GAO U.S. GOVERNMENT ACCOUNTABILITY OFFICE

Weapon System Sustainment
Navy Ship Usage Has Decreased as Challenges and Costs Have Increased

GAO-23-106440
Report to Congressional Committees

January 2023

Source: U.S. Navy/Mass Communication Specialist 3rd Class E. A. Parsons.

Weapon System Sustainment
Navy Ship Usage Has Decreased as Challenges and Costs Have Increased

Highlights of **GAO-23-106440**, a report to congressional committees **January 2023**

Sustainment Challenges Have Worsened across the Ship Classes Reviewed

GAO reviewed key sustainment metrics for 10 ship classes and found that from fiscal years 2011 through 2021, these classes faced persistent and worsening sustainment challenges. Specifically, the number of maintenance cannibalizations (working parts removed and reused elsewhere due to parts shortages), casualty reports (reports of events that impair ships' ability to do a primary mission), and days of maintenance delay (days beyond the scheduled end date for depot maintenance) have each increased, while steaming hours (the number of hours a ship is generally in an operating or training status) have decreased. Additionally, the Navy is not fully or accurately tracking other metrics—operational availability and materiel availability—that the Department of Defense and the Navy have determined are key to assessing ship effectiveness despite a prior GAO recommendation to do so.

Changes in Sustainment Metrics per Ship across Selected Navy Ship Classes, Fiscal Years 2011 through 2021

Ship class	Total inventory	Maintenance cannibalizations[a]	Category 3 and 4 casualty reports	Days of maintenance delay
Ticonderoga-class cruiser (CG-47)	22	+3 ▲	-1 ▼	+7 ▲
Nimitz-class aircraft carrier (CVN-68)	10	+4 ▲	+2 ▲	+7 ▲
Arleigh Burke-class destroyer (DDG-51)	68	+7 ▲	+19 ▲	+20 ▲
Freedom-class littoral combat ship (LCS-1)	10	+15 ▲	+26 ▲	0 ●
Independence-class littoral combat ship (LCS-2)	12	+3 ▲	+26 ▲	+19 ▲
America-class amphibious assault ship (LHA-6)[b]	2	-1 ▼	+13 ▲	0 ●
Wasp-class amphibious assault ship (LHD-1)	8	+9 ▲	+43 ▲	+10 ▲
San Antonio-class amphibious transport dock (LPD-17)	11	+3 ▲	+10 ▲	+33 ▲
Whidbey Island-class dock landing ship (LSD-41)	8	+6 ▲	+24 ▲	+19 ▲
Harpers Ferry-class dock landing ship (LSD-49)	4	+7 ▲	-11 ▼	-16 ▼
Fleetwide		**+6** ▲	**+15** ▲	**+14** ▲

● No change (neutral) ▲ Increase (negative) ▼ Decrease (positive)

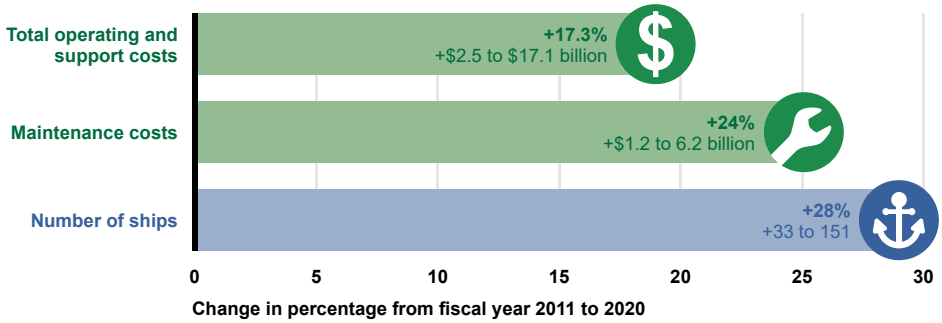
Source: GAO analysis of U.S. Navy data. | GAO-23-106440

Note: The above are numbers and not percentages and are rounded to the nearest whole number.
[a]Cannibalization data for fiscal years 2011 through 2014 is incomplete. Therefore, cannibalization trends begin fiscal year 2015.
[b]The first *America* class amphibious assault ship was commissioned in 2014, so readiness trends for this class reflect fiscal years 2015 through 2021.

Operating and Support (O&S) and Steaming Hour Costs Have Increased

Total O&S costs increased by about $2.5 billion from fiscal years 2011 and 2020 for the 10 ship classes GAO examined, including a $1.2 billion increase in maintenance costs. The Navy also added about 33 ships to these classes. Collectively, the number of steaming hours for the ships declined over the timeframe.

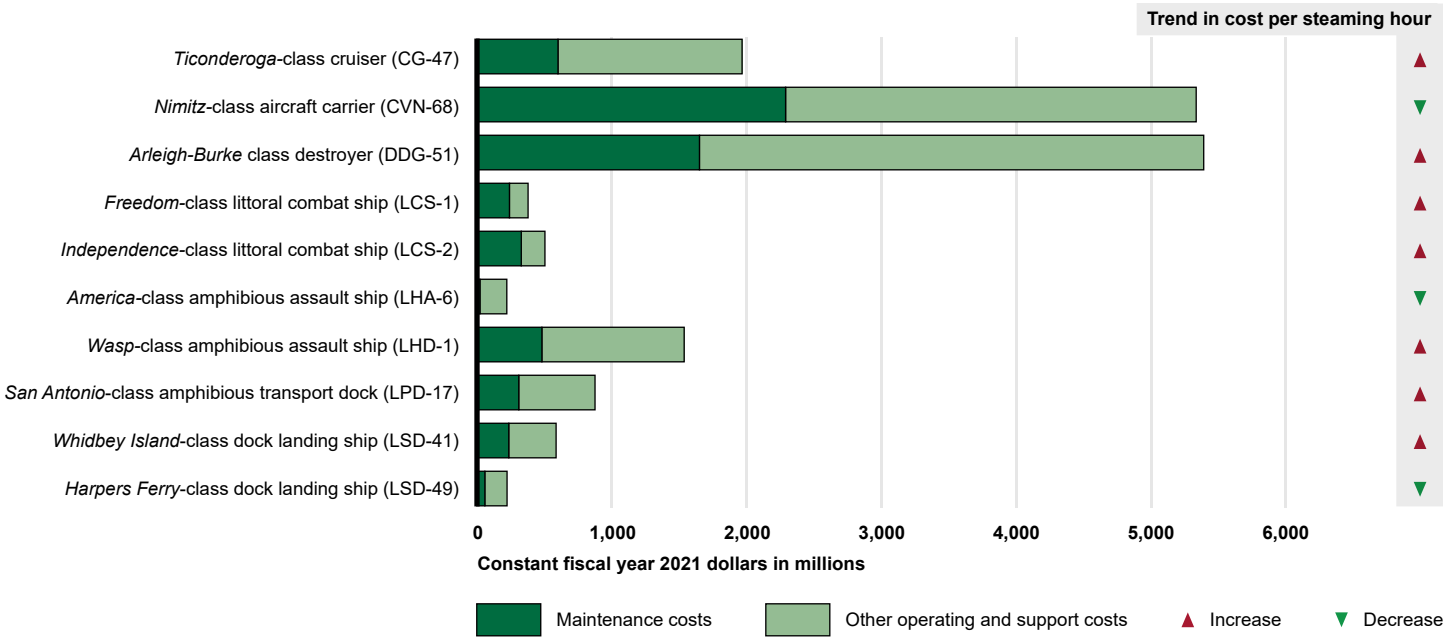
Change in Costs and Number of Ships Over Time



Source: GAO analysis of Navy data. | GAO-23-106440

GAO found the average O&S cost per steaming hour—used to measure the cost to provide operational steaming hours—across the 10 ship classes increased from fiscal year 2011 to 2020. Specifically, most ship classes we reviewed experienced an increase in O&S cost per steaming hour across the timeframe.

Operating and Support Costs, by Ship Class, Fiscal Year 2020 and the Ship Class' Trend in Average Cost per Steaming Hour, Fiscal Years 2011 and 2020



Source: GAO analysis of Navy data. | GAO-23-106440

The increase in O&S cost per steaming hour occurred for several reasons. First, a decrease in steaming hours contributed to the increase in cost per steaming hour. Second, GAO's prior work shows that a number of other challenges have increased sustainment costs for ships, such as maintenance delays that have resulted in some ships deferring maintenance. Over time this situation has resulted in worsening ship conditions and increased costs to repair and sustain ships. GAO has made dozens of recommendations, which the Navy has generally concurred with, to improve the Navy's sustainment of its ships. While taking actions, the Navy has not fully implemented many of GAO's recommendations, including that the Navy

- establishes performance goals and measures to better manage deferred depot maintenance backlog;
- better track data on and address challenges with executing intermediate maintenance periods; and
- take steps to ensure that new ships are reliable and can be sustained as planned when procured.

Why This Matters

The Department of Defense (DOD) spends tens of billions of dollars annually to sustain its weapon systems in an effort to ensure that these systems are available to simultaneously support today's military operations and maintain the capability to meet future defense requirements. Costs to operate and sustain the 151 Navy ships included in this review totaled approximately $17 billion in fiscal year 2020. GAO's past work has shown that the Navy has faced significant readiness challenges over the last decade. This is a public version of a sensitive report issued in December 2022. GAO removed specific details on steaming hours that DOD deemed sensitive.

How GAO Did This Study

GAO initiated this work due to: 1) continuing interest in the operational availability and O&S costs for major weapon systems; and 2) as part of our response to a provision in section 802 of the William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021 for us to report on sustainment reviews conducted by the military services with a specific focus on O&S cost growth. GAO reviewed documentation and interviewed program office officials to identify reasons for the trends in key sustainment rates and O&S costs as well as any challenges in sustaining the selected ship classes.

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Abbreviations

ASD (Sustainment)	Assistant Secretary of Defense for Sustainment
CLS	Contractor Logistics Support
DECKPLATE	Decision Knowledge Programming for Logistics Analysis and Technical Evaluation
DOD	Department of Defense
LCS	Littoral Combat Ship
OPNAV	Office of the Chief of Naval Operations
O&S	Operating and Support
OSMIS	Operating and Support Management Information System
PEO	Program Executive Office
NAVSEA	Naval Sea Systems Command
USD (A&S)	Under Secretary of Defense for Acquisition and Sustainment
VAMOSC	Visibility and Management of Operating and Support Costs system

U.S. GOVERNMENT ACCOUNTABILITY OFFICE
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January 31, 2023

Congressional Committees

The Department of Defense (DOD) spends tens of billions of dollars annually to sustain its weapon systems in an effort to ensure that these systems are available to simultaneously support today's military operations and maintain the capability to meet future defense requirements. Operating and support (O&S) costs historically account for approximately 70 percent of a weapon system's total life-cycle cost—costs to operate and sustain the weapon system from initial operations through the end of its life.[1] Costs to operate and sustain the 151 Navy ships included in our review totaled approximately $17 billion in fiscal year 2020. Weapon systems are costly to sustain in part because they often incorporate a complex array of technical subsystems and components and need expensive repair parts and logistics support to meet required readiness levels.

We testified before the Senate Committee on Armed Services in December 2018 and again in December 2019, highlighting current and future Navy readiness challenges and emphasizing that rebuilding readiness will require time and sustained management attention.[2] In December 2020, we stated that the Navy continued to face significant readiness challenges that have developed over more than a decade of conflict.[3] We previously reported that these challenges prevent the service from reaping the full benefit of its existing forces and attaining the level of readiness called for by the 2018 National Defense Strategy.

[1]The Navy defines sustainment as the broad range of planning, resourcing, supply, and maintenance activities required to maintain the readiness and operational capability of fielded systems that includes, but is not limited to, product support for fielded major weapons systems. Secretary of the Navy Instruction 5400.15D, *Department of the Navy Research and Development, Acquisition, Associated Life-Cycle Management, and Sustainment Responsibilities and Accountability* (Jan. 19, 2021).

[2]GAO, *Navy and Marine Corps: Rebuilding Ship, Submarine, and Aviation Readiness Will Require Time and Sustained Management Attention*, GAO-19-225T (Washington, D.C.: Dec.12, 2018). GAO, *Navy Maintenance: Persistent and Substantial Ship and Submarine Maintenance Delays Hinder Efforts to Rebuild Readiness*, GAO-20-257T (Washington, D.C.: Dec. 4, 2019).

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

Specifically, the Navy faces multiple interrelated challenges in the areas of maintenance, personnel, and training that continue to hinder its efforts to rebuild ship and submarine readiness. The Navy recognizes that addressing these challenges will require years of sustained management attention and resources.

We initiated this work due to continuing congressional interest in the operational availability and O&S costs for major weapon systems. Additionally, we initiated this work as part of our response to a provision in section 802 of the William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021 for us to report on information associated with sustainment reviews conducted by the military services with a specific focus on O&S cost growth.[4]

This report examines (1) the trends in key sustainment metrics and any related sustainment challenges for selected ship classes during fiscal years 2011 through 2021, and (2) the trends in costs to operate and support the selected ship classes since fiscal year 2011. In addition, we provide "Sustainment Quick Looks" for each of the 10 ship classes included in our review. These "Sustainment Quick Looks" include detailed information on sustainment metrics, ship inventory changes, and O&S costs experienced by each ship class over the period of fiscal years 2011 through 2021.

This report is a public version of a sensitive report that we issued in December 2022. The Department of Defense deemed some of the information—specifically detailed data associated with the number of steaming hours conducted by the ship classes—in our December report to be sensitive, which must be protected from public disclosure. Therefore, this report omits this detailed information. Although the information provided in this report is more limited, the report addresses the same objectives as the sensitive report and uses the same methodology.

To conduct our review, we selected 10 ship classes that represent a large portion of the Navy's total ship population. Specifically, as of November 2022, the selected ship classes represented 153 of the Navy's total ship battle force of 292, and additional ships from some of the ship classes we

[4]Pub. L. No. 116-283 (2021). We are currently conducting work on the section 802 provision in a separate engagement.

examined are in production.[5] A list of the 10 ship classes selected for our review are included in appendix I of this report.

We worked with the Navy to identify metrics key to sustainment and any goals used to track performance related to the metrics. We then collected and analyzed data from the Navy on those key sustainment metrics for each of the 10 ship classes, including maintenance schedules, casualty reports, and cannibalization rates for fiscal years 2011 through 2021. We also obtained information from program office officials regarding the reasons for changes in sustainment metrics and any challenges in sustaining these ships.

We also collected and analyzed O&S cost data from the Department of the Navy's cost reporting system, the Navy Visibility and Management of Operating and Support Costs system (VAMOSC). Specifically, we collected O&S cost data for fiscal years 2011 through 2020, the last fiscal year for which complete data were available at the time of our review. We obtained information from program office officials about reasons for changes and trends in O&S costs.

We conducted data-reliability assessments of the sustainment metrics and O&S cost data by reviewing related documentation, interviewing knowledgeable agency officials, and performing electronic data testing for missing data, outliers, and obvious errors. We determined these data to be sufficiently reliable for the purposes of summarizing trends in key sustainment metrics and O&S costs since fiscal year 2011. Appendix I provides further information on our scope and methodology.

The performance audit upon which this report is based was conducted from March 2021 to December 2022 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate, evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives. We subsequently worked with DOD from December 2022 to January 2023 to prepare this public version of the original sensitive report

[5]For our initial ship sustainment quick look, we focused on surface ships and did not include submarines in our review. As of November 2022, the Navy had 68 submarines in its battle force.

for release. We also prepared this public version in accordance with these standards.

Background

Roles and Responsibilities for the Sustainment of Ships

Several DOD organizations and Navy commands have responsibilities for sustainment of the Navy's ships, among other things.

Office of the Assistant Secretary of the Navy (Research, Development & Acquisition). Secretary of the Navy Instruction 5400.15D states that the Assistant Secretary of the Navy for Research, Development & Acquisition (ASN (RD&A)) will exercise the authority to perform all acquisition functions assigned to the Secretary of the Navy, to the extent those functions can properly be delegated.[6] This office is also responsible for the development, sustainment, and procurement of systems that satisfy the requirements of the Chief of Naval Operations, as well as the Commandant of the Marine Corps, the two most senior military officers within the Department of the Navy.[7] This responsibility includes overall supervision of sustainment, including maintenance, as well as related activities that ensure the readiness and operational capability of fielded systems throughout their life cycles.

Office of the Chief of Naval Operations (OPNAV). The Chief of Naval Operations is responsible to the Secretary of the Navy for the command, utilization of resources, and operating efficiency of the operating forces of the Navy and of the Navy's support activities. The Chief of Naval Operations is responsible for serving as the primary focal point for developing department-level policy on all matters dealing with sustainment and life-cycle logistics, for approval by ASN (RD&A), and ensuring resourcing of sustainment, maintenance, and supply support align with Navy objectives and priorities in equipping and ensuring operational readiness of forces.

[6]Secretary of the Navy Instruction 5400.15D, *Department of the Navy Research and Development, Acquisition, Associated Life-Cycle Management, and Sustainment Responsibilities and Accountability* (Jan. 19, 2021).

[7]Secretary of the Navy Instruction 5400.15D.

Naval Sea Systems Command (NAVSEA). The Commander of Naval Sea Systems Command is responsible for:

- supporting the acquisition and sustainment communities in engineering, building, purchasing, and maintaining ships, submarines, and other watercraft, as well as their combat systems;[8]
- acting for, and exercising the authority of the ASN (RD&A), to directly supervise management of assigned programs and maintaining oversight of cost, schedule, technical and performance maintenance;
- reporting to ASN(RD&A) for all matters pertaining to research, development, acquisition, and sustainment; and[9]
- estimating funding requirements for maintenance periods and including them in its budget submissions.

Program Executive Office (PEO) Ships, PEO Unmanned and Small Combatants, and PEO Aircraft Carriers. Within the ASN (RD&A) are Program Executive Offices that are responsible for directly supervising the management of assigned programs and maintaining oversight of cost, schedule, and performance. They are also responsible for coordinating with the relevant system commanders (in the case of ships, Naval Sea Systems Command) to ensure acquisition and sustainment issues pertaining to supportability of their systems are coordinated and addressed throughout the entire life cycle.

Key Sustainment Metrics for Ships

We worked with the Navy to identify several metrics key to understanding the condition and sustainment of Navy ships.

- **Steaming Hours** refer to the number of hours a ship is operating its main propulsion plant. Steaming hours are accrued when the engine that a ship requires to move is powered on, either while the ship is at sea or while it is in port. We omitted specific details on steaming hours for the ship classes throughout this report, because DOD deemed the information sensitive.
- **Cannibalizations** are the removal of serviceable material or components from one piece of equipment for installation into another

[8]See Secretary of the Navy Instruction 5400.15D.

[9]Chief of Naval Operations Instruction 5450.340A, *Mission, Functions, and Tasks of Commander, Naval Sea Systems Command* (June 29, 2016) (incorporating change 1, effective Dec. 9, 2019) and Secretary of the Navy Instruction 5400.15D.

to restore the latter to an operational condition.[10] We have previously reported on the adverse effects of cannibalizations. The adverse effects of cannibalizations include higher maintenance costs due to increased workloads, morale and personnel retention problems, and taking expensive weapon systems out of service for long periods of time.[11]

- **Casualty reports** are used to record events that impair, to varying degrees, a ship's ability to accomplish its primary mission. Navy casualty reports fall into three categories of increasing severity: category 2, category 3, and category 4, with category 4 indicating a deficiency in mission-essential equipment that causes a loss of at least one primary mission.[12]
- **Days of maintenance delay** represent any days beyond the scheduled end date for depot maintenance. Navy ships require periodic maintenance, and the most thorough depot maintenance is conducted at public and private shipyards. Before ships enter depot maintenance periods, the Navy schedules a date for when that maintenance period will end. However, we have previously found Navy depot maintenance periods often extend beyond their scheduled end date.[13]

In addition, DOD's capability requirements guidance, the Joint Capabilities Integration and Development System, requires all programs

[10]Chief of Naval Operations Instruction 4440.19G, *Policies and Priority Rules for Cannibalization of Operational Equipment and Diversion of Material at Contractor Plants to Meet Urgent Operational Requirements* (May 5, 2021).

[11]GAO, *Military Aircraft: Services Need Strategies to Reduce Cannibalizations*, GAO-02-86 (Washington, D.C.: Nov. 21, 2001).

[12]According to Navy officials, category 4 casualty reports represent the failure of specific equipment that causes a ship to lose its capability to perform one primary mission, while category 2 and 3 casualty reports do not represent a loss of primary mission capability. However, officials noted that category 3 casualty reports could represent that a ships' ability to perform a primary mission has been degraded. In addition, the Navy's categorization of casualty reports tends to be subjective or based on other factors than the severity of the defect, such as, according to maintenance officials, communicating a maintenance priority. In other words, there are additional deficiencies that could be mission-critical that may not be captured by category 3 or 4 casualty reports. See GAO, *Navy Shipbuilding: Increasing Focus on Sustainment Early in the Acquisition Process Could Save Billions*, GAO-20-2, (Washington, D.C.: Mar. 24, 2020).

[13]GAO, Navy Ships: *Applying Leading Practices and Transparent Reporting Could Help Reduce Risks Posed by Nearly $1.8 Billion Maintenance Backlog*. GAO-22-105032. Washington, D.C.: May 9, 2022.

to establish key performance parameters for sustainment.[14] This requirement helps ensure that acquisition programs provide a weapon system to the warfighter with optimal availability and reliability at an affordable price. The sustainment key performance parameter is comprised of two measures—operational availability and materiel availability—which addresses the availability of the ship throughout its life cycle.

- **Operational availability** provides a measure of time or probability that a ship or an individual ship system, such as a propulsion plant, will be available for operational use when required. The Navy identifies operational availability as a primary measure of readiness for weapon systems and key equipment critical to the operation of those systems.[15]
- **Materiel availability** measures the percentage of total inventory of a system that is operationally capable, based on materiel condition. Material availability provides a number between 0 and 1 representing the percentage of time that the ship can be tasked for all primary warfare areas.

Cost Reporting

DOD's *Operating and Support Cost-Estimating Guide* provides direction to the military departments on developing estimates to support various analyses and reviews throughout the program life cycle.[16] DOD requires that each military department maintain a database that collects historical data on the O&S costs for major fielded weapon systems.[17] DOD's Office of Cost Assessment and Program Evaluation provides policy guidance on this requirement, known as the Visibility and Management of Operating and Support Costs program; specifies the common format in which the

[14]The Joint Capabilities Integration and Development System is a process created in 2003 to guide the development of capabilities across DOD, help DOD identify capability gaps, and validate the requirements of proposed capability solutions to mitigate those gaps.

[15]Chief of Naval Operations Instruction 3000.12B, *Operational Availability of Equipment and Weapon Systems* (Apr. 26, 2021).

[16]DOD, Office of the Secretary of Defense—Cost Assessment and Program Evaluation, *Operating and Support Cost-Estimating Guide* (September 2020).

[17]DOD Instruction 5000.73, *Cost Analysis Guidance and Procedures* (Mar. 13, 2020). The Air Force uses the Air Force Total Ownership Cost system, the Army uses the Operating and Support Cost Management Information System, and the Navy uses the Navy Visibility and Management of Operating and Support Costs system to collect and report on historical weapon system O&S costs.

data are to be reported; and monitors its implementation by each of the military departments.

In accordance with DOD's *Operating and Support Cost-Estimating Guide*, O&S costs are categorized using the following five overarching elements:[18]

1. unit-level personnel—cost of operators, maintainers, and other support personnel assigned to operating units;[19]
2. unit operations—cost of unit operating materiel (e.g., fuel), and training material, unit support services, and unit travel;
3. maintenance—cost of system maintenance including depot- and intermediate-level maintenance;
4. sustaining support—cost of system support activities that are provided by organizations other than the system's operating units; and
5. continuing system improvements—cost of system hardware and software modifications.

Prior GAO Work on Ships

Over the years we have reported on the Navy's challenges in maintaining its fleet. Specifically, we have reported on the Navy's:

- **Inability to consistently complete depot-level maintenance on time:** In a series of reports, we have identified the key factors causing depot maintenance delays, including the Navy's ability to ensure a

[18]These five cost elements are further classified into additional subcategories. For example, the Navy's maintenance cost element is further classified into subcategories including consumable materials and repair parts, depot-level repairables, depot maintenance, and other maintenance. Also, the Air Force's maintenance cost element is further classified into subcategories including consumable materials and repair parts, contractor logistics support, depot-level repairables, depot maintenance, interim contractor support, and other maintenance.

[19]DOD refers to this as "unit level manpower".

workforce that has key critical skills related to ship sustainment and the conditions of the naval shipyards.[20]

- **Significant sustainment challenges affecting its operation of the Littoral Combat Ships (LCS):** In February 2022, we reported that the Navy has spent at least $3.3 billion to operate and support its LCS since 2008 and faces significant challenges maintaining and operating these ships.[21] We also reported that the Navy's estimate to operate and support these ships had risen, and that the Navy's O&S cost estimates for the LCS do not account for the cost implications of its maintenance approach.
- **Challenges in performing intermediate maintenance for ships:** In February 2022, we identified four main challenges affecting the Navy's performance of intermediate maintenance periods: (1) shortages of crew serving on board ships as well as shortages of the workforce at shore-based maintenance providers, (2) high operational tempo, (3) limitations in maintenance training, and (4) parts and materials shortages.[22] We noted that ships' crews and shore-based maintenance providers have undertaken some efforts to improve the performance of intermediate maintenance periods, but we identified aspects that may limit the effectiveness of their efforts.
- **Significant backlog of maintenance on ships:** In May 2022, we reported that the Navy was facing a significant maintenance backlog that Navy officials said contributed to their decision to decommission nine ships before they have reached the end of their service lives.[23] Early decommissioning leads to a smaller fleet and could hinder efforts to meet operational requirements. We found that the depot maintenance backlog has largely affected surface ships, including

[20]See GAO-21-225T; GAO, *Navy Shipyards: Actions Needed to Address the Main Factors Causing Maintenance Delays for Aircraft Carriers and Submarines,* GAO-20-588 (Washington, D.C.,: Aug. 20, 2020); *DOD Depot Workforce: Services Need to Assess the Effectiveness of Their Initiative to Maintain Critical Skills;* GAO-19-51 (Washington, D.C.: Reissued with revisions on Dec. 26, 2018); and *Naval Shipyards: Actions Needed to Improve Poor Conditions That Affect Operations,* GAO-17-548 (Washington, D.C.: Sept. 12, 2017). Also, see the Related GAO Products section at the end of this report.

[21]GAO, *Littoral Combat Ship: Actions Needed to Address Significant Operational Challenges and Implement Planned Sustainment Approach*, GAO-22-105387 (Washington, D.C.: Feb. 24, 2022).

[22]GAO, *Navy Ship Maintenance: Actions Needed to Monitor and Address the Performance of Intermediate Maintenance Periods,* GAO-22-104510 (Washington, D.C.: Feb. 8, 2022).

[23]GAO-22-105032.

Ticonderoga-class cruisers and *Whidbey Island*-class dock landing ships included in this review. We made nine recommendations to incorporate leading practices, such as: use performance goals and measures for managing deferred maintenance, assess fully the risk of the backlog, and improve Navy reporting on the depot maintenance backlog—both internally and to Congress and U.S. taxpayers. DOD generally concurred with these recommendations.

- **Poor planning for sustainment during the acquisition process for Navy ships:** We reported in March 2020 that the Navy had delivered warships to its fleet over the past 10 years that required more effort to sustain than initially planned.[24] In assessing how these classes of ships were sustained, we found 150 examples of class-wide problems, such as unreliable ship systems. These problems stemmed from the Navy not identifying, evaluating, or mitigating sustainment risks during the acquisition process. We found that it would cost the Navy $4.2 billion to correct just the 30 percent of these problems for which the Navy had data on estimated repair costs. We also reported that the Navy had not consistently addressed sustainment risks in acquisition planning documents. For example, the operating and support costs included in cost estimates did not capture all sustainment risks that could affect costs. As a result, for six shipbuilding programs whose costs we could assess, the Navy had underestimated sustainment costs by $130 billion.[25]

Across these reports, we have made numerous recommendations to help the Navy improve the sustainment of its ships. The Navy has generally agreed with these recommendations and taken steps to implement some of them, such as updating shipyard workforce requirements and working to improve shipyard conditions and performance.

Sustainment Challenges Have Worsened, and Key Metrics Have Not Been Fully Used

Our analysis of key metrics shows the 10 ship classes we reviewed face persistent sustainment challenges that have worsened from fiscal year 2011 through 2021—increasing depot maintenance delays, growing numbers of cannibalizations and casualty reports, and fewer hours that ships were steaming. Additionally, other metrics the Navy has identified as key—operational availability and materiel availability—have not been fully used to assess ship readiness. Lastly, the 10 ship classes we reviewed face a litany of maintenance and supply challenges, such as

[24]GAO-20-2.

[25]The six ship classes included are the *San Antonio* (LPD-17*), Zumwalt* (DDG-1000), *America (*LHA-6), *Gerald R. Ford* (CVN-78), Littoral Combat Ship (LCS), and *Virginia* (SSN-774) classes.

shortages of trained maintenance personnel and diminished manufacturing sources for parts.

Ship Sustainment Challenges Have Worsened since 2011

Maintenance cannibalizations, casualty reports, and depot maintenance delays have generally increased across the reviewed ship classes from fiscal years 2011 through 2021 as shown in figure 1. During this timeframe, steaming hours for these classes generally decreased; however, we removed specific details from the figure showing this general decrease because DOD deemed this information sensitive.

Figure 1: Changes in Sustainment Metrics per Ship for Selected Navy Ship Classes, Fiscal Years 2011 through 2021

Ship class	Maintenance cannibalizations[a]	Category 3 and 4 casualty reports	Days of maintenance delay
Ticonderoga-class cruiser (CG-47)	+3 ▲	-1 ▼	+7 ▲
Nimitz-class aircraft carrier (CVN-68)	+4 ▲	+2 ▲	+7 ▲
Arleigh Burke-class destroyer (DDG-51)	+7 ▲	+19 ▲	+20 ▲
Freedom-class littoral combat ship (LCS-1)	+15 ▲	+26 ▲	0 ●
Independence-class littoral combat ship (LCS-2)	+3 ▲	+26 ▲	+19 ▲
America-class amphibious assault ship (LHA-6)[b]	-1 ▼	+13 ▲	0 ●
Wasp-class amphibious assault ship (LHD-1)	+9 ▲	+43 ▲	+10 ▲
San Antonio-class amphibious transport dock (LPD-17)	+3 ▲	+10 ▲	+33 ▲
Whidbey Island-class dock landing ship (LSD-41)	+6 ▲	+24 ▲	+19 ▲
Harpers Ferry-class dock landing ship (LSD-49)	+7 ▲	-11 ▼	-16 ▼
Fleetwide	**+6** ▲	**+15** ▲	**+14** ▲

● No change (neutral) ▲ Increase (negative) ▼ Decrease (positive)

Source: GAO analysis of U.S. Navy data. | GAO-23-106440

Note: The numbers above are not percentages and are rounded to the nearest whole number.

[a]Cannibalization data for fiscal years 2011 through 2014 is incomplete. Therefore, cannibalization trends reflect fiscal years 2015 through 2021.

[b]The first *America*-class amphibious assault ship was commissioned in 2014, so readiness trends for this class reflect fiscal years 2015 through 2021.

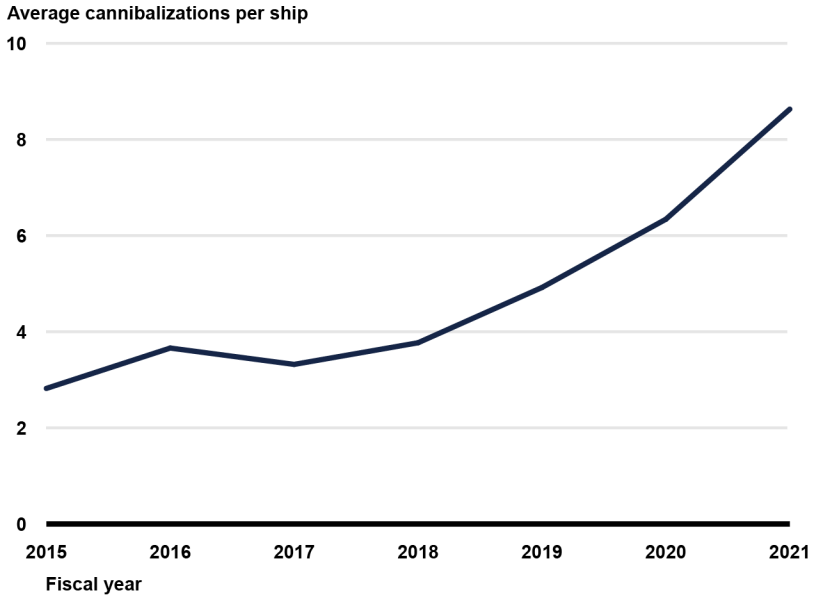
Maintenance Cannibalizations

Officials from program offices for nine of the 10 ship classes we reviewed indicated they faced challenges obtaining spare parts, which has resulted in an increase in ship maintainers reusing parts because new parts are not available. We found that the average number of maintenance cannibalizations per ship rose by about six cannibalizations across the ship classes we examined from fiscal year 2015 through 2021, as shown in figure 2. With the exception of fiscal year 2017, the average number of cannibalizations per ship increased every year from 2015 to 2021. We did not report cannibalization rates for fiscal years 2011 through 2014

because Navy officials told us that their data for these years were incomplete.

We asked Navy officials what drove these increases and they told us ship cannibalizations often occur due to supply chain shortfalls for specific parts. According to these officials, decisions to move parts from one ship to another are made when the supply of a specific part will not meet the operational commitments of a ship. Officials further noted that the specific increase is difficult to quantify but challenges with parts availability have been a specific driver for the increase. Officials added that surface ships have experienced an increasing number of cannibalizations over the past few years. There are many contributing factors depending on the specific equipment or ship system, but most are due to increased demand for material that is not readily available. Parts obsolescence, diminishing manufacturing sources, and material shortages are common issues. According to Navy officials, since the pandemic started, supply chain slowdowns have also become more common, resulting in increased procurement and manufacturing lead times to obtain needed parts.

Figure 2: Average Number of Maintenance Cannibalizations per Ship across Selected Navy Ship Classes, Fiscal Years 2015 through 2021



Source: GAO analysis of Navy data. | GAO-23-106440

Note: Cannibalization data for fiscal years 2011 through 2014 is incomplete and, therefore, not included in this graphic.

The increase in cannibalizations affected the majority of classes examined as shown in figure 3. Nine of the 10 classes experienced an increase in average cannibalizations per ship from fiscal years 2015 through 2021, with the greatest increase experienced by the *Freedom*-class LCS. We previously reported that LCS crews told us they had to cannibalize parts due to challenges locating parts for maintenance and repair of the ship.[26] Of the ship classes we examined, only *America*-class amphibious assault ships experienced fewer cannibalizations in fiscal year 2021 than it had in fiscal year 2015. Navy officials said that they did not have goals for cannibalization rates per ship class, but that the Navy is continually working to minimize them.

Figure 3: Changes in Average Maintenance Cannibalizations per Ship across Selected Navy Ship Classes, Fiscal Years 2015 and 2021

Ship class	Fiscal year 2015	Fiscal year 2021	Change	Trend
Ticonderoga-class cruiser (CG-47)	3	6	3	▲
Nimitz-class aircraft carrier (CVN-68)	4	7	4	▲
Arleigh Burke-class destroyer (DDG-51)	3	9	7	▲
Freedom-class littoral combat ship (LCS-1)	3	18	15	▲
Independence-class littoral combat ship (LCS-2)	1	4	3	▲
America-class amphibious assault ship (LHA-6)	1	0	-1	▼
Wasp-class amphibious assault ship (LHD-1)	3	12	9	▲
San Antonio-class amphibious transport dock (LPD-17)	3	6	3	▲
Whidbey Island-class dock landing ship (LSD-41)	2	8	6	▲
Harpers Ferry-class dock landing ship (LSD-49)	4	11	7	▲
Fleetwide	**3**	**9**	**6**	▲

▲ Increase ▼ Decrease

Source: GAO analysis of U.S. Navy data. | GAO-23-106440

Note: Numbers are rounded and may not therefore align exactly to the total. Cannibalization data for fiscal years 2011 through 2014 is incomplete and, therefore, not included in this graphic.

Officials from the *Nimitz*-class aircraft carriers told us that cannibalizations are driven by combat systems-related equipment. Many of these parts are older and no longer being produced by manufacturers so they are hard to obtain, according to Navy officials. Officials explained that manufacturers for these parts require demand to continue to produce the parts, and it is not economically feasible for them to remanufacture until they receive this demand. According to Navy officials, to mitigate the issue the Navy established an obsolescence working group that analyzes part failures to determine which parts fail most often based on previous history.

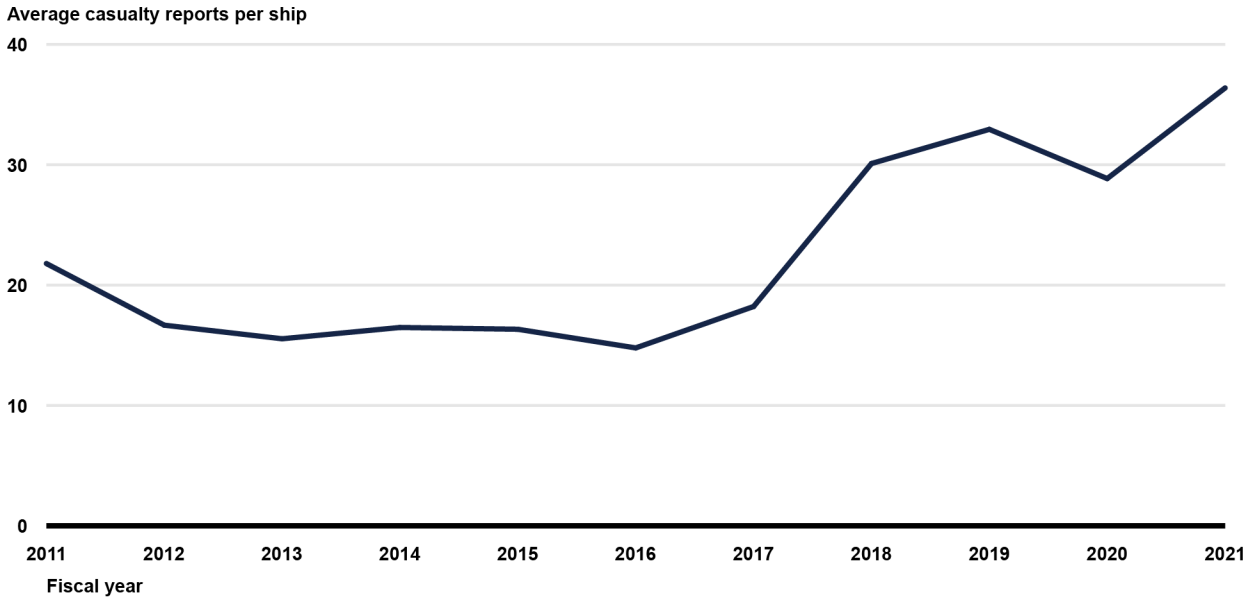
[26]GAO-22-105387.

Additionally, the working group attempts to proactively order the parts most likely to fail in an attempt to get ahead of the problem and avoid delays in getting the parts when they fail.

Casualty Reports

We found that the average number of category 3 and 4 casualty reports per ship increased by 15 from fiscal years 2011 through 2021, as shown in figure 4.[27]

Figure 4: Average Category 3 and 4 Casualty Reports per Ship across Selected Navy Ship Classes, Fiscal Years 2011 through 2021



Source: GAO analysis of Navy data. | GAO-23-106440

We asked Navy officials about changes in the number of category 3 and 4 casualty reports and they told us that the classification of a casualty follows specific guidelines and whether a system falls within these guidelines is determined by the ship's leadership as well as operational guidance based on the local theater commander. We have reported that the Navy's categorization of casualty reports tends to be subjective or based on other factors than the severity of the defect, such as, according

[27]We chose to combine category 3 and category 4 casualty reports in our analysis because both indicate problems that could affect mission capability. While category 4 casualty reports fell across most ship classes from fiscal years 2011 through 2021, they were offset by larger increases in category 3 casualty reports— leading to significantly more casualty reports overall.

to maintenance officials, communicating a maintenance priority.[28] In other words, as we previously reported, there are additional deficiencies that could be mission-critical that may not be captured by category 3 or 4 casualty reports.

Additionally, eight of the 10 ship classes we examined experienced an increase in category 3 and 4 casualty reports from fiscal years 2011 through 2021. As shown in figure 5, the most significant increase in casualty reports were experienced by the *Wasp* class, which saw an increase of about 43 from fiscal year 2021 to fiscal year 2021. Additionally, Littoral Combat Ships—both the *Freedom* and *Independence* classes—saw an increase of about 26 from fiscal year 2011 to fiscal year 2021. We have reported that the Navy has faced significant challenges operating and maintaining its Littoral Combat Ship fleet.[29] We reported that engine failures occurred on 10 of 11 deployments, among other design, navigation, and engine propulsion problems. Navy officials said that they did not have goals for casualty report rates for each ship class, but officials noted that the Navy is continually working to minimize them.

Figure 5: Changes in Average Number of Category 3 and 4 Casualty Reports per Ship across Selected Navy Ship Classes, Fiscal Years 2011 and 2021

Ship class	Fiscal year 2011	Fiscal year 2021	Change	Trend
Ticonderoga-class cruiser (CG-47)	37	36	-1	▼
Nimitz-class aircraft carrier (CVN-68)	10	12	2	▲
Arleigh Burke-class destroyer (DDG-51)	18	37	19	▲
Freedom-class littoral combat ship (LCS-1)	18	44	26	▲
Independence-class littoral combat ship (LCS-2)	11	37	26	▲
America-class amphibious assault ship (LHA-6)[a]	1	14	13	▲
Wasp-class amphibious assault ship (LHD-1)	18	61	43	▲
San Antonio-class amphibious transport dock (LPD-17)	24	34	10	▲
Whidbey Island-class dock landing ship (LSD-41)	20	44	24	▲
Harpers Ferry-class dock landing ship (LSD-49)	30	19	-11	▼
Fleetwide	**22**	**36**	**15**	▲

▲ Increase ▼ Decrease

Source: GAO analysis of U.S. Navy data. | GAO-23-106440

Note: Numbers are rounded and may not exactly align to totals.

[a]The first *America*-class amphibious assault ship was commissioned in 2014, so casualty report trends for this class reflect fiscal years 2015 through 2021.

[28]GAO-20-2.

[29]GAO-22-105387.

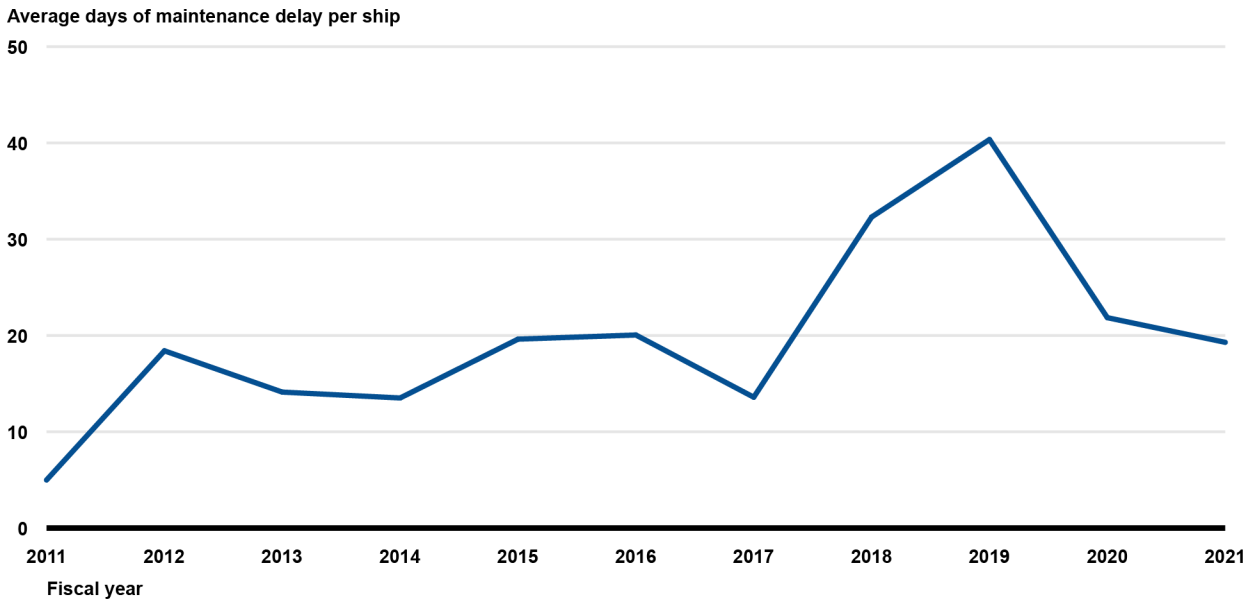
According to Navy officials, increases in category 3 casualties could be subjective as casualty reports are sometimes categorized in a higher category (e.g., a category 3 is categorized as a category 4) because the ship personnel reporting the casualty think they will get parts and assistance sooner based on the higher categorization. These officials also told us that certain casualties for ship systems will get categorized differently based on the location of the ship. For example, officials said that radar failure on a *Nimitz*-class ship operating in U.S. waters could be classified as category 2, while the same radar failure on a ship operating overseas would instead be classified as category 3.

Nimitz-class officials also told us that certain electronic parts, like combat systems equipment, are failing at higher rates than other parts and can be difficult to get as technology changes so quickly. Ship program offices work to identify the specific systems driving casualty reports and to develop trends to inform parts ordering. Officials noted that while a single casualty report might be categorized based on the discretion of ship leadership, an increase in category 3 or 4 casualty reports could be a source for concern and could indicate sustainment challenges.

Days of Depot Maintenance Delay

The average days of depot maintenance delay per ship among the 10 ship classes we examined increased from fiscal years 2011 through 2021 by about 5 days per ship to about 19 days per ship as shown in figure 6. The highest number of days of depot maintenance delay per ship was incurred in fiscal year 2019, with an average of 40 days per ship that year. The average fell in fiscal years 2020 and 2021.

Figure 6: Average Days of Depot Maintenance Delay per Ship across Selected Navy Ship Classes, Fiscal Years 2011 through 2021



Source: GAO analysis of Navy data. | GAO-23-106440

Most of the ship classes we examined—seven of 10—have experienced an increase in average number of days of depot maintenance delay since fiscal year 2011, as shown in figure 7. The *San Antonio* class averaged more than 30 days of depot maintenance delay—the equivalent of about a month of delay—per ship in fiscal year 2021, while *Arleigh Burke* class, the Navy's most numerous ship class, averaged 26 days of depot maintenance delay in that fiscal year. The *Freedom* class and the *America* class did not incur any days of depot maintenance delay in fiscal year 2021.

Figure 7: Average Days of Depot Maintenance Delay per Ship across Selected Navy Ship Classes, Fiscal Years 2011 and 2021

Ship class	Fiscal year 2011	Fiscal year 2021	Change	Trend
Ticonderoga-class cruiser (CG-47)	4	11	7	▲
Nimitz-class aircraft carrier (CVN-68)	9	15	7	▲
Arleigh Burke-class destroyer (DDG-51)	6	26	20	▲
Freedom-class littoral combat ship (LCS-1)	0	0	0	–
Independence-class littoral combat ship (LCS-2)	0	19	19	▲
America-class amphibious assault ship (LHA-6)[a]	0	0	0	–
Wasp-class amphibious assault ship (LHD-1)	0	10	10	▲
San Antonio-class amphibious transport dock (LPD-17)	0	33	33	▲
Whidbey Island-class dock landing ship (LSD-41)	0	19	19	▲
Harpers Ferry-class dock landing ship (LSD-49)	20	4	-16	▼
Fleetwide	**5**	**19**	**14**	▲

▲ Increase ▼ Decrease – No change

Source: GAO analysis of U.S. Navy data. | GAO-23-106440

Note: Numbers are rounded to the nearest whole number. Change may not align exactly due to rounding.

[a]The first *America*-class amphibious assault ship was commissioned in 2014, so depot maintenance delay trends for this class reflect fiscal year 2015 through fiscal year 2021.

We observed that during fiscal year 2021, *Nimitz*-class aircraft carriers experienced a total of 153 days of maintenance delay, an average of 15.3 days per ship in the class. This was a decrease from a high of 385 days (or an average of 38.5 days per ship) of maintenance delay for the class in 2015. Officials noted this general trend of decreasing maintenance delays since that peak value in 2015 continues.

According to Navy officials, the Navy's goal was to incur zero days of depot maintenance delay. However, the average number of days delayed per ship in 2021, 19, is nearly 4 times the average of 5 days in 2011.

We previously reported that the Navy had experienced persistent and substantial ship depot maintenance delays.[30] For more information on the Navy's actions to address depot maintenance delays, see appendix II.

[30]GAO, *Navy Shipyards: Actions Needed to Address the Main Factors Causing Maintenance Delays for Aircraft Carriers and Submarines*, GAO-20-588 (Washington, D.C.: Aug. 20, 2020).

The Navy Has Not Fully Used Key Metrics for Ship Availability

According to DOD guidance and our discussions with Navy officials, operational availability and materiel availability are the two key performance goals for measuring weapon system sustainment throughout a weapon system's life cycle.[31] Navy officials confirmed these measures are considered key to assessing operational and materiel availability of ships. However, while the Navy has matured its abilities to track ship sustainment data at the system level, it has not used these data to assess ship readiness in line with operational and materiel availability objectives even though DOD and Navy guidance identifies operational availability as a primary measure of readiness for weapon systems and equipment and officials indicated that this was the case for materiel availability as well.[32] Navy officials told us that compiling its system-level data into aggregated availability metrics throughout a ship's lifecycle is a significant challenge but remains a key objective for the Navy. We have made recommendations to improve the Navy's ability to measure operational and materiel availability of its ships. Further, a 2021 law required DOD to consider, among other things, whether to redefine these terms.[33]

Operational and Materiel Availability Metrics

The requirement to track operational and materiel availability originates in DOD acquisition guidance.[34] This DOD acquisition guidance requires all programs, including shipbuilding programs, to establish key performance parameters—the most critical requirements a system must demonstrate to deliver an effective military capability—for sustainment. The sustainment key performance parameter is comprised of two measures—operational availability and materiel availability.

Operational availability generally refers to the ability of a piece of equipment or system to be ready for use when expected. Operational availability can track individual pieces of equipment or entire weapon systems, and provides a number between 0 and 1 representing the amount of time that system worked as expected.

We requested that the Navy identify the key systems essential to mission accomplishment for each of the 10 ship classes and provide us data on

[31]Department of Defense Instruction 5000.91, *Product Support Management for the Adaptive Acquisition Framework* (Nov. 4, 2021).

[32]See Chief of Naval Operations Instruction 3000.12B, *Operational Availability of Equipment and Weapon Systems* (Apr. 26, 2021).

[33]National Defense Authorization Act for Fiscal Year 2022, Pub. L. No. 117-81, § 1020(a) (2021).

[34]Department of Defense Instruction 5000.91.

the operational availability of these systems. The Navy provided us data for those systems that it determined were critical for each ship class. Navy officials stated that they had conducted reviews to identify critical systems and were tracking the operational availability of about 90 percent of the systems the Navy had determined to be critical for each ship class. Officials stated that they were using this data to assess the health of individual systems, such as a generator or a radar, and to allocate resources to assist ships in meeting their expected service lives. For example, officials stated they used operational availability scores and determined that *San Antonio-class* amphibious transport docks were experiencing sustainment issues with knuckle boom cranes—cranes used to raise and lower boats to the waterline and load cargo at a pier or at sea. Naval Surface Warfare Center Corona personnel provided feedback and recommendations to improve operational availability.[35] As a result of incorporating these recommendations, officials told us that operational availability for this system on the *San Antonio*-class amphibious transport dock USS *Anchorage* (LPD 23) increased to above target rates—from 0.21 to 0.99. Navy officials stated that through equipment changes, training, and proper shipboard practices, the Navy has the ability to increase the operational availability of knuckle boom cranes on all *San Antonio*-class ships.

However, while the Navy stated that it aggregates the information to gain an understanding of the likelihood that a set of ship systems will be able to accomplish some mission areas, such as shooting a missile, this aggregation is not done for all mission areas or at the ship level. For example, the data provided by the Navy for its *Ticonderoga* class identified key systems, but the Navy has not aggregated the data in a manner that connects these systems to specific mission areas or which allows for an assessment at the individual ship level. As we previously reported, mission-focused analysis across key systems would provide Navy decision makers more meaningful information on the condition of its ships.[36]

Materiel availability measures the percentage of total inventory of a system that is operationally capable, based on materiel condition. Material availability provides a number between 0 and 1 representing the

[35]Naval Surface Warfare Center Corona conducts analytical, data-driven readiness assessments on the Navy's surface, carrier, and submarine systems.

[36]GAO-20-2.

percentage of time that the ship can be tasked for all primary warfare areas.

We also requested data on the materiel availability for the 10 ship classes, which Naval Surface Warfare Center Corona was also tracking. According to Navy officials, materiel availability represents the percentage of time that a ship population is ready for tasking with respect to loss of any primary mission area (as documented by C4 casualty reports) and free of scheduled maintenance. The Navy uses materiel availability for fleet level assessment to measure the availability of a ship population per a given period.

However, the materiel availability data the Navy provided was measured by subtracting the time a ship was either experiencing a category 4 casualty report or was in depot maintenance. As a result and as we previously reported, this data does not account for other factors that affect materiel availability.[37]

GAO Recommendations and Review to Better Define and Measure Operational and Materiel Availability

In March 2020, we recommended that DOD change its definition for setting operational availability for ships by adding information that defines the operational availability requirement by the ship's assigned mission(s) in addition to the ship level and includes all equipment failures that affect the ability of a ship to perform primary missions.[38] DOD partially concurred with this recommendation and stated it would work with the Navy and Joint Staff to develop requirements that are traceable to operational missions and that align with how NAVSEA records critical failures for ship programs. We also recommended that DOD change its definition for setting materiel availability for ships to include all factors that could result in a ship being unavailable for operations, such as unplanned maintenance, unplanned losses, and training. The Navy concurred with this recommendation. While the Navy is tracking these metrics at the system level, implementing our recommendations would allow them to be better positioned to track all factors that could impact operational and materiel availability.

[37]GAO, *Navy Shipbuilding: Increasing Focus on Sustainment Early in the Acquisition Process Could Save Billions*, GAO-20-2 (Washington, D.C.: Mar. 24, 2020). Officials from Naval Surface Warfare Center Corona told us that they had the capacity to include category 3 casualty reports in their materiel availability calculations, but they did not do so because the Navy's definition does not include them.

[38]GAO-20-2.

The National Defense Authorization Act for Fiscal Year 2022 required the Chairman of the Joint Chiefs of Staff to initiate a review of the Joint Capabilities Integration and Development System policy related to the setting of key sustainment performance parameters for shipbuilding programs to ensure such parameters account for a comprehensive range of factors that could affect the operational availability and materiel availability of a ship.[39] Specifically, the act required the review to include the extent to which the term operational availability should be redefined by mission area and to include equipment failures that affect the ability of a ship to perform primary missions. In addition, the act required the review to include the extent to which the term materiel availability should be redefined to take into account factors that could result in a ship being unavailable for operations, including unplanned maintenance, unplanned losses, and training. According to Navy officials, the Navy is working with the Joint Staff to finalize the new definitions. Until these efforts are completed the Navy and Congress may not have enough information to fully understand the condition and availability of ships.

Other Sustainment Challenges Related to Age, Maintenance, and Supply

Many of the ship classes we reviewed are also facing one or more sustainment challenges related to the age of the ship, maintenance constraints, and supply support. According to program officials, these challenges have an effect on operational availability and the costs required to sustain those ships. Figure 8 shows key sustainment challenges that we determined were affecting each of the ship classes we reewed.

[39]Pub. L. No. 117-81, § 1020(a) (2021). The Joint Capabilities Integration and Development System is a process created in 2003 to assess capabilities across DOD, help DOD identify capability gaps, and validate the requirements of proposed capability solutions to mitigate those gaps.

Figure 8: Sustainment Challenges Affecting Selected Navy Ship Classes

	Ticonderoga-class cruiser (CG-47)	*Nimitz*-class aircraft carrier (CVN-68)	*Arleigh Burke*-class destroyer (DDG-51)	*Freedom*-class littoral combat ship (LCS-1)	*Independence*-class littoral combat ship (LCS-2)	*America*-class amphibious assault ship (LHA-6)	*Wasp*-class amphibious assault ship (LHD-1)	*San Antonio*-class amphibious transport dock (LPD-17)	*Whidbey Island*-class dock landing ship (LSD-41)	*Harpers Ferry*-class dock landing ship (LSD-49)
Service life longer than anticipated	●	●							●	●
Unexpected replacement of parts and repairs		●	●	●	●		●	●		●
Access to technical data		●								
Delays in depot maintenance	●	●	●	●	●	●	●	●	●	●
Delays in intermediate maintenance	●		●		●		●			
Shortage of trained maintenance personnel	●		●	●	●	●	●	●	●	●
Unscheduled maintenance	●	●	●	●	●	●	●	●		
Diminishing manufacturing sources	●	●	●		●		●			
Parts obsolescence	●	●	●	●	●		●	●		●
Parts shortages and delays	●	●	●	●	●		●	●	●	●

● Applicable maintenance issue

Source: GAO analysis of Navy information. | GAO-23-106440

Note: Diminishing manufacturing sources refers to the loss, or impending loss, of manufacturers or suppliers of items, raw materials, or software.

O&S Costs Have Increased as Fleet Size Has Grown, with Variation by Ship Class

The Navy's total O&S costs for the 10 ship classes we examined increased by about $2.5 billion from fiscal years 2011 through 2020 while the Navy added 33 ships to its fleet for these classes.[40] Total O&S costs across the ship classes we examined varied in large respect due to the number of ships in the class. To enable comparisons across ship classes, which varied greatly based on the number of ships, we analyzed both total cost for each of the 10 reviewed ship classes as well as costs per ship for each of the ship classes. Even though there was an increase in the number of ships, steaming hours for the examined ship classes declined. Therefore, the cost per steaming hour for the ship classes we examined increased in total with some variation across the examined ship classes. Generally, the increase in cost per steaming hour for the ship

[40]We analyzed O&S cost data for fiscal years 2011 through 2020, the last fiscal year for which complete data were available at the time of our work. We requested the Navy provide this data using constant fiscal year 2021 dollars to inflate all years to ensure inflation was factored in.

classes we examined means the Navy is spending more to operate and sustain the ships for each hour of operational activity.

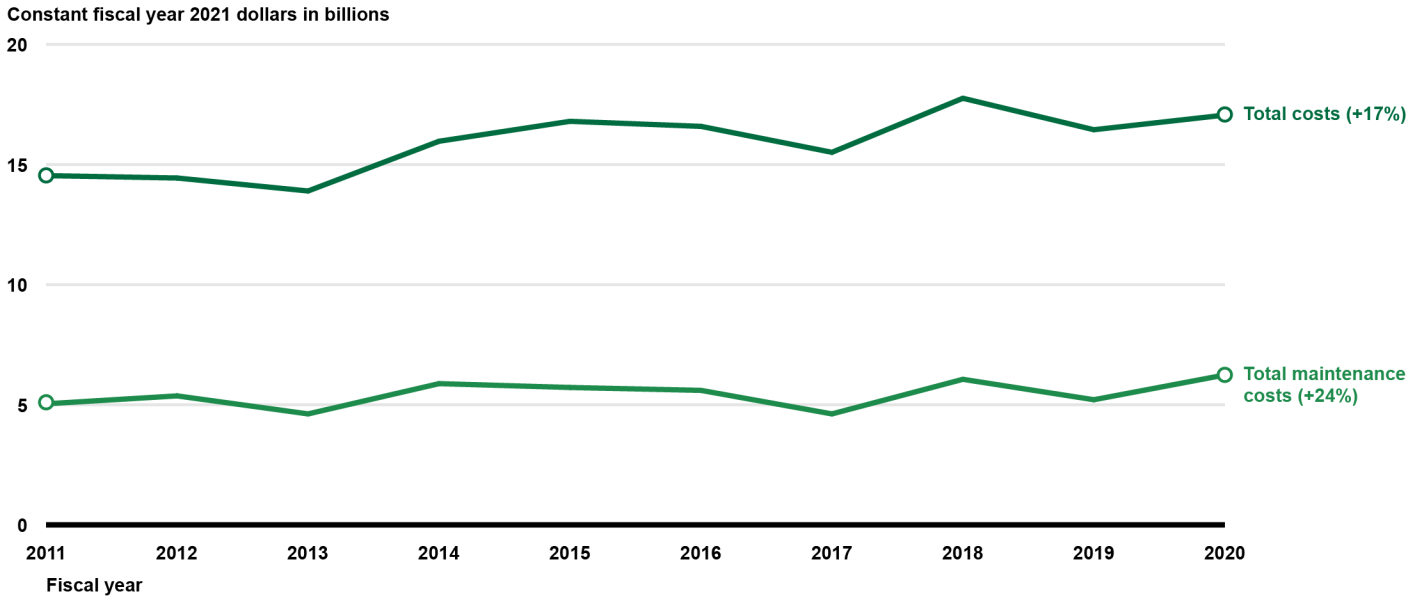
O&S Costs, Maintenance Costs, and Fleet Size Have Increased, with Variation by Ship Class

For the 10 ship classes we reviewed from fiscal years 2011 through 2020 as shown in figure 9, we found that:

- total O&S costs increased by about $2.5 billion (or 17 percent);
- maintenance costs—a subset of O&S costs—increased by about $1.2 billion (or 24 percent); and
- the number of ships increased by about 33 (or 28 percent).

We removed specific details showing the decrease in total steaming hours from the figure because DOD deemed this information sensitive.

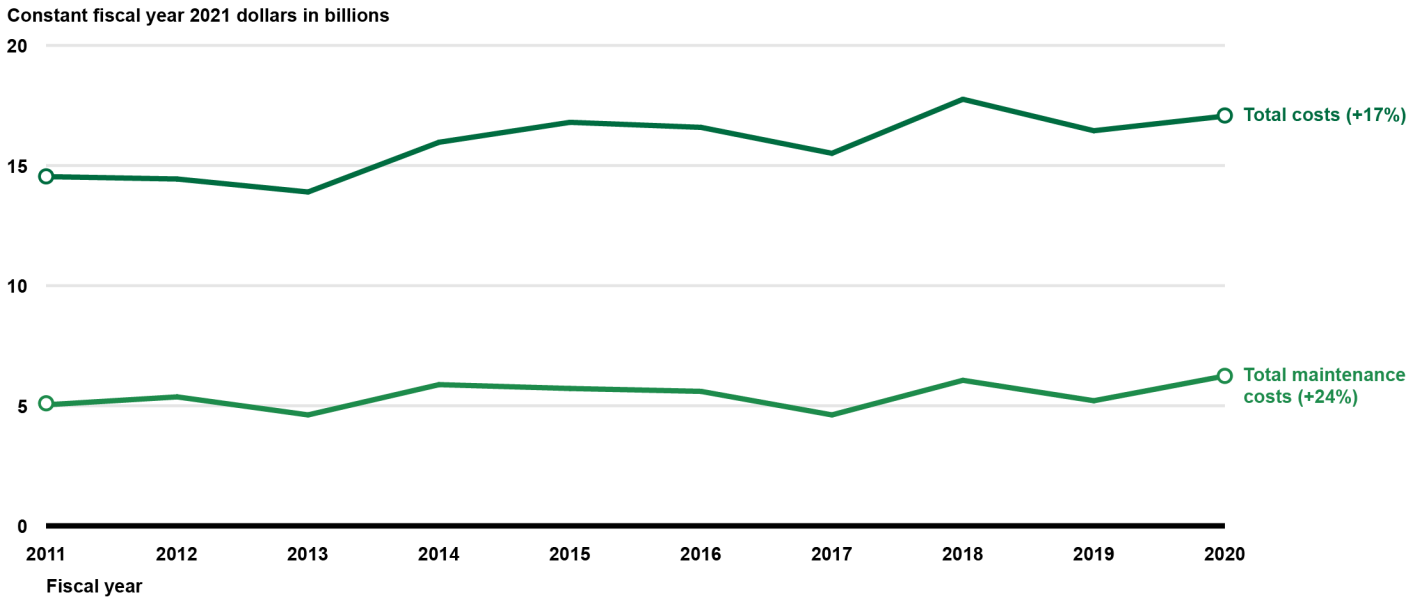
Figure 9: Changes in Cost and Number of Selected Navy Ships, Comparing Fiscal Years 2011 and 2020



Source: GAO analysis of Navy data. | GAO-23-106440

The trends in total O&S and maintenance costs for the 10 ship classes are shown in figure 10.

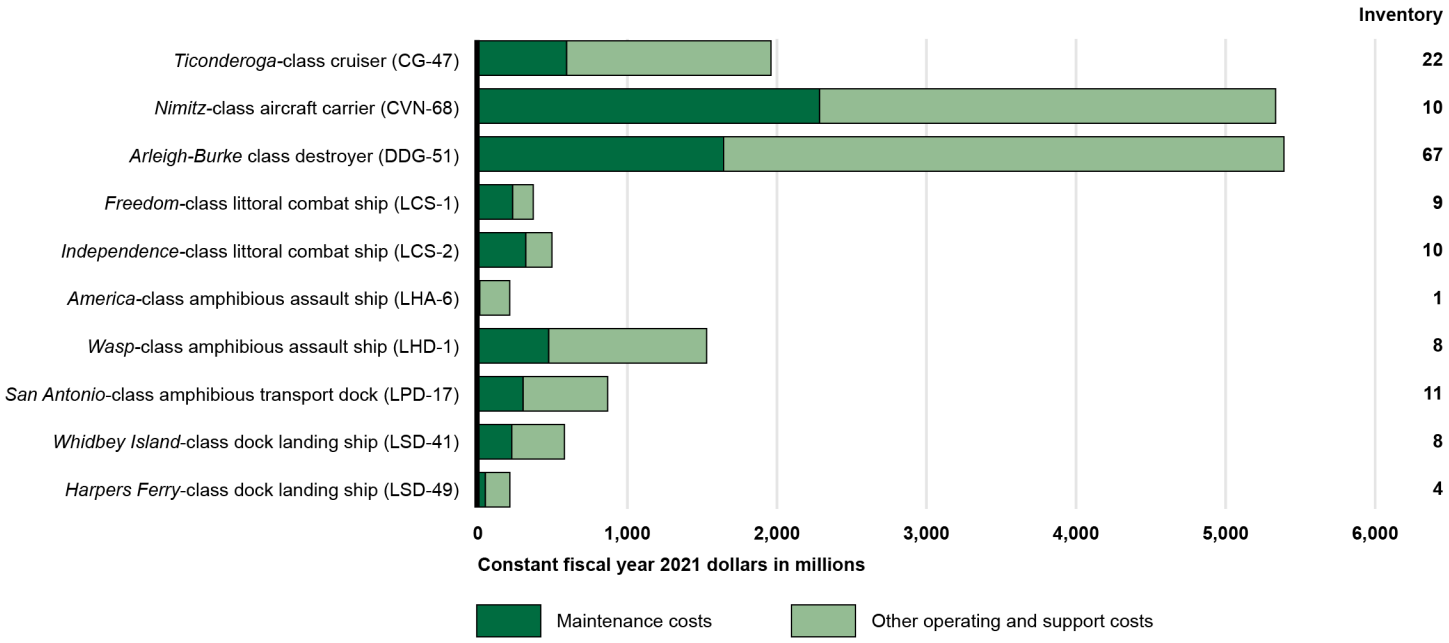
Figure 10: Total Operating and Support and Maintenance Costs, Fiscal Years 2011 through 2020



Source: GAO analysis of Navy data. | GAO-23-106440

O&S and maintenance costs varied across the 10 ship classes for fiscal year 2020, as shown in figure 11. To account for differences in the number of ships included in each of the 10 ship classes reviewed, we analyzed O&S and maintenance costs both on a fleet-wide and a per-ship basis.

Figure 11: Operating and Support Costs, by Ship Class, Fiscal Year 2020



Source: GAO analysis of Navy data. | GAO-23-106440

Note: Other operating and support costs include costs such as those for unit personnel and operations.

Since 2011, five classes of ships experienced costs increases, two experienced consistent costs, and three experienced decreased costs:

- **Increased costs:** Total O&S costs for five of the 10 ship classes increased by more than 5 percent—including the *Arleigh Burke*, *Independence*, *Freedom*, *San Antonio*, and Wasp classes.[41] For example, the *Arleigh Burke* class's O&S costs increased by about $1.3 billion from about $4.1 billion in fiscal year 2011 to $5.4 billion in fiscal year 2020. For example, the *Independence*-class LCS experienced a sharp increase from about $2 million in 2011 to about $390 million in 2020. For some ship classes, this cost growth could be driven by the fielding of additional ships. Both the *Freedom*-class and the *Independence*-class ship numbers grew considerably, from one to nine and then to one to 10 from 2011 through 2020 respectively. But the *Arleigh Burke* class saw maintenance costs grow significantly

[41]As ship costs tend to fluctuate from year to year, we determined cost increases or decreases of more than 5 percent to be significant and took steps to understand what drove those cost increases.

faster (about 32 percent) than force structure (59 to 67 ships, or about a 14-percent increase). As noted earlier, the 10 ship classes we reviewed experienced an increase of about 33 ships during the period of fiscal years 2011 through 2020. Sustainment costs are affected by the addition of ships. Therefore, in addition to analyzing total cost changes per ship class, we also examined cost per ship within each ship class to allow for comparisons across ship classes.

- **Consistent costs:** Total O&S costs for two of the 10 ship classes remained relatively stable—changing less than 5 percent. For example, the *Ticonderoga* class changed from about $1.91 billion in fiscal year 2011 to about $1.97 billion in fiscal year 2020. The *America* class did not report costs until it entered service in 2014, but total costs remained relatively stable, rising from about $217 million in 2015 to about $223 million in 2020.
- **Decreased costs:** Total O&S costs for three of the 10 ship classes decreased by more than 5 percent, including the *Nimitz*, *Whidbey Island*, and *Harpers Ferry* classes. For example, costs for the *Whidbey Island* class decreased by about $151 million from about $740 million in fiscal year 2011 to about $590 million in fiscal year 2020.

Maintenance costs comprise a large portion of the total O&S costs. For example, in fiscal year 2020, total maintenance costs for the 10 ship classes reviewed represented an average of about 37 percent of the total O&S cost. Since 2011, the six classes of ships experienced maintenance costs increases, one experienced consistent costs, and three experienced decreased costs in constant year 2021 dollars:

- **Increased costs:** Maintenance costs for six of the 10 ship classes reviewed increased by more than 5 percent—including the *Arleigh Burke*, *Freedom*, *Independence*, *America*, Wasp, and *San Antonio* classes. The increases varied greatly from a low of about $8 million for the *America* class to about $661 million for the *Arleigh Burke* class.
- **Consistent costs:** Maintenance costs for the *Whidbey Island* class fluctuated, but its 2011 maintenance costs were within 5 percent of its 2020 maintenance costs—from about $245 million in fiscal year 2011 to about $238 million in fiscal year 2020.
- **Decreased costs:** Maintenance costs for three of the 10 ship classes decreased by more than 5 percent—including the *Ticonderoga*, *Nimitz*, and *Harpers Ferry* classes, while the inventory of ships for these classes remained static during fiscal years 2011 through 2020. For example, the *Harpers Ferry* class's costs decreased from about

$173 million in fiscal year 2011 to about $60 million in fiscal year 2020.

Cost per Steaming Hour Increased and Varied Across the Reviewed Ship Classes

Cost per steaming hour is useful for measuring the cost to provide operational steaming hours and has generally increased from fiscal year 2011 through fiscal year 2020. Most ship classes we reviewed experienced an increase in the cost per steaming hour when comparing fiscal years 2011 and 2020 as shown in figure 12. We omitted additional details about the average cost per steaming hour for the 10 selected ship classes, because DOD deemed this information sensitive.

Figure 12: Trend in Average Cost per Steaming Hour for 10 Selected Ship Classes, Fiscal Years 2011 and 2020

Ship class	Trend
Ticonderoga-class cruiser (CG-47)	▲
Nimitz-class aircraft carrier (CVN-68)	▼
Arleigh Burke-class destroyer (DDG-51)	▲
Freedom-class littoral combat ship (LCS-1)	▲
Independence-class littoral combat ship (LCS-2)	▲
America-class amphibious assault ship (LHA-6)[a]	▼
Wasp-class amphibious assault ship (LHD-1)	▲
San Antonio-class amphibious transport dock (LPD-17)	▲
Whidbey Island-class dock landing ship (LSD-41)	▲
Harpers Ferry-class dock landing ship (LSD-49)	▼
Fleetwide	▲

▲ Increase ▼ Decrease

Source: GAO analysis of U.S. Navy data. | GAO-23-106440

[a]The first America-class amphibious assault ship was commissioned in 2014.

According to Navy officials, a decrease in steaming hours—which led in part to the increase in cost per steaming hours—means the technical requirements or need for the ship to be underway has decreased. Also, a decrease is not necessarily a reflection of the inability of ships to perform their missions based on sustainment challenges. Navy officials further explained that steaming hours are an indication of the financial health of

the fleet and allocation of steaming hours is driven by budgetary concerns and the cost of fuel.[42]

However, as overall steaming hours decrease, and total O&S costs increase, steaming hours have become more expensive; a trend likely to continue. We have reported that operating costs for classes included in our review are likely to continue to increase. For example, we have reported that the Navy:

- is at risk of failing to plan for cost increases that could create funding challenges for the Littoral Combat Ships, which jeopardizes the ability to deliver capabilities at the time they are expected.[43]
- has had a substantial deferred maintenance backlog that likely results in more expensive repairs, reduced ship service life, worsened shipyard capacity shortfalls, and reduced operational readiness.[44]
- is implementing a 20-year effort to modernize its shipyards; however, the Navy faces a number of challenges to implementing its efforts, including unknown long-term costs, and it remains to be seen whether the Navy will be able to follow through on its dry dock improvement, facility layout optimization, and equipment recapitalization plans.[45]

In addition, depot maintenance delays, which affect steaming hour per ship, can lead to growth in the cost to operate and sustain ships. As noted earlier in this report, we found that the average days of depot maintenance delay per ship among the 10 ship classes we examined increased—when fiscal years 2011 and 2021 were compared—by about 5 days per ship. We have reported that increased maintenance periods, in turn, compress the time during which ships are available for training and operations. The Navy began implementing a revised operational

[42]Navy officials told us that ships accruing steaming hours are not always underway at sea. The Navy tracks steaming hours for ships underway (i.e., training and operations) and those not underway (i.e., where a ship in port is self-powered with electricity from the ship's generator rather than taking power from the shore). Surface fleet officials stated that one reason a ship might accrue steaming hours while not underway is due to delays with the port infrastructure's ability to provide equipment or personnel to rig shore power immediately before or after an underway period.

[43]GAO-22-105387.

[44]GAO-22-105032.

[45]GAO, *Naval Shipyards: Ongoing Challenges Could Jeopardize Navy's Ability to Improve Shipyards*, GAO-22-105993 (Washington, D.C.: May 10, 2022).

schedule in November 2014, referred to as the Optimized Fleet Response Plan, to address this and other operational issues.[46] We reported in 2016 that successful implementation of the Optimized Fleet Response Plan depends on the shipyards completing maintenance on time so that depot maintenance delays do not reduce the time that ships are available for training and operations.[47] However, our work since 2016 has demonstrated that the Navy has been unable to complete maintenance periods on time, and Navy maintenance schedules showed that maintenance was consistently delayed.[48]

The Navy's ability to maintain and repair its ships, while ensuring their availability to get underway quickly to perform missions, plays a critical role in sustaining readiness. Delays in completing maintenance can reduce the amount of time during which these ships are available for operations and training. As we have reported, sustained Navy leadership attention and the implementation of our prior recommendations are important to the Navy making continued progress in the sustainment of its ships.[49]

Sustainment Quick Looks for Selected DOD Ship Classes

This section contains Sustainment Quick Looks that provide information on 10 Navy ship classes. Each Sustainment Quick Look presents information and data on the life cycle, sustainment strategy, availability and condition, O&S costs, and sustainment challenges for the ship class. To develop these Quick Looks, we collected information and data on each ship class from the program offices and the Navy, obtained and reviewed agency documents, and interviewed program office and other Navy officials. See the next page for an illustration of the layout of each Sustainment Quick Look. We omitted specific information on steaming

[46]*See* Chief of Naval Operations Instruction 3000.15A, *Optimized Fleet Response Plan* (Nov. 10, 2014).

[47]GAO, *Military Readiness: Progress and Challenges in Implementing the Navy's Optimized Fleet Response Plan*, GAO-16-466R (Washington, D.C.: May 2, 2016).

[48]For example, see GAO, *Navy Ships: Applying Leading Practices and Transparent Reporting Could Help Reduce Risks Posed by Nearly $1.8 Billion Maintenance Backlog*, GAO-22-105032 (Washington, D.C.: May 9, 2022); GAO, *Navy Maintenance: Navy Report Did Not Fully Address Causes of Delays or Results-Oriented Elements,* GAO-21-66 (Washington, D.C.: Oct. 29, 2020); and GAO, *Navy Shipyards: Actions Needed to Address the Main Factors Causing Maintenance Delays for Aircraft Carriers and Submarines*, GAO-20-588 (Washington, D.C.: Aug. 20, 2020).

[49]GAO-21-225T.

hours from the Sustainment Quick Looks because DOD deemed this information sensitive.

Key to Sustainment Quick Looks

A Program Name
Name and hull code of the ship class.

B Program Essentials
Programmatic information, including original manufacturer, approach to sustainment, and depot maintenance locations.

C Background and Service Life
A description of the ship class over its life cycle.

Availability and Condition

- Information on the number of ships of that class in the Navy's fleet, cannibalizations, casualty reports, and days of maintenance delay per ship for fiscal years 2011 through 2021.

Operating and Support Costs

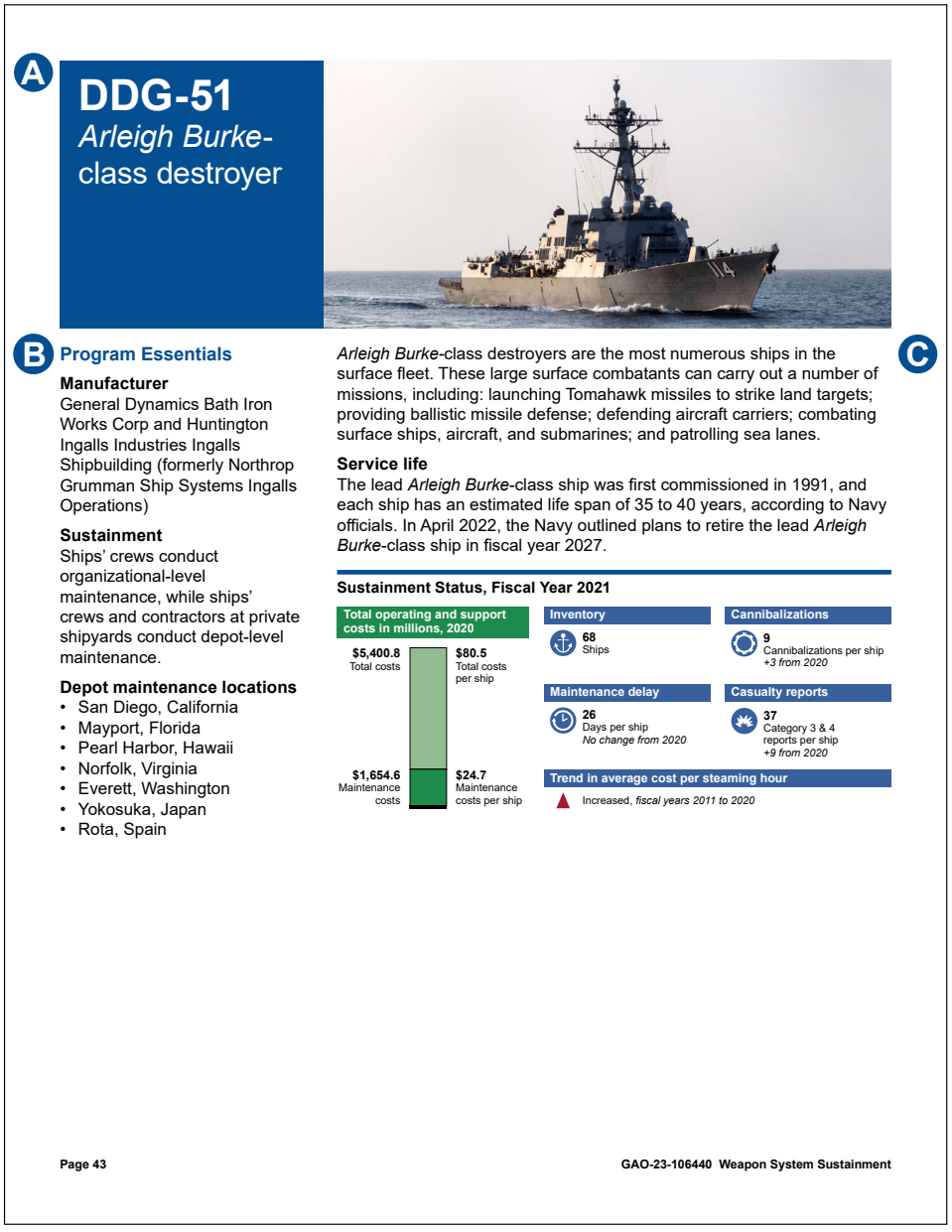
- Total O&S costs trends for the ship class for fiscal years 2011 through 2020.

Sustainment Challenges

- Specific sustainment challenges the ship program offices indicated that the ship class has faced.

Program Office Comments

- General comments provided by the cognizant program office.



CG-47
Ticonderoga-class cruiser

Program Essentials

Manufacturer
Huntington Ingalls Industries Ingalls Shipbuilding and General Dynamics Bath Iron Works

Sustainment
Ships' crews conduct organizational-level maintenance, while ships' crews and contractors at private shipyards conduct depot-level maintenance.

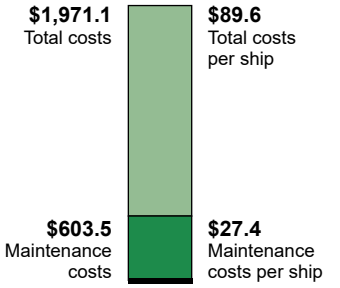
Depot maintenance locations
- San Diego, California
- Pearl Harbor, Hawaii
- Norfolk, Virginia
- Yokosuka, Japan

Cruisers are large surface combatants, like destroyers. Cruisers can carry out a number of missions, including: launching Tomahawk missiles to strike land targets, providing ballistic missile defense, defending aircraft carriers, combating surface ships, aircraft, and submarines; and patrolling sea lanes.

Service life
According to Navy officials, the lead *Ticonderoga*-class ship was first commissioned in 1983, and each ship has an estimated 35-year lifespan. In April 2022, the Navy outlined plans to retire 16 of the 22 *Ticonderoga*-class cruisers between fiscal years 2023 and 2027.

Sustainment Status, Fiscal Year 2021

Total operating and support costs in millions, 2020



Inventory
22
Ships

Cannibalizations
6
Cannibalizations per ship
+1 from 2020

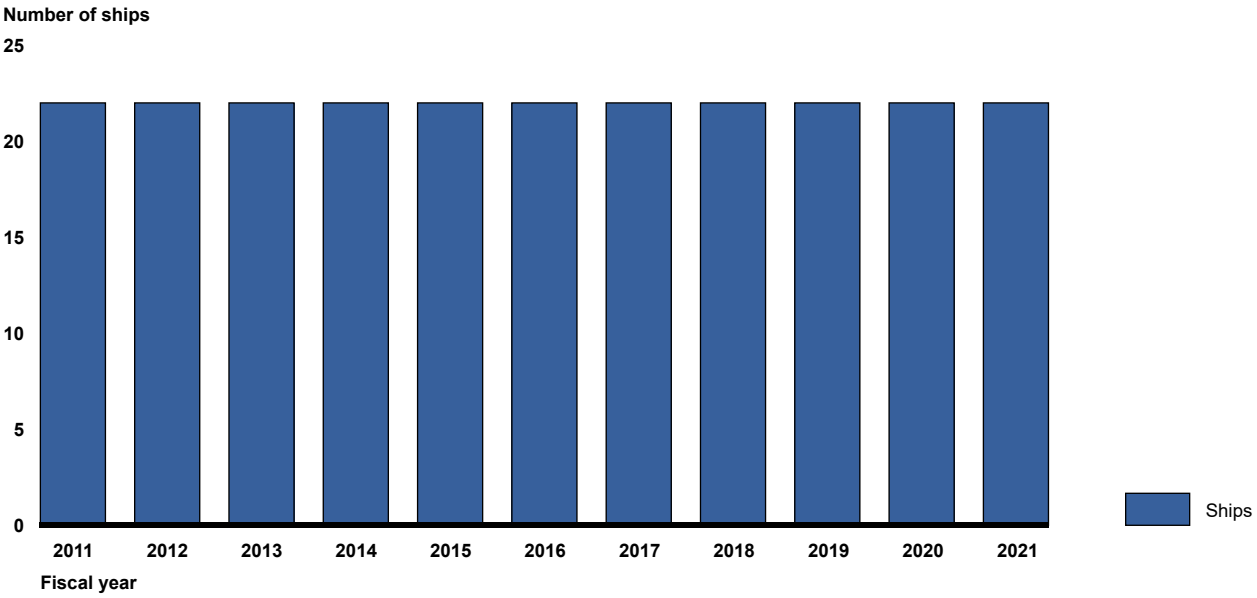
Maintenance delay
11
Days per ship
+2 from 2020

Casualty reports
36
Category 3 & 4 reports per ship
+2 from 2020

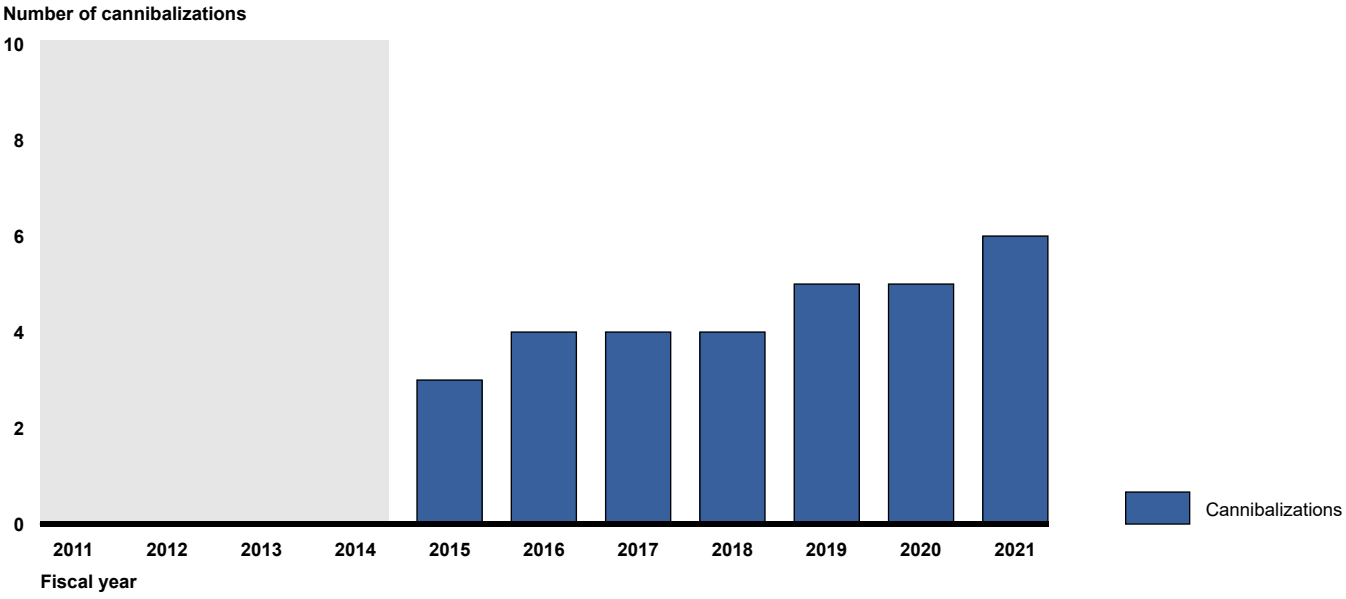
Trend in average cost per steaming hour
Increased, *fiscal years 2011 to 2020*

Availability and Condition

Inventory



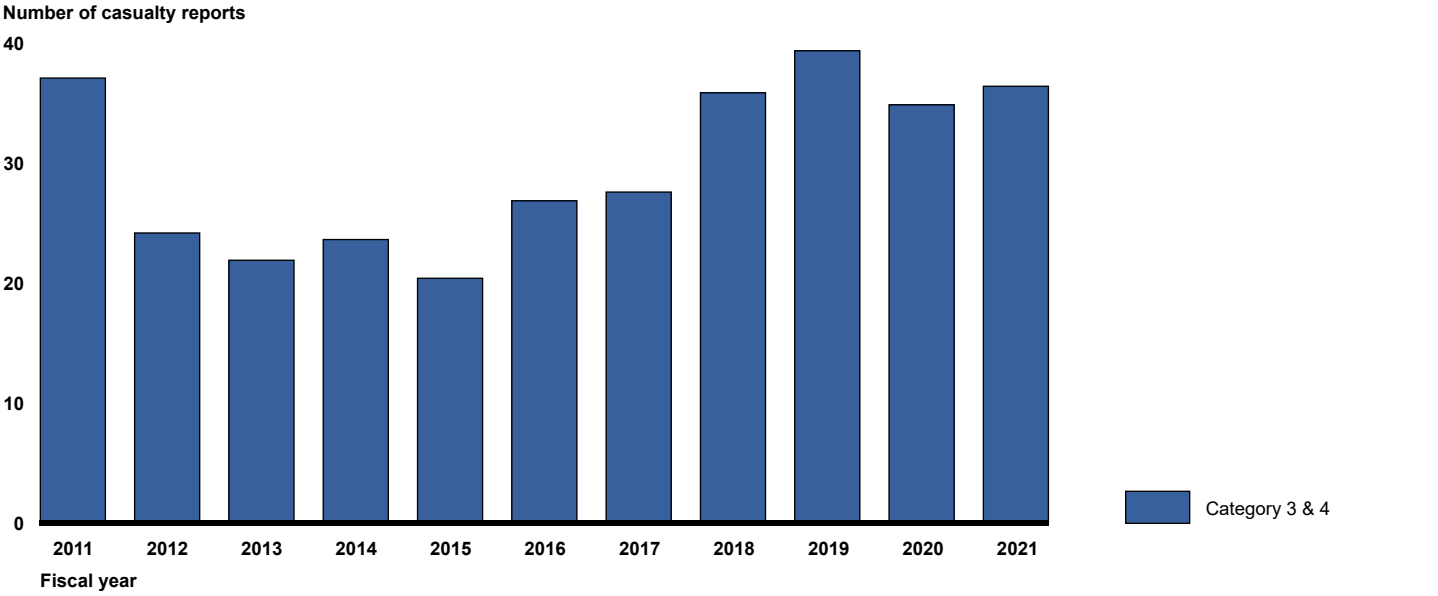
Cannibalizations per Ship



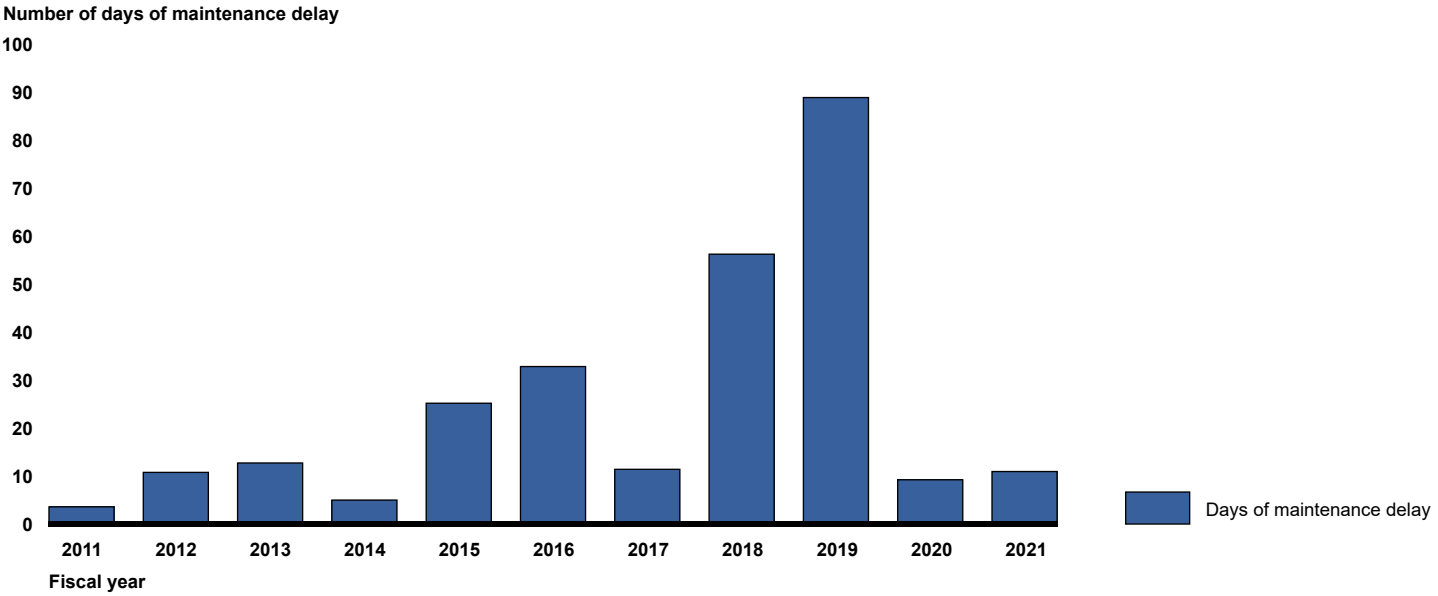
Note: According to the Navy, data for fiscal years 2011 through 2014 is incomplete and, therefore, not included in this graphic.

Availability and Condition

Casualty Reports per Ship

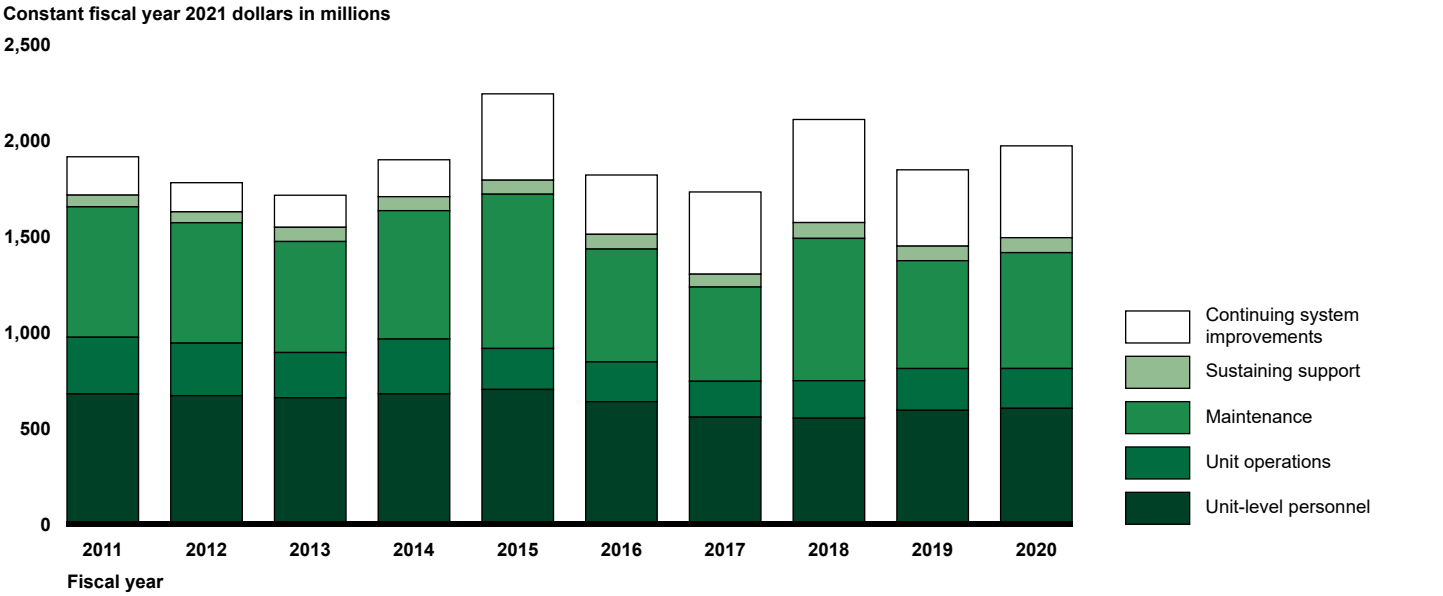


Days of Maintenance Delay per Ship

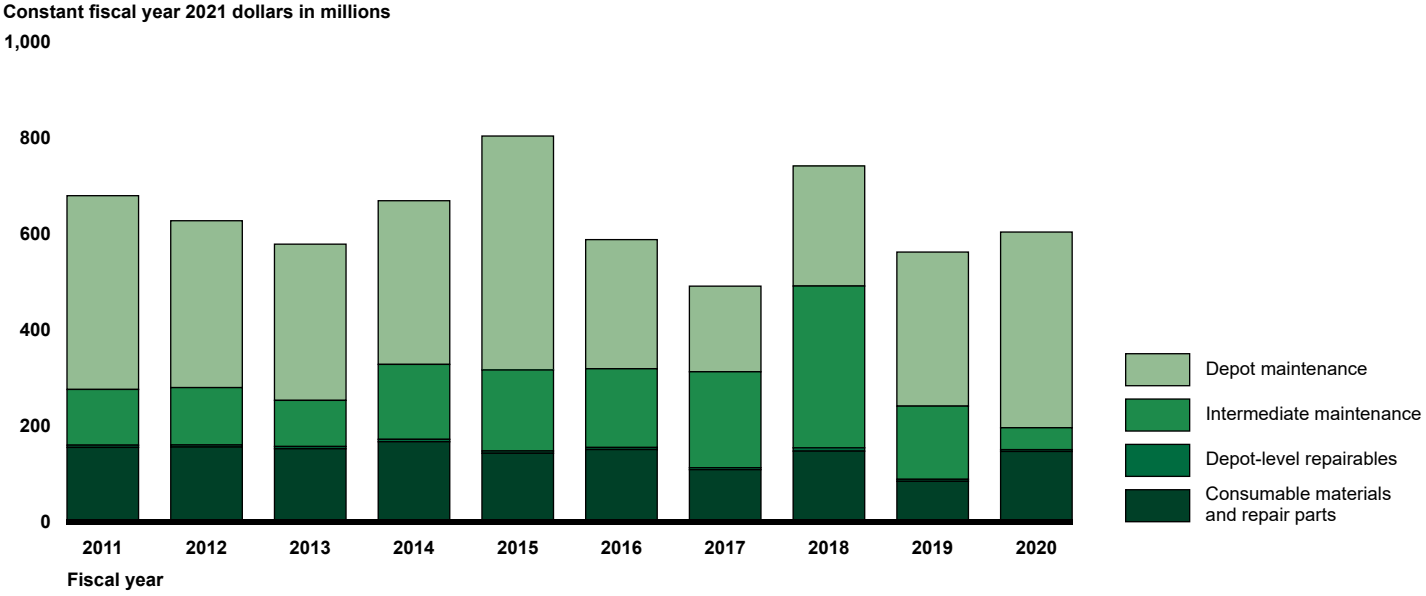


Operating and Support Costs

Total Operating and Support Costs

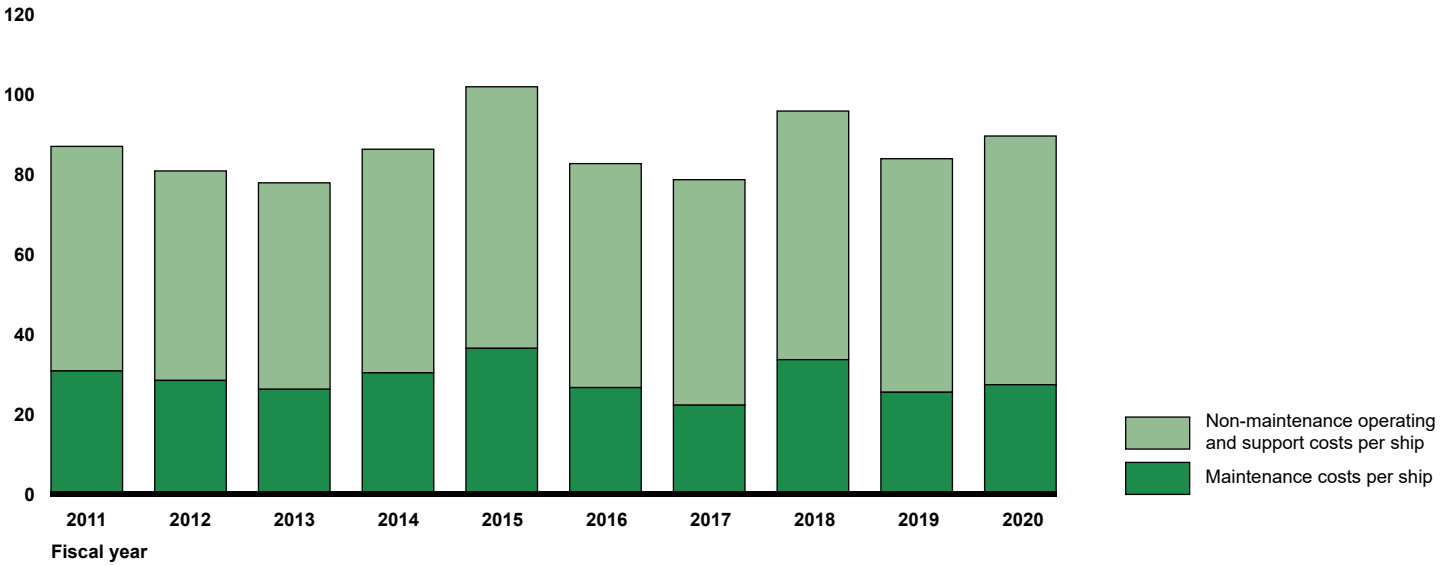


Maintenance Costs



Operating and Support Costs

Operating and Support Costs per Ship



Sustainment Challenges

Aging ships

- Service life extension
- Unexpected repairs and replacement of parts

Maintenance

- Access to technical data
- Delays in depot maintenance
- Delays in intermediate maintenance
- Shortage of trained maintenance personnel
- Unscheduled maintenance

Supply support

- Diminishing manufacturing source
- Parts obsolescence
- Parts shortage and delay

Program Office Comments

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

CVN-68
Nimitz-class aircraft carrier

Program Essentials

Manufacturer
Huntington Ingalls Industries
Newport News Shipbuilding

Sustainment
Ships' crews conduct organizational-level maintenance, while ships' crews and civilian workers at the Navy's public shipyards generally conduct depot-level maintenance.

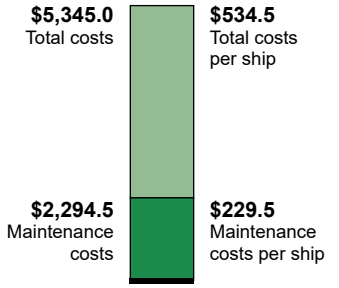
Depot maintenance locations
- San Diego, California
- Newport News, Virginia
- Portsmouth, Virginia
- Bremerton, Washington
- Yokosuka, Japan

The *Nimitz*-class are aircraft carriers, the largest ships in the Navy. Aircraft carriers deploy as part of a carrier strike group comprised of smaller ships, and give the United States the ability to project power across the world.

Service life
According to Navy officials, the lead *Nimitz*-class ship was first commissioned in 1975, and each ship has an estimated life span of 50 to 52 years. The Navy plans to have the *Nimitz* class in its fleet through 2061, according to officials. In April 2022, the Navy outlined plans to retire the lead *Nimitz*-class ship in fiscal year 2025 and one other ship in 2027.

Sustainment Status, Fiscal Year 2021

Total operating and support costs in millions, 2020



Inventory
10
Ships

Cannibalizations
7
Cannibalizations per ship
+3 from 2020

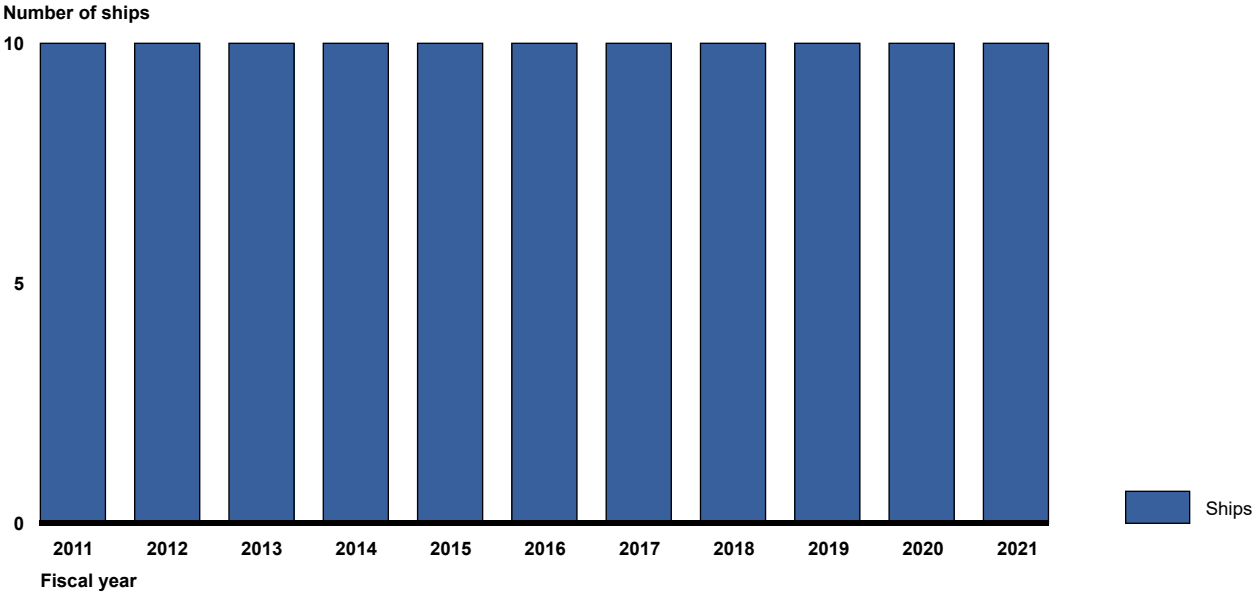
Maintenance delay
15
Days per ship
+11 from 2020

Casualty reports
12
Category 3 & 4 reports per ship
+3 from 2020

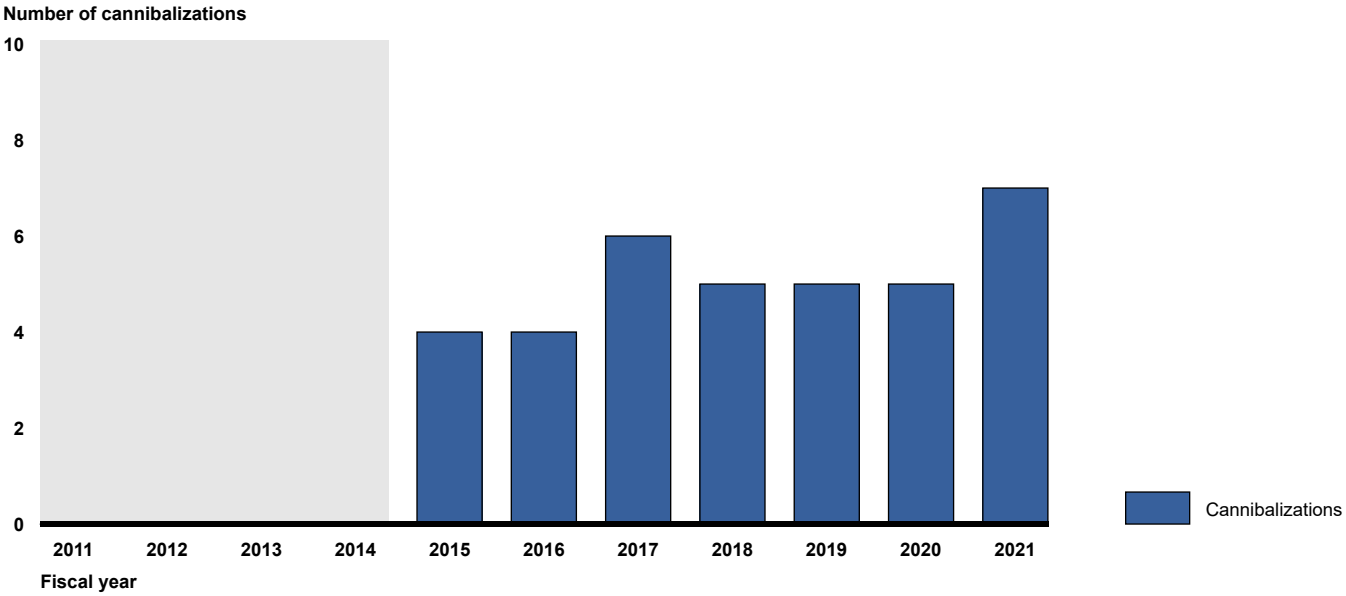
Trend in average cost per steaming hour
Decreased, *fiscal years 2011 to 2020*

Availability and Condition

Inventory



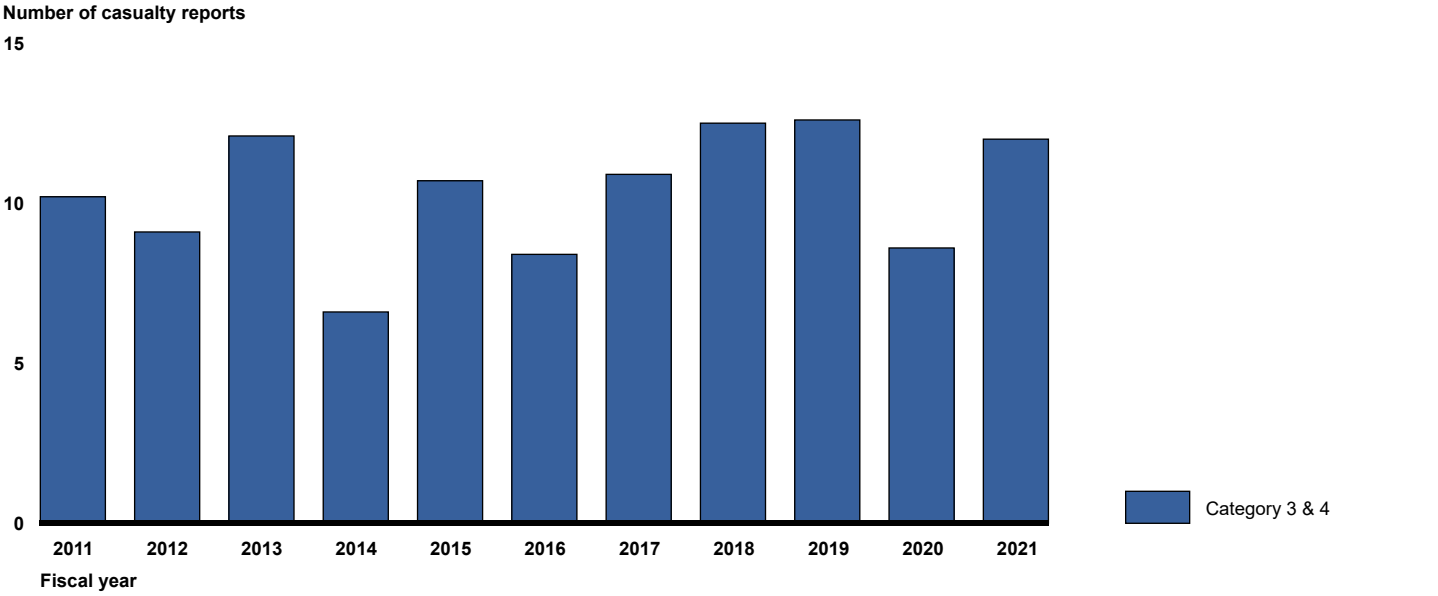
Cannibalizations per Ship



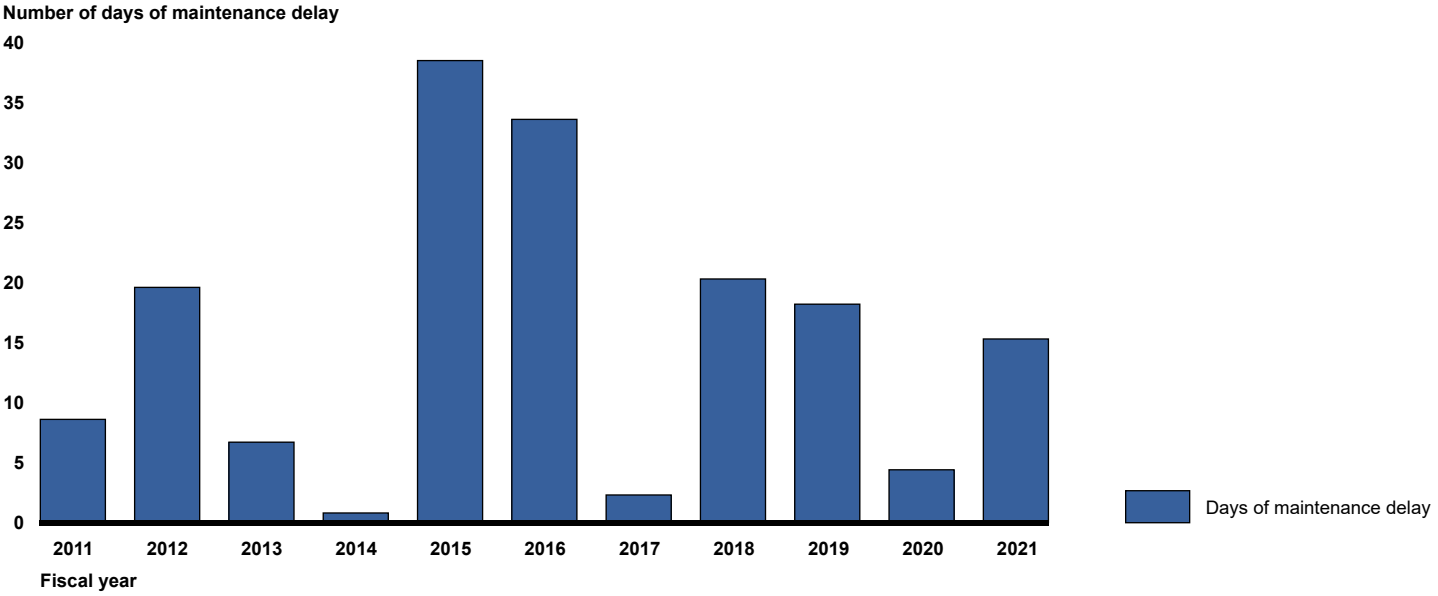
Note: According to the Navy, data for fiscal years 2011 through 2014 is incomplete and, therefore, not included in this graphic.

Availability and Condition

Casualty Reports per Ship

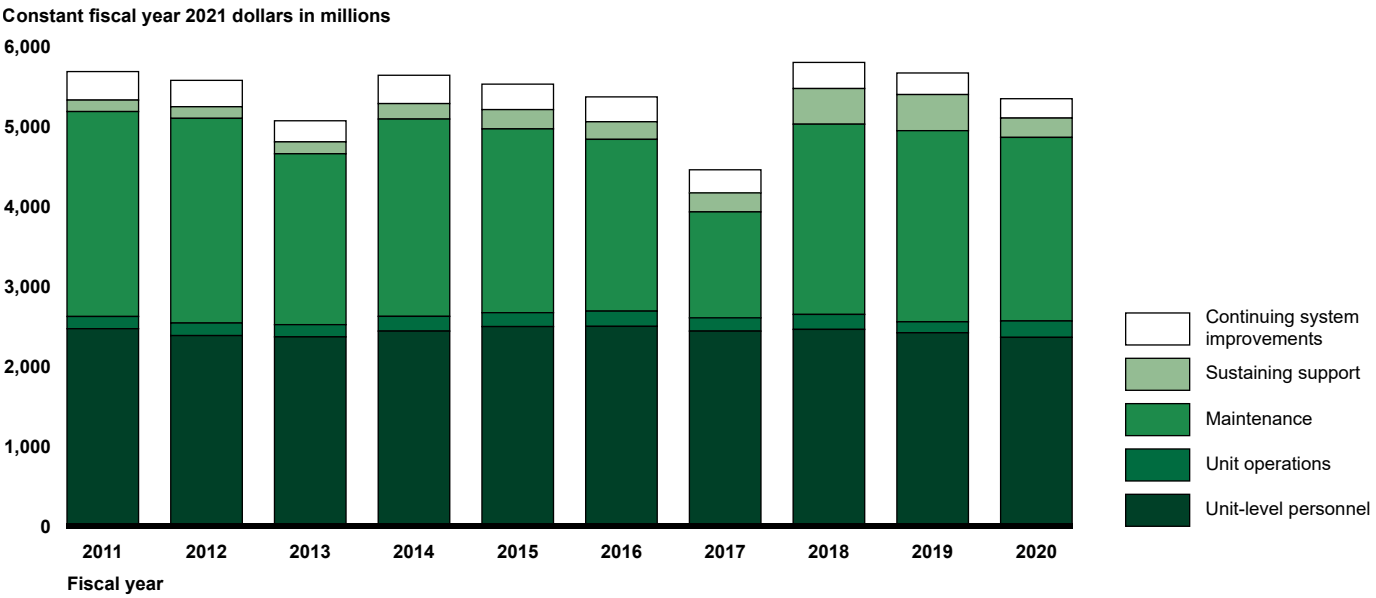


Days of Maintenance Delay per Ship

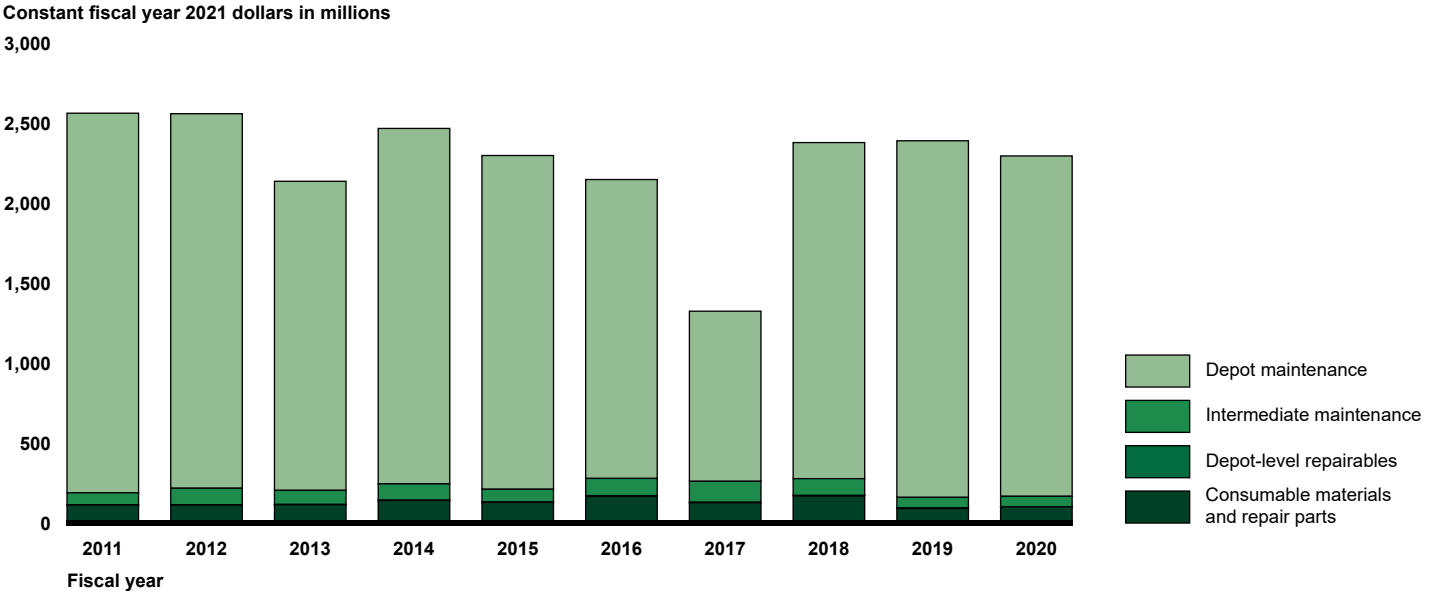


Operating and Support Costs

Total Operating and Support Costs

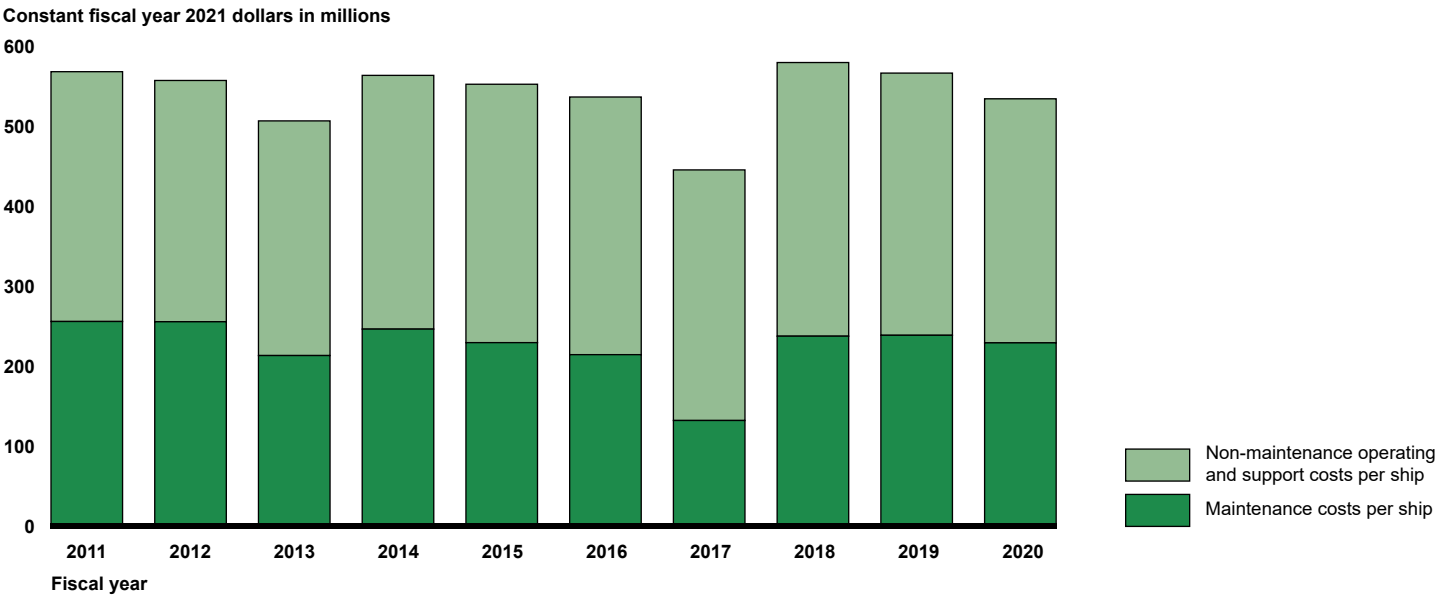


Maintenance Costs



Operating and Support Costs

Operating and Support Costs per Ship



Sustainment Challenges

Aging ships

- Service life extension
- Unexpected repairs and replacement of parts

Maintenance

- Access to technical data
- Delays in depot maintenance
- Delays in intermediate maintenance
- Shortage of trained maintenance personnel
- Unscheduled maintenance

Supply support

- Diminishing manufacturing source
- Parts obsolescence
- Parts shortage and delay

Program Office Comments

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

DDG-51
Arleigh Burke-class destroyer

Program Essentials

Manufacturer
General Dynamics Bath Iron Works Corp and Huntington Ingalls Industries Ingalls Shipbuilding (formerly Northrop Grumman Ship Systems Ingalls Operations)

Sustainment
Ships' crews conduct organizational-level maintenance, while ships' crews and contractors at private shipyards conduct depot-level maintenance.

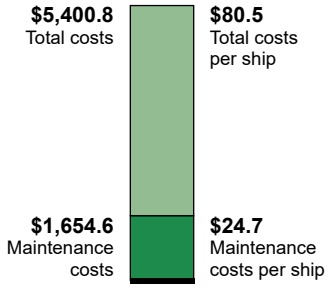
Depot maintenance locations
- San Diego, California
- Mayport, Florida
- Pearl Harbor, Hawaii
- Norfolk, Virginia
- Everett, Washington
- Yokosuka, Japan
- Rota, Spain

Arleigh Burke-class destroyers are the most numerous ships in the surface fleet. These large surface combatants can carry out a number of missions, including: launching Tomahawk missiles to strike land targets; providing ballistic missile defense; defending aircraft carriers; combating surface ships, aircraft, and submarines; and patrolling sea lanes.

Service life
The lead *Arleigh Burke*-class ship was first commissioned in 1991, and each ship has an estimated life span of 35 to 40 years, according to Navy officials. In April 2022, the Navy outlined plans to retire the lead *Arleigh Burke*-class ship in fiscal year 2027.

Sustainment Status, Fiscal Year 2021

Total operating and support costs in millions, 2020



Inventory
68
Ships

Cannibalizations
9
Cannibalizations per ship
+3 from 2020

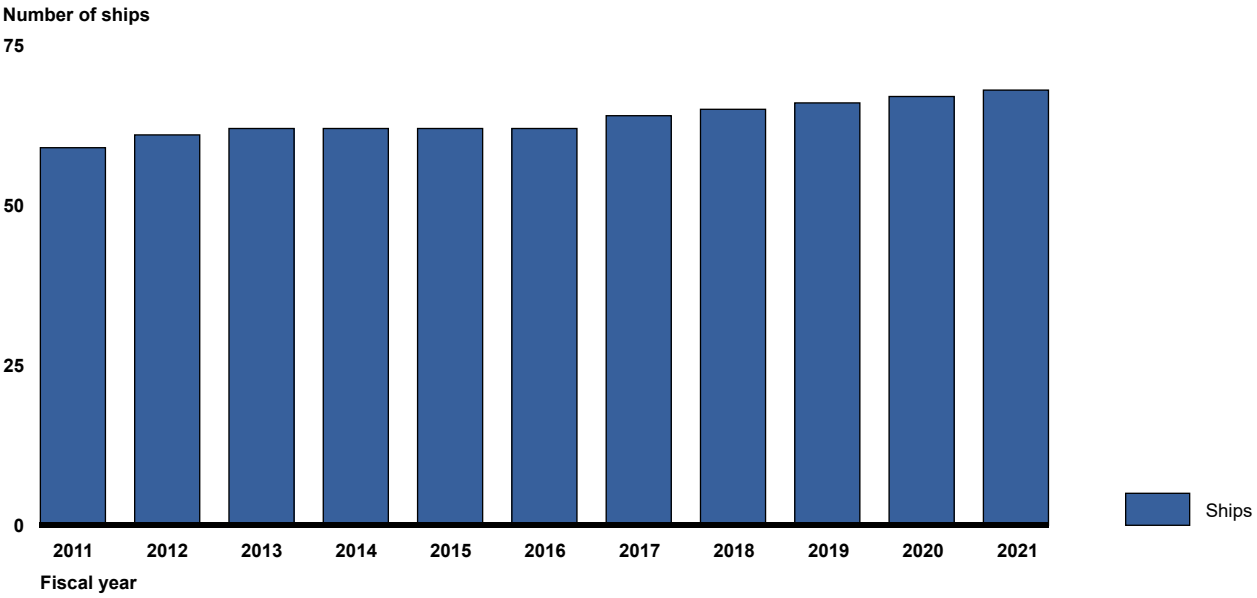
Maintenance delay
26
Days per ship
No change from 2020

Casualty reports
37
Category 3 & 4 reports per ship
+9 from 2020

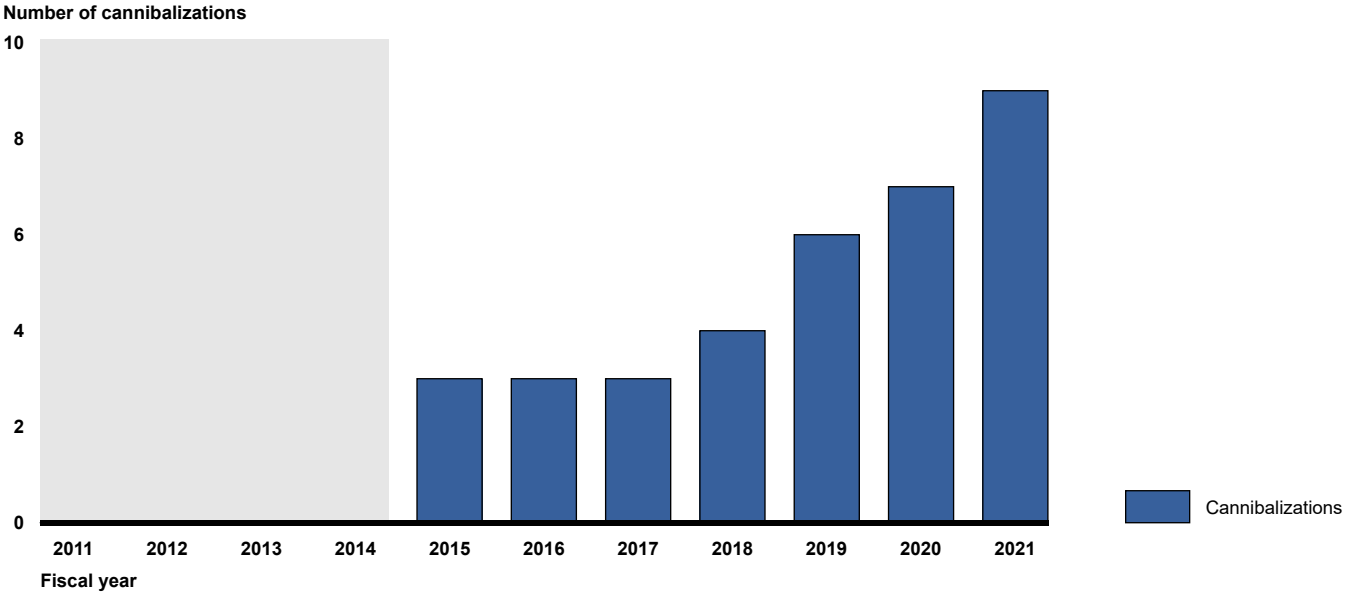
Trend in average cost per steaming hour
Increased, *fiscal years 2011 to 2020*

Availability and Condition

Inventory



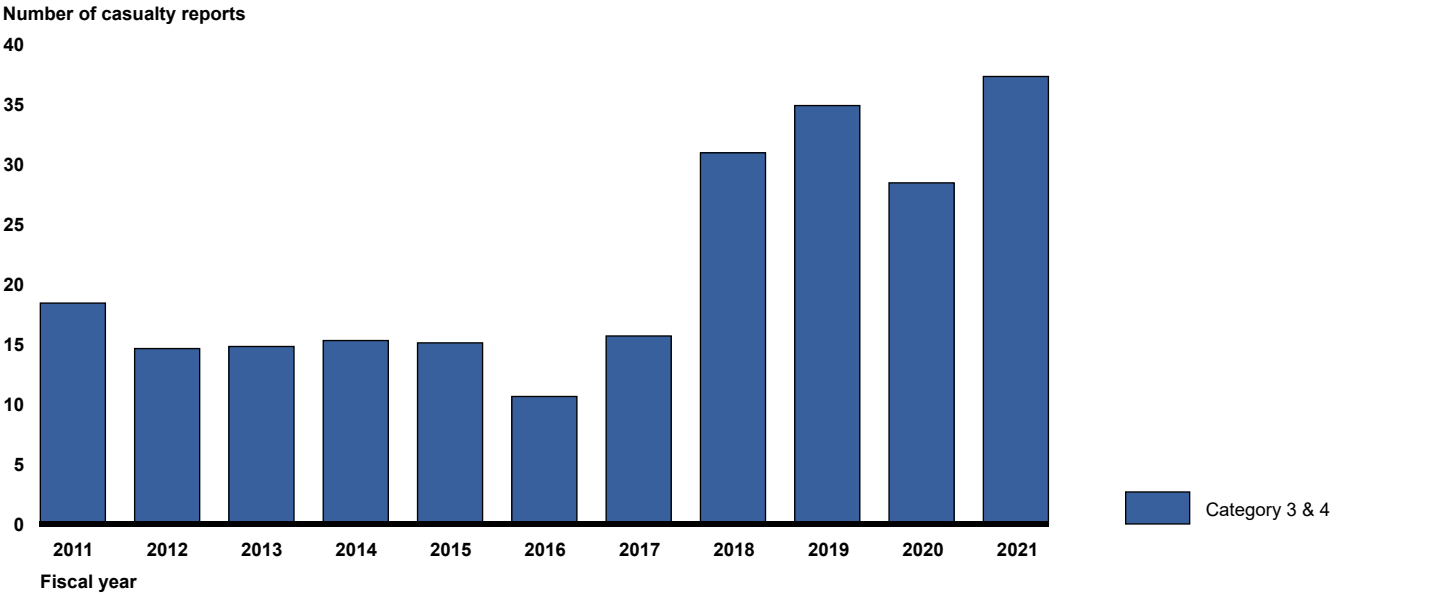
Cannibalizations per Ship



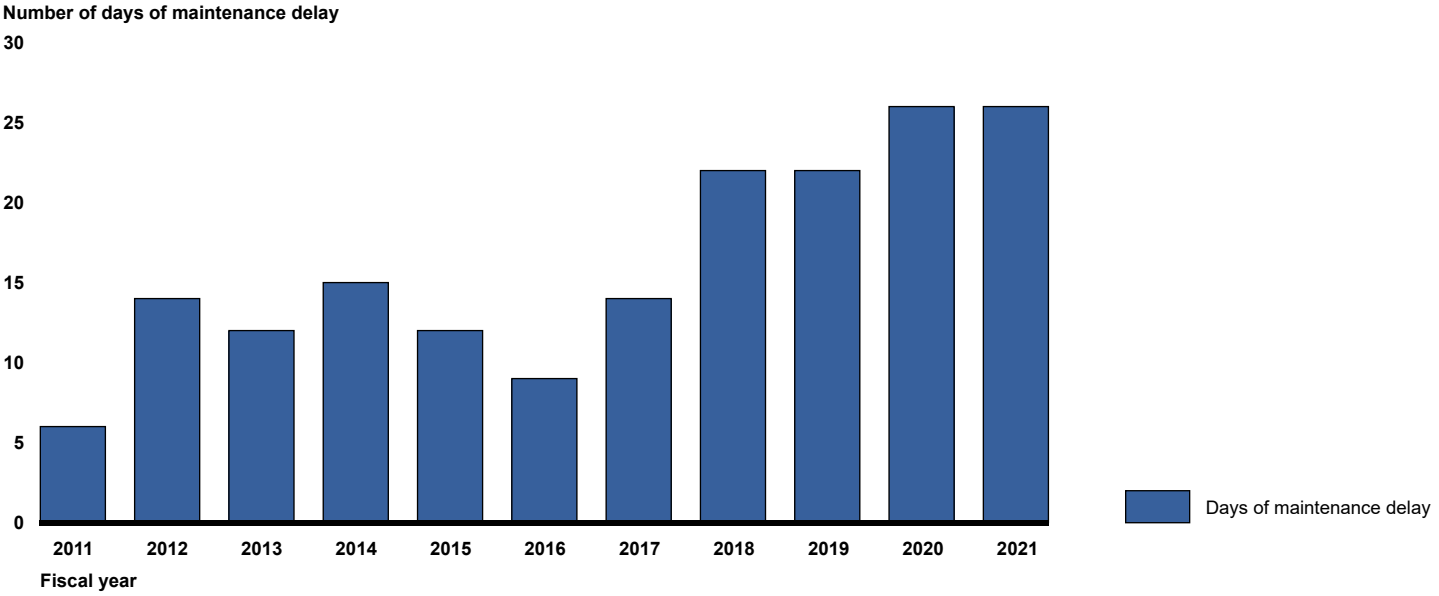
Note: According to the Navy, data for fiscal years 2011 through 2014 is incomplete and, therefore, not included in this graphic.

Availability and Condition

Casualty Reports per Ship

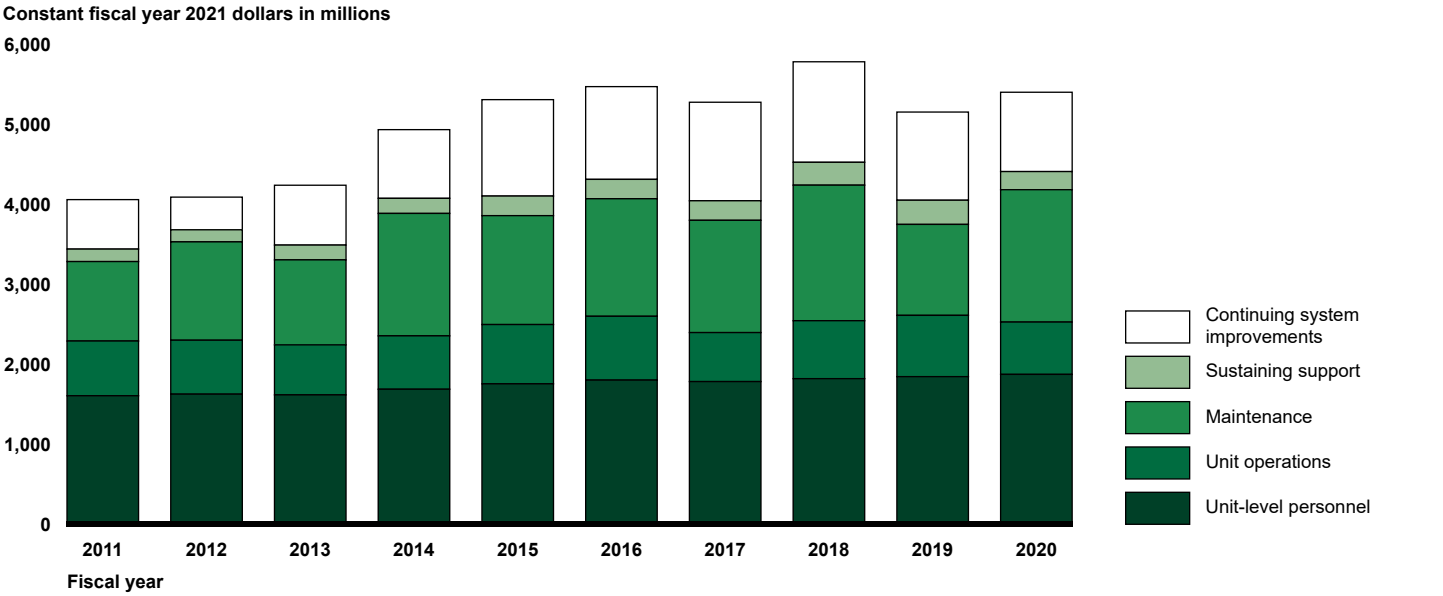


Days of Maintenance Delay per Ship

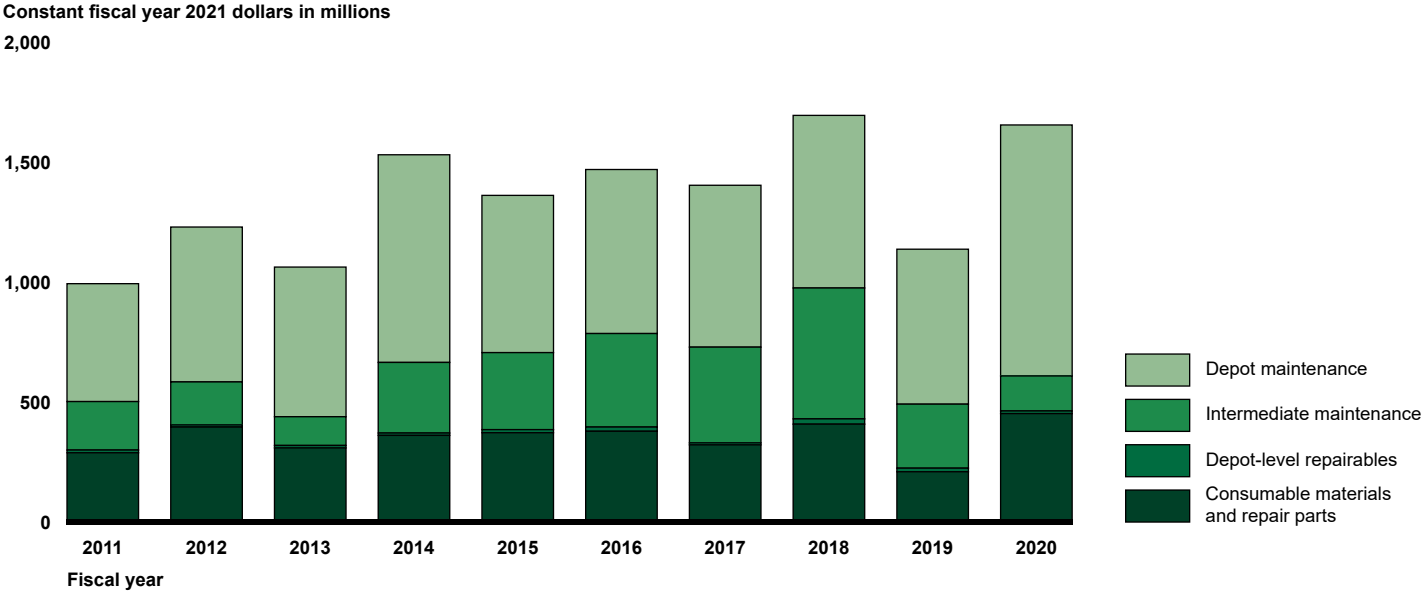


Operating and Support Costs

Total Operating and Support Costs

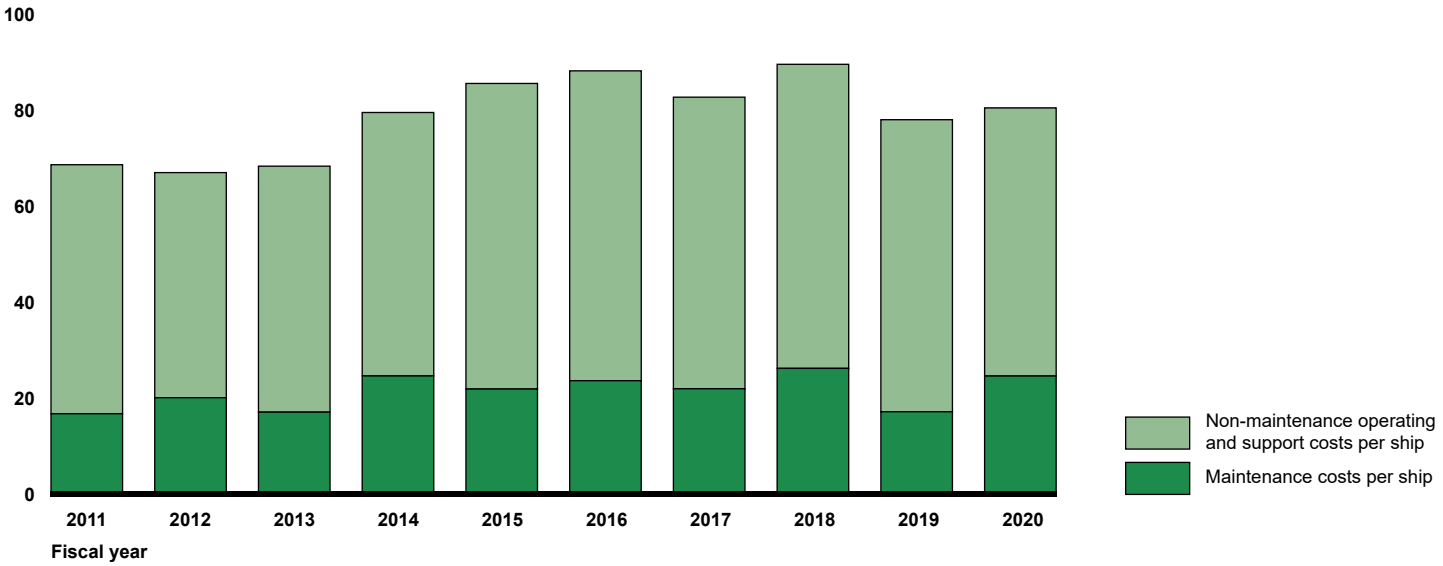


Maintenance Costs



Operating and Support Costs

Operating and Support Costs per Ship



Sustainment Challenges

Aging ships

- Service life extension
- Unexpected repairs and replacement of parts

Maintenance

- Access to technical data
- Delays in depot maintenance
- Delays in intermediate maintenance
- Shortage of trained maintenance personnel
- Unscheduled maintenance

Supply support

- Diminishing manufacturing source
- Parts obsolescence
- Parts shortage and delay

Program Office Comments

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

LCS-1
Freedom-variant littoral combat ship

Program Essentials

Manufacturer
Fincantieri Marinette Marine

Sustainment
Contractors primarily conduct organizational-level maintenance and also conduct depot-level maintenance.

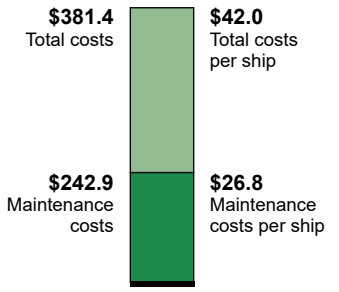
Depot maintenance locations
- San Diego, California
- Mayport, Florida

The LCS class are small surface combatants designed to achieve the Navy's security objectives while freeing up more expensive, multi-mission, large surface combatants like cruisers and destroyers. The LCS class includes two variants. Each ship is deployed with a mission package to perform a specific mission, currently either mine countermeasures or surface warfare, according to Navy officials. Each package consists of mission modules that contain mission systems (vehicles, sensors, weapons systems), support equipment, and software. *Freedom*-variant ships comprise the odd-numbered LCS. Because the two variants have different designs, configurations, and readiness and cost trends, we are treating each variant as a separate class in the report body.[1]

Service life
According to Navy officials, the lead *Freedom*-variant ship was first commissioned in 2008, and each ship has an estimated 25-year life span. The Navy retired the lead ship of this variant in fiscal year 2021, according to information provided by officials. In April 2022, the Navy outlined plans to retire 9 more *Freedom*-variant ships in fiscal year 2023.

Sustainment Status, Fiscal Year 2021

Total operating and support costs in millions, 2020



Inventory
10
Ships

Cannibalizations
18
Cannibalizations per ship
+1 from 2020

Maintenance delay
0
Days per ship
No change from 2020

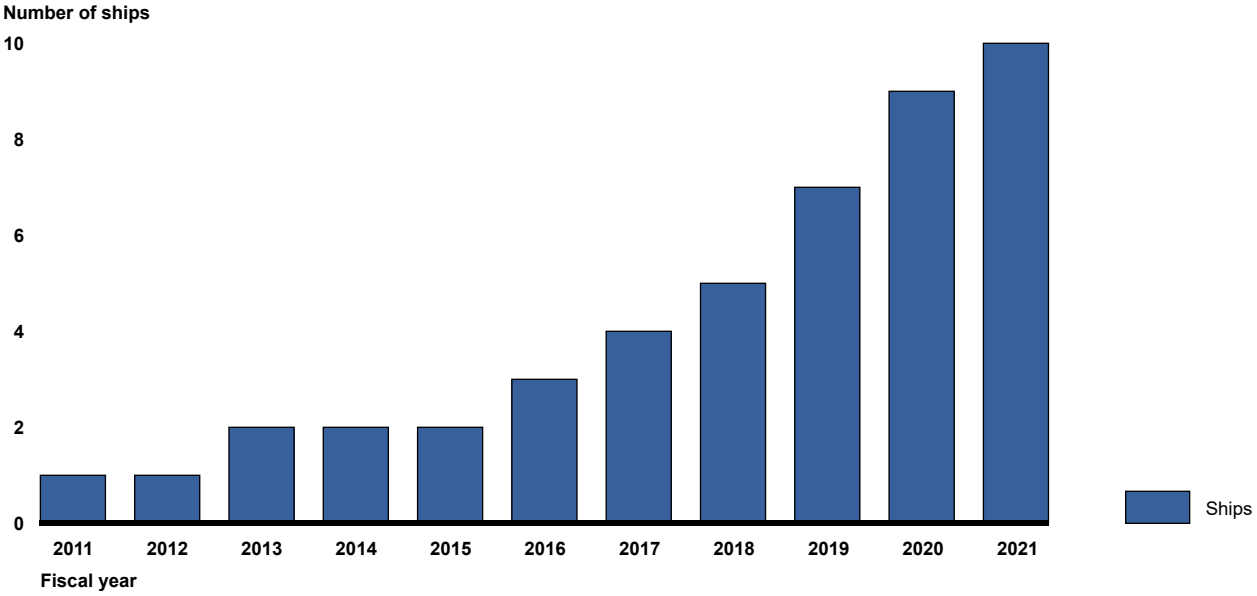
Casualty reports
44
Category 3 & 4 reports per ship
-2 from 2020

Trend in average cost per steaming hour
Increased, *fiscal years 2011 to 2020*

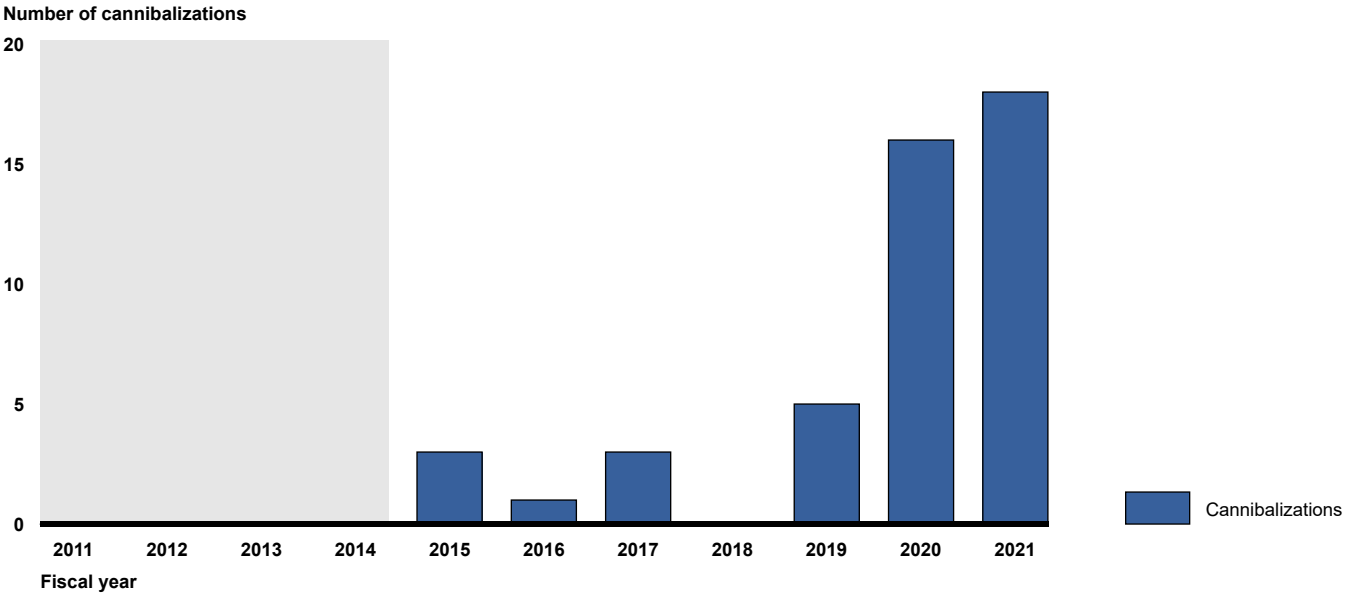
[1]We have previously reported on significant operational and sustainment challenges affecting both LCS variants. See GAO, *Littoral Combat Ship: Actions Needed to Address Significant Operational Challenges and Implement Planned Sustainment Approach*, GAO-22-105387 (Washington, D.C.: Feb. 24, 2022).

Availability and Condition

Inventory



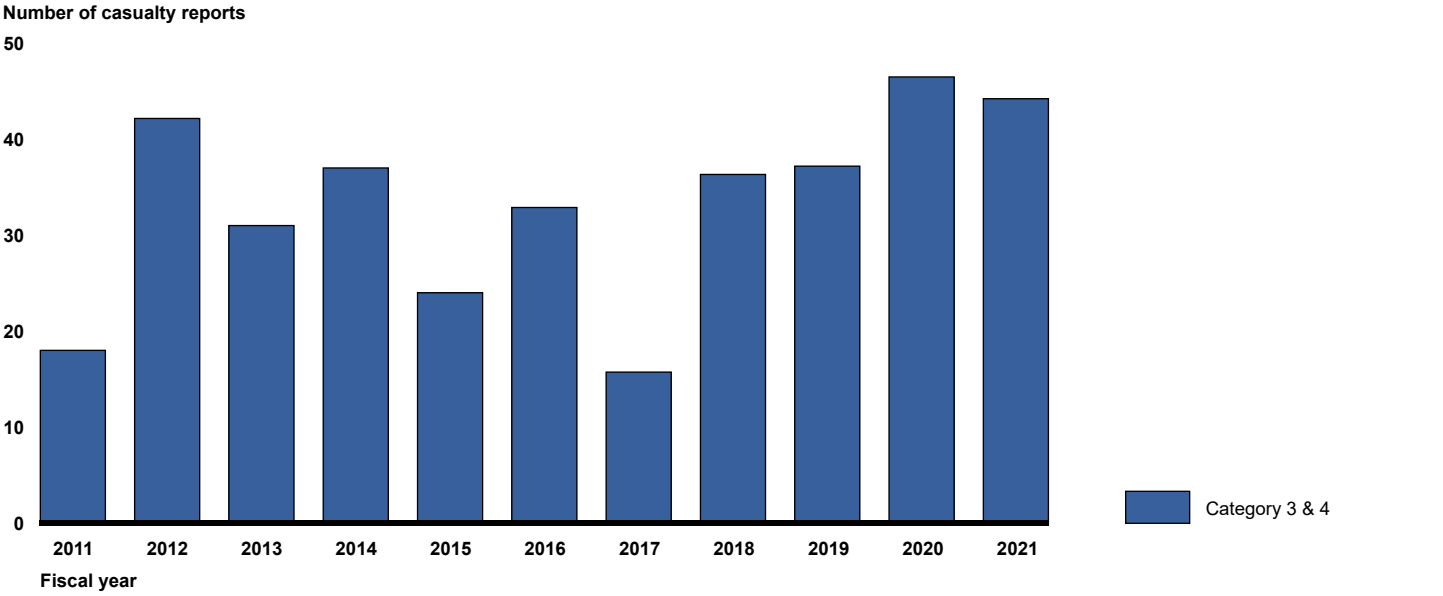
Cannibalizations per Ship



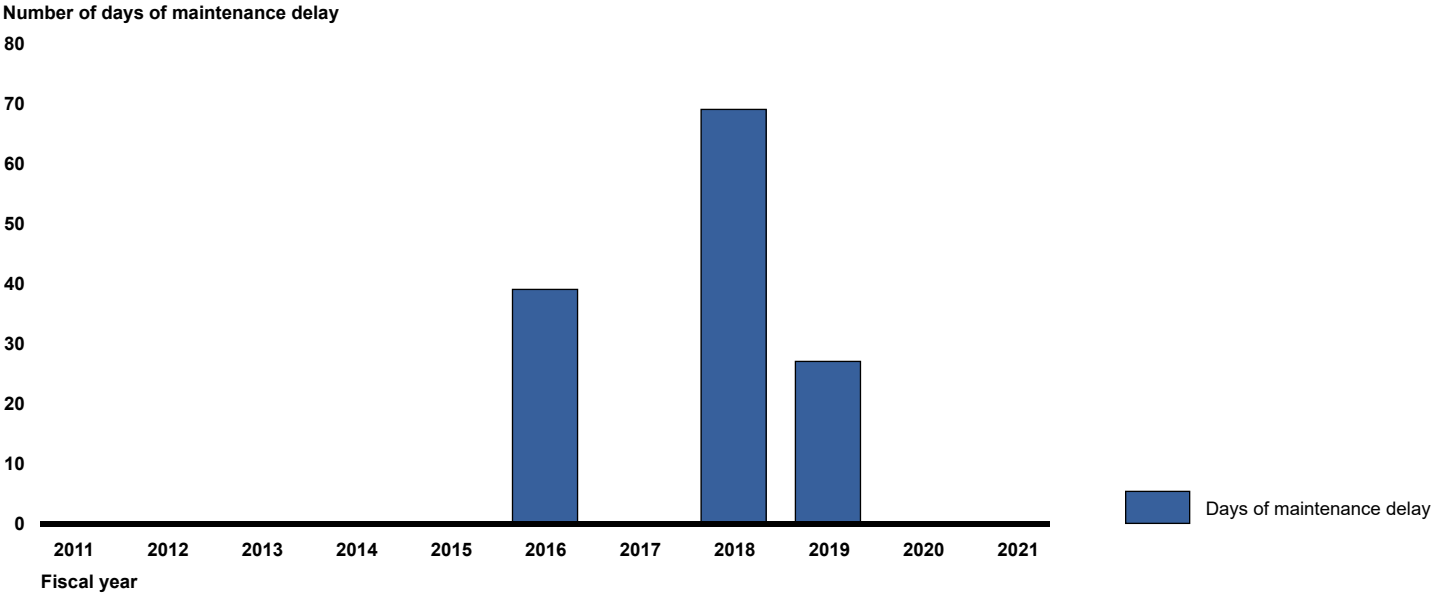
Note: According to the Navy, data for fiscal years 2011 through 2014 is incomplete and, therefore, not included in this graphic.

Availability and Condition

Casualty Reports per Ship

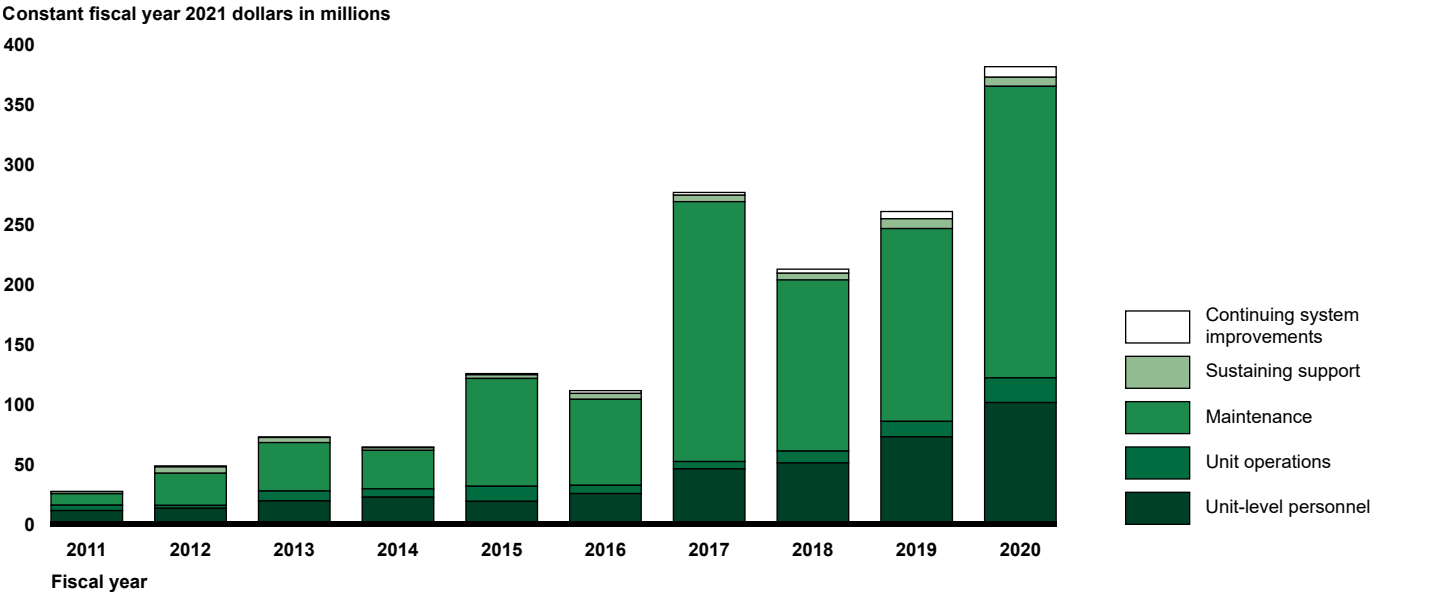


Days of Maintenance Delay per Ship

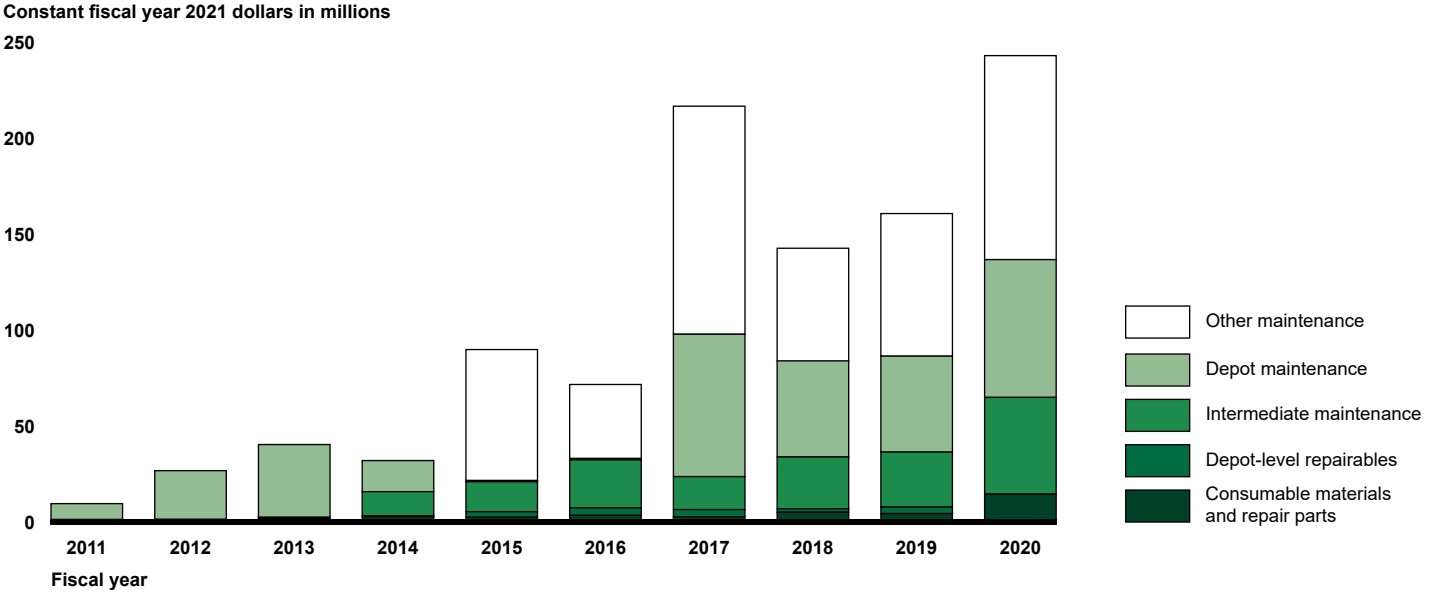


Operating and Support Costs

Total Operating and Support Costs

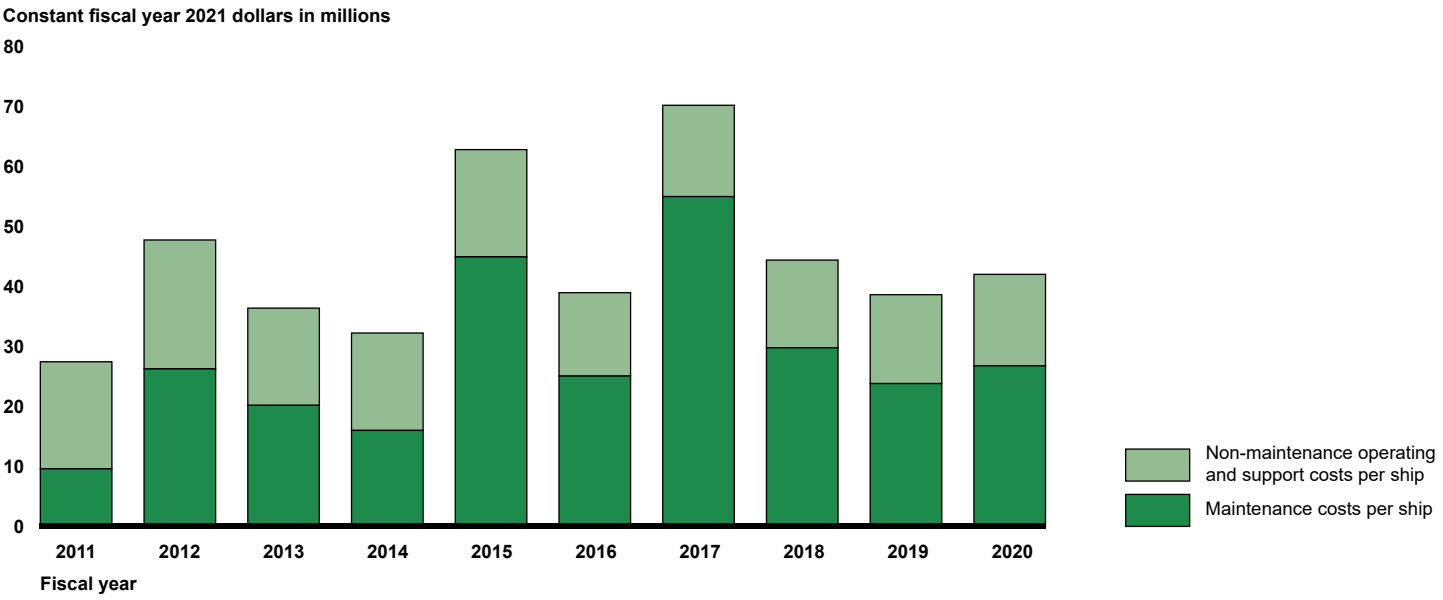


Maintenance Costs



Operating and Support Costs

Operating and Support Costs per Ship



Sustainment Challenges

Aging ships

- Service life extension
- Unexpected repairs and replacement of parts

Maintenance

- Access to technical data
- Delays in depot maintenance
- Delays in intermediate maintenance
- Shortage of trained maintenance personnel
- Unscheduled maintenance

Supply support

- Diminishing manufacturing source
- Parts obsolescence
- Parts shortage and delay

Program Office Comments

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

LCS-2
Independence-variant littoral combat ship

Program Essentials

Manufacturer
Austal USA

Sustainment
Contractors primarily conduct organizational-level maintenance and also conduct depot-level maintenance.

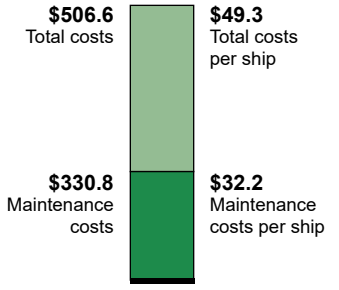
Depot maintenance locations
- San Diego, California
- Seattle, Washington

The LCS class are small surface combatants designed to achieve the Navy's security objectives while freeing up more expensive, multi-mission, large surface combatants like cruisers and destroyers. The LCS class includes two variants. Each ship is deployed with a mission package to perform a specific mission, currently either mine countermeasures or surface warfare, according to Navy officials. Each package consists of mission modules that contain mission systems (vehicles, sensors, weapons systems), support equipment, and software. *Independence*-variant ships comprise the even-numbered LCS. Because the two variants have different designs, configurations, and readiness and cost trends, we are treating each variant as a separate class in the report body.[1]

Service life
According to Navy officials, the lead *Independence*-variant ship was first commissioned in 2010, and each ship has an estimated 25-year life span. The Navy retired the lead ship of this variant in fiscal year 2021, according to information provided by officials. In April 2022, the Navy outlined plans to retire 2 more *Independence*-variant ships in fiscal year 2024.

Sustainment Status, Fiscal Year 2021

Total operating and support costs in millions, 2020



Inventory
12
Ships

Cannibalizations
4
Cannibalizations per ship
No change from 2020

Maintenance delay
19
Days per ship
+12 from 2020

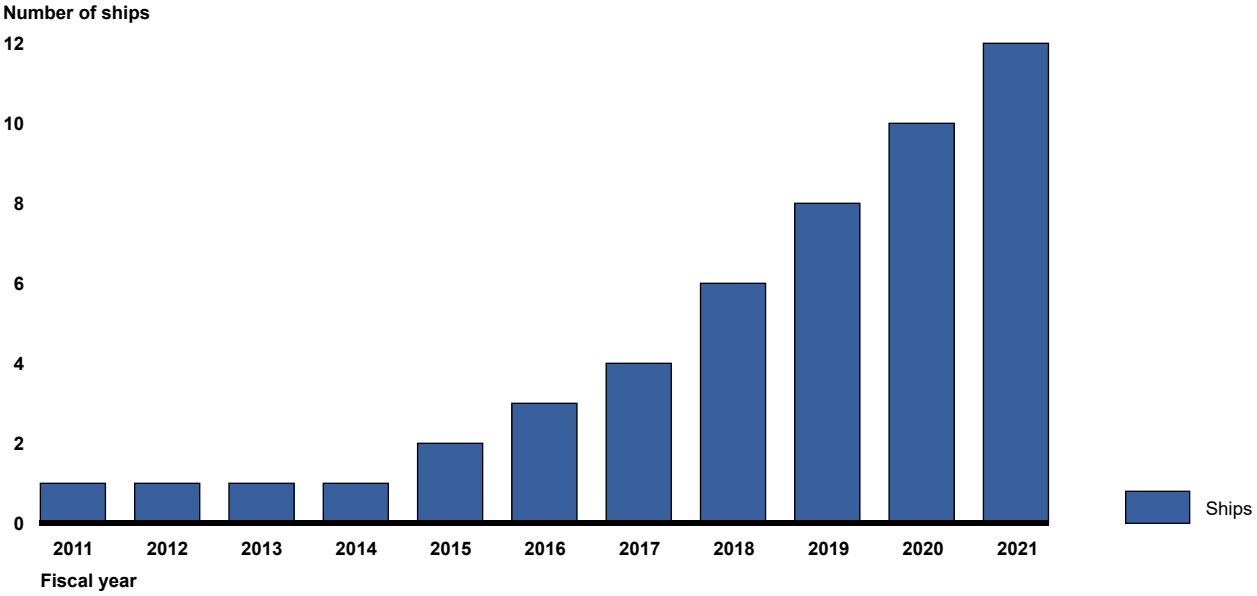
Casualty reports
37
Category 3 & 4 reports per ship
No change from 2020

Trend in average cost per steaming hour
Increased, *fiscal years 2011 to 2020*

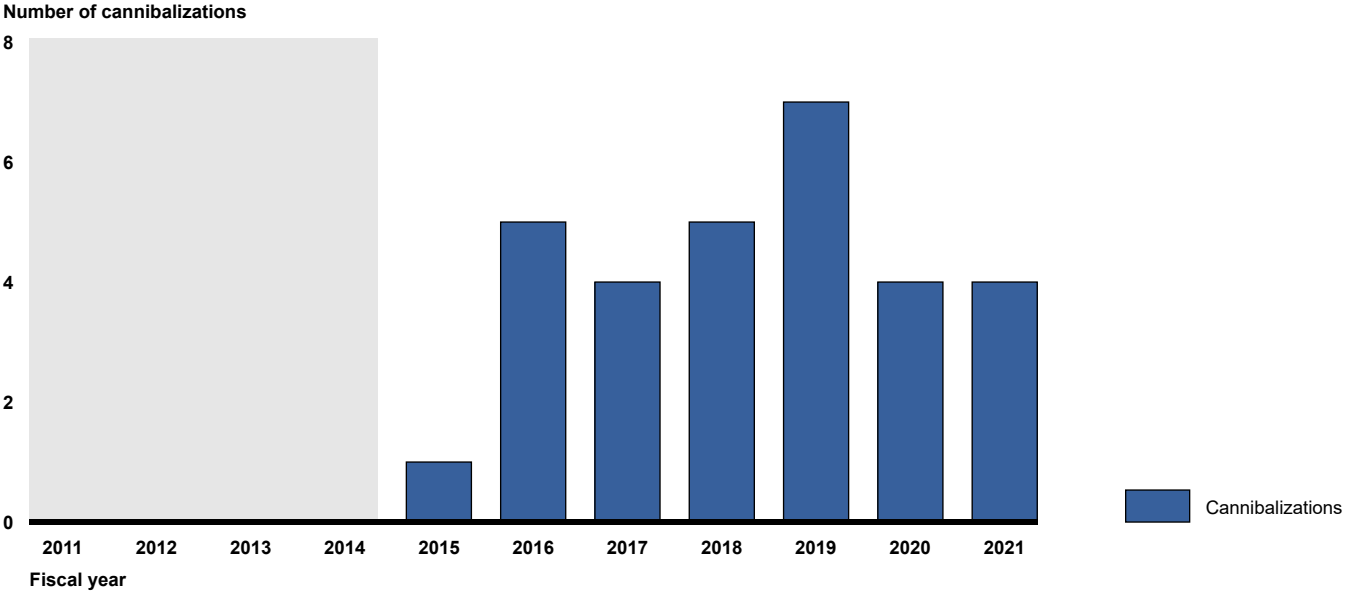
[1]We have previously reported on significant operational and sustainment challenges affecting both LCS variants. See GAO, *Littoral Combat Ship: Actions Needed to Address Significant Operational Challenges and Implement Planned Sustainment Approach*, GAO-22-105387 (Washington, D.C.: Feb. 24, 2022).

Availability and Condition

Inventory



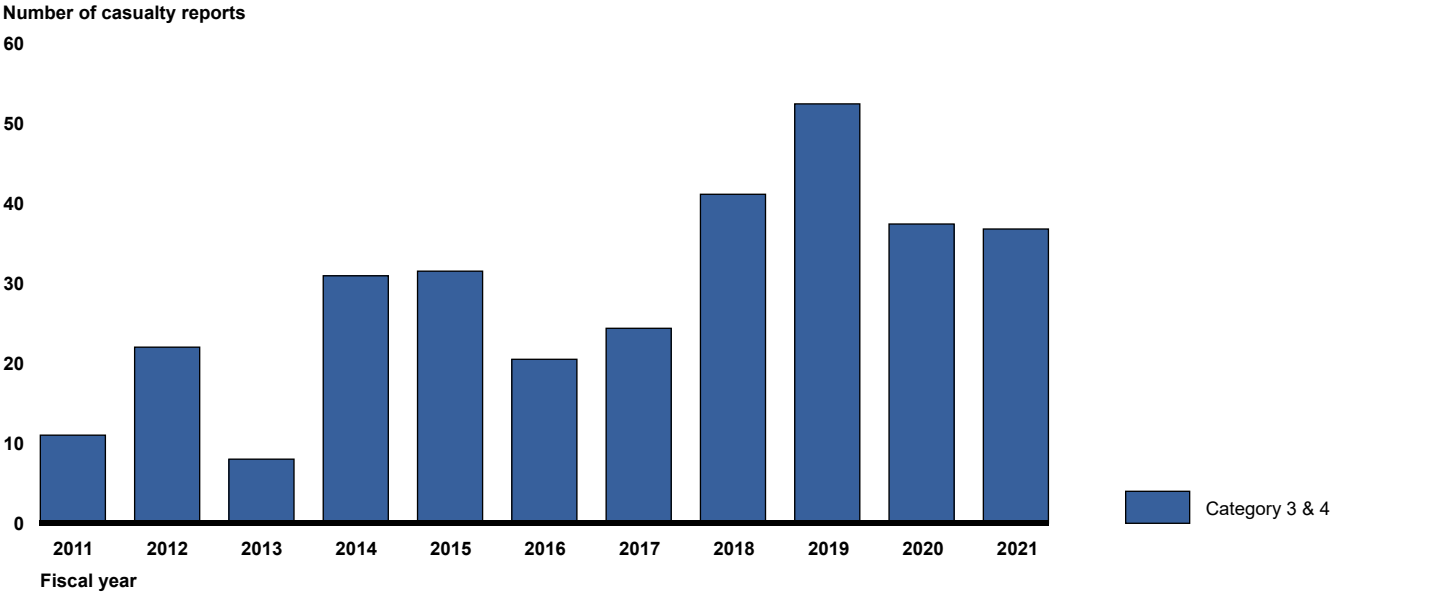
Cannibalizations per Ship



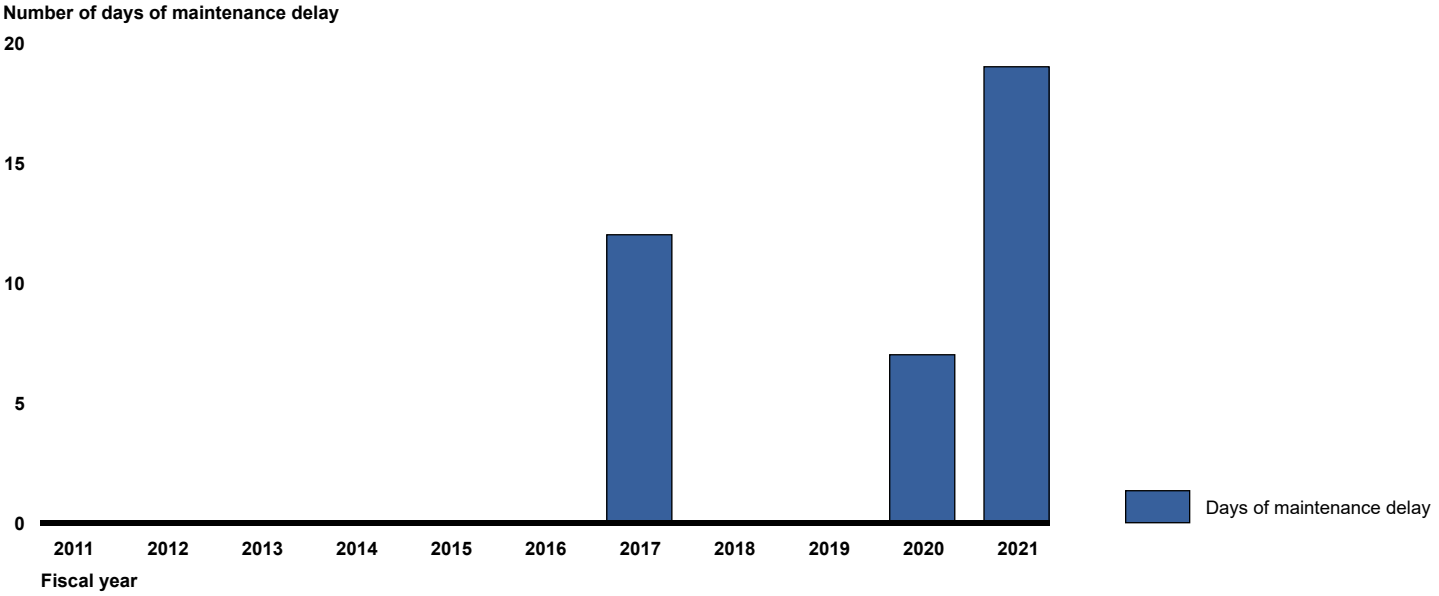
Note: According to the Navy, data for fiscal years 2011 through 2014 is incomplete and, therefore, not included in this graphic.

Availability and Condition

Casualty Reports per Ship

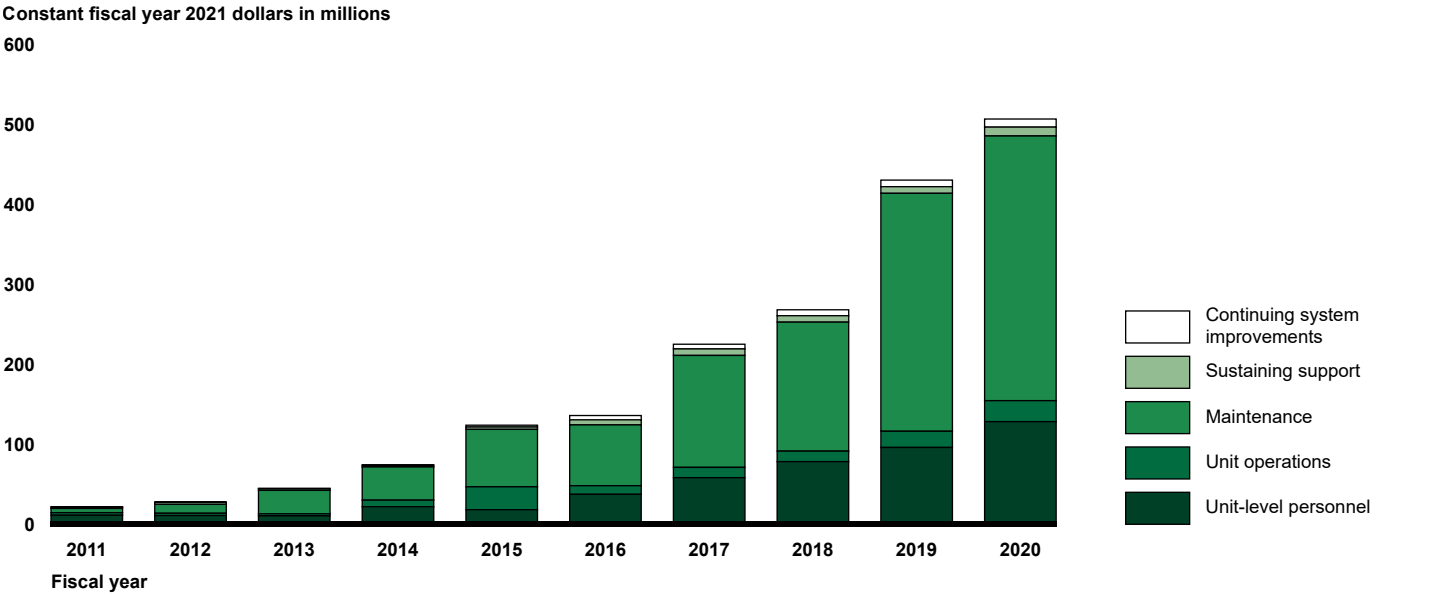


Days of Maintenance Delay per Ship

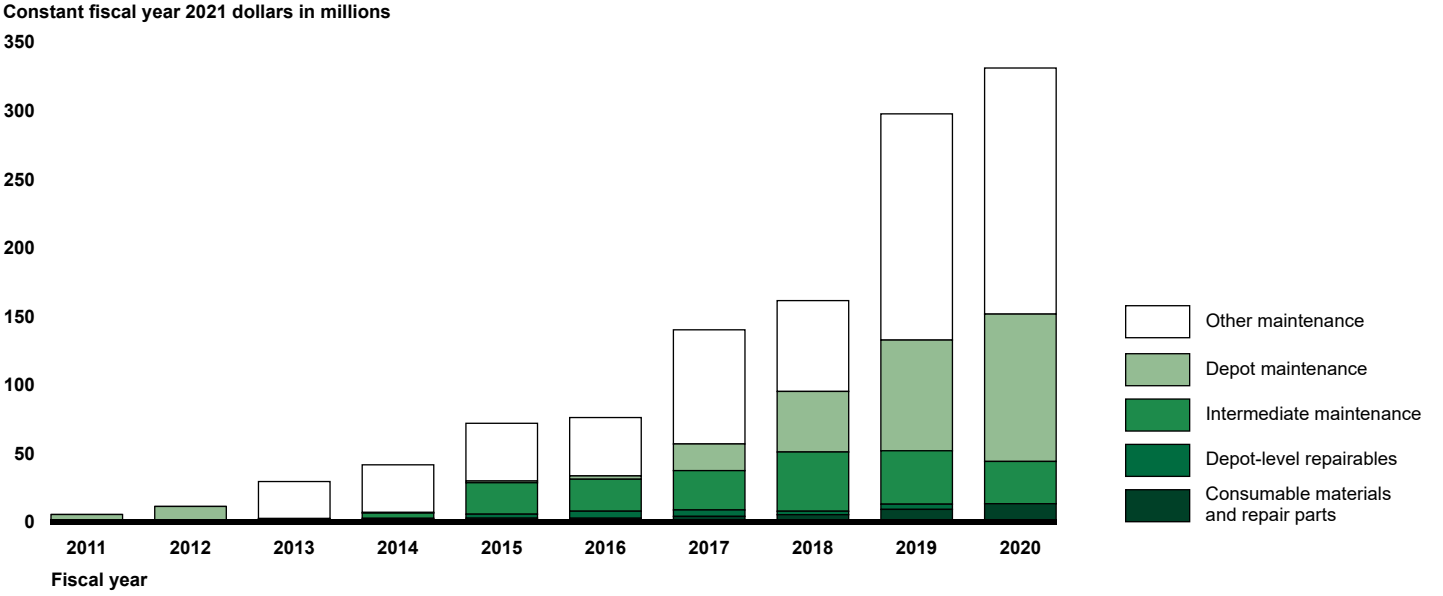


Operating and Support Costs

Total Operating and Support Costs

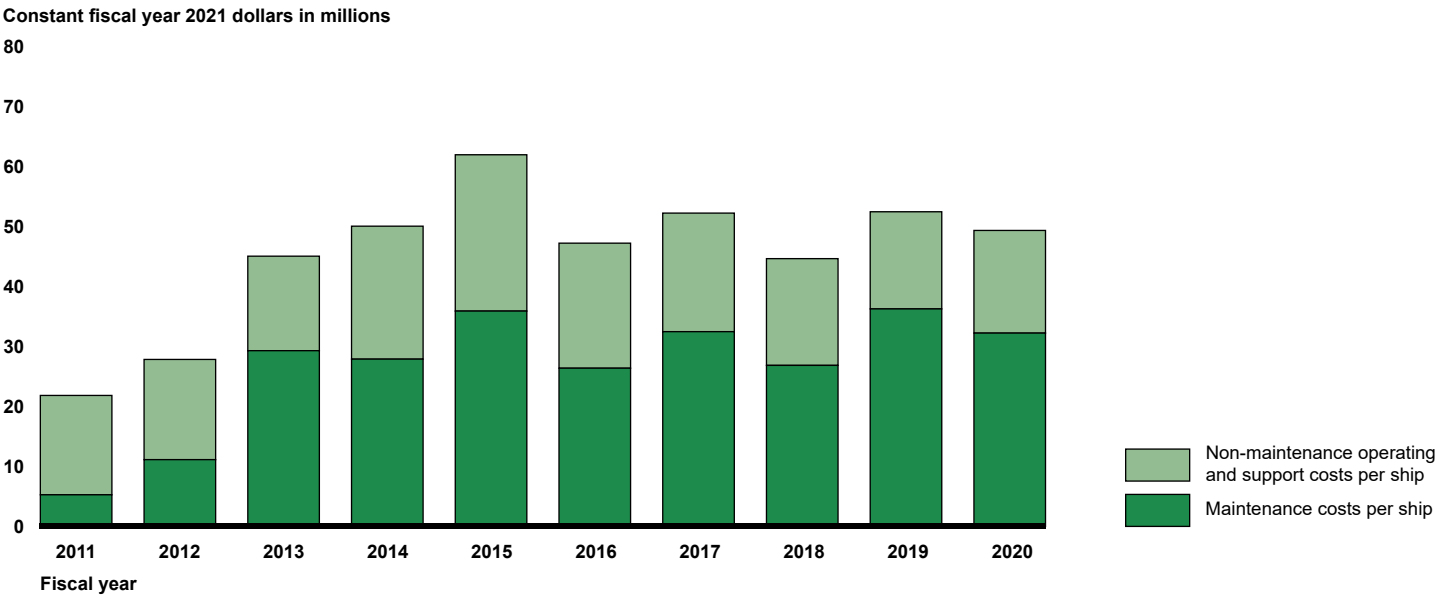


Maintenance Costs



Operating and Support Costs

Operating and Support Costs per Ship



Sustainment Challenges

Aging ships

- Service life extension
- Unexpected repairs and replacement of parts

Maintenance

- Access to technical data
- Delays in depot maintenance
- Delays in intermediate maintenance
- Shortage of trained maintenance personnel
- Unscheduled maintenance

Supply support

- Diminishing manufacturing source
- Parts obsolescence
- Parts shortage and delay

Program Office Comments

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

LHA-6
America-class amphibious assault ship

Program Essentials

Manufacturer
Huntington Ingalls Industries Ingalls Shipbuilding (formerly Northrop Grumman Ship Systems Ingalls Operations)

Sustainment
Ships' crews conduct organizational-level maintenance, while ships' crews and contractors at private shipyards conduct depot-level maintenance.

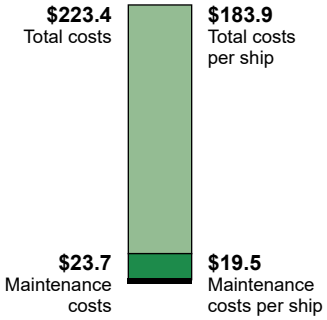
Depot maintenance locations
- San Diego, California
- Sasebo, Japan

Like the older *Wasp* class, the *America* class are amphibious assault ships designed to carry Marine expeditionary units, including helicopters and fixed-wing aircraft, and to operate alongside other amphibious warfare ships in amphibious ready groups.

Service life
The lead *America*-class ship was first commissioned in 2014, and each ship has an estimated 40-year life span, according to Navy officials.

Sustainment Status, Fiscal Year 2021

Total operating and support costs in millions, 2020



Inventory
2
Ships

Cannibalizations
0
Cannibalizations per ship
-2 from 2020

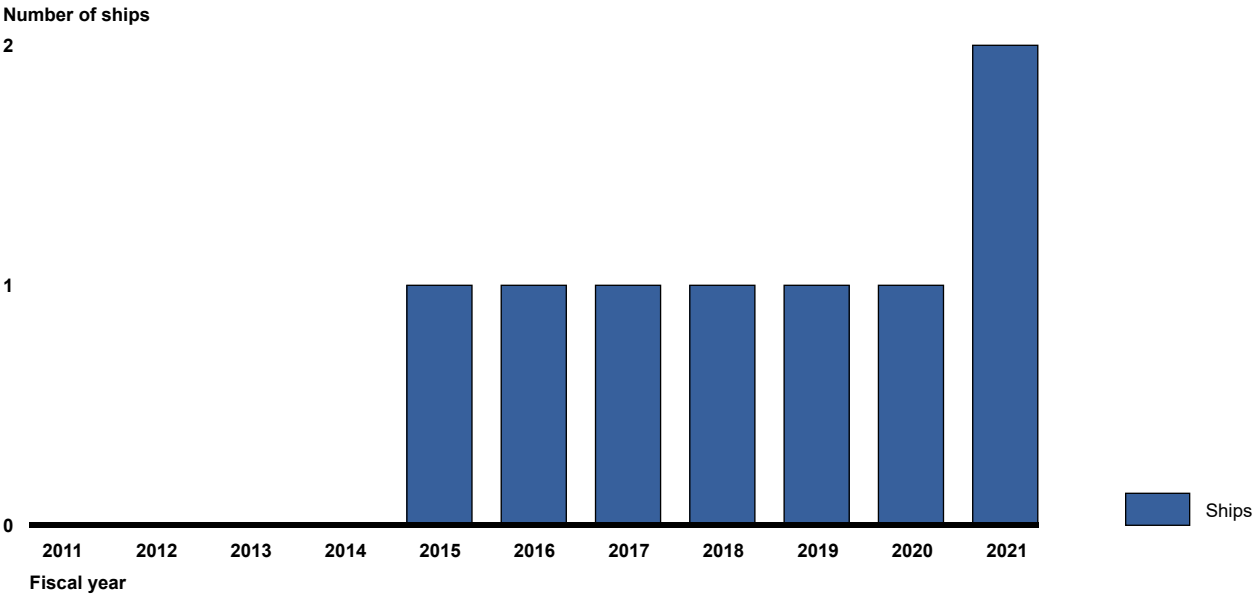
Maintenance delay
0
Days per ship
No change from 2020

Casualty reports
14
Category 3 & 4 reports per ship
-1 from 2020

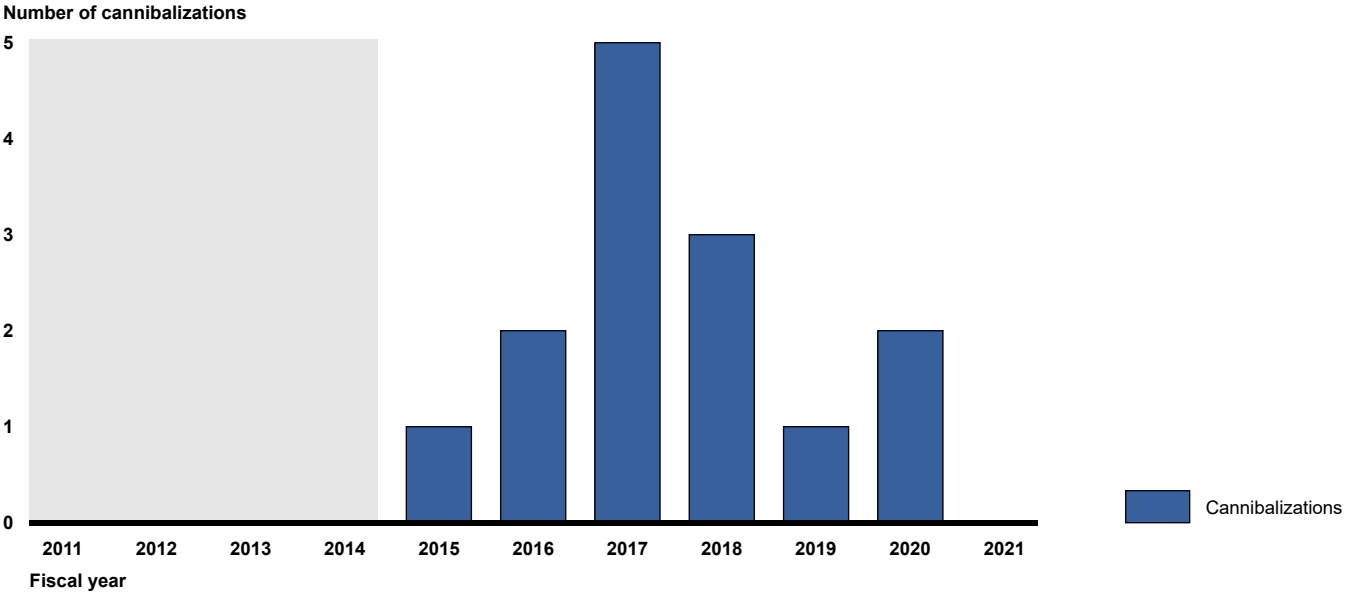
Trend in average cost per steaming hour
▼ Decreased, *fiscal years 2011 to 2020*

Availability and Condition

Inventory



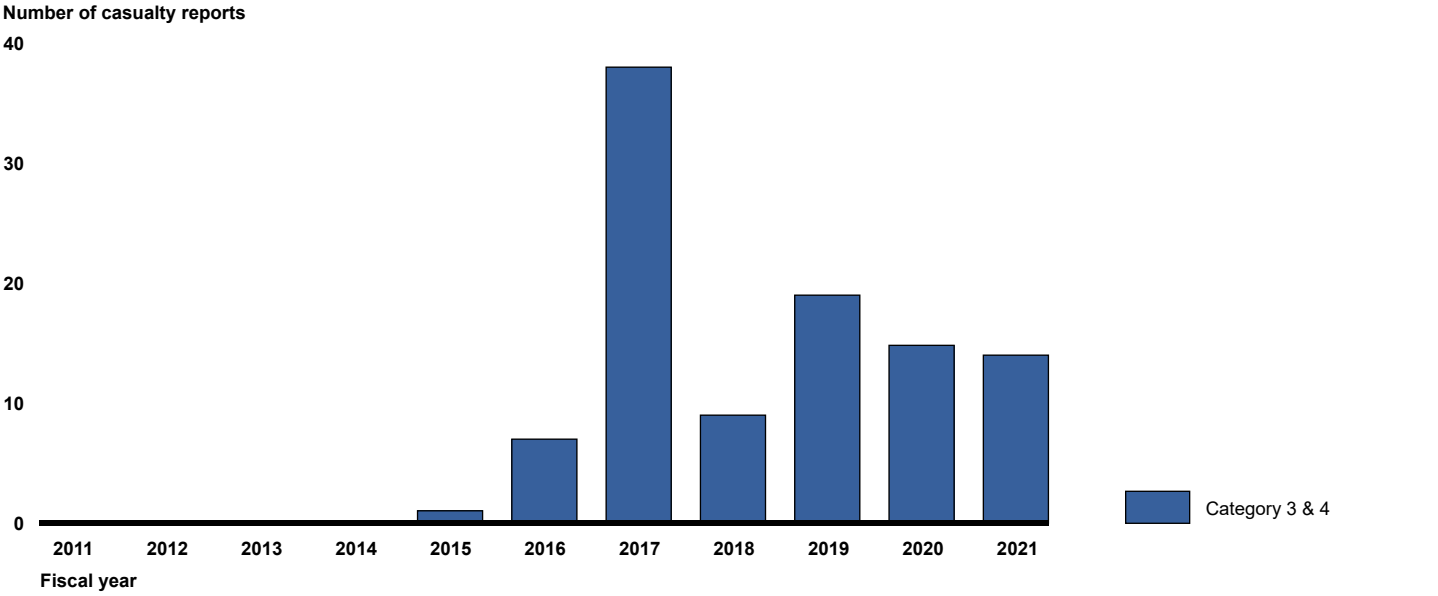
Cannibalizations per Ship



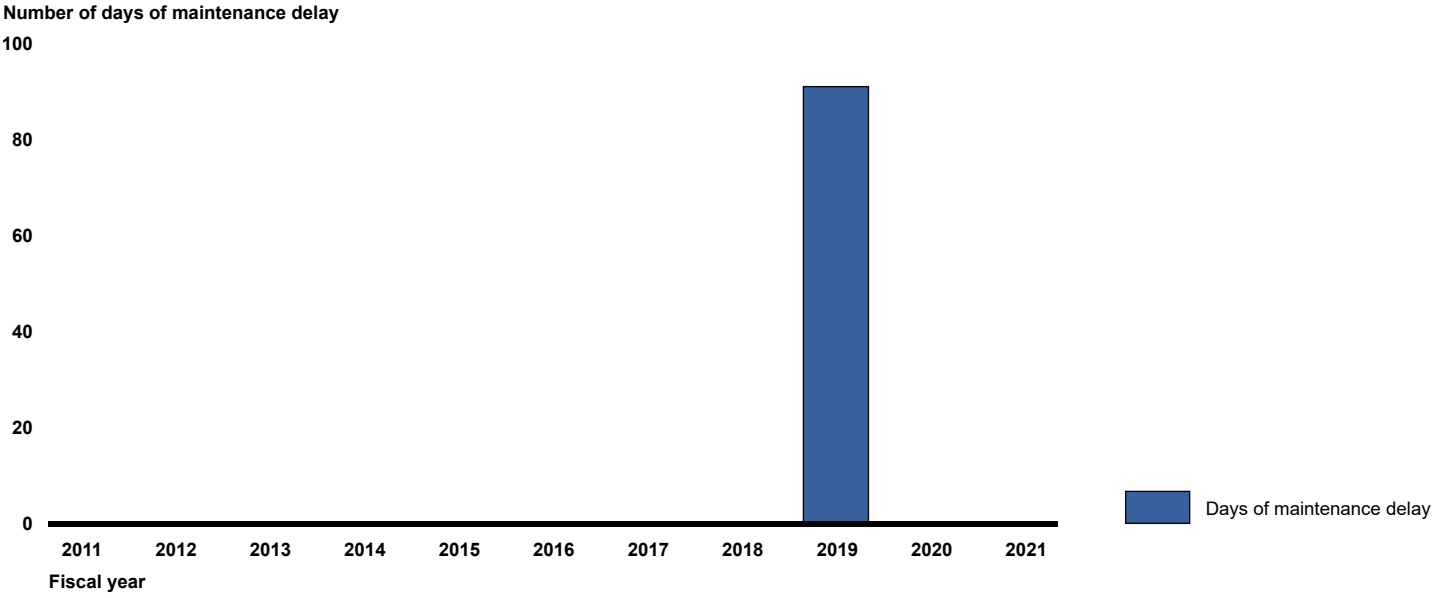
Note: According to the Navy, data for fiscal years 2011 through 2014 is incomplete and, therefore, not included in this graphic.

Availability and Condition

Casualty Reports per Ship

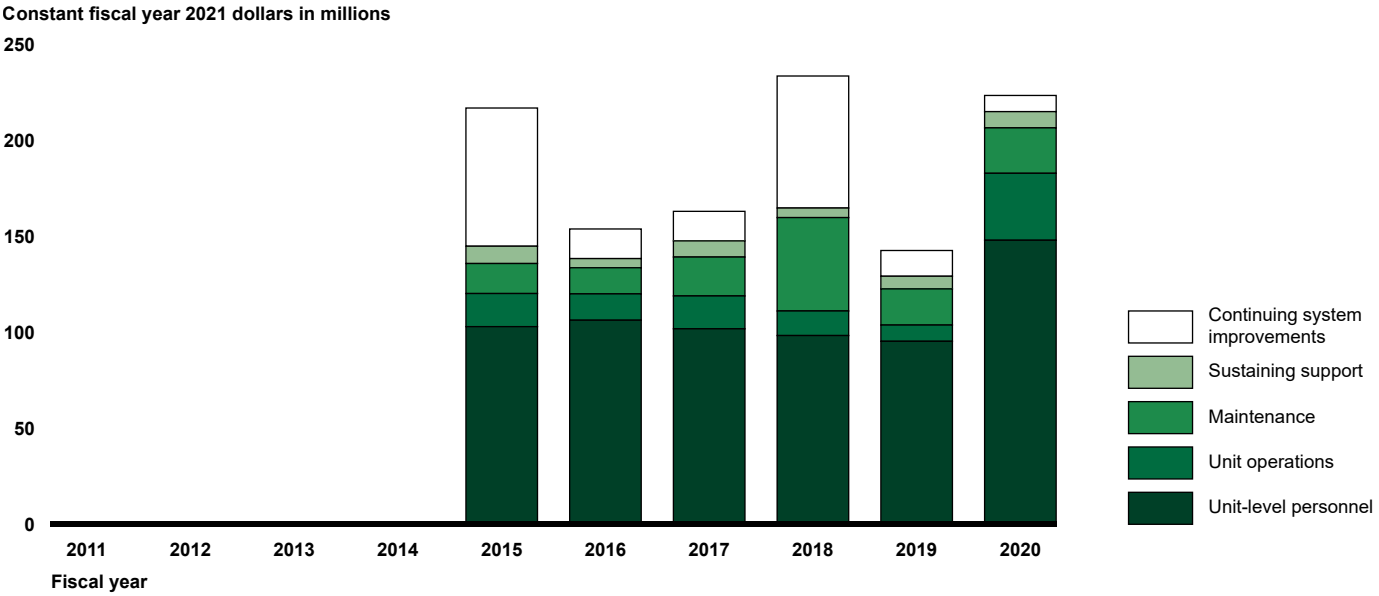


Days of Maintenance Delay per Ship

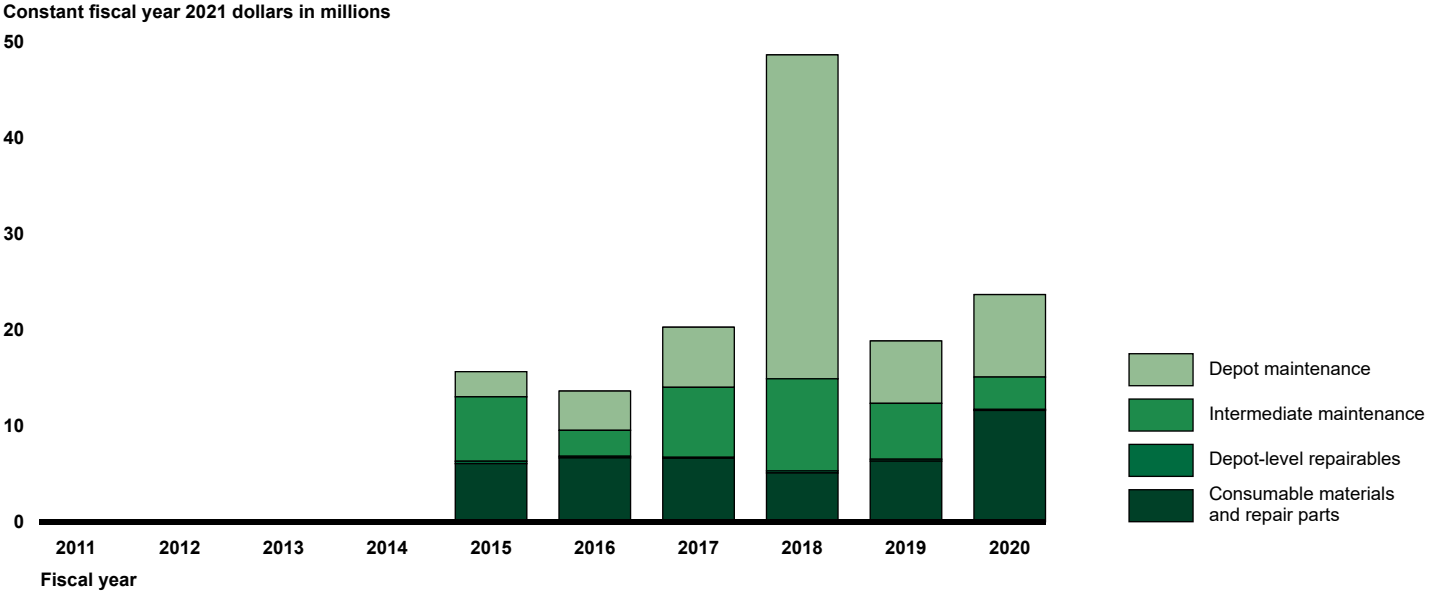


Operating and Support Costs

Total Operating and Support Costs

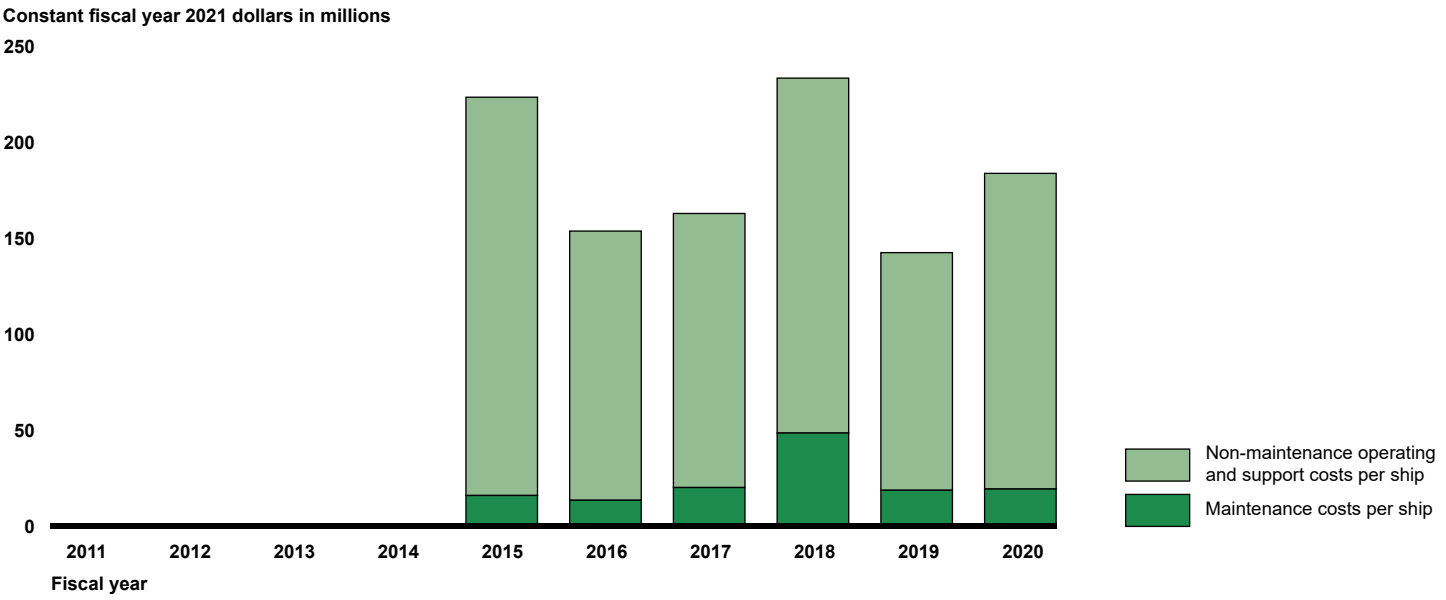


Maintenance Costs



Operating and Support Costs

Operating and Support Costs per Ship



Sustainment Challenges

Aging ships

- Service life extension
- Unexpected repairs and replacement of parts

Maintenance

- Access to technical data
- Delays in depot maintenance
- Delays in intermediate maintenance
- Shortage of trained maintenance personnel
- Unscheduled maintenance

Supply support

- Diminishing manufacturing source
- Parts obsolescence
- Parts shortage and delay

Program Office Comments

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

LHD-1
Wasp-class amphibious assault ship

Program Essentials

Manufacturer
Huntington Ingalls Industries Ingalls Shipbuilding (formerly Northrop Grumman Ship Systems Ingalls Operations)

Sustainment
Ships' crews conduct organizational-level maintenance, while ships' crews and contractors at private shipyards conduct depot-level maintenance.

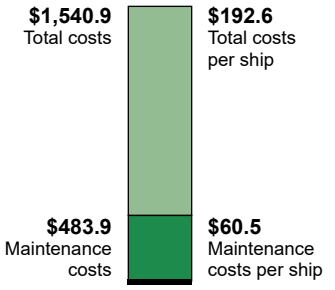
Depot maintenance locations
- San Diego, California
- Norfolk, Virginia

Like the newer *America* class, the *Wasp* class are amphibious assault ships. They are designed to carry Marine expeditionary units, including helicopters and fixed-wing aircraft, and to operate alongside other amphibious warfare ships in amphibious ready groups.

Service life
According to Navy officials, the lead *Wasp*-class ship was first commissioned in 1989, and each ship has an estimated 40-year life span. The Navy retired one ship of this class in fiscal year 2021 after it was damaged in a fire.

Sustainment Status, Fiscal Year 2021

Total operating and support costs in millions, 2020



Inventory
8
Ships

Cannibalizations
12
Cannibalizations per ship
+6 from 2020

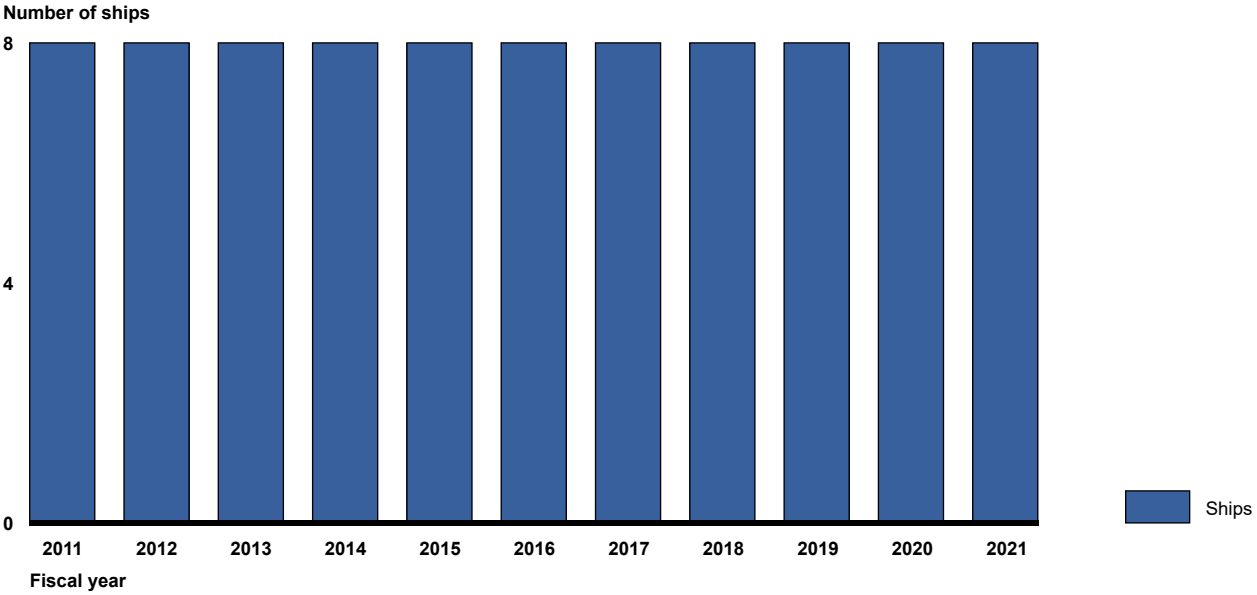
Maintenance delay
10
Days per ship
-15 from 2020

Casualty reports
61
Category 3 & 4 reports per ship
+22 from 2020

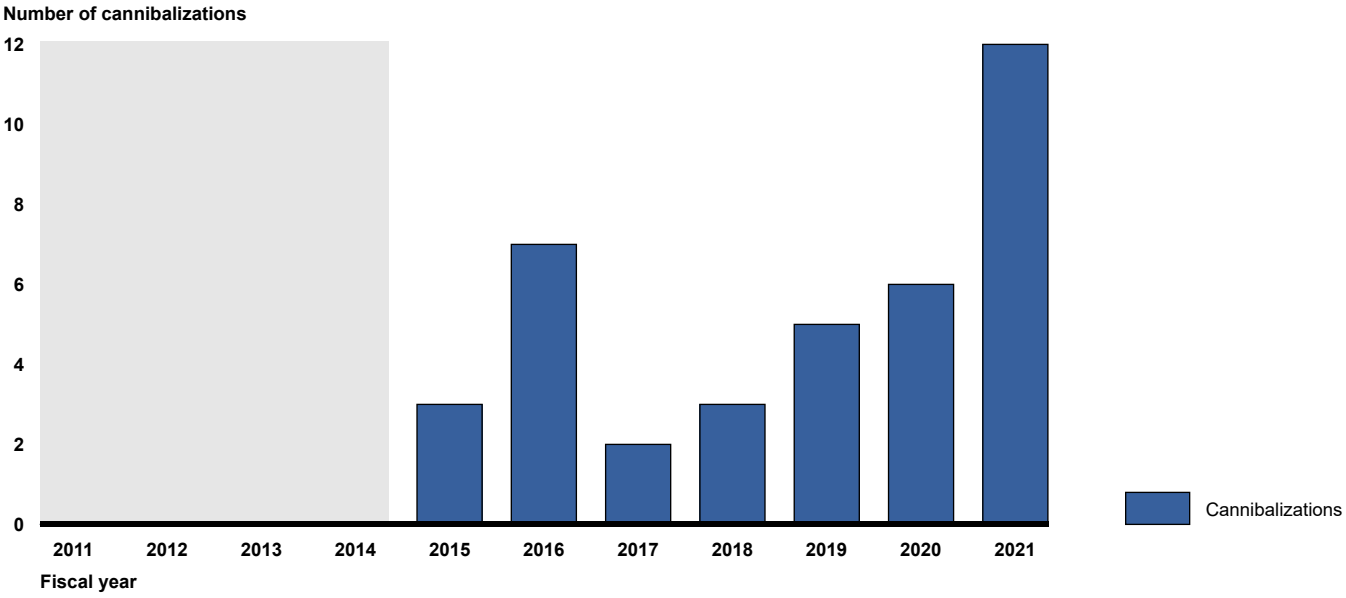
Trend in average cost per steaming hour
▲ Increased, *fiscal years 2011 to 2020*

Availability and Condition

Inventory



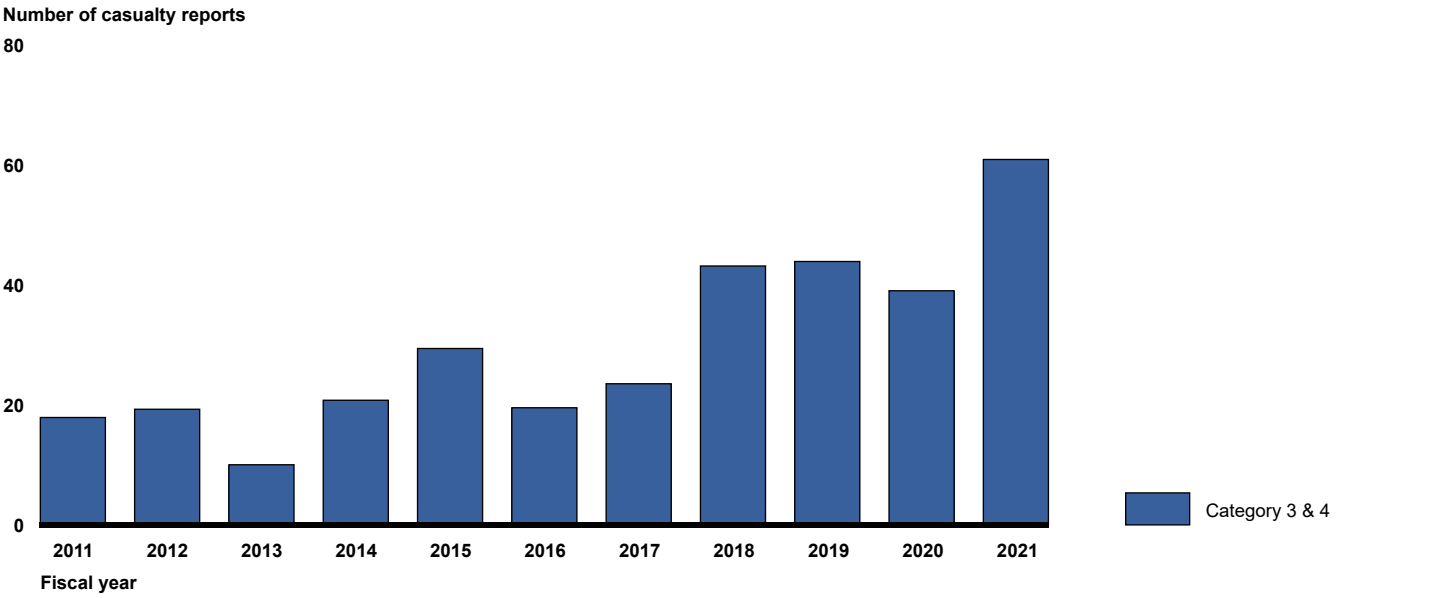
Cannibalizations per Ship



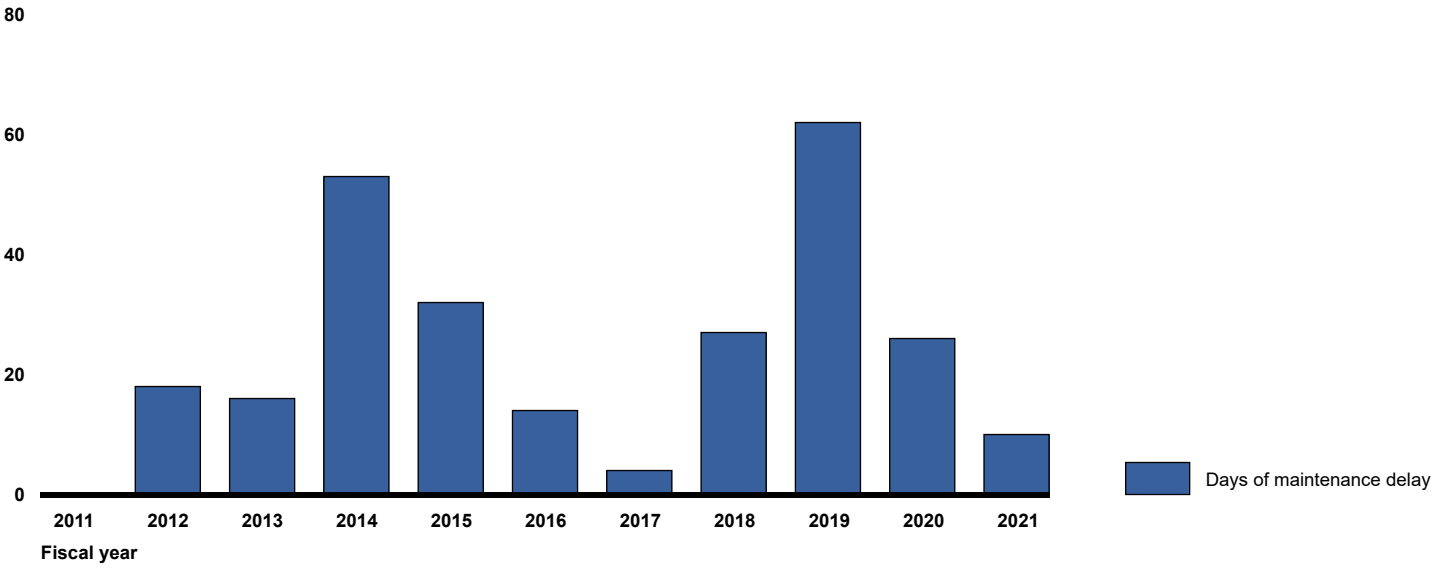
Note: According to the Navy, data for fiscal years 2011 through 2014 is incomplete and, therefore, not included in this graphic.

Availability and Condition

Casualty Reports per Ship

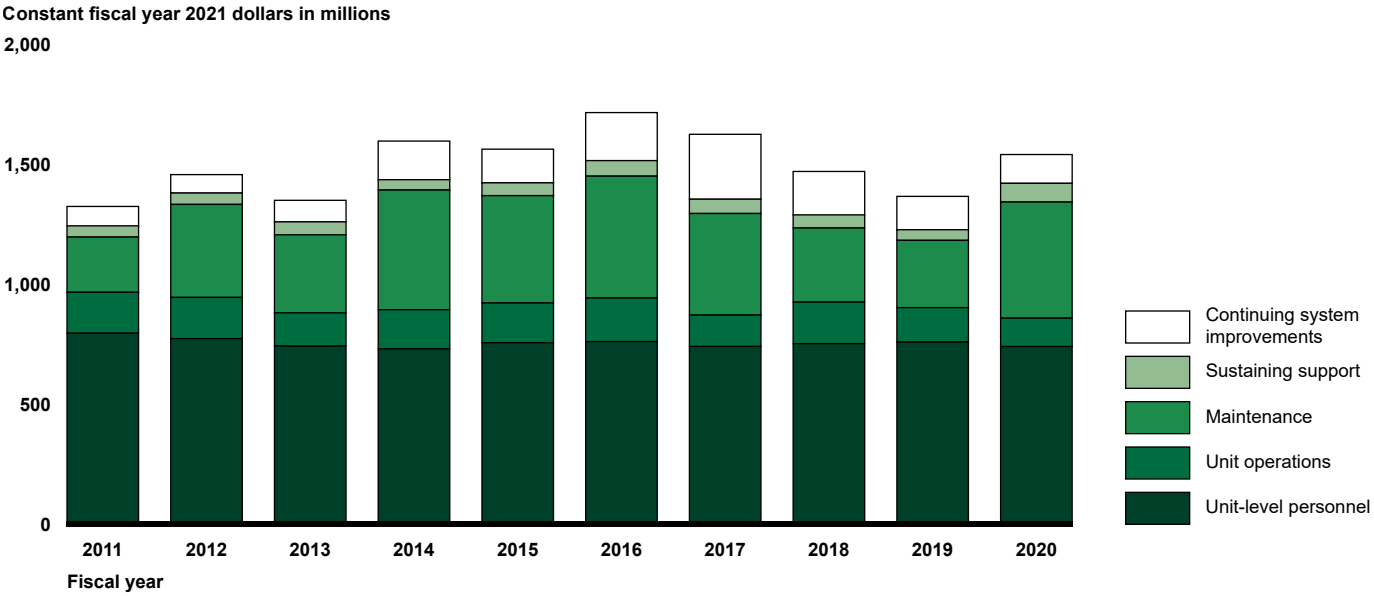


Days of Maintenance Delay per Ship

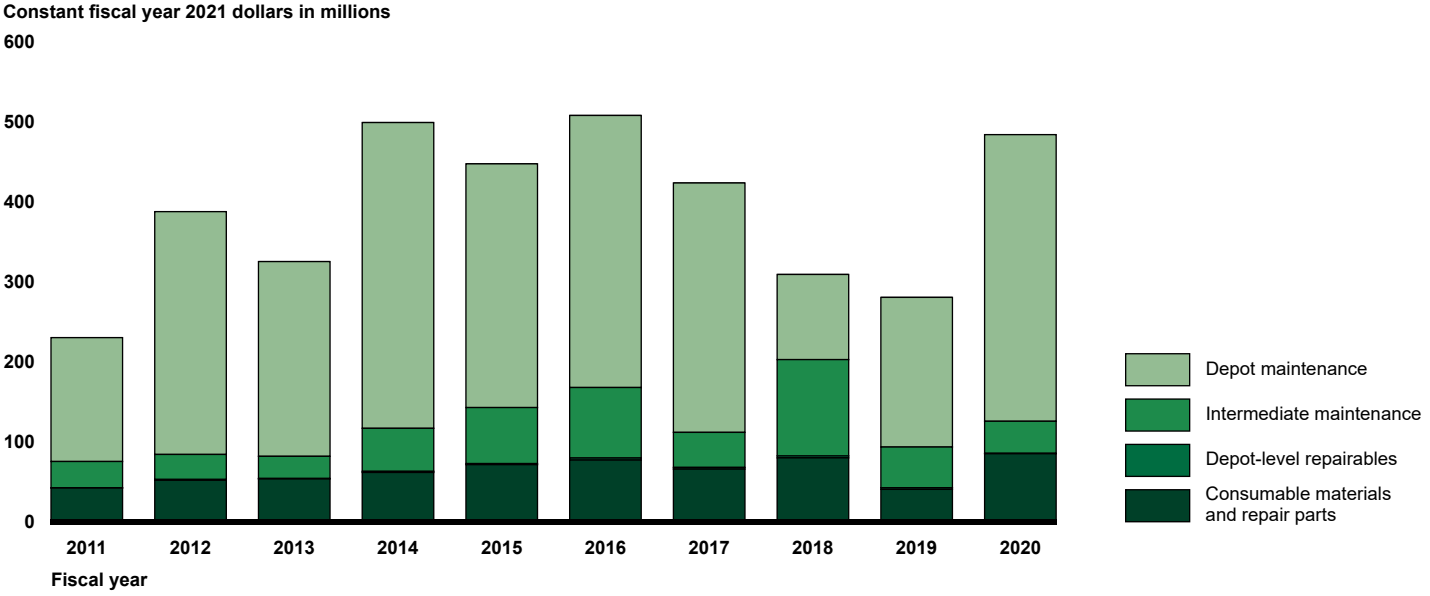


Operating and Support Costs

Total Operating and Support Costs



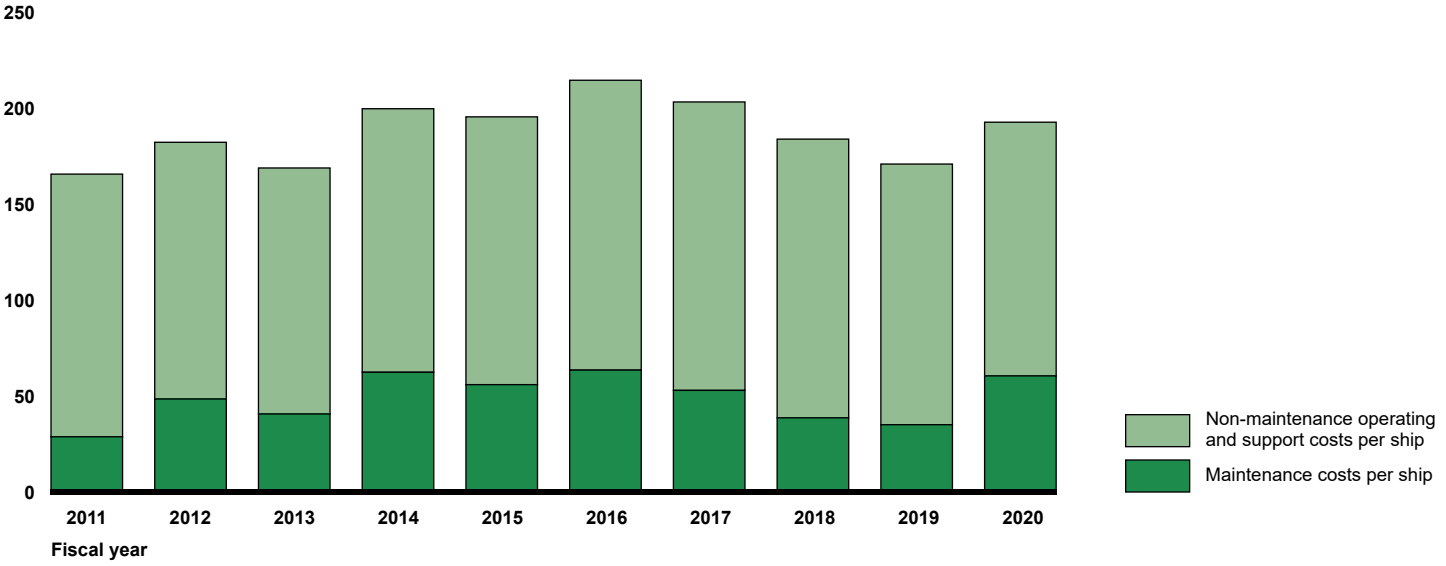
Maintenance Costs



Operating and Support Costs

Operating and Support Costs per Ship

Constant fiscal year 2021 dollars in millions



Sustainment Challenges

Aging ships

- Service life extension
- Unexpected repairs and replacement of parts

Maintenance

- Access to technical data
- Delays in depot maintenance
- Delays in intermediate maintenance
- Shortage of trained maintenance personnel
- Unscheduled maintenance

Supply support

- Diminishing manufacturing source
- Parts obsolescence
- Parts shortage and delay

Program Office Comments

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

LPD-17
San Antonio-class amphibious transport dock

Program Essentials

Manufacturer
Huntington Ingalls Industries Ingalls Shipbuilding (formerly Northrop Grumman Ship Systems Avondale Operations)

Sustainment
Ships' crews conduct organizational-level maintenance, while ships' crews and contractors at private shipyards conduct depot-level maintenance.

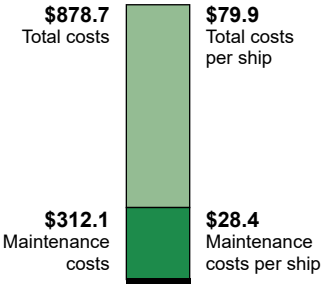
Depot maintenance locations
- San Diego, California
- Norfolk, Virginia
- Sasebo, Japan

The *San Antonio* class are amphibious transport docks, designed to transport Marines and their equipment and to allow them to land with helicopters, landing craft, and amphibious vehicles.

Service life
According to Navy officials, the lead *San Antonio*-class ship was first commissioned in 2006, and each ship has an estimated 40-year life span.

Sustainment Status, Fiscal Year 2021

Total operating and support costs in millions, 2020



Inventory
11
Ships

Cannibalizations
6
Cannibalizations per ship
No change from 2020

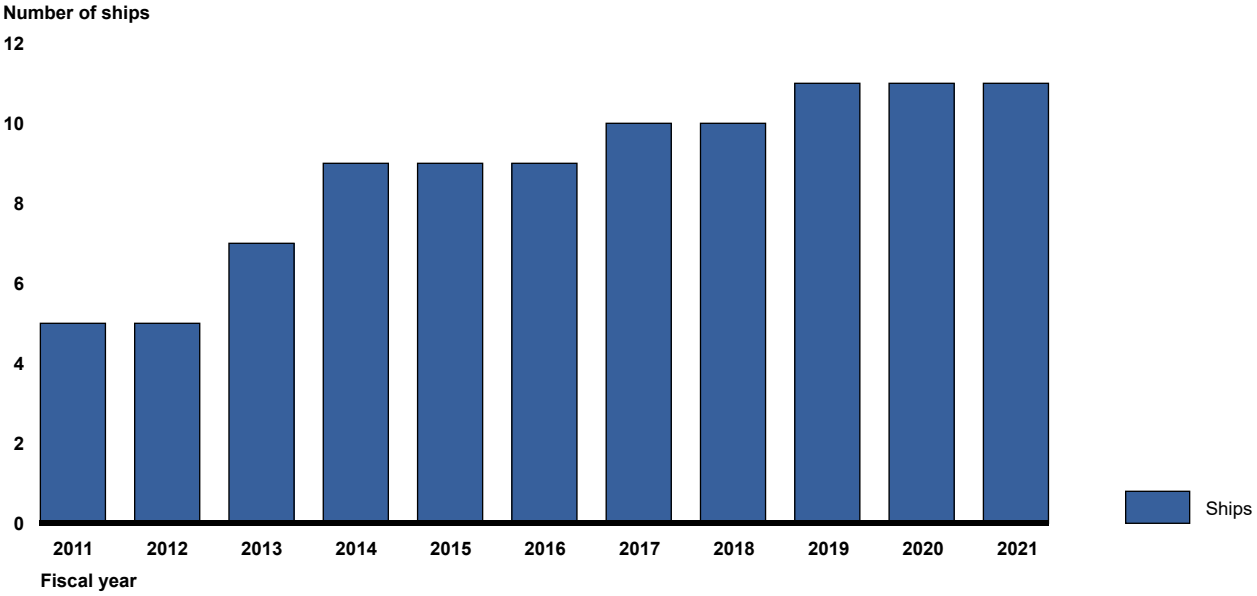
Maintenance delay
33
Days per ship
-25 from 2020

Casualty reports
34
Category 3 & 4 reports per ship
+9 from 2020

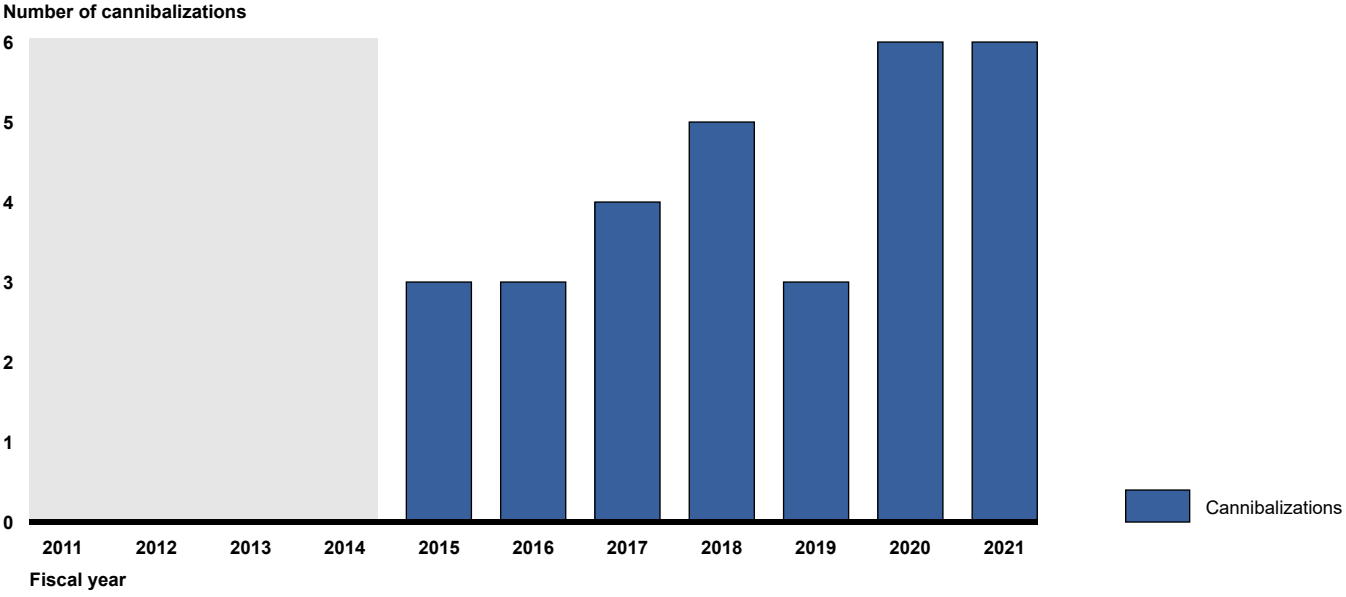
Trend in average cost per steaming hour
Increased, *fiscal years 2011 to 2020*

Availability and Condition

Inventory



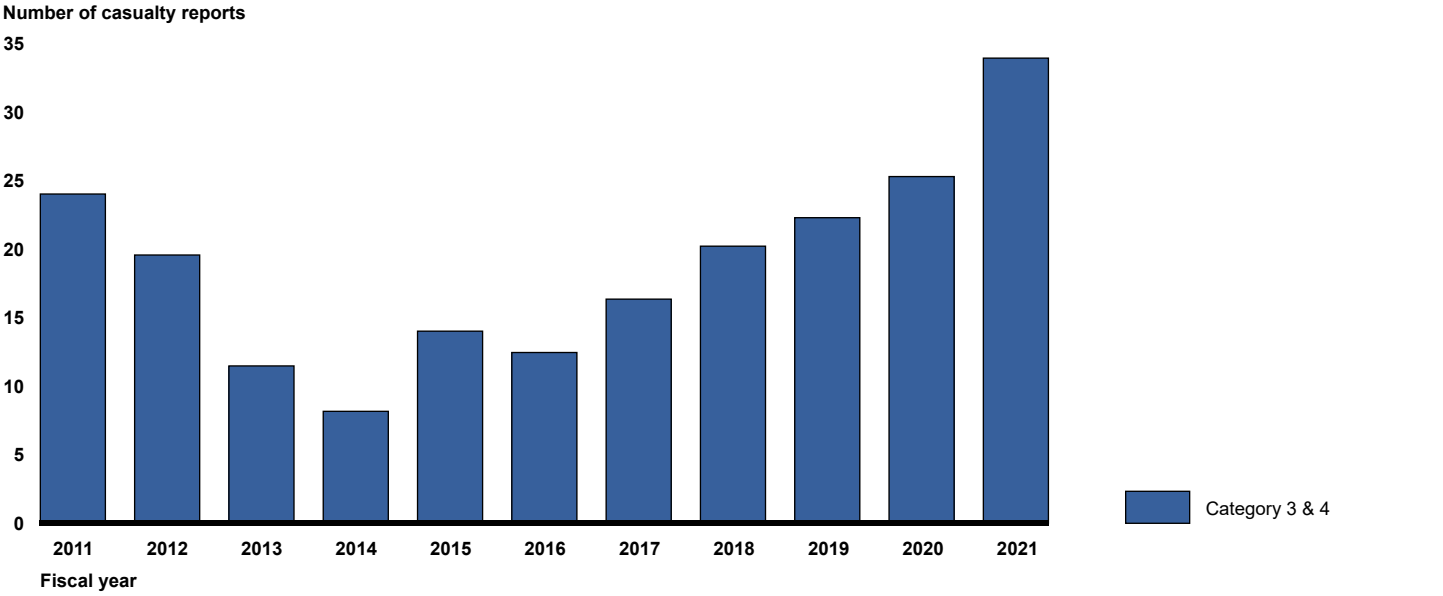
Cannibalizations per Ship



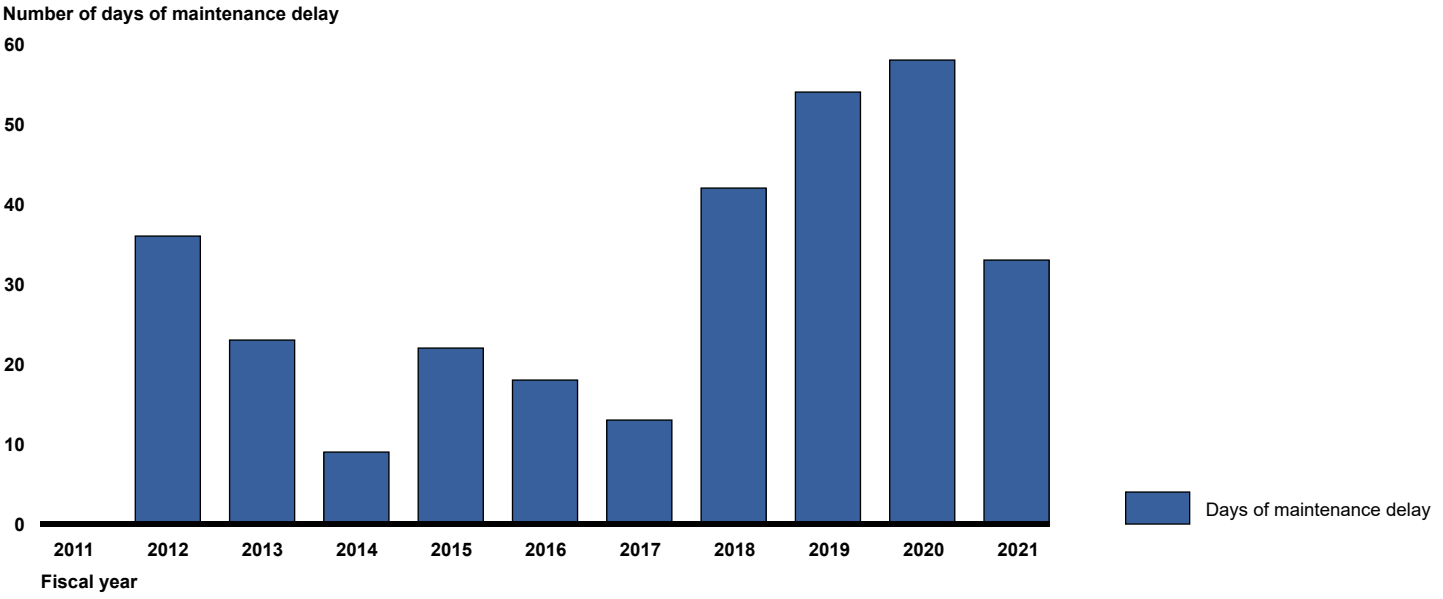
Note: According to the Navy, data for fiscal years 2011 through 2014 is incomplete and, therefore, not included in this graphic.

Availability and Condition

Casualty Reports per Ship

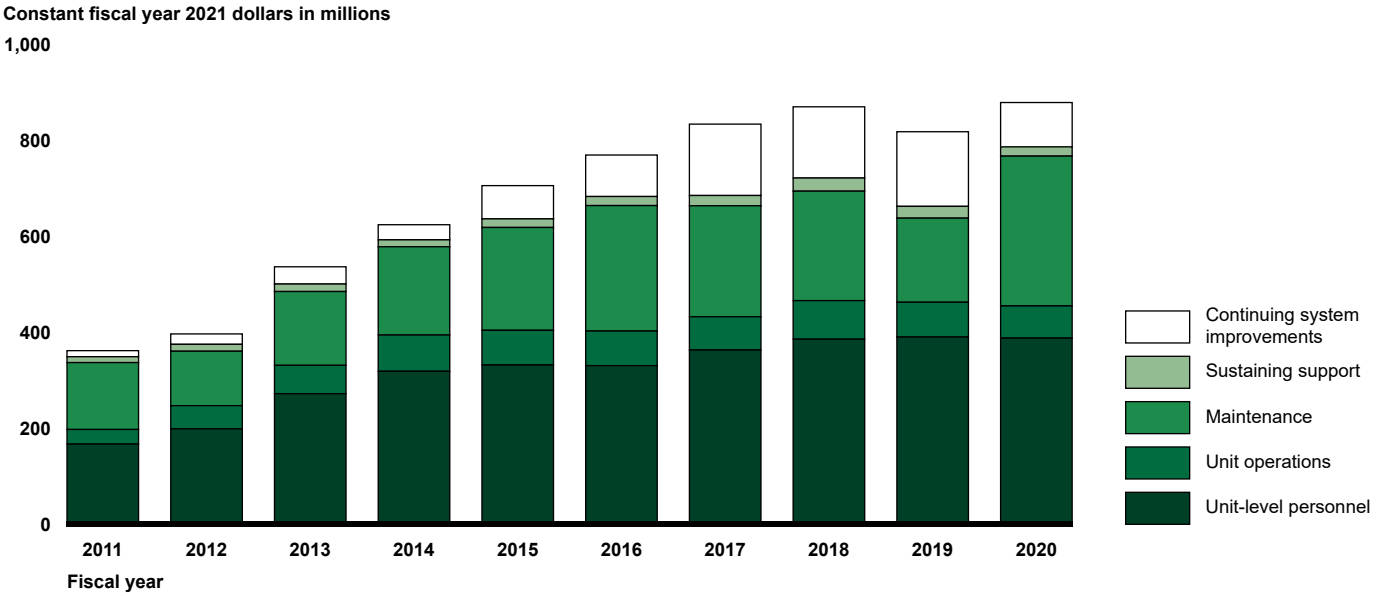


Days of Maintenance Delay per Ship

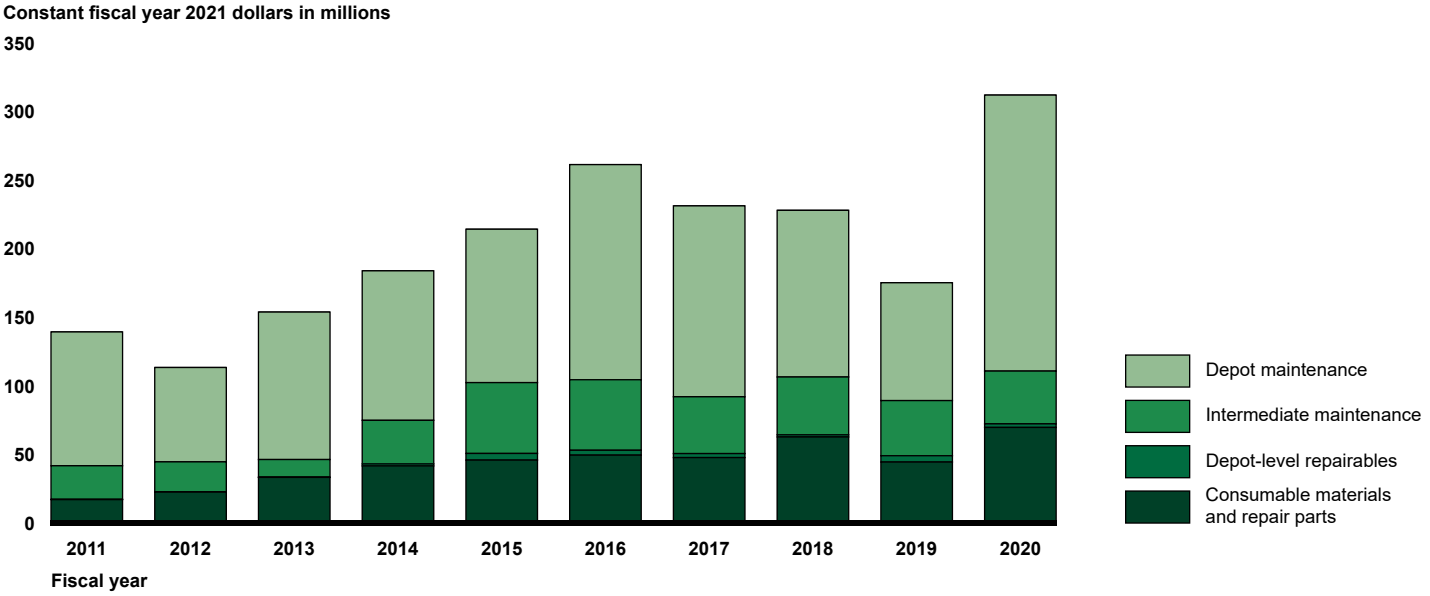


Operating and Support Costs

Total Operating and Support Costs

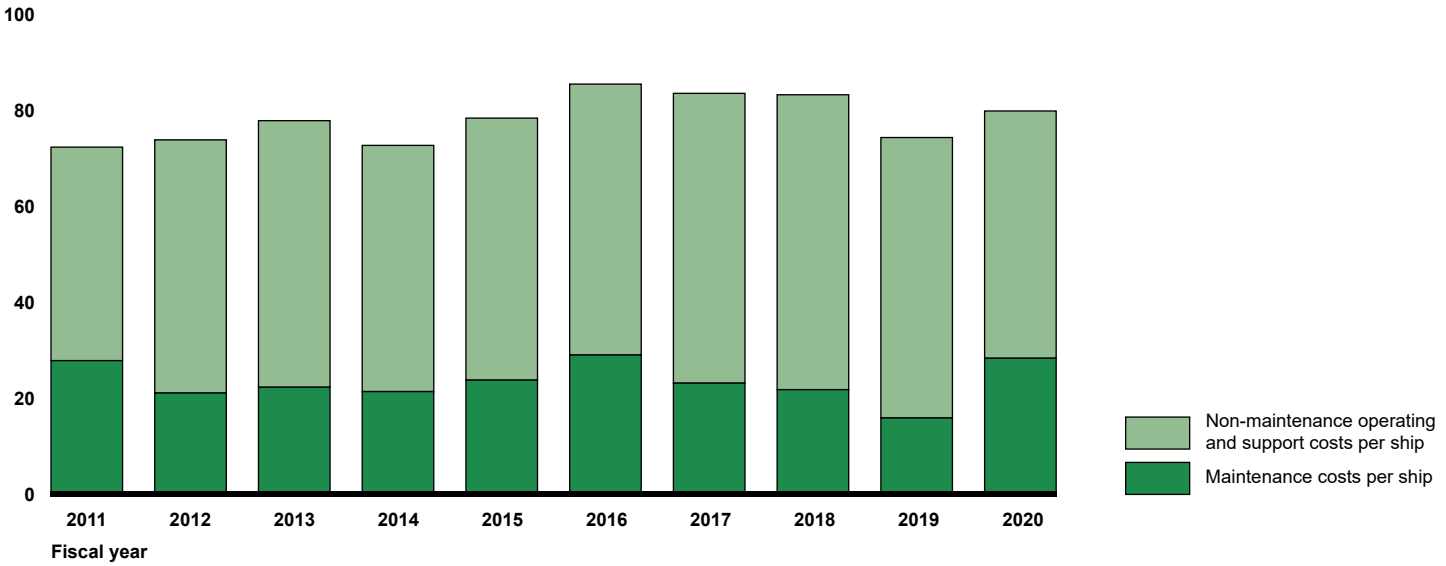


Maintenance Costs



Operating and Support Costs

Operating and Support Costs per Ship



Sustainment Challenges

Aging ships

- Service life extension
- Unexpected repairs and replacement of parts

Maintenance

- Access to technical data
- Delays in depot maintenance
- Delays in intermediate maintenance
- Shortage of trained maintenance personnel
- Unscheduled maintenance

Supply support

- Diminishing manufacturing source
- Parts obsolescence
- Parts shortage and delay

Program Office Comments

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

LSD-41
Whidbey Island-class dock landing ship

Program Essentials

Manufacturer
Lockheed Shipbuilding and Construction Company (now closed) and Avondale Industries (now closed)

Sustainment
Ships' crews conduct organizational-level maintenance, while ships' crews and contractors at private shipyards conduct depot-level maintenance.

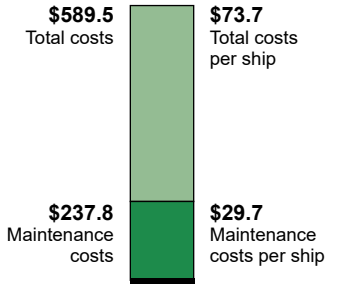
Depot maintenance locations
- San Diego, California
- Norfolk, Virginia
- Sasebo, Japan

Like the newer *Harpers Ferry* class, the *Whidbey Island* class are dock landing ships, the smallest class of amphibious warfare ships. They are designed to transport Marines and their equipment and to allow them to land with helicopters, landing craft, and amphibious vehicles.

Service life
According to Navy officials, the lead *Whidbey Island*-class ship was first commissioned in 1985 and each ship has an estimated 40-year life span. The Navy retired 2 ships from this class in fiscal years 2021 and 2022. In April 2022, the Navy outlined plans to retire the remaining 6 ships from fiscal years 2023 through 2026.

Sustainment Status, Fiscal Year 2021

Total operating and support costs in millions, 2020



Inventory
8
Ships

Cannibalizations
8
Cannibalizations per ship
+5 from 2020

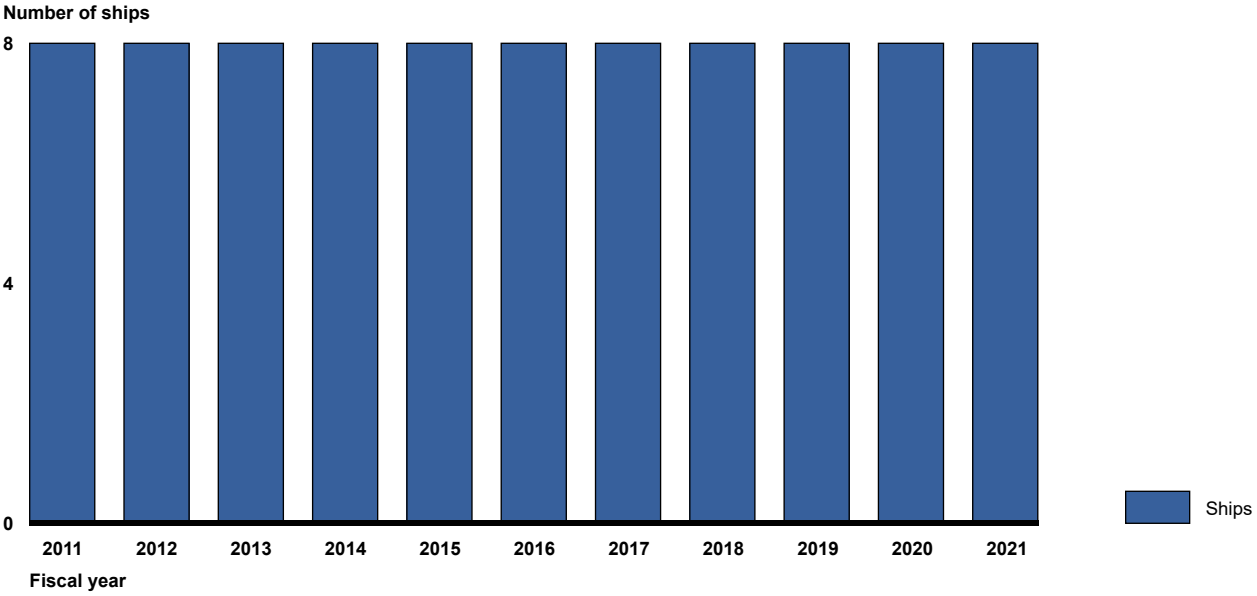
Maintenance delay
19
Days per ship
-30 from 2020

Casualty reports
44
Category 3 & 4 reports per ship
+30 from 2020

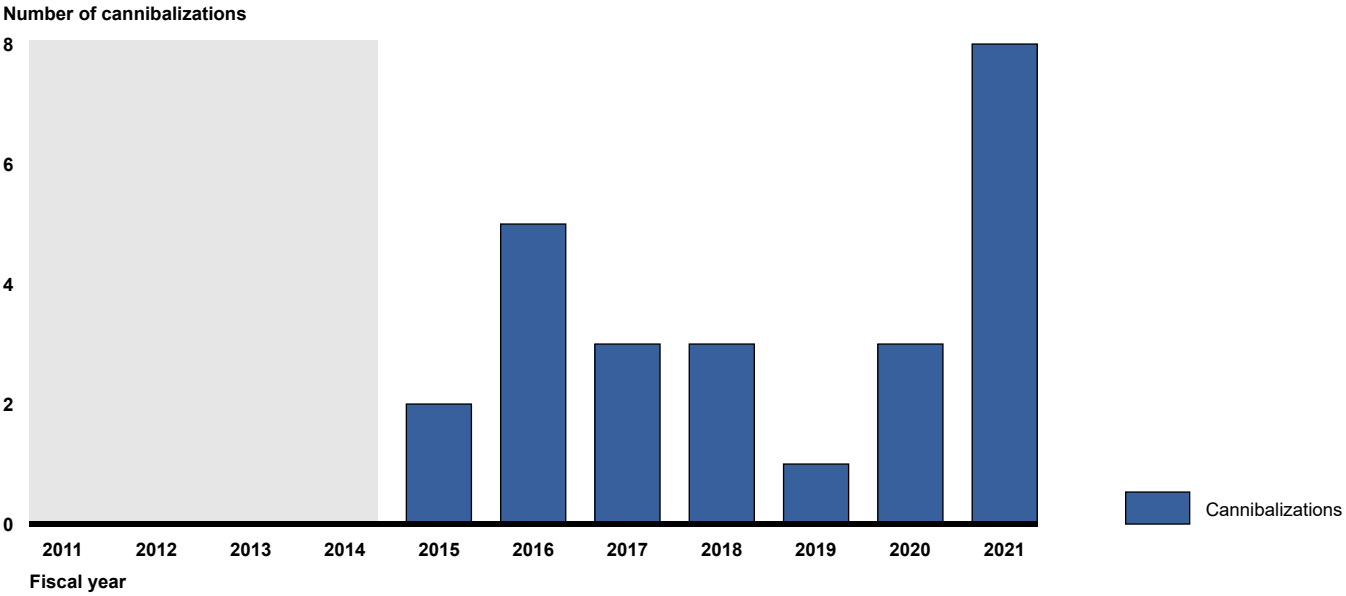
Trend in average cost per steaming hour
Increased, *fiscal years 2011 to 2020*

Availability and Condition

Inventory



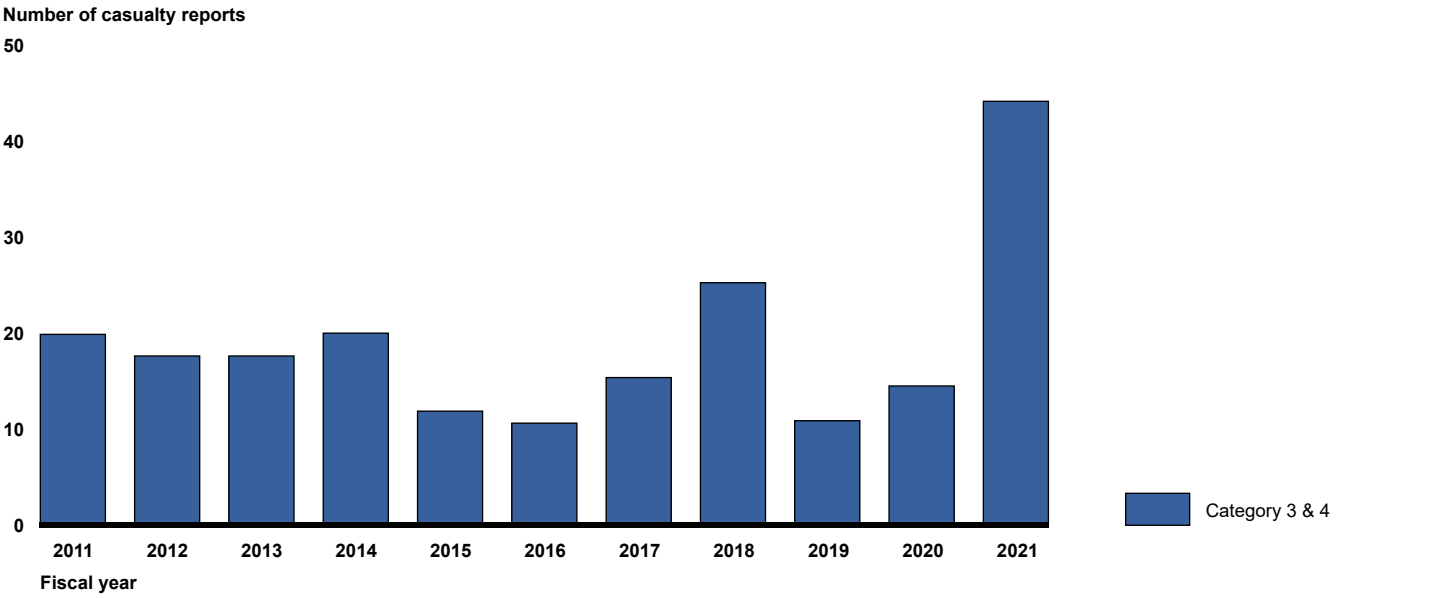
Cannibalizations per Ship



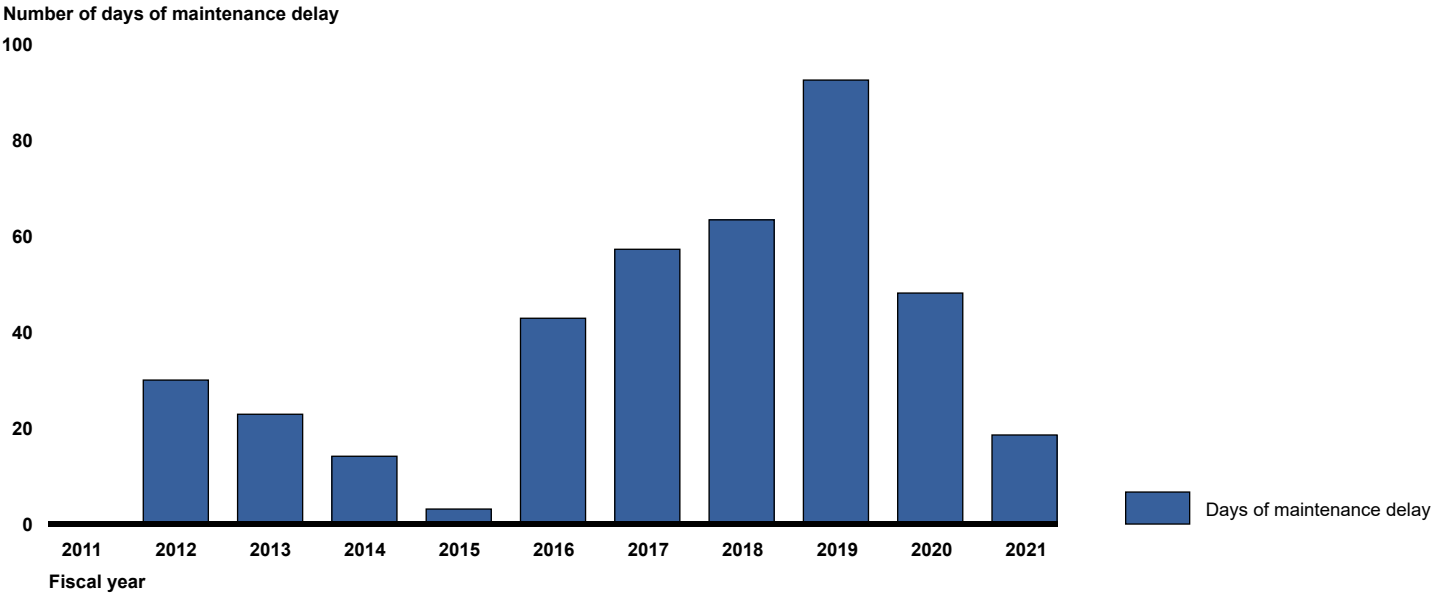
Note: According to the Navy, data for fiscal years 2011 through 2014 is incomplete and, therefore, not included in this graphic.

Availability and Condition

Casualty Reports per Ship

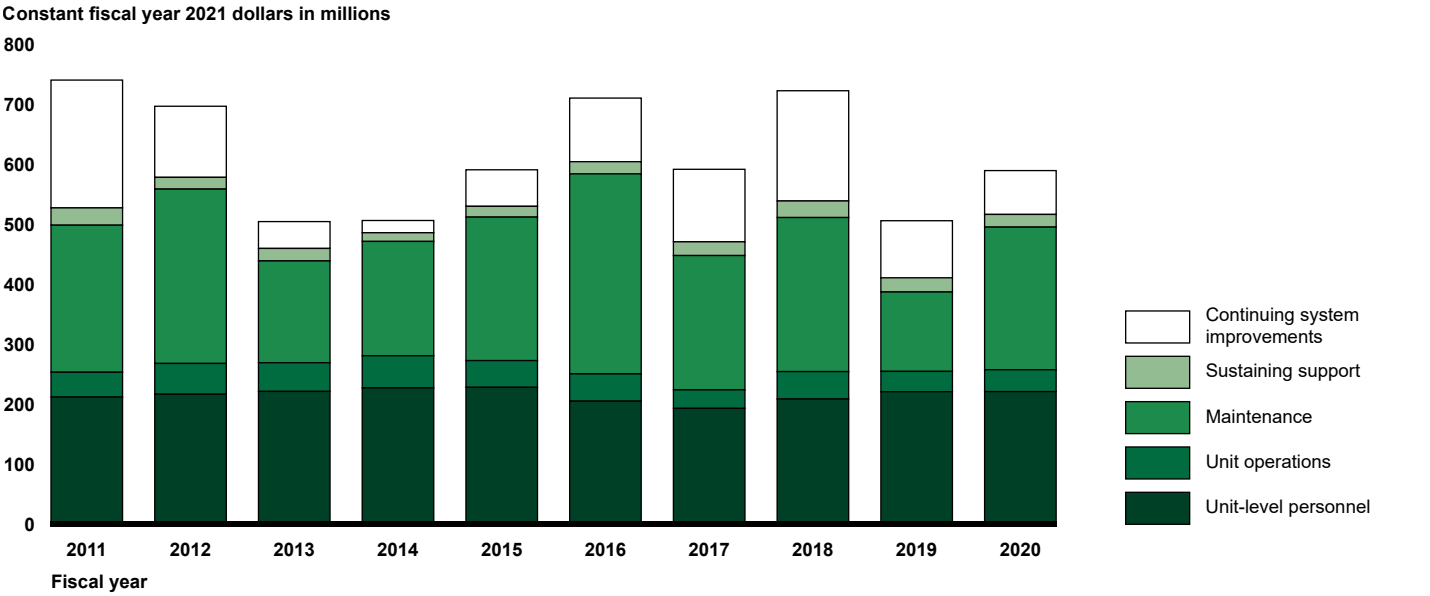


Days of Maintenance Delay per Ship

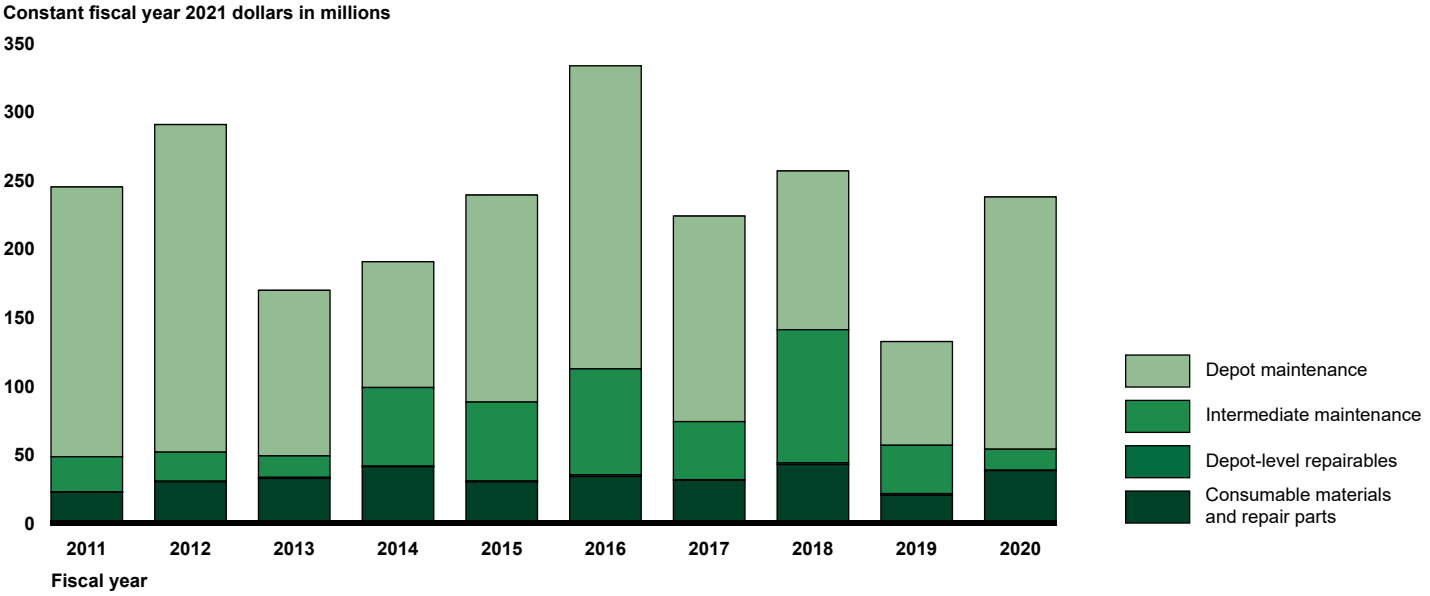


Operating and Support Costs

Total Operating and Support Costs

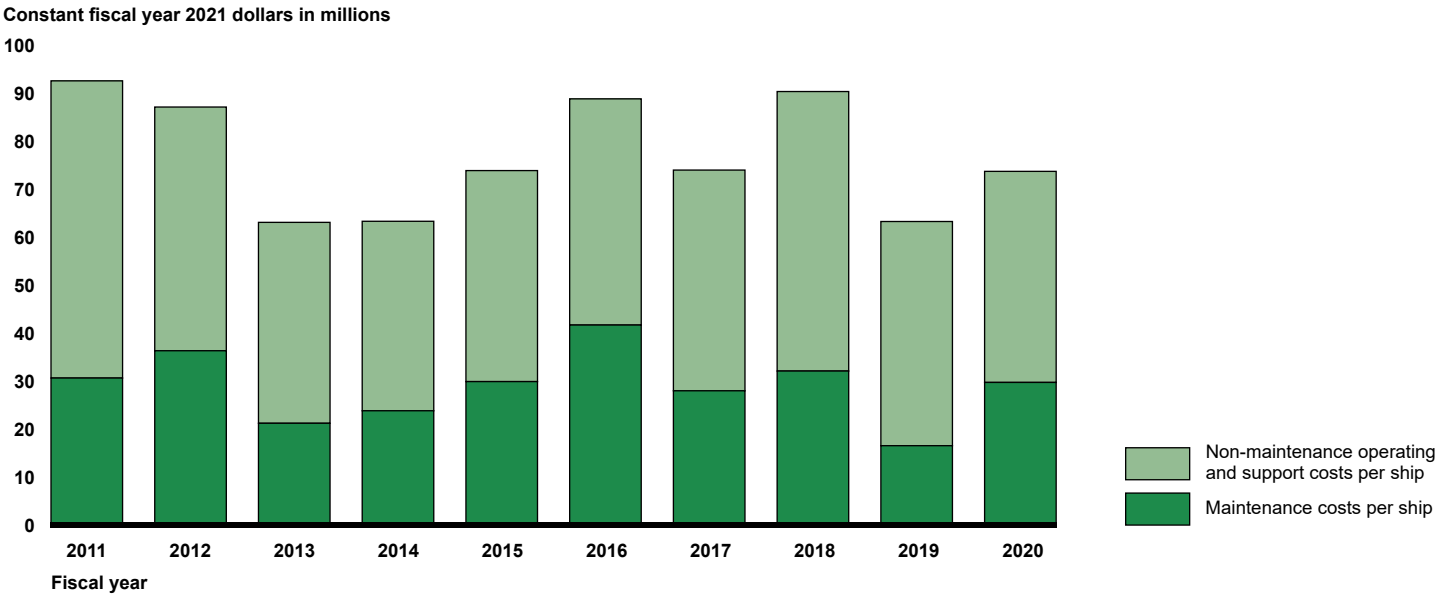


Maintenance Costs



Operating and Support Costs

Operating and Support Costs per Ship



Sustainment Challenges

Aging ships

- Service life extension
- Unexpected repairs and replacement of parts

Maintenance

- Access to technical data
- Delays in depot maintenance
- Delays in intermediate maintenance
- Shortage of trained maintenance personnel
- Unscheduled maintenance

Supply support

- Diminishing manufacturing source
- Parts obsolescence
- Parts shortage and delay

Program Office Comments

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

LSD-49
Harpers Ferry-class dock landing ship

Program Essentials

Manufacturer
Avondale Industries (now closed)

Sustainment
Ships' crews conduct organizational-level maintenance, while ships' crews and contractors at private shipyards conduct depot-level maintenance.

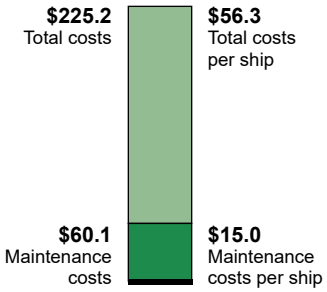
Depot maintenance locations
- San Diego, California
- Norfolk, Virginia

Like the older *Whidbey Island* class, the *Harpers Ferry* class are dock landing ships, the smallest class of amphibious warfare ships. They are designed to transport Marines and their equipment and to allow them to land with helicopters, landing craft, and amphibious vehicles.

Service life
The lead *Harpers Ferry*-class ship was first commissioned in 1995, and each ship has an estimated 40-year life span, according to Navy officials. In April 2022, the Navy outlined plans to retire all 4 ships of this class in fiscal years 2024 and 2025.

Sustainment Status, Fiscal Year 2021

Total operating and support costs in millions, 2020



Inventory
4
Ships

Cannibalizations
11
Cannibalizations per ship
+8 from 2020

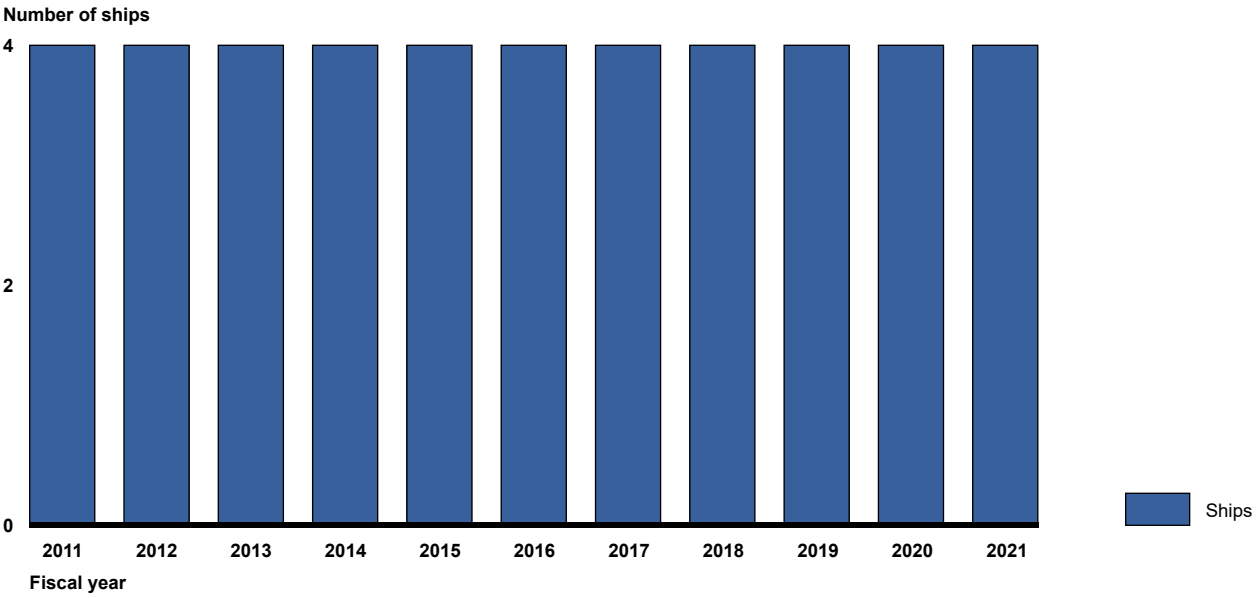
Maintenance delay
4
Days per ship
+4 from 2020

Casualty reports
19
Category 3 & 4 reports per ship
+4 from 2020

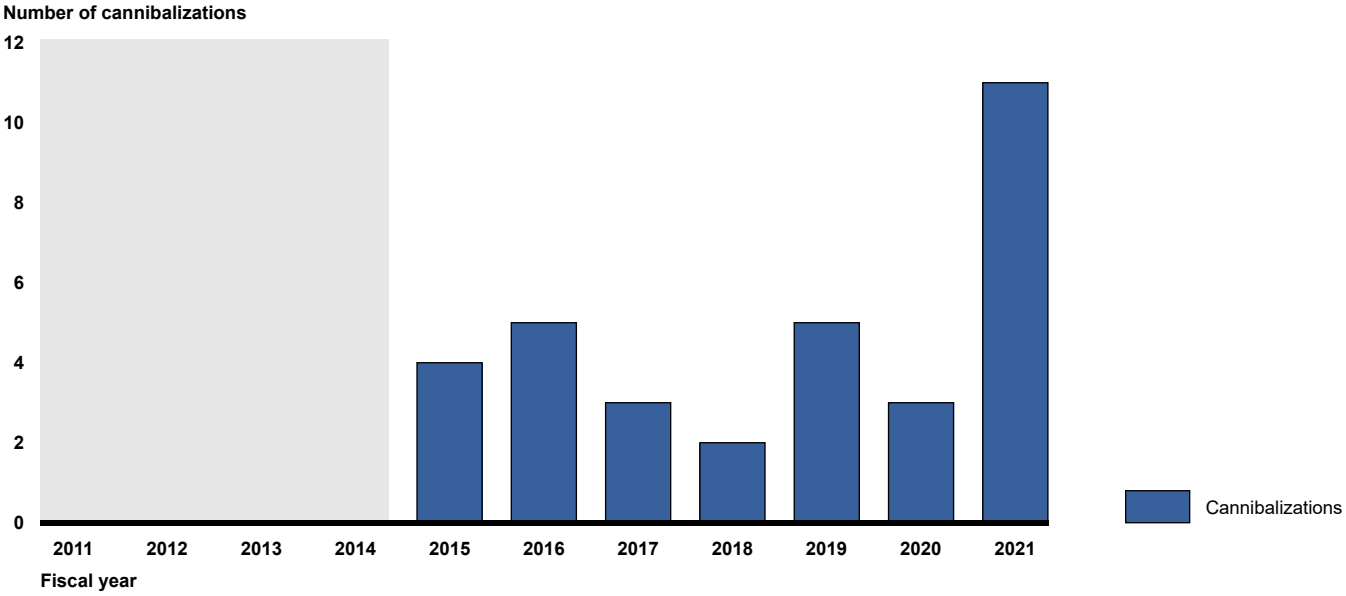
Trend in average cost per steaming hour
Decreased, *fiscal years 2011 to 2020*

Availability and Condition

Inventory



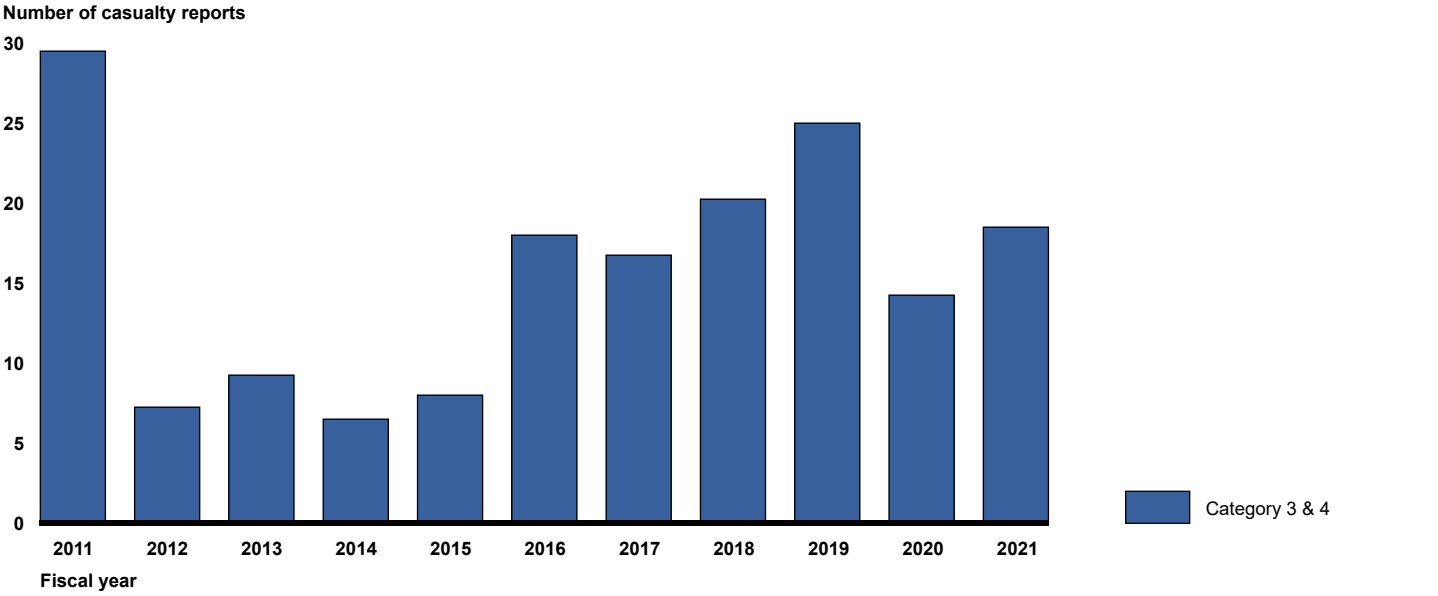
Cannibalizations per Ship



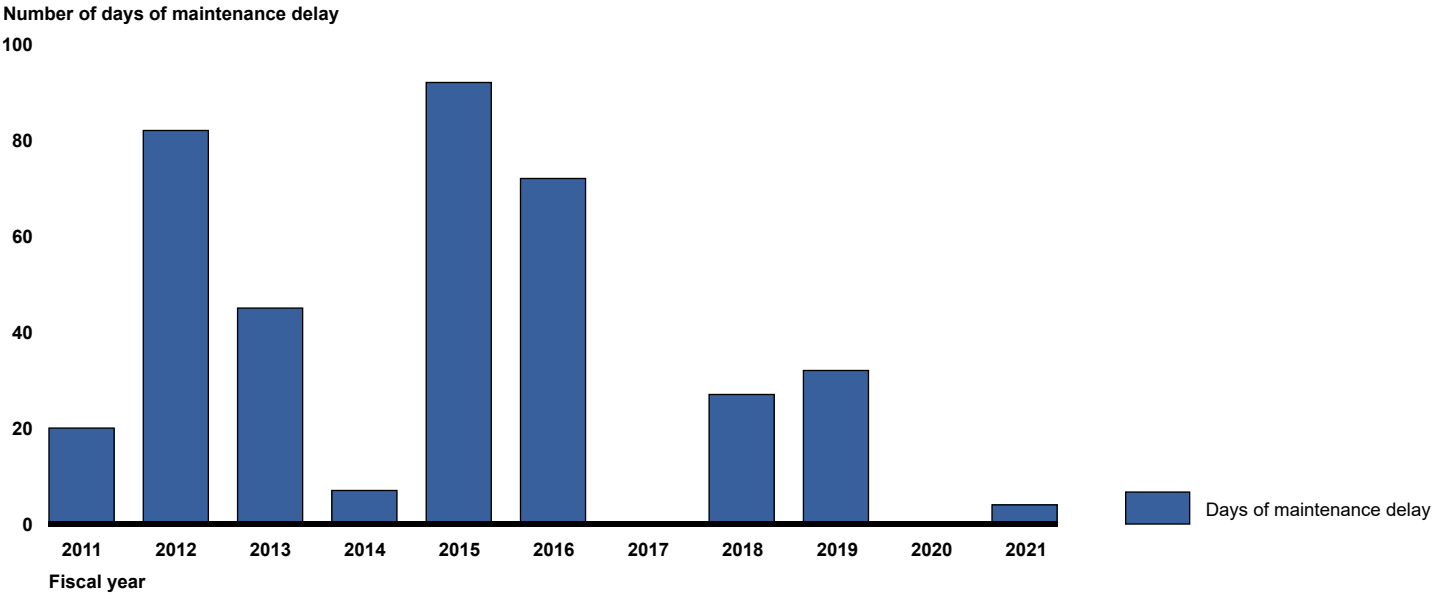
Note: According to the Navy, data for fiscal years 2011 through 2014 is incomplete and, therefore, not included in this graphic.

Availability and Condition

Casualty Reports per Ship

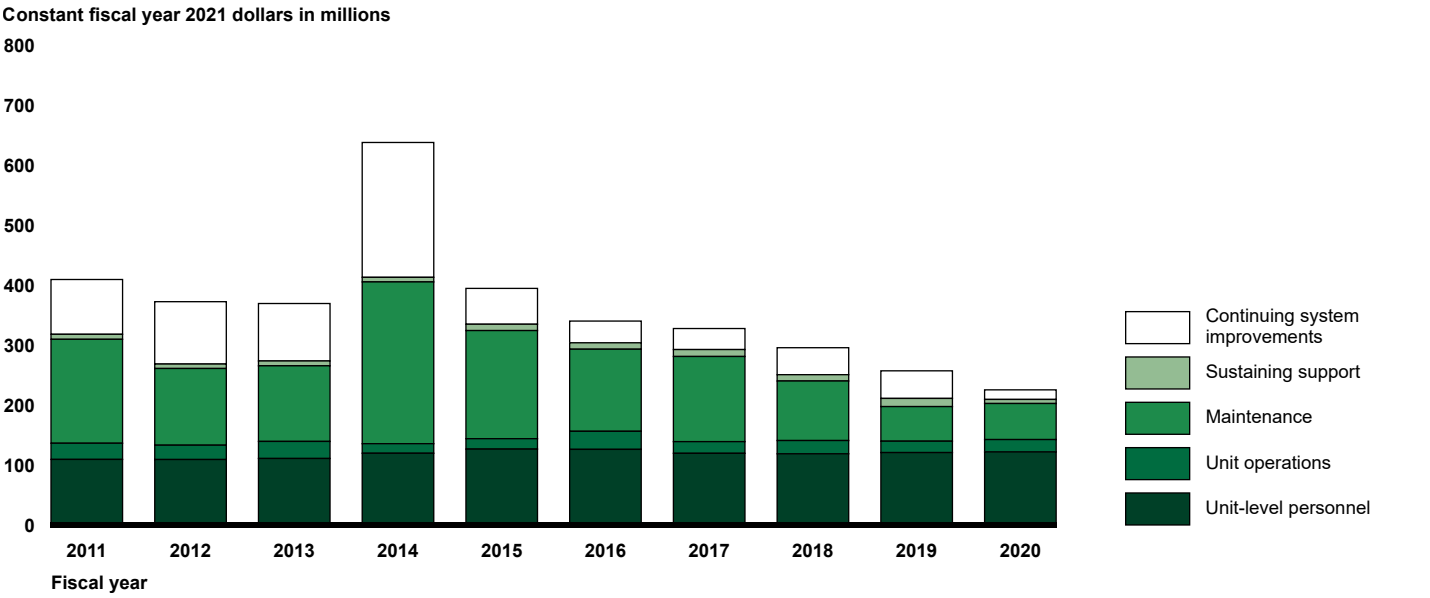


Days of Maintenance Delay per Ship

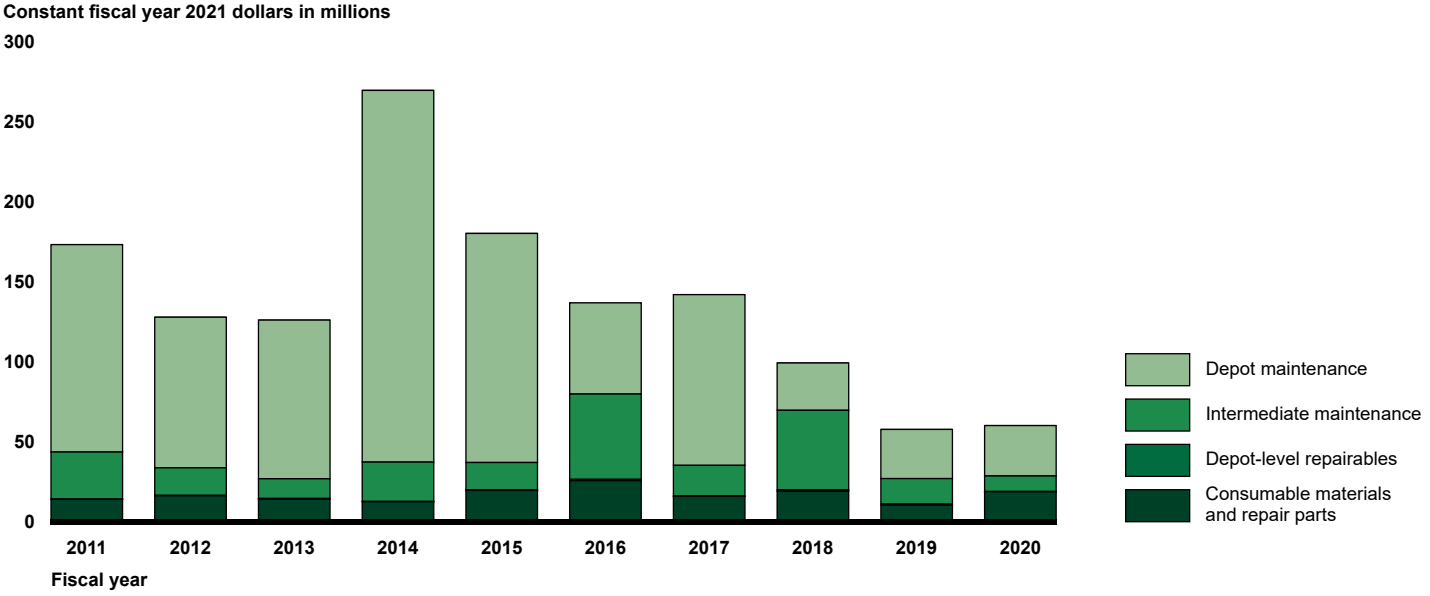


Operating and Support Costs

Total Operating and Support Costs

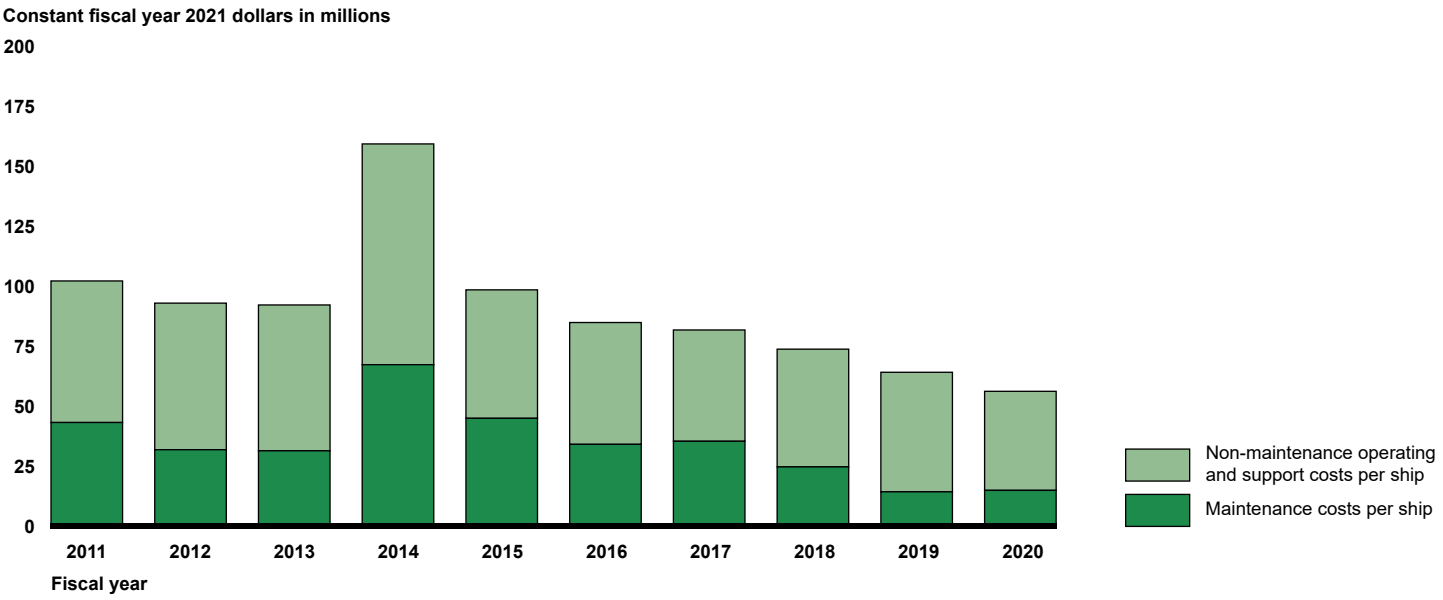


Maintenance Costs



Operating and Support Costs

Operating and Support Costs per Ship



Sustainment Challenges

Aging ships

- Service life extension
- Unexpected repairs and replacement of parts

Maintenance

- Access to technical data
- Delays in depot maintenance
- Delays in intermediate maintenance
- Shortage of trained maintenance personnel
- Unscheduled maintenance

Supply support

- Diminishing manufacturing source
- Parts obsolescence
- Parts shortage and delay

Program Office Comments

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

Agency Comments

We provided a draft of this report to DOD for review and comment. DOD provided a response, reproduced at appendix III, which acknowledged its receipt and review of the report. DOD also provided technical comments, which we incorporated as appropriate.

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

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

Diana Maurer
Director, Defense Capabilities and Management

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The Honorable Adam Smith
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House of Representatives

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Appendix I: Objectives, Scope, and Methodology

This report examines (1) the trends in key sustainment metrics for selected ship classes during fiscal years 2011 through 2021; and (2) the trends in costs to operate and support the selected ship classes since fiscal year 2011.

In addition, we provide "Sustainment Quick Looks" for each of the 10 ship classes included in our review. These "Sustainment Quick Looks" include detailed information on sustainment metrics, ship inventory changes, and operating and support (O&S) costs experienced by each ship class during the period of fiscal years 2011 through 2021.[1]

This report is a public version of a sensitive report that we issued in December 2022. The Department of Defense deemed some of the information—specifically detailed data associated with the number of steaming hours conducted by the ship classes—in our December report sensitive, which must be protected from public disclosure. Therefore, this report omits this detailed information. Although the information provided in this report is more limited, the report addresses the same objectives as the sensitive report and uses the same methodology.

To conduct our review, we selected the following 10 ship classes that represent a large portion of the Navy's total ship population which includes aircraft carriers, cruisers, destroyers, littoral combat ships, submarines, amphibious warfare, mine warfare, combat logistics, and fleet support ships.[2] Specifically, as of November 2022, the selected ship classes represented about 153 of the Navy's total ship battle force of 292, and additional ships from some of the ship classes we examined were in production.[3] Included in our review are 10 ship classes, including nine classes of surface ships and the *Nimitz*-class aircraft carriers:

- Aircraft Carriers

[1]We analyzed O&S cost data for fiscal years 2011 through 2020, the last fiscal year for which complete data were available at the time of our review.

[2]For the purposes of our review, we are treating the two Littoral Combat Ships—the *Freedom* (odd-numbered hulls of LCS) and *Independence* (even-numbered hulls of LCS)—as separate ship classes given their differences. The two variants have significantly different designs and configurations and are manufactured by different shipbuilders. Additionally, we found that readiness and cost trends between the two variants also differed.

[3]For our initial ship sustainment quick look, we focused on surface ships and did not include submarines, combat logistics, and other support ships in our review. As of October 2022, the Navy has 68 submarines in its battle force.

  - CVN-68 *Nimitz*-class aircraft carrier
- Surface Combatants
  - CG-47 *Ticonderoga*-class cruiser
  - DDG-51 *Arleigh Burke*-class destroyer
  - LCS-1 *Freedom*-class littoral combat ship
  - LCS-2 *Independence*-class littoral combat ship
- Amphibious Warfare Ships
  - LHA-6 *America*-class amphibious assault ship
  - LHD-1 *Wasp*-class amphibious assault ship
  - LPD-17 *San Antonio*-class amphibious transport dock
  - LSD-41 *Whidbey Island*-class dock landing ship
  - LSD-49 *Harpers Ferry*-class dock landing ship

For objective one, we worked with the Navy to identify those metrics key to sustainment to understand ship usage and maintenance and any goals used to track performance related to the metrics. We focused on sustainment metrics that the Navy agreed are key to ship readiness—steaming hours, maintenance cannibalizations, category 3 and 4 casualty reports, depot maintenance delays, operational availability, and materiel availability. We then collected and analyzed data from the Navy on those key sustainment metrics for each of the 10 ship classes, including maintenance availability schedules and casualty reports and cannibalization rates for fiscal years 2011 through 2021.[4] We also obtained information from program office officials and our issued work regarding the reasons for changes in sustainment metrics as well as any challenges in sustaining these ships.

For objective two, we collected and analyzed O&S data from the Department of the Navy's cost reporting system, the Navy Visibility and Management of Operating and Support Costs system (VAMOSC). Specifically, we collected O&S cost data for fiscal years 2011 through 2020, the last fiscal year for which complete data were available at the time of our work. Not all O&S cost elements were available for fiscal year 2021, such as consumable materials and repair parts, so we excluded

[4]Casualties are events that impair, to varying degrees, a ship's ability to accomplish its primary mission. Cannibalization refers to the removal of serviceable material or components from one piece of equipment for installation into another to restore the latter to an operational condition.

this year from our analysis. To understand the effect that factors such as fleet size and usage could have on ship costs, we analyzed O&S and maintenance costs on a fleet-wide, per-ship, and per-steaming hour basis. For our analysis of cost trends, we chose to report data on a per-ship and per-steaming hour basis to account for changes in fleet size and ship usage over the period. We also obtained information through questionnaire responses from program office officials about the reasons for changes and trends in O&S costs. We requested the Navy provide this data using constant fiscal year 2021 dollars to inflate all years to ensure inflation was factored in.

To develop the Sustainment Quick Looks for each ship class, we obtained historical and current information, including the number of ships in the inventory, manufacturers, depot maintenance locations, and key dates in the life cycle of each ship class (the year the Navy commissioned the lead ship, the year production will cease, and the year the class will be retired). We used this information, as well as the information collected for objectives one and two on sustainment metrics and O&S costs, in each Sustainment Quick Look. In the Quick Looks, we show sustainment metrics for fiscal years 2011 through 2021 and illustrate how those metrics have changed over that timeframe. We also analyzed O&S costs and compared the costs to changes in ship inventory and steaming hours. Through reviewing questionnaire responses and interviews with knowledgeable program office officials, we identified sustainment challenges and mitigation actions the Navy is taking to address these challenges.

We conducted data-reliability assessments of the data provided. To do this, we reviewed related documentation; held interviews with knowledgeable agency officials; and performed electronic data testing for missing data, outliers, and obvious errors. Additionally, we shared the sustainment metrics and O&S cost data with the program offices that manage each ship class for review and comment, to ensure the accuracy of the data being presented. As a result, we determined these data to be sufficiently reliable for the purposes of summarizing trends in key sustainment metrics and O&S costs since fiscal year 2011.

We conducted the performance audit upon which this report is based from March 2021 to December 2022 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate, evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a

reasonable basis for our findings and conclusions based on our audit objectives. We subsequently worked with DOD from December 2022 to January 2023 to prepare this public version of the original sensitive report for release. We also prepared this public version in accordance with these standards.

Appendix II: Navy Actions to Address Depot Maintenance Delays

According to information provided to us by Navy officials, the Navy began an initiative in fiscal year 2019 called Performance to Plan that, among other goals, is intended to address depot maintenance delays. Navy officials told us they have used Performance to Plan to identify drivers of maintenance delays across the fleet. Private shipyards perform maintenance for the nine surface ship classes included in our review. Navy officials also outlined the following mitigating actions they were taking to address the following drivers of depot maintenance delays:

- **Workload planning based on past performance:** One driver of delays is that private shipyards do not have the capacity to fully accomplish maintenance within the planned schedule, according to program officials. To mitigate the issue, Navy officials told us they were using an Availability Duration Scorecard. The scorecard allows them to set maintenance schedules based on how long that private shipyard took to perform similar work in the past. Officials said NAVSEA coordinates with Type Commanders and operating personnel to maintain steady workload levels at each port to sustain the workforce while not overburdening port capacity.
- **Unexpected work, late addition of new work:** Officials told us that all nine surface ship classes experienced delays caused by two factors: the growth in magnitude of previously planned work, and the identification of the need for new work that was not previously planned. We previously reported that growth and new work contributed to surface ship depot maintenance delays.[1] We reported that the Navy considered the addition of work requirements after a contract was awarded to be the key cause of delays at the private shipyards. We also noted that problems with growth and new work are not new as we reported in 2016 that the Navy has struggled to accommodate growth and new work since at least 2011.[2]

  To mitigate the effects of these issues, the Navy uses Directed Maintenance Strategy and class maintenance plans to predict the duration and extent of future repairs while planning maintenance periods, according to officials. In addition, the Navy performs assessments to identify and mitigate growth and new work and includes estimated growth work in the contract specifications so it can be planned for and funded in advance, officials stated. Further, the

[1]GAO, *Navy Maintenance: Navy Report Did Not Fully Address Causes of Delays or Results-Oriented Elements*, GAO-21-66 (Washington, D.C.: Oct. 29, 2020).

[2]GAO, *Military Readiness: Progress and Challenges in Implementing the Navy's Optimized Fleet Response Plan,* GAO-16-466R (Washington D.C.: May 2, 2016).

Navy has been requiring leadership review before new work can be accepted and added, according to program officials.

- **Material delays:** When material needed to repair a ship is delivered late, it can lead to additional delays that make it challenging to accomplish maintenance according to schedule, according to Navy officials.[3] To mitigate material delays, Navy officials stated they have taken several steps, including creating a new directorate within NAVSEA to identify and stock reoccurring long lead time materials before they are needed. In 2016, we reported that DOD and the Navy had not conducted business case analyses on the benefit of additional transfers of inventory management functions for supply, storage, and distribution at the Navy shipyards to the Defense Logistics Agency (DLA) even though there were demonstrated improvements with such transfers at Navy and Air Force aviation-maintenance depots.[4] We recommended that DOD, DLA, and the Navy assess the costs and benefits through a comprehensive business case analysis for DLA to manage these inventory management functions. DOD concurred with this recommendation. However, as of March 2022, DOD has not completed a comprehensive business case analysis. Without DOD completing a business case analysis, decision-makers will not be positioned to make cost-effective decisions ensuring materiel availability at the time of need.
- **Adequate time between contract award and the start of maintenance:** According to Navy officials, contract awards should occur no later than 120 days before the start of maintenance to allow sufficient time for contractors to adequately perform production planning, develop an integrated production and test schedule, and procure material not requiring a long lead time. The officials stated that Performance to Plan has determined a relationship between contract awards that occur after that targeted timeframe and depot availability delays. To address contract-related delays, the Navy has taken steps to award contracts earlier, including moving all planning milestones earlier and implementing a review process during the contracting process to reduce delays, according to program officials.

[3]Information provided by Navy officials indicates material delivered more than 30 days after being ordered is considered late.

[4]GAO, *Defense Inventory: Further Analysis and Enhanced Metrics Could Improve Service Supply and Depot Operations*, GAO-16-450 (Washington, D.C.: June 9, 2016). We continue to track this report as part of our annual report on fragmentation, overlap, and duplication in the federal government. See GAO, *2022 Annual Report: Additional Opportunities to Reduce Fragmentation, Overlap, and Duplication and Achieve Billions of Dollars in Financial Benefits*, GAO-22-105301 (Washington, D.C.: May 11, 2022).

Also, officials noted they were developing new acquisition strategies, such as including grouping multiple availabilities with similar work scope into a single contract.

- **Improvements in maintenance schedules:** Officials said timely and accurate integrated production schedules were important so both the Navy and contractors can gauge overall progress against their planned schedule and so they can direct resources to mitigate delays. Under NAVSEA requirements, private shipyard contractors are required to maintain an integrated maintenance schedule and to update them weekly as maintenance is being performed, program officials stated. To improve the timeliness and accuracy of these schedules, NAVSEA's Commander, Navy Regional Maintenance Center has implemented a weekly review and evaluation process to ensure schedules meet NAVSEA's minimum requirements, according to Navy officials.[5]

The factors described in this section represent causes of delays at contracted private shipyards for the nine surface ship classes we examined. Although aircraft carriers are not maintained at private shipyards, we have reported that the Navy had difficulty completing aircraft carrier depot maintenance on time at the Navy's four public shipyards.[6] Specifically, we reported in 2020 that the Navy had been late on more than half—10 of 18—of the aircraft carrier maintenance periods from fiscal years 2015 through 2019. Our analysis found that the main causes of these delays were unplanned work—growth work and new work—as well as inadequate capacity, capability, and prioritization of the shipyard workforce.

Navy officials told us that while they generally believed there was sufficient capacity at the Navy's public shipyards to maintain *Nimitz*-class ships, they faced depot maintenance challenges due to growth and new work. Officials said they were also using Performance to Plan and the Naval Sustainment System-Shipyards Initiatives to mitigate maintenance delays on *Nimitz*-class ships. The Navy has taken positive steps to

[5]Commander, Navy Regional Maintenance Center (CNRMC) is a Naval Sea Systems (NAVSEA) command field activity, headquartered in Norfolk, Va. The command operates the Navy's four Regional Maintenance Centers (RMCs) and two detachment sites in their execution of surface ship maintenance and modernization. Their primary focus in surface maintenance is providing combat-ready ships from a maintenance and material condition perspective to the fleet and type commanders to execute the missions of the ships.

[6]GAO, *Navy Shipyards: Actions Needed to Address the Main Factors Causing Maintenance Delays for Aircraft Carriers and Submarines*, GAO-20-588 (Washington, D.C.: Aug. 20, 2020).

address depot maintenance delays for surface ships and the *Nimitz* class. For example, Navy officials stated that as of November 2022, the Navy completed 13 of the last 18 *Nimitz*-class maintenance periods either on time or within two weeks of the planned completion date, with two of the five delays attributable to the effect of the COVID-19 pandemic. Our analysis indicates that *Nimitz*-class aircraft carriers accrued fewer days of maintenance delay in fiscal years 2019, 2020, and 2021 than they did in fiscal year 2018 (see the Sustainment Quick Look for this class). However, despite these positive steps, the Navy continues to experience delays in aircraft carrier depot maintenance.

We have reported that the Navy's Shipyard Performance to Plan initiative may help NAVSEA and shipyard leadership better understand factors contributing to depot maintenance delays and inform decisions to address them.[7] However, we reported that NAVSEA has not developed over half of its metrics for measuring the effect of the unplanned work and workforce factors or implemented related goals, action plans, milestones, and a monitoring process to improve the timely completion of maintenance. Though having a complete set of metrics would help the Navy better address the main causes of depot maintenance delays, metrics on their own would not resolve those issues. Unless NAVSEA uses the key elements of a results-oriented management approach to address factors contributing to depot maintenance delays—such as unplanned work and workforce issues at the Navy shipyards—delays in maintenance periods and idle time are likely to persist. Completing these actions as soon as possible could increase the overall availability of aircraft carriers and submarines to perform needed training and operations in support of their various missions and improve readiness.

[7]GAO-20-588. In fiscal year 2019, the Navy began an initiative to improve Navy surface ship, submarine, and aviation readiness. This initiative, called Performance to Plan, designates Commander, Naval Surface Forces, and Commander, NAVSEA, to improve performance of ship maintenance in private and public shipyards. NAVSEA refers to this initiative as the Shipyard Performance to Plan initiative that includes efforts related to aircraft carriers and submarines, and also separately for surface ships.

Appendix III: Comments from the Department of Defense

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

SUSTAINMENT

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

Dear Ms. Maurer,

This is the Department of Defense (DoD) response to the Government Accountability Office (GAO) Draft Report GAO-22-105339SU, "WEAPON SYSTEM SUSTAINMENT: Navy Ship Usage Has Decreased As Challenges and Costs Have Increased," dated October 13, 2022 (GAO Code 105339SU).

Enclosed at TAB A is the sensitivity review, which notes that the percentage of time steaming and steaming hours of each ship class should be marked as Controlled Unclassified Information (CUI). The Department's consolidated comments on the draft report are enclosed at TAB B.

Sincerely,

RAMDASS.VICKY.SHASHINDERAJ.1019209780
Digitally signed by RAMDASS.VICKY.SHASHINDERAJ.1019209780
Date: 2022.11.18 10:39:39 -05'00'

Dr. Vic Ramdass
Deputy Assistant Secretary of Defense,
Materiel Readiness

Enclosures:
As stated

Appendix IV: GAO Contact and Staff Acknowledgments

GAO Contact

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

Staff Acknowledgments

In addition to the contact named above, John Bumgarner (Assistant Director), Susan Tindall (Analyst-in-Charge), Emily Biskup, Chris Cronin, Sara Daleski, Chad Hinsch, Michael Holland, David Jones, Jennifer Leotta, Diana Moldafsky, Lillian Ofili, Richard Powelson, Janine Prybyla, Bryan Rezende, Michael Silver, and Carter Stevens, made key contributions to this report.

Appendix V: Additional Source Information for Images and Figures

This appendix contains credit, copyright, and other source information for images, tables, or figures in this product when that information was not listed adjacent to the image or figure.

CG-47
Source: U.S. Navy/Mass Communication Specialist 2nd Class N. Bauer (photo); GAO analysis of U.S. Navy information (charts). | GAO-23-106440

CVN-68
Source: U.S. Navy/Mass Communication Specialist 3rd Class A. Langholf (photo); GAO analysis of U.S. Navy information (charts). | GAO-23-106440

DDG-51
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LCS-1
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LHA-6
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Related GAO Products

Navy Sustainment

Naval Shipyards: Ongoing Challenges Could Jeopardize Navy's Ability to Improve Shipyards. GAO-22-105993. Washington, D.C.: May 10, 2022.

Navy Ships: Applying Leading Practices and Transparent Reporting Could Help Reduce Risks Posed by Nearly $1.8 Billion Maintenance Backlog. GAO-22-105032. Washington, D.C.: May 9, 2022.

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Navy Maintenance: Navy Report Did Not Fully Address Causes of Delays or Results-Oriented Elements. GAO-21-66. Washington, D.C.: October 29, 2020.

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Navy Maintenance: Persistent and Substantial Ship and Submarine Maintenance Delays Hinder Efforts to Rebuild Readiness. GAO-20-257T. Washington, D.C.: December 4, 2019.

DOD Depot Workforce: Services Need to Assess the Effectiveness of Their Initiatives to Maintain Critical Skills. GAO-19-51. Washington, D.C.: Reissued with revisions on December 26, 2018.

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Prior Weapon System Sustainment Quick Looks

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

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

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