aircraft availability goal. However, they said that the average was about 5.5 in 2018 and 3.8 in 2019. According to officials, the decrease from fiscal year 2018 to fiscal year 2019 was a result of decisions to delay inductions due to poor performance at the contractor depot. Program officials said that they conducted the additional inspections to determine whether the induction date could be delayed in an effort to maximize aircraft availability. However, they noted that the extra inspections can increase aircraft availability for a period of time, but the aircraft will still need to be inducted for depot maintenance, and the projected average number of aircraft in the depot for fiscal year 2020 is about 6.8 aircraft.
- They rewrote the E-8C programmed depot maintenance plan over the past several years using Maintenance Steering Group-3 methodology, which follows the best practices of commercial airlines and should be better suited to the E-8C fleet's aging aircraft with a long service life. To verify and validate the new methodology, in March 2020 the Air Force inducted into depot maintenance at Warner Robins Air Logistics Complex an E-8C aircraft for a major inspection. Program officials also said they plan to begin fully implementing the new programmed depot maintenance plan in fiscal year 2021, and that they expect the E-8C fleet's aircraft availability to improve by 16 percent or more by fiscal year 2023 as the new plan is implemented across the fleet.

Supply Support: Program officials informed us that pylon repair has been one of the top drivers for delays in depot maintenance. The Air Force has required more parts than originally expected for the repair of pylons—which are used to hold the aircraft's engines to the wings—due to the age of the pylons and workmanship issues at Northrop Grumman's depot maintenance facility, according to officials. Program officials said they discovered significant process problems with pylon repair at the contractor facility and worked with the contractor to correct the issues. Additionally, they said that they identified seven sets of unused KC-135 pylons that had undergone a major structural improvement program and now reflect an improved design. These pylons were no longer being used by the KC-135 program due to the KC-135 fleet's having its engines replaced ("re-engined"), and that they were structurally interchangeable with the E-8C pylon, according to the officials. However, the two pylon configurations had different system components. According to program officials, the E-8C program office awarded a task on a larger contract with Boeing in September 2019 to convert the legacy E-8C pylon to the improved KC-135 configuration with all new structural and system components. Program officials told us that they then awarded a task on the same Boeing contract to develop the engineering and conversion data to make the KC-135 pylons useable on E-8C aircraft. That effort is complete, and E-8C program officials said that they expect to add another contract task under the contract with Boeing to convert the KC-135 pylons in August 2020. The E-8C program office plans for the KC-135 converted pylons to be installed on seven aircraft, and for 10 aircraft sets of the newly converted E-8C pylons to be used on the remainder of the E-8C fleet. The E-8C program office projects that the first set of KC-135 pylons will be available for installation in fiscal year 2021. The KC-135 and E-8C converted pylons will be installed on aircraft during major inspections and programmed depot maintenance, and the fleet will be completely updated in about 3 years.

Engines: The E-8C's TF33 engines are the leading cause of the aircraft's being designated as not mission capable. Maintenance and supply issues with the E-8C engines from fiscal year 2011 through fiscal year 2018 have hampered the readiness of the aircraft, according to the program office. In 2018 Congress directed CAPE to report on a cost, schedule, and implementation plan for restarting a dormant legacy E-8C re-engining program that the Air Force originally initiated in 2007.[3] In January 2019 CAPE issued a report that assessed three courses of action and concluded that continuing with the current engines provided the best cost-benefit and was most aligned with the National Defense Strategy.[4] According to CAPE, continuing with the current engines delivers E-8C mission capable aircraft at the lowest total cost, the lowest programmatic risk, and a similar cost per mission capable aircraft ratio as the other potential courses of action. Since CAPE's report was completed, the Air Force officials said that they are designing a modification to disable the engine's thrust reversers to address this issue without a loss of required

[3]See House Report 115-874, the Conference Report accompanying a bill for the John S. McCain National Defense Authorization Act for Fiscal Year 2019.

[4]*Office of the Secretary of Defense Cost Assessment and Program Evaluation E-8C JSTARS Re-engine Report to Congress*, (Jan. 23, 2019).

operational capability. They anticipate that the modification will be ready for production in early 2021. Additionally, the officials said that they plan to begin a study to improve the reliability and maintainability of the engine by the end of fiscal year 2020.

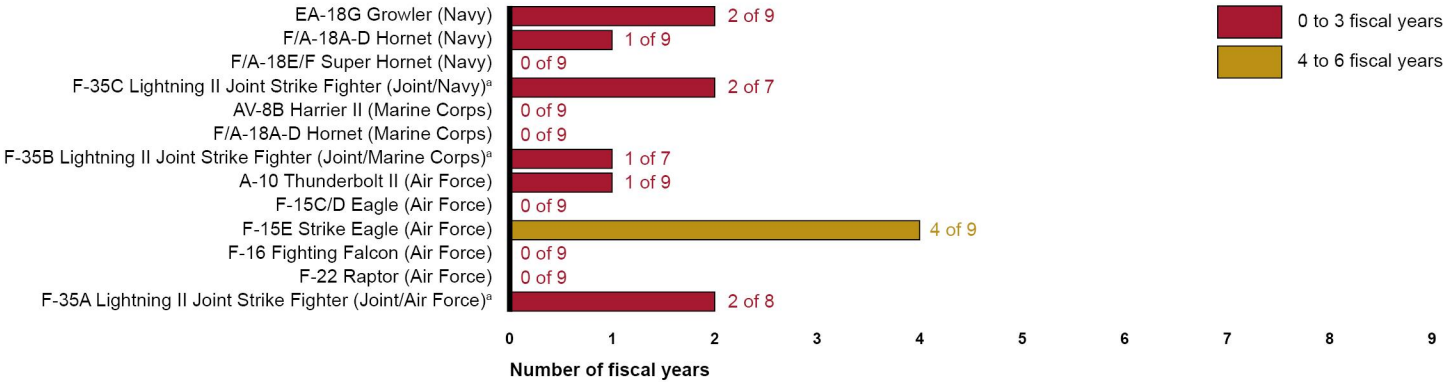
Program Office Comments

In commenting on a draft of this assessment, the program office provided technical comments, which were incorporated where appropriate. Program officials stated that they have planned for the E-8C service life to be capable of reaching 2045 and beyond, depending on Air Force needs. They also said that the propulsion system will increasingly be a negative driver to mission capable rate as the fleet ages.

Fighter aircraft

Source: U.S Marine Corps/Sgt. Dominic Romero. | GAO-21-101SP

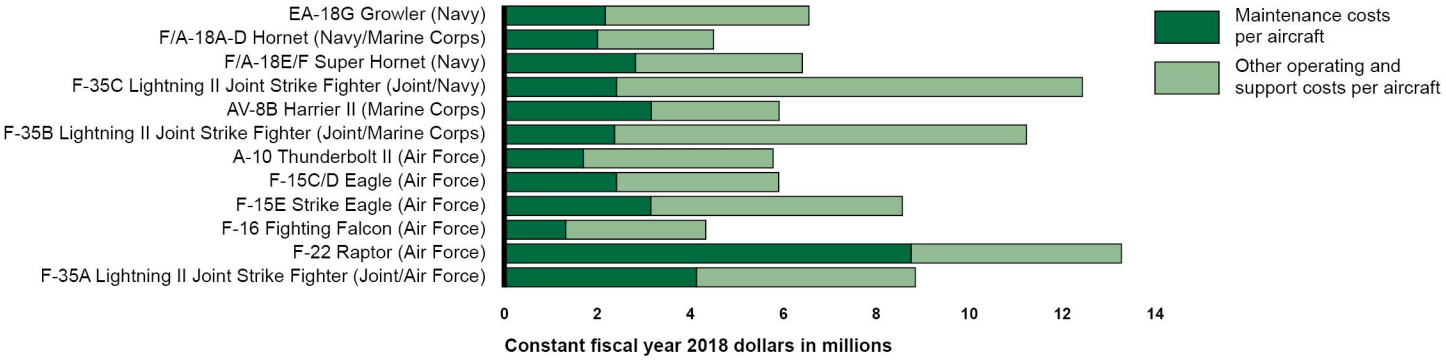
Number of Times Selected Fighter Aircraft Met Their Annual Mission Capable Goal, Fiscal Years 2011 through 2019



Source: GAO analysis of Navy and Air Force data. | GAO-21-101SP

[a]The military departments did not provide mission capable goals for all nine years for these aircraft.

Operating and Support Costs per Aircraft for Selected Department of Defense Fighter Aircraft, Fiscal Year 2018



Source: GAO analysis of Navy and Air Force data. | GAO-21-101SP

Source: U.S. Navy/Elizabeth A. Wolter. | GAO-21-101SP

EA-18G Growler Sustainment Quick Look

Common Name: Growler

Lead Service: Navy

Program Essentials

Manufacturer: Boeing

Sustainment: Depot maintenance conducted at Navy Fleet Readiness Centers and Boeing and field maintenance conducted by Navy maintainers

Program Office: Program Manager – Air 265, Naval Air Systems Command, Patuxent River, Maryland

Fiscal Year 2019 Data

Average age: 6.6 years

Average lifetime flying hours: 1,844 hours per aircraft

Depot maintenance activity and squadron locations:

▲ Depot maintenance activity location

● Squadron location

Source: GAO. | GAO-21-101SP

Sustainment Challenges and Mitigation Actions

As a newer aircraft, the EA-18G is experiencing maintenance and supply challenges. The Navy's actions to mitigate these challenges include increasing available space at depots for repairs and identifying additional vendor sources for parts.

Background

The EA-18G Growler is the fourth major variant of the F/A-18 family of aircraft and was first manufactured in 2007 to replace the EA-6B Prowler. The EA-18G is the first newly designed electronic warfare aircraft produced in more than 35 years and combines the F/A-18 Super Hornet platform with an advanced electronic warfare suite.

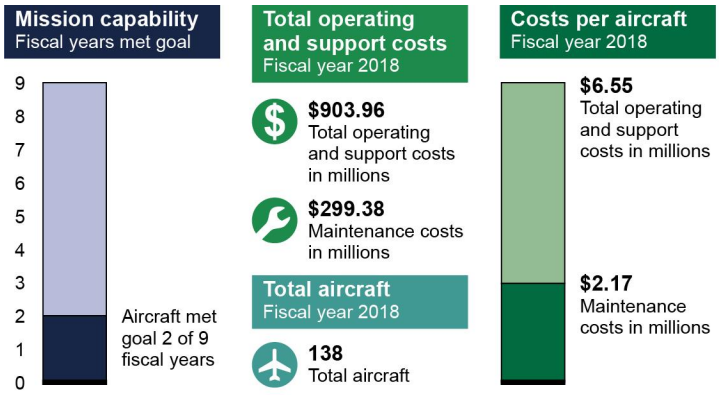
Life Cycle of the EA-18G

Source: GAO analysis of Navy data. | GAO-21-101SP

Overview

From fiscal years 2011 through 2019, the EA-18G fleet met or exceeded its mission capable goals in 2 of the 9 fiscal years and its mission capable rate decreased. The fleet's mission capable rate decreased because, according to officials, EA-18Gs were being inducted into depots as part of planned depot maintenance, shortages of maintenance personnel, and reduction in manufacturing sources to supply parts. Total operating and support (O&S) costs consistently increased, from about $336.34 million in fiscal year 2011 to about $903.96 million in fiscal year 2018, as the size of the fleet grew from 54 to 138 with continued production of the aircraft during the time frame. Further, in fiscal year 2018, maintenance costs per aircraft accounted for about one-third of the total costs per aircraft.

EA-18G Sustainment Status



Source: GAO analysis of Navy data. | GAO-21-101SP

Data table for EA-18G Sustainment Status

Mission capability	Aircraft met goal 2 of 9 fiscal years
Total operating and support costs in millions (FY18)	$903.96
Maintenance costs in millions (FY18)	$299.38
Total aircraft (FY18)	138
Total operating and support costs per aircraft in millions (FY18)	$6.55
Maintenance costs per aircraft in millions	$2.17

Sustainment Strategy

- The EA-18G Acquisition Logistics Support Plan (2006)—a sustainment planning document—describes the Navy's plan for design, development, and fielding of the aircraft. Some of the key support program elements include developing support equipment and technical data, testing requirements for avionics, and facilities requirements, among others. According to Navy officials, they are currently updating a life-cycle sustainment plan, which will include a section for each variant of the F/A-18s, but they do not have a timeline of when it will be finalized.
- In November 2018, the Navy implemented the Naval Sustainment Systems approach in response to the Secretary of Defense's requirement that critical aircraft, such as the EA-18G, achieve an 80-percent mission capable goal. The Naval Sustainment Systems approach employs industry best practices to improve aircraft readiness by reforming several Navy processes, such as leveraging proven commercial best practices to enhance fleet readiness centers, improving supply chain, and developing an engineering-driven system to improve aircraft sustainability. Previously in this report, we discussed the Navy's progress in achieving this goal and noted that the Navy uses different data to assess its progress than the data it provided below for our analysis. Navy officials acknowledge that the data below provides a more comprehensive measure on the health of the aircraft, systems, and components. See appendix II for additional information on this issue.
- The Navy Fleet Readiness Centers maintain the aircraft using planned maintenance intervals, which typically occur every 72 months. The Navy also partners with Boeing to provide wholesale supply and depot repair support for major components, such as the engine.

Availability and Condition

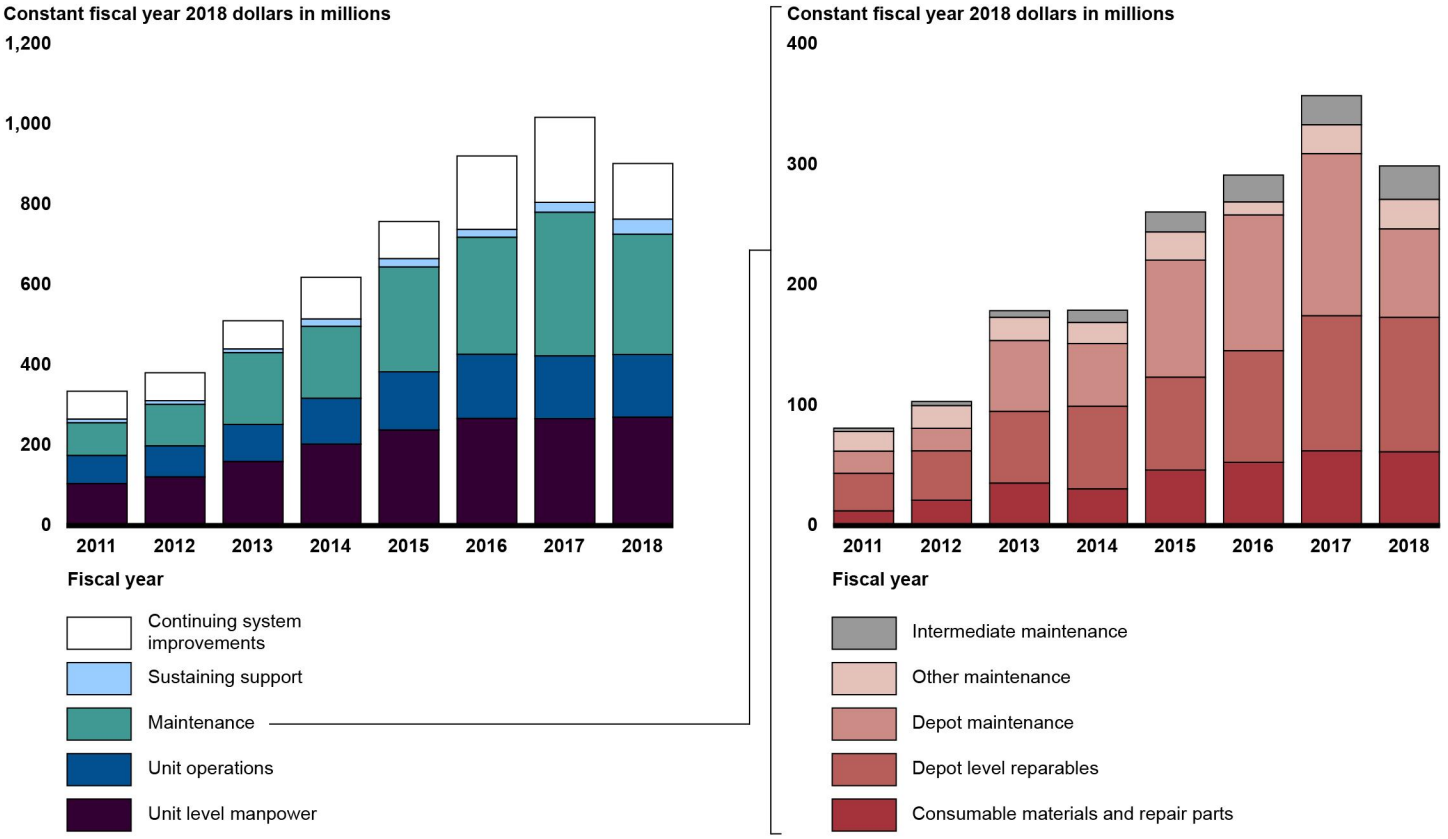
The EA-18G fleet met or exceeded its annual mission capable goals in 2 of the 9 fiscal years from fiscal year 2011 through fiscal year 2019 and its mission capable rate decreased during the time period. According to officials, prior to 2018, mission capable rates were not prioritized as the Navy was focused on other metrics, such as the ready-basic aircraft metric. This was the minimum aircraft availability metric that indicated an aircraft was safe to fly. However, with the renewed focus on mission capability, the Navy has implemented initiatives, such as the Naval Sustainment Systems approach, in an effort to improve mission capable rates, as previously discussed.

From fiscal year 2011 through fiscal year 2019, the EA-18G's rates increased for not mission capable maintenance and not mission capable supply. Officials attributed these increases to supply chain issues, such as parts obsolescence, increased lead times to procure parts, and diminishing manufacturing sources, which lengthened the time that EA-18G aircraft were not mission capable. Specific details on mission capable and not mission capable rates were omitted because the information was deemed by DOD to be sensitive.

Operating and Support Costs

From fiscal years 2011 through 2018, the EA-18G's total O&S costs increased from about $336.34 million to about $903.96 million. Maintenance accounted for the largest share of O&S costs, averaging about $219.19 million per year, or 32 percent of the total O&S costs over the period, and maintenance costs have also increased. According to officials, these increases can be attributed to the increase in the inventory of the EA-18G fleet, from 54 aircraft fiscal year 2011 to 138 aircraft in fiscal year 2018. Further, depot-level reparables was the most significant contributor to maintenance costs, averaging about $74.27 million per year from fiscal years 2011 through 2018, or 34 percent of the total maintenance costs during the time period. Intermediate maintenance costs accounted for the smallest share, averaging about $14.18 million per year, or 6 percent of the total maintenance costs from fiscal years 2011 through 2018.

EA-18G Total Operating and Support Costs



Source: GAO analysis of Navy data. | GAO-21-101SP

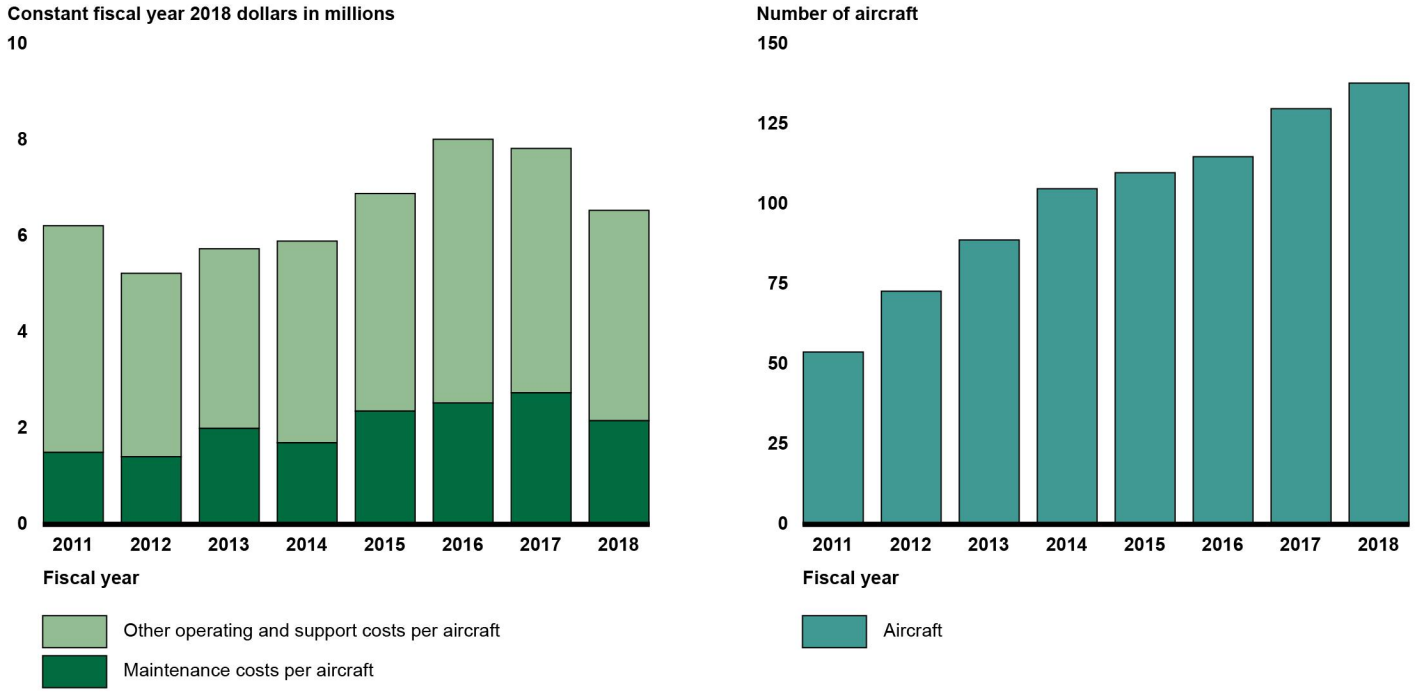
Data table for EA-18G Total Operating and Support Costs (Constant fiscal year 2018 dollars in millions)

Fiscal year	Unit level manpower	Unit operations	Maintenance	Sustaining support	Continuing system improvements
2011	105.95	70.15	81.5	9.11	69.63
2012	122.82	76.98	103.66	9.39	69.72
2013	161.31	92.12	179.03	9.24	70.13
2014	204.5	114.1	179.49	18.44	104
2015	239.64	145.13	261.07	20.79	92.83
2016	268.22	160.02	291.7	19.72	183.01
2017	268.02	156.55	357.7	24.76	212.32
2018	271.62	156.55	299.38	37.75	138.66

Fiscal year	Consumable materials and repair parts	Depot level reparables	Depot maintenance	Other maintenance	Intermediate maintenance
2011	12.68	31.23	18.31	16.5	2.77
2012	21.58	41.01	18.78	18.78	3.49
2013	35.74	59.64	58.76	19.29	5.6
2014	30.96	68.65	52.15	17.39	10.33
2015	46.64	77.07	97.35	23.34	16.67
2016	53.02	92.66	112.89	10.72	22.4
2017	62.57	112.18	134.76	23.93	24.26
2018	61.79	111.72	73.44	24.53	27.9

From fiscal year 2011 through fiscal year 2018, the EA-18G's O&S cost per aircraft generally increased from about $6.23 million to about $6.55 million. Also, maintenance costs per aircraft accounted for about one-third of the total cost per aircraft, averaging about $2.06 million per year during the same time period. The number of aircraft increased from 54 aircraft in fiscal year 2011 to 138 aircraft in fiscal year 2018, as discussed previously.

EA-18G Operating and Support Costs per Aircraft



Source: GAO analysis of Navy data. | GAO-21-101SP

Data table for EA-18G Operating and Support Costs per Aircraft (Constant fiscal year 2018 dollars in millions)

Fiscal year	Maintenance costs per aircraft	Other operating and support costs per aircraft
2011	1.51	4.72
2012	1.42	3.82
2013	2.01	3.74
2014	1.71	4.2
2015	2.37	4.53
2016	2.54	5.49
2017	2.75	5.09
2018	2.17	4.38

Fiscal year	Number of aircraft
2011	54
2012	73
2013	89
2014	105
2015	110
2016	115
2017	130
2018	138

Sustainment Challenges and Mitigation Actions

Maintenance: The EA-18G is experiencing several maintenance challenges. For example, while the majority of the squadrons are located at Whidbey Island, Washington, most of the component repairs are performed at Fleet Readiness Center—West in Lemoore, California. However, according to officials, Lemoore's depots have limited capacity to repair these components, creating a maintenance backlog. Additionally, depot maintenance for the EA-18G is performed at Fleet Readiness Center—Northwest in Whidbey Island, Washington; however, there is a shortage of depot and field maintenance personnel due to attrition and an inability to find skilled workers. The Navy's ongoing and planned actions to mitigate these challenges include implementing the Naval Sustainment Systems approach to leverage best practices in the maintenance industry; establishing additional maintenance support for systems on the EA-18G, such as the electronic warfare system and the generator control unit; increasing available space at depots to repair the aircraft; training depot and field maintainers to be proficient in repairing parts of the aircraft outside their assigned position; and allowing depot and field maintainers to work overtime to keep up with maintenance schedules.

Supply Support*:* The EA-18G is experiencing parts shortages because, according to officials, it is taking longer to repair parts as the aircraft ages. Also, contractors are no longer producing some of these parts. The Navy's ongoing and planned actions to mitigate these challenges include implementing its Naval Sustainment Systems to identify additional vendor sources, performing hardware and software upgrades, reverse engineering (the process of examining an item, such as a spare part, with the intent of replicating its design), employing incentive strategies to procure new parts, building additional organic repair capability and streamlining organic repair processes, adding capability at Fleet Readiness Center—Northwest, completing system test upgrades to support component repairs, and updating organic shop processes at Fleet Readiness Centers to improve component repair completion times.

Program Office Comments

In commenting on a draft of this assessment, the program office provided technical comments, which we incorporated where appropriate.

Source: U.S Marine Corps/Sgt. Dominic Romero. | GAO-21-101SP

F/A-18A-D Hornet Strike Fighter Sustainment Quick Look

Common Name: Legacy Hornet

Lead Service: Navy and Marine Corps

Program Essentials

Manufacturer: McDonnell Douglas and Boeing

Sustainment: Depot maintenance conducted at Navy Fleet Readiness Centers and Boeing and field maintenance conducted by Navy maintainers

Program Office: Program Manager – Air 265, Naval Air Systems Command, Patuxent River, Maryland

Fiscal Year 2019 Data

Average age: 27.6 years

Average lifetime flying hours: 7,585 hours per aircraft

Depot maintenance activity and squadron locations:

Source: GAO. | GAO-21-101SP

Sustainment Challenges and Mitigation Actions

The F/A-18A-D is an aircraft operating beyond its planned service life with maintenance and supply challenges. The Navy's actions to mitigate these challenges include extending the service life of the aircraft, allowing maintainers to work overtime to reduce backlog, and streamlining repair processes.

Background

The F/A-18A-D Hornet Strike Fighter is a twin engine, multimission tactical aircraft initially fielded in the 1980s. In its fighter mode, it is used primarily as a fighter escort and air defense; in its attack mode, it is used for interdiction and air support.

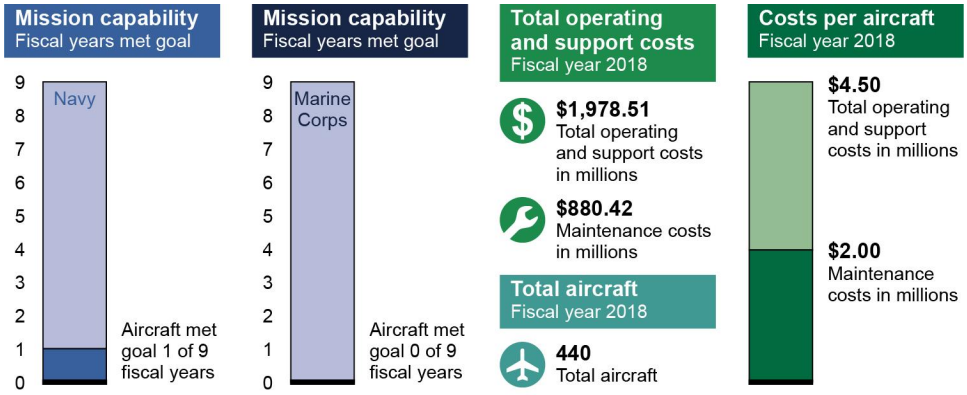
Life Cycle of the F/A-18A-D

Source: GAO analysis of Navy data. | GAO-21-101SP

Overview

From fiscal years 2011 through 2019, the Navy's F/A-18A-D fleet met or exceeded its annual mission capable goals in one of the 9 fiscal years and the Marine Corps' F/A-18A-D fleet fell short of its goals every year. The mission capable rates for both the Navy's and the Marine Corps' F/A-18A-D fleets decreased during the time period. Total operating and support (O&S) costs for the fleet decreased consistently from about $3.09 billion in fiscal year 2011 to about $1.98 billion in fiscal year 2018, partly due to the F/A-18A-D being transitioned out of service to be replaced by the F-35 Joint Strike Fighter. In fiscal year 2018, the O&S costs per aircraft were $4.5 million, with about $2 million per aircraft dedicated to maintenance issues.

F/A-18A-D Sustainment Status



Source: GAO analysis of Navy data. | GAO-21-101SP

Data table for F/A-18A-D Sustainment Status

Mission capability: Navy	Aircraft met goal 1 of 9 fiscal years
Mission capability: Marine Corps	Aircraft met goal 0 of 9 fiscal years
Total operating and support costs in millions (FY18)	$1,978.51
Maintenance costs in millions (FY18)	$880.42
Total aircraft (FY18)	440
Total operating and support costs per aircraft in millions (FY18)	$4.50
Maintenance costs per aircraft in millions	$2.00

Sustainment Strategy

- The In-Service Support Plan (2001) documents the engineering, logistics, and financial resources necessary to ensure continued readiness and supportability for the remainder of the aircraft's service life. According to Navy officials, they are currently updating a life-cycle sustainment plan that will include a section for each variant of the F/A-18s, and they do not have a timeline of when it will be finalized.
- In November 2018, the Navy implemented the Naval Sustainment Systems approach in response to the Secretary of Defense's requirement that critical aircraft, such as the F/A-18A-D, achieve an 80 percent mission capable rate. The Naval Sustainment Systems approach plans to leverage proven commercial best practices to enhance fleet readiness centers, improve the supply chain, and develop an engineering-driven system to improve aircraft sustainability. Previously in this report, we discussed the Navy's progress in achieving this goal. Additionally, we noted that the Navy uses different data to assess its progress in achieving this goal than the data it provided below for our analysis. Navy officials acknowledge that the data below provides a more comprehensive measure on the health of the aircraft, systems, and components. See appendix II for additional information on this issue.
- The Navy implemented the High-Flight-Hour program in 2006 to extend the service life from 8,000 to 10,000 flight hours by inspecting and repairing airframes, and replacing major components and parts.
- The Navy Fleet Readiness Centers maintain the aircraft using planned maintenance intervals, which typically occur every 48 months for carrier deploying aircraft, and every 72 months for land-based aircraft.

Availability and Condition

From fiscal year 2011 through fiscal year 2019, the Navy's F/A-18A-D fleet met or exceeded its annual mission capable goals in one of the 9 fiscal years and its mission capable rate decreased during the time period. According to officials, the decrease in the mission capable rate occurred, partly, as a result of sequestration in 2013, which limited funding to support scheduled depot maintenance, resulting in less aircraft available for training and missions. In addition, the aircraft is aging requiring additional repairs and the inventory of the F/A-18A-D is decreasing as the aircraft is approaching its end of service.

From fiscal year 2011 through fiscal year 2019, the Marine Corps' F/A-18A-D fleet fell short of its annual mission capable goals each year, and its mission capable rate decreased over the same time period. According to officials, the Marine Corps' F/A-18A-D fleet missed its goals partly because of the increased inspections and repairs associated with the service-life extension of the aircraft.

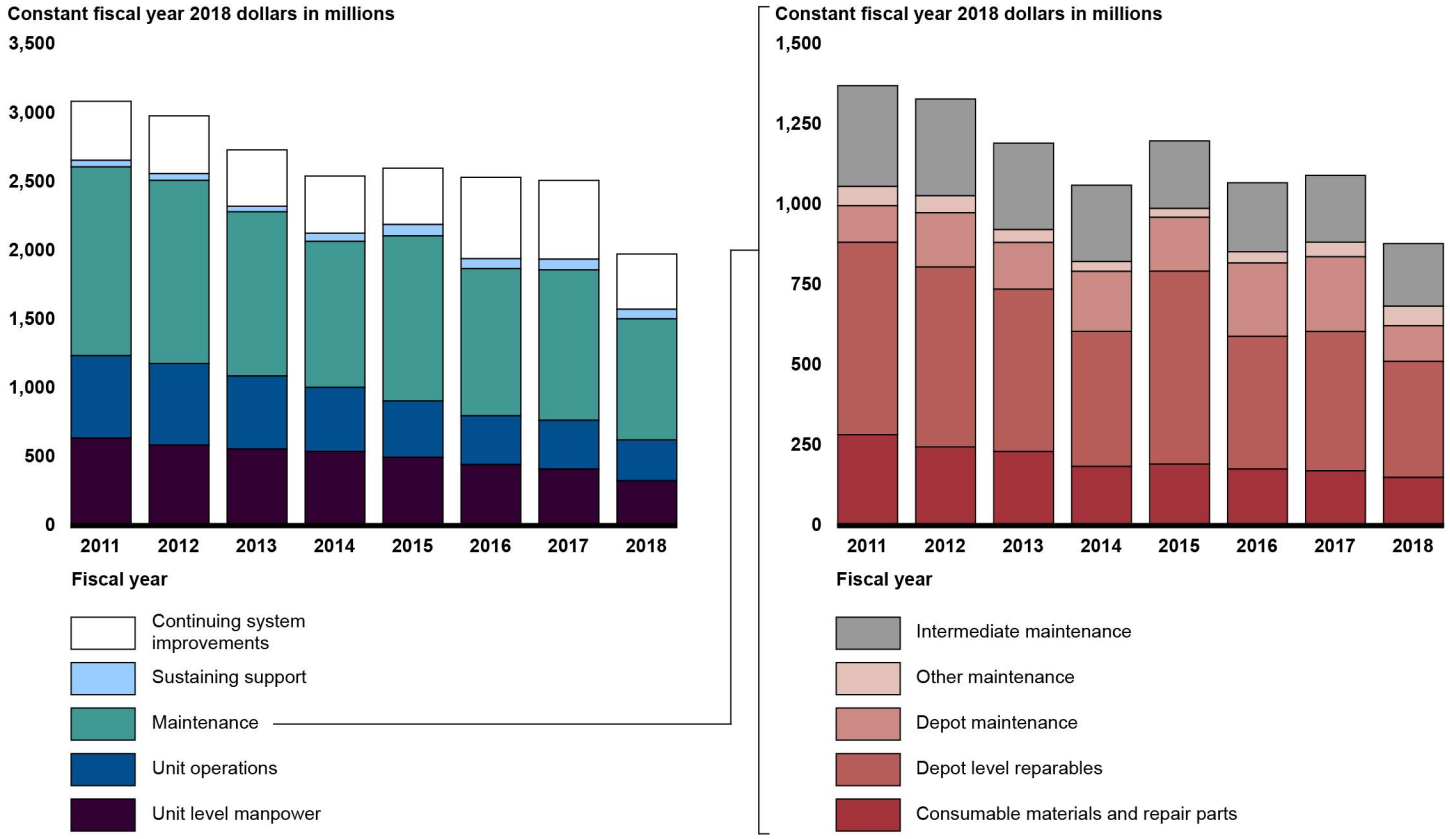
The Navy's F/A-18A-D not mission capable maintenance (NMCM) rates in fiscal years 2011 and 2019 were about the same and it's not mission capable supply (NCMS) rate increased when comparing those two years. According to officials, the NMCS increase was a result of a greater demand for parts for repairs associated with service-life extension activities and maintenance issues that were not anticipated for a fleet with an original service life of 6,000 flight hours.

The Marine Corps' F/A-18A-D NMCM rate increased from fiscal year 2011 thorugh fiscal year 2019 and its NMCS rate increased slightly. According to officials, the overall increase in the not mission capable rates was a result of increased inspections and repairs associated with extending the service life of the aircraft. Specific details on mission capable and not mission capable rates were omitted because the information was deemed by DOD to be sensitive.

Operating and Support Costs

From fiscal year 2011 through fiscal year 2018, the Navy's and Marine Corps' F/A-18A-D's total O&S costs decreased from about $3.09 billion to about $1.98 billion. Maintenance costs accounted for the largest share of O&S costs, averaging about $1.15 billion per year, or 44 percent of total O&S cost over the period, but total annual O&S costs have decreased. According to officials, this was a result of the decrease in the total fleet aircraft of the F/A-18A-D across the Navy and Marine Corps, from 581 aircraft in fiscal year 2011 to 440 aircraft in fiscal year 2018 as aircraft were transitioned out of service. Also, the cost of depot-level reparables was the most significant contributor to maintenance costs, averaging about $487.18 million a year, or 42 percent of the total maintenance costs from fiscal years 2011 through 2018.

F/A-18A-D Total Operating and Support Costs



Source: GAO analysis of Navy data. | GAO-21-101SP

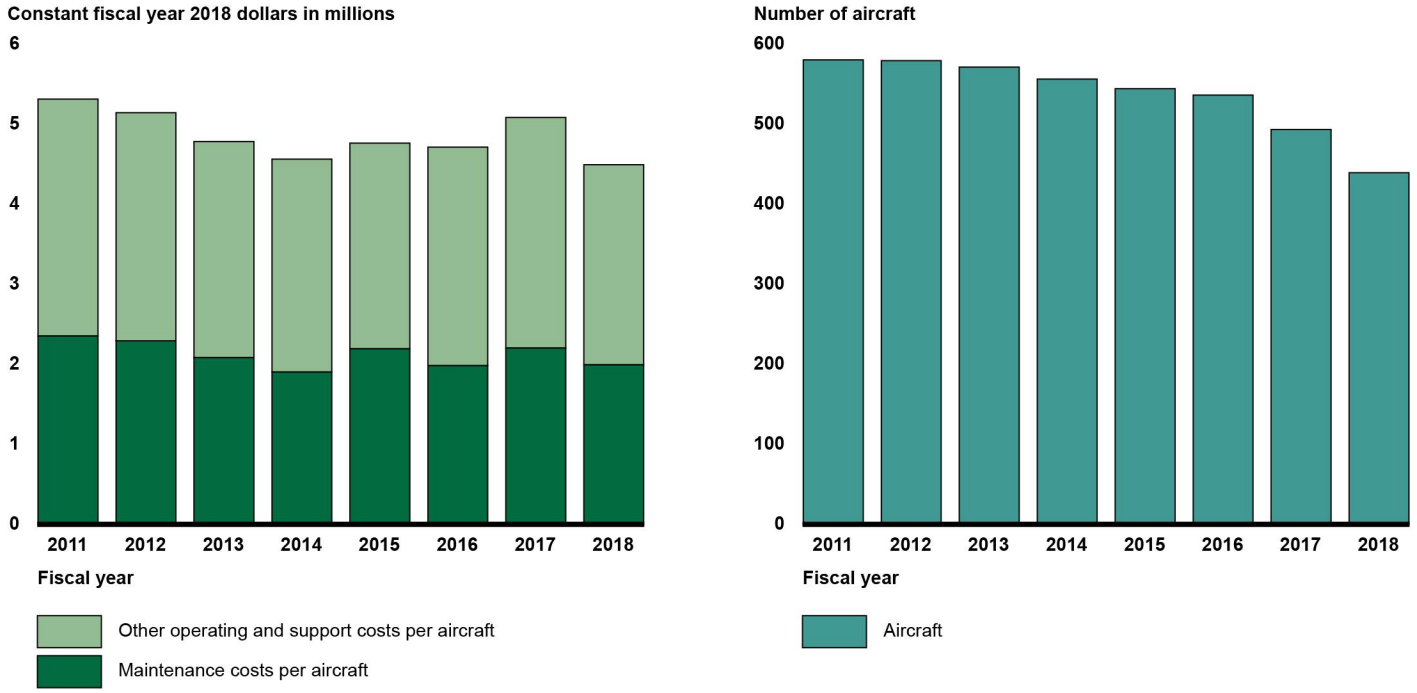
Data table for F/A-18A-D Total Operating and Support Costs (Constant fiscal year 2018 dollars in millions)

Fiscal year	Unit level manpower	Unit operations	Maintenance	Sustaining support	Continuing system improvements
2011	640.9	599.11	1372.5	47.47	429.67
2012	589.78	593.06	1331.19	48.76	419.88
2013	561.6	529.88	1193.45	41.68	409.73
2014	543.69	465.12	1062.55	59	414.92
2015	501.75	407.96	1200.57	83.57	408.58
2016	448.45	354.43	1070.11	72.26	591.41
2017	415.04	354.81	1093.04	77.98	573.76
2018	329.58	297.83	880.42	68.97	401.71

Fiscal year	Consumable materials and repair parts	Depot level reparables	Depot maintenance	Other maintenance	Intermediate maintenance
2011	285.14	599.49	113.84	60.15	313.87
2012	247.13	560.19	169.13	53.08	301.66
2013	232.23	506.11	145.76	39.79	269.57
2014	185.89	421.02	187.14	30.37	238.13
2015	193.26	601.22	167.94	27.59	210.56
2016	177.73	413.8	228.57	34.83	215.19
2017	172.31	434.04	233.29	45.19	208.21
2018	152.11	361.55	111.05	60.61	195.1

From fiscal years 2011 through 2018, the O&S costs per F/A-18A-D aircraft generally decreased from about $5.32 million to about $4.50 million. This was a result of the decrease in total fleet aircraft, as previously discussed, along with a corresponding reduction in unit operations and unit-level manpower. Also, maintenance costs per aircraft were about 40 percent of total O&S costs per aircraft across the time frame.

F/A-18A-D Operating and Support Costs per Aircraft and Fleet Size



Source: GAO analysis of Navy data. | GAO-21-101SP

Data table for F/A-18A-D Operating and Support Costs per Aircraft and Fleet Size (Constant fiscal year 2018 dollars in millions)

Fiscal year	Maintenance costs per aircraft	Other operating and support costs per aircraft
2011	2.36	2.96
2012	2.3	2.85
2013	2.09	2.7
2014	1.91	2.66
2015	2.2	2.57
2016	1.99	2.73
2017	2.21	2.88
2018	2	2.5

Fiscal year	Number of aircraft
2011	581
2012	580
2013	572
2014	557
2015	545
2016	537
2017	494
2018	440

Sustainment Challenges and Mitigation Actions

Aging: The Navy and Marine Corps have extended the F/A-18A-D's service life by 4,000 flight hours beyond its planned service life of 6,000 flight hours. As the fleet ages, some F/A-18A-D have been permanently removed from service, decreasing the number of aircraft available for missions. The Navy's and Marine Corp's ongoing and planned actions to mitigate these challenges include extending the service life of the F/A-18A-D to 10,000 flight hours through its High Flight Hour program—such as replacing major components including the landing gear—to increase the service life of the aircraft, and moving aircraft between squadrons to meet the requirements of deploying missions.

Maintenance: As the Navy's and Marine Corps' F/A-18A-D age beyond their designed service lives, they require additional maintenance for repairs that were not originally planned, such as repairs for corrosion, which have created engineering challenges and maintenance activities that take longer to perform. Also, shortages of depot and field maintenance personnel because of attrition and the inability to find skilled workers have caused maintenance backlogs. The Navy's and Marine Corps' ongoing and planned actions to accelerate maintenance improvements include implementing the Naval Sustainment System that leverages best practices in the maintenance industry, according to Navy officials; training depot and field maintainers to be proficient in repairing parts of the aircraft outside their assigned position; allowing depot and field maintainers to work overtime to keep up with maintenance schedules; and mitigating the effects of personnel shortages, where feasible, by augmenting with contractor personnel to perform maintenance activities.

Supply Support: The Navy's and Marine Corps' F/A-18A-D are experiencing shortages of parts due to obsolescence and reduced vendor base and depot capacity. The Navy's ongoing and planned actions through the Naval Sustainment System include identifying alternate vendors for parts, performing hardware and software upgrades that improve reliability and maintainability, reverse engineering parts in order to be able to improve supply availability, streamlining repair processes for parts, leveraging their foreign partner's depot capability while standing up additional repair capabilities for parts, implementing new contracting incentive strategies—such as long term performance based sustainment contracts—and partnering with original equipment manufacturers for supply support.

Program Office Comments

In commenting on a draft of this assessment, the program office provided technical comments, which we incorporated where appropriate.

Source: U.S. Navy/Chief Mass Communication Specialist Shannon Renfroe. | GAO-21-101SP

F/A-18E/F Super Hornet Sustainment Quick Look

Common Name: Super Hornet

Lead Service: Navy

Program Essentials

Manufacturer: Boeing

Sustainment: Depot maintenance conducted at Navy Fleet Readiness Centers and field maintenance conducted by Navy maintainers

Program Office: Program Manager – Air 265, Naval Air Systems Command, Patuxent River, Maryland

Fiscal Year 2019 Data

Average age: 12.1 years

Average lifetime flying hours: 3,526 hours per aircraft

Depot maintenance activity and squadron locations:

Source: GAO. | GAO-21-101SP

Sustainment Challenges and Mitigation Actions

The F/A-18E/F is a frequently-used aircraft with maintenance and supply challenges. The Navy's actions to mitigate these challenges include implementing the Naval Sustainment System and plans to extend the service life of the aircraft.

Background

The F/A-18E/F Super Hornet was first manufactured in 1997. The F/A-18E/F is a twin-engine strike fighter, an air-to-ground attack aircraft, as well as an air-to-air fighter. Its missions include escort and fleet air defense, force projection, interdiction, and close air support, among others.

Life Cycle of the F/A-18E/F

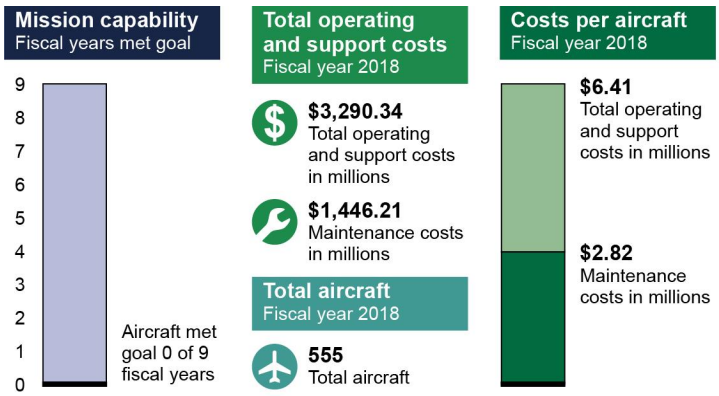
Initial Operational Capability Full Operational Capability

Source: GAO analysis of Navy data. | GAO-21-101SP

Overview

From fiscal years 2011 through 2019, the F/A-18E/F fleet did not meet any of its annual mission capable goals and its mission capable rate decreased. Total operating and support (O&S) costs steadily increased from about $2.16 billion in fiscal year 2011 to about $3.29 billion in fiscal year 2018. In fiscal year 2018, maintenance costs were $1.45 billion, or 44 percent, of total O&S costs and the largest contributors were depot-level reparables ($551.02 million) and depot maintenance ($303.25 million). From fiscal years 2011 through 2018, the O&S cost per aircraft for the F/A-18E/F increased by over three-quarters of a million dollars, while the mission capable rate steadily declined to below 50 percent.

F/A-18E/F Sustainment Status



Source: GAO analysis of Navy data. | GAO-21-101SP

Data table for F/A-18E/F Sustainment Status

Mission capability	Aircraft met goal 0 of 9 fiscal years
Total operating and support costs in millions (FY18)	$3,290.34
Maintenance costs in millions (FY18)	$1,446.21
Total aircraft (FY18)	555
Total operating and support costs per aircraft in millions (FY18)	$6.41
Maintenance costs per aircraft in millions	$2.82

Sustainment Strategy

- The Navy is extending the service life of the F/A-18E/F aircraft through a Service Life Management Program. Based upon the Navy's assessment of the number of flight hours the aircraft can safely continue to fly, the Navy has a contract with Boeing to extend the service life of the Super Hornet from 6,000 to 10,000 hours through modifications.
- The F/A-18E/F aircraft are maintained at Navy Fleet Readiness Centers under planned maintenance intervals that occur about every 72 months.

In November 2018, the Navy implemented the Naval Sustainment Systems approach in response to the Secretary of Defense's requirement that critical aircraft, such as the F/A-18E/F, achieve an 80-percent mission capable goal. According to the Navy, the Naval Sustainment System approach plans to leverage proven commercial best practices to enhance fleet readiness centers, improve the supply chain, and develop an engineering-driven system to improve aircraft sustainability, among other things. Previously in this report, we discussed the Navy's progress in achieving this goal. Additionally, we noted that the Navy uses different data to assess its progress in achieving this goal than the data it provided below for our analysis. Navy officials acknowledge that the data below provides a more comprehensive measure on the health of the aircraft, systems, and components. See appendix II for additional information on this issue.

Availability and Condition

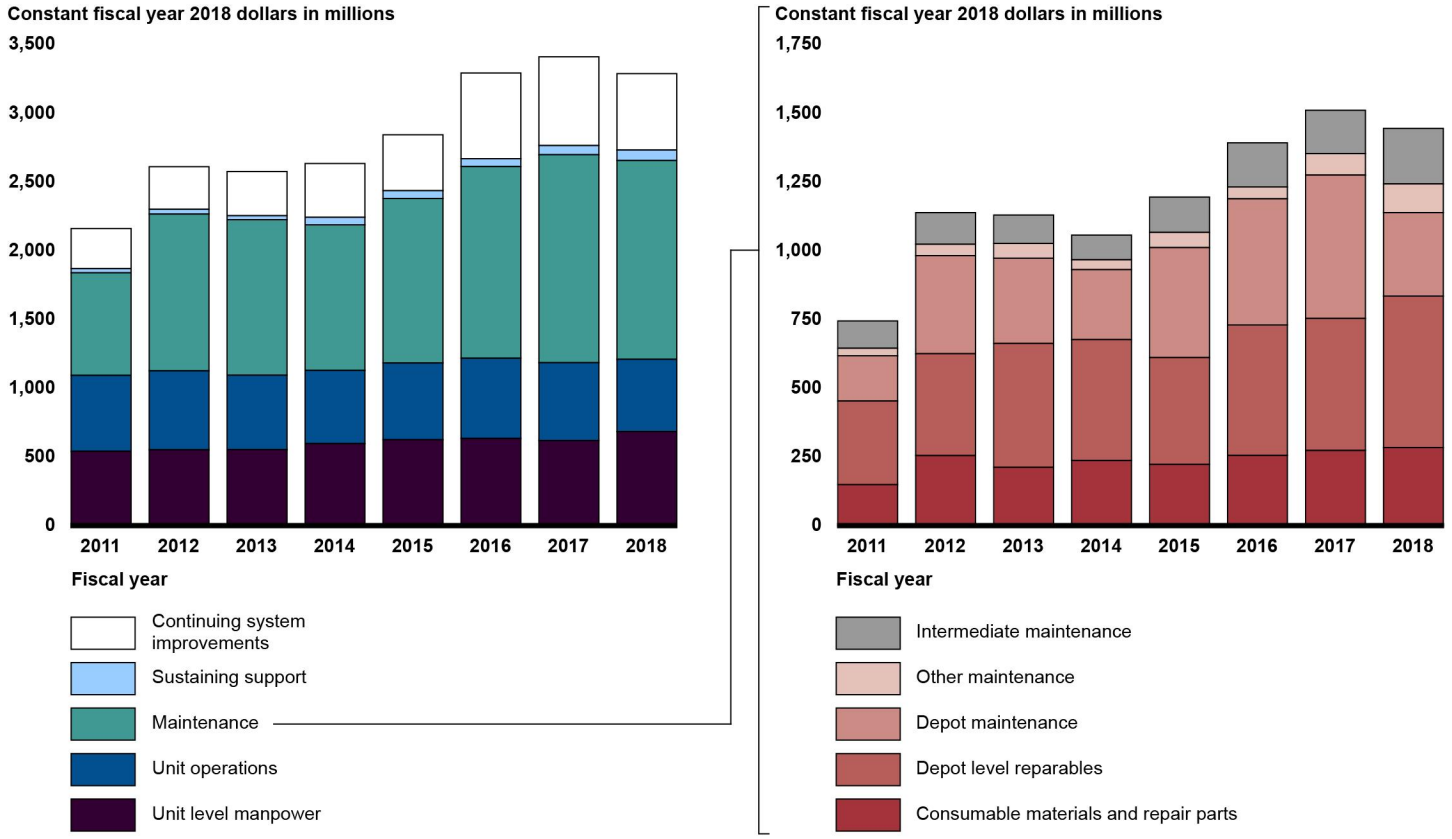
From fiscal year 2011 through fiscal year 2019, the F/A-18E/F fleet missed all of its annual mission capable goals and its mission capable rate decreased during the time period.

From fiscal years 2011 through 2019, the F/A-18E/F's rates increased for not mission capable maintenance (NMCM) and not mission capable supply (NMCS). The NMCM rate was higher in the interim years, but by fiscal year 2019 the NMCM rate was about the same as it was in fiscal year 2011.. According to Navy officials, the increases in the not mission capable rates during this time were the result of budget sequestration and associated funding shortages. In addition, the increase in aircraft inventory, along with aging airframes, imposed additional requirements on the maintenance community and negatively affected the NMCM rate. Further, officials cited excessive supplier lead times, diminishing manufacturing sources, and material requirements that were not originally forecasted for the initial 6,000-hour service-life expectancy as other reasons for the NMCS rate increase. Specific details on mission capable and not mission capable rates were omitted because the information was deemed by DOD to be sensitive.

Operating and Support Costs

From fiscal year 2011 through fiscal year 2018, the F/A-18E/F's total O&S costs increased about $1.13 billion, from $2.16 billion to $3.29 billion, as mission capable rates decreased. Costs for maintenance and continuing systems improvements increased the most over the period, about $700.15 million and $263.73 million, respectively. Navy officials stated that maintenance costs increased due to sustained high flight hours, which increased the probability of parts failure on the aircraft, and an increasing aircraft inventory, as the F/A-18E/F is still in production. Maintenance costs also increased as the Navy has worked to address extensive maintenance needs associated with extending the service life of the aircraft from 6,000 hours to 10,000 hours, according to Navy officials. For example, several life-limited components, such as particular surfaces on the aircraft, require replacement at 6,000 flight hours, and this has increased the depot-level reparable costs in the fiscal year 2016-2018 time frames. Officials said that the continuing system-improvement cost increases in fiscal years 2016 through 2018 were due to a number of modification efforts, such as improvements to the avionics for the aircraft and modifications associated with the service-life extension.

F/A-18E/F Total Operating and Support Costs



Source: GAO analysis of Navy data. | GAO-21-101SP

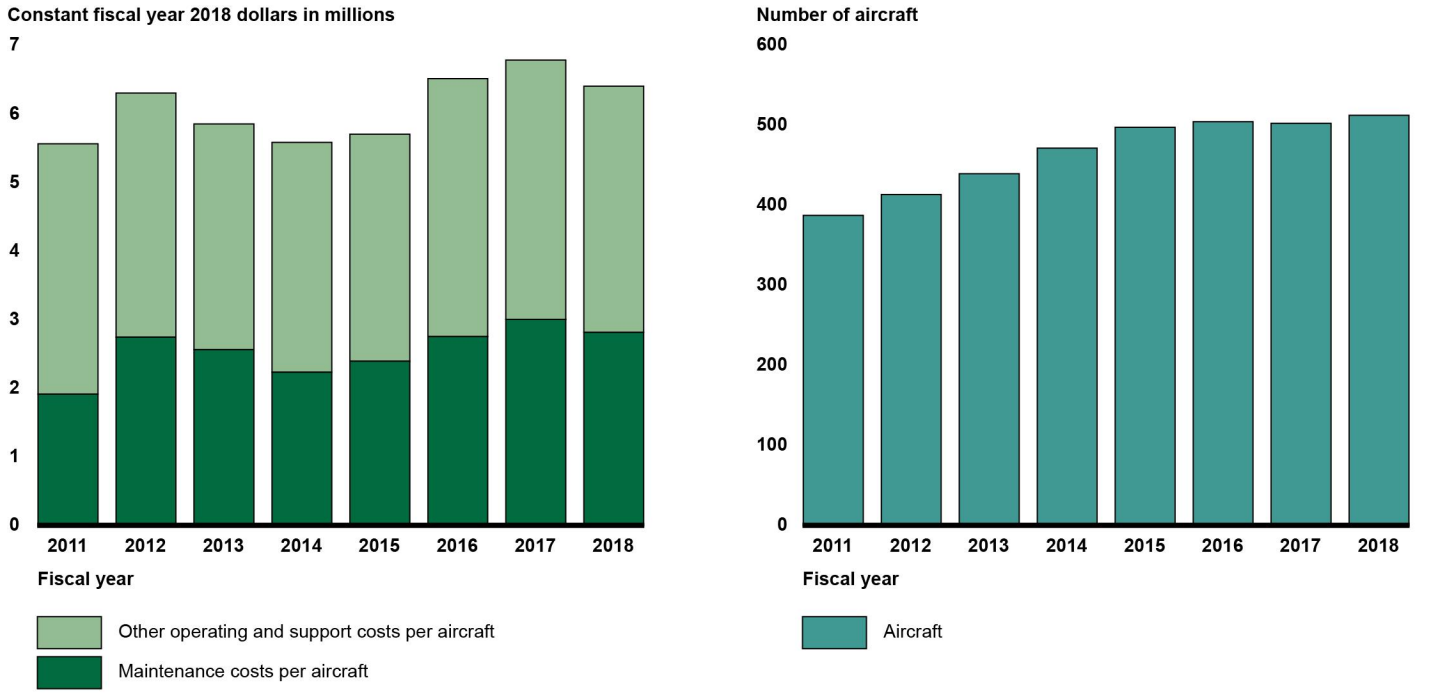
Data table for F/A-18E/F Total Operating and Support Costs (Constant fiscal year 2018 dollars in millions)

Fiscal year	Unit level manpower	Unit operations	Maintenance	Sustaining support	Continuing system improvements
2011	544.67	551.88	746.06	29.28	292.08
2012	555.09	573.89	1139.59	35.3	308.94
2013	556.26	541.37	1130.77	29.49	320.87
2014	601.28	531.66	1058.15	54.63	391.39
2015	628.91	556.99	1196.3	56.77	406.31
2016	637.99	583.26	1393.5	56.73	622.68
2017	622.96	566.01	1512.26	65.93	644.84
2018	687.89	525.2	1446.21	75.24	555.81

Fiscal year	Consumable materials and repair parts	Depot level reparables	Depot maintenance	Other maintenance	Intermediate maintenance
2011	151.34	303.88	164.21	27.53	99.11
2012	256.51	370.36	356.37	41.41	114.94
2013	214.1	450.24	309.79	53.41	103.23
2014	238.84	439.76	253.88	35.81	89.85
2015	224.77	388.44	399.56	55.24	128.28
2016	257.2	474	458.83	43.13	160.33
2017	275.19	480.39	520.8	78.1	157.78
2018	285.58	551.02	303.25	104.27	202.08

From fiscal year 2011 through fiscal year 2018, the O&S costs per aircraft for the F/A-18E/F increased from about $5.58 million to about $6.41 million, while the mission capable rate steadily declined to below 50 percent. Also, maintenance costs per aircraft increased from about $1.92 million (34 percent of the total O&S costs per aircraft) in fiscal year 2011 to $2.82 million per aircraft (44 percent of the total O&S costs per aircraft) in fiscal year 2018. The number of F/A-18E/F aircraft increased from 388 to 513 during the same time frame.

F/A-18E/F Operating and Support Costs per Aircraft and Fleet Size



Source: GAO analysis of Navy data. | GAO-21-101SP

Data table for F/A-18E/F Operating and Support Costs per Aircraft and Fleet Size (Constant fiscal year 2018 dollars in millions)

Fiscal year	Maintenance costs per aircraft	Other operating and support costs per aircraft
2011	1.92	3.65
2012	2.75	3.56
2013	2.57	3.29
2014	2.24	3.35
2015	2.4	3.31
2016	2.76	3.76
2017	3.01	3.78
2018	2.82	3.59

Fiscal year	Number of aircraft
2011	388
2012	414
2013	440
2014	472
2015	498
2016	505
2017	503
2018	513

Sustainment Challenges and Mitigation Actions

Aging: Since the Navy frequently used the F/A-18E/F over the past decade to support contingency operations, the aircraft has required additional maintenance and, according to Navy officials, the aircraft requires a life extension to remain a viable weapon system. According to officials, the Navy is extending the F/A18E/F's service life from 6,000 flight hours to 10,000 flight hours, as previously discussed. The Navy plans to implement lessons learned from other service-life extension programs (e.g., F/A-18A-D Hornet Strike Fighter), such as monitoring depot induction flows and obtaining contractor support from Boeing to assist with initial program challenges, including knowledge, skills, and facilities.

Maintenance: According to officials, the number of F/A-18E/F aircraft that are not mission capable for maintenance is a significant challenge, as are historically-inconsistent funding levels in sustainment accounts. Officials said that the Navy developed a plan for the F/A-18E/F to improve readiness, and that the enhancements being driven through the establishment of the Navy Sustainment Systems in November 2018, discussed previously, are the actions being taken to increase the aircraft's mission capable rate. Additionally, to promote more stable sustainment funding, Navy officials are preparing a 2-year program sustainment budget and an additional, 3-year sustainment funding plan to inform leadership of the long-term requirements of the program. This plan will be updated annually to align with each budget cycle.

Supply Support: Even though the F/A-18E/F is still in production, the aircraft is experiencing shortages of parts that suppliers are no longer producing. Also, according to officials, suppliers are slow in providing parts, which increases maintenance wait times. Ongoing and planned actions include locating other vendor sources, reverse engineering, and cannibalizing parts (i.e., removing serviceable parts from one aircraft and installing them in another aircraft). Additionally, the Naval Sustainment System, discussed earlier, includes an Integrated Supply Chain Management Team to improve supply support, according to Navy officials.

Program Office Comments

In commenting on a draft of this assessment, the program office provided technical comments, which we incorporated where appropriate.

Source: U.S. Air Force/Defense Visual Information Distribution Service. | GAO-21-101SP

F-35 Lightning II Joint Strike Fighter Sustainment Quick Look

Common Name: F-35

Lead Service: Joint

Program Essentials

Manufacturer: Lockheed Martin
Sustainment: Depot maintenance conducted by Lockheed Martin and field maintenance conducted by service personnel.
Program Office: Joint Program Office, Arlington, Virginia

Fiscal Year 2019 Data

Average age: F-35A: 3.1 years; F-35B: 4.0 years; F-35C: 3.9 years.
Average lifetime flying hours: F-35A: 561 hours; F-35B: 616 hours; F-35C: 677 hours.
Depot maintenance activity and squadron locations:

▲ Depot maintenance activity location
● Squadron location

Source: GAO. | GAO-21-101SP

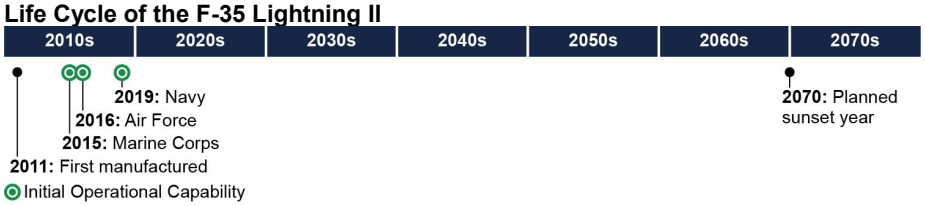
Sustainment Challenges and Mitigation Actions

The F-35 faces significant challenges related to its supply chain and the program office is taking steps to address these challenges.

Background

The F-35 Lightning II is a strike fighter aircraft that integrates low-observable (stealth) technology with advanced sensors and computer networking capabilities for the U.S. Air Force, Marine Corps, and Navy. Each service has its own variant of the aircraft with service-specific capabilities. The Air Force utilizes the F-35A, the Marine Corps utilizes the F-35B and the F-35C, and the Navy utilizes the F-35C. Production on the F-35 is expected to continue through fiscal year 2044. In this report, we focus on the United States' F-35 fleet.

Life Cycle of the F-35 Lightning II

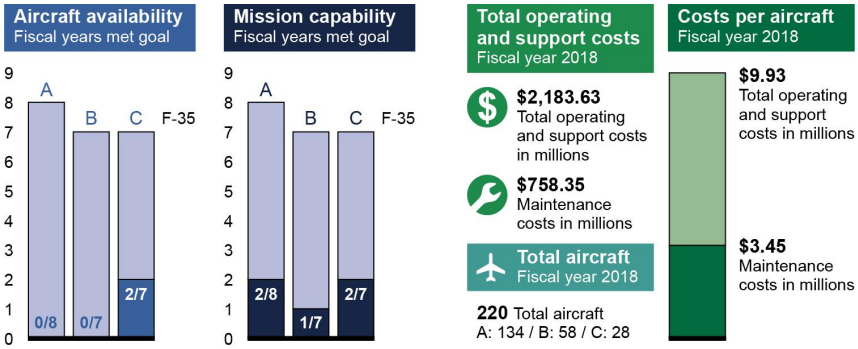


Source: GAO analysis of DOD information. | GAO-21-101SP

Overview

The F-35 variants met few of their threshold performance targets for air vehicle availability and mission capable rates from fiscal years 2012 through 2019, and none of the variants met their objective threshold targets for either of the rates. However, the aircraft availability and mission capable rates for all of the F-35 variants increased during the time period. Total operating and support (O&S) costs for all three variants have increased over time as more airplanes are produced. From fiscal year 2011 to fiscal year 2018, total O&S costs for the F-35 program increased from $55.60 million to $2,183.63 million, with $758.35 million, or about 35 percent, spent on maintenance. The majority of the costs were from the F-35A, which has the most aircraft inventory.

F-35 Sustainment Status



Source: F-35 Joint Program Office. | GAO-21-101SP

Data table for F-35 Sustainment Status

Aircraft availability	A: Aircraft met goal 0 of 8 fiscal years B: Aircraft met goal 0 of 7 fiscal years C: Aircraft met goal 2 of 7 fiscal years
Mission capability	A: Aircraft met goal 2 of 8 fiscal years B: Aircraft met goal 1 of 7 fiscal years C: Aircraft met goal 2 of 7 fiscal years
Total operating and support costs in millions (FY18)	$2,183.63
Maintenance costs in millions (FY18)	$758.35
Total aircraft (FY18)	220 (A: 134, B: 58, C: 28)
Total operating and support costs per aircraft in millions (FY18)	$9.93
Maintenance costs per aircraft in millions	$3.45

Sustainment Strategy

- The F-35's Life-Cycle Sustainment Plan was issued in January 2019 and describes performance imperatives, metrics, and eight success elements. According to the plan, these success elements are the first steps towards achieving an 80 percent mission capable rate for combat aircraft. The plan also defines actions to reduce operating and maintenance costs each year.
- Sustainment of the F-35 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. As such, it establishes sustainment requirements, manages funding, develops contracts, and provides direction for and oversees the execution of F-35 sustainment strategy and policy.
- 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 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.
- The F-35 program is a joint, multinational acquisition program with a global supply chain 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. All F-35 program participants share a global pool of F-35 spare parts.

Availability and Condition

From fiscal years 2012 through 2019, the F-35A fleet did not meet its annual threshold performance targets for air vehicle availability, but met the threshold performance targets for the mission capable rate in 2 of the 8 fiscal years. The F-35A fleet did not meet any of its annual objective performance targets—for either the air vehicle availability rate or the mission capable rate. However, the F-35A's availability and mission capable rates both increased over the eight-year period.

The F-35B fleet did not meet its annual threshold performance targets for air vehicle availability, but met these targets for its mission capable rate in 1 of the 7 years from fiscal years 2013 through 2019. The F-35B fleet did not meet any of its annual objective performance targets—for either the aircraft availability rate or the mission capable rate. However, both the F-35B's aircraft availability rate and mission capable rate increased over the seven-year period.

From fiscal years 2013 through 2019, the F-35C fleet met its annual threshold performance targets for air vehicle availability in 2 of the 7 years and met the threshold performance targets for the mission capable rate in 2 of the 7 fiscal years. The F-35C fleet did not meet any of its annual objective performance targets—for either the aircraft availability rate or the mission capable rate. However, both the F-35C's aircraft availability rate and its mission capable rate increased over the eight-year period.

Although the rates varied somewhat during the time period, in general, from fiscal years 2012 through 2019 the not mission capable maintenance rates for all of the F-35 variants decreased and the not mission capable supply rates increased. Spare parts shortages throughout the F-35 supply chain are contributing to F-35 aircraft being unable to perform as many missions or to fly as often as the warfighter requires. As we have previously reported, 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.[1] Several factors contributed to these parts shortages, including F-35 parts breaking more often than expected, and DOD's limited capability to repair parts when they break. Specific details on mission capable and not mission capable rates were omitted because the information was deemed by DOD to be sensitive.

Operating and Support Costs

The F-35 is DOD's most costly weapon system, with sustainment costs estimated at more than $1 trillion over a 60-year life cycle. Total O&S costs have grown from $55.6 million in fiscal year 2011 to $2.18 billion in fiscal year 2018, with the F-35A accounting for the majority of those costs. Maintenance costs have increased from $15.76 million to $758.35 million during this same timeframe, again with the the F-35A accounting for the majority of these costs. In 2018, DOD established affordability constraints based on the military services' furture budget projections. These new affordabiltiy 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. Total O&S costs for the F-35A have risen from $55.60 million in fiscal year 2011 to $1.18 billion in fiscal year 2018. Maintenance costs for the F-35A also increased during this time period, from $15.76 million in fiscal year 2011 to $553.71 million in fiscal year 2018, and the percentage of the total O&S costs spent on maintenance increased from 28 percent to 47 percent.

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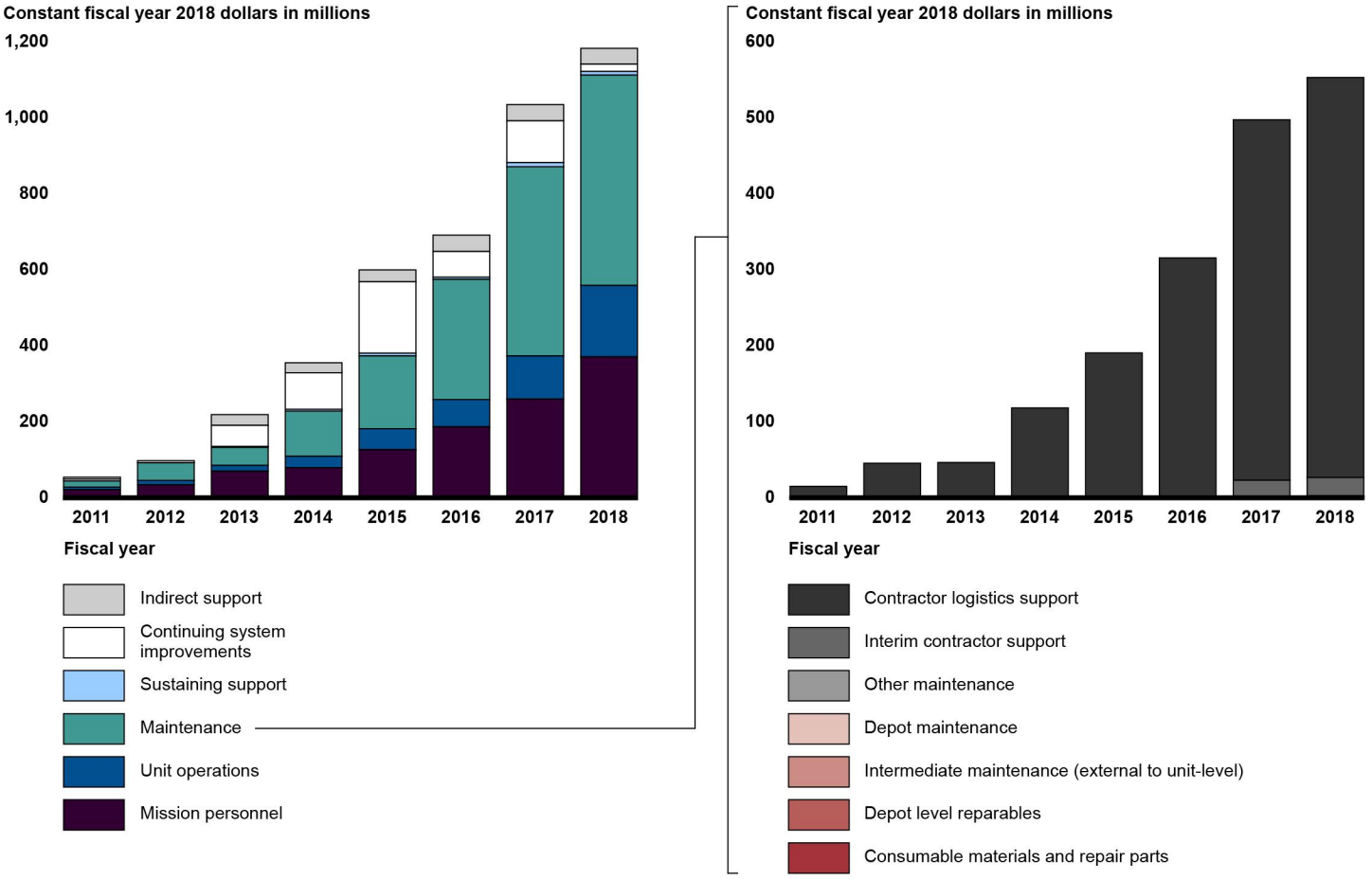
[1]See GAO, *F-35 Aircraft Sustainment: DOD Needs to Address Substantial Supply Chain Challenges*, GAO-19-321 (Washington, D.C.: Apr. 25, 2019).

F-35A Total Operating and Support Costs



Source: F-35 Joint Program Office. | GAO-21-101SP

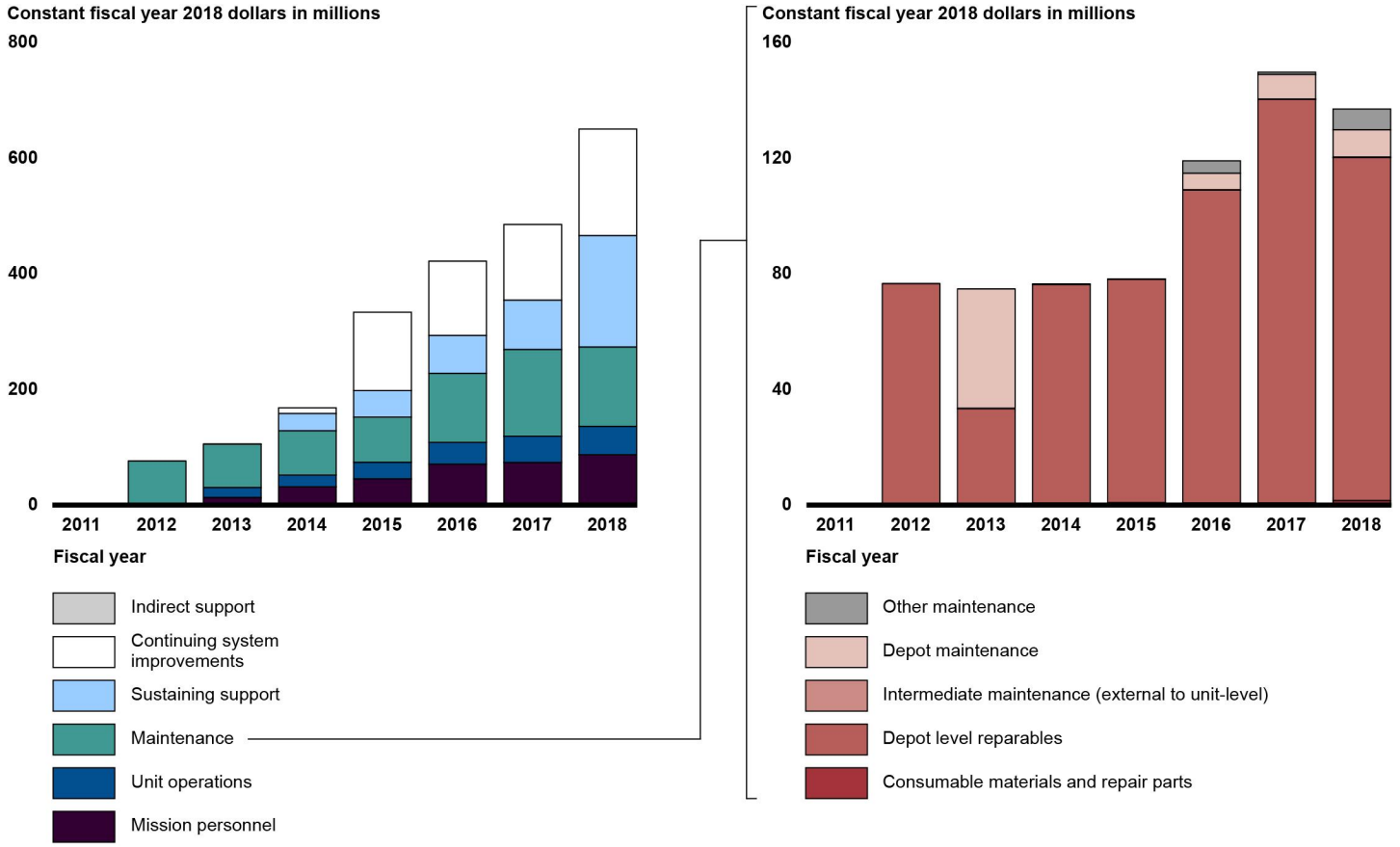
Data table for F-35A Total Operating and Support Costs (Constant fiscal year 2018 dollars in millions)

Fiscal year	Mission personnel	Unit operations	Maintenance	Sustaining support	Continuing system improvements	Indirect support
2011	22.81	6.9	15.76	0	4.77	5.35
2012	35.39	11.82	46.19	0.01	0.04	5.81
2013	71.75	14.98	47.22	2.79	55.39	28.43
2014	80.94	29.85	118.92	4.75	95.9	26.62
2015	128.01	55.29	191.46	7.12	187.92	31.42
2016	188.49	71.48	316.37	5.63	67.76	43.24
2017	261.08	113.54	498.11	11.04	109.83	42.92
2018	372.53	187.79	553.71	9.43	19.39	41.54

Fiscal year	Consumable materials and repair parts	Depot level reparables	Intermediate maintenance (external to unit-level)	Depot maintenance	Other maintenance	Interim contractor support	Contractor logistics support
2011	0.02	0	0	0.02	0	0	15.73
2012	0.06	0	0	0.08	0	0	46.04
2013	0.09	0	0	0.21	0	0	46.93
2014	0.25	0	0	0.45	0	0	118.22
2015	0.53	0.01	0	0.72	0	0	190.2
2016	1.12	0.03	0	0.84	0.03	0	314.34
2017	0.92	0.03	0	1.2	0.02	21.55	474.39
2018	1.65	0.13	0	1.39	0	24.23	526.31

Total O&S costs for the F-35B increased from $77.13 million in fiscal year 2012 to $651.13 million in fiscal year 2018, while total maintenance costs increased from $76.74 million to $137.18 million during this same time frame. Maintenance costs were steady from fiscal year 2012 through fiscal year 2015, then began to increase in fiscal year 2016. In fiscal year 2018, maintenance costs accounted for 21 percent of the total O&S costs for the F-35B.

F-35B Total Operating and Support Costs



Source: F-35 Joint Program Office. | GAO-21-101SP

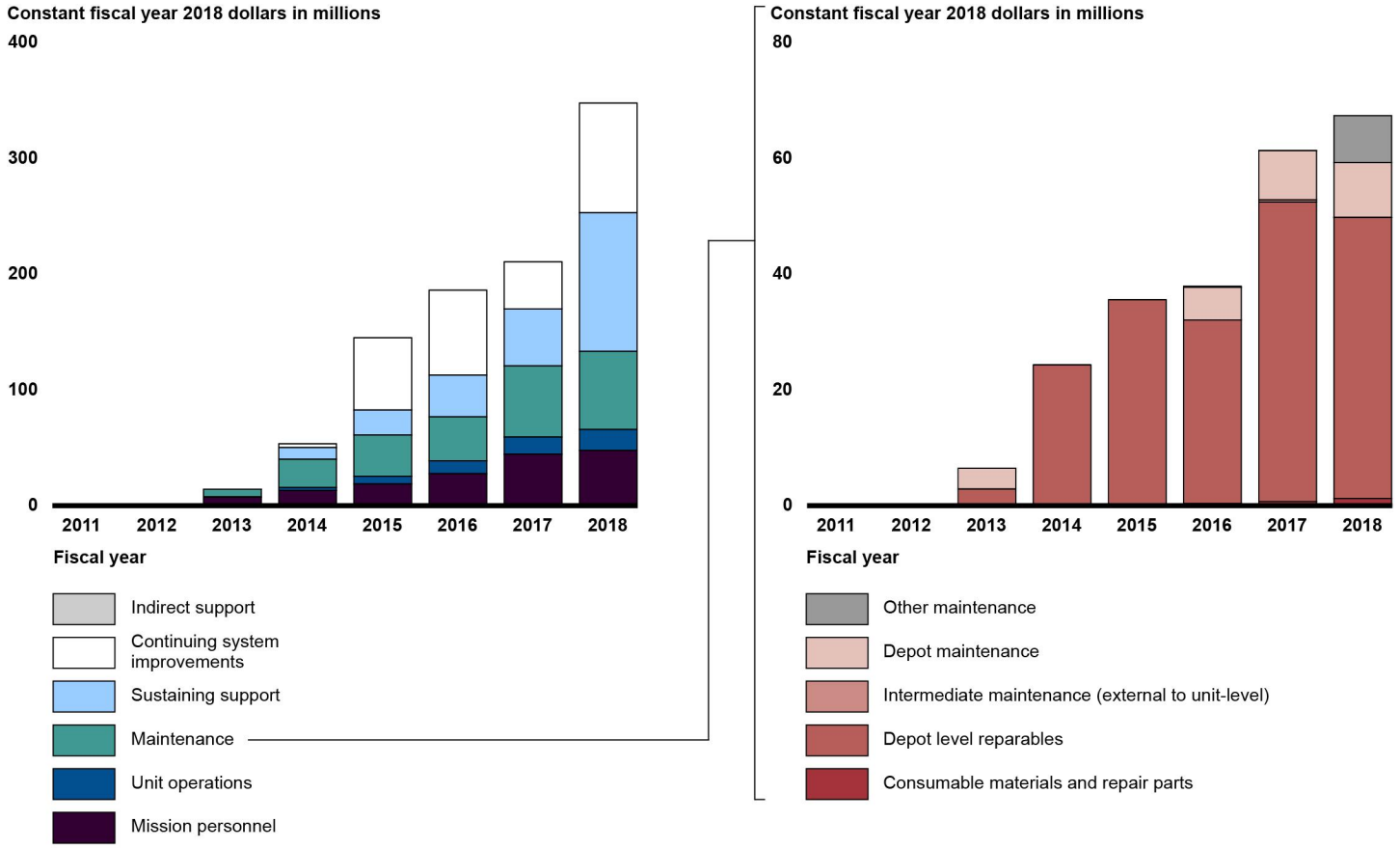
Data table for F-35B Total Operating and Support Costs (Constant fiscal year 2018 dollars in millions)

Fiscal year	Mission personnel	Unit operations	Maintenance	Sustaining support	Continuing system improvements	Indirect support
2011	0	0	0	0	0	0
2012	0.39	0	76.74	0	0	0
2013	13.83	17.31	74.95	0.23	0	0
2014	32.58	20.23	76.62	29.71	9.86	0
2015	46.03	28.71	78.41	45.75	135.61	0
2016	71.34	37.87	119.27	65.56	128.53	0
2017	74.32	45.72	149.93	85.25	130.85	0
2018	88.03	48.83	137.18	192.82	184.27	0

Fiscal year	Consumable materials and repair parts	Depot level reparables	Intermediate maintenance (external to unit-level)	Depot maintenance	Other maintenance
2011	0	0	0	0	0
2012	0	76.74	0	0	0
2013	0.46	33.02	0.15	41.32	0
2014	0.87	75.57	0.18	0	0
2015	1.03	77.22	0.17	0	0
2016	0.91	108.2	0.13	5.67	4.36
2017	0.91	139.56	0.14	8.5	0.83
2018	1.73	118.66	0.13	9.46	7.2

For the F-35C, total O&S costs have increased from $14.68 million in fiscal year 2013 to $348.10 million in fiscal year 2018. During this same time period, maintenance costs increased from $6.55 million to $67.46 million, though the percentage of total costs spent on maintenance decreased from 45 percent in fiscal year 2013 to 19 percent in fiscal year 2018.

F-35C Total Operating and Support Costs



Source: F-35 Joint Program Office. | GAO-21-101SP

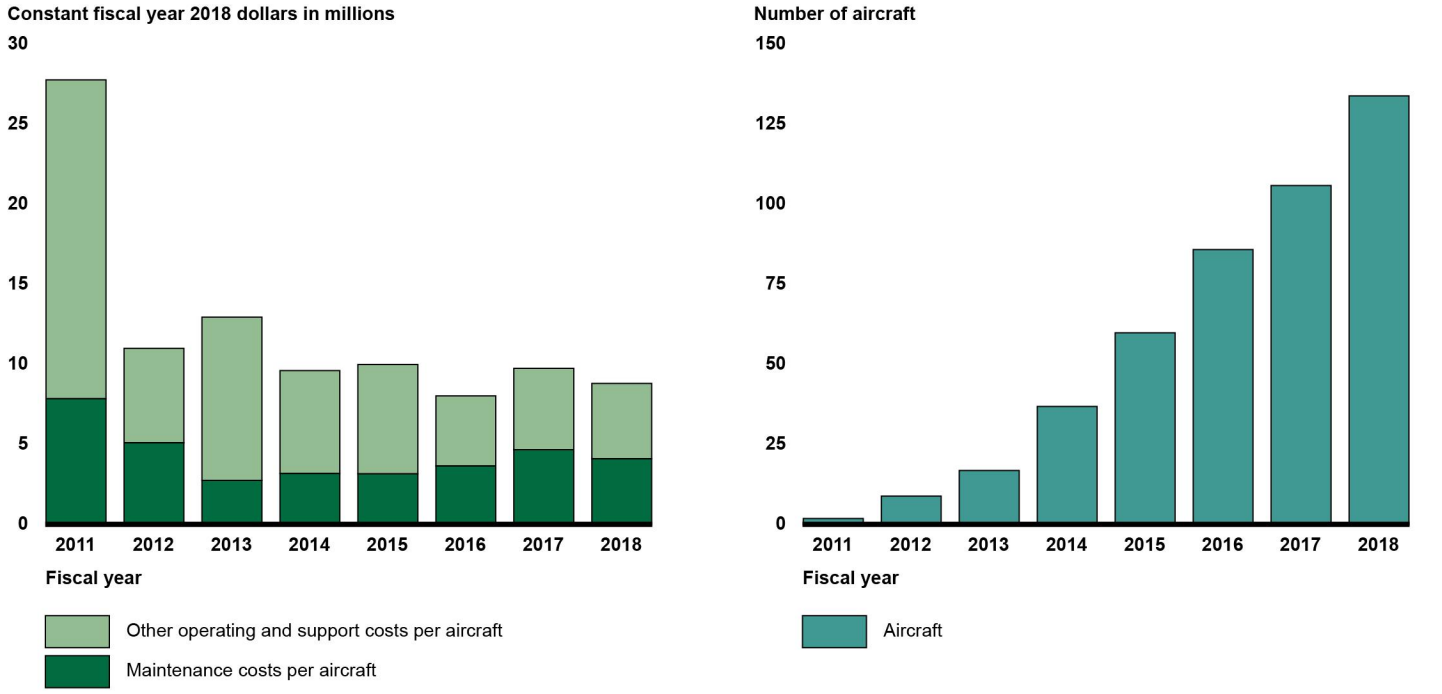
Data table for F-35C Total Operating and Support Costs (Constant fiscal year 2018 dollars in millions)

Fiscal year	Mission personnel	Unit operations	Maintenance	Sustaining support	Continuing system improvements	Indirect support
2011	0	0	0	0	0	0
2012	0	0	0	0	0	0
2013	7.92	0.19	6.55	0.02	0	0
2014	13.53	2.62	24.39	10.14	3.17	0
2015	19.23	6.61	35.66	21.61	62.31	0
2016	28.08	11.1	38	35.97	73.44	0
2017	44.98	14.74	61.45	49.22	40.68	0
2018	48.11	18.21	67.46	119.74	94.59	0

Fiscal year	Consumable materials and repair parts	Depot level reparables	Intermediate maintenance (external to unit-level)	Depot maintenance	Other maintenance
2011	0	0	0	0	0
2012	0	0	0	0	0
2013	0.09	2.87	0	3.59	0
2014	0.1	24.29	0	0	0
2015	0.18	35.48	0	0	0
2016	0.48	31.67	0	5.67	0.17
2017	0.81	51.71	0.39	8.5	0.03
2018	1.33	48.54	0.02	9.46	8.11

As the size of the fleet has grown, the total O&S cost per aircraft for the F-35 has decreased. Per aircraft total O&S costs for the F-35 fleet have decreased from $27.8 million in fiscal year 2011 to $9.93 million in fiscal year 2018. For the F-35A, total O&S costs per aircraft have decreased from $27.8 million in fiscal year 2011 to $8.84 million in fiscal year 2018. During this time period, the size of the F-35A fleet has increased from two to 134.

F-35A Operating and Support Costs per Aircraft and Fleet Size



Source: F-35 Joint Program Office. | GAO-21-101SP

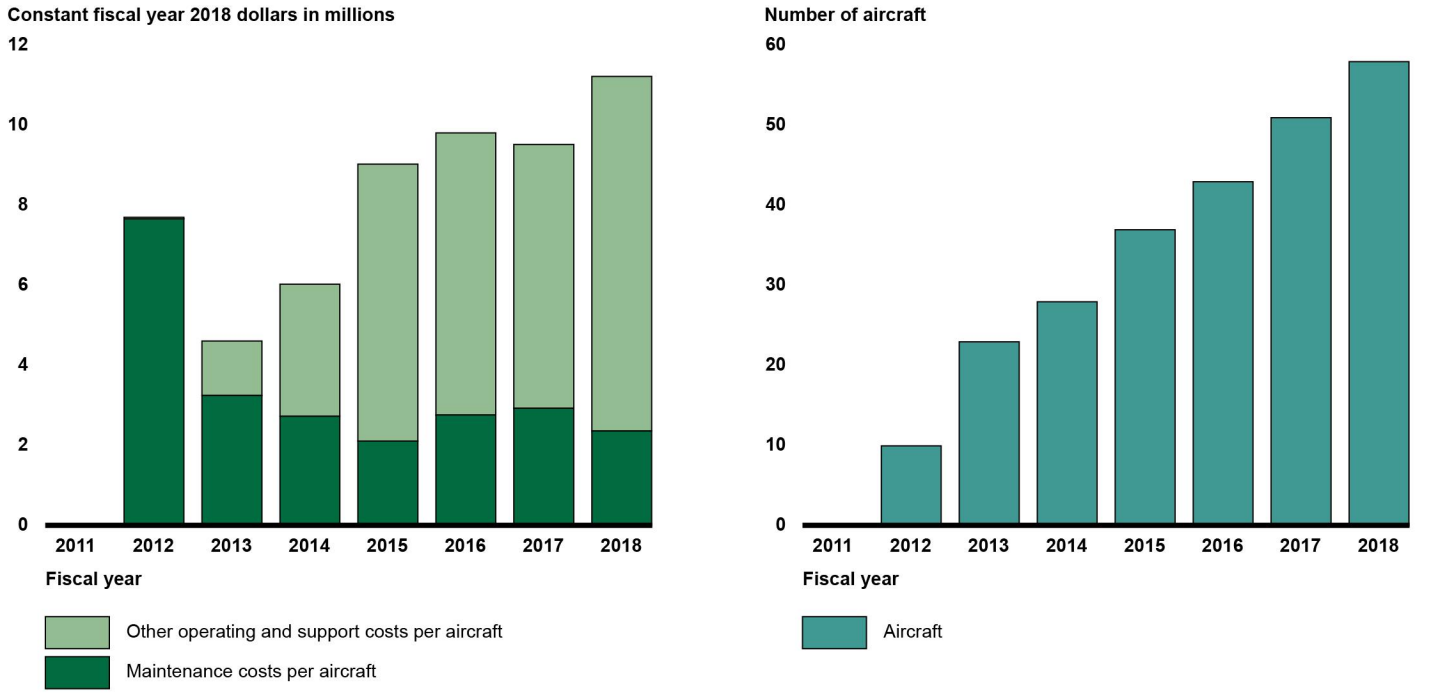
Data table for F-35A Operating and Support Costs per Aircraft and Fleet Size (Constant fiscal year 2018 dollars in millions)

Fiscal year	Maintenance costs per aircraft	Other operating and support costs per aircraft
2011	7.88	19.92
2012	5.13	5.9
2013	2.78	10.2
2014	3.21	6.43
2015	3.19	6.83
2016	3.68	4.38
2017	4.7	5.08
2018	4.13	4.71

Fiscal year	Number of aircraft
2011	2
2012	9
2013	17
2014	37
2015	60
2016	86
2017	106
2018	134

Per aircraft total O&S costs for the F-35B have increased from $7.71 million in fiscal year 2012 to $11.23 million in fiscal year 2018. During this same time period, the percentage of costs attributed to maintenance has changed from almost 100 percent in fiscal year 2012 to 21 percent in fiscal year 2018.

F-35B Operating and Support Costs per Aircraft and Fleet Size



Source: F-35 Joint Program Office. | GAO-21-101SP

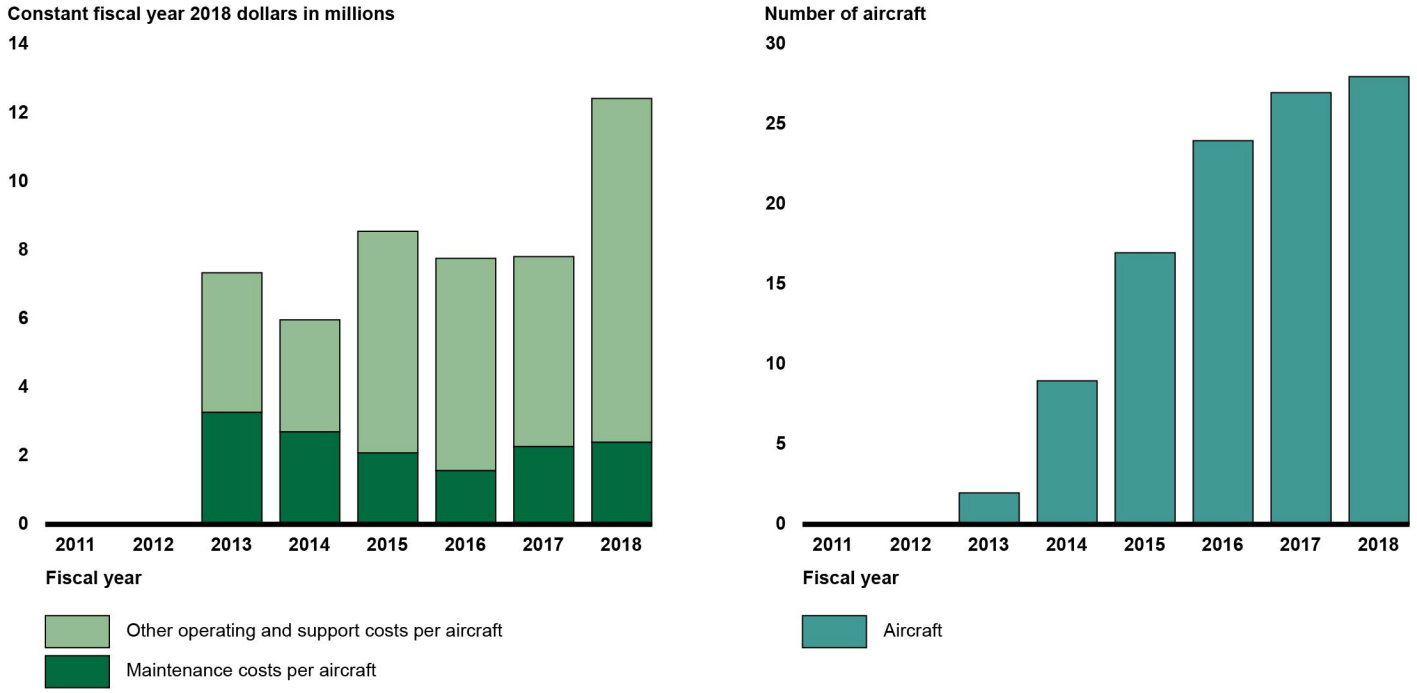
Data table for F-35B Operating and Support Costs per Aircraft and Fleet Size (Constant fiscal year 2018 dollars in millions)

Fiscal year	Maintenance costs per aircraft	Other operating and support costs per aircraft
2011	0	0
2012	7.67	0.04
2013	3.26	1.36
2014	2.74	3.3
2015	2.12	6.92
2016	2.77	7.05
2017	2.94	6.59
2018	2.37	8.86

Fiscal year	Number of aircraft
2011	0
2012	10
2013	23
2014	28
2015	37
2016	43
2017	51
2018	58

For the F-35C, per aircraft total O&S costs have increased from $7.34 million in fiscal year 2013, to $12.43 million in fiscal year 2018 while the number of aircraft have increased from two to 28 during this same time period.

F-35C Operating and Support Costs per Aircraft and Fleet Size



Source: F-35 Joint Program Office. | GAO-21-101SP

Data table for F-35C Operating and Support Costs per Aircraft and Fleet Size (Constant fiscal year 2018 dollars in millions)

Fiscal year	Maintenance costs per aircraft	Other operating and support costs per aircraft
2011	0	0
2012	0	0
2013	3.28	4.07
2014	2.71	3.27
2015	2.1	6.46
2016	1.58	6.19
2017	2.28	5.54
2018	2.41	10.02

Fiscal year	Number of aircraft
2011	0
2012	0
2013	2
2014	9
2015	17
2016	24
2017	27
2018	28

Challenges and Mitigation Actions

Supply: As we have previously reported, the F-35 has experienced spare parts shortages. In 2018, DOD had a repair backlog of about 4,300 F-35 parts. DOD is taking steps to address these issues such as improving timing of spare parts deliveries. In addition, DOD purchased certain parts in advance, but as the F-35 has been modified over time, these parts can no longer be used on the aircraft. For example, 44 percent of purchased parts were incompatible with aircraft the Marine Corps took on a recent deployment. Finally, DOD's networks for moving F-35 parts around the world are immature, and F-35 customers overseas have experienced long wait times for parts needed to repair aircraft. 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. We have made recommendations to DOD to improve these issues. DOD concurred and has identified several actions it is planning to take, including developing a process to modify spare parts packages to better match deploying aircraft, revising business rules to better prioritize scarce parts, and working with the contractor to provide better supply-related data.

Maintenance: In addition to parts shortages, DOD has limited capability to repair parts when they break. Specifically, as of April 2019, the F-35 program was failing to meet four of its eight reliability and maintainability targets—which determine the likelihood that the aircraft will be in maintenance rather than available for operations—including metrics related to part removals and part failures. For example, we previously reported that the special coating on the F-35 canopy that enables the aircraft to maintain its stealth had failed more frequently than expected, and that the manufacturer was unable to produce enough canopies to meet demands. These reliability challenges are exacerbated by DOD's limited capability to repair broken parts at the military depots. The capabilities to repair parts are currently 8 years behind schedule. DOD originally planned to have repair capabilities at the depots ready by 2016, but the depots will not have the capability to repair all parts at expected demand rates until 2024. As a result, the average time taken 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 as long as planned. According to the Joint Program Office, it has taken several steps to accelerate depot repair, including reducing the time it takes to activate a depot, aligning procurement and delivery of repair parts so that parts are available earlier, and initiating performance-based logistics contracts with original equipment manufacturers to incentivize performance and cost improvements.

Program Office Comments

The Joint Program Office provided technical comments, which we incorporated where appropriate.

Source: U.S. Marine Corps/Lance Cpl. Dalton Swanbeck. | GAO-21-101SP

AV-8B Harrier Sustainment Quick Look

Common Name: AV-8B

Lead Service: Marine Corps

Program Essentials

Manufacturers: McDonnell Douglas, British Aerospace, Boeing, BAE Systems

Sustainment: Depot maintenance conducted at Navy Fleet Readiness Centers and field maintenance conducted by Marine Corps maintainers

Program Office: Program Manager-Air 257, Naval Air Systems Command, Patuxent River, Maryland

Fiscal Year 2019 Data

Average age: 24.1 years

Average lifetime flying hours: 5,169 hours

Depot maintenance activity and squadron locations:

▲ Depot maintenance activity location

● Squadron location

Source: GAO. | GAO-21-101SP

Sustainment Challenges and Mitigation Actions

The AV-8B faces maintenance personnel and supply challenges. Actions to mitigate these challenges include upgrading components and developing other vendors for parts.

Background

The AV-8B Harrier is a vertical/short take-off and landing attack aircraft first manufactured in 1984. The AV-8B conducts close air support, intermediate range intercept, and attack missions. The AV-8B can deploy from aircraft carriers and other suitable seagoing platforms, as well as forward operating bases, expeditionary airfields, and remote landing sites.

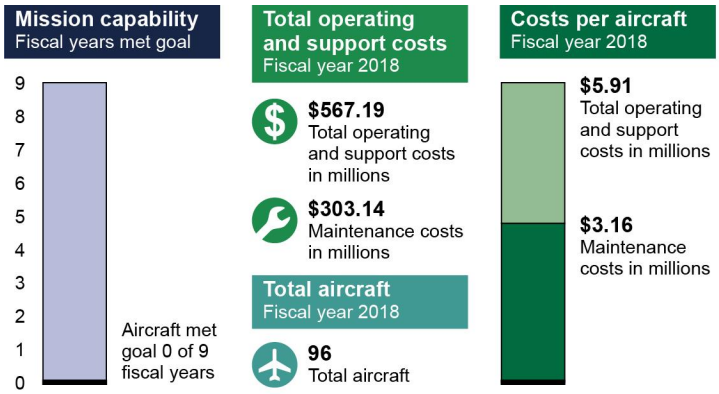
Life Cycle of the AV-8B

Source: GAO analysis of Navy data. | GAO-21-101SP

Overview

The AV-8B fleet did not meet any of its annual mission capable goals from fiscal years 2011 through 2019 and its mission capable rate decreased during the time period. According to program officials, this decrease was partly because of challenges in operations and maintenance planning due to wartime surges and an uncertain deployment schedule. Total operating and support (O&S) costs have generally decreased, from $832.66 million in fiscal year 2011, to $567.19 million in fiscal year 2018. All of the O&S cost categories decreased except sustaining support, partly because the inventory is decreasing as the Marine Corps transitions AV-8B squadrons to the F-35B Lightening II Joint Strike Fighter. In fiscal year 2018, about half of the total $5.91 million O&S costs per aircraft was for aircraft maintenance.

AV-8B Sustainment Status



Source: GAO analysis of Navy data. | GAO-21-101SP

Data table for AV-8B Sustainment Status

Mission capability	Aircraft met goal 0 of 9 fiscal years
Total operating and support costs in millions (FY18)	$567.19
Maintenance costs in millions (FY18)	$303.14
Total aircraft (FY18)	96
Total operating and support costs per aircraft in millions (FY18)	$5.91
Maintenance costs per aircraft in millions	$3.16

Sustainment Strategy

- The AV-8B was originally expected to remain in service through 2015, according to the AV-8B Logistics Program Plan (2016). However, the Marine Corps currently plans to keep the AV-8B in service through 2028. Changes in the length of service life have been partly the result of F-35B Joint Strike Fighter production delays, as sufficient numbers of the F-35Bs that are needed to replace the AV-8B fleet will not be available until years later than originally planned.
- The AV-8B is maintained at Navy Fleet Readiness Centers under planned maintenance intervals occurring at least every 1,500 flight hours. Supply support is provided by Naval Supply Systems Command and Defense Logistics Agency; contractor support services are provided by Boeing and BAE Systems.

Availability and Condition

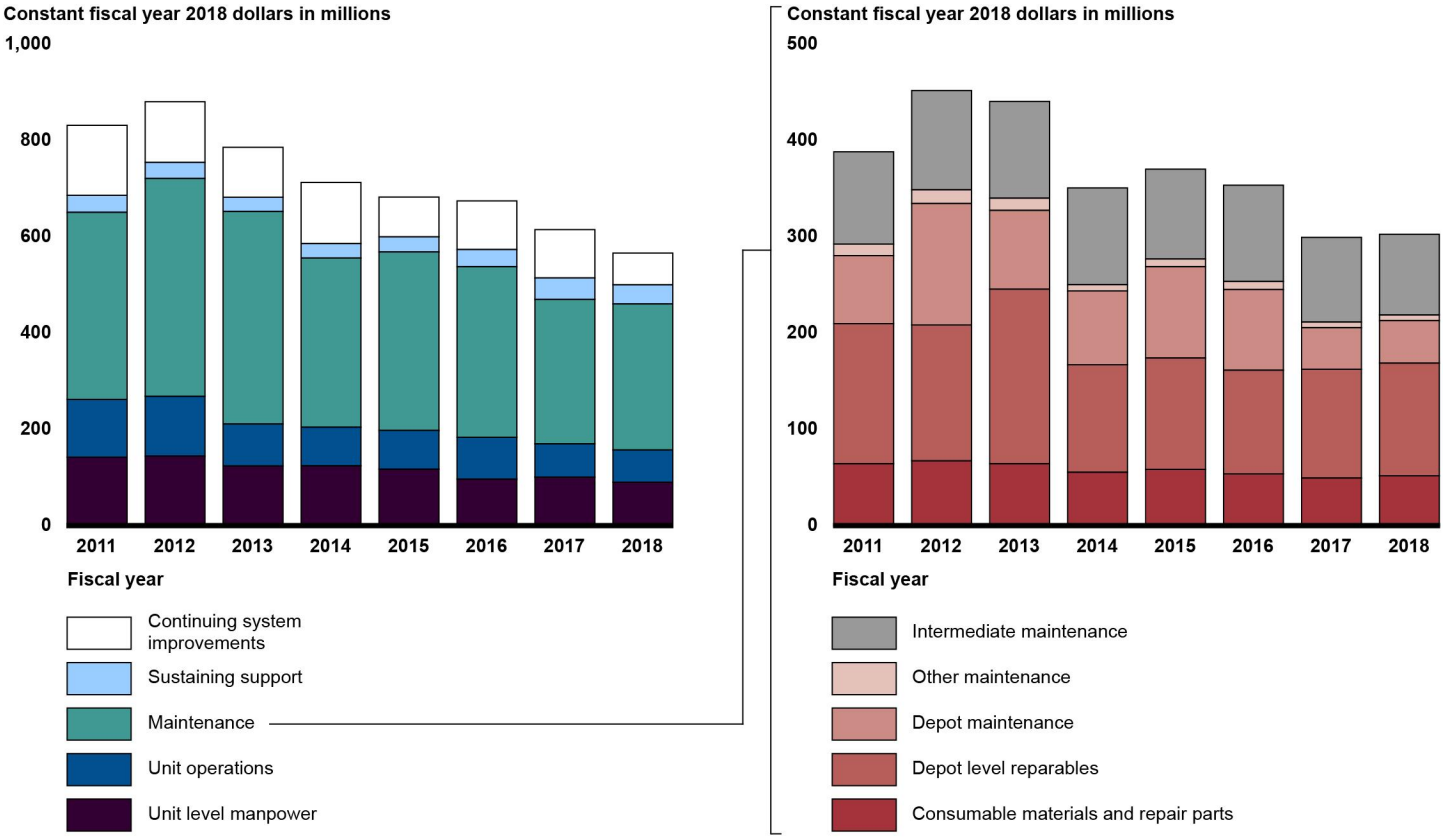
From fiscal year 2011 through fiscal year 2019, the AV-8B fleet missed all of its annual mission capable goals and its mission capable rate decreased during the time period.

The AV-8B fleet's rates increased for not mission capable maintenance (NMCM) and not mission capable supply (NMCS) from fiscal years 2011 through 2019, but the NMCS rate was only slightly higher at the end of the period. A Marine Corps Independent Readiness Review commissioned in fiscal year 2014 concluded that AV-8B maintenance personnel levels were unable to support the demands for labor, among other things. An AV-8B program official confirmed that there were still too few maintainers across the AV-8B fleet in fiscal year 2018 and also stated that there were more squadrons and aircraft currently in the inventory than expected. The official explained that, although two AV-8B squadrons had transitioned to F-35B squadrons, the number of AV-8B aircraft was not reduced. Also, several new systems and upgrades were added to the aircraft that further exacerbated the maintenance personnel issue, according to the program official. Program officials noted that increases in not mission capable rates were also partly because the program faced challenges in operations and maintenance planning due to combat surges from Operations Iraqi Freedom and Enduring Freedom and delays in the transition of the AV-8B squadrons' Pacific deployments to F-35 squadrons. Specific details on mission capable and not mission capable rates were omitted because the information was deemed by DOD to be sensitive.

Operating and Support Costs

The AV-8B fleet's total O&S costs decreased about $265 million—or 32 percent—from $832.66 million in fiscal year 2011, to $567.19 million in fiscal year 2018. Maintenance costs accounted for the largest share of the program's O&S costs, averaging about 51 percent of total costs from fiscal year 2011 through fiscal year 2018. Maintenance costs decreased during the 8-year time period, along with all of the other O&S cost categories except sustaining support. According to a program official, O&S costs decreased for several reasons. First, the Marine Corps operated 23 fewer AV-8Bs in 2018 than in 2011, partly due to the loss of six aircraft following the 2012 Camp Bastion attack in Afghanistan and the transition of two AV-8B squadrons to the F-35 Joint Strike Fighter. Second, the Marine Corps flew the AV-8B less following Operation Iraqi Freedom and Operation Enduring Freedom. Finally, total O&S costs decreased because of the use of the parts inventory from the GR-9 fleet, the United Kingdom's AV-8B equivalent, after it was purchased in 2011. Program officials stated that maintenance costs were higher in fiscal years 2012 and 2013 due to the reconstitution of aircraft from Operation Enduring Freedom and because of the parts that were replaced and repaired following the attack on Camp Bastion. The cost of depot-level reparables was the most significant contributor to maintenance costs, averaging about $129.16 million a year, or 35 percent of the total maintenance costs from fiscal year 2011 through fiscal year 2018. A program official noted that over 60 percent of AV-8B parts are repaired at Navy Fleet Readiness Centers. The other maintenance cost category accounted for the smallest share of maintenance costs, averaging about $9.18 million a year, or 2 percent of total maintenance costs during the same time period.

AV-8B Total Operating and Support Costs



Source: GAO analysis of Navy data. | GAO-21-101SP

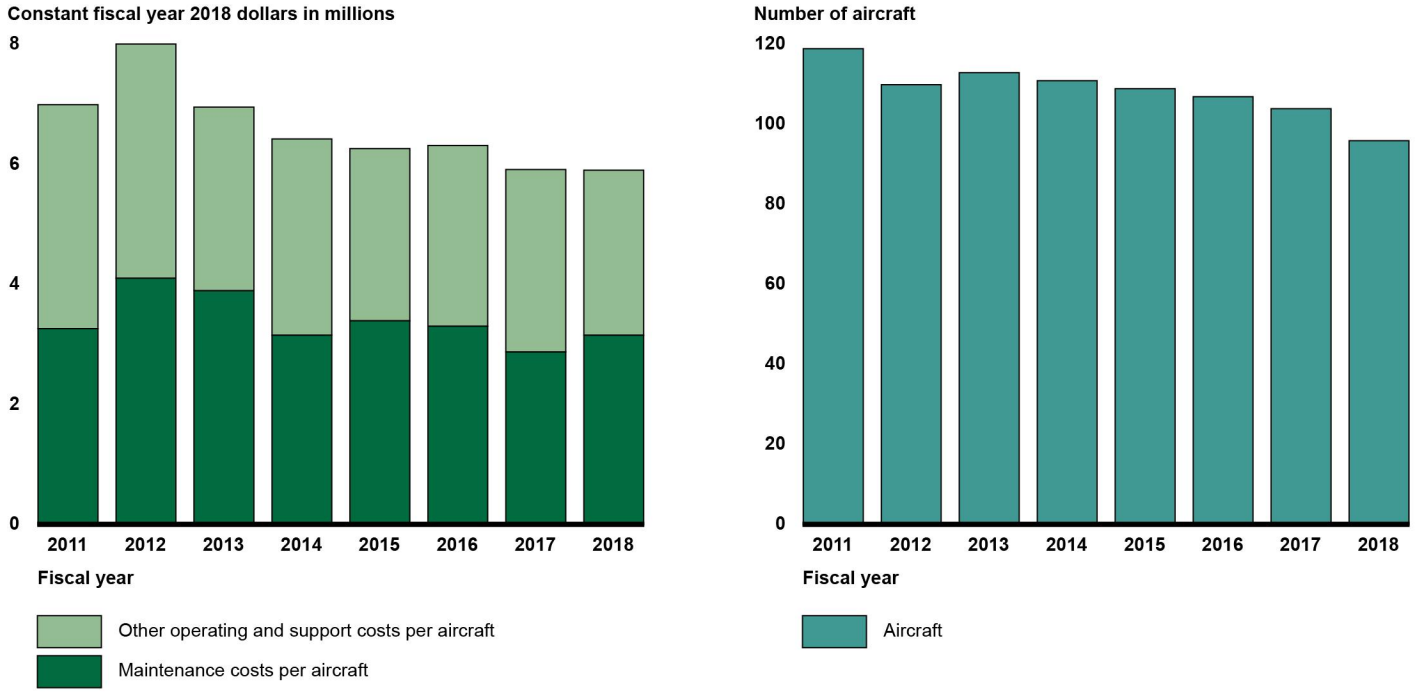
Data table for AV-8B Total Operating and Support Costs (Constant fiscal year 2018 dollars in millions)

Fiscal year	Unit level manpower	Unit operations	Maintenance	Sustaining support	Continuing system improvements
2011	143.16	120.01	388.77	35.44	145.28
2012	145.57	124.15	452.58	33.37	126.04
2013	124.93	87.5	441.23	29.57	103.89
2014	125.24	80.32	351.31	30.05	127.05
2015	118.2	80.63	370.88	31.3	82.76
2016	97.68	87.07	354.15	35.71	101.13
2017	102.15	68.97	299.92	44.46	100.58
2018	91.27	67.19	303.14	39.81	65.78

Fiscal year	Consumable materials and repair parts	Depot level reparables	Depot maintenance	Other maintenance	Intermediate maintenance
2011	64.77	145.57	70.58	12.02	95.84
2012	67.75	141.32	126.08	14.16	103.26
2013	64.86	181.34	81.83	12.64	100.56
2014	56.04	111.61	76.61	6.53	100.53
2015	58.98	115.71	94.74	8.02	93.43
2016	54.35	107.56	83.99	8.25	100
2017	49.98	113.07	43.05	5.97	87.85
2018	52.25	117.11	44.05	5.84	83.89

The number of AV-8B aircraft declined from 119 to 96 aircraft from fiscal year 2011 through fiscal year 2018. The total O&S costs per aircraft went down from about $8.02 million in fiscal year 2012, to about $5.91 million in fiscal year 2018. With the exception of fiscal years 2012, 2013, and 2017, the maintenance costs per aircraft has remained fairly steady, averaging about $3.40 million per aircraft.

AV-8B Operating and Support Costs per Aircraft and Fleet Size



Source: GAO analysis of Navy data. | GAO-21-101SP

Data table for AV-8B Operating and Support Costs per Aircraft and Fleet Size (Constant fiscal year 2018 dollars in millions)

Fiscal year	Maintenance costs per aircraft	Other operating and support costs per aircraft
2011	3.27	3.73
2012	4.11	3.9
2013	3.9	3.06
2014	3.17	3.27
2015	3.4	2.87
2016	3.31	3.01
2017	2.88	3.04
2018	3.16	2.75

Fiscal year	Number of aircraft
2011	119
2012	110
2013	113
2014	111
2015	109
2016	107
2017	104
2018	96

Sustainment Challenges and Mitigation Actions

Aging: Many AV-8B aircraft are operating beyond the planned service life of 6,000 flight hours, but program officials stated that assessments by the Marine Corps have determined that the aircraft are still able to operate. According to officials, the Marine Corps has several ongoing and planned actions to keep the AV-8B in service until it is replaced by the F-35B Joint Strike Fighter, including upgrading engine components and reassessing the life expenditure model based on actual flight profiles to make sure the aircraft can continue to meet Marine Corps mission needs.

Maintenance: The AV-8B required additional maintenance for unplanned repairs due to the system's aging airframe, maintenance activities taking longer to perform, and the AV-8B's vulnerability to foreign-object damage due to the aircraft's design and its operating locations. Also, according to Marine Corps officials, there is a shortage of AV-8B-specific maintenance personnel because of the previous expected transition to the F-35. These officials stated that the Marine Corps' ongoing and planned actions include identifying all parts and components that need to be repaired and replaced during the inspection phase, keeping up with maintenance schedules, conducting analyses on major components and upgrading as needed, and increasing awareness of maintainers and other personnel to mitigate foreign-object damage. Program officials also noted that depot, contractor, and field maintainers are coordinating efforts at Fleet Readiness Centers to reduce the time needed for disassembly and reassembly processes to reduce maintenance backlogs.

Supply Support: The AV-8B experienced shortages of parts that suppliers are no longer producing. The Marine Corps' ongoing and planned actions, according to officials, include developing additional vendor sources, hardware and software upgrades, the removal of parts from damaged aircraft for use on operating aircraft once the parts have been inspected and approved for use, and continuing engineering analysis to identify items that can be used from the purchase of the United Kingdom's GR-9 equivalent of the AV-8B.

Program Office Comments

In commenting on a draft of this assessment, the program office provided technical comments, which were incorporated where appropriate. Also, officials noted the following: In fiscal year 2019, six AV-8B aircraft were placed in preservation on the flight line and four aircraft were recommended for the Stricken Aircraft Reclamation and Disposal Program, reducing the number of in-reporting aircraft from 16 to 14 per squadron. Also, while the material procured from the United Kingdom's GR-9 fleet has had a measurable effect on AV-8B supply support and the NMCS rate over the period addressed in this report, it is not expected that the availability of material remaining will guarantee similar results for the next 9 years until the planned sunset year. Therefore, the continued identification and development of vendors and repair sources in the continental United States and the United Kingdom are critical, as well as a comprehensive contractor logistic support strategy to enhance the ability of the AV-8B to maintain relevance, meet deployment requirements, and successfully achieve the out-of-service date.

Source: U.S. Air Force/Tech. Sgt. Paul Labbe. | GAO-21-101SP

A-10 Thunderbolt II Sustainment Quick Look

Common Name: A-10

Lead Service: Air Force

Program Essentials

Manufacturer: Fairchild Republic Company

Sustainment: Depot maintenance conducted by the Air Force at Ogden Air Logistics Complex, Utah, and by a contractor overseas; field maintenance performed by Air Force maintainers

Program Office: Hill Air Force Base, Utah

Fiscal Year 2019 Data

Average age: 39 years

Average lifetime flying hours: 11,625 hours per aircraft

Depot maintenance activity and squadron locations:

Source: GAO. | GAO-21-101SP

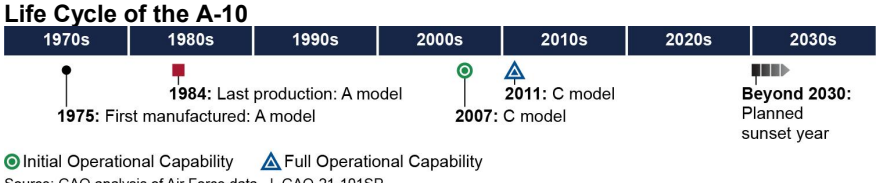
Sustainment Challenges and Mitigation Actions

The A-10 faces aging and maintenance challenges. Mitigation actions include purchase of new wings, a Central Interface Control Unit refresh, and the use of reliability centered maintenance.

Background

The A-10 Thunderbolt II was first manufactured in 1975 and is expected to remain in service through at least 2030. The A-10 is a single-seat aircraft specifically designed for close air support and defeating enemy armor. The A-10 is maneuverable at low speeds and altitude and can carry a variety of conventional munitions. The aircraft's wide combat radius and short takeoff and landing capability permit operations near the front lines.

Life Cycle of the A-10

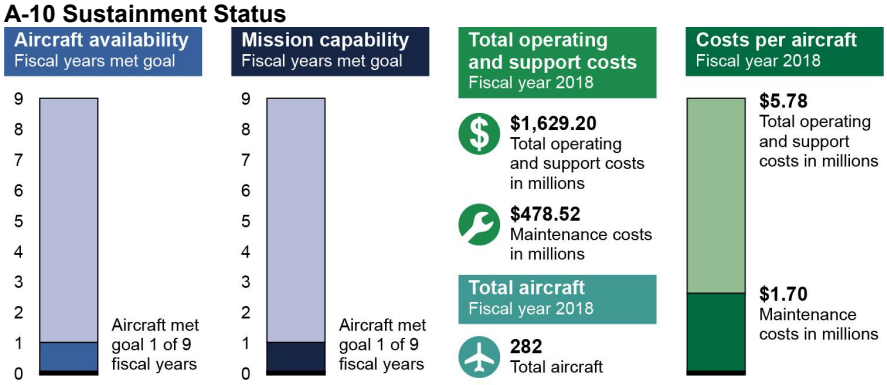


Source: GAO analysis of Air Force data. | GAO-21-101SP

Overview

From fiscal years 2011 through 2019, the A-10 fleet met its aircraft availability and mission capability goals in one of the 9 years. The A-10's aircraft availability rate increased slightly and its mission capability rate was less than one percentage point higher in fiscal year 2019 than it was in fiscal year 2011. Total operating and support costs (O&S) for the A-10 fleet decreased from about $2.22 billion in fiscal year 2011 to about $1.63 billion in fiscal year 2018—a decrease of about $588 million over this period. According to Air Force officials, this decrease was largely due to the retirement of 61 high-hour aircraft, resourcing decisions made as a result of the Air Force's proposed—but not congressionally approved—divestiture of the entire A-10 fleet, and the temporary removal of 18 aircraft from service that was also due to resourcing decisions. Further, total O&S costs per aircraft decreased from $6.41 million in fiscal year 2011 to $5.78 million in fiscal year 2018.

A-10 Sustainment Status



Source: GAO analysis of Air Force data. | GAO-21-101SP

Data table for A-10 Sustainment Status

Aircraft availability	Aircraft met goal 1 of 9 fiscal years
Mission capability	Aircraft met goal 1 of 9 fiscal years
Total operating and support costs in millions (FY18)	$1,629.20
Maintenance costs in millions (FY18)	$478.52
Total aircraft (FY18)	282
Total operating and support costs per aircraft in millions (FY18)	$5.78
Maintenance costs per aircraft in millions	$1.70

Sustainment Strategy

- The A-10's Life-Cycle Sustainment Plan (2014) states that the Air Force performs depot inspections and repair of the A-10 air vehicle and engine, with the exception of Pacific Air Forces aircraft, which receive programmed depot maintenance and modifications under a contract with Korea Air Lines. The supply chain is managed by the Air Force's 448th Supply Chain Management Wing and the Defense Logistics Agency.
- Programmed depot maintenance is performed on a 5 to 14-year cycle depending on the amount and type of flight hours flown by each A-10 aircraft, according to an Air Force official.

Availability and Condition

From fiscal year 2011 through 2019, the A-10 fleet fell short of its annual aircraft availability and mission capable goals each year except one. The A-10's aircraft availability and mission capable rate increased slightly from fiscal years 2011 through 2019. Both of these rates were higher by varying amounts during the time period. Air Force officials said that the availability rate fluctuations were largely based on changes in depot inductions due to the retirement of 61 A-10s in fiscal years 2013 and 2014 and the service's proposals in fiscal years 2015 through 2017 to divest the entire A-10 fleet.[2] Additionally, in fiscal years 2016 and 2017, the Air Force temporarily removed 18 aircraft from service. According to Air Force officials, the mission capable rate variations were due, in part, to traditional aging aircraft concerns and resource decisions tied to the proposed divestiture.

From fiscal years 2011 through 2019, the A-10's rates for not mission capable maintenance and not mission capable both maintenance and supply decreased slightly and it's not mission capable supply rate increased slightly. Specific details on mission capable and not mission capable rates were omitted because the information was deemed by DOD to be sensitive.

Operating and Support Costs

From fiscal years 2011 through 2018, the A-10's total O&S costs decreased from $2.22 billion to $1.63 billion. According to Air Force officials, this decrease was due to many reasons, including:

- The Air Force reduced the A-10 fleet by retiring 61 high flying hour aircraft in fiscal years 2013 and 2014.
- In fiscal years 2015 through 2017, the Air Force proposed that an entire A-10 fleet be divested. Although the fleet divestiture was not approved by Congress, the Air Force reduced the amount of funds that were programmed for sustaining support and continuing system improvements. This included canceling additional investments in new wings.
- The Air Force temporarily removed 18 aircraft from service in late fiscal year 2015 through fiscal year 2017 and reallocated personnel and resources to other priority Air Force needs.

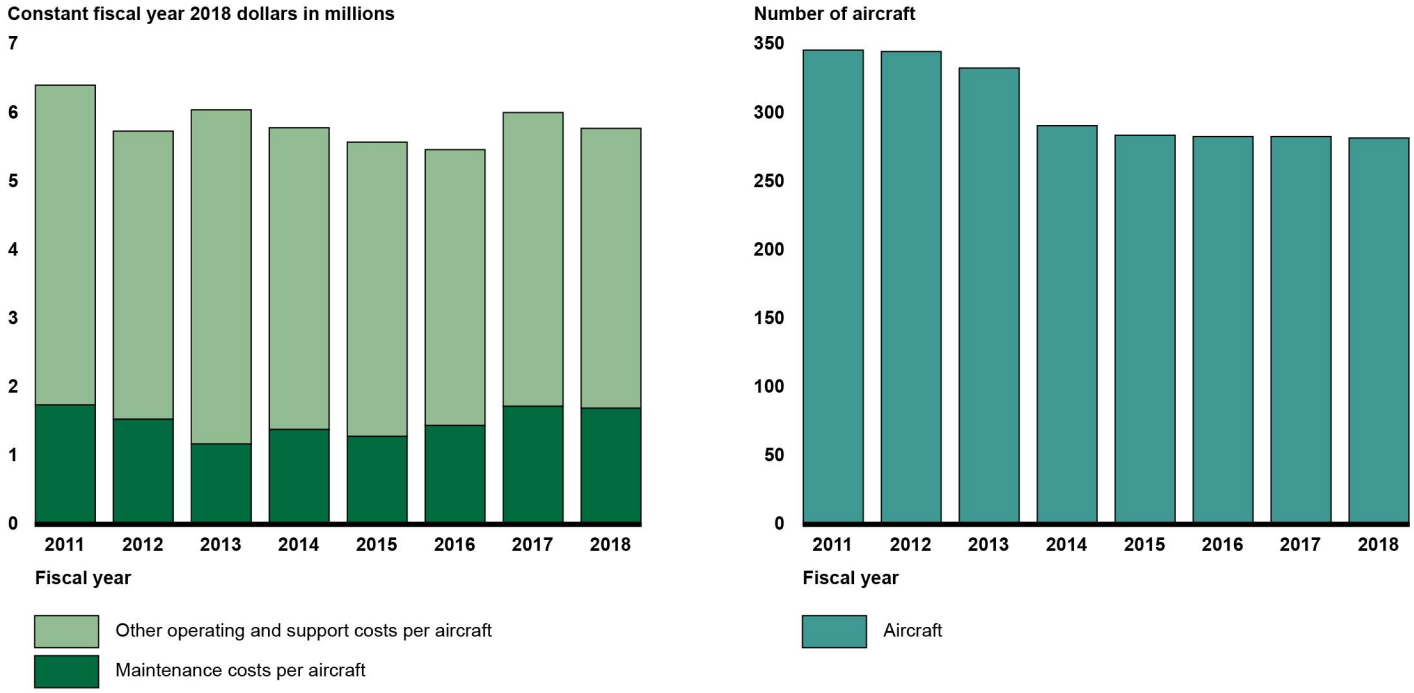
Although maintenance costs also decreased during the time period, these costs increased in fiscal years 2017 and 2018 from a low in fiscal year 2016. According to officials, depot maintenance costs increased as a result of the aircraft with older wings that were more costly to maintain. (At the end of fiscal year 2018, they said that 164 aircraft had received new wings.) Also, officials said that depot maintenance costs increased due to a rise in depot inductions after substantial funding cuts were made in fiscal year 2015 due to the proposed divestiture. While O&S costs decreased from fiscal years 2011 through 2018, aircraft availability and mission capable rates fluctuated. Officials stated that O&S costs can have a significant effect on aircraft availability. For example, they said that during years when a divestiture is proposed, investment in depot maintenance is often reduced, resulting in fewer aircraft being inducted, which can significantly improve the aircraft availability rate because more aircraft are available for operations and training since they are not in depot maintenance. According to the officials, this occurred in fiscal years 2012 and 2015.

A-10 Total Operating and Support Costs

From fiscal years 2011 through 2018, the A-10's total O&S costs per aircraft decreased from $6.41 million to $5.78 million and maintenance costs per aircraft decreased from $1.75 million to $1.70 million per aircraft. During the same time frame, the total A-10 fleet size decreased from 346 to 282, or by 64 aircraft.

[2]GAO, *Force Structure: Better Information Needed to Support Air Force A-10 and Other Future Divestment Decisions*, GAO-16-816 (Washington, D.C.: Aug. 24, 2016). GAO found, among other things, that DOD and the Air Force did not have quality information on the full implications of A-10 divestment, including gaps that could be created by A-10 divestment and mitigation options.

A-10 Operating and Support Costs per Aircraft and Fleet Size



Source: GAO analysis of Air Force data. | GAO-21-101SP

Data table for A-10 Operating and Support Costs per Aircraft and Fleet Size (Constant fiscal year 2018 dollars in millions)

Fiscal year	Unit level manpower	Unit operations	Maintenance	Sustaining support	Continuing system improvements	Indirect support
2011	804.75	417.23	604.45	51.68	250.77	88.65
2012	818.47	458.76	530.77	40.02	44.81	88.55
2013	777.24	452.62	393.66	32.18	271.64	87.9
2014	741.74	400.05	403.16	35.22	14.49	89.39
2015	696.41	379.58	367.74	26.89	30.14	84.31
2016	645.77	333.34	410.41	35.52	46.87	76.63
2017	654.16	391.72	488.36	39.49	63.65	62.46
2018	662.64	353.9	478.52	45.54	24.92	63.67

Fiscal year	Consumable materials and repair parts	Depot level reparables	Depot maintenance	Other maintenance	Interim contractor support	Contractor logistics support
2011	110.87	359.96	118.16	0.02	0	15.43
2012	90.43	306.97	108.77	0	0	24.6
2013	70.87	213.46	87.41	1.42	0	20.49
2014	70.3	169.42	129.41	0.43	0.31	33.28
2015	73.06	181.63	95.73	0.04	0	17.28
2016	78.05	173.53	129.39	0.06	0	29.38
2017	92.89	180.55	186.96	0.04	0	27.91
2018	84.73	152.22	227.07	0	0	14.5

Sustainment Challenges and Mitigation Actions

Aging: According to officials, most aging-related challenges facing the A-10 involve the aircraft's structure, including the wings, fuselage, and flight controls. Examples of mitigation plans include the purchase of new A-10 wings to address economic repair and service-life requirements; completion of permanent fuselage repairs during programmed depot maintenance to affordably reach warfighter service-life targets; and redesign of critical components like the Central Interface Control Unit—which integrates aircraft functions and capabilities—to improve reliability.

Maintenance: Maintenance challenges are often tied to aging, supply support and related issues that typically manifest themselves in greater investments of time and resources to complete critical tasks such as phase inspections and gun and engine maintenance. A-10 program officials stated that they attempt to continuously improve the risk-based scheduling of aircraft for depot inductions in order to safely and cost-effectively expand the programmed depot maintenance intervals. On average, program officials report that these efforts have increased the time between programmed depot maintenance inductions by 750 hours per aircraft. Additionally, program officials said they have an active reliability centered maintenance program that began in fiscal year 2017 and they expect this program to increase the number of hours in the A-10 inspection cycle between inspections by 100 (from 500 to 600 hours) starting in fiscal year 2020. Prior reliability centered maintenance efforts reduced the total number of maintenance work hours for recurring inspections by over 100,000 hours from fiscal year 2008 through fiscal year 2014, according to officials.

Supply Support: The A-10 program office stated that supply support has been a challenge for the A-10. In particular, the A-10 has experienced issues associated with diminishing manufacturing sources, raw material availability, reliability degradation of parts, and unforeseen, one-off issues related to a particular part. To mitigate these supply issues, the A-10 program office and its Air Force and Defense Logistics Agency supply chain partners have taken various actions, including end-of-life buys, incentivized contracts, redesigns of existing parts, and the design and procurement of new parts incorporating more modern components.

Program Office Comments

In commenting on a draft of this assessment, the program office provided technical comments, which we incorporated where appropriate. Further, the program office reiterated that, since fiscal year 2011, the A-10 has experienced significant turbulence and uncertainty tied to actual and proposed divestitures and the entire Air Force A-10 enterprise and its industry partners have worked to mitigate impacts and maximize aircraft availability and mission capable rates. Officials said that sustainment challenges are expected to persist through fiscal year 2023 when significant investments in new wings and an improved Central Interface Control Unit will recapitalize the fleet, and prepare it for operations into the 2030s.

Source: U.S. Air Force/Senior Airman Zachary Bumpus. | GAO-21-101SP

F-15C/D Eagle Sustainment Quick Look

Common Name: F-15C/D

Lead Service: Air Force

Program Essentials

Manufacturer: McDonnell Douglas (acquired by Boeing)
Sustainment: Depot maintenance conducted at Warner Robins Air Logistics Complex, Georgia, and Korean Air Lines, Gimhae Korea; field maintenance performed by Air Force maintainers and contractors at overseas locations
Program Office: Robins Air Force Base, Georgia

Fiscal Year 2019 Data

Average age: 35 years
Average lifetime flying hours: 8,558 hours per aircraft
Depot maintenance activity and squadron locations:

Source: GAO. | GAO-21-101SP

Sustainment Challenges and Mitigation Actions

The F-15C/D faces challenges with aging, increased maintenance, and decreased supply parts. Mitigation actions include extending its service life, and working with the Defense Logistics Agency to improve parts availability.

Background

The F-15C/D Eagles are all-weather, maneuverable, tactical single-seat fighters (F-15C) and two-seat fighters (F-15D) designed to perform air-to-air combat missions. The F-15 C/D has electronic systems and weaponry to detect, acquire, track and attack enemy aircraft while operating in friendly or enemy-controlled airspace. The F-15C/D models were last produced in 1989.

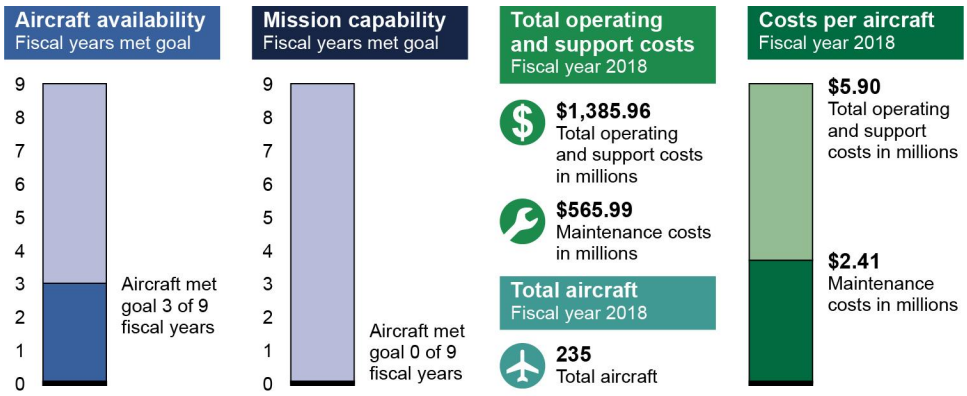
Life Cycle of the F-15C/D

Source: GAO analysis of Air Force data. | GAO-21-101SP

Overview

The F-15C/D fleet met or exceeded its aircraft availability goals for 3 of the 9 fiscal years from fiscal years 2011 through 2019, but did not meet any of its annual mission capable goals. The F-15C/D's aircraft availability rate and mission capable rate both increased during the time period. Total operating and support (O&S) costs decreased from about $1.88 billion in fiscal year 2011 to about $1.39 billion in fiscal year 2018 due to significant decreases in unit operations and indirect support costs over this period. As a result, the annual O&S costs per aircraft decreased from $7.53 million to $5.90 million over the time period. Further, in fiscal year 2018, maintenance costs per aircraft accounted for about 41 percent of the total O&S costs per aircraft.

F-15C/D Sustainment Status



Source: GAO analysis of Air Force data. | GAO-21-101SP

Data table for F-15C/D Sustainment Status

Aircraft availability	Aircraft met goal 3 of 9 fiscal years
Mission capability	Aircraft met goal 0 of 9 fiscal years
Total operating and support costs in millions (FY18)	$1,385.96
Maintenance costs in millions (FY18)	$565.99
Total aircraft (FY18)	235
Total operating and support costs per aircraft in millions (FY18)	$5.90
Maintenance costs per aircraft in millions	$2.41

Sustainment Strategy

- The F-15 program office has implemented a strategy for addressing aircraft modifications that primarily consists of implementing major modifications during programmed depot maintenance at Warner Robins Air Logistics Complex and at Korean Air Lines, for aircraft located at Kadena Air Base, Japan.
- The F-15 Program Office has developed and begun to implement an aircraft availability improvement plan that includes several initiatives. For example, in order to increase the number of aircraft available to squadrons for training and operations, the program office has an ongoing effort to reduce the number of F-15C/D aircraft in programmed depot maintenance. The program office is also working to improve the reliability and maintainability of key components, such as the integrated drive generator that generates electrical power for the aircraft.
- According to program officials, the Air Force has changed the planned retirement date of the F-15C/D fleet several times—currently the sunset year is 2045. It has also changed the number of F-15C/Ds that would be retired as the Air Force's overall force-structure requirements have changed. Officials also noted that this uncertainty about the future size of the fleet makes it difficult to plan the procurement of spare parts and the repair and overhaul of the aircraft and its components.

Availability and Condition

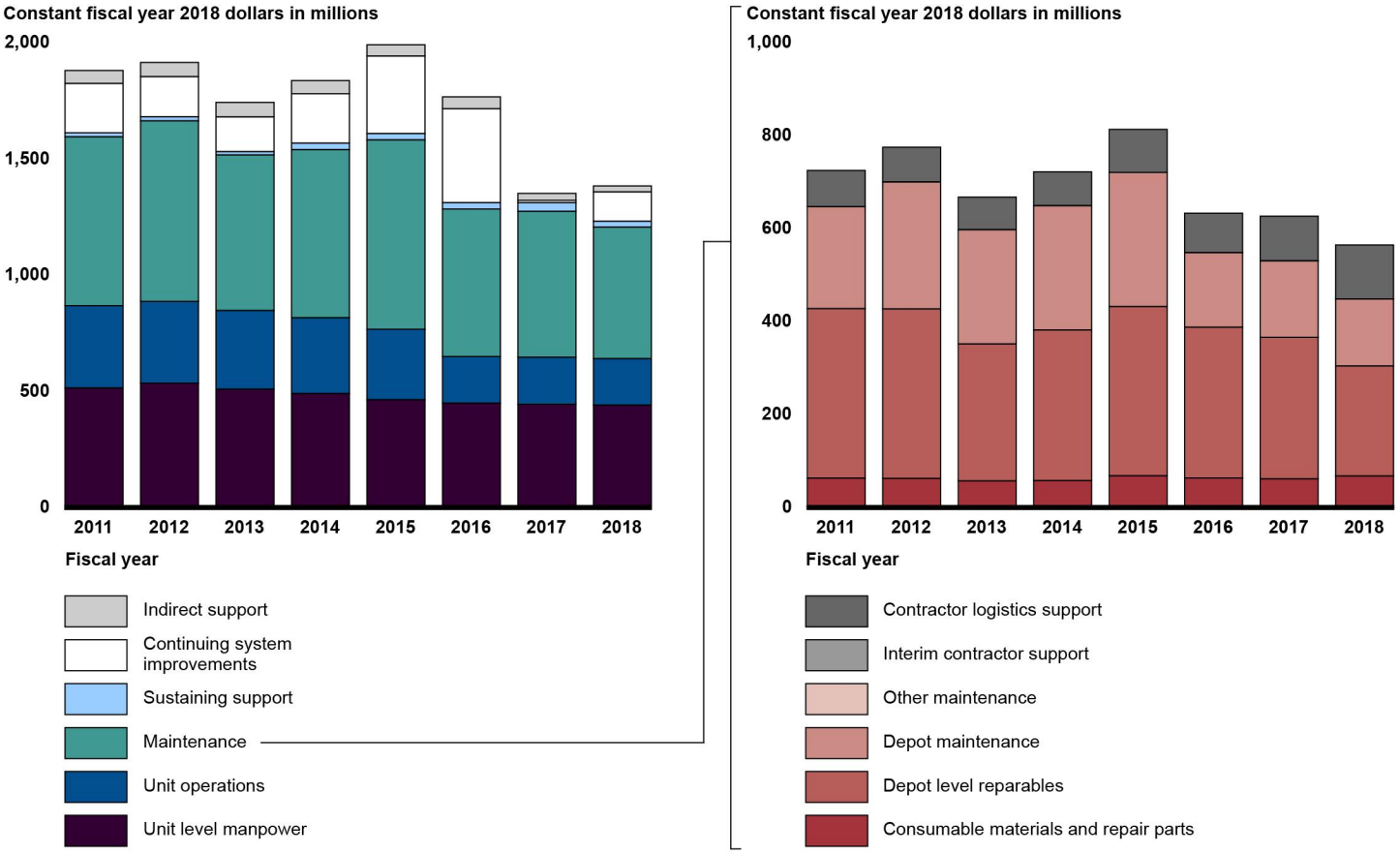
(FOUO) The F-15C/D fleet met or exceeded its aircraft availability goals for 3 of the 9 fiscal years from fiscal year 2011 through fiscal year 2019, but it did not meet its mission capable goals for any of those years. The F-15C/D's aircraft availability rate and mission capable rate both increased during the time period. According to program officials, the aircraft availability and mission capable rates were at their lowest in fiscal year 2011 due to F-15C/D manning challenges as avionics trained technicians shifted to maintaining the F-22 fleet, reductions in the F-15C/D combat air force fleet—including transfers to the Air National Guard—and radar upgrades that increased unscheduled maintenance downtime.

From fiscal year 2011 through fiscal year 2019, the rates decreased for not mission capable maintenance (NMCM), not mission capable supply (NMCS) and not mission capable both (NMCB) maintenance and supply, but the NMCS and NMCB rates decreased only slightly. The NMCM rate was the largest factor affecting the mission capability of the F-15C/D fleet during this time frame and was the highest in fiscal year 2011 due to validation requirements for cracks in the longeron (i.e., a longitudinal structural component of an aircraft's fuselage), which increased unscheduled maintenance hours, and contributed to the manning challenges and combat air fleet reductions discussed above. Specific details on mission capable and not mission capable rates were omitted because the information was deemed by DOD to be sensitive.

Operating and Support Costs

Total O&S costs for the F-15C/D fleet decreased from about $1.88 billion in fiscal year 2011 to about $1.39 billion in fiscal year 2018 in part due to a reduction in the size of the F-15C/D fleet over the timeframe. According to officials, the largest driver of O&S costs has been depot-level reparables and consumable parts, which have had the most direct impact to aircraft availability and mission capable rates. Officials also stated that the majority of fluctuations in depot maintenance costs can be attributed to rate changes in the working capital fund. Officials added that any variations to these numbers can and most likely will impact the rate (i.e., price) charged from year to year by the Warner Robins Air Logistics Complex for conducting depot maintenance.

F-15C/D Total Operating and Support Costs Compared



Source: GAO analysis of Air Force data. | GAO-21-101SP

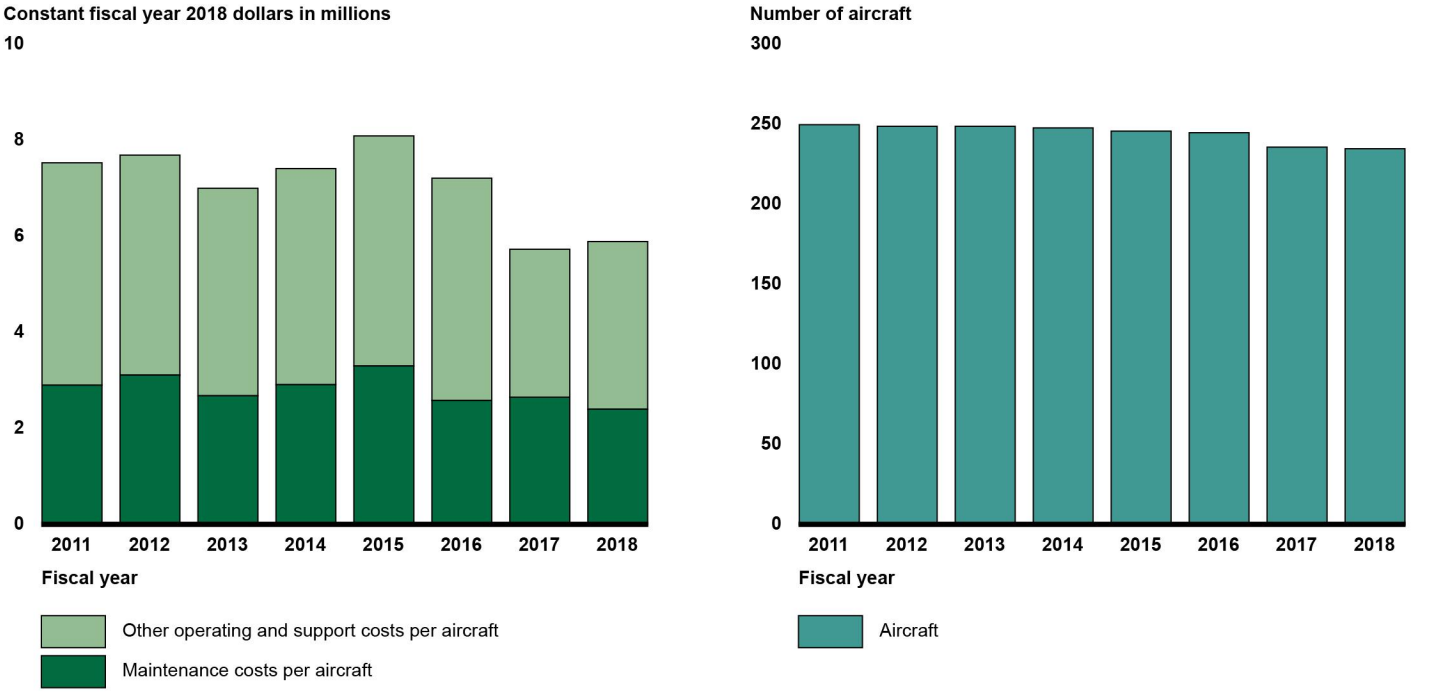
Data table for F-15C/D Total Operating and Support Costs Compared (Constant fiscal year 2018 dollars in millions)

Fiscal year	Unit level manpower	Unit operations	Maintenance	Sustaining support	Continuing system improvements	Indirect support
2011	516.69	354.14	726.34	17.23	211.98	56.46
2012	537.25	352.26	776.17	17.67	172.66	61.02
2013	511.32	338.8	668.91	14.48	148.92	63.17
2014	492.83	326.12	723.2	27.61	212.67	56.57
2015	466.26	303.02	814.65	27.56	333.24	48.54
2016	451.35	200.72	634.4	27.44	403.82	51.59
2017	446.56	202.09	627.82	37.44	10.14	30.18
2018	442.45	199.89	565.99	25.44	126.08	26.11

Fiscal year	Consumable materials and repair parts	Depot level reparables	Depot maintenance	Other maintenance	Interim contractor support	Contractor logistics support
2011	64.28	364.75	219.39	0	0	77.92
2012	63.73	364.57	273	0	0	74.87
2013	58.16	294.97	245.56	0	0	70.22
2014	58.84	324.23	267.1	0	0	73.02
2015	69.42	363.81	288.59	0	0	92.83
2016	64.66	324.47	160.04	0.07	0	85.16
2017	62.57	304.7	164.48	0.02	0	96.05
2018	69.05	236.66	144.09	0	0	116.19

The total number of aircraft in the F-15C/D fleet decreased slightly from 250 in fiscal year 2011 to 235 in fiscal year 2018. Additionally, total O&S costs per aircraft decreased from $7.53 million to $5.90 million per aircraft and maintenance cost per aircraft decreased from $2.91 million to $2.41 million during this time period.

F-15C/D Operating and Support Costs per Aircraft and Fleet Size



Source: GAO analysis of Air Force data. | GAO-21-101SP

Data table for F-15C/D Operating and Support Costs per Aircraft and Fleet Size (Constant fiscal year 2018 dollars in millions)

Fiscal year	Maintenance costs per aircraft	Other operating and support costs per aircraft
2011	2.91	4.63
2012	3.12	4.58
2013	2.69	4.32
2014	2.92	4.5
2015	3.31	4.79
2016	2.59	4.63
2017	2.66	3.08
2018	2.41	3.49

Fiscal year	Number of aircraft
2011	250
2012	249
2013	249
2014	248
2015	246
2016	245
2017	236
2018	235

Sustainment Challenges and Mitigation Actions

Aging and Maintenance: As the F-15C/D continues to age, many top-level Air Force officials question whether the aircraft can continue to effectively meet its air superiority mission, given structural fatigue issues that have affected the fuselage and wings. The program office recently completed a comprehensive full-scale fatigue test, which ran for several years and identified key structural areas that will have to be inspected frequently and eventually replaced as the F-15C/D ages. All F15C/Ds, due to age, will require a considerable amount of maintenance on the longerons and other associated structural components. Maintenance man-hours are also increasing as the aircraft ages because some major systems and components have become less reliable. For example, the program office, through its reliability and maintainability program, identified two key systems—the integrated drive generator and stability and flight control devices—needing improvement. The Aircraft Availability Improvement Plan identifies initiatives that are being implemented to increase the reliability of these aircraft systems.

Supply Support: Supply support has also been an issue for the F-15C/D fleet due in part to decreasing supply sources for parts that rely on older technology, according to program officials. Program officials told us they have been working with the Air Force Sustainment Center and the Defense Logistics Agency to identify key structural components that will need to be procured ahead of time to ensure the parts are available when the aircraft needs them. In addition, program officials stated that the Air Force Sustainment Center has dedicated $104 million to increasing the inventory of parts that are considered critical. Officials added that the Defense Logistics Agency has also increased stock levels for consumable parts and expanded its existing F-15 parts contract with Boeing.

Program Office Comments

(FOUO) In commenting on a draft of this assessment, the F-15 program office stated that although the F-15C/D fleet has not met its aircraft availability goals in recent years, the preponderance of the related readiness reduction is a result of aircraft structural challenges due to numerous longeron cracks in the airframe. Officials stated that the decision to replace longerons fleet wide will mitigate the fleet risk, resulting in lower non-aircraft availability and increased fleet combat readiness. Officials also stated that they remain committed to driving down F-15 total O&S costs and reducing aircraft non-availability by implementing the Aircraft Availability Improvement Plan initiatives in the maintenance, supply and depot non-availability categories, and to support mission requirements until the Air Force retires the aircraft. The program office also provided technical comments which we incorporated where appropriate.

Source: U.S. Air National Guard/Airman 1st Class Tiffany A. Emery. | GAO-21-101SP

F-15E Strike Eagle Sustainment Quick Look

Common Name: F-15E

Lead Service: Air Force

Program Essentials

Manufacturer: Boeing

Sustainment: Depot Maintenance conducted at Warner Robins Air Logistics Complex, Georgia, and field maintenance performed by Air Force personnel

Program Office: Robins Air Force Base, Georgia

Fiscal Year 2019 Data

Average age: 27.04 years

Average lifetime flying hours: 7,685 hours per aircraft

Depot maintenance activity and squadron locations:

▲ Depot maintenance activity location

● Squadron location

Source: GAO. | GAO-21-101SP

Sustainment Challenges and Mitigation Actions

The F-15E faces challenges with aging, increased maintenance, and obtaining needed parts. Mitigation actions include extending its service life and working with the Defense Logistics Agency to improve parts availability.

Background

The F-15E Strike Eagle is a dual-role fighter designed to perform air-to-air and air-to-ground missions. An array of avionics and electronics systems gives the F-15E the capability to fight at low altitude, day or night, and in all weather. It was first manufactured in 1986 and was declared fully operational in 1994.

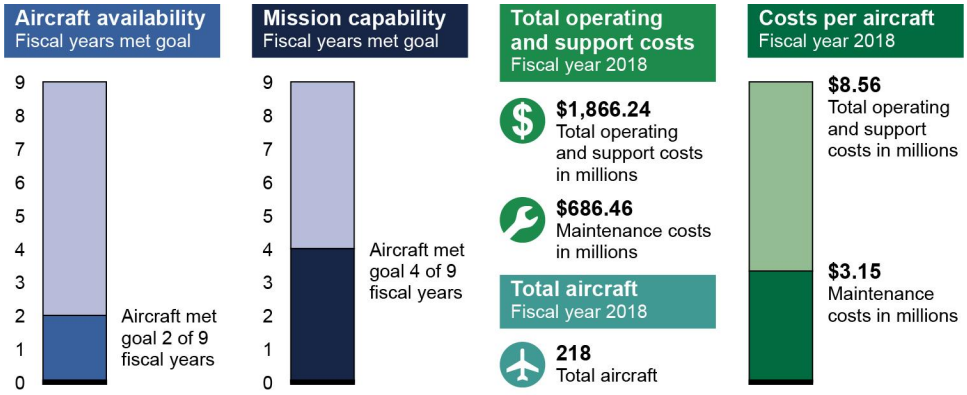
Life Cycle of the F-15E

Source: GAO analysis of Air Force data. | GAO-21-101SP

Overview

The F-15E fleet exceeded its aircraft availability goals in 2 of the 9 fiscal years from fiscal years 2011 through 2019, and met or exceeded its mission capable goals in 4 of the 9 years. The F-15E's aircraft availability rate and mission capable rate decreased during the time period. Total operating and support (O&S) costs decreased from about $2.19 billion in fiscal year 2011 to about $1.87 billion in fiscal year 2018 due to decreases in unit operations, maintenance, and unit-level manpower costs. Over this same time frame, the total number of aircraft decreased and the annual O&S costs per aircraft decreased from $9.92 million to $8.56 million. In fiscal year 2018, maintenance costs per aircraft accounted for about 37 percent of the total O&S costs per aircraft.

F-15E Sustainment Statu



Source: GAO analysis of Air Force data. | GAO-21-101SP

Data table for F-15E Sustainment Statu

Aircraft availability	Aircraft met goal 2 of 9 fiscal years
Mission capability	Aircraft met goal 4 of 9 fiscal years
Total operating and support costs in millions (FY18)	$1,866.24
Maintenance costs in millions (FY18)	$686.46
Total aircraft (FY18)	218
Total operating and support costs per aircraft in millions (FY18)	$8.56
Maintenance costs per aircraft in millions	$3.15

Sustainment Strategy

- The F-15 program office has a sustainment strategy for the F-15E that includes implementing major modifications during programmed depot maintenance at Warner Robins Air Logistics Complex. Expanded shifts for contract field teams performing modification installs are planned in order to reduce aircraft downtime.
- The F-15 program office has developed and begun to implement an aircraft availability improvement plan for fiscal years 2019-2024 that includes several initiatives to improve the availability of the aircraft, such as initiatives to improve the availability of spare parts and the reliability of some key systems on the aircraft.

Availability and Condition

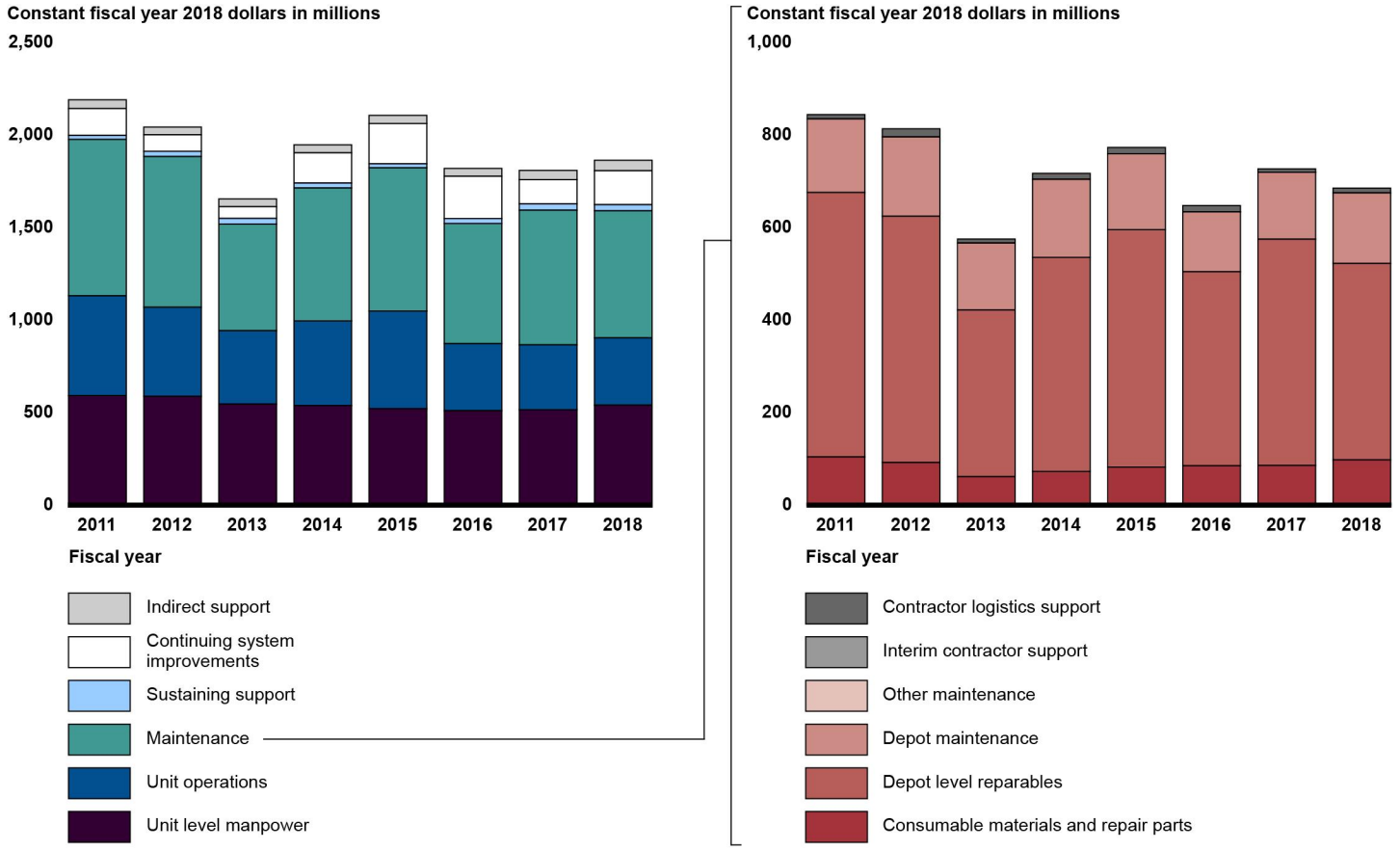
The F-15E fleet exceeded its aircraft availability goals for 2 of the 9 fiscal years from fiscal year 2011 through fiscal year 2019, and met or exceeded its mission capable goals for 4 of the 9 years during that period. The F-15E's aircraft availability rate and mission capable rate decreased during the time period. The F-15E aircraft availability improvement plan states that the current decline in availability is significant when compared to the historical norm. The plan concluded that achieving future aircraft availability goals is unlikely due to significant increases in F-15E modifications through the 2020s, namely the electronic warfare upgrade, which is the largest modification ever to the aircraft. Additionally, program officials said the aircraft availability and mission capable rates were impacted by fluctuations in the number of aircraft in depot, radar upgrades on all aircraft that has increased time in depot, and slightly higher than planned time awaiting supply parts.

From fiscal years 2011 through 2019, the F-15E's rate increased slightly for not mission capable maintenance (NMCM) and the rates decreased slightly for not mission capable for supply (NMCS) and not mission capable both (NMCB) maintenance and supply. According to program officials, the primary drivers for the recent NMCM rate increase were: the fuel system; airframe, weapons delivery and flight controls; special inspections in support of deployments, and rebuild and maintenance efforts. According to program officials, the largest driver of the aircraft not being mission capable was maintenance issues, such as challenges with the ejection seats and environment control systems. Program officials also said that key aircraft components, such as the integrated drive generators that provide electrical power for the aircraft, and stability and flight control devices are the traditional drivers for the not mission capable for supply rates because more time is needed to stand up a new production line for the generators and more time needed to procure new overhaul and repair kits with redesigned components for the stability and flight-control devices. Specific details on mission capable and not mission capable rates were omitted because the information was deemed by DOD to be sensitive.

Operating and Support Costs

Total O&S costs for the F-15E fleet decreased from approximately $2.19 billion in fiscal year 2011 to about $1.87 billion in fiscal year 2018. The largest drivers of O&S cost were maintenance and unit level manpower during the time period. With respect to maintenance costs, the largest categories were depot-level reparables and depot maintenance. Officials attributed the majority of fluctuations in depot-maintenance costs to rate changes in the working capital fund. The officials explained that variations to these numbers impact the rate (i.e., price) charged from year to year by the Warner Robins Air Logistics Complex for conducting depot maintenance.

F-15E Total Operating and Support Costs



Source: GAO analysis of Air Force data. | GAO-21-101SP

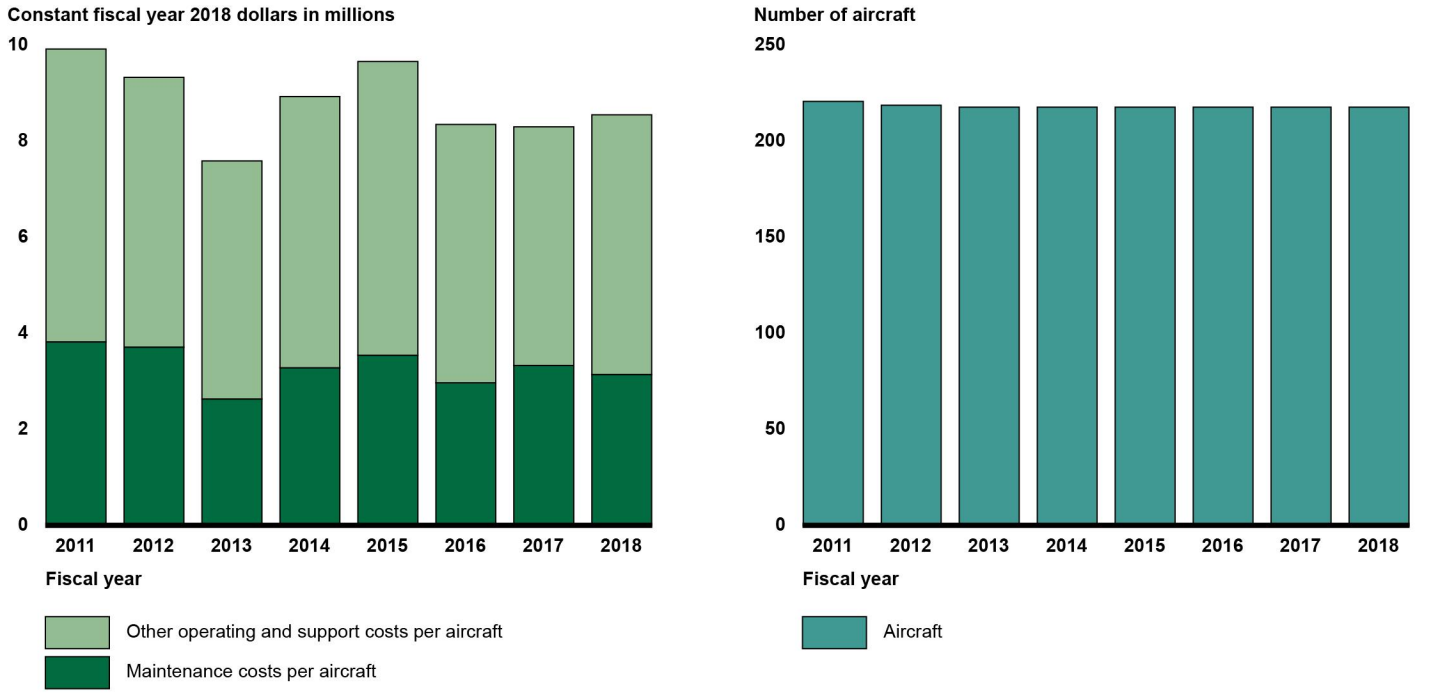
Data table for F-15E Total Operating and Support Costs (Constant fiscal year 2018 dollars in millions)

Fiscal year	Unit level manpower	Unit operations	Maintenance	Sustaining support	Continuing system improvements	Indirect support
2011	595.35	538.55	845.41	21.8	144.7	47.23
2012	590.85	481.56	814.54	28.15	88.67	42.2
2013	549.39	396.11	576.46	30.15	63.68	41.73
2014	540.42	458.13	718.18	26.62	163.08	43.85
2015	524.34	527.33	774.23	21.42	217.9	43.66
2016	513.49	362.53	648.71	27.31	228.09	42.36
2017	517.95	350.77	727.85	34.11	130.73	50.08
2018	543.25	363.33	686.46	33.84	182.82	56.54

Fiscal year	Consumable materials and repair parts	Depot level reparables	Depot maintenance	Other maintenance	Interim contractor support	Contractor logistics support
2011	105.29	571.81	158.85	0	0	9.46
2012	93.48	532.33	171.23	0	0	17.5
2013	62.81	360.01	144.84	0	0	8.8
2014	73.98	462.67	168.71	0	0	12.83
2015	83.16	513.64	163.9	0.06	0	13.47
2016	86.4	419.15	129.32	0.08	0	13.77
2017	86.86	489.07	144.7	0.05	0	7.17
2018	98.86	424.76	152.34	0	0	10.5

The F-15E fleet consists of 218 aircraft to meet the fleet's operational requirements. While the total number of aircraft in the F-15E fleet remained fairly constant from fiscal years 2011 through 2018, the total O&S costs per aircraft decreased. Specifically, the O&S costs per aircraft decreased from $9.92 million to $8.56 million during this time period. In addition, maintenance costs per aircraft decreased from $3.83 million to $3.15 million during the same time frame.

F-15E Operating and Support Costs per Aircraft and Fleet Size



Source: GAO analysis of Air Force data. | GAO-21-101SP

Data table for F-15E Operating and Support Costs per Aircraft and Fleet Size (Constant fiscal year 2018 dollars in millions)

Fiscal year	Maintenance costs per aircraft	Other operating and support costs per aircraft
2011	3.83	6.1
2012	3.72	5.62
2013	2.64	4.96
2014	3.29	5.65
2015	3.55	6.12
2016	2.98	5.38
2017	3.34	4.97
2018	3.15	5.41

Fiscal year	Number of aircraft
2011	221
2012	219
2013	218
2014	218
2015	218
2016	218
2017	218
2018	218

Sustainment Challenges and Mitigation Actions

Aging: As the F-15E ages, structural issues have been identified that affect the fuselage and wings. The program office recently completed a comprehensive full-scale fatigue test that ran for several years and identified key structural areas that will have to be inspected more frequently and eventually replaced as the F-15E ages.

Maintenance: The program office has an effort to reduce the number of F-15E aircraft in planned depot maintenance to 24 in fiscal year 2019, which is 12 aircraft less than the number of depot inductions in fiscal year 2018. According to program officials, this is a one-time action that addresses fiscal year 2019 depot inductions only and reflects the decision to help improve the depot capacity losses that occurred in fiscal year 2019 due to the increased condemnation rate of F-15C/D longerons and the non-availability of new longerons to replace them, which resulted in delays to F-15E programmed depot maintenance inductions. Officials stated that the F-15E depot-focused improvement initiative is an Aircraft Availability Improvement Plan initiative to extend the programmed depot maintenance interval from 6 years to 7.5 years beginning in the first quarter of fiscal year 2020, which would reduce the number of depot inductions by up to four aircraft per year. Additionally, the F-15E aircraft availability improvement plan states that the integrated drive generators and the stability and flight-control devices have become increasingly less reliable. The plan identifies initiatives that are in place to increase the reliability of these aircraft systems, which are projected in the future to improve the aircraft availability rates.

Supply Support: Supply support has also been an issue for the F-15E fleet due in part to decreasing supply sources for parts that rely on older technology, according to officials. Program officials told us they have been working with the Air Force Sustainment Center and the Defense Logistics Agency to identify key structural components that will need to be procured ahead of time to ensure the parts are available when the aircraft needs them. In addition, program officials stated that the Air Force Sustainment Center has dedicated $104 million to increasing the inventory of parts that are considered critical. Officials added that the Defense Logistics Agency has increased stock levels for consumable F-15 parts and expanded its existing parts contract with Boeing.

Program Office Comments

In commenting on a draft of this assessment, the F-15 program office stated that they concur with our observations. The program office also provided technical comments, which we incorporated where appropriate.

Source: U.S. Air Force/Airman 1st Class Matthew Seefeldt. | GAO-21-101SP

F-16 Fighting Falcon Sustainment Quick Look

Common Name: F-16

Lead Service: Air Force

Program Essentials

Manufacturer: Lockheed Martin

Sustainment: Depot maintenance conducted at Ogden Air Logistics Complex, Utah, and contract depots in Belgium and South Korea; and field maintenance conducted by Air Force maintainers and contractors

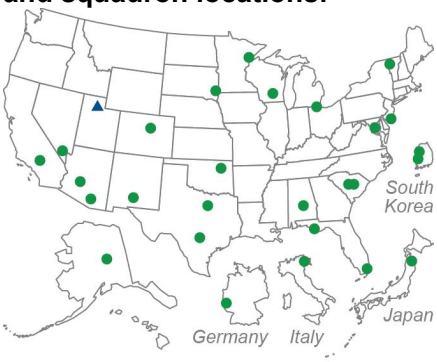
Program Office: Hill Air Force Base, Utah

Fiscal Year 2019 Data

Average age: 29 years

Average lifetime flying hours: 7,099 hours per C model aircraft and 6,368 hours per D model aircraft

Depot maintenance activity and squadron locations:



▲ Depot maintenance activity location

● Squadron location

Source: GAO. | GAO-21-101SP

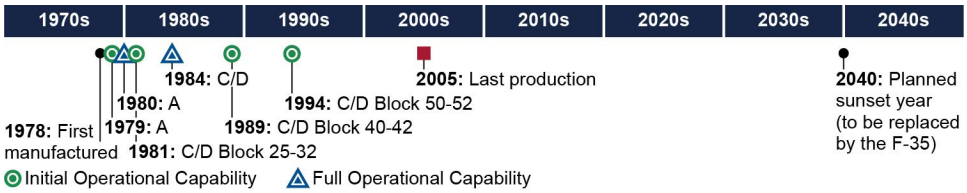
Sustainment Challenges and Mitigation Actions

Some F-16 aircraft are operating beyond their expected service life with maintenance and supply challenges. Planned actions to mitigate these challenges include extending the service life of the aircraft, identifying all parts that need to be replaced during the inspection phase of maintenance, and identifying alternate vendors for parts.

Background

The F-16 Fighting Falcon is a compact, single-engine, multirole fighter aircraft first manufactured in 1978. It is a highly maneuverable aircraft with single- and two-seat models that participates in air-to-air combat and air-to-surface attack missions.

Life Cycle of the F-16

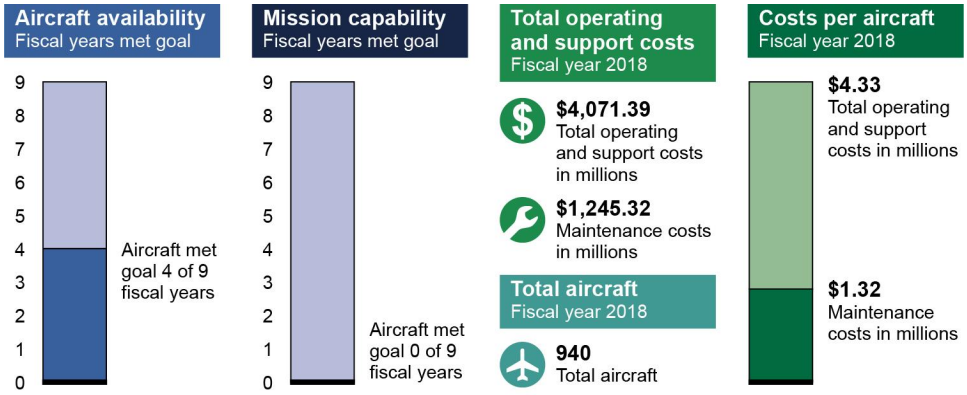


Source: GAO analysis of Air Force data. | GAO-21-101SP

Overview

From fiscal years 2011 through 2019, the F-16 fleet met or exceeded its annual aircraft availability goals in 4 of the 9 years, but did not meet any of its mission capable goals during this time frame—including its Department of Defense mission capable goal for fiscal year 2019. The F-16's aircraft availability rate and mission capable rate decreased slightly during the time period. Total operating and support (O&S) costs for the fleet decreased from about $5.17 billion in fiscal year 2011 to about $4.07 billion in fiscal year 2018 in part because the number of aircraft decreased. In fiscal year 2018, the O&S costs per aircraft were $4.33 million with about $1.32 million per aircraft (or 31 percent) spent on maintenance issues.

F-16 Sustainment Status



Source: GAO analysis of Air Force data. | GAO-21-101SP

Data table for F-16 Sustainment Status

Aircraft availability	Aircraft met goal 4 of 9 fiscal years
Mission capability	Aircraft met goal 0 of 9 fiscal years
Total operating and support costs in millions (FY18)	$4,071.39
Maintenance costs in millions (FY18)	$1,245.32
Total aircraft (FY18)	940
Total operating and support costs per aircraft in millions (FY18)	$4.33
Maintenance costs per aircraft in millions	$1.32

Sustainment Strategy

- The F-16 Fighting Falcon Weapon System Life-Cycle Sustainment Plan (2017) documents the operations and support planning for the F-16, including strategies to keep the weapon system reliable, maintainable, affordable, and supportable through its projected life cycle.
- Aircraft depot-level maintenance and field-level maintenance is performed by both Air Force maintainers and contractor personnel.
- The Air Force implemented a Service Life Extension Program in 2011 to extend the service life of 300 F-16 aircraft from 8,000 to 13,856 flying hours by (1) identifying life-limiting structural components through durability testing and analysis, (2) developing modifications and repair designs, and (3) validating the modifications and a repair kit. The modifications and repairs are planned through 2029 and, as of December 2019, the estimated cost was $1.1 billion.

Availability and Condition

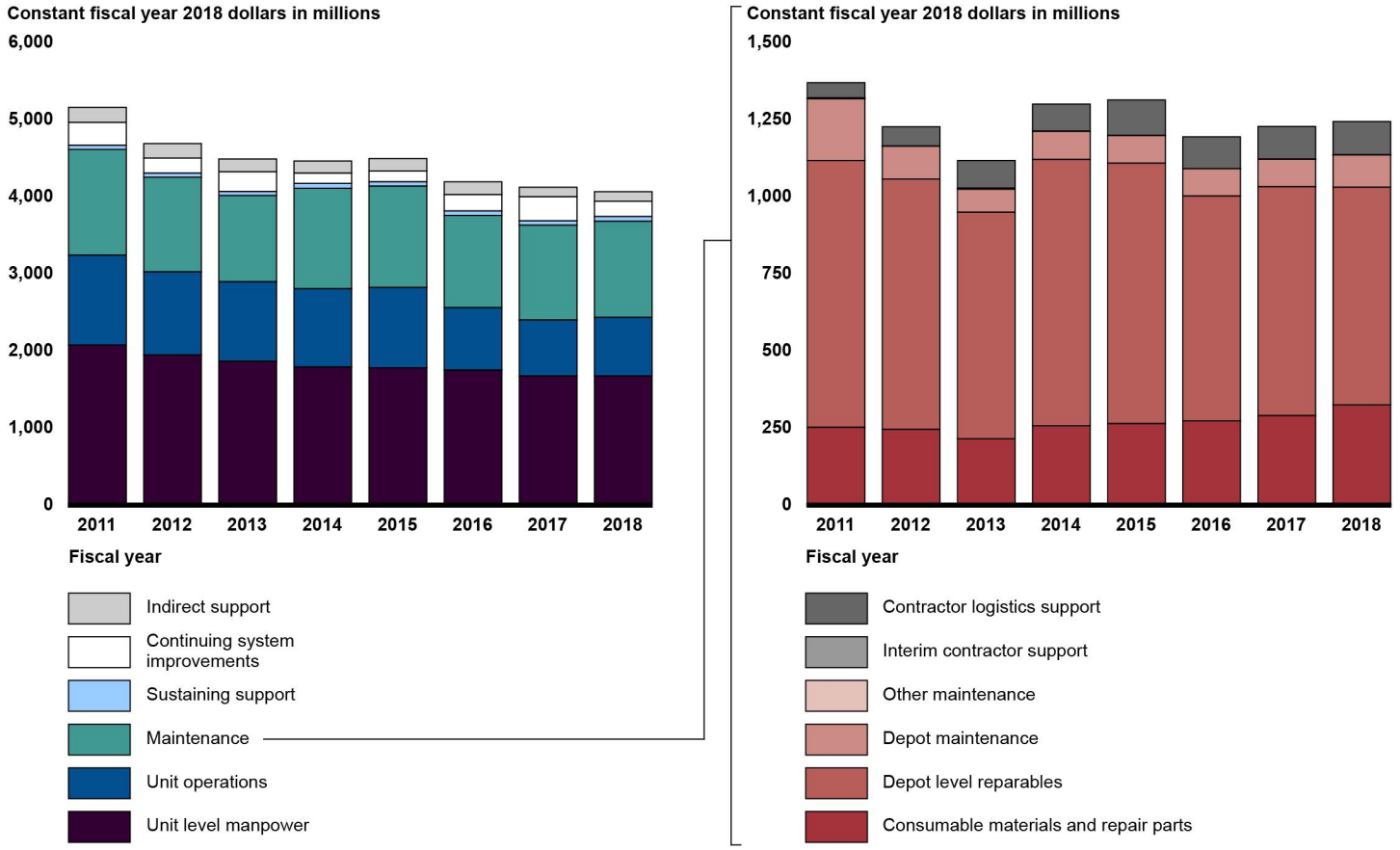
From fiscal year 2011 through fiscal year 2019, the F-16 fleet met or exceeded its aircraft availability goals in 4 of the 9 years and came close to meeting its goals in 4 additional years. However, the F-16 missed its mission capable goals every year during this period—including its Department of Defense mission capable goal for fiscal year 2019. According to program officials, the F-16's inability to meet its mission capable goals is due in part to the age of the fleet and related supply and maintenance challenges. The F-16's aircraft availability rate and mission capable rate decreased slightly during the time period.

Between fiscal year 2011 and fiscal year 2019, the rates for not mission capable maintenance (NMCM) and not mission capable supply slightly increased, while the not mission capable both maintenance and supply rate slightly decreased. According to officials, these not mission capable rates were influenced by multiple factors, including operations tempo, training, manning levels, support equipment and parts availability. Officials also stated that two of the top NMCM rate drivers were engine inlets and phase inspections. The specific details on mission capable and not mission capable rates were omitted because the information was deemed by DOD to be sensitive.

Operating and Support Costs

From fiscal year 2011 through fiscal year 2018, the F-16's total O&S costs decreased from about $5.17 billion to about $4.07 billion, primarily due to a decrease in the total number of aircraft, according to officials. Maintenance was the second largest O&S cost category behind unit-level manpower. According to program officials, increased maintenance costs in fiscal years 2014, 2015, and 2017 were due to out-of-cycle depot repairs and the replacement of structural components and radar-absorbent material on the aircraft. Depot-level reparables, the most significant category of maintenance costs, averaged about $786.85 million a year, while consumable materials and repair parts averaged $267.27 million a year from fiscal years 2011 through 2018.

F-16 Total Operating and Support Costs



Source: GAO analysis of Air Force data. | GAO-21-101SP

Data table for F-16 Total Operating and Support Costs (Constant fiscal year 2018 dollars in millions)

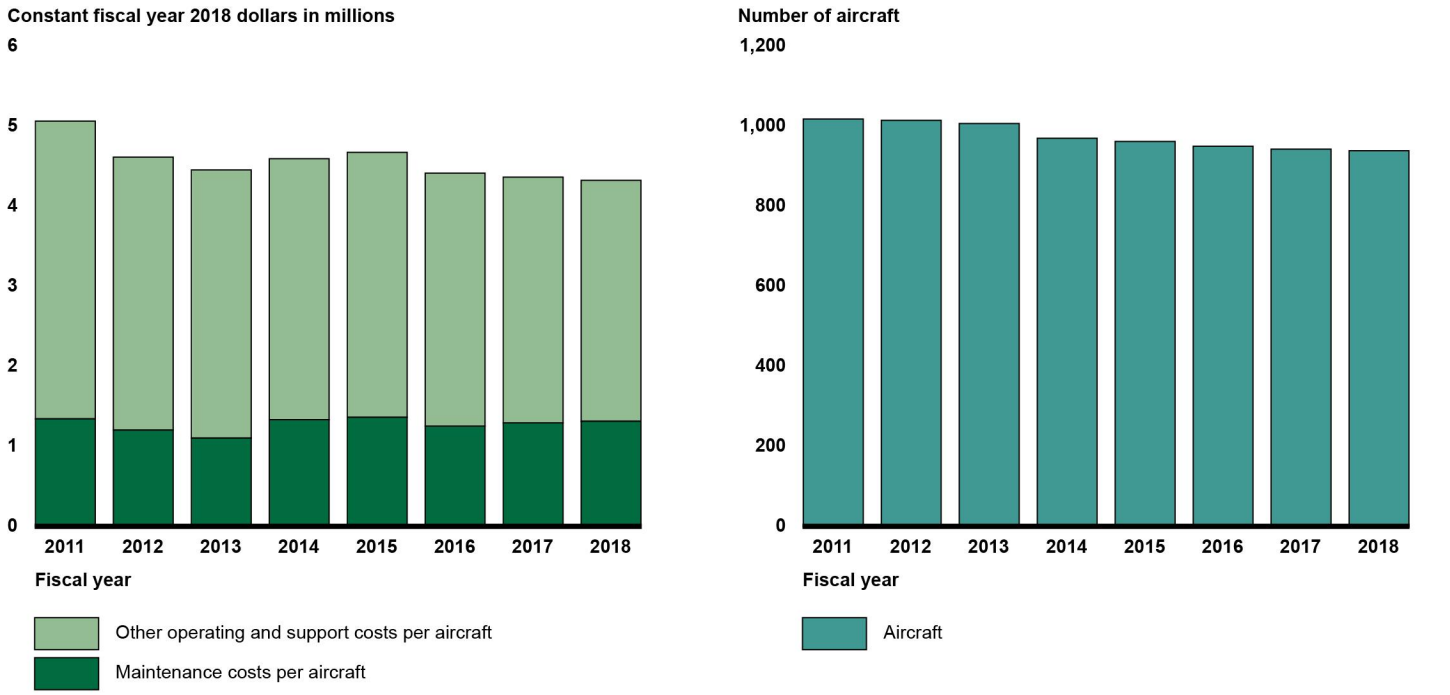
Fiscal year	Unit level manpower	Unit operations	Maintenance	Sustaining support	Continuing system improvements	Indirect support
2011	2083.46	1164.75	1371.41	54.05	296.12	196.87
2012	1956.78	1075.36	1228.26	51.96	195.17	187.66
2013	1871.19	1032.66	1118.76	50.79	256	166.32
2014	1798.42	1015.39	1301.94	64.67	131.54	158.21
2015	1786.95	1041.97	1315.71	54.86	139.95	161.88
2016	1758.72	809.85	1196.17	57.57	212.53	164.27
2017	1681.9	725.82	1229.39	56.57	311.85	124.7
2018	1682.14	759.88	1245.32	61.91	198.7	123.45

Fiscal year	Consumable materials and repair parts	Depot level reparables	Depot maintenance	Other maintenance	Interim contractor support	Contractor logistics support
2011	254.07	865	199.81	0.12	3.07	49.34
2012	247.65	811.25	106.45	0.11	0.04	62.77
2013	217.18	734.38	74.5	1.06	2.17	89.47
2014	259.19	863.37	90.77	0.7	0.13	87.78
2015	266.19	844.15	89.84	0.27	0.23	115.03
2016	275.12	728.88	88.26	0.25	0.46	103.19
2017	291.94	742.26	88.86	0.22	0	106.11
2018	326.81	705.53	104.84	0.12	0.14	107.89

From fiscal year 2011 through fiscal year 2018, the O&S costs per F-16 aircraft generally decreased from about $5.07 million to about $4.33 million. According to officials, this was a result of the decrease in aircraft inventory from

1,019 aircraft in fiscal year 2011 to 940 aircraft in fiscal year 2018. This decrease occurred due to the retirement of older aircraft in the fleet. On average, maintenance costs per aircraft were about $1.28 million (or about 28 percent) of total O&S costs per aircraft during this time period.

F-16 Operating and Support Costs per Aircraft and Fleet Size



Source: GAO analysis of Air Force data. | GAO-21-101SP

Data table for F-16 Operating and Support Costs per Aircraft and Fleet Size (Constant fiscal year 2018 dollars in millions)

Fiscal year	Maintenance costs per aircraft	Other operating and support costs per aircraft
2011	1.35	3.72
2012	1.21	3.41
2013	1.11	3.35
2014	1.34	3.26
2015	1.37	3.31
2016	1.26	3.16
2017	1.3	3.07
2018	1.32	3.01

Fiscal year	Number of aircraft
2011	1019
2012	1016
2013	1008
2014	971
2015	963
2016	951
2017	944
2018	940

Sustainment Challenges and Mitigation Actions

Aging: The Air Force plans to keep some of its F-16 fleet flying until 2046 through a service-life extension. The service-life extension is vital to maintaining the Air Force's air superiority mission, since officials explained that F-35 aircraft are not being delivered as quickly as originally anticipated. The Air Force's ongoing and planned actions include extending the service life of 300 F-16 aircraft by 5,856 flying hours beyond its planned 8,000 flying-hour service life, using a phased approach. This Service-Life Extension Program began in December 2016 and is scheduled to last through 2029 at an estimated cost of $1.1 billion as of December 2019. According to program officials, this service-life extension program does not guarantee that all the aircraft will be able to fly until 2046.

Maintenance: Officials stated that, as the F-16 ages, it is requiring additional maintenance for repairs that were not originally planned, such as replacing the bulkhead (i.e., a dividing wall or barrier between compartments in a an aircraft), longerons (i.e., a longitudinal structural component of an aircraft's fuselage), and skins (i.e., repair of major structural elements that may exhibit areas of cracking related to stress concentrations and number of flight hours on the aircraft). Therefore, maintenance activities are taking longer, and aircraft downtime has increased. The Air Force's ongoing and planned actions include mitigation efforts to counter corrosion by identifying all parts and components that need to be repaired and replaced during the phase and depot inspections, and discussion of issues at F-16 Health of Fleet meetings held monthly to identify causes and possible solutions.

Supply Support: The F-16 is experiencing shortages of parts because of diminishing manufacturing sources and increasing need for low-demand items. The Air Force's ongoing and planned actions include identifying alternate vendors, reverse engineering of parts, and cannibalizing parts from other aircraft.

Program Office Comments

In commenting on a draft of this assessment, the program office provided technical comments, which we incorporated where appropriate.

Source: U.S. Air Force/Tech. Sgt. Natasha Stannard. | GAO-21-101SP

F-22 Raptor Sustainment Quick Look

Common Name: F-22

Lead Service: Air Force

Program Essentials

Manufacturer: Lockheed Martin and Pratt & Whitney (engines)

Sustainment: Lockheed Martin provides sustainment support. Ogden Air Logistics Complex, Utah, provides depot maintenance. Air Force maintainers provide field maintenance.

Program Office: Wright-Patterson Air Force Base, Ohio

Fiscal Year 2019 Data

Average age: 12 years

Average lifetime flying hours: 1,866 hours per aircraft

Depot maintenance activity and squadron locations:

▲ Depot maintenance activity location

● Squadron location

Source: GAO. | GAO-21-101SP

The F-22 faces challenges with its low-observable system and spare parts. The Air Force is contracting to increase low observable repair capacity and securing additional funding for spare parts.

Background

The F-22 Raptor is one of the newest Air Force aircraft. The F-22 performs air-to-air and air-to-ground missions and is designed to attack enemy aircraft and ground targets at great distances.

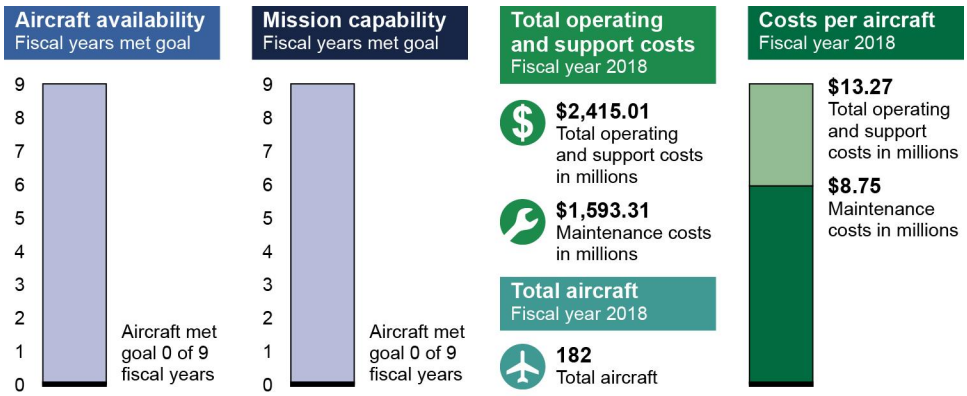
Life Cycle of the F-22

Source: GAO analysis of Air Force data. | GAO-21-101SP

Overview

The F-22 fleet did not meet its annual aircraft availability or mission capable goals for any year from fiscal years 2011 through 2019 and did not meet the Department of Defense's mission capable goal for fiscal year 2019. Both the F-22's aircraft availability and mission capable rates decreased during the nine year period. Total operating and support (O&S) costs increased from about $2.34 billion in fiscal year 2011 to about $2.42 billion in fiscal year 2018. Furthermore, maintenance costs—the largest share of O&S costs—increased by a total of $556.21 million during this period. Total O&S costs per aircraft decreased from $14.34 million in fiscal year 2011 to $13.27 million in fiscal year 2018 and an average of about 54 percent was dedicated to maintenance costs.

F-22 Sustainment Status



Source: GAO analysis of Air Force data. | GAO-21-101SP

Data table for F-22 Sustainment Status

Aircraft availability	Aircraft met goal 0 of 9 fiscal years
Mission capability	Aircraft met goal 0 of 9 fiscal years
Total operating and support costs in millions (FY18)	$2,415.01
Maintenance costs in millions (FY18)	$1,593.31
Total aircraft (FY18)	182
Total operating and support costs per aircraft in millions (FY18)	$13.27
Maintenance costs per aircraft in millions	$8.75

Sustainment Strategy

- The 2017 F-22 Life-Cycle Management Plan, in conjunction with the Engine Life Management Plan, codifies the sustainment strategy for the F-22 program. It guides logistics sustainment and modernization strategy execution within the F-22 program and support organizations, and communicates the strategy to Air Force leadership.
- The F-22 program office has a performance-based logistics contract with Lockheed Martin for overall aircraft sustainment. The Air Force conducts depot maintenance under a public/private partnership agreement with Lockheed Martin. Pratt & Whitney provides engine sustainment at Tinker Air Force Base, Oklahoma.
- The program office has various initiatives to support sustainment, such as maintaining a comprehensive diminishing manufacturing sources program and proactively supporting the continued sustainment of component parts of the aircraft through various replacement programs, such as the F-22 Reliability and Maintainability Program. This initiative is an ongoing effort to drive continuous improvement in availability.

Availability and Condition

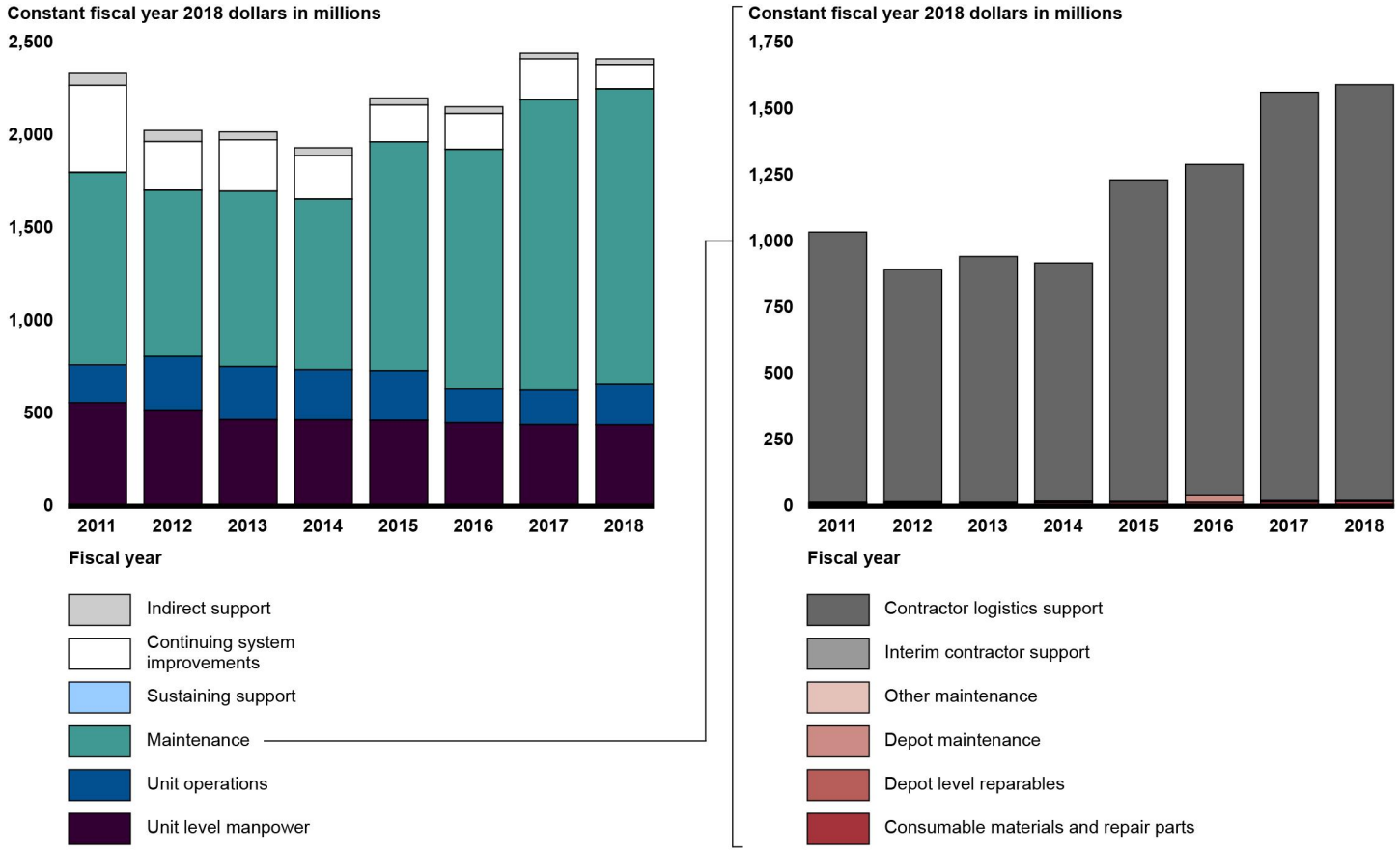
The F-22 fleet did not meet its annual goals for either the aircraft availability or mission capable rate for any year from fiscal year 2011 through fiscal year 2019, including the Department of Defense's 80 percent mission capable goal for fiscal year 2019. Both the F-22's aircraft availability and mission capable rates decreased during the nine year period. According to program officials, the F-22's low aircraft availability and mission capable rates were tied to degradation of the aircraft's low-observable system coating, supply shortages, and execution of higher-than-budgeted flying hours. Officials stated that after 2017 the Air Force devoted additional funding for the F-22 to help procure time-sensitive spares, repairs, and consumable parts.

From fiscal year 2011 through fiscal year 2019, the rates increased slightly for not mission capable maintenance (NMCM) and not mission capable supply (NMCS), while the not mission capable both (NMCB) maintenance and supply rate decreased slightly. According to program officials, the NMCM rate increased in part due to quality control issues in the low-observable system inspection process and low-observable maintenance continues to drive the NMCM rate. Program officials also stated that the devastation caused by Hurricane Michael to Tyndall Air Force Base, Florida—the primary location for F-22 pilot training—and the F-22's supply chain, maintenance and flying operations, increased the NMCM rate. Specific details on mission capable and not mission capable rates were omitted because the information was deemed by DOD to be sensitive.

Operating and Support Costs

Total O&S costs increased from about $2.34 billion in fiscal year 2011 to about $2.42 billion in fiscal year 2018. According to program office officials, this increase in O&S costs was due to increased flying-hour execution and scheduled engine depot inductions. Maintenance costs—the largest share of O&S costs during the time period—increased from $1.04 billion to $1.59 billion. From fiscal year 2015 through fiscal year 2018 there was a constant increase in maintenance costs due to increases in contractor logistics support costs.

F-22 Total Operating and Support Costs



Source: GAO analysis of Air Force data. | GAO-21-101SP

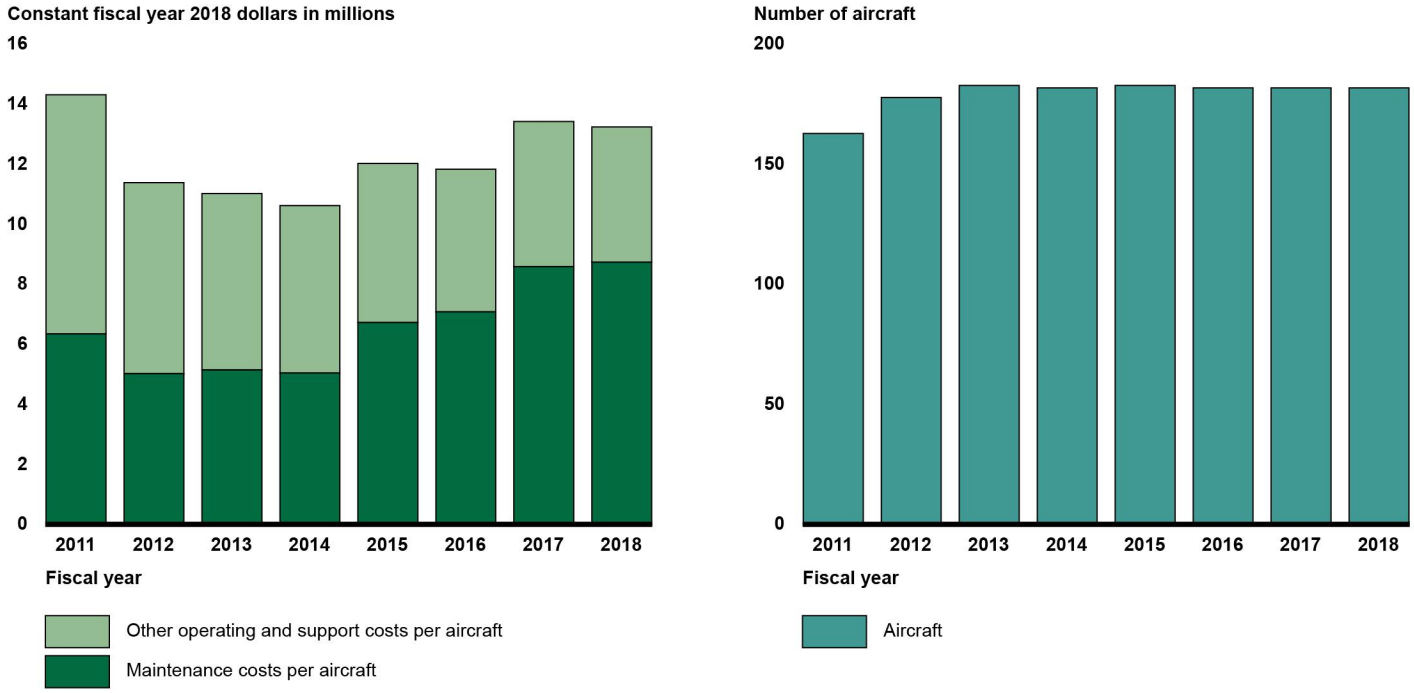
Data table for F-22 Total Operating and Support Costs (Constant fiscal year 2018 dollars in millions)

Fiscal year	Unit level manpower	Unit operations	Maintenance	Sustaining support	Continuing system improvements	Indirect support
2011	561.32	203.95	1037.1	1.53	468.76	63.98
2012	522.54	287.26	896.82	1.02	261.45	59.86
2013	470.31	285.82	945.16	0.99	275.84	43
2014	469.18	269.77	920.24	0.91	233.41	42.13
2015	466.88	266.51	1233.94	1.32	197.3	37.65
2016	453.5	181.54	1291.97	0.98	191.71	36.86
2017	443.68	185.52	1564.72	1.01	219.68	31.26
2018	442.31	216.59	1593.31	1.85	129.98	30.98

Fiscal year	Consumable materials and repair parts	Depot level reparables	Depot maintenance	Other maintenance	Interim contractor support	Contractor logistics support
2011	12.98	1.03	2.75	0	0	1020.33
2012	11.64	3.95	2.77	0	0	878.47
2013	12.91	1.18	2.23	0	0	928.84
2014	15.07	3.13	2.28	0	0.49	899.27
2015	16.04	1.85	1.84	0	0.65	1213.56
2016	16.18	1.55	27.68	0.06	0	1246.49
2017	18.33	2.2	2.03	0.04	0	1542.11
2018	20	1.38	1.82	0	0	1570.11

From fiscal year 2011 through fiscal year 2018, the total O&S costs per F-22 aircraft varied. The highest O&S costs per aircraft was about $14.34 million in fiscal 2011 and the lowest O&S costs per aircraft was $10.64 million in fiscal year 2014. In fiscal year 2018, the total O&S costs per aircraft was $13.27 million. While the number of aircraft in the F-22 fleet remained fairly stable since fiscal year 2014, there was an increase in O&S costs per aircraft since 2014 due to the consistent increase in the maintenance costs per aircraft during this same period. Since fiscal year 2014, maintenance costs increased from $5.06 million per aircraft to $8.75 million in fiscal year 2018 and accounted for about 59 percent of the total O&S costs per aircraft. According to program officials, the increase in maintenance costs per aircraft was due to a 30 to 50 percent increase in flying hours during this period.

F-22 Operating and Support Costs per Aircraft and Fleet Size



Source: GAO analysis of Air Force data. | GAO-21-101SP

Data table for F-22 Operating and Support Costs per Aircraft and Fleet Size (Constant fiscal year 2018 dollars in millions)

Fiscal year	Maintenance costs per aircraft	Other operating and support costs per aircraft
2011	6.36	7.97
2012	5.04	6.36
2013	5.16	5.88
2014	5.06	5.58
2015	6.74	5.3
2016	7.1	4.75
2017	8.6	4.84
2018	8.75	4.51

Fiscal year	Number of aircraft
2011	163
2012	178
2013	183
2014	182
2015	183
2016	182
2017	182
2018	182

Sustainment Challenges and Mitigation Actions

Aging and Maintenance: As the F-22 ages, it requires additional maintenance for repairs related to corrosion and the aging of its low-observable coating. Program officials stated that the low-observable coating degradation began expanding to areas of the aircraft at a faster pace than unit maintenance could control, driving a major spike in maintenance required to preserve the overall health of the aircraft. Program officials told us that the Air Force has ongoing and planned actions to counter (1) corrosion, by identifying all parts that need to be repaired and replaced during the inspection phase; and (2) the low observable issue, by depot reversion repair and opening an additional repair line facility to handle the increased number of unplanned inlet coating repairs. Program officials added that the Air Force has been piloting a robotic solution to apply the low-observable coating that has been working well and has helped address their skilled worker shortage.

Supply Support: According to program officials, the F-22 experienced shortages of parts from 2014 through 2018 because flying operations exceeded allocated budgets in 4 of 5 years and vendors that supply parts did not have lay-in materiel to address the magnitude of increased flying hours. Program officials noted when major unplanned changes occur in forecasted flying hours, it creates negative effects on the supply networks. Program officials told us they are (1) maintaining a comprehensive diminishing manufacturing sources program to minimize material shortages and (2) receiving out-of-cycle supply funding increases to improve supply issues. Further, program officials stated that the fundamental shift from a cost-plus-fixed fee to cost-plus-incentive fee contract for supply services will yield cost savings through 2022.

Program officials also stated that they are implementing efforts to improve the F-22 mission capable rate by the end of fiscal year 2019, including improving spare-parts management; increasing maintenance capacity to accelerate needed aircraft repairs; and enhancing training and proficiency to improve the generation of mission-ready aircraft.

Program Office Comments

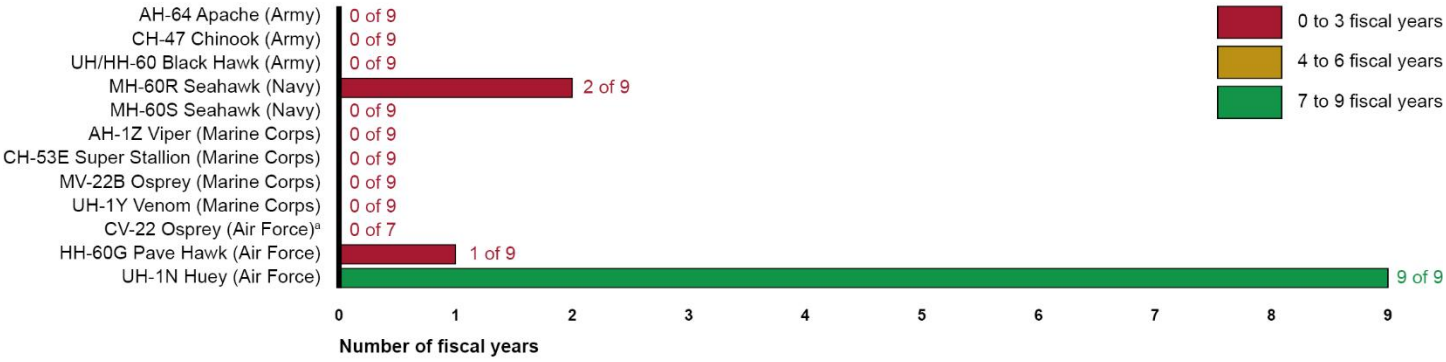
In commenting on a draft of this assessment, the program office provided technical comments, which we incorporated where appropriate.

Rotary aircraft

AH-1Z Viper

Source: U.S. Marine Corps/Sgt. Jesus Sepulveda Torres. | GAO-21-101SP

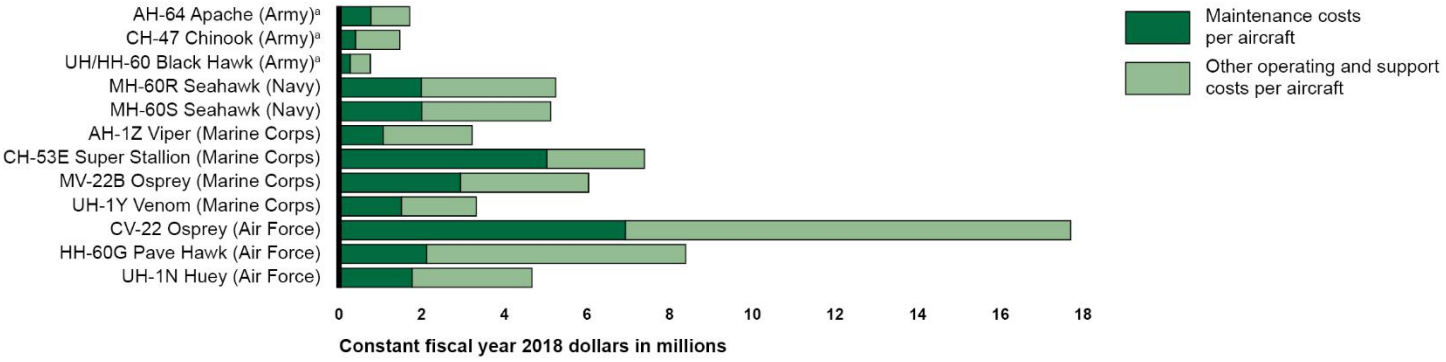
Number of Times Selected Rotary Aircraft Met Their Annual Mission Capable Goal, Fiscal Years 2011 through 2019



Source: GAO analysis of Army, Navy, and Air Force data. | GAO-21-101SP

[a]The Air Force did not provide the mission capable goals for all nine years for this aircraft.

Operating and Support Costs per Aircraft for Selected Department of Defense Rotary Aircraft, Fiscal Year 2018



Source: GAO analysis of Army, Navy, and Air Force data. | GAO-21-101SP

[a]We obtained fiscal year 2018 operating and support (O&S) cost data from the Army, but we learned from the Army that the data were inaccurate. Thus, the costs presented here for the Army aircraft are based on fiscal year 2017 O&S data.

Source: U.S. Army/Captain Brian Harris. | GAO-21-101SP

AH-64 Apache Sustainment Quick Look

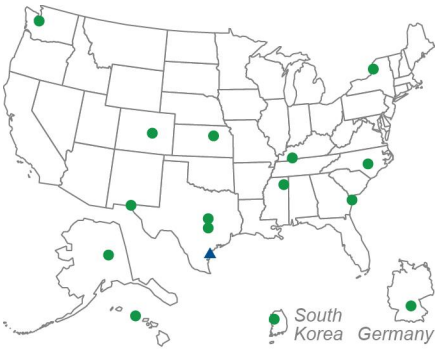
Common Name: AH-64
Lead Service: Army

Program Essentials

Manufacturer: Boeing Company Integrated Defense Systems
Sustainment: Boeing and the Army sustain the airframe and Lockheed Martin sustains the sensors
Program Office: Redstone Arsenal, Alabama

Fiscal Year 2019 Data

Average age: 11.6 years (AH-64D); 3.4 years (AH-64E)
Average lifetime flying hours: 5,574 hours (AH-64D); 1,236 hours (AH-64E)
Depot maintenance activity and combat aviation brigade locations:



▲ Depot maintenance activity location
● Combat aviation brigade location

Source: GAO. | GAO-21-101SP

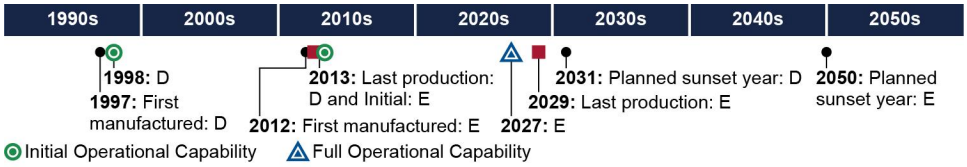
Sustainment Challenges and Mitigation Actions

The Army is upgrading its AH-64Ds to AH-64Es to improve capability and reduce unscheduled maintenance. In addition, the Army is working to improve the availability of spare parts.

Background

The AH-64 Apache is an attack helicopter that was first manufactured in 1984 as the AH-64A and later re-manufactured as the AH-64D in 1997. The models of the Apache currently in use, the AH-64D and AH-64E, can perform a variety of missions including ground force security, fixed based operations, aerial escorts, reconnaissance, and single or multiple enemy combatant engagements.

Life Cycle of the AH-64



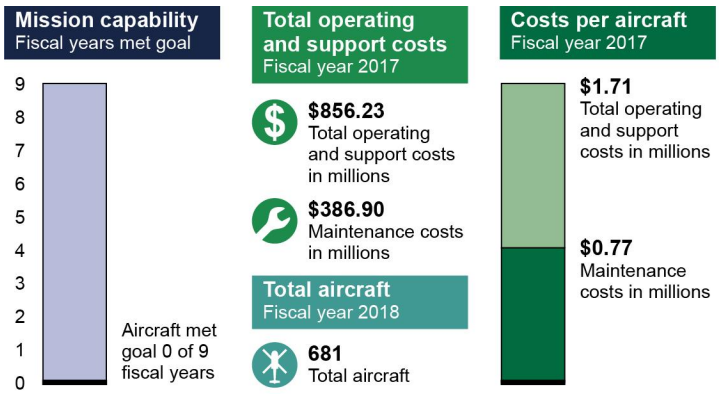
Source: GAO analysis of Army data. | GAO-21-101SP

Note: Many of the AH-64Ds were rebuilt from the original AH-64A models, which were first manufactured in 1985.

Overview

From fiscal year 2011 to fiscal year 2019, the AH-64 fleet did not meet its mission capable goal. According to Army officials, not mission capable rate trends were due to spare parts quality and reliability issues, which required replacement and maintenance actions. Operating and support (O&S) costs per aircraft decreased from about $1.89 million in fiscal year 2011 to $1.71 million in fiscal year 2017.

AH-64 Sustainment Status



Source: GAO analysis of Army data. | GAO-21-101SP

Data table for AH-64 Sustainment Status

Mission capability	Aircraft met goal 0 of 9 fiscal years
Total operating and support costs in millions (FY18)	$856.23
Maintenance costs in millions (FY18)	$386.90
Total aircraft (FY18)	681
Total operating and support costs per aircraft in millions (FY18)	$1.71
Maintenance costs per aircraft in millions	$0.77

Note: We obtained fiscal year 2018 operating and support (O&S) cost data from the Army, but we learned from the Army that the data was inaccurate. Thus, the costs presented here for the Army aircraft are based on fiscal year 2017 O&S cost data.

Sustainment Strategy

- The Apache Block III Life-Cycle Sustainment Plan (2012) documents plans to execute the upgrade program for the AH-64. The plan focuses on delivering warfighter required capabilities and implementing a comprehensive support strategy to support near-term and future sustainment strategy decisions. According to officials, the AH-64 program office is currently drafting a new version of the sustainment plan that will incorporate follow-on test and evaluation results and updated performance-based logistics contracts numbers. There was no planned release date for the sustainment plan at the time of this review.
- To provide sustainment support to the AH-64, the Army entered into performance-based logistics contracts with Boeing and Lockheed Martin. Boeing and the Army are responsible for supporting the sustainment of the airframe and Lockheed Martin provides sustainment support for the AH-64's sensors. Under these contracts, Boeing and Lockheed Martin provide management of the supply chain, maintenance, transportation, configuration, and reliability and obsolescence. Further, Boeing is responsible for establishing and conducting Army depot maintenance capability for the AH-64E.
- According to officials, the AH-64 has various initiatives to support sustainment, such as addressing acquisition lead times, corrosion prevention, obsolescence issues, and intellectual property rights problems.

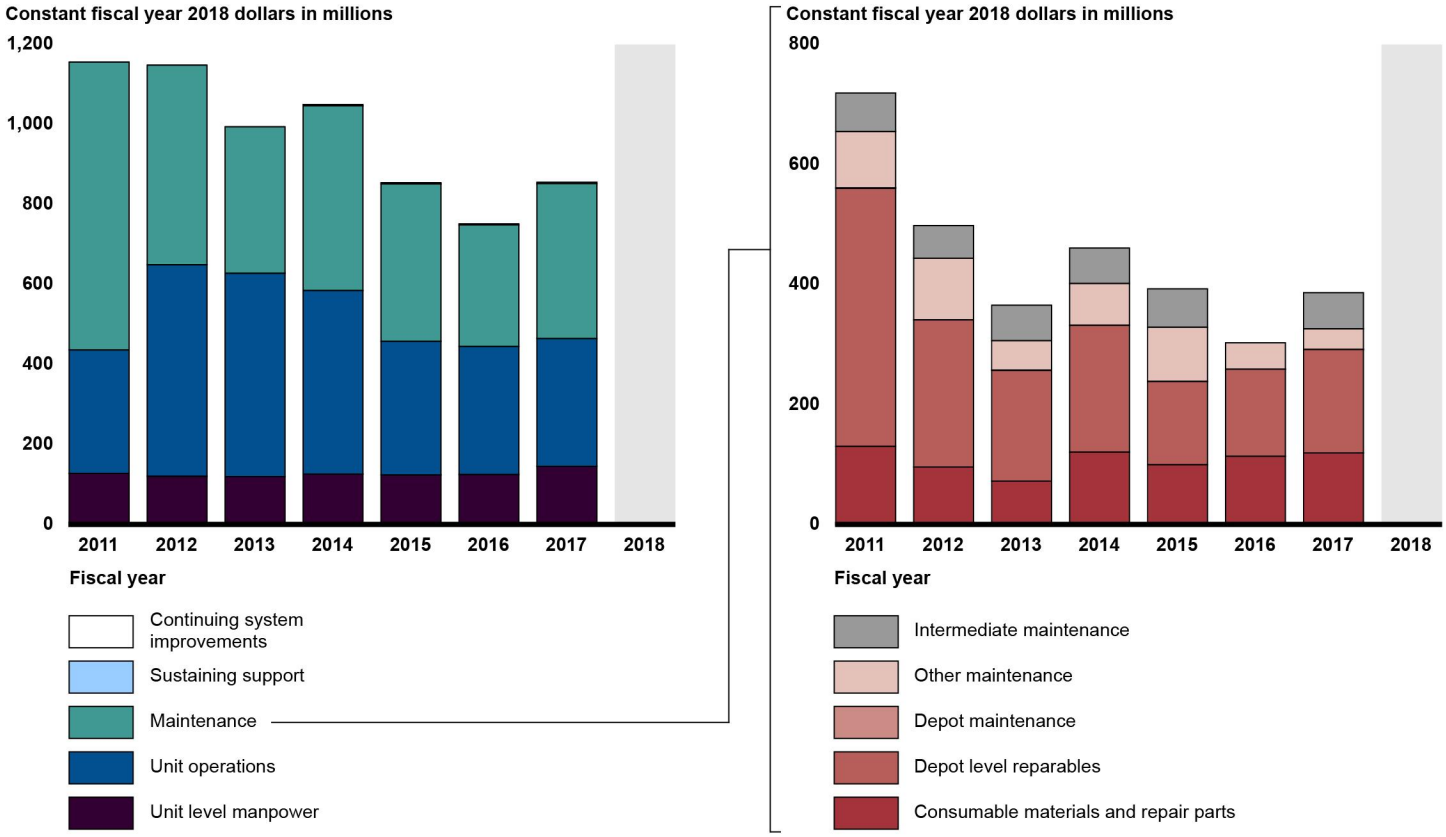
Availability and Condition

From fiscal year 2011 through fiscal year 2019, the AH-64 fell short of its mission capable goal each year. Further, from fiscal year 2011 through fiscal year 2019, the not mission capable maintenance (NMCM) and not mission capable supply (NMCS) rates varied. Officials explained that the NMCM and NMCS rate trends were due to spare parts quality and reliability issues, which required replacement and maintenance actions. Specific details on mission capable and not mission capable rates were omitted because the information was deemed by DOD to be sensitive.

Operating and Support Costs

The AH-64's overall O&S costs decreased from $1.16 billion in fiscal year 2011 to about $856.23 million in fiscal year 2017. Maintenance costs accounted for 46 percent of O&S costs over the period, and decreased overall by $332.55 million from fiscal years 2011 through 2017. According to officials, the AH-64Ds in the worst condition were the first aircraft to be scheduled for upgrade to the AH-64E fleet. Therefore, the officials stated that this upgrade increased the efficiency of the overall fleet and decreased overall maintenance costs for the aircraft. Depot-level reparables was the most significant category of maintenance costs, averaging $218.07 million per year, or 49 percent of total maintenance costs, from fiscal years 2011 through 2017. Depot maintenance costs was the smallest share, averaging $0.38 million per year, or less than 0.1 percent of total maintenance costs, during the same time period.

AH-64 Total Operating and Support Costs



Source: GAO analysis of Army data. | GAO-21-101SP

Data table for AH-64 Total Operating and Support Costs (Constant fiscal year 2018 dollars in millions)

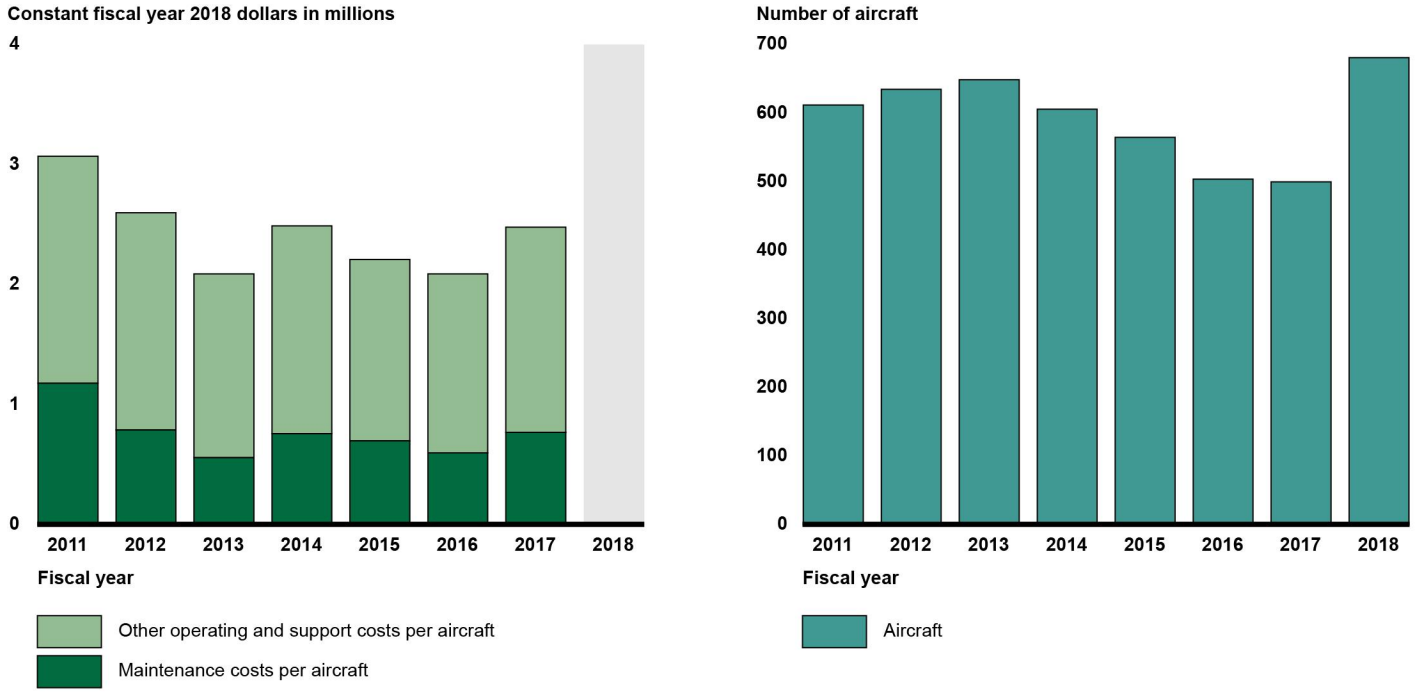
Fiscal year	Unit level manpower	Unit operations	Maintenance	Sustaining support	Continuing system improvements
2011	128.64	308.49	719.45	0	0
2012	121.58	528.38	498.73	0	0
2013	120.64	508.25	366.01	0	0
2014	127.05	458.69	461.43	3.14	0
2015	124.72	334.13	393.31	3.14	0
2016	126.12	319.74	303.57	3.04	0
2017	146.43	319.3	386.9	3.61	0

Fiscal year	Consumable materials and repair parts	Depot level reparables	Depot maintenance	Other maintenance	Intermediate maintenance
2011	130.9	429.53	1.13	93.7	64.19
2012	96.43	245.11	0	102.72	54.48
2013	72.93	184.42	0.53	49.02	59.12
2014	121.31	211.22	0	69.5	59.4
2015	100.14	138.87	0.08	90.34	63.86
2016	114.29	145.14	0.06	44.08	0
2017	120.03	172.19	0.11	34.31	60.26

Note: We obtained fiscal year 2018 operating and support (O&S) cost data from the Army, but we learned from the Army that the data was inaccurate. Thus, the costs presented here for the Army aircraft are based on fiscal year 2017 O&S data.

From fiscal years 2011 through 2017, the AH-64's O&S costs per aircraft decreased from about $1.89 million to $1.71 million and the mission capable rate decreased. Also, maintenance costs per aircraft, on average, accounted for almost half of the total cost per aircraft over the same time period, averaging about $770,000 million per year. Additionally, the number of aircraft in the fleet increased from 612 in fiscal year 2011 to 681 in fiscal year 2018.

AH-64 Operating and Support Costs per Aircraft and Fleet Size



Source: GAO analysis of Army data. | GAO-21-101SP

Data table for AH-64 Operating and Support Costs per Aircraft and Fleet Size (Constant fiscal year 2018 dollars in millions)

Fiscal year	Maintenance costs per aircraft	Other operating and support costs per aircraft
2011	1.18	1.89
2012	0.79	1.81
2013	0.56	1.53
2014	0.76	1.73
2015	0.7	1.51
2016	0.6	1.49
2017	0.77	1.71

Fiscal year	Number of aircraft
2011	612
2012	635
2013	649
2014	606
2015	565
2016	504
2017	500

Note: We obtained fiscal year 2018 operating and support (O&S) cost data from the Army, but we learned from the Army that the data was inaccurate. Thus, the costs presented here for the Army aircraft are based on fiscal year 2017 O&S data.

Sustainment Challenges and Mitigation Actions

Maintenance: According to program officials, delayed administrative timelines for executing repair contracts negatively affected maintenance times for the AH-64. The Army's ongoing actions include putting additional tools in place to provide proper notification of expiring contracts so that Army officials can extend and quickly award contracts before the expiration date.

Supply Support: Army officials have stated that the Army has experienced issues with parts quality that have caused delays in repair times, delayed production timelines when procuring spare parts for the AH-64, and parts shortages. According to officials, the program office has faced challenges related to manufacturer parts quality issues, which led to additional maintenance actions and increased the NMCM and NMCS rates in 2017 and 2018. To address these issues, the program office worked with manufacturers to perform required replacement and maintenance actions reducing both the unit burden and the time required to complete corrective maintenance actions, as well as to form a strategic plan to prevent future parts reliability issues. Additionally, officials stated they have also faced production and repair delays of parts, which the Army has worked to mitigate by leading monthly engagements with parts suppliers to reduce production lead times. Finally, to combat parts shortages, Army officials stated that they continually work with Boeing and the Defense Logistics Agency to expedite deliveries to address parts shortages affecting Corpus Christi Army Depot and commercial repair output of parts.

Program Office Comments

In commentating on a draft of this assessment, the program office provided technical comments, which we incorporated where appropriate.

Source: U.S. Army/Scott T. Sturkol. | GAO-21-101SP

CH-47 Chinook Sustainment Quick Look

Common Name: CH-47

Lead Service: Army

Program Essentials

Manufacturer: Boeing

Sustainment: Depot maintenance conducted at Army depots and contractor sites. Field maintenance conducted by Army personnel at the unit level.

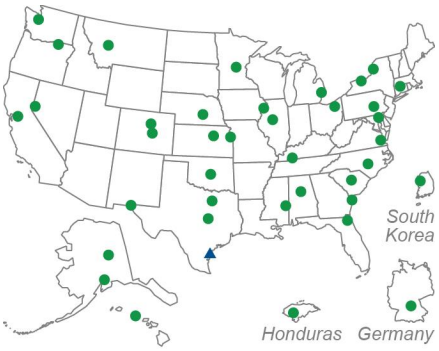
Program Office: Project Manager Cargo Helicopters, Redstone Arsenal, Alabama.

Fiscal Year 2019 Data

Average age: 6.53 years (CH-47F)

Average lifetime flying hours: 1,285.28 hours per aircraft (CH-47F)

Depot maintenance activity and combat aviation brigade locations:



▲ Depot maintenance activity location

● Combat aviation brigade location

Source: GAO. | GAO-21-101SP

Sustainment Challenges and Mitigation Actions

The Army finished transitioning its CH-47Ds to CH-47Fs to improve capability and reduce unscheduled maintenance. However, the program office is working to address remaining supply support issues with corrective action plans and process improvements.

Background

The CH-47 Chinook is a heavy-lift cargo rotary wing aircraft that was first manufactured in 1982. It transports forces and heavy equipment to provide routine aerial sustainment of maneuver forces. Between fiscal year 2011 and fiscal year 2018 there were two models of the CH-47, D and F, with program office officials confirming that the D model was retired in 2018. According to program office officials, modernization from the CH-47D to the CH-47F began in 2004, with planned completion of a full fleet upgrade by 2022, and as of 2019 there have been no D models flying.

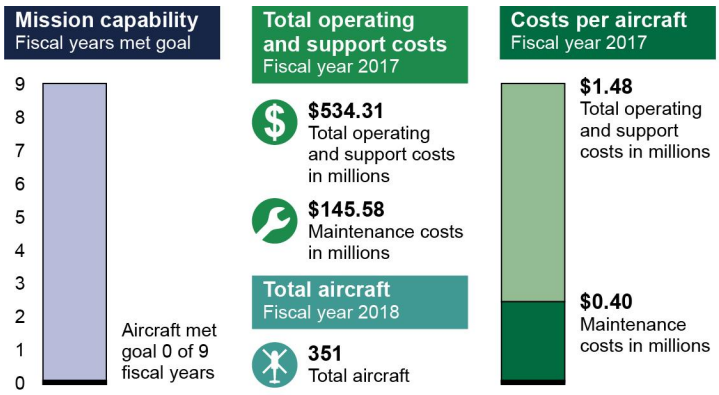
Life Cycle of the CH-47

Source: GAO analysis of Army data. | GAO-21-101SP

Overview

In fiscal year 2019, the CH-47 fleet did not meet its mission capable rate goal due to maintenance and supply issues, and did not meet its goal for any year from fiscal year 2011 to fiscal year 2019. Unavailability due to maintenance and supply issues decreased from fiscal year 2011 to fiscal year 2019 because, according to officials, the newer CH-47Fs replaced the older CH-47Ds. Additionally, operating and support (O&S) costs per aircraft decreased from about $2.07 million in fiscal year 2011 to about $1.48 million in fiscal year 2017. According to officials, maintenance costs decreased because the CH-47Fs required less unscheduled maintenance than the CH-47Ds.

CH-47 Sustainment Status



Source: GAO analysis of Army data. | GAO-21-101SP

Data table for CH-47 Sustainment Status

Mission capability	Aircraft met goal 0 of 9 fiscal years
Total operating and support costs in millions (FY18)	$534.31
Maintenance costs in millions (FY18)	$145.58
Total aircraft (FY18)	351
Total operating and support costs per aircraft in millions (FY18)	$1.48
Maintenance costs per aircraft in millions	$0.40

Note: We obtained fiscal year 2018 operating and support (O&S) cost data from the Army, but we learned from the Army that the data were inaccurate. Thus, the costs presented here for the Army aircraft are based on fiscal year 2017 O&S data.

Sustainment Strategy

- The CH-47F Chinook with Block II Life-Cycle Sustainment Plan (2016) documents the modernization program for the CH-47 and provides a product support strategy to minimize the costs and logistics footprint within the existing supply chain while meeting warfighter requirements. This upgrade strategy allows the CH-47 program office to incrementally insert technology upgrades into the CH-47F model while maintaining affordability and meeting requirements.
- There was no depot maintenance program for the CH-47 between fiscal year 2011 and fiscal year 2019 because the aircraft was being modernized, according to program office officials. The Army initially sustained the CH-47 with interim contractor support and then transitioned to either organic or limited performance-based logistics support. Field maintenance is performed by combat aviation brigade personnel.
- According to officials, the Defense Logistics Agency and Army Aviation and Missile Command provide supply support for the CH-47.

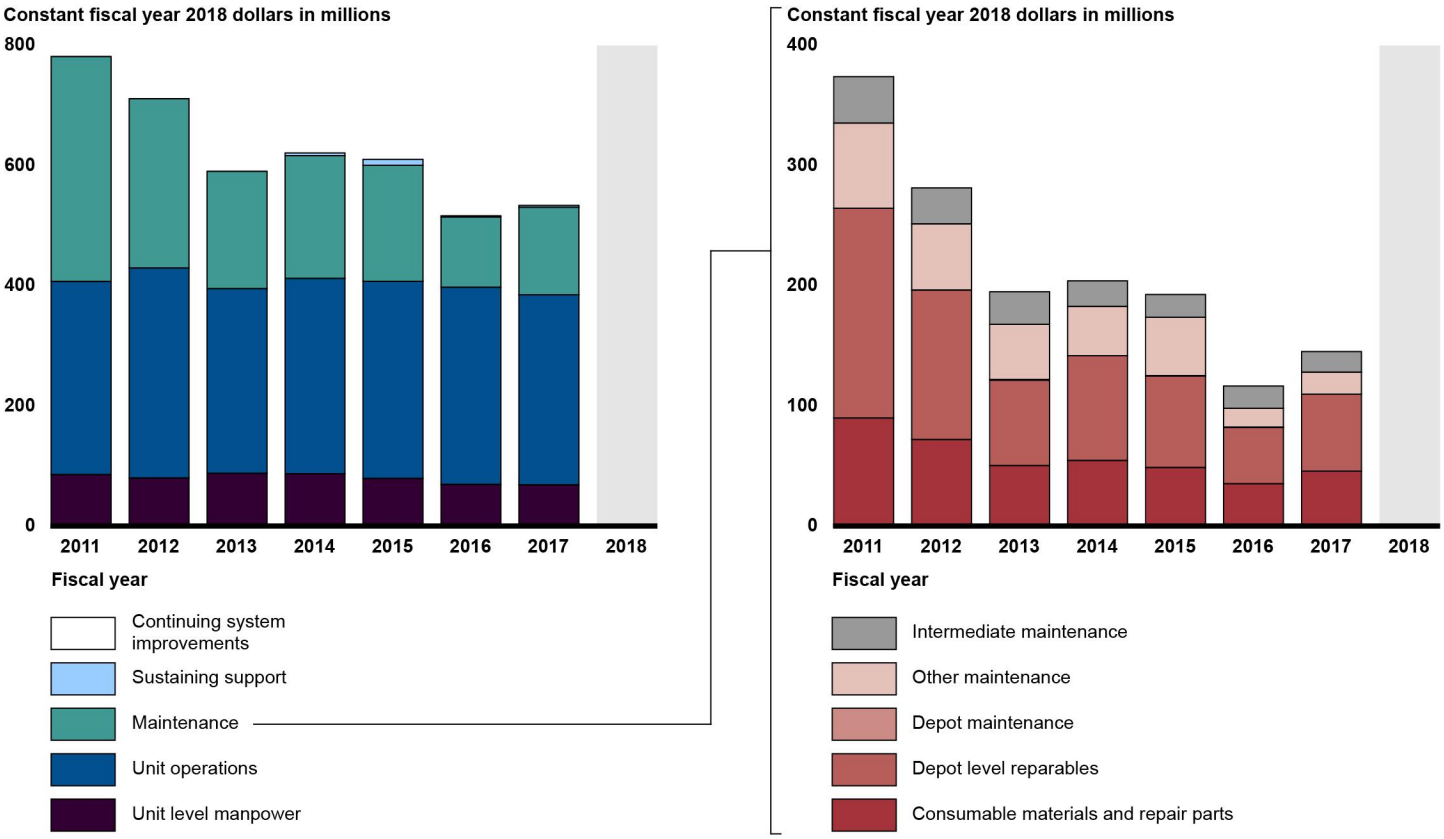
Availability and Condition

From fiscal year 2011 through fiscal year 2019, the CH-47 missed its mission capable goals. However, the percent of mission capable aircraft increased from fiscal year 2011 to fiscal year 2019 as more CH-47F aircraft were operated and maintained. According to officials, the CH-47 missed its goals because the CH-47D—which required more unscheduled maintenance than the CH-47F—was still in the fleet at that time. The CH-47D was no longer flying as of 2019, and officials expect to complete the fleet upgrade to the CH-47F by 2022. From fiscal year 2011 through fiscal year 2019, the not mission capable maintenance (NMCM) rate decreased, while the not mission capable supply (NMCS) rate remained relatively steady. Specific details on mission capable and not mission capable rates were omitted because the information was deemed by DOD to be sensitive.

Operating and Support Costs

From fiscal year 2011 through fiscal year 2017, the CH-47's total O&S costs decreased from $781.82 million to $534.31 million, as the mission capable rate increased. Unit operations costs accounted for the largest share of O&S costs over the period, averaging about $324.96 million per year during the same time period. Maintenance costs decreased significantly, from $374.22 million in fiscal year 2011 to $145.48 million in fiscal year 2017. According to officials, the older CH-47Ds required more unscheduled maintenance than did the newer CH-47Fs, so as the fleet was upgraded, maintenance costs—and as a result overall O&S costs—decreased.

CH-47 Total Operating and Support Costs



Source: GAO analysis of Army data. | GAO-21-101SP

Data table for CH-47 Total Operating and Support Costs (Constant fiscal year 2018 dollars in millions)

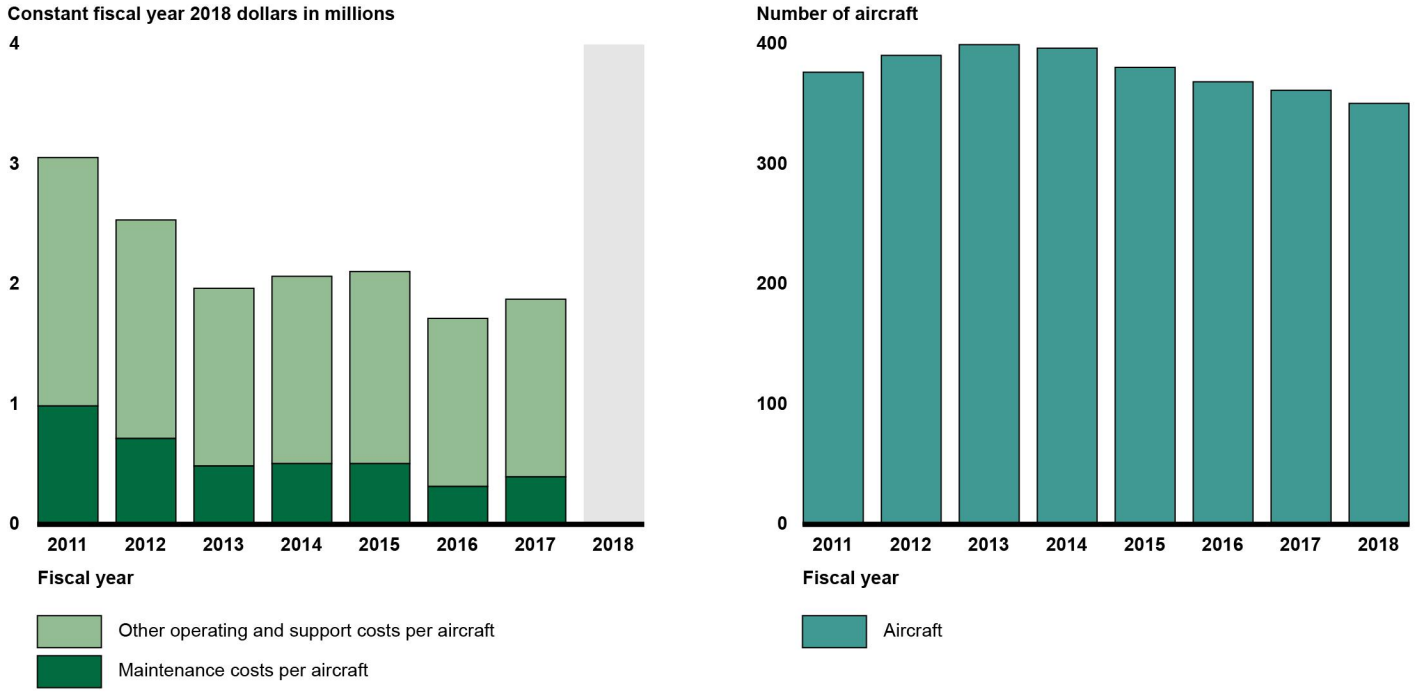
Fiscal year	Unit level manpower	Unit operations	Maintenance	Sustaining support	Continuing system improvements
2011	86.48	321.13	374.22	0	0
2012	80.71	349.29	281.68	0	0
2013	88.54	307.06	195.3	0	0
2014	87.71	324.97	204.36	4.46	0
2015	79.87	328.06	193.09	9.98	0
2016	70.1	327.91	116.93	2.14	0
2017	69.37	316.33	145.58	3.02	0

Fiscal year	Consumable materials and repair parts	Depot level reparables	Depot maintenance	Other maintenance	Intermediate maintenance
2011	90.29	174.53	0	70.72	38.68
2012	72.41	124.26	0	55.09	29.93
2013	50.68	71.06	0.53	46.02	27.02
2014	54.96	87.15	0	41.01	21.24
2015	49.12	76.12	0.28	48.67	18.91
2016	35.54	46.85	0.24	15.83	18.46
2017	46.14	64.04	0	18.23	17.18

Note: We obtained fiscal year 2018 operating and support (O&S) cost data from the Army, but we learned from the Army that the data were inaccurate. Thus, the costs presented here for the Army aircraft are based on fiscal year 2017 O&S data.

From fiscal year 2011 through fiscal year 2017, the CH-47's O&S costs per aircraft decreased from $2.07 million to $1.48 million, while mission capable rates increased. Also, maintenance costs per aircraft decreased from $0.99 million in fiscal year 2011 to $0.4 million in fiscal year 2017. According to officials, the Army was transitioning the older CH-47Ds, which required more unscheduled maintenance, to the newer CH-47Fs during the time period. Additionally, the number of aircraft decreased from 377 aircraft in fiscal year 2011 to 362 aircraft in fiscal year 2017; however, according to officials, the Army plans to have 465 CH-47F aircraft—246 new builds and 219 upgraded CH-47D models—once the upgrade process is complete in 2022.

CH-47 Operating and Support Costs per Aircraft and Fleet Size



Source: GAO analysis of Army data. | GAO-21-101SP

Data table for CH-47 Operating and Support Costs per Aircraft and Fleet Size (Constant fiscal year 2018 dollars in millions)

Fiscal year	Maintenance costs per aircraft	Other operating and support costs per aircraft
2011	0.99	2.07
2012	0.72	1.82
2013	0.49	1.48
2014	0.51	1.56
2015	0.51	1.6
2016	0.32	1.4
2017	0.4	1.48

Fiscal year	Number of aircraft
2011	377
2012	391
2013	400
2014	397
2015	381
2016	369
2017	362
2018	351

Note: We obtained fiscal year 2018 operating and support (O&S) cost data from the Army, but we learned from the Army that the data were inaccurate. Thus, the costs presented here for the Army aircraft are based on fiscal year 2017 O&S data.

Sustainment Challenges and Mitigation Actions

Maintenance: According to program office officials, the CH-47D required more unscheduled maintenance than did the CH-47F, which is typical for older aircraft. However, as the fleet is fully upgraded to CH-47F models, this unscheduled maintenance is expected to decrease, resulting in greater availability of the aircraft for Combat Aviation Brigades. In addition, according to officials, the program office began implementation of a new scheduled maintenance plan for the CH-47F fleet in June 2019, which is based on best commercial practice and methodology. Under this plan, officials stated that task inspection intervals have been significantly extended; for example, heavy maintenance inspections scheduled at 200 and 400 flying hours will now be performed at 320 and 640 flying hours,

which officials expect will lead to a 2.5 percent reduction in scheduled maintenance downtime across the fleet. According to program office officials, the goal is to have the entire CH-47F fleet under this new maintenance plan by July 2021.

Supply Support: According to program office officials, one of the biggest sustainment challenges for the CH-47 has been having access to low-demand, but critical, parts, such as airframe components and outer surface skins. To mitigate this issue, officials told us that they utilize the open CH-47F production line to get parts that are causing availability issues, and that they have had specific parts fabricated at Army Logistics Readiness Centers. Further, supply chain management issues continue to be a problem, due to a low volume of parts in the system, long production lead times, and delinquent deliveries, according to officials. According to officials, the program office continues to work with Boeing and other contractors to identify high risk parts and suppliers and to implement corrective actions for the root causes, improve processes, and develop risk mitigation strategies for each part and its supplier. According to officials, they also have ongoing engagements with the Defense Logistics Agency, Army Aviation and Mission Command, and Army Contracting Command, as well as with original equipment manufacturers and suppliers, to mitigate excessive lead times and delinquent deliveries. Lastly, officials stated that managing avionics and software systems to address obsolescence issues has been a significant challenge that is expected to continue at an increasing rate. According to officials, the program office conducts proactive obsolescence monitoring for components and seeks out industry support to mitigate this issue, but these re-design efforts—even if funded by the original equipment manufacturers—are costly.

Program Office Comments

In commenting on a draft of this assessment, the program office provided technical comments, which we incorporated where appropriate.

Source: U.S. Army/Scott T. Sturkol. | GAO-21-101SP

UH/HH-60 Black Hawk Sustainment Quick Look

Common Name: Black Hawk Utility Helicopter

Lead Service: Army

Program Essentials

Manufacturer: Sikorsky Aircraft Corporation

Sustainment: Depot maintenance conducted at the Corpus Christi Army Depot. Field maintenance conducted by Army personnel at the unit level.

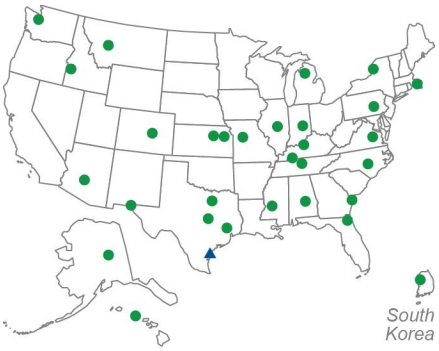
Program Office: Program Manager Utility Helicopters, Redstone Arsenal, Alabama

Fiscal Year 2019 Data

Average age: 15.86 years

Average number of lifetime flying hours: 184.2 hours per aircraft

Depot maintenance activity and combat aviation brigade locations:



▲ Depot maintenance activity location

● Combat aviation brigade location

Source: GAO. | GAO-21-101SP

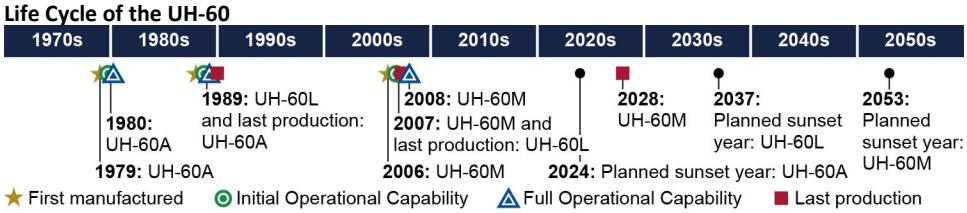
Sustainment Challenges and Mitigation Actions

The UH/HH-60 fleet faces parts supply challenges. Officials are implementing actions to improve the acquisition and quality of spare parts.

Background

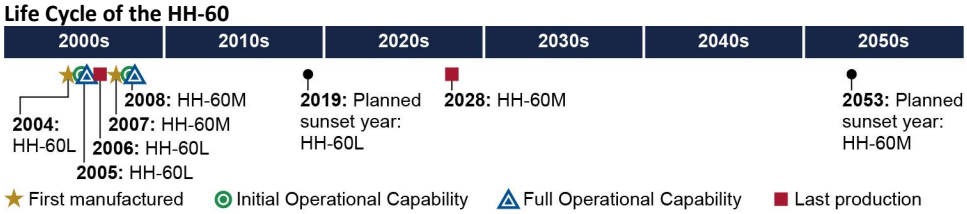
The UH/HH-60 Black Hawk is a utility tactical transport helicopter. The UH-60 provides air assault, general support, command and control, and special operations support to combat, stability, and support operations, and the HH-60 is a variant that also provides aeromedical evacuation services. The HH-60 and UH-60 are managed in an integrated manner due to their similarities, according to Army officials.

Life Cycle of the UH-60



Source: GAO analysis of Air Force data. | GAO-21-101SP

Life Cycle of the HH-60

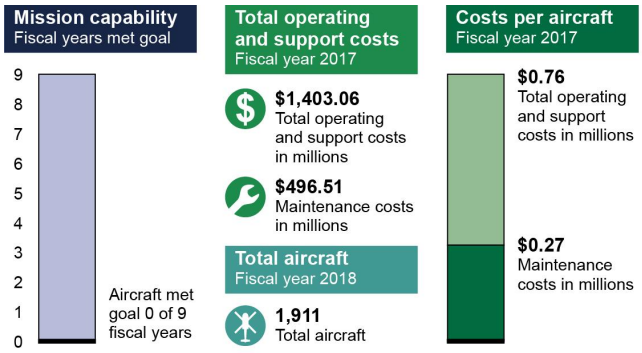


Source: GAO analysis of Air Force data. | GAO-21-101SP

Overview

The UH/HH-60 fleet did not meet its mission capable goal in any year from fiscal year 2011 through 2019. However, the percent of mission capable aircraft increased from fiscal year 2011 to year 2019. Operating and support (O&S) costs per aircraft decreased, from about $1.06 million in fiscal year 2011 to $0.76 million in fiscal year 2017.

UH/HH-60 Sustainment



Source: GAO analysis of Army data. | GAO-21-101SP

Data table for UH/HH-60 Sustainment

Mission capability	Aircraft met goal 0 of 9 fiscal years
Total operating and support costs in millions (FY18)	$1,403.06
Maintenance costs in millions (FY18)	$496.51
Total aircraft (FY18)	1,911
Total operating and support costs per aircraft in millions (FY18)	$0.76
Maintenance costs per aircraft in millions	$0.27

Note: We obtained fiscal year 2018 operating and support (O&S) cost data from the Army, but we learned from the Army that the data were inaccurate. Thus, the costs presented here for the Army aircraft are based on fiscal year 2017 O&S data.

Sustainment Strategy

- The H-60L and H-60M Life Cycle Sustainment Plans provide a roadmap for the sustainment of the aircraft, with the UH-60A being covered under the H-60L plan, according to Army officials. The Army manages the UH-60A, UH/HH-60L, and UH/HH-60M in an integrated manner, according to program officials.
- The Army is focused on executing a 100-percent organic core capability for all UH/HH-60 airframes and depot-level reparables. The Army performs depot maintenance on the aircraft at Corpus Christi Army Depot, Texas.
- The Army uses Sikorsky Aircraft Corporation, the Army Supply System, and the Defense Logistics Agency to obtain parts for the aircraft. Specifically, the Army uses long-term strategic contracts that are managed by the Defense Logistics Agency to procure spare parts for the UH/HH-60.

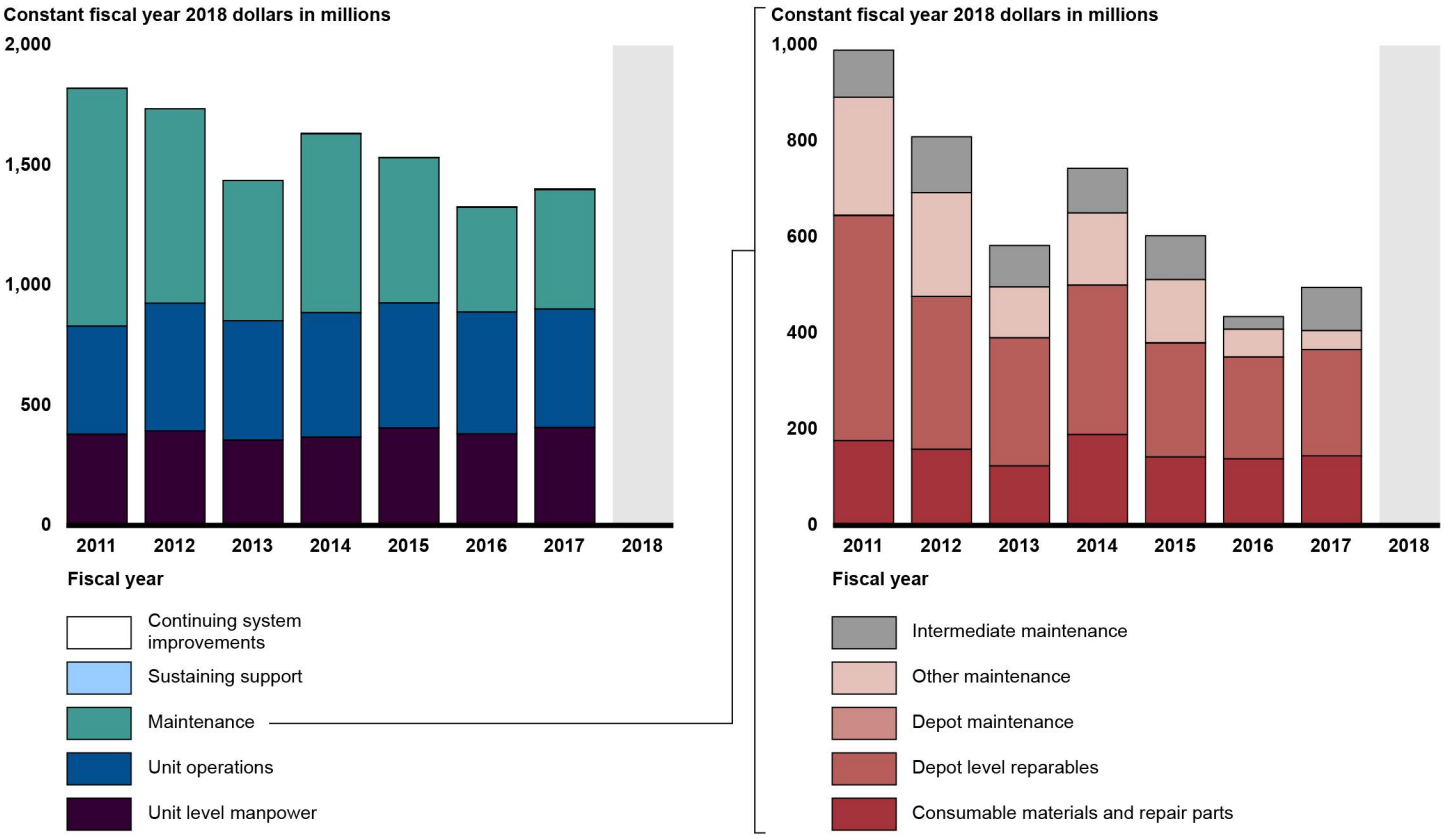
Availability and Condition

From fiscal year 2011 through fiscal year 2019, the UH/HH-60 missed its mission capable goals. However, the percent of mission capable aircraft increased from fiscal year 2011 to fiscal year 2019. According to officials, the UH/HH-60 missed its goals because of spare parts quality issues as well as a reduction of repair programs and late deliveries of supply items by the vendor. From fiscal year 2011 through fiscal year 2019, the not mission capable maintenance (NMCM) rate decreased, while the not mission capable supply (NMCS) rate increased. Officials explained that the increase in the NMCS rate was due, in part, to spare parts quality and availability issues, which required replacements due to recalls for safety purposes. Specific details on mission capable and not mission capable rates were omitted because the information was deemed by DOD to be sensitive.

Operating and SupportCosts

From fiscal year 2011 through fiscal year 2017, the UH/HH-60's overall O&S costs decreased, from about $1.82 billion in fiscal year 2011 to about $1.4 billion in fiscal year 2017. Maintenance accounted for 43 percent of O&S costs over the period, but overall O&S costs decreased by $494.06 million between fiscal years 2011 and 2017. According to officials, upgrading the UH-60A aircraft to UH-60M aircraft decreased the overall maintenance costs for the fleet. Depot-level reparables was the most significant category of maintenance costs, averaging $290.66 million per year, or 44 percent of total maintenance costs from fiscal years 2011 through 2017. Depot maintenance was the smallest maintenance cost category, averaging $0.53 million per year, or less than 1 percent of total maintenance costs for the same time period.

UH/HH-60 Total Operating and Support Costs



Source: GAO analysis of Army data. | GAO-21-101SP

Data table for UH/HH-60 Total Operating and Support Costs (Constant fiscal year 2018 dollars in millions)

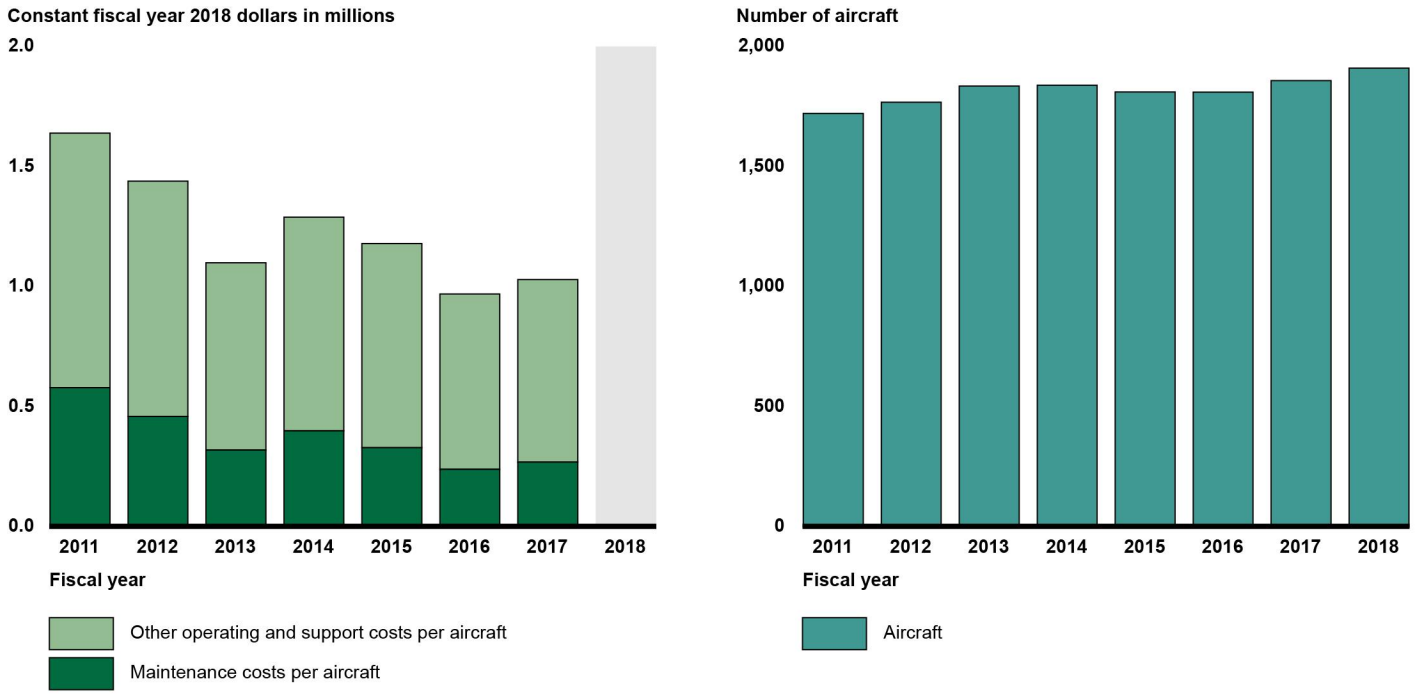
Fiscal year	Unit level manpower	Unit operations	Maintenance	Sustaining support	Continuing system improvements
2011	382.09	449.56	990.57	0	1.29
2012	395.98	531.11	810.19	0	0
2013	357.43	497.02	583.92	0	0
2014	370.29	517.94	744.74	1.39	0
2015	408.29	520.62	604.3	1.66	0
2016	383.02	507.58	436.14	1.72	0
2017	409.88	493.41	496.51	3.25	0.01

Fiscal year	Consumable materials and repair parts	Depot level reparables	Depot maintenance	Other maintenance	Intermediate maintenance
2011	177.51	468.57	1	245.54	97.94
2012	159.49	318.39	0	216.09	116.23
2013	125.02	266.57	0	106.05	86.28
2014	190.42	310.83	0.01	150.28	93.2
2015	143.6	236.92	0.94	131.55	91.28
2016	139.55	212	0.18	57.81	26.61
2017	146.13	221.35	0	39.29	89.75

Note: We obtained fiscal year 2018 operating and support (O&S) cost data from the Army, but we learned from the Army that the data were inaccurate. Thus, the costs presented here for the Army aircraft are based on fiscal year 2017 O&S data.

From fiscal year 2011 through fiscal year 2017, the UH/HH-60's O&S costs per aircraft decreased, from about $1.06 million to $0.76 million, while the mission capable rate increased, from 69 percent to 74 percent. Maintenance costs per aircraft, on average, accounted for about 43 percent of the total O&S costs per aircraft, averaging $0.37 million per year between fiscal years 2011 and 2017. Additionally, the number of aircraft in the fleet increased, from 1,722 in fiscal year 2011 to 1,911 in fiscal year 2018.

UH/HH-60 Operating and Support Costs per Aircraft and Fleet Size



Source: GAO analysis of Army data. | GAO-21-101SP

Data table for **UH/HH-60 Operating and Support Costs per Aircraft and Fleet Size (Constant fiscal year 2018 dollars in millions)**

Fiscal year	Maintenance costs per aircraft	Other operating and support costs per aircraft
2011	0.58	1.06
2012	0.46	0.98
2013	0.32	0.78
2014	0.4	0.89
2015	0.33	0.85
2016	0.24	0.73
2017	0.27	0.76

Fiscal year	Number of aircraft
2011	1722.25
2012	1768.67
2013	1836.25
2014	1839.17
2015	1811.5
2016	1810.5
2017	1858.33
2018	1910.75

Note: We obtained fiscal year 2018 operating and support (O&S) cost data from the Army, but we learned from the Army that the data were inaccurate. Thus, the costs presented here for the Army aircraft are based on fiscal year 2017 O&S data.

Sustainment Challenges and Mitigation Actions

Supply Support: The Army has experienced parts quality challenges that have caused delays in repair and parts production lead times for the UH/HH-60. To address these challenges, the program office is adjusting lead time requirements and using more long-term contracts with manufacturers. Additionally, officials stated that they have worked to mitigate parts issues by leading monthly engagements with parts suppliers to reduce production lead times. Army officials also stated that they continually work with Sikorsky Aircraft Corporation and the Defense Logistics Agency to expedite deliveries for parts shortages impacting Corpus Christi Army Depot and commercial repair output.

Program Office Comments

In commenting on a draft of this assessment, the program office provided technical comments, which we incorporated where appropriate.

Source: U.S. Navy/Mass Communication Specialist 2nd Class Mark Andrew Hays. | GAO-21-101SP

MH-60R Seahawk Sustainment Quick Look

Common Name: MH-60 Romeo

Lead Service: Navy

Program Essentials

Manufacturer: Sikorsky

Sustainment: Depot maintenance conducted at Navy Fleet Readiness Centers and field maintenance conducted by Navy maintainers

Program Office: Program Manager – Air 299, Naval Air Systems Command, Patuxent River, Maryland

Fiscal Year 2019 Data

Average age: 6.76 years

Average lifetime flying hours: 2,547 hours per aircraft

Depot maintenance activity and squadron locations:

▲ Depot maintenance activity location

● Squadron location

Source: GAO. | GAO-21-101SP

Sustainment Challenges and Mitigation Actions

The MH-60R faces maintenance challenges, as its fleet size grew rapidly between fiscal years 2011 and 2019. Officials are working to address these issues.

Background

The MH-60R Seahawk is a twin engine helicopter first manufactured in 2005. Its primary missions are anti-submarine warfare, anti-surface warfare, and electromagnetic warfare. The MH-60R is designed to operate aboard cruisers, destroyers, littoral combat ships, and aircraft carriers. The aircraft is equipped with a 250-foot cable rescue hoist with a 600-pound lift capability, and a cargo hook with a 6,000-pound capacity.

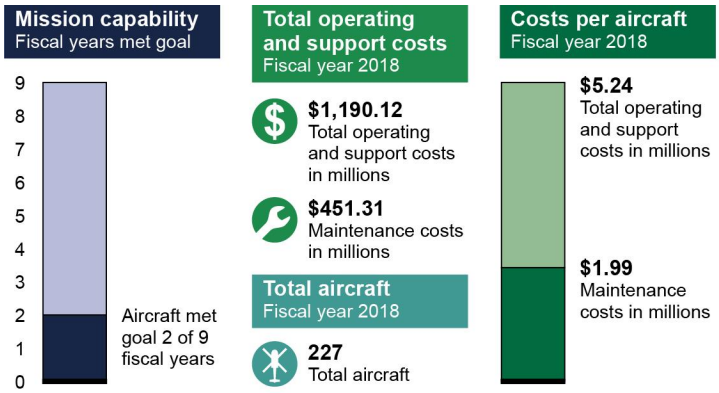
Life Cycle of the MH-60R

Source: GAO analysis of Navy data. | GAO-21-101SP

Overview

In fiscal year 2019, the MH-60R fleet did not meet its mission capable goal because some of the fleet was not mission capable due to depot, maintenance, and supply issues. In addition, the MH-60R exceeded its mission capable goals in only two years from fiscal year 2011 through 2019. Total not mission capable rates increased from fiscal year 2011 to fiscal year 2019 because of low maintenance personnel-to-aircraft ratios, according to Navy officials. Additionally, operating and support (O&S) costs per aircraft increased, from about $4.33 million in fiscal year 2011 to about $5.24 million in fiscal year 2018. According to officials, O&S costs grew during this time period because the total number of aircraft increased, which required additional personnel to maintain and support additional fielded aircraft, squadrons, and sites.

MH-60R Sustainment Status



Source: GAO analysis of Navy data. | GAO-21-101SP

Data table for MH-60R Sustainment Status

Mission capability	Aircraft met goal 2 of 9 fiscal years
Total operating and support costs in millions (FY18)	$1,190.12
Maintenance costs in millions (FY18)	$451.31
Total aircraft (FY18)	227
Total operating and support costs per aircraft in millions (FY18)	$5.24
Maintenance costs per aircraft in millions	$1.99

Sustainment Strategy

- The MH-60R Multi-Mission Helicopter Acquisition Logistics Support Plan (2005) describes the strategy to coordinate and manage the logistics elements supporting the sustainment of the program. The plan provides the planning data to accomplish life-cycle support for the program and contains logistics information and a production planning management tool. Further, the plan is designed to utilize the benefits derived from support planning and program accomplishments on other H-60 aircraft in an attempt to eliminate the need for redevelopment, re-validation, and re-verification of Navy resources.
- The Naval Supply Systems Command awarded a performance-based logistics contract in 2015 to primarily repair MH-60 depot-level reparables and manage the inventory of those spare parts, with the option for the contractor to buy parts if replacements were needed.
- Depot maintenance occurs at Navy Fleet Readiness Centers, and Navy maintainers sustain and conduct field maintenance for the MH-60R. Generally, depot maintenance occurs every 3 years, according to officials.

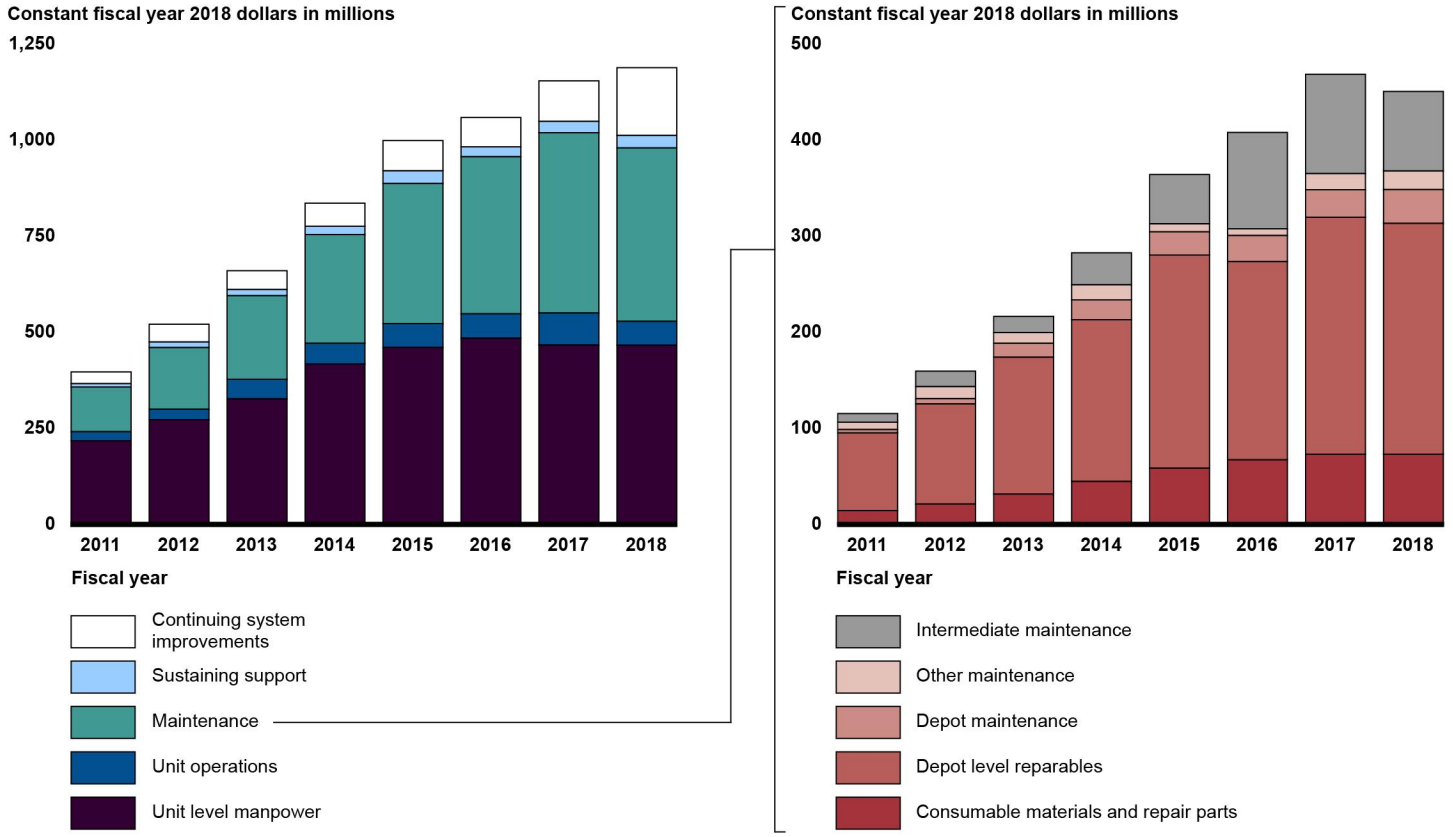
Availability and Condition

The MH-60R exceeded its mission capable goals in only two years from fiscal year 2011 through 2019. Also, the percent of mission capable aircraft decreased each year from fiscal year 2011 to fiscal year 2019. According to Navy officials, the MH-60R missed its mission capable goals due to low maintenance personnel-to-aircraft ratios, insufficient skills of and training for maintenance personnel, and a lack of updated technical publications. From fiscal year 2011 through fiscal year 2019, the not mission capable rates maintenance (NMCM) and supply (NMCS) rates generally increased. According to Navy officials, the NMCM rate increase was due to a shortage of maintenance personnel as the number of aircraft increased. Furthermore, in fiscal years 2018 and 2019, the NMCS rate was increasingly an issue for the aircraft, and officials explained that parts inventories were unable to keep pace with aircraft deliveries. Specific details on mission capable and not mission capable rates were omitted because the information was deemed by DOD to be sensitive.

Operating and Support Costs

From fiscal year 2011 through fiscal year 2018, the MH-60R's total O&S costs tripled, which officials said was largely due to an increase in the fleet size—from 92 aircraft in fiscal year 2011 to 227 in fiscal year 2018. According to officials, this increase in the fleet size led to additional personnel requirements to maintain the aircraft and sites. Maintenance costs accounted for a large share of O&S costs over the period, increasing from about $115.94 million in fiscal year 2011 to $451.31 million in fiscal year 2018, which officials explained was caused by the increase in the number of aircraft and flight hours. The largest category of maintenance costs was depot-level reparables, which increased from about $80.73 million in fiscal year 2011 to $240.3 million in fiscal year 2018. According to officials, the increase in costs for depot-level reparables was due to an increase in depot inductions as new aircraft entered their first depot maintenance induction cycles and warranties expired on new production parts.

MH-60R Total Operating and Support Costs



Source: GAO analysis of Navy data. | GAO-21-101SP

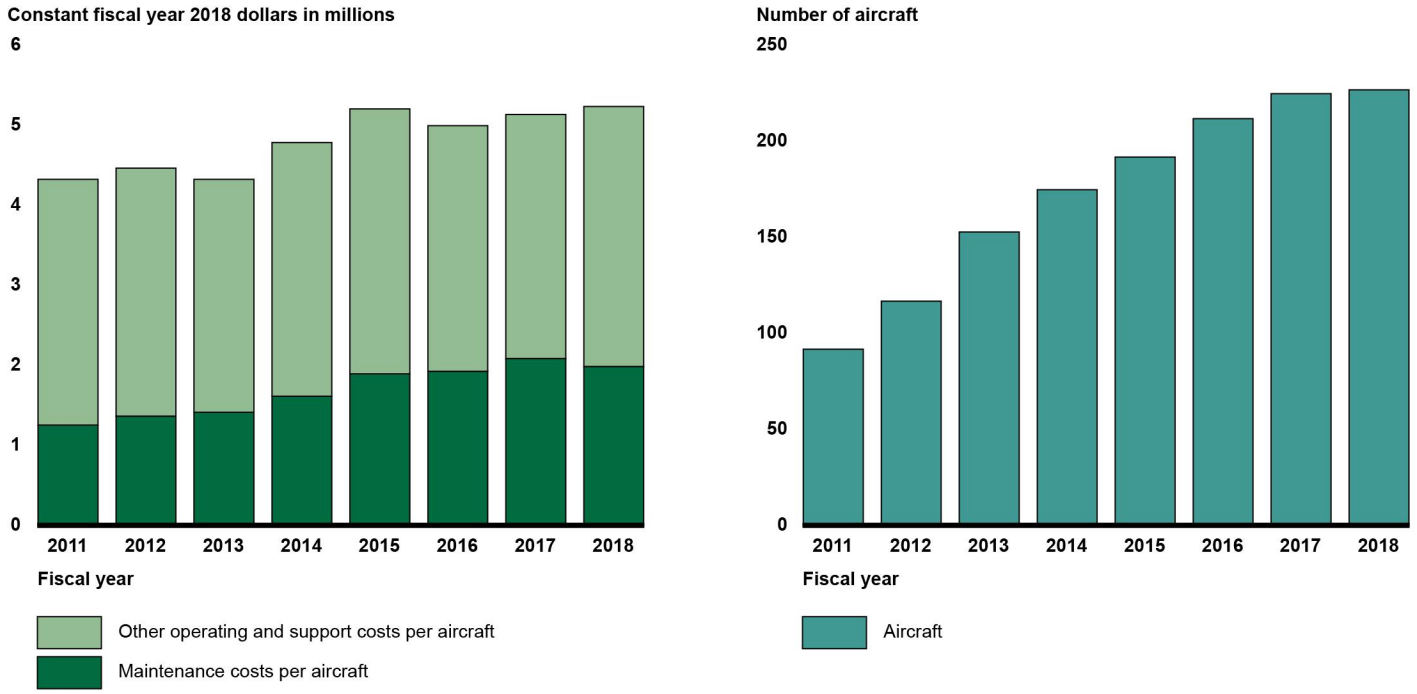
Data table for MH-60R Total Operating and Support Costs (Constant fiscal year 2018 dollars in millions)

Fiscal year	Unit level manpower	Unit operations	Maintenance	Sustaining support	Continuing system improvements
2011	219.27	23.76	115.94	8.93	30.6
2012	274.31	27.01	160.16	14.65	46.31
2013	328.31	50.97	217.21	16.42	48.94
2014	419.24	53.54	283.24	21.27	60.19
2015	461.91	62.11	364.79	32.81	78.85
2016	486.36	63.27	408.59	25.98	76.16
2017	468.28	83.22	469.14	29.79	105.38
2018	467.85	62	451.31	32.71	176.25

Fiscal year	Consumable materials and repair parts	Depot level reparables	Depot maintenance	Other maintenance	Intermediate maintenance
2011	15.02	80.73	3.57	7.67	8.95
2012	21.75	104.16	5.65	12.35	16.25
2013	32.14	142.56	14.45	11.19	16.87
2014	45.36	168.38	20.55	15.67	33.29
2015	59.1	221.97	24.15	8.21	51.36
2016	67.78	206.42	27.09	7.02	100.28
2017	73.66	246.61	28.8	16.68	103.39
2018	73.69	240.3	35.11	19.32	82.89

From fiscal year 2011 through fiscal year 2018, the MH-60R's O&S costs per aircraft increased from about $4.33 million in fiscal year 2011 to $5.24 million in fiscal year 2018. Unit level manpower, maintenance, and continuing system improvement costs increased as the number of aircraft more than doubled, from 92 aircraft in fiscal year 2011 to 262 aircraft in fiscal year 2019. According to officials, this increase in fleet size increased the number of flying hours, which also led to an increase in fuel costs captured under unit operations costs over this time period.

MH-60R Operating and Support Costs per Aircraft Compared and Fleet Size



Source: GAO analysis of Navy data. | GAO-21-101SP

Data table for MH-60R Operating and Support Costs per Aircraft Compared and Fleet Size (Constant fiscal year 2018 dollars in millions)

Fiscal year	Maintenance costs per aircraft	Other operating and support costs per aircraft
2011	1.26	3.07
2012	1.37	3.1
2013	1.42	2.91
2014	1.62	3.17
2015	1.9	3.31
2016	1.93	3.07
2017	2.09	3.05
2018	1.99	3.25

Fiscal year	Number of aircraft
2011	92
2012	117
2013	153
2014	175
2015	192
2016	212
2017	225
2018	227

Sustainment Challenges and Mitigation Actions

Maintenance: According to officials, maintenance of the MH-60R has been challenging due to a lack of adequately trained maintenance personnel, technical publications, and funding. The officials explained that the number of aircraft requiring support increased above the primary authorized allowance, and the funding provided for support equipment and logistics was not increased to support the assigned aircraft. To combat these issues, officials stated that they are working to adjust priorities to better support the fleet, better communicate requirements for sustainment, and develop performance plans.

Supply: Officials acknowledged that there was an increased shortage of parts to repair the aircraft in fiscal year 2018. Officials also told us that they are working to be proactive and better position the program to react to any unforeseen issues with parts wearing out. Specifically, program officials reported that they are planning to better align the number of aircraft requiring support—which currently exceeds the primary authorized allowance—with the available resources for sustaining the fleet, to ensure that the fleet is not larger than they have the supply support to handle.

Program Office Comments

In commenting on a draft of this assessment, the program office provided technical comments, which we incorporated where appropriate.

Source: U.S. Navy/Mass Communication Specialist 3rd Class Steven Edgar. | GAO-21-101SP

MH-60S Seahawk Sustainment Quick Look

Common Name: MH-60 Sierra

Lead Service: Navy

Program Essentials

Manufacturer: Sikorsky

Sustainment: Depot maintenance conducted at Navy Fleet Readiness Centers and field maintenance conducted by Navy maintainers

Program Office: Program Manager – Air 299, Naval Air Systems Command, Patuxent River, Maryland

Fiscal Year 2019 Data

Average age: 10.93 years

Average lifetime flying hours: 3,889 hours per aircraft

Depot maintenance activity and squadron locations:

▲ Depot maintenance activity location

● Squadron location

Source: GAO. | GAO-21-101SP

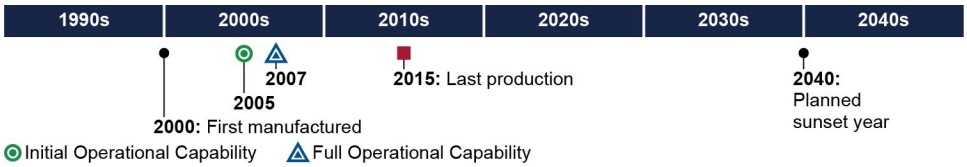
Sustainment Challenges and Mitigation Actions

The MH-60S faces challenges due to maintenance and supply issues. Program office officials are working to adjust priorities to better support the fleet.

Background

The MH-60S Seahawk is a twin engine helicopter first manufactured in 2000. Its primary missions are anti-surface warfare, combat search and rescue, organic airborne mine countermeasure, and combat support missions. The MH-60S is designed to operate aboard cruisers, destroyers, littoral combat ships, and aircraft carriers. This aircraft, which shares an airframe with the MH-60R, is equipped with a 250-foot cable with a 600-pound lift capability, and a cargo hook with a 6,000-pound capacity.

Life Cycle of the MH-60S

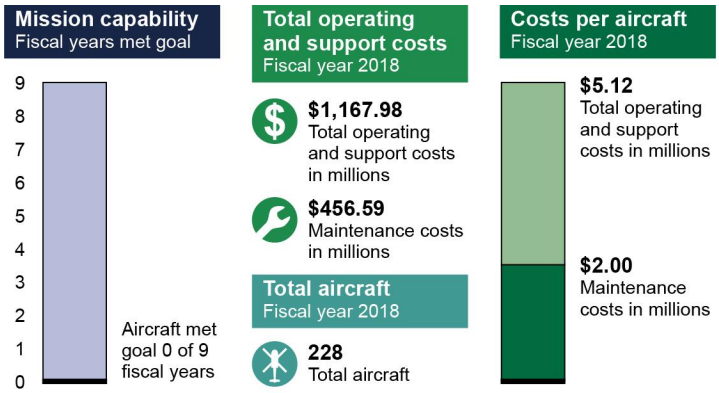


Source: GAO analysis of Navy data. | GAO-21-101SP

Overview

In fiscal year 2019, the MH60S fleet did not meet its mission capable rate goal, nor in any other year since fiscal year 2011. The MH-60S did not meet its goal because of depot, maintenance, and supply issues. Not mission capable rates increased from fiscal year 2011 to fiscal year 2019 because of low maintenance personnel-to-aircraft ratios, according to Navy officials. Additionally, operating and support (O&S) costs per aircraft increased, from about $4.1 million in fiscal year 2011 to about $5.12 million in fiscal year 2018. According to officials, O&S costs increased largely because of an increase in the number of total aircraft, which required additional personnel to maintain and support the additional fielded aircraft, squadrons, and sites.

MH-60S Sustainment Status



Source: GAO analysis of Navy data. | GAO-21-101SP

Data table for MH-60S Sustainment Status

Mission capability	Aircraft met goal 0 of 9 fiscal years
Total operating and support costs in millions (FY18)	$1,167.98
Maintenance costs in millions (FY18)	$456.59
Total aircraft (FY18)	228
Total operating and support costs per aircraft in millions (FY18)	$5.12
Maintenance costs per aircraft in millions	$2.00

Sustainment Strategy

- The MH-60S Life Cycle Sustainment Plan (2002) describes the strategy to monitor and accomplish MH-60S program objectives, program schedules, and assigned program responsibilities. The plan provides the logistics considerations, a management tool for program resources, and other planning data to accomplish life-cycle support for the program.

- In 2015, the Naval Supply Systems Command awarded a performance-based logistics contract to repair MH-60 depot-level reparables and manage the inventory of those spare parts, with the option for the contractor to buy parts if replacements were needed.
- Depot maintenance occurs at Navy Fleet Readiness Centers and Navy maintainers sustain and conduct field maintenance for the MH-60S. Generally, depot maintenance occurs every 3 years, according to officials.

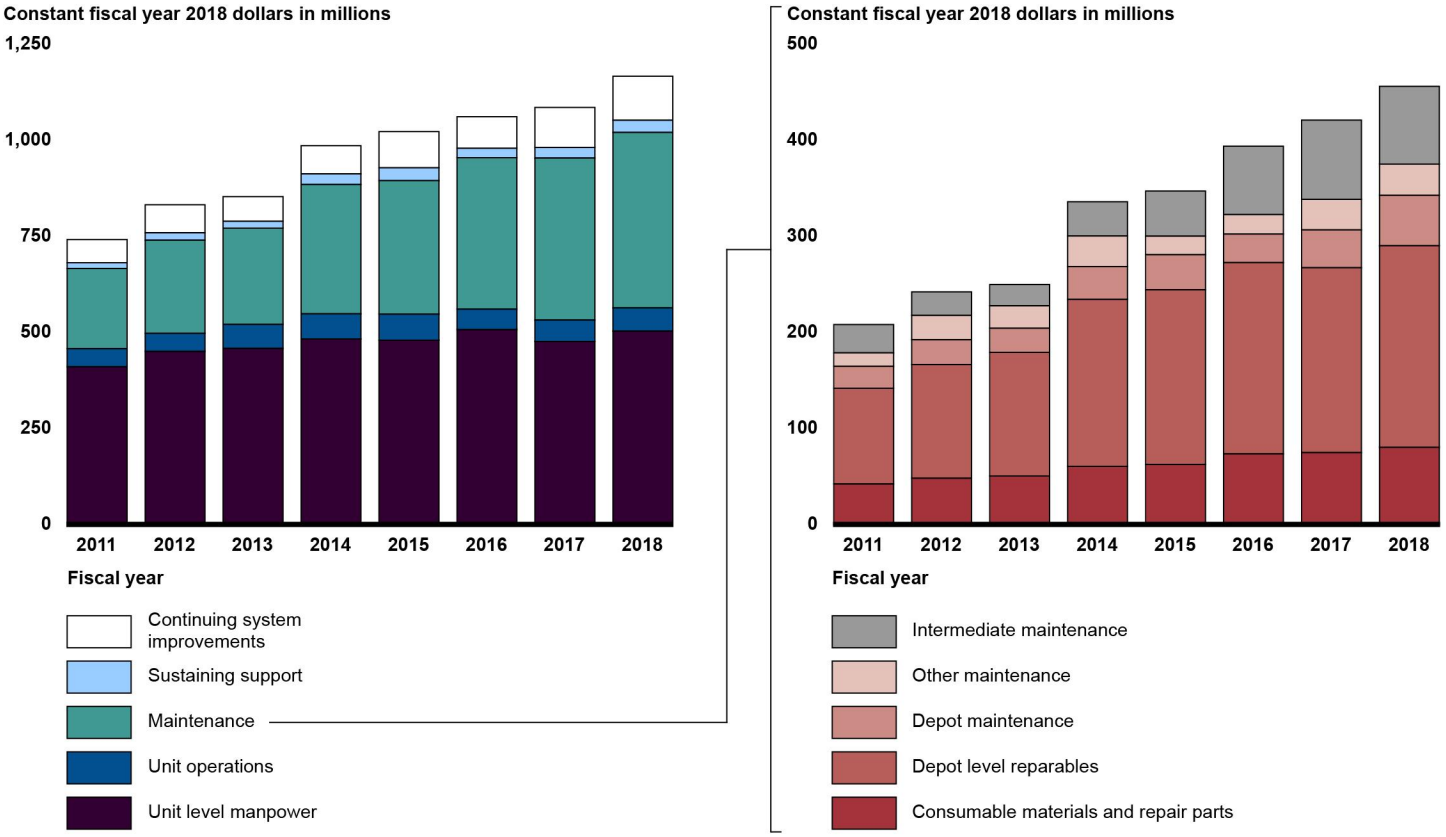
Availability and Condition

The MH-60S missed its mission capable goals from fiscal year 2011 through fiscal year 2019. Also, the percent of mission capable aircraft decreased. According to Navy officials, the MH-60S missed its mission capable goals due to low maintenance personnel-to-aircraft ratios, insufficient skills of and training for maintenance personnel, and a lack of supporting products, to include technical publications. From fiscal year 2011 through fiscal year 2019, the rates generally increased for not mission capable maintenance (NMCM) and not mission capable supply (NMCS). According to Navy officials, the NMCM rate increased due to a lack of maintenance personnel as the number of aircraft increased. Furthermore, in fiscal years 2018 and 2019 NMCS was increasingly an issue for the aircraft, as the spares posture was unable to support fielding aircraft, according to officials. Specific details on mission capable and not mission capable rates were omitted because the information was deemed by DOD to be sensitive.

Operating and Support Costs

From fiscal year 2011 through fiscal year 2018, the MH-60S's total O&S costs rose by about 57 percent, which officials told us was largely due to an increase in fleet size—from 181 aircraft in fiscal year 2011 to 228 in fiscal year 2018. According to officials, this increase in fleet size led to additional personnel requirements to maintain the aircraft and sites. Maintenance costs accounted for a large share of O&S costs over the period, increasing from about $208.7 million in fiscal year 2011 to $456.59 million in fiscal year 2018, which officials attributed to the increase in the number of aircraft and flight hours. The most significant category of maintenance costs was depot-level reparables, which increased from about $99.57 million in fiscal year 2011 to $209.68 million in fiscal year 2018. According to officials, the increase in costs for depot-level reparables was due to an increase in depot inductions as new aircraft entered their first depot maintenance induction cycles.

MH-60S Total Operating and Support Costs



Source: GAO analysis of Navy data. | GAO-21-101SP

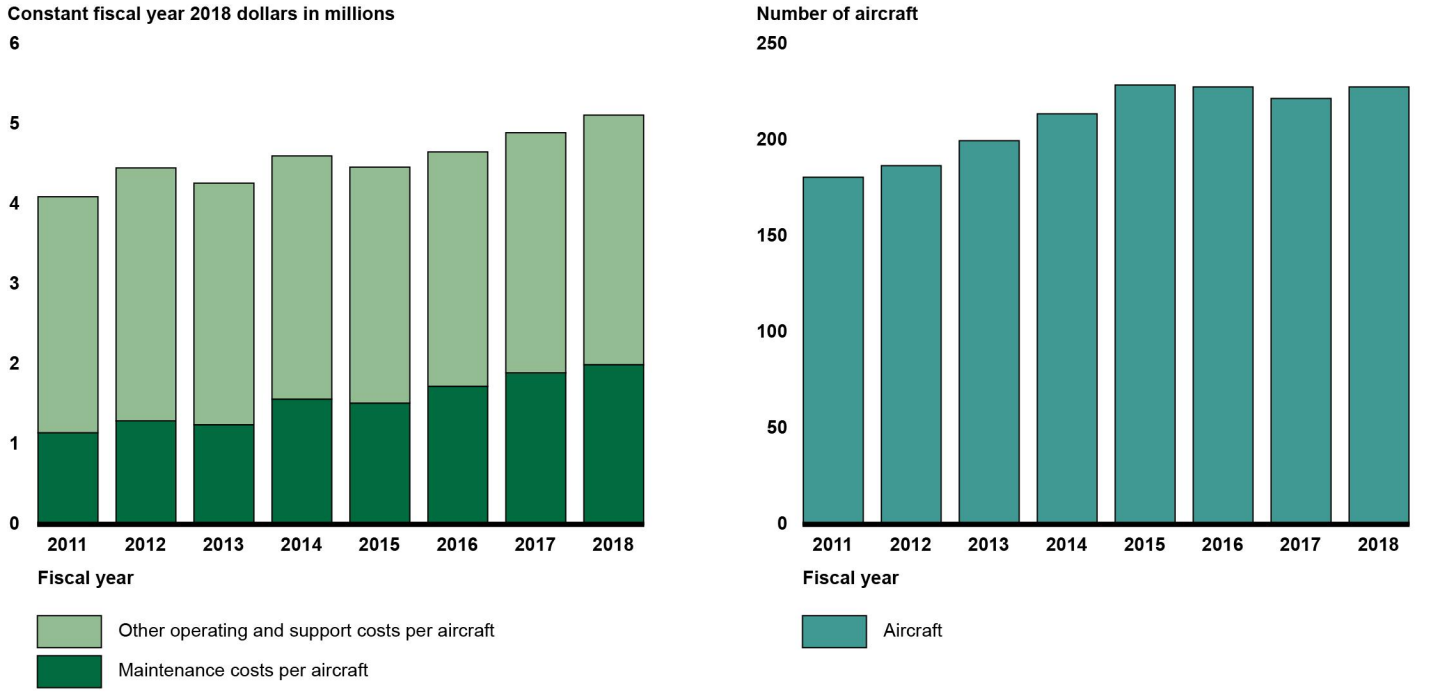
Data table for MH-60S Total Operating and Support Costs (Constant fiscal year 2018 dollars in millions)

Fiscal year	Unit level manpower	Unit operations	Maintenance	Sustaining support	Continuing system improvements
2011	411.59	47.07	208.71	15.16	60.21
2012	451.56	47.19	242.58	19.19	72.74
2013	459.41	62.85	250.33	17.83	63.98
2014	484.28	65.36	336.53	27.45	73.6
2015	480.97	67.69	347.64	33.37	94.05
2016	508.38	53.23	394.33	24.45	81.91
2017	477.58	55.8	421.47	27.67	103.98
2018	504.59	60.54	456.59	31.55	114.71

Fiscal year	Consumable materials and repair parts	Depot level reparables	Depot maintenance	Other maintenance	Intermediate maintenance
2011	42.74	99.57	22.83	14.02	29.54
2012	48.74	118.26	25.78	25.37	24.43
2013	50.91	128.77	25.14	23.34	22.16
2014	60.93	173.86	34.23	31.76	35.75
2015	63.03	181.8	36.53	19.33	46.95
2016	73.93	199.27	29.58	20.46	71.1
2017	75.26	192.59	39.23	31.83	82.56
2018	80.9	209.68	52.64	32.44	80.93

From fiscal year 2011 through fiscal year 2018, the MH-60S's O&S costs per aircraft increased from about $4.1 million in fiscal year 2011 to $5.12 million in fiscal year 2018. This occurred due to increases in costs as the number of aircraft increased by about 26 percent, from 181 aircraft in fiscal year 2011 to 228 aircraft in fiscal year 2018. According to officials, this increase in fleet size increased the number of flying hours, which also led to an increase in fuel costs captured under unit operations costs over this time.

MH-60S Operating and Support Costs per Aircraft and Fleet Size



Source: GAO analysis of Navy data. | GAO-21-101SP

Data table for MH-60S Operating and Support Costs per Aircraft and Fleet Size (Constant fiscal year 2018 dollars in millions)

Fiscal year	Maintenance costs per aircraft	Other operating and support costs per aircraft
2011	1.15	2.95
2012	1.3	3.16
2013	1.25	3.02
2014	1.57	3.04
2015	1.52	2.95
2016	1.73	2.93
2017	1.9	3
2018	2	3.12

Fiscal year	Number of aircraft
2011	181
2012	187
2013	200
2014	214
2015	229
2016	228
2017	222
2018	228

Sustainment Challenges and Mitigation Actions

Maintenance: Maintenance of the MH-60S has been challenging due to a lack of adequately trained maintenance personnel, technical publications, and funding. According to officials, while the number of aircraft requiring support increased above the primary authorized allowance at squadrons, the funding provided for support equipment and logistics was not increased to support the assigned aircraft. To combat these issues, officials are working to adjust priorities to better support the fleet, better communicate requirements for sustainment, and develop performance plans.

Supply: Officials acknowledged that there was an increased shortage of parts to repair the aircraft in fiscal year 2018. Officials also told us that they are working to better position the program to react to any unforeseen issues with parts wearing out. Specifically, program officials reported that they are planning to better align the number of aircraft requiring support—which is currently over the primary authorized allowance—with the available resources for sustaining the fleet, to ensure that the fleet is not larger than they have the supply support to handle.

Program Office Comments

In commenting on a draft of this assessment, the program office provided technical comments, which we incorporated where appropriate.

Source: U.S. Marine Corps/Sgt. Jesus Sepulveda Torres. | GAO-21-101SP

AH-1Z Viper Sustainment Quick Look

Common Name: AH-1Z

Lead Service: Marine Corps

Program Essentials

Manufacturer: Bell Helicopter Textron Inc.

Sustainment: Depot maintenance conducted at Navy Fleet Readiness Centers, Bell, and Tobyhanna Army Depot; and field maintenance conducted by Marine Corps maintainers

Program Office: Program Manager – Air 276, Naval Air Systems Command, Patuxent River, Maryland

Fiscal Year 2019 Data

Average age: 4.4 years

Average lifetime flying hours: 946 hours per aircraft

Depot maintenance activity and squadron locations:

▲ Depot maintenance activity location

● Squadron location

Source: GAO. | GAO-21-101SP

Sustainment Challenges and Mitigation Actions

The AH-1Z is experiencing maintenance and supply challenges. The Marine Corps' mitigation actions include reducing unscheduled maintenance, reducing the number of aircraft, and improving supply chains.

Background

The AH-1Z Viper is a close air support, armed escort reconnaissance, anti-armor operations, and anti-air warfare aircraft first manufactured in 2006. It is designed with a four-bladed composite rotor system, four-bladed tail rotor, and a fully integrated glass cockpit. The aircraft is equipped with an integrated advanced fire control system and the capacity to support multiple weapon configurations.

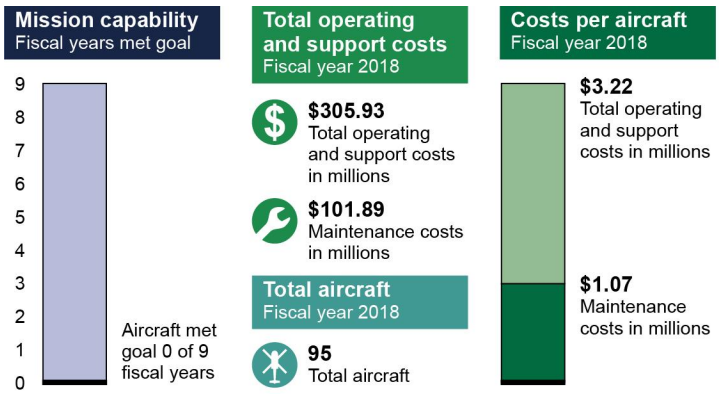
Life Cycle of the AH-1Z

Source: GAO analysis of Navy data. | GAO-21-101SP

Overview

From fiscal year 2011 through fiscal year 2019, the AH-1Z fleet did not meet its mission capable rate goal. Specifically, in fiscal year 2019, the AH-1Z did not meet its goal because of depot, maintenance, and supply issues. Not mission capable rates due to depot, maintenance, and supply issues increased from fiscal year 2011 to fiscal year 2019 because squadrons did not have enough maintainers or spare parts to support more aircraft than what was authorized to perform their mission, according to officials. Additionally, total operating and support (O&S) costs per aircraft increased, from about $2.68 million in fiscal year 2011 to about $3.36 million in fiscal year 2018. According to officials, O&S costs per aircraft increased as a result of the upgrade from the older AH-1W aircraft to the newer AH-1Z aircraft.

AH-1Z Sustainment Status



Source: GAO analysis of Navy data. | GAO-21-101SP

Data table for AH-1Z Sustainment Status

Mission capability	Aircraft met goal 0 of 9 fiscal years
Total operating and support costs in millions (FY18)	$305.93
Maintenance costs in millions (FY18)	$101.89
Total aircraft (FY18)	95
Total operating and support costs per aircraft in millions (FY18)	$3.22
Maintenance costs per aircraft in millions	$1.07

Sustainment Strategy

- The Life-Cycle Sustainment Plan (2016) provides the overall framework for the sustainment of the AH-1Z throughout its life cycle. This plan documents the program's integrated product support plan and total life-cycle support management strategy.
- The Marine Light Helicopter Independent Readiness Review (2017) provides an in-depth look into AH-1Z sustainment issues and identifies actionable recommendations to mitigate challenges.
- Marine Corps field maintainers maintain the AH-1Z at the squadron level. The Navy Fleet Readiness Centers conduct depot maintenance under a planned interval of 54 months. Naval Supply Systems Command and the Defense Logistics Agency provide supply chain management.
- The Naval Supply Systems Command entered into a performance-based logistics contract with Bell Helicopter Textron beginning in fiscal year 2020 to provide timely, cost-effective repairs as well as supply support.

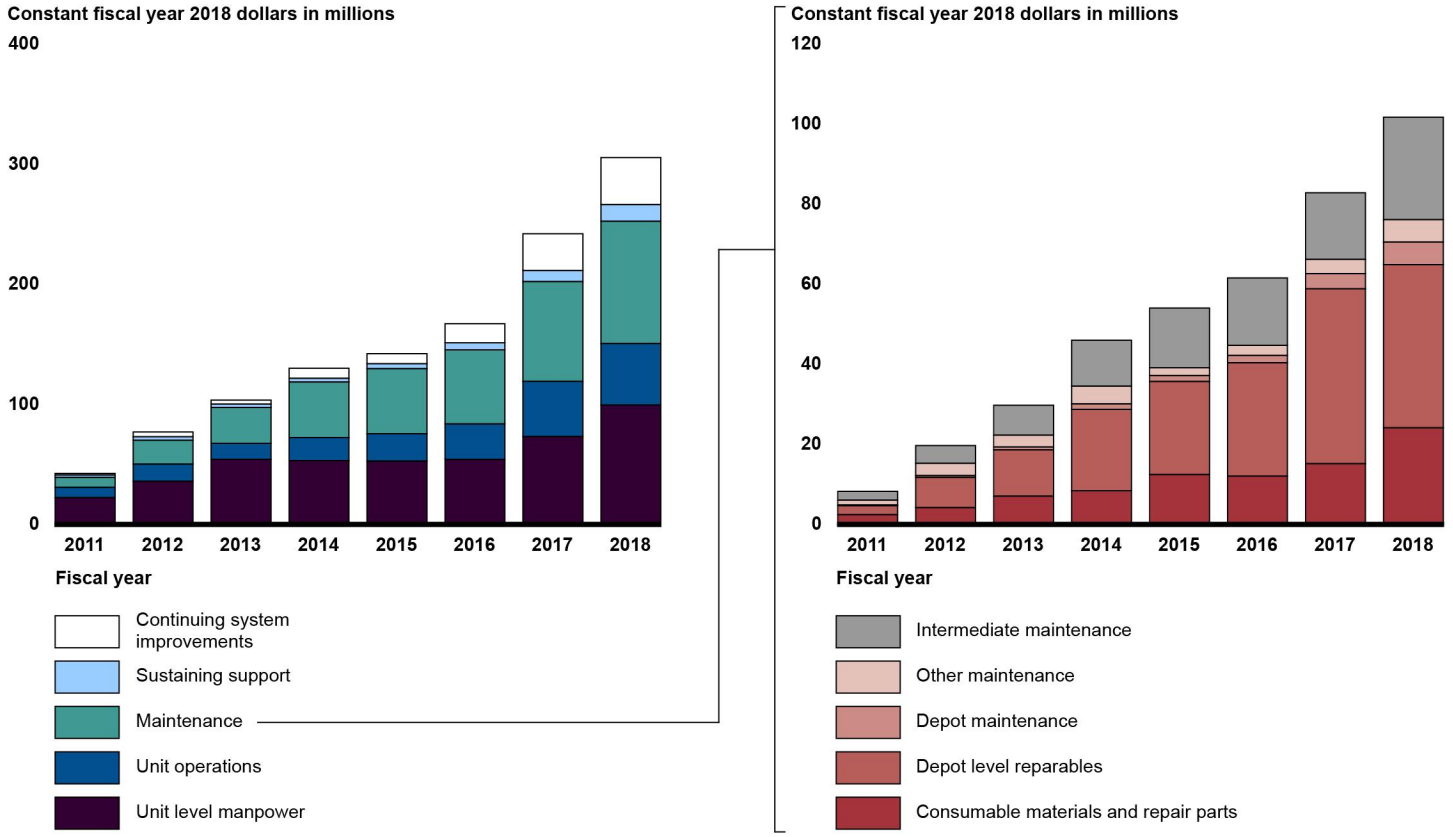
Availability and Condition

From fiscal year 2011 through fiscal year 2019, the AH-1Z missed its mission capable goals. Also, the percent of mission capable aircraft decreased during this time period. From fiscal year 2011 through fiscal year 2018, the not mission capable maintenance (NMCM) rate increased and the not mission capable supply (NMCS) rate decreased. Officials stated that the increase in the NMCM rate between fiscal years 2011 and 2018 was due to a high rate of unscheduled maintenance, inadequate maintainer training and not enough maintainers, and other poor maintenance practices—such as insufficient preventive maintenance and corrosion control—that sacrifice long-term sustainment in order to meet flight schedules. Specific details on mission capable and not mission capable rates were omitted because the information was deemed by DOD to be sensitive.

Operating and Support Costs

From fiscal year 2011 through fiscal year 2018, the AH-1Z's total O&S costs increased. According to officials, O&S costs increased because the AH-1Z inventory went up from 16 aircraft in fiscal year 2011 to 95 aircraft in fiscal year 2018 as squadrons transitioned from the older predecessor aircraft to the newer AH-1Z and maintainers were trained on the new system. Unit level manpower and maintenance costs accounted for the largest shares of O&S costs over the period. Unit level manpower costs increased from about $22.82 million in fiscal year 2011 to about $99.87 million in fiscal year 2018, whereas maintenance costs increased from about $8.37 million to about $101.88 million. In fiscal year 2018, depot-level reparables was the largest category of maintenance costs at about $40.79 million, while depot maintenance was the smallest category of maintenance costs at $5.61 million. Officials stated that depot-maintenance costs were low because the AH-1Z fleet was in the early stages of being fielded and the aircraft has only recently begun to enter depot maintenance.

AH-1Z Total Operating and Support Costs



Source: GAO analysis of Navy data. | GAO-21-101SP

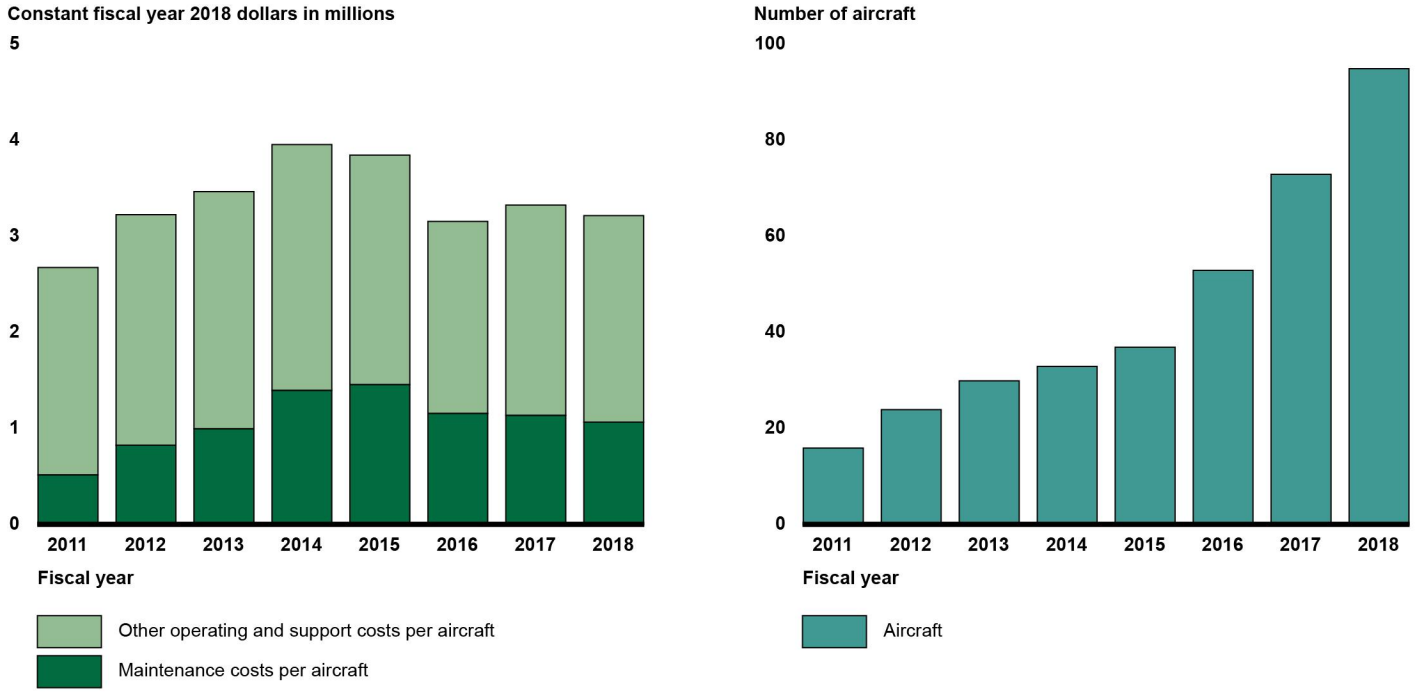
Data table for AH-1Z Total Operating and Support Costs (Constant fiscal year 2018 dollars in millions)

Fiscal year	Unit level manpower	Unit operations	Maintenance	Sustaining support	Continuing system improvements
2011	22.82	8.46	8.37	1.95	1.27
2012	36.44	14.27	19.83	2.88	4.06
2013	54.64	13.33	29.94	2.73	3.32
2014	53.61	19.24	46.15	3.16	8.36
2015	53.16	22.8	54.2	4.05	8.51
2016	54.52	29.63	61.71	5.85	15.92
2017	73.54	46.09	82.98	9.29	30.62
2018	99.87	51.24	101.88	13.85	39.09

Fiscal year	Consumable materials and repair parts	Depot level reparables	Depot maintenance	Other maintenance	Intermediate maintenance
2011	2.57	2.23	0.21	1.2	2.17
2012	4.31	7.55	0.45	3.09	4.43
2013	7.19	11.57	0.73	2.96	7.48
2014	8.57	20.31	1.34	4.44	11.5
2015	12.6	23.24	1.49	1.96	14.91
2016	12.2	28.31	1.83	2.52	16.86
2017	15.3	43.68	3.82	3.56	16.63
2018	24.26	40.79	5.61	5.6	25.63

From fiscal year 2011 through fiscal year 2018, the AH-1Z's O&S costs per aircraft generally increased from fiscal year 2011 through fiscal year 2014 and generally decreased from fiscal year 2015 through fiscal year 2018, while the mission capable rate decreased. Also, maintenance costs per aircraft, on average, accounted for one-third of total cost per aircraft, averaging about $1.07 million per year. According to officials, that is a result of an increase in the number of depot reparable demands and an increase in component costs. Additionally, as noted previously, the AH-1Z fleet increased by 79 aircraft, from 16 aircraft in fiscal year 2011 to 95 aircraft in fiscal year 2018.

AH-1Z Operating and Support Costs per Aircraft and Fleet Size



Source: GAO analysis of Navy data. | GAO-21-101SP

Data table for AH-1Z Operating and Support Costs per Aircraft and Fleet Size (Constant fiscal year 2018 dollars in millions)

Fiscal year	Maintenance costs per aircraft	Other operating and support costs per aircraft
2011	0.52	2.16
2012	0.83	2.4
2013	1	2.47
2014	1.4	2.56
2015	1.46	2.39
2016	1.16	2
2017	1.14	2.19
2018	1.07	2.15

Fiscal year	Number of aircraft
2011	16
2012	24
2013	30
2014	33
2015	37
2016	53
2017	73
2018	95

Sustainment Challenges and Mitigation Actions

Maintenance: The AH-1Z faces maintenance challenges related to a high rate of unscheduled maintenance and an inability to fully support current aircraft numbers at the squadron level. As a result, officials stated that unscheduled maintenance is driving the maintenance planning, instead of the maintenance plans driving the maintenance workload. This reactive maintenance disrupts the scheduled maintenance plan and leaves only work hours available to complete the bare minimum maintenance to keep the aircraft flyable while deferring more in-depth maintenance work to later, according to officials. To mitigate this situation, officials told us that they are updating long-term maintenance processes, which include—but are not limited to—technical publication updates, an analysis of maintenance levels, improving maintainer technical knowledge, and the establishment of a corrosion prevention program. Further, the program office has established fleet support team site offices at each major H-1 location to assist the fleet with maintenance and troubleshooting discrepancies.

Supply Support: The AH-1Z has experienced supply challenges, which officials are working to mitigate in several ways. For example, program office officials told us that the number of aircraft at the standard squadron is approximately 25 percent above the normal authorized allowance for which squadrons are staffed and equipped. As a result, squadrons are unable to support the AH-1Z. To mitigate this issue, officials told us they are working to adjust the fleet size to ensure that the squadrons do not have any overages they cannot support, and have implemented the Light Attack Aircraft Management Plan to perform short- and long-term preservation to excess inventory, thereby reducing workload to the fleet and burdens to the supply system. Further, the officials stated that, to alleviate supply chain delays, the Navy Supply Systems Command entered into a performance-based logistics contract with Bell in December 2019 for rotors and drives components and the Defense Logistics Agency is planning to enter into a performance-based contract with Bell in late fiscal year 2020 for about 3,600 consumable items.

Program Office Comments

In commenting on a draft of this assessment, the program office provided technical comments, which we incorporated where appropriate.

Source: U.S. Navy/Mass Communication Specialist 2nd Class Kyle Carlstrom. | GAO-21-101SP

CH-53E Sustainment Quick Look

Common Name: Super Stallion

Lead Service: Marine Corps

Program Essentials

Manufacturer: Sikorsky

Sustainment: Field maintenance conducted by USMC maintainers and depot maintenance conducted at Navy Fleet Readiness Centers and Korean Air Co., Ltd

Program Office: Program Manager – Air 261, Naval Air Systems Command, Patuxent River, Maryland

Fiscal Year 2019 Data

Average age: 31.8 years

Average lifetime flying hours: 6,363.48 hours per aircraft

Depot maintenance activity and squadron locations:

▲ Depot maintenance activity location

● Squadron location

Source: GAO. | GAO-21-101SP

Sustainment Challenges and Mitigation Actions

The CH-53E is an aging aircraft with maintenance and supply challenges. Actions to mitigate these challenges include resetting the fleet, revising the integrated maintenance program, and improving the supply chain.

Background

The CH-53E Super Stallion helicopter, which transports heavy equipment and supplies for amphibious assault, was first manufactured in 1978. The aircraft incorporates secure communications capability, a global positioning system, aviator night vision imaging systems heads up display sensors, and it carries three 50-caliber guns to support combat and rescue missions.

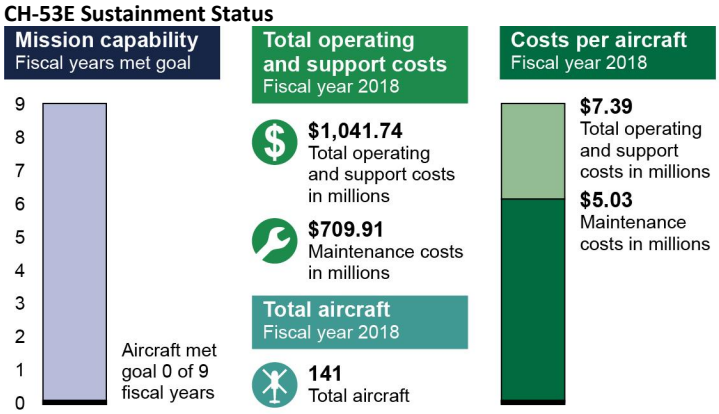
Life Cyle of the CH-53E

Source: GAO analysis of Navy data. | GAO-21-101SP

Overview

In year 2019, the CH-53E fleet did not meet its mission capable goal. The CH-53E did not meet its goal due to maintenance and supply issues. In addition, from fiscal year 2011 to fiscal year 2019, the CH-53E did not meet its mission capable goal and not mission capable rates increased from fiscal year 2011 to fiscal year 2019. According to officials, this decrease in mission capability was due to aging issues, including ineffective depot maintenance, aircraft not properly reset to full mission capability following combat, poor supply support and obsolescence, and decreased maintenance efficiency. Additionally, operating and support (O&S) costs per aircraft increased from $6.74 million in fiscal year 2011 to $7.39 million in fiscal year 2018. Maintenance costs were the largest contributor to O&S costs, at 58 percent per year on average. Depot-level reparables was the largest category of maintenance costs for the CH-53E, which made up 50 percent of total maintenance costs, on average.

CH-53E Sustainment Status



Source: GAO analysis of Navy data. | GAO-21-101SP

Data table for CH-53E Sustainment Status

Mission capability	Aircraft met goal 0 of 9 fiscal years
Total operating and support costs in millions (FY18)	$1,041.74
Maintenance costs in millions (FY18)	$709.91
Total aircraft (FY18)	141
Total operating and support costs per aircraft in millions (FY18)	$7.39
Maintenance costs per aircraft in millions	$5.03

Sustainment Strategy

- The Life-Cycle Sustainment Plan (2016) documents the program's integrated product support plan and total life-cycle support management strategy and provides a roadmap toward achieving performance requirements and minimizing the life-cycle cost associated with acquisition and sustainment through transition to the CH-53K.
- Supply support is provided by the Naval Supply Systems Command and the Defense Logistics Agency. According to program office officials, the Naval Supply Systems Command entered into a performance-based logistics contract with Sikorsky Aircraft Corporation in 2005 for repair support of 10 components and was expanded later for an additional 54 components.
- According to officials, the CH-53E is maintained organically by Marine Corps maintainers and at Navy Fleet Readiness Centers and Korean Air Co., Ltd., under a depot planned maintenance interval (PMI) cycle. The PMI event takes 7 months to complete and occurs every 900 to 1,600 flight hours.

Availability and Condition

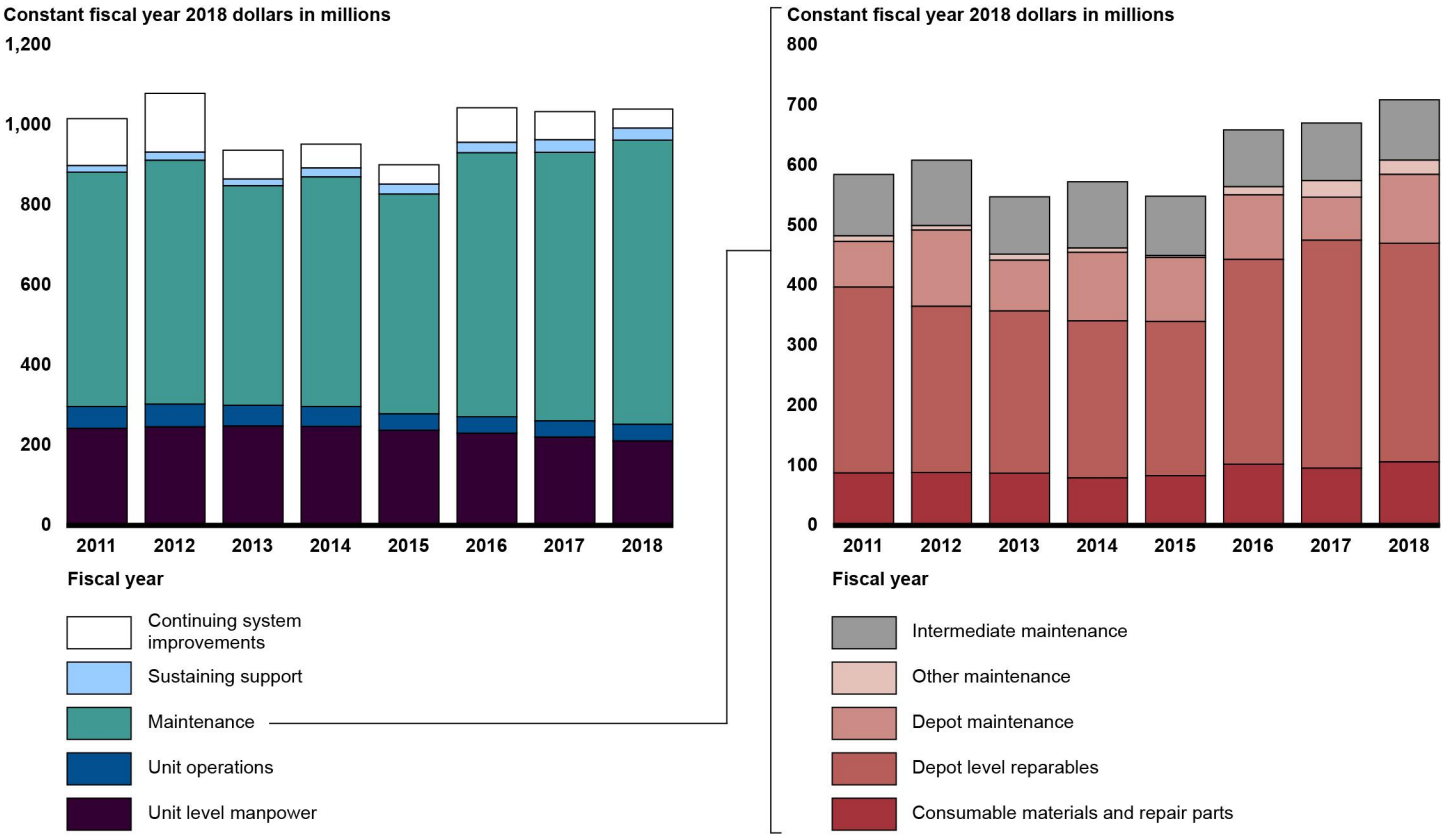
From fiscal year 2011 through fiscal year 2019, the CH-53E program missed its mission capable goal and the mission capable rate decreased from fiscal year 2011 to fiscal year 2019. The percent of mission capable aircraft decreased largely due to maintenance issues and reporting metrics changes, according to officials.

From fiscal year 2011 through fiscal year 2019, the not mission capable maintenance (NMCM), depot (NMCD), and supply (NMCS) rates increased. According to officials, the increases in the NMCM and NMCS rates were due to insufficient numbers of squadron maintenance personnel, whose effectiveness was hindered by a lack of required support equipment, inadequate technical support, and an overall lack of formal and on-the-job, follow-on training. Further, persistent critical parts shortages added to maintenance and supply delays. Officials stated that these parts shortages were a result of obsolescence issues and of relying on historical demand patterns instead of utilizing predictive demand to improve readiness. According to officials, a 2017 change in metrics calculations caused the increase in the NMCD rate and therefore shifted the mission capable rate downward, and a change to data business rules in 2018 caused a decrease in the NMCM rate and an increase in the NMCS rate. Specific details on mission capable and not mission capable rates were omitted because the information was deemed by DOD to be sensitive.

Operating and Support Costs

The CH-53E's total O&S costs remained fairly steady from fiscal year 2011 through fiscal year 2018, averaging around $1 billion per year. Maintenance costs accounted for the largest share of O&S costs over the period, averaging about $613.29 million per year, or 61 percent of the total. Depot-level reparables was the most significant maintenance cost category, averaging $307.49 million per year.

CH-53E Total Operating and Support Costs



Source: GAO analysis of Navy data. | GAO-21-101SP

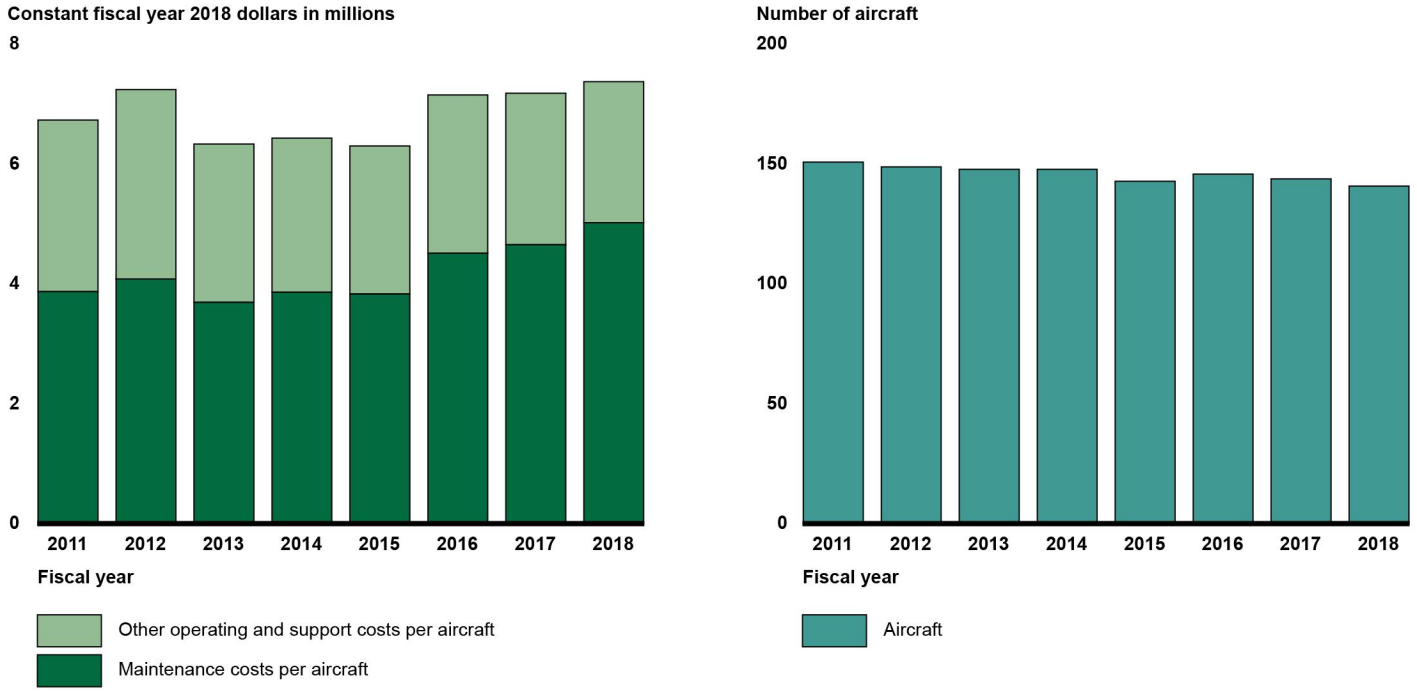
Data table for CH-53E Total Operating and Support Costs (Constant fiscal year 2018 dollars in millions)

Fiscal year	Unit level manpower	Unit operations	Maintenance	Sustaining support	Continuing system improvements
2011	243.54	54.69	585.58	16.77	117.14
2012	247.55	56.79	609.3	20.34	146.69
2013	249.7	51.93	548.17	17.17	71.93
2014	248.19	50.36	573.4	22.25	59.74
2015	239.02	40.94	549.2	24.98	48.31
2016	231.49	41.28	659.71	25.81	86.62
2017	221.85	40.62	671.08	31.09	70.49
2018	212.42	41.5	709.91	30.21	47.71

Fiscal year	Consumable materials and repair parts	Depot level reparables	Depot maintenance	Other maintenance	Intermediate maintenance
2011	88.29	309.62	75.84	9.49	102.34
2012	89.08	276.65	127.12	7.53	108.92
2013	88.07	270.18	84.46	10.14	95.33
2014	80	261.6	114.25	6.97	110.57
2015	83.66	256.8	106.6	3.41	98.73
2016	102.91	340.99	107.62	13.52	94.67
2017	96.28	379.75	71.82	27.31	95.92
2018	106.72	364.3	114.64	23.56	100.69

From fiscal year 2011 through fiscal year 2018, the CH-53E's O&S costs per aircraft increased from $6.74 million to $7.39 million, while the mission capable rate decreased. Also, maintenance costs per aircraft, on average, accounted for more than half of total O&S costs per aircraft, averaging about $4.2 million per year. Additionally, the number of aircraft decreased, from 151 in fiscal year 2011 to 141 in fiscal year 2018, due to a lack of available aircraft, as the back-up aircraft inventory was previously exhausted.

CH-53E Operating and Support Costs per Aircraft and Fleet Size



Source: GAO analysis of Navy data. | GAO-21-101SP

Data table for CH-53E Operating and Support Costs per Aircraft and Fleet Size (Constant fiscal year 2018 dollars in millions)

Fiscal year	Maintenance costs per aircraft	Other operating and support costs per aircraft
2011	3.88	2.86
2012	4.09	3.16
2013	3.7	2.64
2014	3.87	2.57
2015	3.84	2.47
2016	4.52	2.64
2017	4.66	2.53
2018	5.03	2.35

Fiscal year	Number of aircraft
2011	151
2012	149
2013	148
2014	148
2015	143
2016	146
2017	144
2018	141

Sustainment Challenges and Mitigation Actions

Aging: The CH-53E has been in operation for close to 40 years, with the mission capable rate declining from fiscal year 2011 through fiscal year 2019 due to challenges associated with an aging platform, according to officials. Sikorsky conducted a service-life extension study in the mid-1990s and determined that replacing the bulkhead—a dividing wall or barrier between compartments—would extend the service life of the CH-53E from 6,000 to 10,000 hours. As a result, Marine Corps aviation funded all bulkhead replacements. Despite the higher-than-average utilization rates for aircraft deployed in support of the wars in Iraq and Afghanistan, a plan rotating aircraft to reduce the number of flying hours has ensured that only three aircraft should reach the end of their service lives prior to 2024, which is the first year that CH-53Es will be retired.

Maintenance: According to a 2015 Marine Corps readiness review, many of the CH-53E's readiness issues are due to very heavy and hard usage in 11 years of wartime, along with a lack of needed depot maintenance to restore the aircraft upon their return. Additionally, there is a shortage of squadron maintenance personnel, and their effectiveness is hindered by a lack of required support equipment, inadequate technical support, an insufficient quantity of specially trained and qualified squadron personnel, and an overall lack of formal and on-the-job, follow-on training. Lastly, there is a high number of aircraft in maintenance outside of squadrons, which is one of the leading causes of the reduced number of aircraft available to operational commanders. The Marine Corps' ongoing and planned actions include resetting the CH-53E fleet to full mission capability beginning in 2016, directing renewed focus on training to increase technical expertise of aircraft maintainers, changing the CH-53E depot planned maintenance interval (PMI) from a calendar to a flight hour requirement in 2017, and implementing a depot readiness initiative in 2018 to quickly return post-PMI aircraft to a mission capable status.

Supply Support: The CH-53E is experiencing shortages of parts due to diminishing manufacturing sources, obsolescence issues, and over-reliance on demand history to drive supply support decisions instead of using more forward-looking, predictive criteria that make a difference in readiness. As a result, the program office has ongoing and planned actions to improve supply chain performance by expanding the use of product support arrangements and performance-based logistics contracts with industry partners and by implementing demand planning and predictive forecasting tools to determine parts inventory requirements.

Program Office Comments

In commenting on a draft of this assessment, the program office provided technical comments, which we incorporated where appropriate.

Source: U.S. Marine Corps/Sgt. Aaron Henson. | GAO-21-101SP

MV-22B Osprey Joint Advanced Vertical Lift Aircraft Sustainment Quick Look

Common Name: MV-22B Osprey

Lead Service: Marine Corps

Program Essentials

Manufacturer: Bell-Boeing Joint Program Office

Sustainment: Depot maintenance conducted at Navy Fleet Readiness Centers, Marine Corps Air Station – Hawaii, and Army Center – Huntsville, Alabama; and field maintenance conducted by Marine Corps, Navy, and contractor maintainers

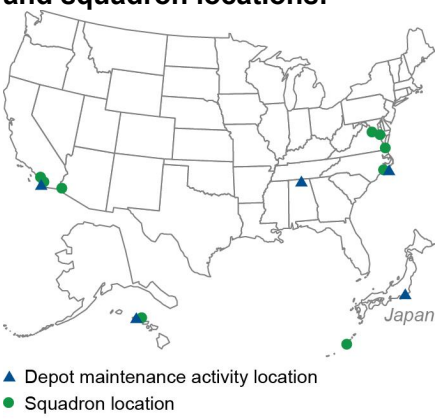
Program Office: V-22 Joint Program Office – Air 275, Naval Air Systems Command, Patuxent River, Maryland

Fiscal Year 2019 Data

Average age: 8 years

Average lifetime flying hours: 1,400 per aircraft

Depot maintenance activity and squadron locations:



Source: GAO. | GAO-21-101SP

Sustainment Challenges and Mitigation Actions

The MV-22B is experiencing aging, maintenance, and supply challenges. The Marine Corps' mitigation actions include corrosion repair, preventing aircraft deterioration, and improving supply chains.

Background

The MV-22B Osprey Joint Advanced Vertical Lift was the first tilt rotor aircraft, having been first manufactured in 1996. The aircraft operates as a helicopter when taking off and landing vertically, and it has the long-range cruise capabilities of a twin turboprop aircraft. The aircraft transports troops, equipment, and supplies, and it operates from ships or expeditionary airfields ashore.

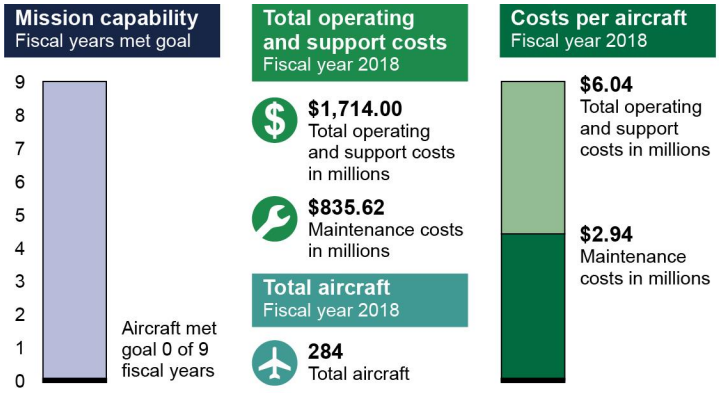
Life Cycle of the MV-22

Source: GAO analysis of Navy data. | GAO-21-101SP

Overview

In fiscal year 2019, the MV-22B fleet did not meet its mission capable goal due to depot, maintenance, and supply issues. Further, the MV-22B fleet did not meet its mission capable goal in any year from fiscal year 2011 to fiscal year 2019. According to officials, unavailability due to depot, maintenance, and supply issues increased from in fiscal year 2011 to fiscal year 2019 because of issues with corrosion, engineering delays, and supply shortages. Additionally, operating and support (O&S) costs per aircraft decreased slightly, from about $6.58 million in fiscal year 2011 to about $6.04 million in fiscal year 2018. According to officials, costs per aircraft decreased as more aircraft were introduced into the fleet.

MV-22B Sustainment Status



Source: GAO analysis of Navy data. | GAO-21-101SP

Data table for MV-22B Sustainment Status

Mission capability	Aircraft met goal 0 of 9 fiscal years
Total operating and support costs in millions (FY18)	$1,714.00
Maintenance costs in millions (FY18)	$835.62
Total aircraft (FY18)	284
Total operating and support costs per aircraft in millions (FY18)	$6.04
Maintenance costs per aircraft in millions	$2.94

Sustainment Strategy

- The Life-Cycle Sustainment Plan (2014) provides the overall framework for the sustainment of the MV-22B system throughout its life cycle. This plan documents the program's integrated product support plan and total life-cycle support management strategy.
- The Joint Program Office manages the MV-22B for the Marine Corps, the CV-22 Osprey for the Air Force and United States Special Operations Command, and the CMV-22 for the Navy, as they are similar systems. Bell-Boeing provides a portion of product support, such as on-site fleet support, in-service engineering support, and access to parts, among other things, through a performance-based logistics contract managed by the Joint Program Office.
- Marine Corps field maintainers maintain the MV-22B at the squadron level. The Navy Fleet Readiness Centers conduct depot maintenance under a planned interval of every 24 months. Naval Supply Systems Command and Defense Logistics Agency provide supply support.

Availability and Condition

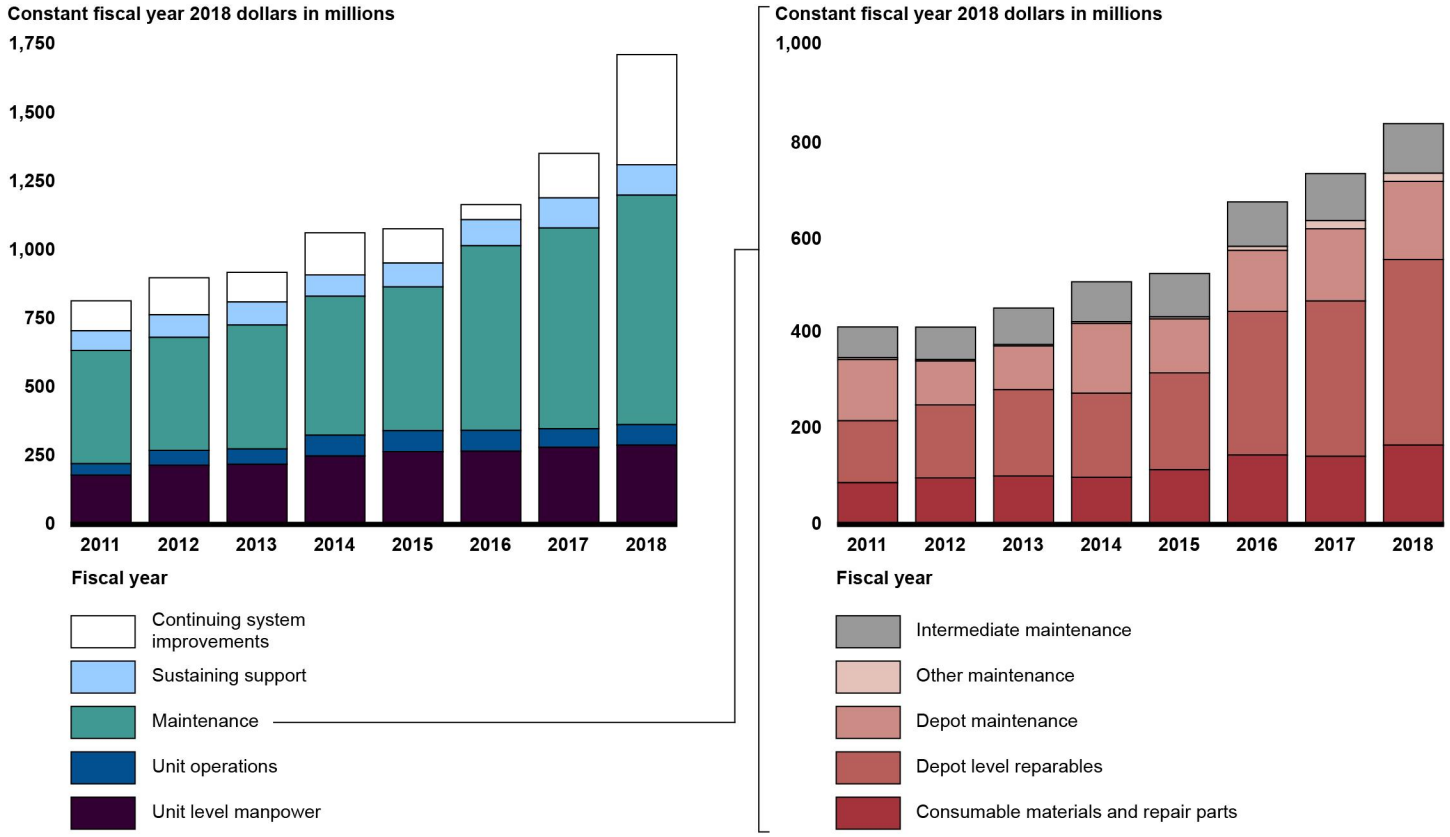
From fiscal year 2011 through fiscal year 2019, the MV-22B missed its mission capable goals and the percent of mission capable aircraft decreased from fiscal year 2011 to fiscal year 2019. According to officials, the MV-22B is missing its annual goals because of corrosion issues, materiel unavailability, and issues caused by technical data gaps and engineering delays.

From fiscal year 2011 through fiscal year 2019, the rates generally increased for not mission capable depot (NMCD), not mission capable maintenance (NMCM), and not mission capable supply (NMCS). According to officials, a November 2018 update to the approach to calculating the mission capability data for this aircraft resulted in this decrease in the NMCM rate and increase in the NMCS rate. Specific details on mission capable and not mission capable rates were omitted because the information was deemed by DOD to be sensitive.

Operating and Support Costs

From fiscal year 2011 through fiscal year 2018, the MV-22B's total O&S costs more than doubled, as the number of aircraft increased from 124 to 284. Additionally, in 2017 the Navy implemented a new aircraft retrofitting program that modifies the aircraft's configuration to address reliability or safety concerns. This program resulted in increased costs in the continuing system improvements category, specifically in fiscal year 2018. Joint Program Office officials noted that this reconfiguration does not result in immediate improvements to reliability, but is expected to help in the future. Maintenance costs increased each year and accounted for 50 percent of the total O&S costs from fiscal years 2011 through 2018, averaging about $568 million per year. Depot-level reparables was the most significant category of maintenance costs, averaging $231 million per year during the same time period.

MV-22B Total Operating and Support Costs



Source: GAO analysis of Navy data. | GAO-21-101SP

Data table for MV-22B Total Operating and Support Costs (Constant fiscal year 2018 dollars in millions)

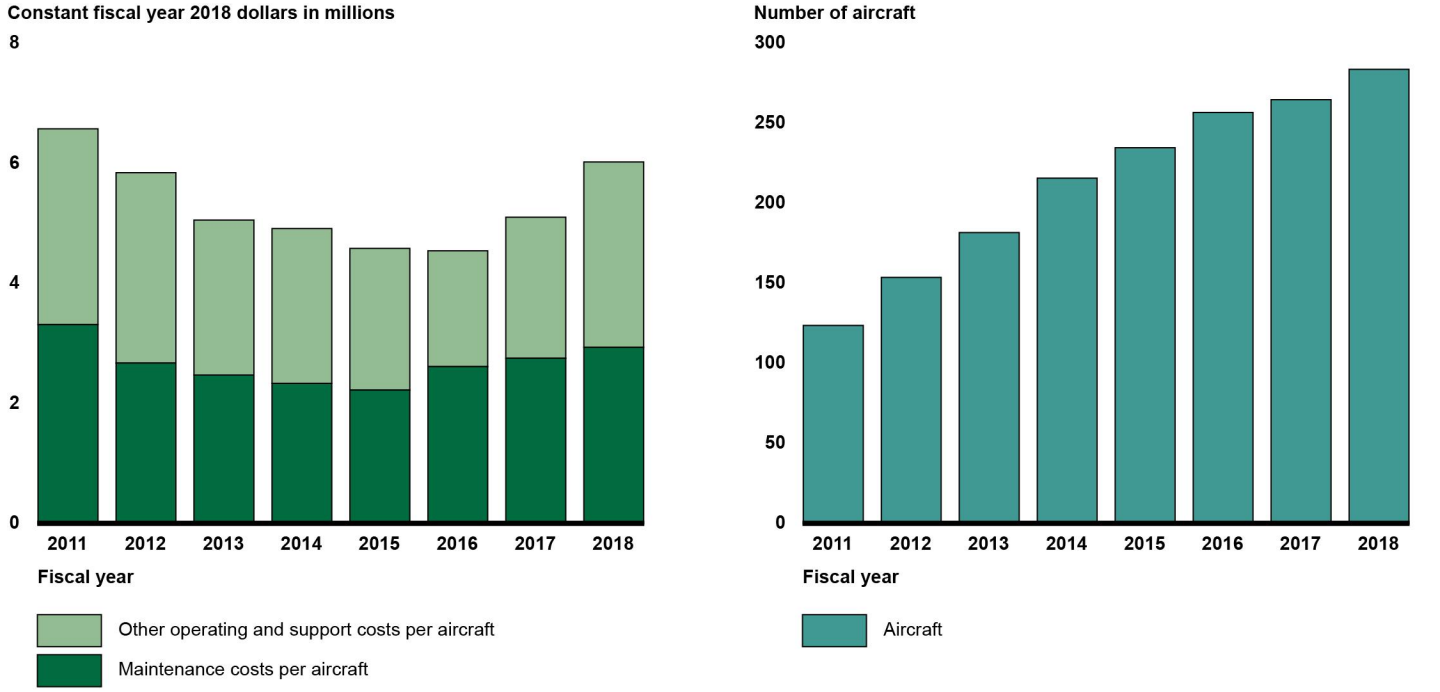
Fiscal year	Unit level manpower	Unit operations	Maintenance	Sustaining support	Continuing system improvements
2011	181.25	42.27	412.19	72.01	108.69
2012	217.43	54.24	412.09	82.36	134.51
2013	221.23	55.76	451.57	83.98	108.1
2014	251.57	75.43	506.45	77.69	153.23
2015	267.16	76.56	523.77	86.95	124.56
2016	269.02	75.71	672.54	94.95	55.24
2017	282.71	67.96	731.52	109.68	161.87
2018	290.85	74.9	835.62	111.04	401.59

Fiscal year	Consumable materials and repair parts	Depot level reparables	Depot maintenance	Other maintenance	Intermediate maintenance
2011	87.86	129.1	127.22	4.24	63.77
2012	98.14	151.68	91.62	2.88	67.78
2013	102.12	179.67	90.94	2.84	75.99
2014	99.45	174.91	145.26	3.61	83.22
2015	114.82	201.9	112.11	4.46	90.48
2016	145.71	298.83	127.14	8.39	92.46
2017	143.02	323.45	150.1	16.97	97.97
2018	166.18	386.5	162.74	16.89	103.31

The MV-22B's total O&S costs per aircraft decreased steadily from fiscal year 2011 through fiscal year 2016 before increasing in fiscal years 2017 and 2018. Specifically, O&S costs per aircraft increased from $4.54 million in fiscal

year 2016 to $6.04 million in fiscal year 2018, while the mission capable rate decreased. According to officials, this increase is a result of additional demand for aircraft propeller blades in fiscal years 2017 and 2018, which had increased in price by 209 percent. Maintenance costs per aircraft, on average, accounted for about half of the total costs per aircraft, averaging about $2.7 million per year from fiscal years 2011 through 2018. Additionally, the number of aircraft more than doubled, from 124 aircraft in fiscal year 2011 to 284 aircraft in fiscal year 2018, with a planned fleet size of 360 MV-22Bs by fiscal year 2024.

MV-22B Operating and Support Costs per Aircraft and Fleet Size



Source: GAO analysis of Navy data. | GAO-21-101SP

Data table for MV-22B Operating and Support Costs per Aircraft and Fleet Size (Constant fiscal year 2018 dollars in millions)

Fiscal year	Maintenance costs per aircraft	Other operating and support costs per aircraft
2011	3.32	3.26
2012	2.68	3.17
2013	2.48	2.58
2014	2.34	2.58
2015	2.23	2.36
2016	2.62	1.93
2017	2.76	2.35
2018	2.94	3.09

Fiscal year	Number of aircraft
2011	124
2012	154
2013	182
2014	216
2015	235
2016	257
2017	265
2018	284

Sustainment Challenges and Mitigation Actions

Aging: As the MV-22B ages and more aircraft undergo depot-level maintenance, officials are finding more evidence of corrosion. Officials told us that they have developed a corrosion roadmap that allows them to discover where

corrosion is present, and that they have involved original equipment manufacturing partners in finding and repairing corroded parts. As a result, the Joint Program Office released about 12 technical directives to repair and prevent corrosion. According to Joint Program Office officials, the benefits of these improvements are starting to reduce the rate of corrosion-related failures and removals. Further, according to officials, they are currently working on developing additional repairs so that the entire fleet is not affected by these corrosion issues.

Maintenance: An independent review of the Osprey program found that the MV-22B currently has too many configurations—over 70 in total—for the Joint Program Office to maintain adequately and consistently. To mitigate this issue, the Joint Program Office plans to reduce the number of configurations and ultimately achieve a common configuration, which officials hope will result in less time spent on unplanned maintenance and inspections. The first aircraft to undergo reconfiguration will be completed in fiscal year 2020. The MV-22B also faces maintenance issues related to technical data gaps. For example, according to officials, non-standard, complex repairs require temporary engineering instructions. To mitigate this situation, officials told us that they had developed an engineering hotline and held daily engineering phone calls to reduce the amount of time it takes them to address maintenance issues, review outstanding engineering requests, and discuss next steps. According to Joint Program Office officials, this has resulted in a reduction of average turnaround time by approximately 50 percent for temporary engineering instructions, thereby reducing data gaps. The Joint Program Office officials also stated that they are addressing the technical data gaps by delivering 170 Structural Repair Manuals over the next 5 years to reduce fleet demand and improve repair turnaround time. The joint program office has also begun an aircraft preservation program to help reduce the number of aircraft deemed not mission capable due to maintenance. For example, according to officials, when MV-22B aircraft are not in use, they will be preserved in a mission capable state until needed, thereby reducing the amount of damage caused by environmental factors such as humidity and reducing the amount of time to fix any issues. Lastly, the Joint Program Office stated that it has awarded a Performance Based Logistics and Engineering (PBL&E) contract that directly incentivizes industry to align with fleet goals of reducing the number of “long-term down” aircraft and reduce NMCM rates. According to the Joint Program Office, the PBL&E contract also incentivizes rapid engineering responses, which should improve mission capable rates by reducing time spent awaiting maintenance, eliminating technical data gaps, and informing root cause and corrective actions. According to the Joint Program Office, these efforts resulted in the number of MV-22B “long-term down” aircraft being reduced from 66 to 33 in 2019.

Supply Support: The MV-22B has experienced spare parts availability issues, which officials are working to mitigate in several ways. For example, Joint Program Office officials told us that they designed a semi-annual program with Navy Supply Systems Command to discuss problem components and try to resolve the major issues. The Joint Program Office also reported pursuing initiatives such as working with Navy Supply Systems Command and the Defense Logistics Agency to award contracts incentivizing materiel availability. For example, according to Joint Program officials, they plan to implement a performance-based contract with Bell-Boeing in 2019 to incentivize meeting-expedited delivery times. In addition, officials reported that the Defense Logistics Agency has initiatives underway to rectify incorrect part identification numbers so that the correct parts are ordered at the correct rate.

Program Office Comments

In commenting on a draft of this assessment, the Joint Program Office stated that its efforts initiated in fiscal years 2018 and 2019 to accelerate readiness recovery produced results in fiscal year 2019 and will continue to improve readiness. Specifically, the Joint Program Office stated that the MV-22B in fiscal year 2019 was able to increase its flight hours over fiscal year 2018 and meet the fiscal year 2019 flight hour goal. The Joint Program Office noted that the improvements it has made should continue to result in improved MV-22B readiness rates in the years to come.

Source: U.S. Marine Corps/Staff Sgt. Donald Holbert. | GAO-21-101SP

UH-1Y Venom Sustainment Quick Look

Common Name: UH-1Y

Lead Service: Marine Corps

Program Essentials

Manufacturer: Bell Helicopter Textron Inc.

Sustainment: Depot maintenance conducted at Navy Fleet Readiness Centers, Bell, and Tobyhanna Army Depot; and field maintenance conducted by Marine Corps maintainers

Program Office: Program Manager – Air 276, Naval Air Systems Command, Patuxent River, Maryland

Fiscal Year 2019 Data

Average age: 6.9 years

Average lifetime flying hours: 1,389 hours per aircraft

Depot maintenance activity and squadron locations:

Source: GAO. | GAO-21-101SP

Sustainment Challenges and Mitigation Actions

The UH-1Y is experiencing maintenance and supply challenges. The Marine Corps' mitigation actions include reducing unscheduled maintenance, reducing the fleet size, and improving supply chains.

Background

The UH-1Y Venom is a combat assault support, airborne command and control, search and rescue, and special operations support rotary aircraft first manufactured in 2006. It is designed with a four-bladed composite rotor system and integrated digital cockpit, and it provides heavy load carrying ability.

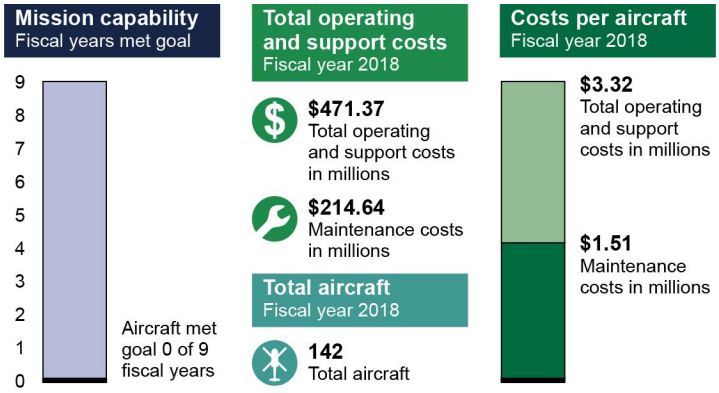
Life Cycle of the UH-1Y

Source: GAO analysis of Navy data. | GAO-21-101SP

Overview

The UH-1Y did not meet its mission capable goal in any year from fiscal year 2011 to fiscal year 2019. Specifically, in fiscal year 2019, the UH-1Y fleet did not meet its mission capable goal due to depot, maintenance, and supply issues. Unavailability due to depot, maintenance, and supply issues increased from fiscal year 2011 fiscal year 2019 because, according to officials, squadrons are not manned or equipped with spare parts to support the inventory of aircraft. Additionally, operating and support (O&S) costs per aircraft generally remained steady, with an increase from about $3.18 million in fiscal year 2011 to $3.32 million in fiscal year 2018. According to officials, the increase was due to the costs associated with the upgrade from the older UH-1N aircraft to the newer UH-1Y aircraft, which was completed in 2018.

UH-1Y Sustainment Status



Source: GAO analysis of Navy data. | GAO-21-101SP

Data table for UH-1Y Sustainment Status

Mission capability	Aircraft met goal 0 of 9 fiscal years
Total operating and support costs in millions (FY18)	$471.37
Maintenance costs in millions (FY18)	$214.64
Total aircraft (FY18)	142
Total operating and support costs per aircraft in millions (FY18)	$3.32
Maintenance costs per aircraft in millions	$1.51

Sustainment Strategy

- The H-1 – Acquisition Category 1C Life-Cycle Sustainment Plan (2016) provides the overall framework for the sustainment of the UH-1Y throughout its life cycle. This plan documents the program's integrated product support plan and total life-cycle support management strategy.
- The Marine Light Helicopter Independent Readiness Review (2017) describes UH-1Y readiness and sustainment issues and identifies recommendations to mitigate challenges.
- Marine Corps field maintainers maintain the UH-1Y at the squadron level. The Navy Fleet Readiness Center - East conducts depot maintenance under a planned interval of 54 months. Naval Supply Systems Command and Defense Logistics Agency provide supply chain management.
- The Naval Supply Systems Command entered into a performance-based logistics contract with Bell Helicopter Textron beginning in fiscal year 2020 to provide timely, cost-effective repairs as well as supply support.

Availability and Condition

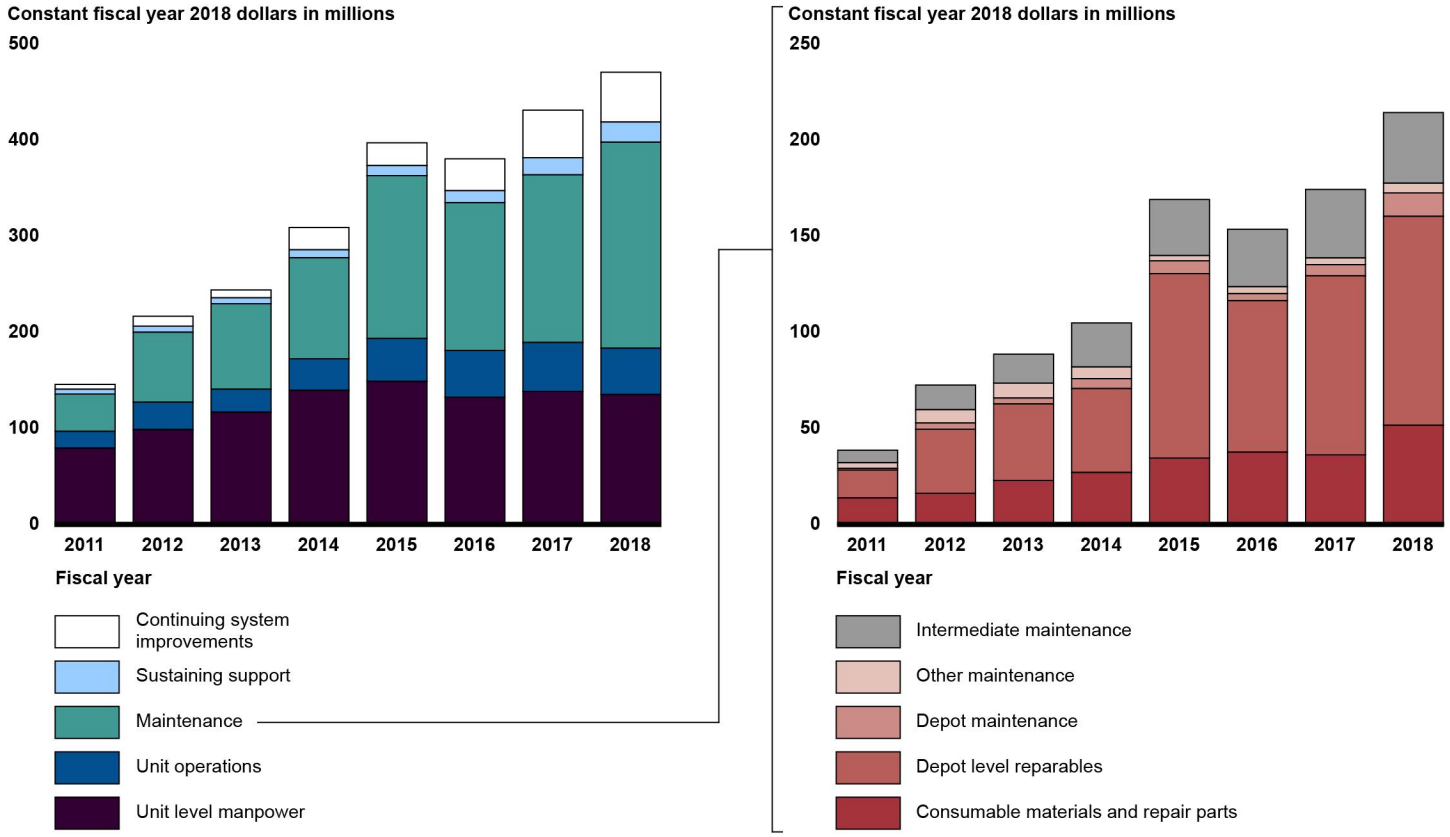
From fiscal years 2011 through 2019, the UH-1Y generally experienced a decreasing mission capable rate and did not meet its mission capable goal in any year during this time period. According to officials, the UH-1Y is missing its goals because there are too many aircraft—approximately 25 percent more than the normally authorized allowance—that need to be maintained when compared to the amount of maintainers and supply support, which leads to fewer mission capable aircraft.

From fiscal year 2011 through fiscal year 2018, the not mission capable maintenance (NMCM) rate increased and the not mission capable supply (NMCS) rate decreased. Officials stated that the increase in the NMCM rate between fiscal years 2011 and 2018 was due to a high rate of unscheduled maintenance, inadequate maintainer training and not enough maintainers, and other poor maintenance practices—such as insufficient preventive maintenance and corrosion control—that sacrifice long-term sustainment for meeting flight schedules. Specific details on mission capable and not mission capable rates were omitted because the information was deemed by DOD to be sensitive.

Operating and Support Costs

For fiscal years 2011 through 2018, the UH-1Y's total O&S costs increased as the mission capable rate decreased. According to officials, O&S costs increased because the UH-1Y inventory went up from 46 aircraft in fiscal year 2011 to 142 aircraft in fiscal year 2018 as squadrons transitioned from the older UH-1N aircraft to the newer UH-1Y aircraft—which began in 2007 and concluded in 2017— and maintainers were trained on the new system. Maintenance costs, which increased from about $38.94 million in fiscal year 2011 to about $214.64 million in fiscal year 2018, accounted for the largest share of O&S costs over the period. Depot-level reparables was the most significant category of maintenance costs, at about $108.77 million in fiscal year 2018. Depot-level reparable costs were higher at the end of the time period due to an increasing number of repair demands and an increase in the cost of parts, according to program officials.

UH-1Y Total Operating and Support Costs



Source: GAO analysis of Navy data. | GAO-21-101SP

Data table for UH-1Y Total Operating and Support Costs (Constant fiscal year 2018 dollars in millions)

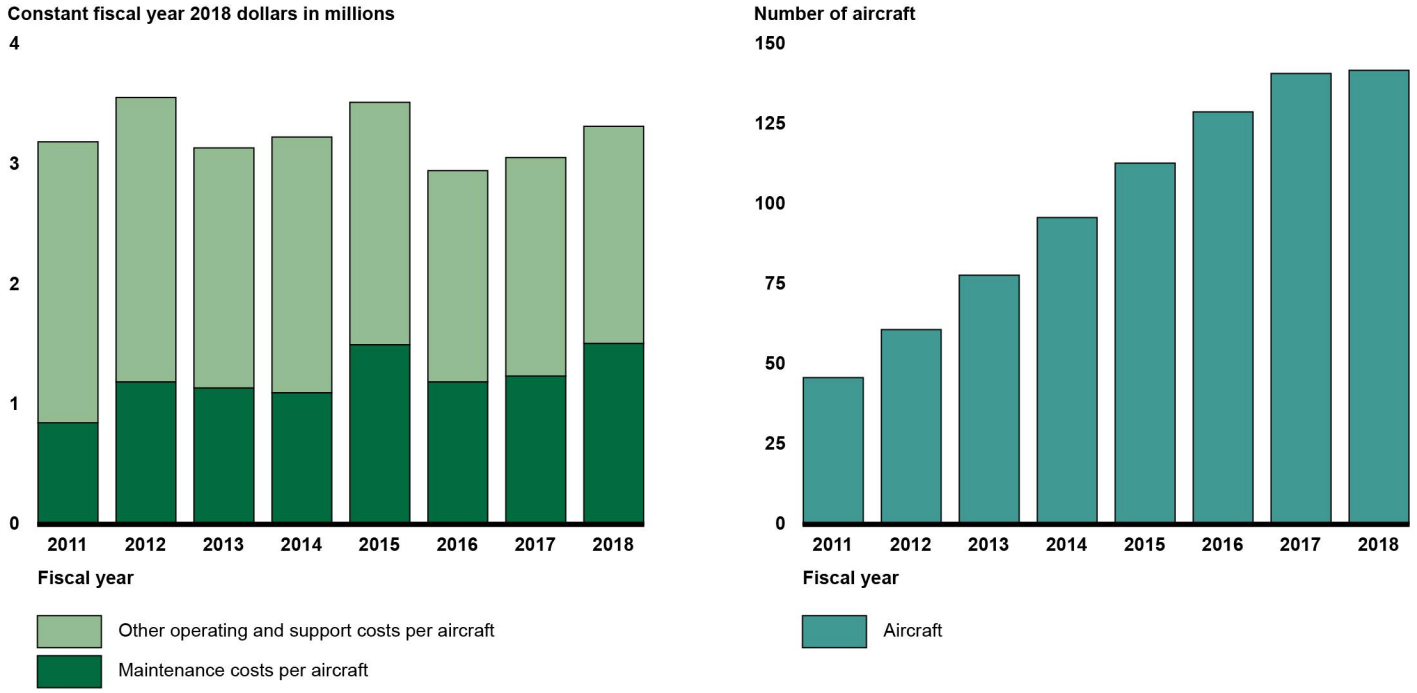
Fiscal year	Unit level manpower	Unit operations	Maintenance	Sustaining support	Continuing system improvements
2011	79.97	17.47	38.94	5.01	4.97
2012	99.36	28.43	72.8	6.47	10.24
2013	117.55	23.76	88.95	6.25	8.17
2014	140.22	32.73	105.18	8.42	23.13
2015	149.51	44.68	169.45	10.56	23.65
2016	133.05	48.56	153.9	12.45	33.2
2017	138.94	50.98	174.65	17.8	49.43
2018	135.78	48.16	214.63	20.98	51.82

Fiscal year	Consumable materials and repair parts	Depot level reparables	Depot maintenance	Other maintenance	Intermediate maintenance
2011	14.09	14.51	0.87	2.96	6.51
2012	16.47	33.35	3.23	6.94	12.8
2013	23.14	39.86	3.11	7.72	15.12
2014	27.36	43.62	5.2	6.07	22.93
2015	34.83	96.02	6.64	2.73	29.22
2016	37.91	78.85	3.69	3.58	29.87
2017	36.53	93.15	5.82	3.49	35.66
2018	51.92	108.77	12.17	5.07	36.71

From fiscal year 2011 through fiscal year 2018, the UH-1Y'sO&S costs per aircraft remained steady, averaging about $3.25 million per year, while the mission capable rate decreased. Also, maintenance costs per aircraft, on

average, accounted for more than one-third of total O&S costs per aircraft, averaging about $1.21 million per year. According to officials, this was a result of increase in the number of depot reparable demands and an increase in the cost of parts. Additionally, as noted previously, the UH-1Y fleet increased by 96 aircraft, from 46 aircraft in fiscal year 2011 to 142 aircraft in fiscal year 2018.

UH-1Y Operating and Support Costs per Aircraft and Fleet Size



Source: GAO analysis of Navy data. | GAO-21-101SP

Data table for UH-1Y Operating and Support Costs per Aircraft and Fleet Size (Constant fiscal year 2018 dollars in millions)

Fiscal year	Maintenance costs per aircraft	Other operating and support costs per aircraft
2011	0.85	2.34
2012	1.19	2.37
2013	1.14	2
2014	1.1	2.13
2015	1.5	2.02
2016	1.19	1.76
2017	1.24	1.82
2018	1.51	1.81

Fiscal year	Number of aircraft
2011	46
2012	61
2013	78
2014	96
2015	113
2016	129
2017	141
2018	142

Sustainment Challenges and Mitigation Actions

Maintenance: The UH-1Y faces maintenance challenges related to a high rate of unscheduled maintenance and an inability to fully support current aircraft numbers at the squadron level. As a result, officials stated that unscheduled

maintenance is driving the maintenance planning instead of the maintenance plans driving the maintenance workload. This reactive maintenance disrupts the scheduled maintenance plan and only leaves work hours available to complete the bare minimum maintenance to keep the aircraft flyable while deferring more in-depth maintenance work to later, according to officials. To mitigate this situation, officials told us that they are updating long-term maintenance processes, which include—but are not limited to—technical publication updates, an analysis of maintenance levels, improving maintainer technical knowledge, and the establishment of a corrosion prevention program. Further, the program office has established fleet support team site offices at each major H-1 location to assist the fleet with maintenance and troubleshooting discrepancies.

Supply Support: While NMCS rates decreased between fiscal year 2011 and 2018, the UH-1Y has experienced supply issues, which officials are working to mitigate in several ways. For example, program office officials told us that the number of aircraft at the standard squadron is approximately 25 percent above the normal authorized allowance—which is the number for which supplies are purchased; therefore, squadrons are unable to provide support for the excess aircraft. To mitigate this issue, officials told us they are working to adjust the fleet size by rotating the aircraft in and out of the fleet on a periodic basis to ensure that the squadrons do not have any overages they cannot support, and they have implemented the Light Attack Aircraft Management Plan to perform short- and long-term preservation to excess inventory, reducing workload to the fleet and burdens to the supply system. Further, to alleviate supply chain delays, the officials stated that the Navy Supply Systems Command entered into a performance-based logistics contract with Bell in December 2019 for rotors and drives components and the Defense Logistics Agency is planning to enter into a performance-based contract with Bell in late fiscal year 2020 for about 3,600 consumable items.

Program Office Comments

In commenting on a draft of this assessment, the program office provided technical comments, which we incorporated where appropriate.

Source: U.S. Air Force/Airman 1st Class Jennifer Zima. | GAO-21-101SP

CV-22 Osprey Joint Advanced Vertical Lift Aircraft Sustainment Quick Look

Common Name: CV-22

Lead Service: Air Force

Program Essentials

Manufacturer: Bell-Boeing Joint Program Office

Sustainment: Depot maintenance conducted at Navy Fleet Readiness Centers – East and Southwest and field maintenance conducted by service maintainers

Program Office: V-22 Joint Program Office – Air 275, Naval Air Systems Command, Patuxent River, Maryland

Fiscal Year 2019 Data

Average age: 7.9 years

Average lifetime flying hours: 1,860 hours per aircraft

Depot maintenance activity and squadron locations:

▲ Depot maintenance activity location

● Squadron location

Source: GAO. | GAO-21-101SP

Sustainment Challenges and Mitigation Actions

The CV-22 is experiencing maintenance and supply challenges. The Air Force's mitigation actions include purchasing retiring parts, establishing a common configuration for all CV-22 models, and improving supply chains.

Background

The CV-22 Osprey is a tiltrotor aircraft that was first manufactured as the Special Operation Forces variant of Marine Corps' MV-22B Osprey in 2005. The aircraft takes off vertically and, once airborne, the engine and prop rotors can rotate into a forward position. The CV-22 enables Air Force Special Operations Command aircrews to conduct long-range infiltration, exfiltration, and resupply missions at low altitudes.

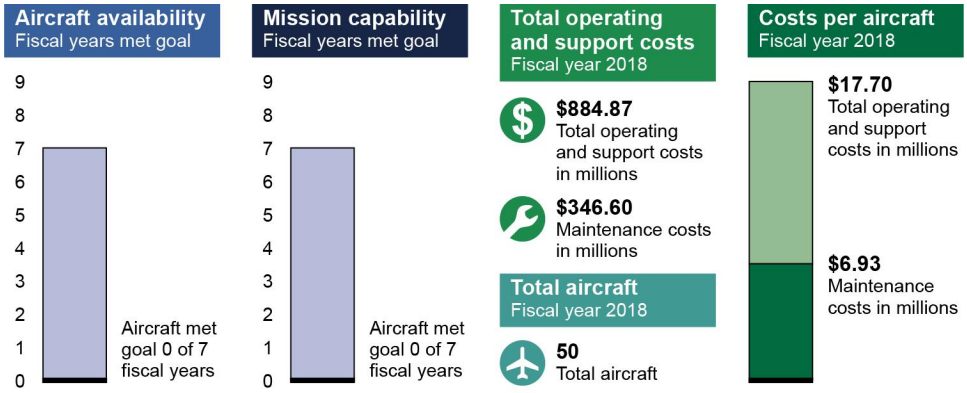
Life Cycle of the CV-22

Source: GAO analysis of Air Force data. | GAO-21-101SP

Overview

From fiscal years 2013 to 2019, the CV-22 fleet did not meet its aircraft availability or mission capable rate goals. In fiscal year 2019, the CV-22 fleet did not meet its goals due to maintenance and supply issues. Maintenance and supply issues were related to scheduled and unscheduled depot work, component unreliability, and increased inspection times, according to officials. Additionally, operating and support (O&S) costs per aircraft decreased from about $25.6 million in fiscal year 2011 to about $17.7 million in fiscal year 2018. According to officials, these costs decreased due to an increase in the size of the fleet from 18 to 50 aircraft.

CV-22 Sustainment Status



Source: GAO analysis of Air Force data. | GAO-21-101SP

Data table for CV-22 Sustainment Status

Aircraft availability	Aircraft met goal 0 of 7 fiscal years
Mission capability	Aircraft met goal 0 of 7 fiscal years
Total operating and support costs in millions (FY18)	$884.87
Maintenance costs in millions (FY18)	$346.60
Total aircraft (FY18)	50
Total operating and support costs per aircraft in millions (FY18)	$17.70
Maintenance costs per aircraft in millions	$6.93

Sustainment Strategy

- The V-22 Joint Program Life-Cycle Sustainment Plan (2014) provides the overall framework for the sustainment of the CV-22 system throughout its life cycle. This plan documents the program's integrated product support plan and total life cycle support management strategy.
- The Joint Program Office manages the MV-22B for the Marine Corps, the CV-22 Osprey for the Air Force and United States Special Operations Command, and the CMV-22 for the Navy as they are similar systems. Bell-Boeing provides a portion of product support, such as on-site fleet support, in-service engineering support, and access to parts, among other things, through a performance-based logistics contract managed by the Joint Program Office.
- Air Force field maintainers maintain the CV-22 at the organizational and intermediate levels of maintenance. The Navy Fleet Readiness Centers conduct depot maintenance under a utilization-based maintenance induction schedule; aircraft are inducted for planned depot maintenance at approximately 1,680 flight hours. Naval Supply Systems Command and the Defense Logistics Agency provide supply support.

Availability and Condition

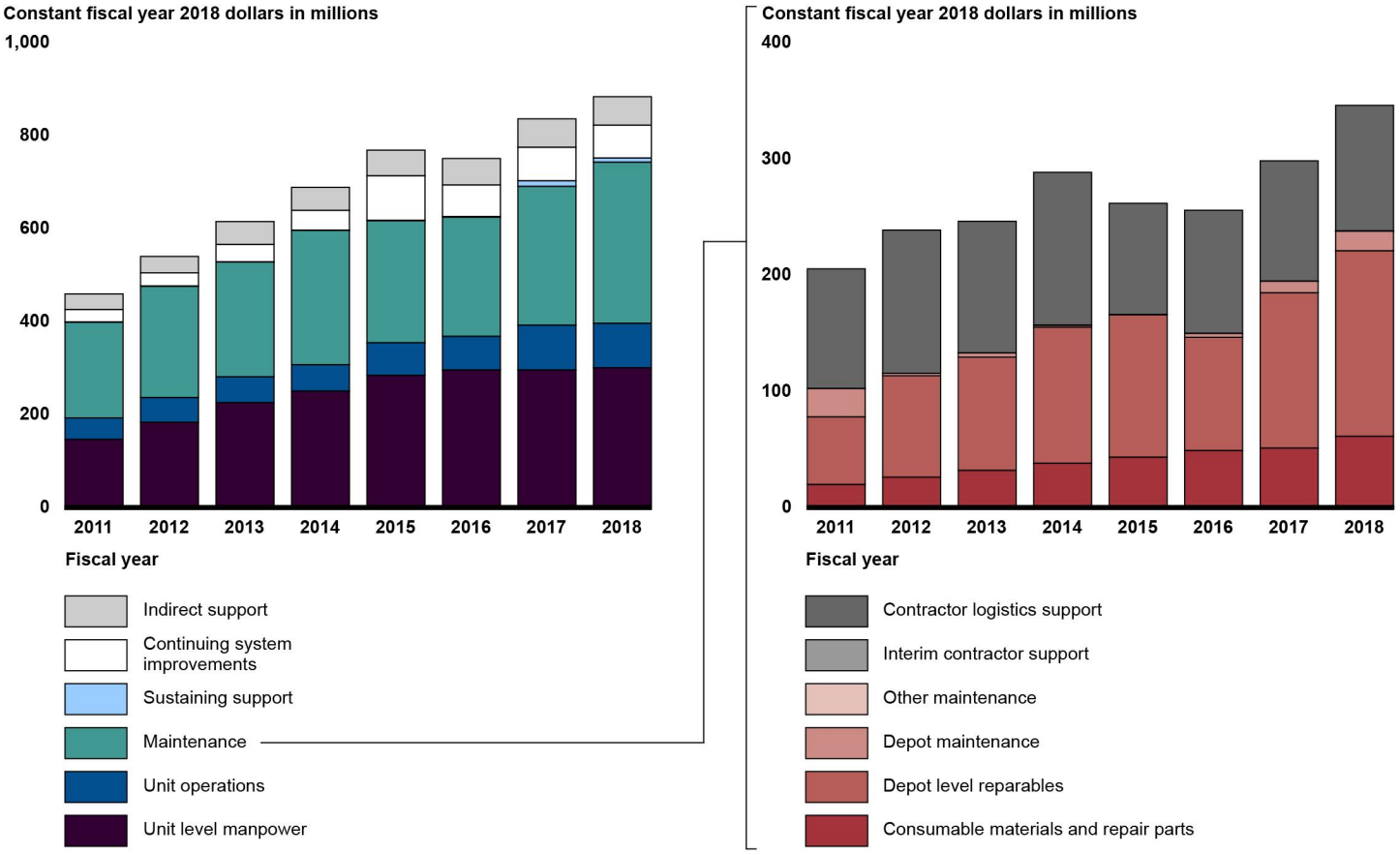
From fiscal year 2013 through fiscal year 2019, the CV-22 failed to meet its aircraft availability and mission capable rate goals. According to officials, the CV-22 missed its goals because of scheduled and unscheduled depot work, unreliability of wiring and components, and the length of time to conduct phase inspections. Additionally, over time the aircraft availability and mission capable goals slightly decreased due to a decrease in requirements, according to officials.

From fiscal year 2011 through fiscal year 2019, the rates increased for not mission capable maintenance (NMCM) and not mission capable both (NMCB) maintenance and supply, while the not mission capable supply (NMCS) rate generally stayed constant. Specific details on mission capable and not mission capable rates were omitted because the information was deemed by DOD to be sensitive.

Operating and Support Costs

From fiscal year 2011 through fiscal year 2018, the CV-22's total O&S costs nearly doubled. According to officials, this increase can largely be attributed to the overall increase in the number of aircraft. Maintenance costs also increased by $140.8 million between fiscal year 2011 and 2018, accounting for about 40 percent of O&S costs over the period. Further, depot-level reparables, the most significant category of maintenance costs, increased from $58.14 million in fiscal year 2011 to $159.59 million in fiscal year 2018.

CV-22 Total Operating and Support Costs



Source: GAO analysis of Air Force data. | GAO-21-101SP

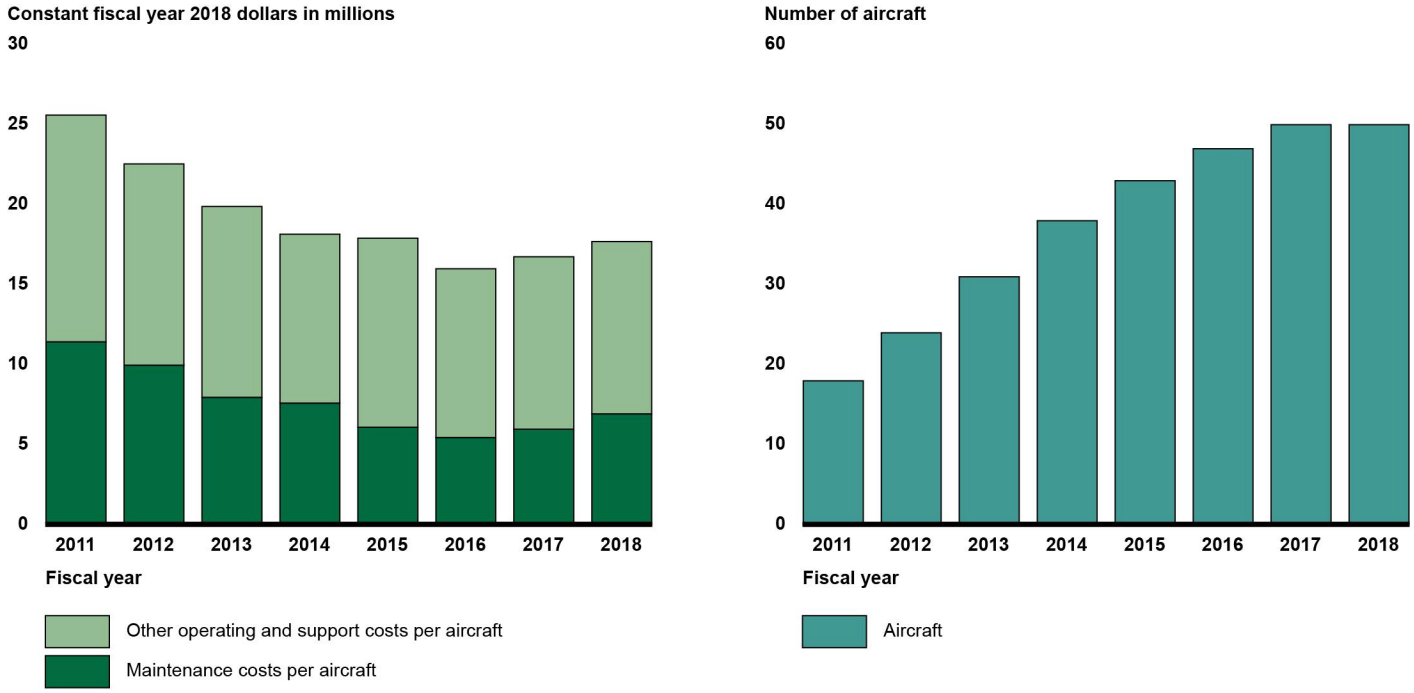
Data table for CV-22 Total Operating and Support Costs (Constant fiscal year 2018 dollars in millions)

Fiscal year	Unit level manpower	Unit operations	Maintenance	Sustaining support	Continuing system improvements	Indirect support
2011	147.53	46.39	205.79	0.81	26.37	33.86
2012	184.81	52.92	239.25	0.94	28.03	35.22
2013	226.61	55.82	246.84	0.82	36.97	49.41
2014	251.61	56.81	288.88	0.79	42.07	49.77
2015	285.47	70.34	262.28	1.26	95.4	55.21
2016	297.13	72.24	256.27	1.78	67.71	56.9
2017	297.06	96.27	298.8	11.87	72.06	61.4
2018	301.7	95.59	346.6	8.98	70.65	61.36

Fiscal year	Consumable materials and repair parts	Depot level reparables	Depot maintenance	Other maintenance	Interim contractor support	Contractor logistics support
2011	20.29	58.14	24.31	0	0	103.06
2012	26.53	87.33	2.19	0.01	0	123.2
2013	32.37	97.43	3.71	0.1	0	113.22
2014	38.59	117.02	1.64	0.06	0	131.57
2015	43.79	122.43	0.1	0.21	0.01	95.74
2016	49.51	97.45	3.3	0.03	0	105.97
2017	51.6	133.6	10.01	0.03	0	103.57
2018	61.7	159.59	17	0.15	0	108.15

The CV-22's total O&S costs per aircraft decreased steadily from fiscal year 2011 through fiscal year 2016 before increasing slightly in fiscal years 2017 and 2018. Specifically, O&S costs per aircraft decreased from $25.60 million in fiscal year 2011 to $16 million in fiscal year 2016 and increased to $17.7 million in fiscal year 2018, while the mission capable rate varied. Maintenance costs per aircraft, on average, accounted for about 40 percent of the total O&S costs per aircraft from fiscal years 2011 through 2018, averaging about $7.68 million per year. Additionally, the number of aircraft more than doubled, from 18 aircraft in fiscal year 2011 to 50 aircraft in fiscal year 2019, with a total expected fleet of 52 aircraft.

CV-22 Operating and Support Costs per Aircraft and Fleet Size



Source: GAO analysis of Air Force data. | GAO-21-101SP

Data table for CV-22 Operating and Support Costs per Aircraft and Fleet Size (Constant fiscal year 2018 dollars in millions)

Fiscal year	Maintenance costs per aircraft	Other operating and support costs per aircraft
2011	11.43	14.17
2012	9.97	12.58
2013	7.96	11.93
2014	7.6	10.56
2015	6.1	11.81
2016	5.45	10.55
2017	5.98	10.77
2018	6.93	10.77

Fiscal year	Number of aircraft
2011	18
2012	24
2013	31
2014	38
2015	43
2016	47
2017	50
2018	50

Sustainment Challenges and Mitigation Actions

Maintenance: According to Joint Program Office officials, the CV-22 currently has too many configurations—22 in total—for the Joint Program Office to maintain adequately and consistently. To mitigate this issue, the Joint Program Office plans to reduce the number of configurations and ultimately achieve either a common configuration or a minimal number of configurations, which officials hope will result in less time spent on unplanned maintenance and aircraft inspections. The full completion of the initiative is planned for fiscal year 2027. Further, officials told us that the configuration challenge affects depot maintenance times, which decreases availability. The Joint Program Office plans to mitigate this challenge through an aggressive modification program to achieve the common configuration.

Joint Program Office officials also told us aircraft availability and mission capability have both been negatively affected by low reliability of wiring and other components. To address these issues, the Joint Program Office is working to fully fund the current and future corrective action plans and engineering proposals to improve the reliability of these components. Lastly, the Joint Program Office stated that it has awarded a Performance Based Logistics and Engineering (PBL&E) contract that directly incentivizes industry to align with fleet goals of reducing the number of “long-term down” aircraft and reduce the NMCM rate. According to the Joint Program Office, the PBL&E contract also incentivizes rapid engineering responses, which should improve mission capable rates by reducing awaiting maintenance time, eliminating technical data gaps, and informing root cause and corrective actions.

Supply Support: The CV-22 has experienced spare part availability issues due to the number of configurations for the aircraft, which officials are working to mitigate in several ways. For example, Joint Program Office officials told us that they are working to implement a common configuration, as stated above, which will reduce the demand on the supply system. The CV-22 has also experienced supply issues when the necessary parts were not readily available to install due to there being no previous demand for the specific part and issues with suppliers. The Joint Program Office plans to improve consumable and reparable material support for the fleet by having the Air Force and the Defense Logistics Agency partner to more accurately measure the need for specific parts to ensure the most needed parts are available for purchase. The Joint Program Office also reports pursuing a number of initiatives, such as working with Navy Supply Systems Command and the Defense Logistics Agency to award contracts incentivizing material availability. The CV-22 has experienced supply shortages after some manufacturers stopped making certain CV-22 parts. According to officials, the program office has purchased additional parts and developed incentives for manufacturers to help ensure there are sufficient parts to effectively maintain the fleet throughout its lifetime, among other things.

Program Office Comments

In commenting on a draft of this assessment, the Joint Program Office stated that its efforts initiated in fiscal years 2018 and 2019 to accelerate readiness recovery produced results in fiscal year 2019 and will continue to improve readiness. Specifically, the Joint Program Office stated that the CV-22 in fiscal year 2019 was able to meet the fiscal year 2019 flight hour goal. The Joint Program Office noted that the improvements it has made should continue to result in improved CV-22 readiness rates in the future.

Source: U.S. Air Force/Senior Airman Greg Nash. | GAO-21-101SP

HH-60G Pave Hawk Sustainment Quick Look

Common Name: HH-60G

Lead Service: Air Force

Program Essentials

Manufacturer: United Technologies/Sikorsky Aircraft Company

Sustainment: Programmed depot maintenance is conducted by government and contractor personnel at various locations and field-level maintenance is performed by Air Force personnel

Program Office: Robins Air Force Base, Georgia

Fiscal Year 2019 Data

Average age: 27.5 years

Average lifetime flying hours: 7070.5 hours per aircraft

Depot maintenance activity and squadron locations:

Source: GAO. | GAO-21-101SP

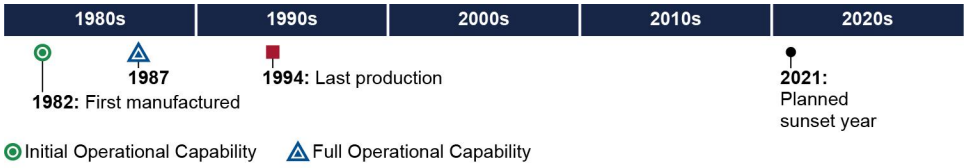
Sustainment Challenges and Mitigation Actions

The HH-60G faces several maintenance and supply challenges, such as prolonged depot maintenance timelines and malfunctioning parts. Mitigation actions include improving the planning of depot maintenance and coordinating across the military on supply support issues.

Background

The HH-60G Pave Hawk is a twin engine helicopter first manufactured in 1982. Its primary mission is to conduct day or night personnel recovery operations into hostile environments to recover isolated personnel during war. The HH-60G is also tasked to perform military operations other than war, including civil search and rescue, medical evacuation, disaster response, and humanitarian assistance.

Life Cycle of the HH-60G

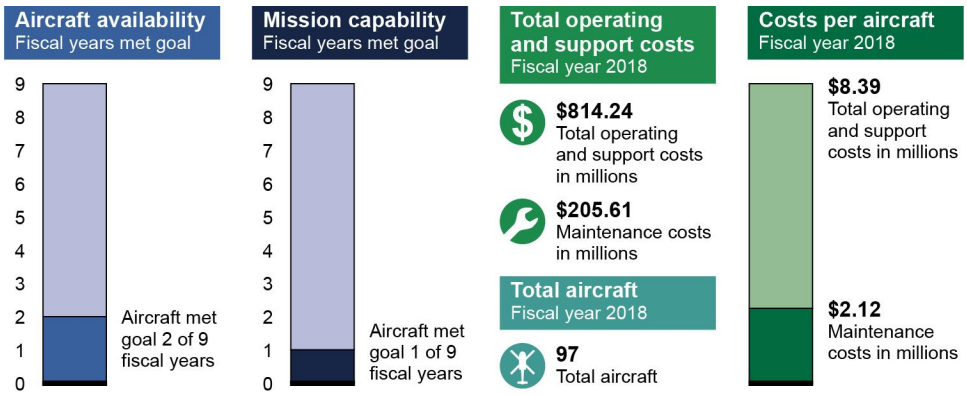


Source: GAO analysis of Air Force data. | GAO-21-101SP

Overview

The HH-60G fleet met the Air Force's aircraft availability goals in two years from fiscal years 2011 through 2019 and met the mission capable goal in one of those years. However, in fiscal year 2019, the HH-60G did not meet its aircraft availability goal or mission capable goal. From fiscal year 2011 through fiscal year 2018, total operating and support (O&S) costs for the HH-60G fleet decreased by $169.60 million, from $983.84 million to $814.24 million. Over the same 8-year period, the HH-60G fleet size decreased from 99 to 97 aircraft, including two test aircraft in fiscal year 2018, according to Air Force officials. The total O&S costs per aircraft decreased from $9.94 million in fiscal year 2011 to $8.39 million in fiscal year 2018, while the maintenance costs per aircraft increased slightly from $2.08 million to $2.12 million during the same timeframe.

HH-60G Sustainment Status



Source: GAO analysis of Air Force data. | GAO-21-101SP

Data table for HH-60G Sustainment Status

Aircraft availability	Aircraft met goal 2 of 9 fiscal years
Mission capability	Aircraft met goal 1 of 9 fiscal years
Total operating and support costs in millions (FY18)	$814.24
Maintenance costs in millions (FY18)	$205.61
Total aircraft (FY18)	97
Total operating and support costs per aircraft in millions (FY18)	$8.39
Maintenance costs per aircraft in millions	$2.12

Sustainment Strategy

- The March 2017 HH-60G Weapon System Life-Cycle Sustainment Plan Version 1.0 Supporting Operations and Support Phase outlines the sustainment strategy for the legacy HH-60G weapon system. According to the plan, the basic H-60 helicopter is operated by the Air Force, Army, Navy, and Coast Guard, and those services, in addition to contractors, all play a role in HH-60G sustainment. According to Air Force officials, the HH-60G fleet is sustained through scheduled inspections, field and depot technical assistance requests, and programmed depot maintenance (performed every 6.5 years). Additionally, these officials stated that structural, maintenance, reliability, and diminishing manufacturing sources and material shortages modifications are made to the aircraft.
- Programmed depot maintenance is conducted by government and contractor personnel at Corpus Christi Army Depot, Navy Fleet Readiness Center Southeast, and Korean Air Lines, among other locations. Field-level maintenance is performed by Air Force, Air Force Reserve Command, and Air National Guard personnel. Supply support is managed by the Air Force Sustainment Center, Army Materiel Command, Naval Air Systems Command, and the Defense Logistics Agency. Officials explained that the Air Force plans to end HH-60G programmed depot maintenance inductions in fiscal year 2020 due to planned aircraft retirements and deliveries of the replacement aircraft (the HH-60W).

Availability and Condition

The HH-60G fleet met the Air Force's aircraft availability goals in two years during fiscal years 2011 through 2019 and met the mission capable goal in one year. According to Air Force officials, the low HH-60G availability rate was largely a result of a smaller fleet size than originally planned due to operational losses from aircraft mishaps. Specifically, the HH-60G program of record was 112 aircraft, but the aircraft inventory was between 99 and 97 in fiscal years 2011 and 2018, including two test aircraft in fiscal year 2018, which reduced the program's ability to achieve the availability rate goal. Air Force officials said that the two test aircraft were a part of their operational loss replacement program. The officials told us that the decline in availability was also a result of increased downtime stemming from the aircraft's heavy modification schedule and depot performance issues, among other reasons.[1] The not mission capable for maintenance (NMCM) rate for the HH-60G fleet varied from fiscal years 2011 through 2019. The not mission capable for supply (NMCS) rate also varied. The not mission capable for both (NMCB) rate trended upwards from fiscal year 2011 to fiscal year 2019. According to Air Force officials, functional check flight delays—the flight required to assess the airborne function of certain repaired or replaced components—was the leading NMCM driver for the fleet. The officials said that functional check flights increased since fiscal year 2013 because the aging HH-60G is often used at its maximum gross weight, which causes airframe structural issues and cracking and additional maintenance to remove and reinstall components. Air Force officials also told us that the NMCS rate was higher in fiscal years 2016 through 2018 largely due to a problem with the aircraft's refueling probes. Unusual numbers of refueling probe oscillations began to occur in fiscal year 2011, with the most occurring in fiscal year 2015. The research and investigation of the problem took several years until the cause was identified in November 2015. According to program officials, fixing the problem required removing all affected refueling probes from the inventory and replacing them, with the last aircraft being repaired in December 2018. Officials noted that the HH-60G's main rotor blade was the largest NMCS driver in fiscal year 2019. Finally, the NMCB rate was higher in fiscal years 2016 through 2019 because of parts shortages that led to cannibalization (i.e., removing serviceable parts from one aircraft and installing them in another aircraft), according to Air Force officials. Data provided by these officials showed that the refueling probe and the main rotor blade were two examples of parts that were cannibalized due to shortages and that impacted the HH-60G's NMCB rate during those years. Specific details on mission capable and not mission capable rates were omitted because the information was deemed by DOD to be sensitive.

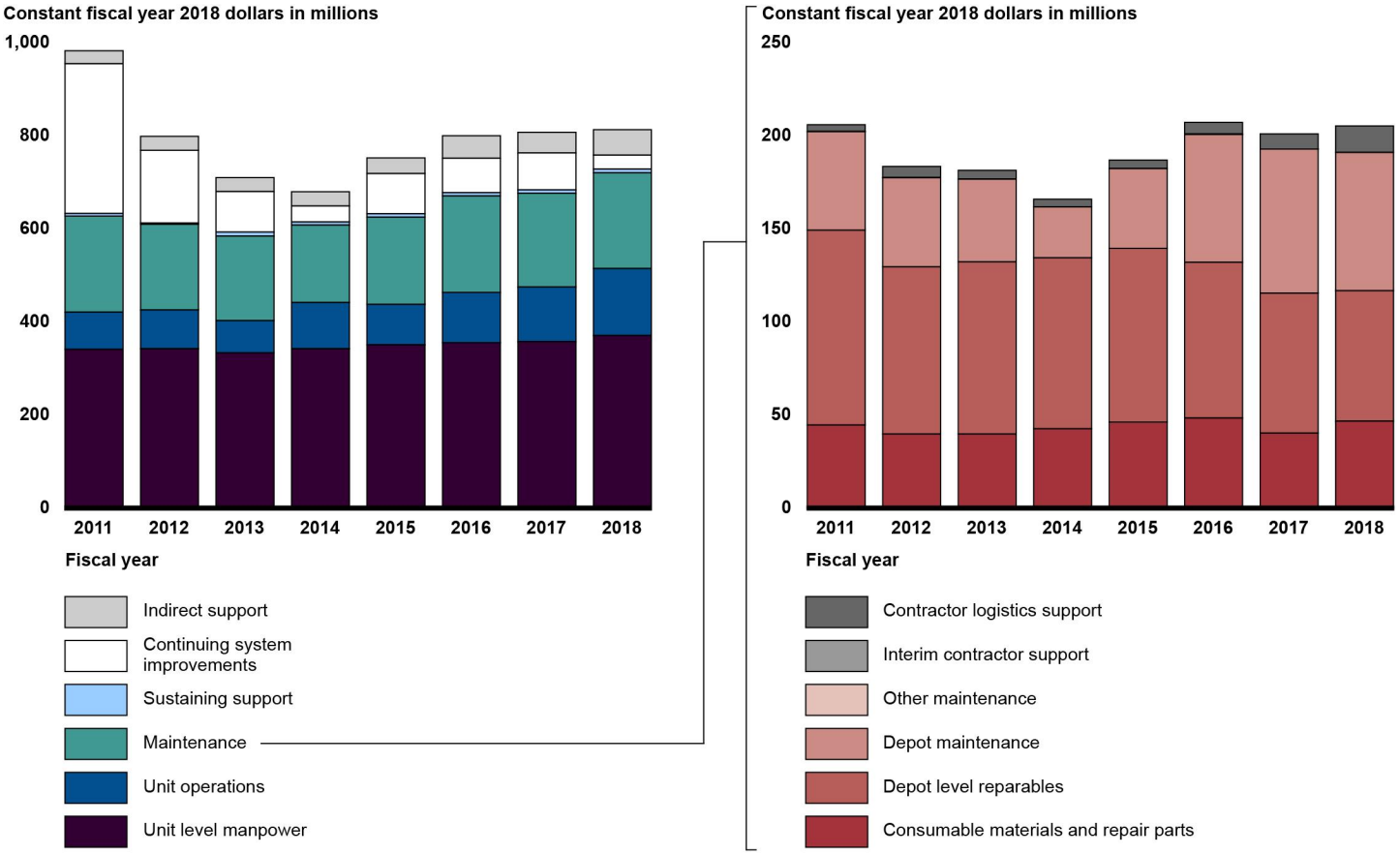
Operating and Supprt Costs

From fiscal year 2011 through 2018, the total O&S costs for the HH-60G fleet decreased by about $169.60 million, from $983.84 million to $814.24 million. When comparing the two fiscal years, most of the decrease was due to a reduction in costs for continuing systems improvements. Continuing system improvements were $292.13 million less in fiscal year 2011 than in fiscal year 2018, but these costs were significantly higher in fiscal year 2011 than the other years in the time period. According to HH-60 program officials, seven major modifications were ongoing during fiscal year 2011, including a service life extension, a gun replacement, and the operational loss replacement program to restore the fleet's aircraft inventory. The $218.45 million spent on the operational loss replacement program in fiscal year 2011 was likely the primary reason why continuing system improvement costs were higher in fiscal year 2011, according to these officials. Maintenance costs were almost the same in fiscal years 2011 and 2018, $206.27 million and $205.61 million respectively. The remaining cost categories all increased during the 8-

[1]GAO, *Military Readiness: Air Force Plans to Replace Aging Personnel Recovery Helicopter Fleet*, GAO-18-605 (Washington, D.C.: Aug. 16, 2018). We reported that HH-60G helicopters spent an average of 332 days undergoing depot level maintenance in fiscal year 2017 compared with 233 days in fiscal year 2007, more than a 40-percent increase. Air Force officials attributed these challenges to the helicopters exceeding their initially planned service life.

year period, with unit operations and unit-level manpower increasing the most, by $63.56 million and $29.85 million, respectively. Program officials noted that higher fuel costs and additional training requirements following significant Air Force-wide personnel cuts were two of the reasons for the higher unit operations costs.

HH-60G Total Operating and Support Costs



Source: GAO analysis of Air Force data. | GAO-21-101SP

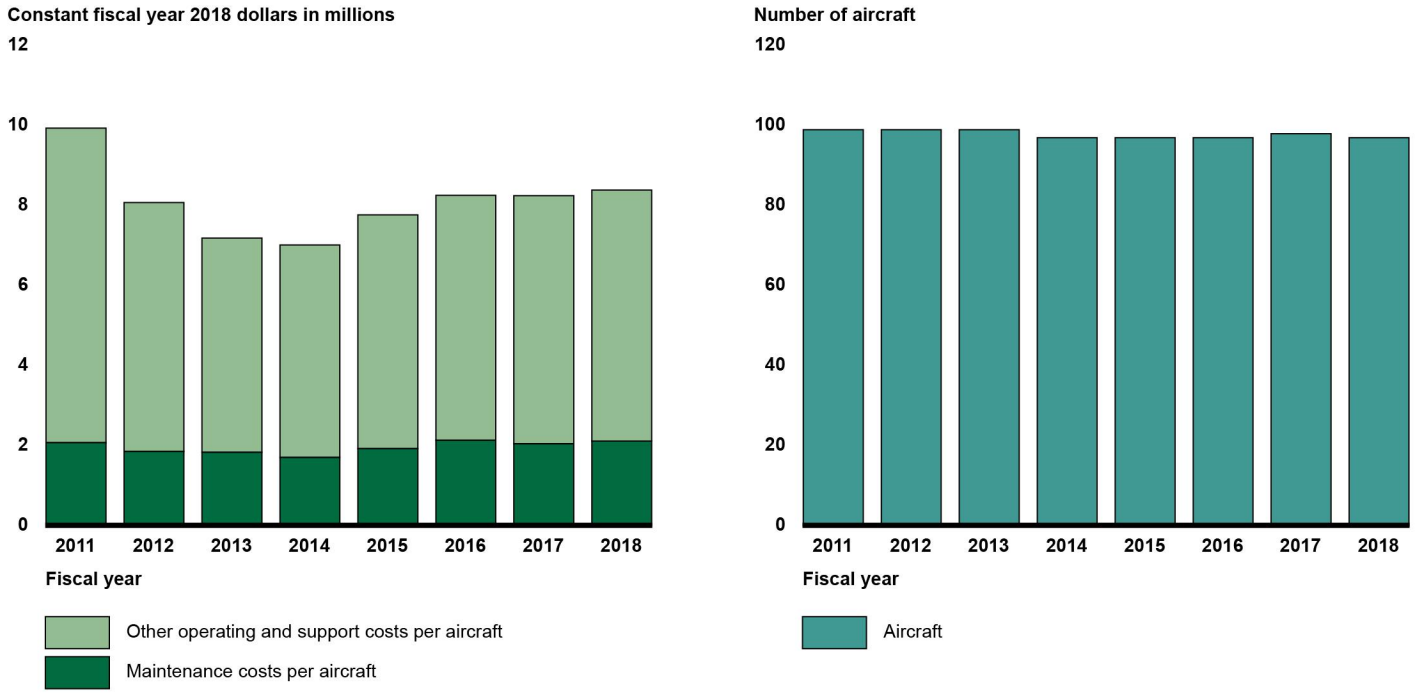
Data table for HH-60G Total Operating and Support Costs (Constant fiscal year 2018 dollars in millions)

Fiscal year	Unit level manpower	Unit operations	Maintenance	Sustaining support	Continuing system improvements	Indirect support
2011	342.28	80.19	206.27	5.52	321.82	27.77
2012	343.78	83.34	183.79	2.9	156.11	29.93
2013	334.62	69.42	181.72	8.52	87.17	29.98
2014	343.7	99.39	166.27	6.54	34.37	30.77
2015	352.1	87.04	187.26	7.16	86.51	33.58
2016	356.66	107.92	207.45	6.88	74.2	48.1
2017	358.92	117.51	201.32	7.25	79.41	44.3
2018	372.13	143.75	205.61	8.31	29.69	54.75

Fiscal year	Consumable materials and repair parts	Depot level reparables	Depot maintenance	Other maintenance	Interim contractor support	Contractor logistics support
2011	44.95	104.63	52.9	0	0.21	3.59
2012	40.1	89.81	47.83	0	0.2	5.86
2013	40.1	92.47	44.39	0	0	4.76
2014	42.94	91.78	27.32	0	0	4.23
2015	46.46	93.35	42.89	0.07	0	4.5
2016	48.66	83.66	68.68	0.24	0	6.22
2017	40.62	75.09	77.48	0.01	0	8.12
2018	46.99	70.08	74.24	0	0	14.3

The total O&S costs per aircraft decreased from $9.94 million in fiscal year 2011 to $8.39 million in fiscal year 2018. Over the 8-year period, the HH-60G fleet size decreased—from 99 to 97 aircraft—and total O&S costs decreased by about $169.60 million, reducing the total O&S costs per aircraft. However, maintenance costs were almost the same in fiscal years 2011 and 2018, $206.27 million and $205.61 million, respectively. Therefore, maintenance costs per aircraft went up slightly, from $2.08 million to $2.12 million, when comparing those two fiscal years.

HH-60G Operating and Support Costs per Aircraft and Fleet Size



Source: GAO analysis of Air Force data. | GAO-21-101SP

Data table for HH-60G Operating and Support Costs per Aircraft and Fleet Size (Constant fiscal year 2018 dollars in millions)

Fiscal year	Maintenance costs per aircraft	Other operating and support costs per aircraft
2011	2.08	7.86
2012	1.86	6.22
2013	1.84	5.35
2014	1.71	5.31
2015	1.93	5.84
2016	2.14	6.12
2017	2.05	6.2
2018	2.12	6.27

Fiscal year	Number of aircraft
2011	99
2012	99
2013	99
2014	97
2015	97
2016	97
2017	98
2018	97

Sustainment Challenges and Mitigation Actions

Maintenance: For many years, the HH-60G program has had a higher rate of operational losses than Air Force officials said were planned, an average of one aircraft every 24 months. The ongoing operational loss replacement program will replace these aircraft by modifying UH-60L aircraft to the HH-60G configuration and will increase the fleet's aircraft availability rate. Air Force officials explained that two test aircraft were delivered in fiscal year 2018, 10 aircraft were delivered between July 2019 and March 2020, and nine aircraft are to be delivered by December 2020 under the operational loss replacement program. Also, functional check flights—the flights required to assess the airborne function of certain repaired or replaced components—have increased, and the delay in obtaining these functional flight checks has become leading NMCM driver for the aging HH-60G fleet, according to Air Force officials. To mitigate this issue, the officials said that they plan to perform an engineering analysis in fiscal year 2020 to determine what can be accomplished on the ground instead of during a flight. Air Force officials also told us that the HH-60G program faces challenges with downtime for modifications and programmed depot maintenance. To reduce the number of aircraft that are down for depot maintenance at one time, the officials said that they started to combine the installation of multiple modifications into blocks and manage the timing of scheduled depot inductions more effectively in fiscal year 2019. However, they found that depot induction schedule changes have increased field maintenance requirements with additional inspections and limited the ability of units to accurately plan flying hour and inspection schedules.

Supply Support: Air Force officials said that the aging fleet, the lack of vendors, and the lack of primary inventory control authority to manage HH-60G parts are several supply support challenges for the HH-60 fleet. The HH-60G program office is an active member of the Team Hawk working group, which works to help solve ongoing sustainment issues and to benefit from the other services' lessons learned, according to Air Force officials. They explained that the Team Hawk working group is a collaboration between the Air Force, Army, Coast Guard, Navy, and the H-60 original equipment manufacturer, to identify and solve sustainment challenges, discuss technical issues, classify risk areas, discuss and investigate collaboration opportunities, and identify parts obsolescence among key stakeholders. Further, HH-60 program officials said that they manage engineering services and reliability and maintainability contracts that give reach-back capabilities to manufacturers and small businesses to identify, study, and solve sustainment and engineering issues. Finally, they stated that an obsolescence/diminishing manufacturing sources and material shortages lead is assigned to the HH-60G program office to identify items with immediate or near-term obsolescence issues, assess the population of problem items, and prioritize the items that are most at risk for current and future readiness.

Program Office Comments

In commenting on a draft of this assessment, the program office provided technical comments, which we incorporated where appropriate.

Source: U.S. Air Force/Senior Airman Jonathan McElderry. | GAO-21-101SP

UH-1N Iroquois Aircraft Sustainment Quick Look

Common Name: UH-1N

Lead Service: Air Force

Program Essentials

Manufacturer: Bell Helicopter/Textron, Inc.

Sustainment: Depot maintenance conducted at Navy Fleet Readiness Center – East and field maintenance conducted by contractors

Program Office: Air Force Life Cycle Management Center, Robins Air Force Base, Georgia

Fiscal Year 2019 Data

Average age: 47 years

Average lifetime flying hours: 14,900 hours per aircraft

Depot maintenance activity and squadron locations:

Source: GAO. | GAO-21-101SP

Sustainment Challenges and Mitigation Actions

The UH-1N is experiencing many challenges related to its age. Officials told us plans to retire the aircraft beginning in 2022 will mitigate aging issues, with full retirement expected by 2032.

Background

The UH-1N Iroquois is a light-lift utility aircraft that was first manufactured in 1956 and last produced in 1974. The aircraft has a crew of three and is capable of flight in inclement weather and nighttime conditions. The UH-1N supports combatant command missions and enables Air Force aircrews to conduct airlifts of emergency security forces and distinguished visitors, and to conduct security and surveillance of off-base nuclear weapons convoys.

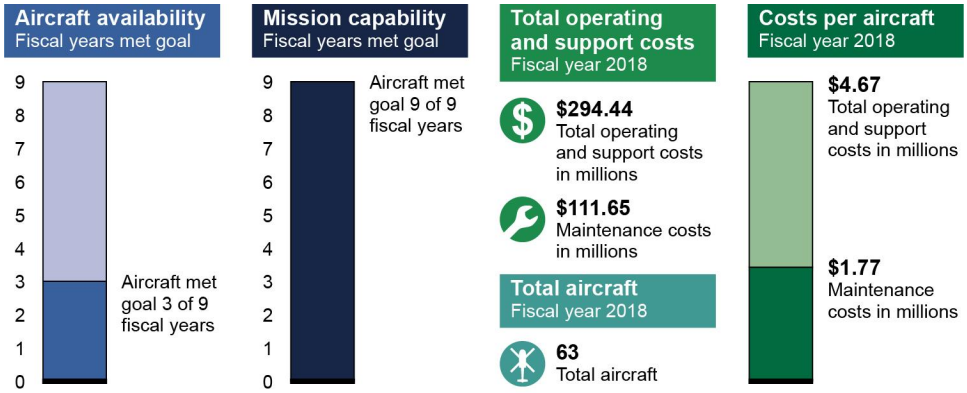
Life Cycle of the UH-1N

Source: GAO analysis of Air Force data. | GAO-21-101SP

Overview

The UH-1N fleet exceeded its mission capable goal in each year from fiscal year 2011 to fiscal year 2019, and exceeded its aircraft availability goal in three years during that same time period. In fiscal year 2019, the UH-1N fleet did not meet its aircraft availability goal, but exceeded its mission capable rate goal. Operating and support (O&S) costs per aircraft increased from about $3.89 million in fiscal year 2011 to about $4.67 million in fiscal year 2018 as a result of an increase in UH-1N maintenance costs.

UH-1N Sustainment Status



Source: GAO analysis of Air Force data. | GAO-21-101SP

Data table for UH-1N Sustainment Status

Aircraft availability	Aircraft met goal 3 of 9 fiscal years
Mission capability	Aircraft met goal 9 of 9 fiscal years
Total operating and support costs in millions (FY18)	$294.44
Maintenance costs in millions (FY18)	$111.65
Total aircraft (FY18)	63
Total operating and support costs per aircraft in millions (FY18)	$4.67
Maintenance costs per aircraft in millions	$1.77

Sustainment Strategy

- The UH-1N Replacement Life-Cycle Sustainment Plan (2018) provides the overall framework for the sustainment of the UH-1N system and its replacement, the MH-139A. This plan documents the UN-1N program's product support and total life cycle support management strategies, and provides plans to sustain the UH-1N while it is being replaced— from 2022 through 2032.
- The program office extended its engineering services support contract with Bell Helicopter Textron, Inc. in December 2018 for the UH-1N fleet to provide engineering assistance with repair questions and modifications.
- The Navy Fleet Readiness Center – East conducts depot maintenance, and the Army is responsible for conducting depot-level maintenance on reparable components. Contractor field maintainers provide organizational and intermediate maintenance for the UH-1N at the squadron level. Army, Navy, Air Force, and Defense Logistics Agency item managers provide supply support.

Availability and Condition

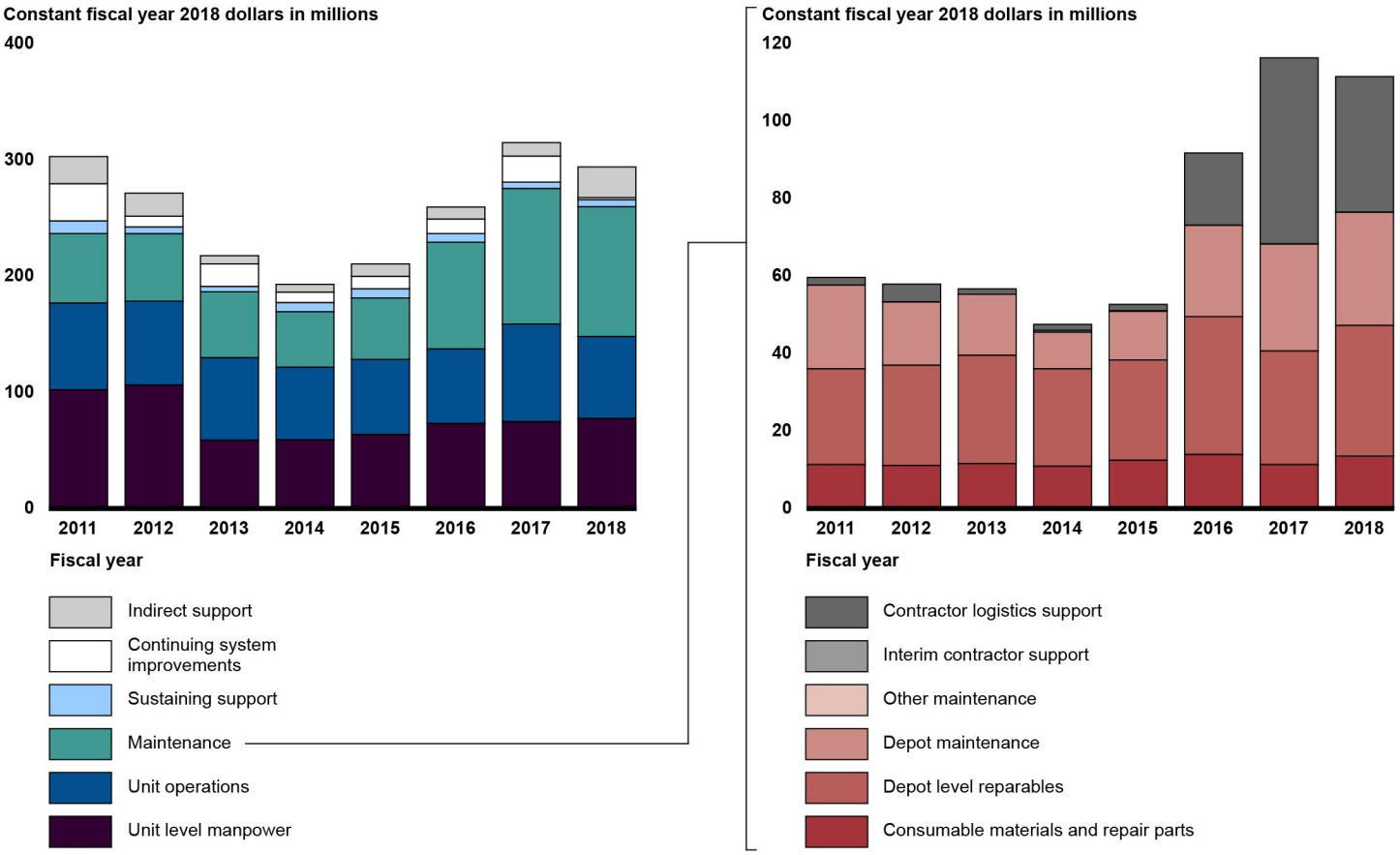
The UH-1N fleet exceeded its mission capable goal in each year from fiscal year 2011 to fiscal year 2019, and exceeded its aircraft availability goal in three years during that same time period.

From fiscal year 2011 through fiscal year 2019, the rates for not mission capable supply (NMCS) and both maintenance and supply (NMCB) stayed fairly constant, while the not mission capable maintenance (NMCM) rate slightly increased. According to officials, the NMCM rate increased due to increased times to remove and re-install components on aircraft due to the age of the aircraft. Specific details on mission capable and not mission capable rates were omitted because the information was deemed by DOD to be sensitive.

Operating and Support Costs

From fiscal year 2011 through fiscal year 2014, the UH-1N's total O&S costs decreased and then increased from fiscal year 2015 through fiscal year 2017, before slightly dropping again in fiscal year 2018. The increase in costs from fiscal year 2014 to fiscal year 2018 was primarily due to an increase in maintenance costs, from $47.65 million in fiscal year 2014 to $111.65 million in fiscal year 2018. According to officials, increases in costs also occurred due to errors in the Air Force Total Ownership Cost database that included TH-1H—an Iroquois training aircraft—engine repair contract costs, and other support costs with the UH-1N.

UH-1N Total Operating and Support Costs



Source: GAO analysis of Air Force data. | GAO-21-101SP

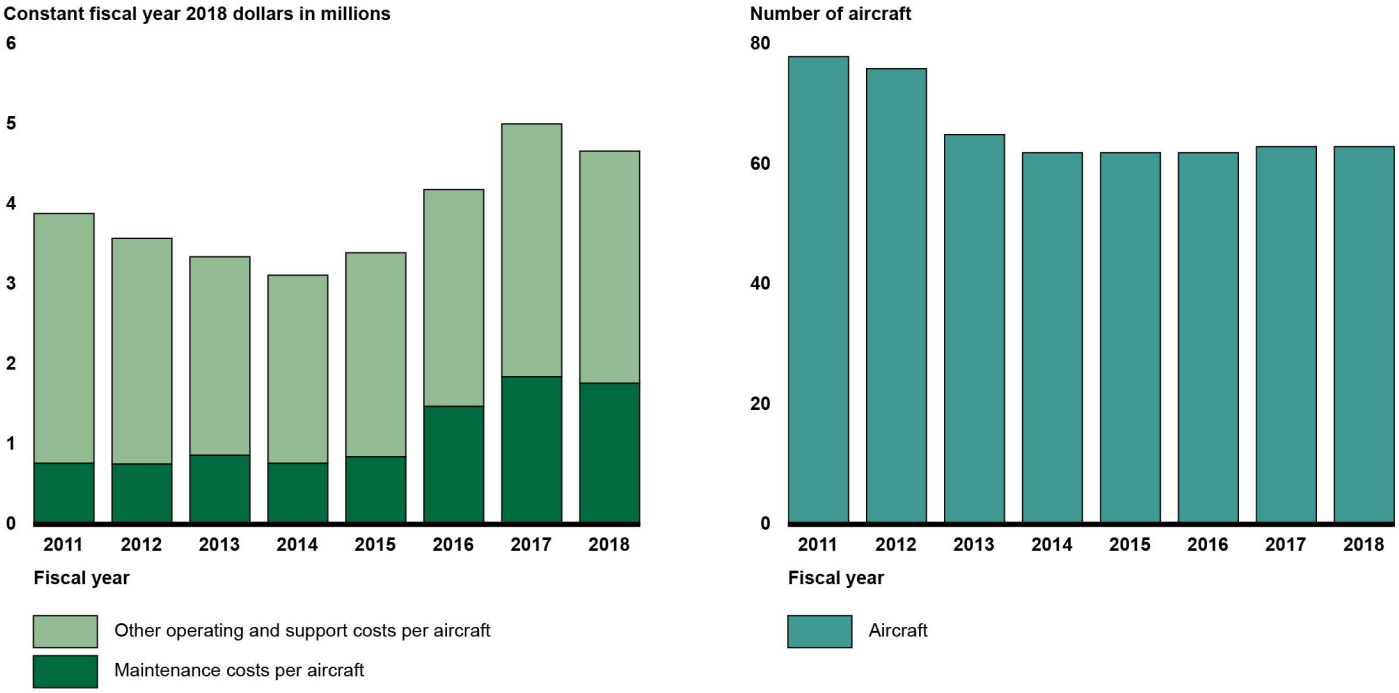
Data table for UH-1N Total Operating and Support Costs (Constant fiscal year 2018 dollars in millions)

Fiscal year	Unit level manpower	Unit operations	Maintenance	Sustaining support	Continuing system improvements	Indirect support
2011	102.62	74.63	59.79	10.76	32.08	23.44
2012	106.61	72.31	58.06	5.65	9.35	19.88
2013	59.19	70.88	56.81	4.53	19.48	7.17
2014	59.64	62.38	47.65	7.93	8.91	6.82
2015	64.12	64.71	52.83	7.74	10.73	10.84
2016	73.59	64.1	91.91	7.4	12.47	10.36
2017	75.19	84.02	116.47	5.6	22.37	11.72
2018	77.84	70.61	111.65	6.02	1.92	26.41

Fiscal year	Consumable materials and repair parts	Depot level reparables	Depot maintenance	Other maintenance	Interim contractor support	Contractor logistics support
2011	11.46	24.75	21.57	0	0	2.01
2012	11.23	25.89	16.32	0.01	0	4.61
2013	11.7	27.96	15.76	0.01	0	1.39
2014	11.02	25.16	9.44	0.46	0	1.58
2015	12.61	25.88	12.54	0.12	0	1.68
2016	14.06	35.6	23.57	0.02	0	18.67
2017	11.48	29.33	27.6	0.01	0	48.04
2018	13.69	33.72	29.19	0	0	35.04

The UH-1N's total O&S costs per aircraft increased from $3.89 million in fiscal year 2011 to $4.67 million in fiscal year 2018. Specifically, O&S costs per aircraft decreased from $3.89 million in fiscal year 2011 to $3.12 million in fiscal year 2014. Since fiscal year 2014, O&S costs per aircraft increased to a high of $5.01 million in fiscal year 2017 before decreasing slightly to $4.67 million in fiscal year 2018. This increase was largely attributable to an increase in maintenance costs, specifically contractor logistics support, depot-level reparables, and depot maintenance. Maintenance costs per aircraft were generally stable from fiscal year 2011 through fiscal year 2015, averaging about $0.81 million per year before increasing to an average of $1.7 million from fiscal year 2016 through fiscal year 2018. As previously discussed, according to officials, increases in costs occurred because of errors in the Air Force Total Ownership Cost database that included TH-1H—an Iroquois training aircraft—engine repair contract costs and other support costs with the UH-1N. Additionally, the number of aircraft decreased from 78 aircraft in fiscal year 2011 to 63 aircraft in fiscal year 2018, as the aircraft approaches its phased retirement beginning in 2022 and concluding in 2032. However, according to officials, TH-1H aircraft may have been captured in the number of aircraft, erroneously inflating the number of aircraft between fiscal years 2011 and 2013.

UH-1N Operating and Support Costs per Aircraft and Fleet Size



Source: GAO analysis of Air Force data. | GAO-21-101SP

Data table for UH-1N Operating and Support Costs per Aircraft and Fleet Size (Constant fiscal year 2018 dollars in millions)

Fiscal year	Maintenance costs per aircraft	Other operating and support costs per aircraft
2011	0.77	3.12
2012	0.76	2.82
2013	0.87	2.48
2014	0.77	2.35
2015	0.85	2.55
2016	1.48	2.71
2017	1.85	3.16
2018	1.77	2.9

Fiscal year	Number of aircraft
2011	78
2012	76
2013	65
2014	62
2015	62
2016	62
2017	63
2018	63

Sustainment Challenges and Mitigation Actions

Aging: According to officials, the age of aircraft components and high number of usage hours has created additional maintenance to remove or reinstall components, which has led to an increase to NMCM time. Further, the Air Force is currently buying over 150 new main rotor blades due to the aging-related high failure rate on the repair line, which negatively impacts the mission capable and aircraft availability rates, according to officials.

Maintenance: According to officials, the aging fleet and lack of repair of UH-1N components has led to maintenance sustainment challenges and unpredictable aircraft schedules. This has prevented units from being able to accurately plan flying hour and inspection schedules, which has resulted in last-minute changes and an increase in unit

maintenance. Additionally, officials stated that the main rotor blade replacements have increased NMCM time due to the requirement for a functional check flight prior to returning aircraft to mission capable status.

Supply Support: According to officials, Defense Logistics Agency parts shortages and tester issues have not allowed the Air Force to keep up with transmission parts demands for the UH-1N. Further, there have also been transmission supply shortage issues—which are repaired by the Army—for the Air Force.

To address sustainment challenges, the UH-1N program office continues to proactively work with the other services to improve the sustainment program across the common H-1 platform. According to officials, they monitor both internal and external sustainment providers to ensure issues are resolved as quickly as possible for minimal impact to overall aircraft availability. For example, one of the supply partners was unable to deliver enough rotor blades. As a result, the services authorized pulling blades from the aircraft in storage to prevent a gap in support until the new blades were delivered. Officials also said that the program office is executing an obsolescence program to minimize costs and offset detrimental sustainment impact, which includes meetings to discuss sustainment issues as they arise.

Program Office Comments

In commenting on a draft of this assessment, the program office provided technical comments, which we incorporated where appropriate.