

February 2001

TACTICAL AIRCRAFT

Modernization Plans Will Not Reduce Average Age of Aircraft



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United States General Accounting Office
Washington, D.C. 20548

February 9, 2001

The Honorable Donald H. Rumsfeld
The Secretary of Defense

Dear Mr. Secretary:

As the Department of Defense (DOD) enters the 21st century, the average ages of its military weapon systems and equipment are increasing, primarily because DOD has not routinely replaced equipment purchased during the Cold War era. According to Defense officials, the aging of weapon systems and equipment reduces readiness. Additionally, to keep pace with the maintenance required for aging systems and equipment, the military services testified that they have diverted funds from accounts designated for modernization to accounts designated for operating and support.

Concerns relating to aging systems and equipment extend to tactical aircraft—which include those fixed-wing fighter and attack aircraft that are typically smaller in size, carry fewer weapons, and fly shorter unrefueled distances than the larger bomber aircraft. Tactical aircraft have played key roles in military actions in the Persian Gulf and Kosovo and are expected to continue as an integral part of the future force structure. DOD has recognized that these weapon systems have been aging as aircraft acquired in the 1970s and 1980s are approaching the end of their service lives. The 1997 Quadrennial Defense Review, which established an overall investment strategy for DOD, stated that among other things DOD should pursue a focused modernization effort to replace aging systems and incorporate cutting-edge technology into the force. Plans to modernize aging tactical aircraft forces include procurement of over 3,700 new tactical aircraft (F/A-18E/Fs, F-22s, and Joint Strike Fighters) and modification of existing aircraft in the services' inventories. The new aircraft are estimated to cost between \$258 billion and \$338 billion over 30 years ending in 2026. A new quadrennial review will soon be undertaken and is scheduled to be complete in September 2001.

On November 14, 2000, we briefed staff from the Department on our analysis of whether DOD's tactical aircraft modernization plans will permit the Navy (including the Marine Corps) and Air Force to reduce the average age of tactical aircraft. As part of this briefing, we also discussed observations concerning (1) the consistency and reliability of information used to determine the impact of aging on aircraft and (2) the extension of

the lives of certain aircraft. This report provides a copy of our briefing and summarizes our key finding and observations. Based on your reported interest in evaluating major weapon system acquisitions, and tactical aircraft programs in particular, we believe this report will provide you with useful information.

DOD's planned investment of \$258 billion to \$338 billion in new tactical aircraft modernization is not likely to decrease the average age¹ of tactical aircraft over the next 25 years.² In looking at individual service procurement plans, our projections of average age show that at the midpoint of the modernization plans in 2011, the average ages of both the Navy and the Air Force tactical aircraft will likely increase. This increase occurs in our projections because older aircraft are not expected to be replaced by newer aircraft at a rate high enough to reduce average age. More specifically, we project that in 2011, the average age of the Air Force's tactical aircraft will grow from 13 to 21 years; for the Navy, it will increase from 10 to 11 years. By 2025, we project that the average age of Navy aircraft will be about 10 years but that Air Force aircraft will have an average age of 16 years. This is greater than in 1997, when the modernization plans began.

In our analysis of the modernization plans, we observed that DOD currently does not have consistent and reliable information to determine the impact of aircraft aging on readiness and operating and support costs. Military leaders have testified they are confident that aging equipment significantly contributes to decreased readiness and increased operating and support costs but that they were unable to clearly quantify the impact. The services currently use standard DOD reliability and maintainability measurements that can be influenced by factors other than aircraft age, making the

¹ Aircraft are designed to last for certain operating periods expressed in flying hours. However, for overall force and replacement planning purposes, the flying hours are translated into years of operation. Historically, DOD has planned to retire aircraft after 20 years of operation. Assuming an even distribution of aircraft by age, the average age goal for a force of aircraft would then be 10 years, one-half the expected retirement age. We were unable to identify current age goals, but the services had historical average age goals for tactical aircraft. The Navy goal was 7.5 years based on a 15-year aircraft life, while the Air Force was 11 years based on a 22-year life. The Navy's goal is lower because the Navy's aircraft operate in a more severe environment on aircraft carriers.

² In projecting average ages, we assumed that new tactical aircraft would be delivered according to the schedules in the services' modernization programs as of December 1999. Any delays in these delivery schedules would result in higher average ages for given periods of time.

measures less effective tools to predict and plan for the future effects of age. Without good information or tools, Defense leaders may not be able to convincingly support concerns relating to aging or to develop effective and timely solutions to problems. The services are currently studying aging aircraft and issues related to operations and support costs. The Navy is focusing on specific problems like wiring and electronics. The Air Force is assessing the overall management policies and structures needed to manage aging issues.

We also observed that DOD and the services' approved financial plans for 2001 and future years do not include funding for structural modifications that the services believe are essential for maintaining certain tactical aircraft in the force. These modifications, estimated to cost about \$1,344 million through fiscal year 2014, are necessary, according to the Navy and the Air Force, to extend the useful lives of about 1,542 F/A-18C/D and F-16 aircraft. These modifications are essential for DOD to maintain sufficient numbers of tactical aircraft to respond to the current defense policy to fight in two nearly simultaneous major theater wars. Service officials stated they plan to include funds for the structural modifications in the fiscal year 2002 Future Years Defense Program that has not yet been approved by DOD.

Conclusions and Recommendations for Executive Action

DOD faces a major challenge as it continues to implement its current tactical aircraft modernization plans. The Navy and the Air Force will not be able to procure enough new tactical aircraft to reduce the average age of tactical aircraft, and over the next 11 years, the average age will continue to increase, especially in the Air Force. The upcoming Quadrennial Defense Review provides an opportunity to assess whether the issue of aging requires concerted attention. Therefore, we recommend that if DOD considers reducing the average age of tactical aircraft as a critical goal for their modernization plans, the 2001 Quadrennial Defense Review should consider alternatives to the current tactical aircraft modernization plans to achieve this goal.

Because the services are studying the relationships of aging aircraft and operations and support costs, and DOD officials told us extending the lives of F/A-18C/D and F-16s are being considered in formulation of the fiscal year 2002 budget, we are making no recommendations at this time regarding these observations.

As you know, 31 U.S.C. 720 requires the head of a federal agency to submit a written statement on actions taken on our recommendations to the Senate Committee on Governmental Affairs and the House Committee on Government Reform not later than 60 days after the date of the report. A written statement must also be submitted to the Senate and House Committees on Appropriations with an agency's first request for appropriations made more than 60 days after the date of the report.

Agency Comments and Our Evaluation

In written comments on a draft of this report, DOD generally agreed with our recommendation that, if DOD considers reducing the average age of tactical aircraft as a critical goal for modernization, the planned 2001 Quadrennial Defense Review consider alternatives to the current tactical aircraft modernization plans to achieve this goal. DOD agreed that the Quadrennial Defense Review is a good opportunity to review the aging of its tactical aircraft. DOD commented, however, that tactical aircraft age is only one of the many issues that will need to be analyzed during this defense review. We understand that many issues need to be analyzed. Our report recognizes the need to blend many factors, including age, in developing an investment strategy to modernize the forces. Our emphasis in this report on the critical importance of aging is largely derived from the strong concerns expressed by DOD and military leaders about aging forces and contentions that aging equipment is a significant problem contributing to declining readiness and increasing operating and support costs.

DOD provided additional information on their plans to address certain specific aging problems and development of tools to better define the impact of age. DOD's comments are included in their entirety in appendix II.

We are sending copies of this report to the Chairmen of the Senate and House Subcommittees on Armed Services, Committees on Appropriations. We will also send copies to the Secretary of the Air Force, the Secretary of the Navy, the Director of the Office of Management and Budget, and other interested parties. We will make copies available to others upon request.

Please contact me at (202) 512-4841 if you or your staff have any questions concerning this report. GAO contact and staff acknowledgments are in appendix III.

Sincerely yours,

A handwritten signature in black ink that reads "Allen Li". The signature is written in a cursive style with a large initial "A" and a distinct "Li" at the end.

Allen Li, Director
Acquisition and Sourcing Management

Tactical Aircraft Forces' Investment Plans



Tactical Aircraft Forces Are Important to U.S. Military Strategy

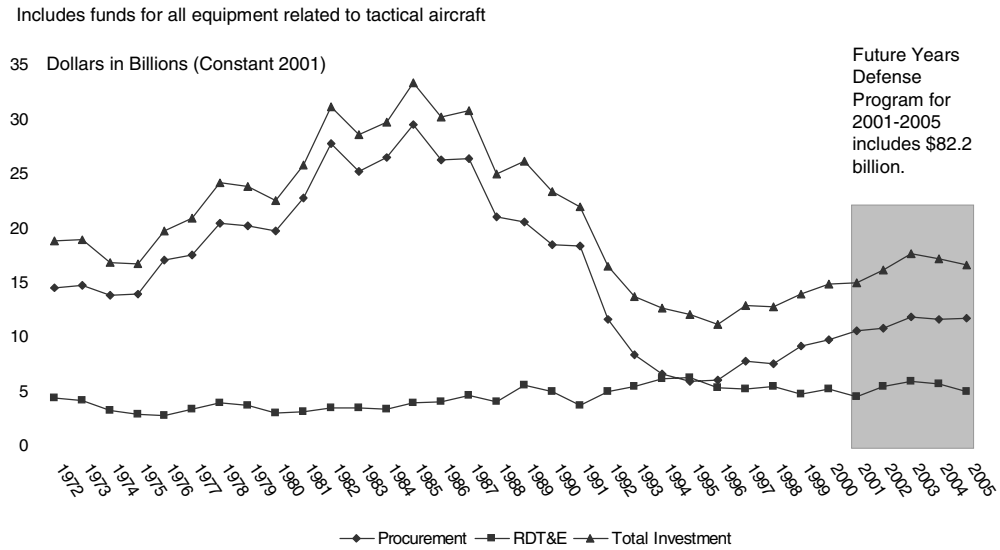
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- A grayscale background image showing the deck of an aircraft carrier. Several tactical aircraft are visible, including a large transport aircraft with the number '75' on its side. The deck is filled with various equipment and structures, creating a sense of a busy military environment.
- Persian Gulf War (Desert Storm)
 - “No Fly Zone” enforcement in Iraq (Northern and Southern Watch)
 - Additional Air Attacks against Iraq (Desert Fox and Desert Thunder)
 - North Atlantic Treaty Organization operations in Kosovo (Allied Force)

Briefing Section I
Tactical Aircraft Forces' Investment Plans

Tactical aircraft forces have been and will continue to be an important part of carrying out U.S. military strategy. They were used extensively in military actions in the Persian Gulf, Iraq, and Kosovo. These forces will continue as an integral part of our military strategy in the future as noted in the Department of Defense (DOD) planning documents, including the 1997 Quadrennial Defense Review and the Joint Chiefs of Staff Joint Vision 2020.



Total DOD Investment in Development and Procurement of Tactical Aircraft

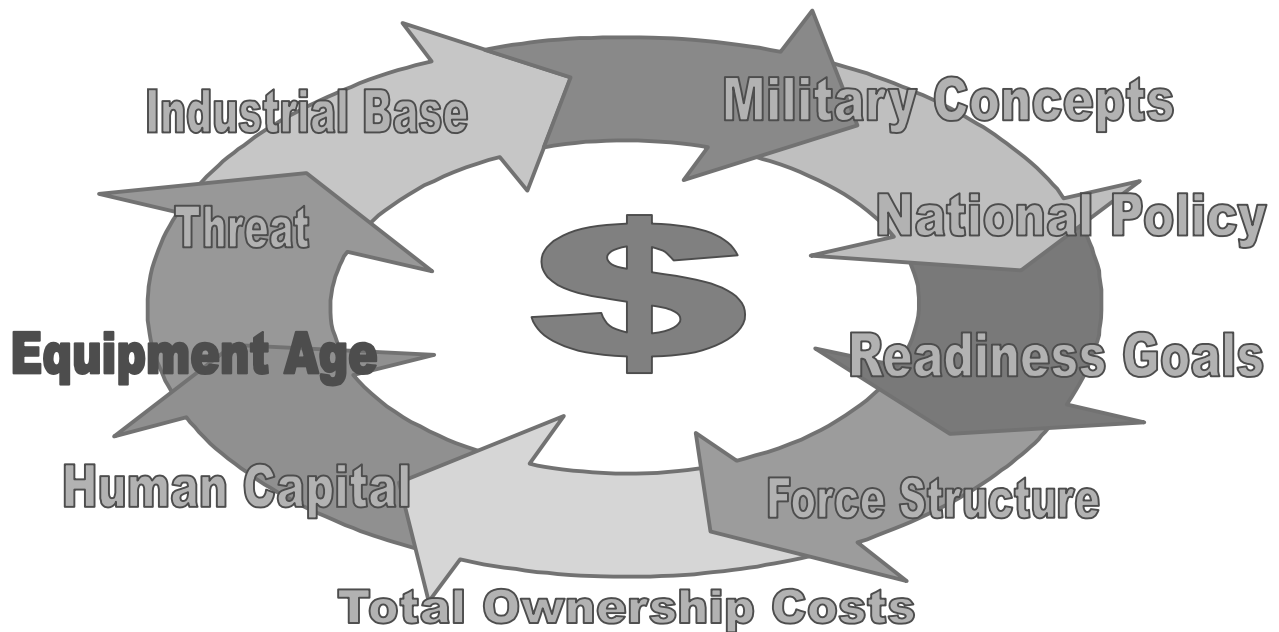


Source: GAO analysis of DOD's 2001 Future Years Defense Program.

The importance of tactical air forces in U.S. military strategy is reflected in the significant DOD investment in development and procurement for the Navy (including the Marine Corps) and the Air Force. From 1972 through 2005, DOD has invested or plans to invest funds to research, develop, and acquire new tactical aircraft and to modify and upgrade aircraft in the inventory. The Future Years Defense Program for 2001-2005 shows that about \$82.2 billion will be invested in tactical aircraft.



**Modernization Planning Involves Blending
of Many Factors Within Affordability Goals**



An investment strategy to modernize the forces should include many factors such as national policy, military concepts, force structure, existing and emerging threats, total ownership cost, human capital needs, the industrial base, and equipment age. During the planning process, these factors should be analyzed and brought together in a comprehensive plan with objectives for the modernization, the specific plans to achieve the objectives, and the resources required. This briefing report includes our analysis of whether DOD's tactical aircraft modernization plans will permit the Navy (including the Marine Corps) and the Air Force to reduce the average age of tactical aircraft. As part of this report, we also make observations on the consistency and reliability of information used to determine the impact of aging on aircraft and the extension of the lives of certain aircraft.



Quadrennial Defense Review Examined Tactical Aircraft Force Requirements

- 1997 Review
- Provided overall guidance and assessed requirements for 1997 through 2015.
- Based on defense policy to fight two major theater wars, the services require
 - 11 Navy Carrier Wings
 - 4 Marine Corps Wings
 - 20 Air Force Tactical Fighter Wings

According to DOD and service representatives, the 1997 Quadrennial Defense Review represents the most comprehensive investment strategy within DOD. The 1997 review identified a number of overall objectives for U.S. military forces, including

- being able to fight and win two nearly simultaneous major theater wars,
- maintaining a continuous overseas presence,
- having capabilities that provide a decisive advantage over our adversaries,
- pursuing a focused modernization effort to replace aging systems and incorporate cutting-edge technologies,
- taking prudent measures to reduce the risks of producing the wrong capabilities or producing a capability too early and having it become obsolete by the time it is needed, and
- ensuring that programs are fiscally executable.



**Quadrennial Defense Review Examined
Tactical Aircraft Force Requirements** (continued)

- Noted overall force was aging as 1970s and 1980s weapons approach end of service lives.
- Concluded increased procurement was needed to ensure forces in later years are as capable as current forces.
- Reaffirmed DOD decisions to procure the F-22, F/A-18E/F, and JSF.
- 2001 Review
 - Scheduled to be complete September 2001.

During the Quadrennial Defense Review, DOD recognized that its overall force was gradually aging, as many weapon systems were approaching the end of their useful lives. DOD concluded that procurement funding was too low to sustain the forces. Also, DOD recognized that it had repeatedly disrupted some modernization programs to provide additional funding for current operations. To create a sound financial foundation for the modernization programs, the Review states that DOD must halt this chronic disruption to modernization programs by properly projecting and funding operating and support activities.

With respect to tactical aircraft, the Review recommends continuing with DOD's procurement of the F-22, F/A-18E/F, and Joint Strike Fighter aircraft but reduces the quantities to a total of 3,739 tactical aircraft.

In our June 1998 report (*Quadrennial Defense Review: Opportunities to Improve the Next Review*, June 25, 1998), we note that in its Review, DOD examined some variations of the services' procurement plans but did not include a thorough, mission-oriented review of the mix of capabilities the United States will need to counter future threats. The Review did not always provide a mission focus that examined trade-offs or facilitated a fundamental reassessment of the modernization needs in light of emerging threats and technological advances. Our report notes that DOD had difficulty in obtaining a consensus to examine changes in the services' planned force structure.



**Aircraft Are Approaching Ages at Which
Tactical Aircraft Have Been Retired in Past**

<u>Current Aircraft</u>	<u>1999 Average Age</u>	<u>Expected Remaining Years in the Inventory</u>
F-14 A/B/D	15 years old	4-9 years
F/A-18 A/B	13 years old	16 years
F-15 A-D	18 years old	31 years for some models
F-16 C/D	10 years old	At least 20 years
A-10	18 years old	31 years
<u>Retired Aircraft</u>	<u>Average Age at Retirement</u>	
A-7D	20 years old	
A-7E	16 years old	
F-4D	24 years old	
F-4E	20 years old	
F-4G	25 years old	
F-111D	20 years old	

Source: GAO calculations of DOD data.

Some aircraft in the inventory are approaching or are at the average ages of other tactical aircraft that were retired in the past. Most aircraft models shown were retired when they reached average ages ranging from 20 to 25 years. The Air Force force structure data showed certain F-15s and A-10s are planned to be in the operational inventory for at least an additional 30 years, at which time their age will average close to 50 years.



Status of Legacy Systems (as of 1999)

<u>Aircraft</u>	<u>Average Age (Years)</u>	<u>Inventory</u>	<u>Production Status</u>
Navy			
F-14 A/B/D	15	195	Completed
F/A-18 A-D	9	776	Completed
AV-8B	8	127	Completed
Air Force			
F-15 A-D	18	522	Completed
F-15 E	9	204	Active
F-16 A-B	17	100	Completed
F-16 C-D	10	1,272	Active
F-117	8	52	Completed
A-10	18	368	Completed

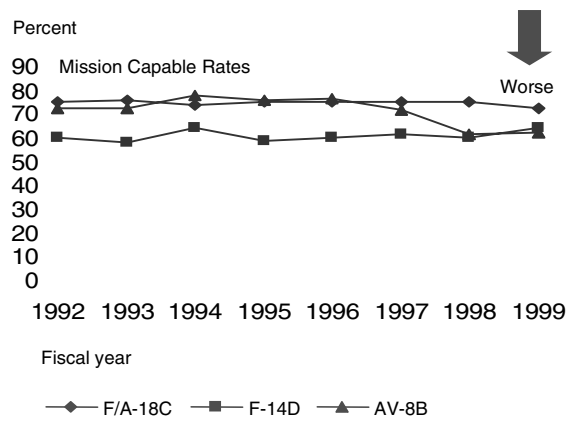
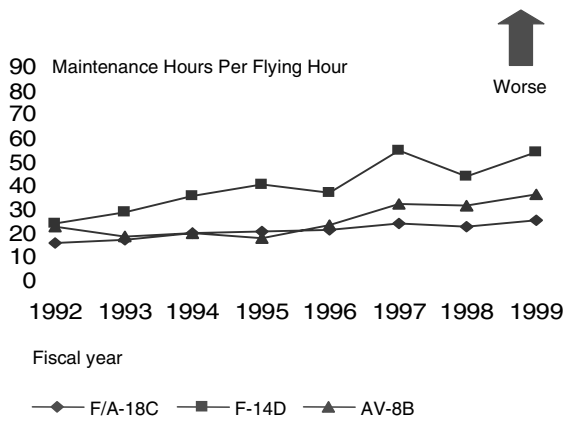
Source: Navy and Air Force data.

Of the existing older aircraft models (legacy systems), only the Air Force's F-16s and F-15Es were still being produced in late 2000. The Air Force has not identified a replacement aircraft for the F-15E at this time, and Congress added funds in the last two fiscal years to keep the F-15E production line open. The Air Force is buying additional F-16s to augment its force to counter enemy ground-based air defenses. Also, F-16s are being produced for sale to various foreign countries. The Air Force A-10s, F-15C/Ds, and F117s have been out of production for several years.

The Navy took delivery of the last F/A-18D in August 2000, making the F/A-18E/F the only Navy tactical aircraft in production. The Navy F-14s and AV-8Bs have been out of production for several years. The Navy plans to retire the F-14s from service in 2008, and the AV-8Bs are being remanufactured to make them like new aircraft.



Trends of Common Measures of Navy Maintenance and Mission Capability

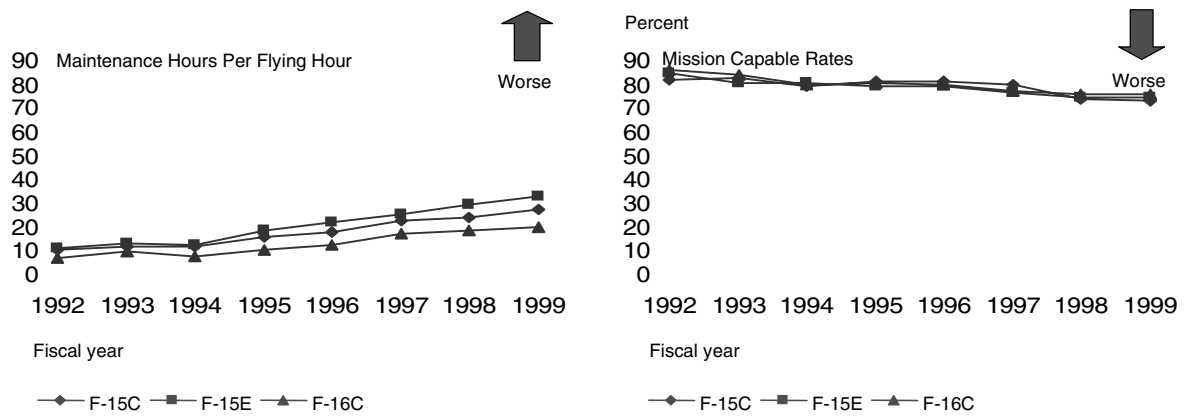


Source: Naval Air Systems Command.

Maintenance indicators over the past several years support the services' concerns about maintainability, availability, and readiness of aging aircraft. The maintenance hours per flying hour for selected aging Navy tactical aircraft indicate worsening trends. However, while mission-capable rates fluctuate with age, there does not appear to be a sustained positive or negative trend. Service officials attribute part of these trends to the impact of aging. They caution, however, that it would be difficult to isolate the aging segment. Other factors not related to age also impact these indicators. For instance, the higher than expected attrition of experienced maintenance personnel from the services has caused the services to depend more heavily on less experienced personnel to repair aircraft. These less experienced personnel take longer to perform maintenance, thus increasing the number of hours required to return an aircraft to flying status.



Trends of Common Measures of Air Force Maintenance and Mission Capability



Source: Air Force Materiel Command.

The Air Force is experiencing trends worse than those in the Navy, as tactical aircraft age. Maintenance and mission capable rates get worse as the aircraft age. As with the Navy, other factors—such as higher than expected attrition of experienced maintenance personnel—may also impact these rates.



**DOD Modernization Plans to Buy
New Tactical Aircraft**

Dollars in Billions (Constant 2000)

Aircraft (Service)	Estimated Cost	Quantity	Acquisition Time Frame	Aircraft to Be Replaced
FA-18E/F (Navy)	\$ 45-\$47	548	1997-2010	F-14; F/A-18C/D
F-22 (Air Force)	\$60-\$67	339	1999-2011	F-15A-D
JSF (Navy)	\$36-\$50	480	2008-2019	
JSF (Marines)	\$32-\$47	609	2006-2023	F/A-18; AV-8B
JSF (Air Force)	\$85-\$127	1,763	2005-2026	F-16; A-10
Total	\$258-\$338	3,739	1997-2026	

Note: Costs estimated by Congressional Budget Office in March 1999.

The Navy (including the Marine Corps) and the Air Force plan to modernize by replacing aging tactical aircraft. They plan to buy 3,739 new tactical aircraft between 1997 and 2026 to replace aging systems in the inventory and improve the capability of the forces. The new tactical aircraft include the F/A-18E/F, F-22, and the Joint Strike Fighter.

The Congressional Budget Office estimated that the total acquisition costs for these programs could be \$258 billion to \$338 billion (2000 constant dollars). Currently identified tactical aircraft modernization plans do not include replacements for the F-15Es or the F-117s, both of which had average ages of 9 and 8 years, respectively, at the end of fiscal year 1999.



Substantial Appropriations Needed to Complete Modernization Program

- As of fiscal year 2001, **84 percent** of the modernization program funds remain to be appropriated. This is broken out as follows.
 - **34 percent** of Research, Development, Test, and Evaluation program funds remain to be appropriated.
 - **94 percent** of Procurement program funds remain to be appropriated.

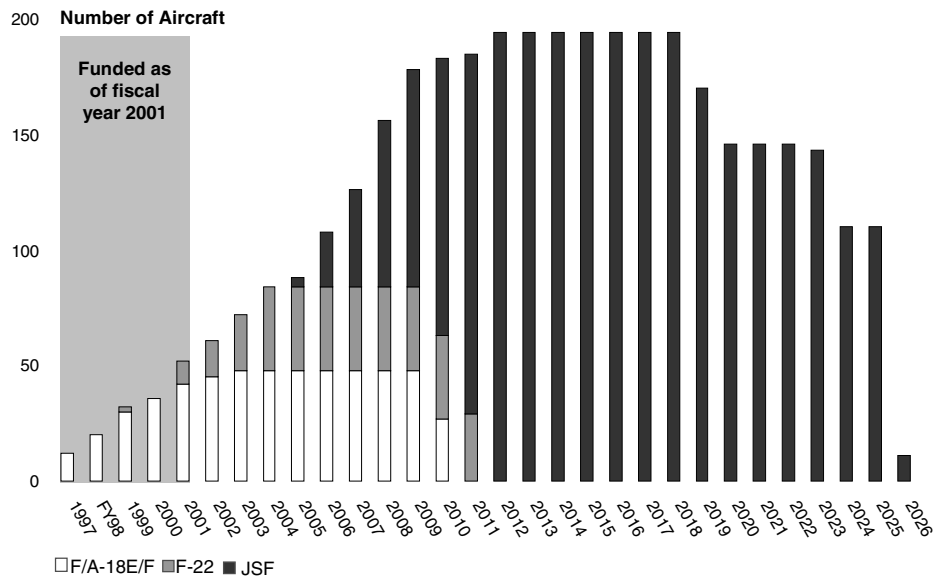
Source: GAO analysis of DOD and CBO data.

Substantial appropriations are still required to complete the tactical aircraft modernization programs (FA-18E/F, F-22, and Joint Strike Fighter). Congress has appropriated most Research, Development, Test and Evaluation (RDT&E) funds estimated to complete the modernization programs. Only 34 percent remains to be appropriated. The Joint Strike Fighter Program has the largest remaining funding requirements, as 80 percent of its RDT&E funds remain to be appropriated beyond fiscal year 2001. The F/A-18E/F and F-22 have 5 percent or less of their RDT&E funds to be appropriated beyond fiscal year 2001.

The bulk of the procurement funds, about 94 percent, for these tactical aircraft modernization programs remain to be appropriated. All three modernization programs have significant funding requirements in the future. The F/A-18E/F still requires 70 percent, the F-22 88 percent, and the Joint Strike Fighter 100 percent of estimated procurement funds to complete the modernization programs.



Planned New Tactical Aircraft Will Take 30 Years to Acquire



Source: Selected Acquisition Reports and service financial plans.

The acquisition for the three new types of tactical aircraft, as currently planned, will take 30 years (1997-2026) to complete. The planned quantities to be bought per year have slowly increased, from a low of 12 aircraft in 1997 to a peak of 194 aircraft per year in 2012. After 2018, the quantities begin to taper off to the final buy of 11 aircraft in 2026.

Analysis Shows That Modernization Plans Will Not Reduce Aircraft Age



Historical Goals for Tactical Aircraft Age and Retirement

Goals

	<u>Average Age</u>	<u>Retirement Age</u>
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Navy	7.5 years	15 years
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Navy	7.5 years	15 years
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Navy	7.5 years	15 years
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Air Force	11 years	22 years
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Air Force	11 years	22 years
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Air Force	11 years	22 years
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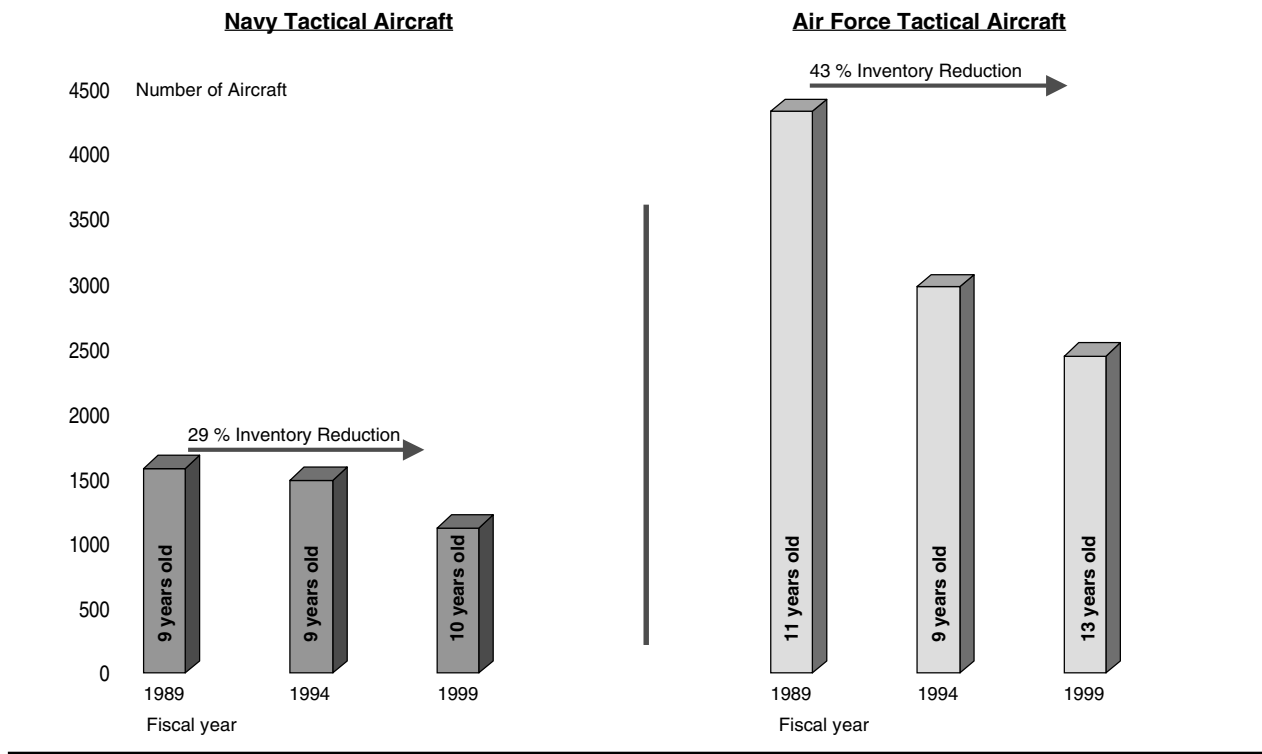
**Briefing Section II
Analysis Shows That Modernization Plans
Will Not Reduce Aircraft Age**

Historically, the services have endeavored to maintain average age and retirement age goals for their tactical aircraft. The Navy goals have been to maintain an aircraft's average age at 7.5 years and to retire aircraft at 15 years. The Air Force goals have been to maintain an aircraft's average age at 11 years and to retire aircraft at 22 years. The Navy attributes its lower goals to an operating environment that is more severe than the Air Force's. Carrier force operations, including catapult take-offs, arrested landings, and a more corrosive sea environment, are more demanding on the aircraft structure.

**Briefing Section II
 Analysis Shows That Modernization Plans
 Will Not Reduce Aircraft Age**



**Inventory Reduced but Average Age
 Increased for Tactical Aircraft**



Source: GAO analysis of Navy and Air Force data.

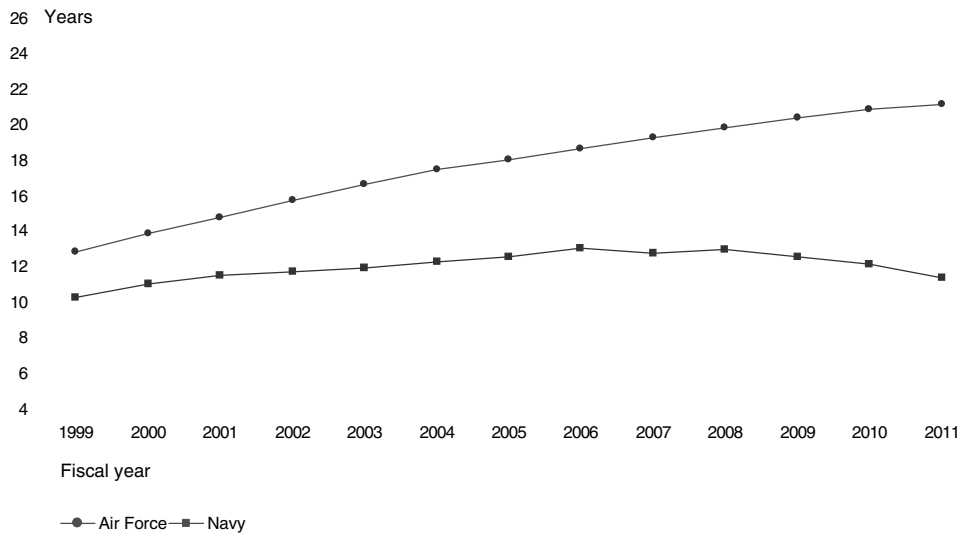
**Briefing Section II
Analysis Shows That Modernization Plans
Will Not Reduce Aircraft Age**

The number of Navy and Air Force aircraft has decreased over the 10-year period from 1989 to 1999, providing an opportunity to eliminate older aircraft from the inventory. During 1989-99 the Navy reduced its force size by 29 percent and the Air Force by 43 percent. Despite these force reductions, however, neither the Navy nor the Air Force met their average age goals in 1999. The average age of Navy aircraft increased from 9 years to 10 years, and the average age of Air Force aircraft increased from 11 years to 13 years.

Briefing Section II
Analysis Shows That Modernization Plans
Will Not Reduce Aircraft Age



Projected Average Age of Navy and Air Force
Tactical Aircraft



Source: GAO analysis of Navy and Air Force data.

**Briefing Section II
Analysis Shows That Modernization Plans
Will Not Reduce Aircraft Age**

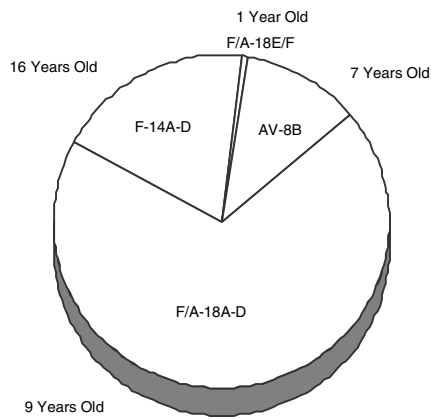
Even with implementation of DOD's modernization plans, the average age of Navy and Air Force tactical aircraft will continue to increase for several years. The trend from fiscal year 1999 to 2011 (the mid-point of DOD's modernization plans) shows that Navy aircraft average age is likely to increase through 2006 to 13 years and then slowly decrease to 11 years in 2011. The Air Force aircraft age, however, is likely to increase throughout this entire period from 13 years in 1999 to 21 years in 2011. In making these projections we assumed there would be no change in the tactical aircraft delivery schedules shown in the services' December 1999 Selected Acquisition Reports.

**Briefing Section II
 Analysis Shows That Modernization Plans
 Will Not Reduce Aircraft Age**

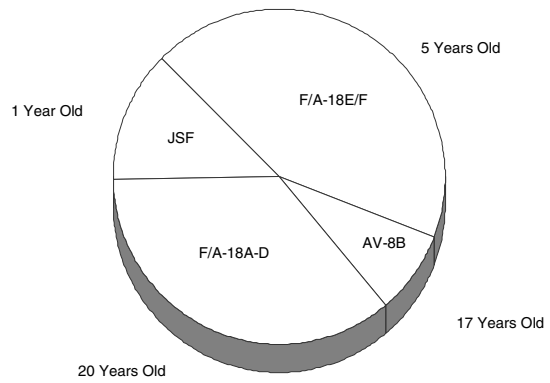


**Navy Slows Aircraft Aging Through Modernization
 But Still Does Not Meet Average Age Goals**

Average Age 10 Years 1999



Average Age 11 Years 2011



44% Legacy Systems Still in Force

Source: GAO analysis of Navy data.

Briefing Section II
Analysis Shows That Modernization Plans
Will Not Reduce Aircraft Age

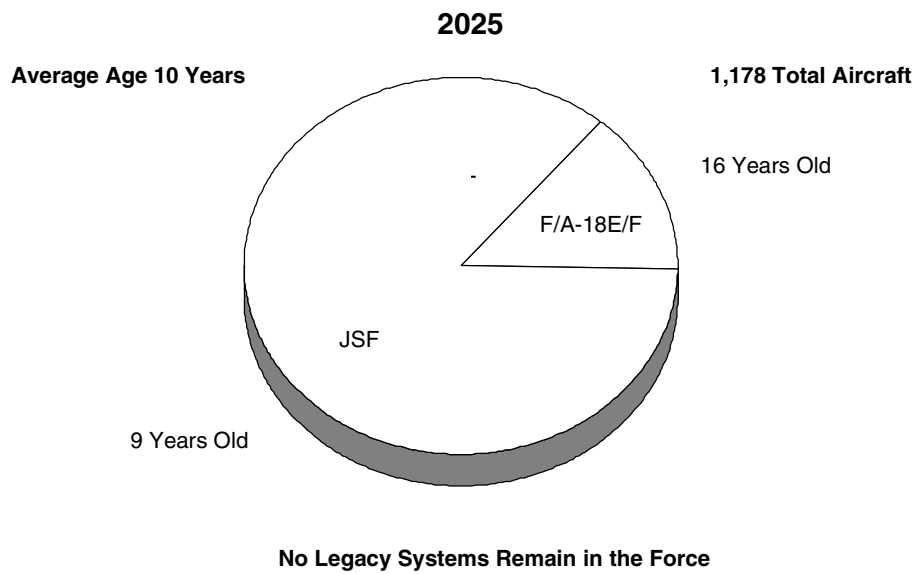
The average age for all Navy tactical aircraft in 1999 was 10 years. The Navy's plans to acquire tactical aircraft will slow the growth in average age, but the Navy will fall short of achieving its historical 7.5-year average age goal for its aircraft. In 1999, most of the Navy force was made up of legacy systems, including F/A-18C/Ds, AV-8Bs and F-14s.

We project that by 2011, the mid-point of the DOD modernization plans, the Navy force will consist of 44 percent legacy aircraft and 56 percent new F/A-18E/Fs and Joint Strike Fighters. The modernization plans will not reduce the average age for the Navy's tactical aircraft; it will result in an increase in average age from 10 years to 11 years. The older aircraft models, F/A-18C/Ds and the AV-8Bs, are likely to reach average ages from 17 to 20 years by 2011.

**Briefing Section II
Analysis Shows That Modernization Plans
Will Not Reduce Aircraft Age**



**Navy Slightly Exceeds Average Age Goals
Near Completion of Modernization**



Source: GAO analysis of Navy data.

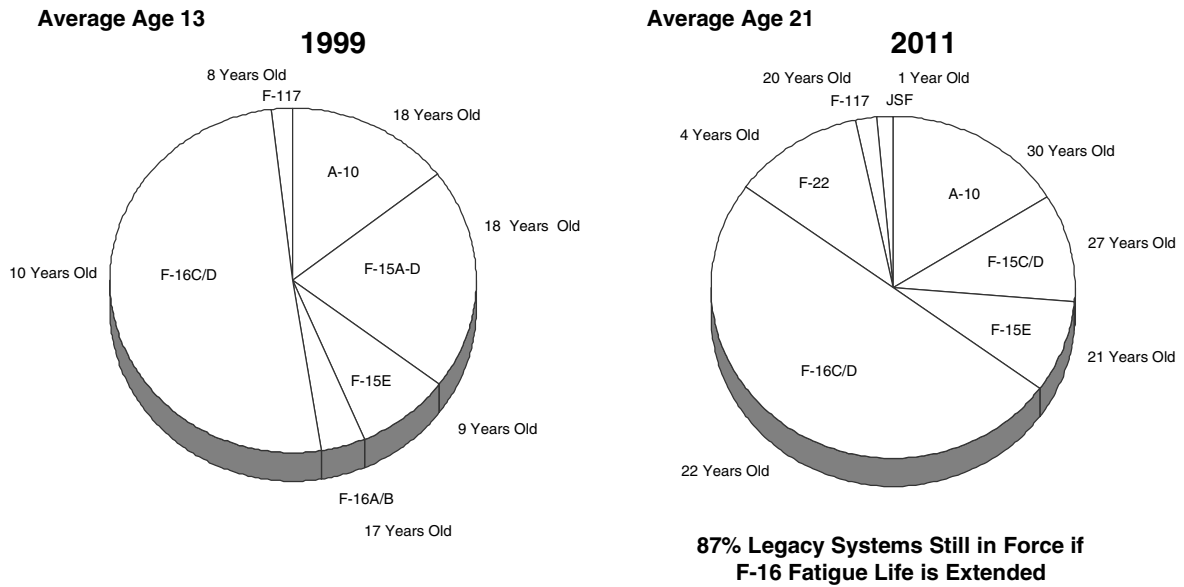
Briefing Section II
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We project that near the completion of DOD's modernization plans in 2025, the average age of Navy's tactical aircraft will be 10 years. Thus, the Navy will not meet its historical goal of an average age of 7.5 years for its tactical aircraft. By this time, the Navy plans to have retired all of the legacy aircraft that made up the tactical aircraft inventory when the modernization program started in 1997. However, the average ages of the F/A-18E/Fs and Joint Strike Fighter will be 16 years and 9 years, respectively.

**Briefing Section II
 Analysis Shows That Modernization Plans
 Will Not Reduce Aircraft Age**



**Air Force Modernization Significantly
 Increases Average Age of Tactical Aircraft**



Source: GAO analysis of Air Force data.

**Briefing Section II
Analysis Shows That Modernization Plans
Will Not Reduce Aircraft Age**

The average age for all Air Force tactical aircraft in 1999 was 13 years. The current Air Force plans to acquire tactical aircraft will not reduce the average age of its current inventory but instead will result in a significant increase. In 1999, the Air Force inventory of tactical aircraft consisted entirely of legacy systems, which include F-15, F-16, F-117, and A-10 aircraft.

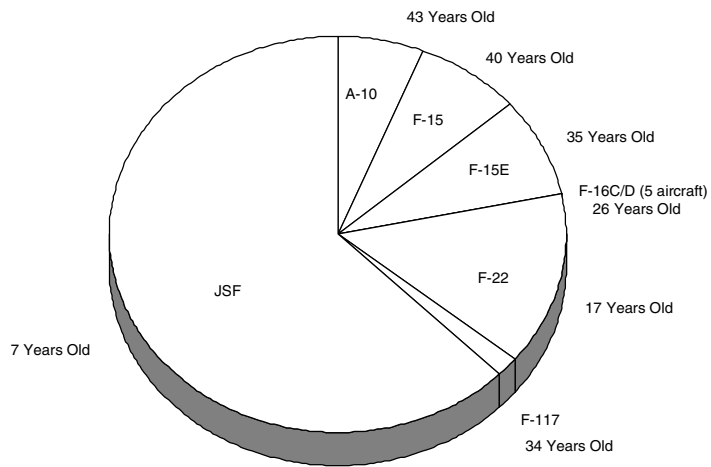
We project that in 2011, the mid-point in DOD's modernization plans, 87 percent of the Air Force tactical aircraft force will be legacy systems. The average age of the total tactical force is expected to increase by 8 years, from 13 years to an average age of 21 years. The newer F-22s, which would make up most of the remaining 13 percent of aircraft inventory in 2011, would be, on average, 4 years old. In 2011, the remaining F-15C/D/Es, F-16C/Ds, F-117s, and A-10s are likely to have average ages that range from 20 to 30 years.

Briefing Section II
Analysis Shows That Modernization Plans
Will Not Reduce Aircraft Age



Air Force Still Exceeds Average Age
Goals Near Completion of Modernization

Average Age 16 Years **2025** **2,421 Total Aircraft**



24% Legacy Systems Still in the Force

Source: GAO analysis of Air Force data.

Briefing Section II
Analysis Shows That Modernization Plans
Will Not Reduce Aircraft Age

Near the completion of DOD's modernization plans in 2025, the average age of the Air Force's tactical aircraft is expected to be 16 years, exceeding the historical average age goal by 5 years. The Air Force estimates that by this time, 24 percent of its tactical aircraft inventory will include aging F-15C/D/Es, F-16C/Ds, F-117s, and A-10s. The average age of these legacy aircraft will range from 26 to 43 years old. In addition, the average age of the F-22s and the Joint Strike Fighter will be 17 years and 7 years, respectively. Therefore, the average age of the Air Force's tactical aircraft is likely to be higher in 2025 than when the modernization efforts began in 1999.

Observations—DOD Lacks Consistent and Reliable Information to Determine the Impact of Aircraft Aging



Impacts of Aging Aircraft According to DOD

- Decreased reliability
- Increased maintenance
- Decreased readiness
- Lower availability of weapon systems for operations and training
- Increased operating and support costs

**Briefing Section III
Observations—DOD Lacks Consistent and
Reliable Information to Determine the
Impact of Aircraft Aging**

DOD has stated that as aircraft age, they tend to break more often, take longer to inspect and maintain, and are less available for operations and training. Aging aircraft cost more to operate and support and result in reduced readiness. While DOD does not fully understand the precise timing and impact of aging, they have generally characterized aging conditions as follows:

- Wear and tear from routine and frequent use over time eventually cause failure of the aircraft structure and components.
- Operations in harsh environments over time cause corrosion that deteriorates aircraft structure and components. (These first two factors increase the frequency of parts failures and the time needed for inspections and maintenance.)
- Modifications need to keep pace with the threat, as aging technology becomes ineffective.
- Support for aging aircraft is difficult because manufacturing sources for spare parts become scarce as technology moves forward and parts become unavailable.



Military Leaders Warn of Aging Equipment Problems

- Joint Chiefs of Staff testimony before the Senate Armed Services Committee on September 27, 2000:
 - Chairman: As aircraft age, the services will continue to use modernization funds for increased maintenance costs.
 - Air Force Chief of Staff: The Air Force has never dealt with a force this old and the average age is accelerating. It takes an inordinate amount of time, work, and money to keep its aging force air worthy and ready.
 - Navy Chief of Staff: The Navy is buying desperately needed aircraft but not at the rate necessary to sustain the future force.

**Briefing Section III
Observations—DOD Lacks Consistent and
Reliable Information to Determine the
Impact of Aircraft Aging**

DOD leaders testified before the Senate Armed Services Committee in September 2000 on the widespread concerns of aging military equipment. Testimony indicated aging is a problem that affects all military equipment and not just aircraft. The common theme was that aging equipment is significantly contributing to declining readiness and increasing operating and support costs. These leaders stated that additional funds must be allocated to keep older equipment at military readiness levels for current operational needs and contingencies. The allocation of additional funds for operations and support impact the ability to plan for sufficient funding to modernize military equipment and further delay the purchases of new equipment.



**Services Highlight Aircraft Aging
Issues**

- Navy Inspector General April 2000 Report:
 - Navy aircraft are older now than anytime in history.
 - As aircraft grow older, component reliability decreases and depot maintenance requirements increase.
 - Reliability levels of aging aircraft do not meet predicted levels.
 - U.S. Air Force Posture Statement 2000:
 - Ages of Air Force aircraft are at unprecedented levels.
 - Maintenance costs to keep the aging aircraft ready are increasing.
-

**Briefing Section III
Observations—DOD Lacks Consistent and
Reliable Information to Determine the
Impact of Aircraft Aging**

In April 2000, the Navy Inspector General reported on naval aviation readiness and factors degrading readiness. The report concluded that aging aircraft are facing obsolescence and declining reliability and are stressing a support system that suffers from reduced staffing and maintenance proficiency. Merely procuring additional spare parts will not solve the aging problem. The Inspector General concluded that the Navy should invest in logistics and engineering efforts to address reliability issues, noting that commercial airlines spend 2 staff years per aircraft for these types of efforts compared to the Navy's investment of 0.5 staff years per aircraft.

The U.S. Air Force Posture Statement 2000 concludes that four factors have caused mission-capable rates of Air Force aircraft to drop 9.9 percent since 1994. These factors were (1) greatly increased deployments since 1990, (2) aging aircraft, (3) problems in funding spare parts through most of the 1990s, and (4) low retention of maintenance technicians. The Posture Statement notes that the age of all Air Force aircraft is unprecedented, with a current average age of 20 years. Under modernization plans, the average age will increase to 30 years by 2015. The Secretary of the Air Force further noted that fatigue, corrosion, and parts obsolescence are driving up the costs of maintaining older aircraft and reducing overall equipment readiness. The Statement concludes that the Air Force must balance the cost of maintaining weapon systems against the cost of replacing major subsystems or the weapon system itself.



**Studies Are Unclear About the Cost
Impacts of Aging Aircraft**

- Some studies indicate that as aircraft get older operating and support costs increase but, Navy and Air Force studies differed on the rate of cost increases and the types of support costs impacted by age.
- At least one other study indicates consistent and reliable data were not available for long enough periods to demonstrate the impacts of age.

**Briefing Section III
Observations—DOD Lacks Consistent and
Reliable Information to Determine the
Impact of Aircraft Aging**

For a 1995 study, the Navy reviewed 1983-95 data and concluded that age-correlated increases in all operating and support costs averaged 2.5 percent. This included costs for organizational and intermediate-level labor, aircraft overhauls, engine rework, depot-level repair items, and other support. The study included 12 fixed-wing and rotor aircraft.

A 1997 report by the Institute for Defense Analysis stated that the effects of age on operating and support costs were not visible in data from 1987 to 1995. It concluded that 20 to 30 years of cost data would be needed to review the entire life cycle of a system, but consistent data could be found only for a 9-year period, from 1987 to 1995.

A 1999 Air Force study of data from 1986 to 1996 concluded aircraft overhaul costs increased by about 3 to 7 percent a year as aircraft age. However, the report concluded that the confidence level of the data in the study was not high enough to indicate age-related cost growth for engine overhauls, software maintenance, and depot-level repair items. The study included nine different bomber, cargo, and fighter aircraft.



**Future Impacts of Aging Are Not
Predictable and Therefore Uncertain**

A 1998 Rand Study on aging aircraft stated there are no established scientific relationships between specific aging factors and future maintenance workload and costs; one cannot predict all maintenance events and add up associated costs.

**Briefing Section III
Observations—DOD Lacks Consistent and
Reliable Information to Determine the
Impact of Aircraft Aging**

A Rand report (*Aging Aircraft: Initial Look at Implications for PDM and Engine Support Cost Growth*, Oct. 1998) stated that there are no effective models to measure and estimate the cost impacts of aging factors such as corrosion or engine fatigue from high temperatures. The report also stated that historically based cost estimating relationships used to estimate future costs may not be valid. Most do not include age as a variable, and if they do include age, there is no historical experience for the extreme ages aircraft will achieve today and in the future. By comparison, past aircraft were replaced at a relatively early age. The report also shows divergent views of the future impacts of age. Optimists believed that current initiatives to control age-related support costs would be successful. Pessimists acknowledged the initiatives but believed they only mask recent demand and workload and that future problems are possible, given the unprecedented ages aircraft will reach. Rand has continued to study the impacts of aging on aircraft at the direction of the Air Force, but as of December 11, 2000, it had not yet released its next planned report.



**Services Approach Continued Study
of Aging Impacts Differently**

The Navy and Air Force continue to study the impacts of age on operating and support costs and readiness.

- The Navy is focusing on more specific aging problems, such as the impacts of age on avionics and aircraft wiring.
- The Air Force is identifying policy needs, information needs, predictive tools, needed skills, and other elements.

**Briefing Section III
Observations—DOD Lacks Consistent and
Reliable Information to Determine the
Impact of Aircraft Aging**

The Navy and the Air Force do not fully understand the impacts of aging on their aircraft or on the costs to operate and support them, and they lack consistent and reliable data and tools to predict these impacts. While the Navy and the Air Force continue to study aging issues, each service's aging aircraft integrated product team appears to be focused on different levels of the problem. The Navy team is investigating aging issues at a more specific and detailed level, trying to discern the impacts of aging on aircraft wiring and avionics components. The Air Force team is trying to develop an overall structure to manage aging issues. It has identified the need for policies, management information, predictive tools, technical skills, and other elements to successfully manage aging aircraft issues.

In the end, both services appear to have goals to better identify the relationships between aging systems, maintenance, and operating and support costs and to better manage aging with better information and tools. However, until the services achieve these goals, they continue to rely on standard DOD reliability and maintainability metrics to show the impacts of aging aircraft. These metrics, such as maintenance staff hours per flying hour, can be influenced by factors other than age, and the services cannot distinguish the precise contribution of aging. For example, the high retirement rate of experienced maintenance personnel could impact this measure because less experienced maintenance personnel take more time to identify and fix problems. Therefore, not knowing the specific impacts of aircraft age reduces the services' ability to cost-effectively resolve the problems associated with aging.

Observations—Useful Lives of the F/A-18 and F-16 Aircraft May Need to be Extended



Important Modifications to Extend Aircraft Life Not Included in DOD Financial Plans

- DOD has identified modifications needed to extend the structural life of the F/A-18C/Ds and F-16 aircraft.
- The Navy and Air Force did not include funds in the fiscal year 2001 budget for these modifications.
- According to the services, without extension of the structural life over one-third of the tactical aircraft could become inoperable, resulting in a lower force size than recommended by the 1997 Quadrennial Defense Review.

Briefing Section IV
Observations—Useful Lives of the F/A-18 and
F-16 Aircraft May Need to be Extended

The Navy F/A-18C/Ds and the Air Force F-16s are experiencing structural problems that will require modifications to keep them in the aircraft inventory for operational use. Neither service included the necessary funding in the Fiscal Year 2001 Future Years Defense Program to develop and incorporate these modifications. If these aircraft are not modified to extend their structural life, about one-third of the tactical aircraft forces could be inoperable, resulting in a lower force size than recommended in the 1997 Quadrennial Defense Review.



Unfunded Requirements for F/A-18C/D Aircraft Life Extension

- The Navy expects F/A-18C/Ds to be in the inventory through 2019, but structural problems will not allow achievement of service life goals, based on flying hours and carrier landings and takeoffs.
- Without service life extensions, the Navy will be 223 aircraft short of requirements in 2014.
- Goals are to extend flying hours from 6,000 to 12,000 and carrier landings and takeoffs from 2,000 to 2,700.
- The Navy estimated the modifications could cost as much as \$878 million for up to 355 aircraft.

Briefing Section IV
Observations—Useful Lives of the F/A-18 and
F-16 Aircraft May Need to be Extended

Modifications to Navy and Marine Corps F/A-18C/D aircraft are needed to extend their service lives beyond their original design. The Navy designed a modification intended to strengthen the structure to double the number of flying hours for the aircraft and increase the number of takeoffs and landings by 700. According to F/A-18C/D program officials, the Navy will experience a shortfall of 223 aircraft in 2014 if this modification, estimated to cost \$878 million (then-year dollars), is not completed.



**Unfunded Requirements for F-16
Aircraft Life Extension**

- The F-16 was designed to fly 8,000 hours. Tests of the structure simulated the planned use over its lifetime.
- F-16s may develop structural problems by the time they operate 5,000 hours because they have been used in more severe conditions than planned.
- The Air Force estimates the cost of the life extension at about \$466 million for F-16s now in the inventory.

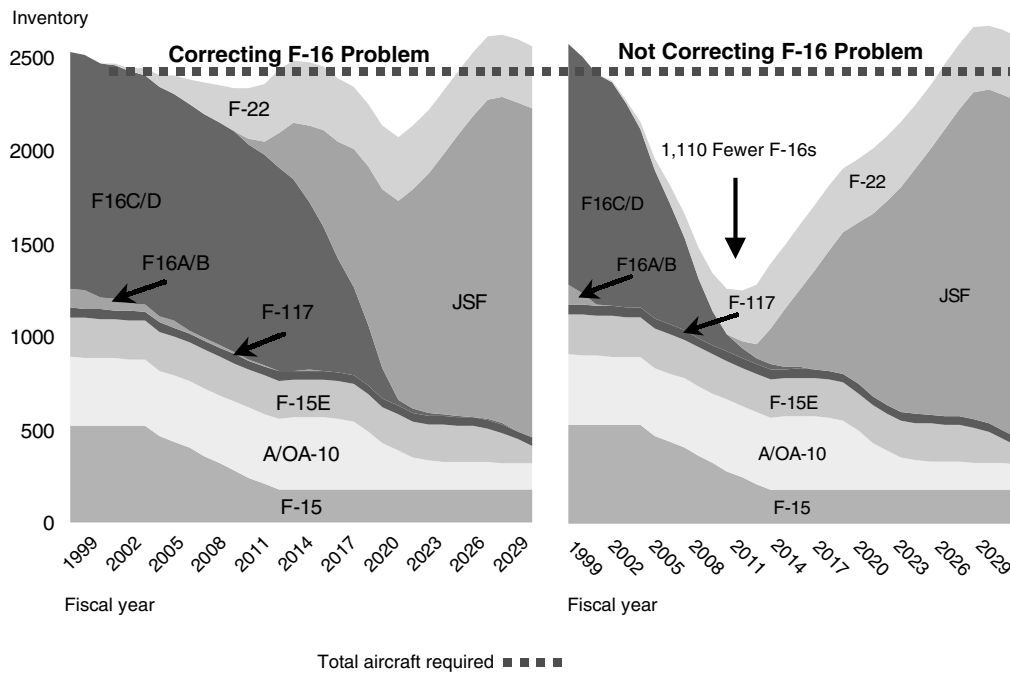
Briefing Section IV
Observations—Useful Lives of the F/A-18 and
F-16 Aircraft May Need to be Extended

Without significant modifications, the F-16 aircraft currently in the inventory are expected to be able to fly only about 5,000 of the 8,000 hours that they were designed to fly. According to F-16 program officials, this limitation is the result of greater stresses in flight because F-16s have been used in more severe operating environments than planned when the aircraft were designed and tested. To enable the F-16s to fly 8,000 hours, the program office has proposed a structural modification program that will extend the F-16's life to the original flying hour design. This program, identified as Falcon Star, is expected to take place from 2004 through 2014 and include 1,187 aircraft. The Air Force estimates the modifications will cost \$16 million for development and \$450 million (then-year dollars) to buy and install modifications. The Air Force did not include funds in the Fiscal Year 2001 Future Years Defense Program for the modifications.

Briefing Section IV
 Observations—Useful Lives of the F/A-18 and
 F-16 Aircraft May Need to be Extended



Number of Air Force Tactical Aircraft Significantly
 Reduced Without F-16 Life Extension



Source: Air Force Air Combat Command.

Briefing Section IV
Observations—Useful Lives of the F/A-18 and
F-16 Aircraft May Need to be Extended

If the Air Force fails to incorporate the life-extension modifications into the F-16 aircraft, the size of the force will be substantially reduced by 2010. The figure shows the impact of not funding and incorporating the modifications to extend the life of the F-16 aircraft. The left side of the chart shows the Air Force tactical aircraft inventories assuming the F-16 modification program is completed, while the right side shows the inventory if the modification program is not completed. The net result according to the Air Force is that the tactical aircraft inventory would be lower by about 1,110 F-16 aircraft in 2010 if the modifications are not completed.

Conclusions and Recommendations



Conclusions

- Despite modernization plans estimated to cost \$258 billion to \$338 billion, the services have not planned to procure enough tactical aircraft to reduce the average age of the force. Therefore, the services will have to depend on aging aircraft to meet future force requirements.
- Over the next 11 years average age will continue to increase, especially in the Air Force.
- The upcoming Quadrennial Defense Review is an opportunity to assess whether the issue of aging is one requiring concerted attention.

Briefing Section V
Conclusions and Recommendations



Recommendations

- We recommend that if DOD considers reducing the average age of tactical aircraft as a critical goal for their modernization plans, the 2001 Quadrennial Defense Review should consider alternatives to the current tactical aircraft modernization plans.

Briefing Section V
Conclusions and Recommendations

Scope and Methodology

To assess whether the Department of Defense's (DOD) tactical aircraft modernization plans will permit the Air Force and the Navy to reduce the average tactical aircraft age, we interviewed officials in the Office of the Secretary of Defense and headquarters offices of the Navy and the Air Force. We reviewed the 1997 Quadrennial Defense Review Report to determine plans for tactical aircraft and the defense forces in general and interviewed officials in Naval Air Systems Command, Air Force Material Command, and Air Force Aeronautical Systems Center to evaluate the individual modernization programs for tactical aircraft. We obtained and evaluated data on tactical aircraft program financial plans, budgets, schedules, and modernization plans to determine the types of improvements planned in the future. This included data defining programs to develop new aircraft and improve existing aircraft. We also obtained and analyzed the aggregate average age data for each tactical aircraft model currently in the inventory. We also obtained current and planned inventory levels for each aircraft model from 1999 through 2025 as well as the planned inventory levels for new tactical aircraft that will enter the force. Using current age data, inventory plans, and delivery schedules, we projected the average age of each tactical aircraft model at points in time during the modernization plans.

We also analyzed Navy and Air Force studies and held discussions with individual aircraft program officials on readiness and operating and support costs of aging aircraft. We discussed information and tools used by the services to measure the impacts of aging on aircraft and the problems associated with using the information and tools. We obtained readiness, reliability, and maintainability data from service databases to analyze trends relative to the age of tactical aircraft currently in the forces. Also, we met with Aging Aircraft Integrated Product Teams in the Navy and the Air Force to discuss impacts of age on aircraft as well as their ongoing and future efforts.

Finally, in addressing whether modifications needed to keep aircraft in service have been included in the fiscal year 2001 Future Years Defense Program, we obtained the fiscal year 2001 Future Years Defense Program and the fiscal year 2001 budgets for the Navy and the Air Force tactical aircraft programs. We also discussed the modification plans with the appropriate service representatives in the program offices responsible for managing the specific weapon systems.

In reporting the total DOD investments in tactical aircraft, we used the fiscal year 2001 Future Years Defense Program, which is reported in

constant 2001 dollars. However, in reporting the individual tactical aircraft program acquisition cost estimates, we used Congressional Budget Office estimates that were in constant 2000 dollars. Modification costs for specific aircraft types were based on service estimates in then-year dollars. The types of dollars used are identified in the briefing sections of the report.

We performed our review from December 1999 through November 2000 in accordance with generally accepted government auditing standards.

Comments From the Department of Defense



ACQUISITION AND
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3000 DEFENSE PENTAGON
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30 JAN 2001

Mr. Allen Li
Director, Acquisition and Sourcing Management
U. S. General Accounting Office
Washington, DC 20548

Dear Mr. Li:

This is the Department of Defense's response to the General Accounting Office draft report, "TACTICAL AIRCRAFT: Modernization Plans Will Not Reduce Average Age of Aircraft," dated December 20, 2000 (GAO Code 707463/OSD Case 3021). The DoD partially concurs with the GAO's recommendation in the draft report.

Comments on the recommendation and additional comments for accuracy and clarification are enclosed.

The Department appreciates the opportunity to comment on the draft report.

Sincerely,

George R. Schneider
Director
Strategic and Tactical Systems

Enclosure



Appendix II
Comments From the Department of Defense

GAO DRAFT REPORT, Dated December 20, 2000
(GAO Code 707463/OSD Case 3021)

“TACTICAL AIRCRAFT: Modernization Plans Will Not Reduce Average
Age of Aircraft”

DOD COMMENTS ON THE DRAFT GAO REPORT RECOMMENDATION

RECOMMENDATION: The GAO noted that: "The upcoming Quadrennial Defense Review provides an opportunity to assess whether the issue of aging requires concerted attention." Therefore the GAO recommended that if DOD considers reducing the average age of tactical aircraft as a critical goal for modernization plans, the 2001 Quadrennial Defense Review should consider alternatives to the current tactical aircraft modernization plans to achieve this goal. (p. 5/GAO Draft Report)

DoD RESPONSE: Partially concur. The Department agrees that the upcoming Quadrennial Defense Review is a good opportunity to review the aging of our tactical aircraft. The age of our tactical aircraft is only one of many issues that will need to be analyzed during the Quadrennial Defense Review. Many other factors, including aircraft effectiveness and survivability, must be considered in this analysis.

ACCURACY AND CLARIFICATION ISSUES

ISSUE 1: Page 4 of the draft report states: "We also observed that DOD and the Services' approved financial plans for 2001 and future years did not include funding for structural modifications that the Services believe are essential for maintaining certain tactical aircraft in the force."

DoD RESPONSE: The Department's proposed aircraft force structure and inventory plans take into account an appraisal of projected service life. Because many individual aircraft types currently are operating at an average service life that exceeds any prior experience, it is difficult to anticipate specific supportability needs. The Department has given considerable attention to the need to accurately understand the readiness and support implications of an aging aircraft force. A series of initiatives has been taken to better understand aging aircraft issues, to make needed repairs and upgrades, and to hedge against unforeseen problems.

For example, the Air Force has initiated—as requested by the F-16 Program Director—the Falcon SStructural Augmentation Roadmap (STAR) program to ensure that all F-16C/D fighter aircraft are structurally sound and capable of fulfilling operational demands. In the FY01 President's Budget, initial funding for USAF Falcon STAR efforts was approved (\$1.5M). The follow-on funding requirements (FY02-07) are being addressed in preparing the President's FY02 budget. We expect Falcon STAR to be fully

Now on p. 5.

Appendix II
Comments From the Department of Defense

funded (FY01-07), as requested by the F-16 Program Director. Funding outside the Fiscal Year Defense Plan (FYDP) has been identified and will be programmed later. Similarly, the Navy has initiated a comprehensive series of analyses to understand service-life issues in the F/A-18C/D fighter/attack aircraft. Funding for the remaining needed F/A-18C/D service-life extension efforts will be considered in preparing the FY03 defense budget. The total funding level can be estimated only after completion of the new Service Life Assessment Program (SLAP), however. The SLAP analysis, which will run for about two years, will evaluate the full structural implications of the service-life issues that have appeared recently.

The Department has structured new aircraft procurement programs specifically in light of service-life projections for the existing aircraft fleet. The Joint Strike Fighter (JSF) program was conceived during 1993-1995 to provide a large number of aircraft, built at a high annual rate, to replace a large number of aircraft that were delivered at high annual production rates during the 1980s. The Department also has taken steps to hedge against unforeseen difficulties. As a hedge against potential delays in JSF, the Department directed in 1996 that a reserve of inactive F-16s (today numbering 100 aircraft) be maintained in secure storage. These F-16s could be remanufactured relatively quickly as part of a response to unforeseen new service-life problems prior to the time that JSF production is in hand. In response to recent F/A-18C/D service-life concerns, the Navy plans to operate some F-14s and F/A-18A/Bs longer than previously planned, as well as to activate some F/A-18E/F units earlier.

ISSUE 2: Page 3 of the draft report asserts that "DoD does not have consistent and reliable information and predictive tools to better isolate the effects of aging on readiness and operating and support costs." Although military leaders have testified that age "significantly contributes to decreased readiness and increasing operating and support costs," they also recognize that "it is difficult to quantify." The report also states that the "services currently use standard DoD reliability and maintainability measurements that can be influenced by factors other than aircraft age, making them less effective tools to predict and plan for the future effects of age."

DoD RESPONSE: The DoD is operating many aircraft at a service life that is unprecedented in length. Overall, increasing age appears to correlate with increased operating costs and reductions in readiness levels. Past attempts to anticipate specific future support needs sometimes have failed to anticipate the range and extent of problems encountered, however. Accordingly, there is some uncertainty in the support needed to ensure adequate readiness and maintainability of these aircraft. The different operational deployment circumstances of the military services' aircraft fleets contribute to differences in technical material practices, readiness assessment, and support needs. The Department has been developing tools to assess the affect of aging upon maintenance costs. Subsequent to this draft report, the Navy has received an analysis that correlates the impact of aircraft aging with increased maintenance requirements.

Now on p. 4.

GAO Contact and Staff Acknowledgments

GAO Contact

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Acknowledgments

In addition to the name above, Michael J. Hazard, Gaines R. Hensley, and Patricia W. Lentini made key contributions to this report.

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