# CBO TESTIMONY

Statement of
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on
Modernizing Tactical Aircraft

before the
Subcommittee on Airland
Committee on Armed Services
United States Senate

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NOTICE

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Mr. Chairman and Members of the Subcommittee, I appreciate the opportunity to discuss the Department of Defense's (DoD's) plans for tactical aviation. Fighter aircraft in the Air Force, Navy, and Marine Corps represent a major part of U.S. combat capability. But maintaining that capability will be costly. DoD plans to purchase more than 3,700 new tactical fighters over the next 27 years at a combined cost of almost $340 billion, according to Congressional Budget Office (CBO) estimates. As you requested, my testimony today addresses the following questions:

- How balanced are DoD's tactical aviation plans? Do they purchase aircraft in sufficient quantities to halt fleet aging? Will DoD need to reduce the numbers of its tactical fighter forces or to equip them less generously in the future?

- Are the plans affordable, or does it appear that funds for tactical aviation could squeeze out other priority programs absent significantly increased funding for purchases?

- How do this year's budget submission out-year assumptions and estimates affect the execution of the tactical aviation modernization plan?

- Do DoD's plans for tactical fighters and other strike assets represent the best and most efficient resource mix?

- What is your assessment of the attempts to reconcile the differences in cost estimating methodologies that have led CBO and DoD to reach different conclusions about overall affordability of the tactical aviation modernization program?

My statement focuses on the costs and affordability of DoD's current plans and whether those plans, if carried out, would buy enough aircraft to meet requirements and keep fleets from growing older. However, CBO has not attempted to construct or analyze alternatives to those plans.

## DoD'S PLANS FOR U.S. TACTICAL AIR FORCES

The Air Force, Navy, and Marine Corps all employ fixed-wing fighter and attack aircraft that perform the air-superiority mission against enemy fighter planes as well as the strike (or attack) and close air support missions of attacking targets on the ground. Current plans call for the equivalent of about 20 wings of tactical fighters in the Air Force. Eleven wings operating from the Navy's large-deck carriers and four wings in the Marine Corps also contain fixed-wing fighter and attack aircraft. To fill out the fighter wings in the Air Force and meet the fighter and attack requirements in the Navy and Marine Corps, DoD needs about 3,500 aircraft.

Six kinds of fighter and attack aircraft make up DoD's current inventory. Most of the Air Force's fleet consists of F-16s (a small, relatively inexpensive, multipurpose plane that performs both fighter and attack roles) and F-15s (a larger, more capable, more expensive fighter). A-10s also perform the close air support role in the Air Force. Much of the Navy's and Marine Corps's inventory consists of F/A-18s, a multipurpose plane that operates both in Navy carrier-based air wings and in Marine Corps fighter squadrons. The F-14, another carrier-based aircraft, is retiring from the Navy's fleet. The Marine Corps also operates the AV-8B Harrier, which can take off in short distances and land vertically—the so-called short takeoff vertical landing (STOVL) capability.

DoD's plans for modernization call for replacing all of those planes with three types of aircraft: the F-22, the F/A-18E/F, and the Joint Strike Fighter (JSF). All three planes are designed to be more effective than the planes they will replace. DoD plans to acquire 339 F-22s for the Air Force and 548 F/A-18E/Fs for the Navy (see Table 1). DoD plans to buy 2,852 Joint Strike Fighters (JSFs)—a multipurpose plane being developed for all three services as well as for the fighter fleets of several other countries.

CBO estimates that the total cost to develop and procure all of those planes will amount to almost $340 billion in 2000 dollars (see Table 2). That estimate

TABLE 1. DoD'S PLANS FOR TACTICAL FIGHTERS AND ATTACK AIRCRAFT

| Aircraft | Aircraft It Will Replace | When It Will Enter Force in Bulk | Primary Missions[a] | Quantity |
|---|---|---|---|---|
| | | **Navy** | | |
| F/A-18E/F | F/A-18A-D | 2000-2005 | Multirole | 548 |
| JSF | n.a. | Early 2010s | Deep Interdiction[b] | 480 |
| | | **Marine Corps** | | |
| JSF | F/A-18, AV-8B | Early 2010s | Close Air Support[b] | 609 |
| | | **Air Force** | | |
| F-22 | F-15A-D | 2000-2010 | Air Superiority | 339 |
| JSF | A-10, F-16[c] | Early 2010s | Multirole | 1,763 |
| | | **DoD Total** | | |
| All Fighters | n.a. | n.a. | n.a. | 3,739 |

SOURCE: Congressional Budget Office.

NOTE: DoD = Department of Defense; JSF = Joint Strike Fighter; n.a. = not applicable.

a. Primary missions are those that the planes are most likely to perform or for which they were designed. Aircraft may perform other missions.

b. The JSF will be required to perform other missions.

c. The JSF may also replace the F-15E and F-117. The Air Force has not made a formal announcement about how it plans to replace its interdiction aircraft.

TABLE 2. COSTS OF PLANNED TACTICAL FIGHTERS AND ATTACK AIRCRAFT

| Aircraft | Procurement: Unit Cost (Millions of 2000 dollars) | Procurement: Total Cost (Billions of 2000 dollars) | RDT&E Costs (Billions of 2000 dollars) | Total Acquisition Costs (Billions of 2000 dollars) |
|---|---|---|---|---|
| | | **Navy** | | |
| F/A-18E/F | 70 to 74 | 38.6 to 40.7 | 6.0 | 44.6 to 46.7 |
| JSF | 53 to 78 | 25.4 to 37.6 | 10.3 to 12.0[a] | 35.7 to 49.6[a] |
| | | **Marine Corps** | | |
| JSF[b] | 52 to 77 | 31.5 to 46.7 | c | 31.5 to 46.7 |
| | | **Air Force** | | |
| F-22 | 105 to 124 | 35.7 to 41.9 | 24.7 to 25.3 | 60.4 to 67.2 |
| JSF | 43 to 65 | 75.0 to 115.0 | 10.3 to 12.1[a] | 85.3 to 127.1[a] |
| | | **DoD Total** | | |
| All Fighters | n.a. | 206.2 to 281.9 | 51.3 to 55.4 | 257.5 to 337.3 |

SOURCE: Congressional Budget Office.

NOTES: The low number in the range in the estimates is based on the Department of Defense's funding estimates or price goals. (DoD's estimate for the Joint Strike Fighter was expressed as a unit flyaway cost, a lower level of estimation than used here.) The high number is CBO's estimate of the price of the plane based on historical patterns among price, weight, and performance.

RDT&E = research, development, test, and evaluation; JSF = Joint Strike Fighter; n.a. = not applicable; DoD = Department of Defense.

a. According to DoD's price goals, the total U.S. development cost for all three versions of the JSF will be $20.6 billion. Foreign nations will contribute an additional $1.4 billion. The department also assumes that the Air Force and the Navy will split development costs. CBO estimates that development will cost $24.1 billion and assumes that the Air Force and Navy will each pay half of the cost.

b. The United Kingdom plans to purchase JSFs with a design similar to that used by the Marine Corps.

c. The development cost for the Marine Corps variant of the JSF is included in the Navy JSF program.

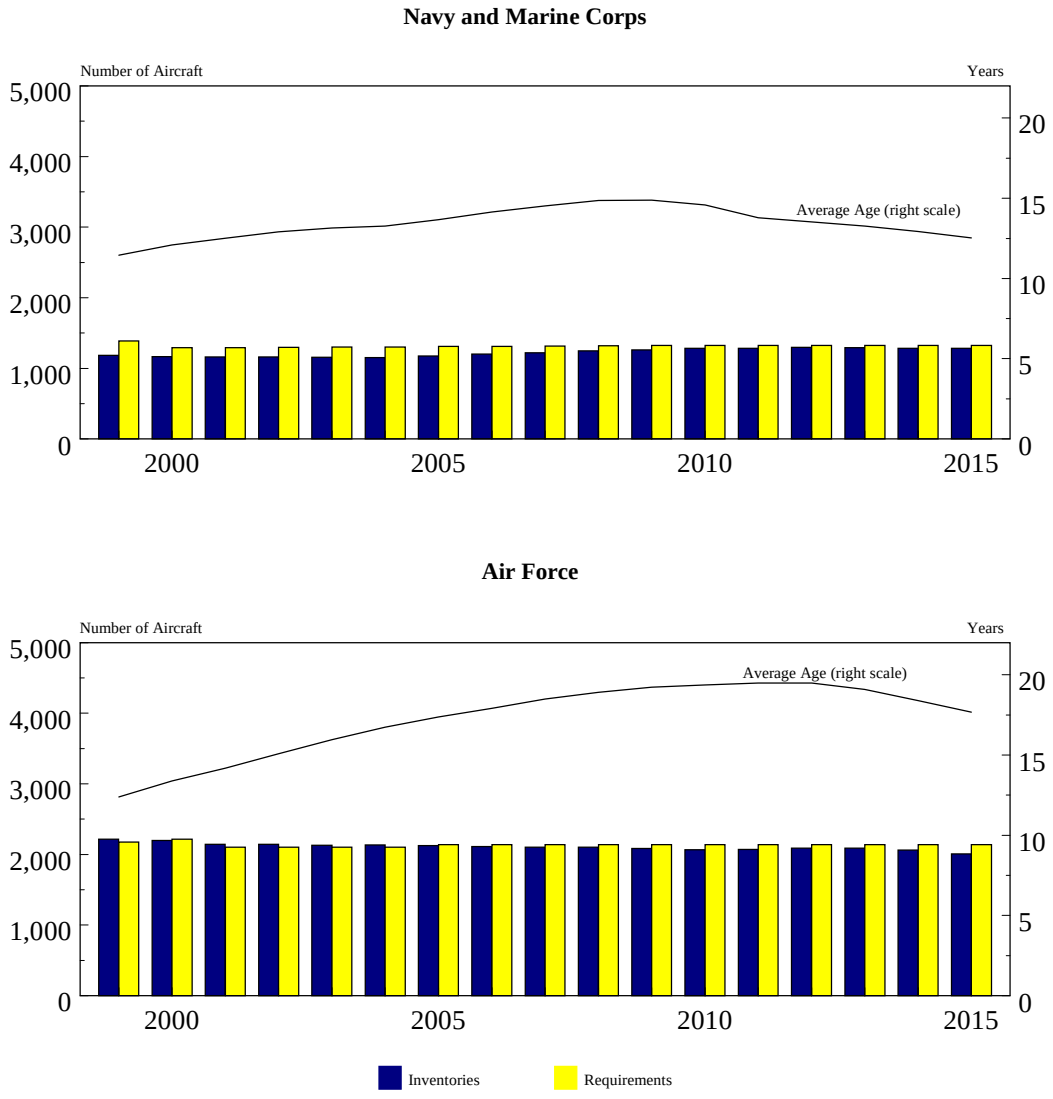
includes total funds for development and procurement and is based on DoD's planned purchases. Only about half of the 3,739 planes would be bought through 2015.

DoD plans to increase spending for those fighters. In this year's budget request, it asked for approximately $4.8 billion to purchase the F/A-18E/F and the F-22 as well as about $1.8 billion for advanced fighter development and $253 million to buy 10 F-16s for the Air Force. Development and procurement funding for new fighters in the six-year period of the current Future Years Defense Program will average about $9.1 billion per year, with purchases making up about $6 billion of that amount.

## DoD'S PLANS BUY ENOUGH AIRCRAFT TO KEEP INVENTORIES IN BALANCE WITH REQUIREMENTS BUT NOT TO HALT FLEET AGING

DoD's planned purchases of F-22s, F/A-18E/Fs, and JSFs will replace most of the military's older fighter aircraft as they retire from service. Those purchases will also keep total inventories of fighters within about 200 planes of total requirements between now and 2015 (see Figure 1, which shows inventories, requirements, and average ages for Navy and Marine Corps tactical fighter fleets and for fleets in the Air Force).

FIGURE 1. FIGHTER AND ATTACK AIRCRAFT INVENTORIES, REQUIREMENTS, AND AVERAGE AGES




SOURCE: Congressional Budget Office based on data from the Department of Defense.

The services will, however, need to keep planes in the fleet for unusually long periods to prevent large shortfalls from developing over the next decade. As a result, the large number of older aircraft will drive the average age of DoD's fleets to unprecedented levels, which could increase modification costs or decrease readiness. As Figure 1 indicates, the average age of Air Force aircraft, which is 12 years today, will exceed 15 years by 2002. That average age will climb to a peak of almost 20 years in 2011 before starting to decline as Joint Strike Fighters become operational. Fighter fleets in the Navy and Marine Corps will remain younger, reaching an average age of almost 15 years in 2007. The average age will increase slightly through 2009 and then begin declining as those services also receive large deliveries of the Joint Strike Fighter.

The Department of Defense uses the average age of its equipment as a measure of the modernity of its fleets. In the past, service leaders have argued that older aircraft fleets will be less capable in combat, since enemy fighter fleets and air defenses will have been modernized. The services also express concern that maintenance and modification costs will rise as the fleet ages and that older weapons could develop unexpected defects that could render them unavailable for conflict unless major, and perhaps time-consuming, modifications or overhauls are completed.

The first concern—obsolescence in the face of an improving threat—may be less of an issue today, at least in comparison with the Cold War years. No current enemy comes close to matching the efforts of the former Soviet Union to develop and buy sophisticated weapons. The services, however, plan to retain some fighters for 20 years or more, and ensuring that obsolescence will not be an issue is much harder over that length of time.

The other two concerns that the services have raised in the past may have received support from recent research. Until recently, DoD was unable to document an empirical relationship between the age of its fleets and the increased costs to operate them, perhaps because the services had few aircraft that greatly exceeded previously experienced retirement ages. Several recent studies, including one by RAND, have begun to document (for larger aircraft such as tankers and commercial transports, at least) some effects of aging on maintenance requirements that would affect both operating costs and the time that systems are down for repair. The RAND analysis suggests that maintenance requirements increase with age and rise sharply after fleets reach an average age of 30 years.

Under current plans, DoD would not purchase enough planes to halt aging for much of the period of CBO's analysis. DoD purchased more than 300 planes a year, on average, over the 20-year period between 1974 and 1993. By contrast, annual

procurement averaged only 44 planes over the past six years and is expected to rise to 72 planes between 2000 and 2005.

CBO's analysis suggests that even under fairly optimistic assumptions about service lives, the department will need to purchase roughly 175 fighter and attack aircraft per year to sustain today's force levels at an average age that is roughly half the age at which the services now expect their fighters to retire. DoD's purchases will not reach that level until the end of the next decade. The aging trends in Navy and Marine Corps fleets will not abate until the end of the next decade, when DoD's purchases of F/A-18E/Fs and Joint Strike Fighters begin entering the fleets in quantity. Air Force fleets will continue to age until 2011, when more than 70 F-22s and JSFs are scheduled to be delivered.

Those JSF purchases could easily be delayed, however. The JSF is scheduled to complete development and enter production about six years from now. Its schedule includes a very short development period for a fighter, compared with recent experience, so a delay in the program would not be surprising. If that happens, the aging of DoD's fighter fleets will continue unchecked until deliveries of the JSF or a replacement begin.

Aging could exacerbate problems for fighter fleets. If older fleets proved to be susceptible to problems with unanticipated structural fatigue, readiness could

decline. If old planes required modifications, they could add substantially to overall funding requirements.

## DoD'S PLANS COULD BE DIFFICULT TO AFFORD WITHOUT CHANGING SPENDING PATTERNS

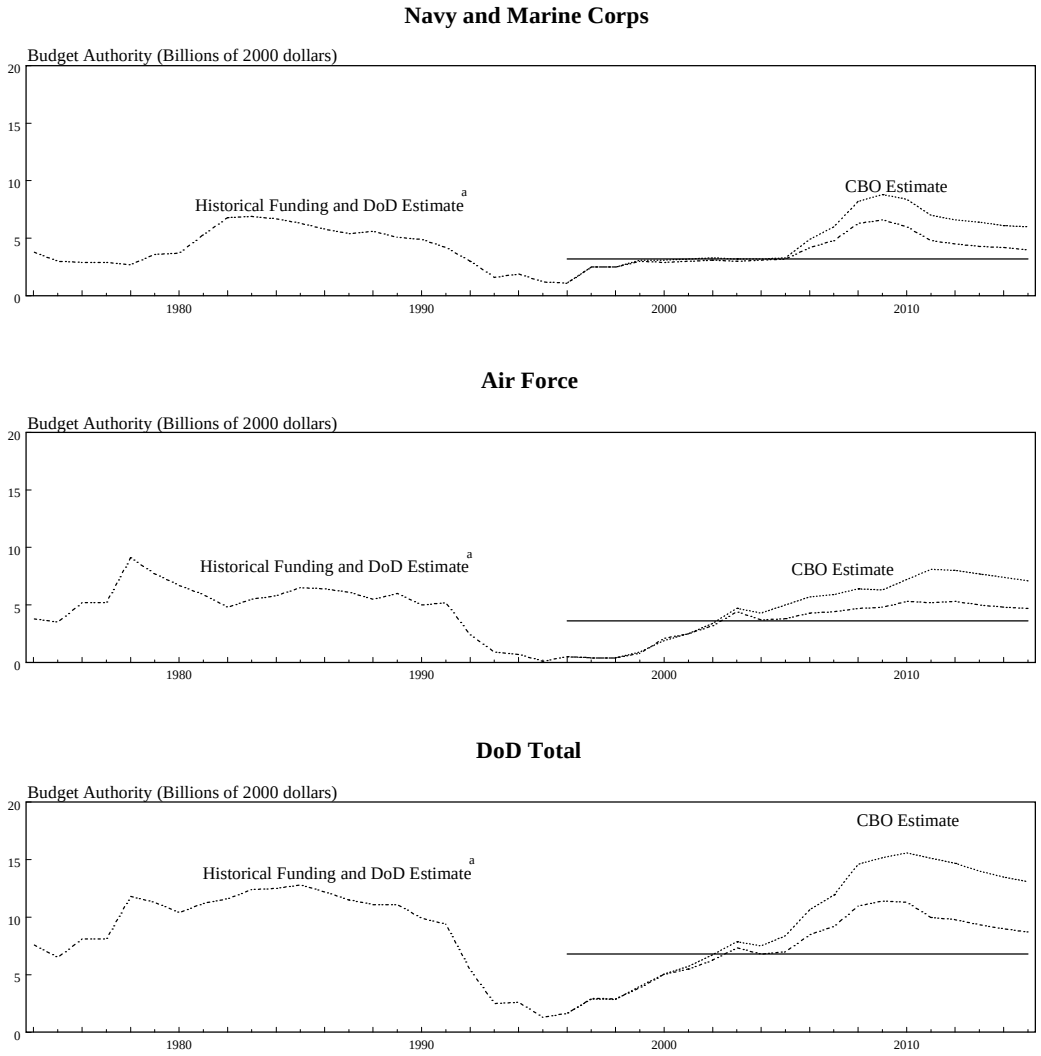
Adding to funding for fighter planes could pose serious difficulties, since the Administration's plans to modernize may already be difficult to afford. Affordability could become an issue for several reasons. First, DoD's fighters may prove to be more expensive than the department expects. Second, competing demands for purchases of other systems could make it difficult to allocate the large shares of future service budgets that would be required to procure planned quantities of fighters. Finally, DoD might not be able to increase procurement budgets as much as it anticipates. Such increases are predicated on finding efficiencies in other parts of the defense budget that have been elusive in the past. They are also based on increases in total defense spending that are tied to offsets elsewhere in the federal budget that are not assured.

CBO's analysis suggests that DoD's expected purchase prices may be optimistic. CBO made two projections of fighter costs—one based on DoD's expectations about development and procurement funding for fighters and the other

based on historical relationships between fighter prices and such factors as weight and capability (see Table 2). (The department has not yet released yearly costs for the Joint Strike Fighter program, though it has provided annual quantities and estimates of total development and procurement costs. Thus, CBO had to estimate the yearly funding associated with DoD's current cost estimate for JSFs.) If historical relationships hold true for the new fighters, DoD might need about $4 billion more to develop its planned aircraft and about $76 billion more to purchase them from today through 2026, when the last JSF would be bought.

Average yearly spending for fighter procurement would also be greater. If DoD's estimates of procurement costs proved too optimistic, annual spending for fighter purchases could average about $14 billion over the 2006-2015 period (see Figure 2 for the phased estimates that have that annual average). Even if costs were kept to the levels in DoD's current estimate, the department would need to spend about $10 billion per year over that period (CBO focused on procurement costs because it has no basis for estimating the development costs that DoD would pay for the generation of fighters that follows the F-22, F/A-18E/F, and JSF.)

FIGURE 2. HISTORICAL AND PROJECTED FUNDING FOR FIGHTER AND ATTACK AIRCRAFT




SOURCE: Congressional Budget Office based on data from the Department of Defense.

NOTES: The solid line from 1996 to 2015 represents funding if fighter procurement receives the average share of service budgets that it received over the 1974-1999 period and budgets rise to the levels projected for 2005.

DoD = Department of Defense.

a. Estimate is based on DoD's goals.

Spending $10 billion a year would require DoD to devote a much larger share of funding to fighters than it has in the past. On average during the 1974-1999 period, the Air Force and the Navy spent 4.3 percent and 3.6 percent, respectively, of their annual budgets on purchasing fighter aircraft. If the services kept to those past averages in the future (assuming that their budgets grew to the levels that are projected in current plans for 2005 and remained at those levels through 2015), they would spend a total of about $6.8 billion for fighter aircraft each year. Thus, funding fighter budgets that averaged $14 billion—the higher of CBO's two estimates of future funding—would require the services to devote about twice the share of funding to fighters in the future that they have in the past.

Even if its budget does not grow, DoD can devote a larger share of future budgets to fighter purchases by spending less in other areas. If DoD decreased spending for purchases of other types of equipment, spending on fighters could rise. But the department expects to increase modernization spending in other areas too. Spending on Navy ships, modernization programs in the Army, and tilt-rotor planes for the Marine Corps, for example, is scheduled to rise during the same period that fighter purchases increase. As a result of those and other plans, DoD might have difficulty boosting the share of modernization funding it spends on fighters in the future.

Alternatively, DoD could increase funding for fighters by making cuts in operating spending. It had expected to use such savings to pay for previously planned increases in procurement. But so far the department has not been able to cut spending on operations without cutting forces. And few defense leaders in either the Congress or the Administration support further force reductions.

## OUT-YEAR ASSUMPTIONS IN THIS YEAR'S BUDGET COULD AFFECT THE ABILITY TO MODERNIZE TACTICAL AVIATION

DoD could spend more on fighters, without altering shares, if its total budgets grow. DoD's aggregate budget submission already contains modest increases in the years beyond the budget year, part of which are allocated to increases in the funds spent on purchases.

But DoD might find it difficult to realize the plans it proposed with its 2000 budget request. Much of the increase in the out-years of this year's budget submission are assumed to come about as part of the Administration's proposed framework for revising Social Security. Yet the Administration and the Congress have not agreed to that framework.

## DO DoD'S PLANS FOR TACTICAL FIGHTERS AND OTHER STRIKE ASSETS REPRESENT THE BEST AND MOST EFFICIENT MIX OF RESOURCES?

A 1997 study by CBO, *A Look at Tomorrow's Tactical Air Forces*, evaluated the costs and effects of various tactical fighter purchases. It considered several alternatives that would provide significant capability at lower cost than DoD's plans. But CBO did not attempt to conduct a cost-benefit analysis that would determine the most efficient mix of strike systems.

DoD operates a number of weapons that can perform strike missions. Those weapons include land- and sea-based cruise missiles and attack helicopters. Unmanned aerial vehicles (UAVs) may also add to DoD's array of weapons that can attack targets on the ground.

Selecting the most efficient mix among those systems depends on a number of factors. Questions that might need to be addressed include the following: What specific missions are strike forces expected to perform? When and where would those missions take place? What assumptions should be made about the quantity and quality of the enemy forces the United States would confront? And what are the performance characteristics of the systems considered (including systems belonging to enemy forces), such as stealth, range, precision-weapons guidance, and sensor performance? The most efficient mix would also depend on assumptions about

weapons costs, including how much costs are affected by those performance characteristics.

Finding answers to all of those questions is very difficult. But without those answers, determining the optimum force mix may be impossible. Those issues are widely debated in the defense community, however, so reaching consensus on a mix could be equally difficult.

## DIFFERENCES BETWEEN CBO'S AND DoD'S ESTIMATES OF FUTURE FIGHTER COSTS

As mentioned earlier, CBO and DoD have reached different conclusions in the past about the overall affordability of DoD's program to modernize tactical aviation. The difference between those conclusions depends in part on different projections of the cost of new aircraft.

Some people within the defense establishment, particularly at the program offices and contractors, argue that the new tactical aircraft programs will be able to deliver aircraft at cheaper prices because industry will use new manufacturing processes and new business practices to hold down costs. They dispute cost estimates that rely on "old methods" and "old cost history," arguing that those

estimates do not reflect the new processes and practices. But it is quite possible that standard methods do reflect those factors.

There is no one “approved” method for estimating the cost of an aircraft or any other system. Each estimator uses a set of relatively standard methods and a database of actual costs as the starting point for building an estimate. How estimators use those methods and data, and what adjustments they make to capture the peculiar aspects of the program in question, determine the estimates they produce.

For example, all cost estimators use "learning curves" to estimate how improving production methods and management, eliminating engineering and manufacturing problems, and making parts easier to produce will lower unit costs. Although estimators do not always know the exact mechanisms behind those savings, they know from experience that savings will almost always occur as production progresses and that the main issue is the extent of the savings.

Consequently, anyone attempting to estimate savings from improved business processes should first ask whether learning curves from comparable systems already capture those effects and how great the risk is of double-counting savings from that source. Second, if the chance of double-counting in the curve itself is slight, the estimator should ask whether double-counting could creep into the estimate from

assumptions about the cost of the first unit—the point of departure for subsequent "learning" or cost savings.

New designs also may entail processes that increase costs. For example, new designs that extensively employ new technologies could be more, rather than less, costly. A prudent estimator would attempt to anticipate the added costs that a program might incur to keep the technical performance of the weapon system on track. Reengineering, prolonged testing, and problems with manufacturing can all lead to increased costs.

The primary differences between CBO's estimates and those from DoD's program offices lie in the assumptions and adjustments made in arriving at the estimates—not in the basic methods or data used. CBO's estimate for the F-22 reflects the agency's assessment of initiatives to redesign parts and to reorganize purchases of materials and manufacturing processes. CBO's current estimate assumes that those activities would reduce the plane's cost by $8 billion (in 2000 dollars). In contrast, the DoD program office and the manufacturers expect $12.5 billion in savings from those same initiatives. In CBO's view, those extra savings are unproven and leave little margin for unforeseen outcomes.

In the case of the Joint Strike Fighter, DoD faces even more uncertainty because that plane is at an earlier stage of development than the F-22. Unlike the

program office, CBO bases its estimate on past relationships between the cost of an aircraft and technical characteristics such as weight and capability. The program office's estimates for unit costs and total procurement funding—on which CBO's lower estimate is based—would seem to anticipate totally new relationships among those variables. CBO believes that making such an assumption for a program at this early stage of development may be premature; the program has not even built test prototypes, no prime contractor has been chosen, and the first production aircraft are six years away under the current schedule.

How might all parties improve their estimates and thus make it more likely that they will be closer in the future? Improvements stemming from the effects of new processes await empirical evidence from ongoing production programs. At this point, most of the evidence for the effects of new processes on costs are either single examples or anecdotes. If the Department of Defense has better empirical or analytic evidence, CBO has not yet seen it.

Since the new programs that incorporate those processes are at the early stages of production, they present DoD with the opportunity to systematically and thoroughly collect empirical cost data that bear on the effects of those new processes. With proper controls for other factors, DoD may be able to isolate the effects of new business and manufacturing processes when it captures actual cost data for new tactical aviation systems like the F/A-18E/F and the F-22 (and also for the V-22, a

tilt-rotor plane that the Marine Corps is purchasing to transport its troops and equipment from ship to shore). Such data could be used in analyses that update or modify existing estimating methods. Such analyses might, in time, either prove claims about the uniquely beneficial effects of new processes or establish that such effects are already part of the historical experience reflected in learning curves and the other methods of cost estimating.

In fact, various DoD offices have already commissioned both RAND and the Institute for Defense Analyses to do research in that area, including looking into the cost of using stealth technologies. But the department must ensure that its research and the research of others is based on complete and accurate data. Although DoD already has a system in place to collect those data, some people have proposed eliminating it. That system, known as the Contractor Cost Data Reporting System, collects the actual cost and labor data associated with work in progress. The rationale for eliminating the system may be to cut administrative costs within DoD and data-collection costs among contractors. However, independent checks on the cost estimates of a program's proponents would suffer if that system was eliminated.

## CONCLUSION

CBO's analysis raises several issues relating to DoD's current plans for fighter purchases. If planned purchases actually occurred, fighter inventories would mostly meet requirements. But DoD's annual purchases over the past six years and those planned for the next six years will be substantially below the average annual purchases that DoD made in the past and well below the purchases DoD would require to preserve today's force levels over the long run.

Because fighter purchases have been so modest, DoD's fleets are aging to unprecedented levels. Fleets in the Air Force will eventually exceed 19 years of age, on average. Navy and Marine Corps fleets will approach 15 years. That aging occurs for Navy and Marine Corps fighter fleets through the end of the next decade, when F/A-18E/Fs and JSFs begin entering fleets in quantity. Aging occurs for Air Force fleets until 2011, when 70 F-22s and JSFs are scheduled to be delivered. But the JSF purchases could easily be delayed, causing fleets to continue to age. Fleet aging could decrease the availability of fighters for combat and could drive up maintenance costs.

Even without added costs from aging, DoD's fighter plans may be difficult to afford. If DoD receives currently planned increases in its budgets in the future—an outcome that is far from assured—it will still need to increase by 50 percent the

average share of funding it has spent on fighter procurement for more than 20 years. If it cannot hold fighter prices down, it needs to double that share. CBO's analysis suggests that DoD may have great difficulty holding fighter prices down as much as it expects. Doing so will require manufacturers to develop totally new relationships between price and performance, which are not yet substantiated.