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HARD CHOICES
Fighter Procurement in the Next Century

by Williamson Murray

Executive Summary

The Pentagon is proposing three fighter programs over the next three decades. The cost of those programs will exceed $300 billion. Yet serious doubts exist about whether the proposed purchases will address the strategic challenges that the United States will face in the next century. Given a constrained defense budget, the lack of a peer competitor, and the return of American forces to North America, the United States confronts a strategic framework substantially different from that of the Cold War.

Moreover, it is unlikely that any enemies that U.S. forces might confront will challenge the United States directly for control of the air. The F/A-18E/F--with its lack of range and its high cost--is not what the U.S. Navy needs. It is doubtful that the Air Force needs the expensive F-22 when it is unlikely that any potential opponent could counter the Air Force's existing F-15s. The Joint Strike Fighter should be purchased, but its purchase delayed. And it is unclear whether the JSF can fulfill the Air Force's need to replace the F-16, the Navy's need for a stealth aircraft, and the Marines' desire for an aircraft with short takeoff and vertical landing capabilities. Considering the Department of Defense's other procurement requirements over the coming three decades, it is unreasonable for the Pentagon to procure expensive high-tech fighters in the proposed numbers and at a cost that will severely limit its other weapons purchases. Thus, two of the three fighter programs--the F-18E/F and the F-22--should be canceled and efforts concentrated on the more futuristic JSF.

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Introduction

In early 1997, according to the Congressional Budget Office, the United States planned to spend approximately $350 billion over the next three decades to research, develop, and acquire fighter aircraft for the U.S. Air Force, the U.S. Navy, and the U.S. Marine Corps. During that time the three services would have acquired approximately 4,400 fighter aircraft. The Quadrennial Defense Review (QDR) later reduced the number of aircraft on order, but not by much.[1] The bill now totals about $300 billion, provided there is no significant cost increase, especially for the Joint Strike Fighter (JSF). Given the likely strategic environment over the next several decades, it is unfortunate that there has been no substantive examination at the highest levels of government of what is possible, or even desirable, for fighter procurement in the present political climate.[2]

Three Fighter Programs on the Books

Three major fighter programs are now on the books. The Navy's F/A-18E/F fighter--a replacement for the F-14s and eventually the F/A-18C/Ds already in the fleet--has begun limited production. The Air Force's F-22--a replacement for the F-15 "Eagle"--will soon begin production. And the JSF, which the Air Force, Navy, and Marines will eventually procure if the program continues on track, is in the early design stages; the first preproduction models will be delivered in 2005. Purchases of the three aircraft will continue well into the third decade of the 21st century. If the programs remain as planned, they will use up a large share (well over 25 percent) of the Pentagon's funding for new weapons systems.[3] The DoD is now rapidly approaching the point of no return in the production of two of those systems. The Navy's F/A-18E/F program is already accelerating, with procurement of 20 aircraft for fiscal year 1998 (at a cost of $2.4 billion) and 30 additional F/A-18E/Fs in 1999 (at a cost of approximately $3 billion).[4] The Pentagon has scheduled procurement to reach 36 aircraft ($3.1 billion) by 2000 and 48 aircraft ($3.1 billion) by 2002.[5]

The story is similar for the F-22. The first two stealthy supersonic fighter aircraft were purchased in FY99. In 2003 the Air Force will begin receiving 24 of those fighters per year at a cost of $4.3 billion.[6] Consequently, any major changes in the DoD's plans for fighter procurement must occur soon. The history of such procurement programs suggests that, once started, they are

almost impossible to stop. The Air Force's B-2 is perhaps the only example of a major weapons program that the Pentagon stopped after substantial production had begun.[7] Moreover, the cancellation of either the F-22 or the F/A-18E/F after 1999 would leave the DoD with small numbers of already procured aircraft. Merely decreasing the procurement levels of all aircraft types each year would substantially increase per unit costs.

Fighter Programs Must Be Seen in a Larger Context

Given the fact that the strategic environment has undergone radical changes as a result of the demise of the Soviet Union and most of its client states, it seems useful to examine the fighter programs from a number of angles. The largest issue is where fighter aircraft should fit within the framework of American strategy in the next century. Here the international as well as the internal political context of American defense planning is of considerable significance. The first section of this paper addresses the most likely strategic and political framework within which U.S. foreign and military policies must exist, as well as the historical background through which the United States has come to place such heavy emphasis on fighter aircraft. The second section of the paper addresses the issues involved in the expenditure of scarce capital for the various fighters that the Pentagon wants to procure. In other words, what is the framework--strategic, operational, and tactical--for the fighter programs: what are the services buying, and what are their arguments for such purchases? The discussion then turns to the opportunity costs of the programs: what will the U.S. defense budget have to give up to realize even a portion of the fighter procurement programs that the services are so vigorously pursuing?

In the coming century the United States will confront a number of disparate, ambiguous challenges. The budget with which to meet those challenges will probably be severely constrained, especially compared with expenditures during the Cold War.[8] Moreover, while the service fighter fleets confront the systemic problem of aging aircraft, the same issue confronts virtually every weapons system in the inventory. As a result, the Navy plans new combat and amphibious ships; the Army plans new artillery and helicopters; and the Marines plan an ambitious program of force modernization, particularly the V-22 vertical lift transport and the new advanced amphibious vehicle.

In the current budgetary environment, there are no easy choices among weapon systems. In fact, as it does with all things connected with war, American defense policy confronts "an option of difficulties."[9] Unfortunately, hard choices are not inherently part of the American culture. Fortunately, there is no clear and present danger to the vital interests of the United States, particularly in comparison to the Cold War. But not making such hard choices now may well have a disastrous impact on the ability of the United States to defend its vital interests in the next century.

The Emerging Strategic Environment

Since the demise of the Soviet Union, one of the major difficulties that the U.S. military has confronted has been the absence of a clear national strategy that rests on a realistic assessment of the strategic environment. The Pentagon's response has been to devise a requirement for the ability to fight two major theater wars concurrently. But in no sense does that approach represent a real strategy for framing defense policy. The National Defense Panel has recently indicated, quite correctly, that it

> views the two-military-theater-of-war construct as a force-sizing function and not a strategy. We are concerned that this construct may have become a force-protection mechanism--a means of justifying the current force structure--especially for those searching for the certainties of the Cold War era.[10]

There has been considerable discussion of the emerging strategic environment--in the U.S. defense community, much of it ahistoric and technophilic.[11] For the most part, the debate has focused on the appearance of peer competitors (even regional competitors) in the relatively near future. The trouble with such arguments is that they are largely unrealistic. Those who might possess the technological, industrial, and economic capabilities, the Europeans and the Japanese, for example, have few political or strategic reasons to seek a contest with the United States. In addition, the continued collapse of the Russian state and its military make it doubtful that Russia could reemerge as the Soviet Union in new form, much less pursue an aggressive foreign policy.[12] The real threat from Russia has more to do with its weaknesses than with its strengths.

China remains the true wild card in the next century. The Chinese have already exhibited considerable troublemaking potential, and China's explosive economic growth heralds the possible emergence of another superpower.[13] Equally significant, the Chinese have never renounced their claims to territories once under their nominal control. Thus, they maintain claims to much of Siberia, Central Asia, substantial portions of Southeast Asia, and the seas lying to the east and southeast of the Chinese mainland. The Chinese have already taken measures to substantiate those last claims.[14]

But China is not likely to use its military beyond the areas immediately contiguous to its frontiers--where it is unlikely that the United States will have many substantive interests. The reason for that has to do with the fact that the Chinese military forces are simply not in the same league as the world's technologically advanced forces, a fact the Chinese largely recognize.[15] Moreover, the Chinese possess little capability to project military power beyond their frontiers. And that situation is unlikely to change in the foreseeable future.[16]

Thus, a real peer competitor seems a remote possibility for at least the next three decades and perhaps for as long as half a century. The implications for U.S. military organizations are profound. At worst, the lack of a peer competitor makes it likely that the United States will confront second-world or Third World military organizations that possess high-technology weapons but not the doctrine, training, and military culture necessary to use them within a coherent operational framework. This is not to argue that such regimes will not have the capacity to inflict substantial damage on U.S. interests. But the threats will probably be asymmetric--that is, those military organizations will attempt to use inexpensive means to attack U.S. weaknesses rather than attempt to match expensive U.S. technology.

The American Situation

For now America's strategic position in the world is quite favorable, particularly compared with our position during the Cold War. No peer competitor is on the horizon, and the beating that U.S. forces inflicted on Iraq makes it unlikely that regional troublemakers will challenge the United States for a long time. Nevertheless, serious problems with U.S. defense policy seem to be insoluble, given current service cultures and expectations.

The most worrisome problem seems to be the unwillingness of much of the U.S. military to recognize that fundamental changes have occurred and are still occurring in the underlying strategic and political framework within which they cast their force structures. The most important change is not that defense budgets have decreased significantly over the past decade. Rather, it is the prospect that they will be constrained or even decline well into the next century.[17] At present, budgetary surpluses seem to have alleviated some of the pressures. But as the U.S. population ages, Social Security and Medicare will put severe pressures on the federal treasury.

Even if the politicians skillfully manage that budgetary crisis, the financial pressures on the budget will probably restrict substantive increases in defense funding. However, the services seem not to have endeavored to keep acquisition plans within realistic funding limits. Thus, the warning is posted for a train wreck of considerable proportions.[18]

Another crucial strategic factor in the defense equation is that since 1991 a substantial number of U.S. troops stationed on foreign bases have returned to the United States. That trend will continue.[19] On the one hand, the American electorate will see less reason to station U.S. troops on foreign soil, while, on the other hand, first-world democratic electorates will become less desirous of the continued presence of those troops.[20]

That trend is already apparent with the Marine air and ground units stationed in Okinawa. Fortunately, any reasonable settlement with North Korea (or the collapse of that state), combined with relatively good behavior on the part of the Chinese, will make it difficult for democratically elected governments in Korea and Japan to justify to their people the continued presence of U.S. troops. A similar situation could obtain in Europe, particularly if the Balkans settle down. However, if conditions worsen, which would make the Europeans more amenable to the continued presence of U.S. troops, policymakers in Washington will be opposed by Congress and the American electorate, who have doubts about commitments to countries with problems that do not directly affect U.S. security interests.

Moreover, in any overseas crisis involving U.S. vital interests, some doubt also exists about whether forward-deployed troops and equipment on foreign bases can actually be used. The United States discovered in the 1986 raid on Libya that it could not obtain access to French and Spanish air space, so F-111 fighter-bombers flying from

England had a long and tortuous route around French and Spanish territory. But the 1986 Libyan raid was only a repeat performance of the 1973 airlift to Israel, during which every European ally except Portugal refused to allow the United States to use bases on its territory to aid the hard-pressed Israeli ground and air forces. Finally, in the recent crisis over weapons inspections in Iraq, the United States discovered that many of its allies in the Persian Gulf, including the Saudis, were hesitant to allow access to bases required by ground-based fighter aircraft.

At present the United States confronts complex problems that have no easy solutions. In the short run (the next three decades), U.S. military forces will have to be ready to fight in areas of vital interest to the nation. In the long run, a peer challenger may emerge. For that reason the United States needs to focus some defense preparations on a high-end threat. But most U.S. preparations need to focus on more immediate mid- to low-level threats. Here the overriding strategic problem will be to get U.S. forces to any crisis that affects U.S. vital interests as expeditiously as possible: in the words of Nathan Bedford Forrest, the U.S. military must get there "furstest with the mostest." Because much American power will deploy from North American bases, the capacity to project and support military forces from the sea and through the air over great distances must become the starting point for sizing and thinking about the U.S. military's force structure.

Fighters: Past, Present, and Future

Fighter aircraft have not always been at the center of the Air Force's conception of air power. Before World War II, Army Air Corps leaders clearly believed that fighters were superfluous to air power's real mission: strategic bombing. It took two catastrophes in the air over Schweinfurt in 1943 to persuade leaders of the Eighth Air Force that long-range escort fighters were absolutely essential to the success of any bombing campaign. Ironically, that lesson had to be relearned in both the Korean and Vietnam Wars. In the later conflict, fighter forces of both the Navy and the Air Force had to carry the burden throughout the "Rolling Thunder" and the "Lindbacker I and II" portions of the air campaign against North Vietnam. Fundamentally flawed tactical assumptions and misperceptions contributed to high losses experienced by U.S. fighter aircraft between 1965 and 1972. One result was that, at the end of the war in 1973, the Air Force,

following the Navy's lead, instituted vigorous training programs and significantly upgraded its fighter forces.

Other results of the air campaigns against North Vietnam were a major upswing in the importance of fighter aircraft in the inventories of the two services and the elevation of pilots in the fighter aircraft communities to positions of dominance in the Air Force. The Strategic Air Command still played a very important role as a deterrent with respect to the Soviet Union, but Tactical Air Command after 1972 dominated the Air Force's conceptions of combat in major as well as minor conflicts. The results showed clearly in the Persian Gulf War.

In that conflict, the Soviet Union's collapse provided the United States and its allies with an advantage of overwhelming military power and obviated the threat of escalation to nuclear war. U.S. and coalition forces had six months to deploy and prepare air and ground forces for the conflict. Moreover, the host Arab nations had already prepared excellent facilities to which Allied forces could deploy and then train to a superb level of effectiveness. The Iraqi regime, having swallowed Kuwait, sat on its hands, confident that the United States would not dare to attack a powerful and committed Iraqi nation led by Saddam Hussein. Saddam seems to have particularly miscalculated the threat that U.S. air power represented. As he suggested on American television in August 1990, "The United States depends on the Air Force. The Air Force has never decided a war."[21] Saddam also dismissed the threat of stealth aircraft. Stealth aircraft, he commented, "will be seen by a shepherd in the desert as well as by Iraqi technology, and they [the Americans] will see how their Stealth falls just like . . . any [other] aggressor aircraft."[22]

Many sources give information about the Gulf War and the contributions that air power made to the winning of that conflict.[23] But the point here is that especially favorable circumstances existed during that war. These circumstances provided U.S. fighter aircraft a favorable environment in which to employ their capabilities:

1. The enemy provided an adequate period of time for the buildup of coalition forces.

2. Coalition bases never came under serious attack.

3. A massive base structure in the Gulf nations allowed for outstanding deployment and logistical support.

4. The Iraqis, having already fought a costly eight-year war against Iran, were in no condition to withstand a sustained air and ground campaign aimed at their homeland.

5. With its vast array of air power, the coalition possessed a surplus of aircraft to cover all the target sets that its air planners wished to attack.

The question is whether the same conditions will exist in future major military confrontations.[24]

The American military's current vision of future war seems to be drawn mostly from its experiences in the Gulf War (or a misreading of those experiences). People like Adm. William Owens, former vice chairman of the Joint Chiefs of Staff, have been arguing, on the basis of the U.S. success in the Gulf War, that the American military will soon be in a position to remove friction, fog, and ambiguity from the battlefield--at least as far as its forces are concerned--and that view has spread far and wide.[25] But such claims are questionable. The advocates of battle-space dominance or dominant maneuver have focused almost entirely on the possibility of a high-tech opponent of American military forces. To a great extent, that view represents a misreading of the Gulf War.

However, the Gulf War did make a number of things clear: Air superiority matters. Stealth matters. Precision matters. Nevertheless, the questions that matter most are what kind of air power, how many stealthy aircraft, and how much precision capability does the United States need, given the demands on other crucial areas of the defense budget and the costs associated with strategic commitments and deployments of U.S. military forces? In some cases, the best choice when considering capabilities, performance, and technology may not be the best choice when considering the harsh strategic and budgetary realities that will soon confront the Pentagon.

The problem is that opponents in the next century will probably be consistently looking for asymmetric responses to U.S. military capabilities. In the aftermath of the Gulf War, an Indian defense expert was purportedly asked how he would handle the U.S. military in a conflict. His reply, "Don't fight the Americans without nuclear weapons," is particularly important because of the damage that space bursts of nuclear weapons would inflict on satellite systems.[26] Clearly, such explosions could, over time, render every civilian system in low earth orbit inoperative.[27] And there is a substantial possibility that

they would also affect most of the military systems in low earth orbit.

But nuclear weapons are not the only weapons that the U.S. military will have to consider. The proliferation of relatively accurate cruise missiles and ballistic missiles will continue. And fighter aircraft address none of those threats. The most likely avenue that any potential opponent might take to challenge U.S. air superiority would consequently not be procurement of high-tech fighters from Russia (or eventually China). The costs of training and technological support systems for fighters are high, and it is unlikely that any second-world or Third World nation could possibly match the training and skill of American pilots.[28] Instead, a more likely approach will be the purchase of relatively inexpensive cruise missiles or Scud-type ballistic missiles with which to attack the airfields where U.S. aircraft are based.[29] Moreover, biological or chemical warheads could greatly complicate the problems U.S. forces would have in sustaining operations.

Ultimately, the Gulf War is not the correct paradigm on which to base thinking about war and military force in the next century. Our opponents will follow asymmetric strategies to attack U.S. bases or to deny the United States those bases through diplomatic or political pressure, and proliferation of nuclear weapons and other weapons of mass destruction will greatly limit the option of using conventional force in many areas of the world. This is not to argue that air superiority will not be a key enabler of the projection and use of military force by the United States in the next century. But U.S. defense planners need to seriously think about what the United States needs in tactical air power and balance the need for tactical aircraft against other requirements.

Fighter Procurement in the Next Century

The key issue confronting the Pentagon's fighter procurement programs is the $300-billion-plus combined cost of the three fighter programs.[30] Each of the tactical fighter programs can find reasons to go forward, and the costs for each program may not seem excessive in isolation. But as Rep. Jim Saxton (R-N.J.) recently suggested in congressional hearings, "We need to look more generally--funding for the F-22, JSF, V-22, C-17, C-5 modernization, readiness issues. Within the framework of all the needs we have just relative to air power, how do we allocate our resources most effectively?"[31] The problem is that each service is putting its case for a new fighter in isolation

rather than in the context of DoD's overall fighter procurement program (it does not have one), much less DoD's overall procurement strategy for the next century (it does not have one, unless an unconstrained shopping list is a procurement strategy).

Given the strategic framework of severely constrained defense budgets and undefined, ambiguous threats, the current unconstrained fighter procurement programs--if they go forward--could have a devastating impact on the overall capabilities of the American military. By consuming much of the Pentagon's acquisition budget, the fighter procurement programs will delay or even kill other programs that are essential to projecting military power to deter or defeat threats to the vital interests of the United States.

The F/A-18E/F

The F/A-18E/F program has been under considerable fire since the early 1990s.[32] The program persists more as the result of serious mistakes made by the naval aviation community than because of the F/A-18E/F's capabilities. Indeed, one could argue that, if the Soviets had placed an agent at the highest levels of the U.S. Navy's aviation community in the early 1980s to sabotage aircraft procurement, the Navy would not be in much worse shape than it is today.

The original model of the F/A-18 resulted from congressional pressure in the late 1970s for the Navy to field a lightweight supplement to the more expensive F-14s that were the mainstay of its fighter force. At the same time, Congress directed the Air Force to buy a lightweight fighter to go with the F-15. Congress then directed the Navy to accept the winner of the fly-off the Air Force was conducting between the General Dynamics YF-16 and the Northrop YF-17 prototypes. The YF-16 won the fly-off, but the Navy selected the YF-17 because it had two engines and because of considerable difficulties in adapting the YF-16 to carrier operations. After extensive redesign, the YF-17 emerged as the F/A-18A/B and then the F/A-18C/D, an aircraft that both the Navy and the Marine Corps bought.[33]

The F/A-18C/D models fit rather well on the decks of U.S. carriers in the 1980s. F-14s provided long-range air defense, and A-6s provided substantial range for bombing strikes. Thus, the F/A-18C/D's lack of range did not carry too heavy a penalty, especially when there were Navy tankers operating off the carriers for refueling or when

Air Force tankers were available (as during the Gulf War). But the F-14 fighter community remained so focused on the air-to-air mission that it failed to vigorously push its aircraft as a possible strike platform. The result was the death of the F-14D, an upgraded and improved model of the F-14, largely because it came late in the Reagan buildup and because of doubts about whether it could serve as a bomber as well as a fighter. In a period of increasing financial stringency in the late 1980s and early 1990s, that was a death sentence.

At the same time, the A-6, developed in the 1950s, was reaching the end of its service life.[34] But the Navy was developing a stealthy strike aircraft, the A-12, to replace the A-6 and to significantly enhance the capacity of carriers to lie off enemy coasts and attack critical targets. Thus, the short range of the F/A-18C/D did not seem an insurmountable problem. Unfortunately for the Navy, the A-12 program turned out so badly that Secretary of Defense Richard Cheney canceled it in 1991. The Navy quickly cobbled together a replacement program, the A-X (which mutated into the A/F-X, suggesting a desire to incorporate fighter as well as attack capabilities into the aircraft). But the arrival of the Clinton administration in early 1993 and its decision to make further cutbacks in military spending resulted in cancellation of the A/F-X and the Air Force's multirole fighter and their replacement by what is now known as the JSF. The Navy was rapidly running out of alternatives, particularly because the JSF was not scheduled for production for at least another decade.

Thus, the F/A-18E/F Super Hornet has emerged as a platform of last resort.[35] The aircraft's major weakness is that for all intents and purposes it is a new aircraft, but one designed within the limitations of the F/A-18C/D airframe. The DoD simply called the F/A-18E/F a modification of an existing aircraft and thus waived the Pentagon's acquisition system's requirements for evaluation of a new aircraft and for competition among aircraft manufacturers. In fact, the Super Hornet is a new aircraft, significantly different from its predecessor. For example, the F/A-18E/F's wing is 25 percent larger than and has only 16 percent commonality (identical components and parts) with the F/A-18C/D wing.[36] Even more telling is that the Super Hornet's airframe is 85 percent different from its predecessor's and includes new engines.[37]

The explanation for the buy is that for political and economic reasons--namely, McDonnell Douglas was in serious financial trouble in 1991--the Pentagon, aided and abetted

by Congress, chose to prop up the manufacturer.[38] The decision also reflected a certain amount of desperation in the naval aviation community after cancellation of the A-12. If the F/18-E/F had been considered a new aircraft, the Navy would have had to issue a Missions Needs Statement and a Cost and Evaluation Analysis--oversight tools that the Pentagon uses to screen out inferior and unneeded systems. By maintaining that the Super Hornet represented only a modification to an existing airframe, the Navy avoided the administrative process of buying new aircraft.

Yet the F/A-18E/F possesses few advantages over the F/A-18C/D. It is not as capable in the air-to-air and air-to-ground missions as is the combination of A-6s and F-14s that it is replacing on the carriers. It has significantly less range and payload than the A-6, which has been the backbone of naval attack aviation for the past three decades. Moreover, it has less range and fewer air-to-air capabilities than the F-14. In aerodynamic terms, the F/A-18E/F does not even compare well with the Soviet MiG-29, which entered service five years before the demise of the Soviet Union. A Canadian test pilot who has flown both aircraft has reported that the MiG-29 is far superior--not a great endorsement for an aircraft that may face greater air-to-air threats in the next century.[39] Not a single country has lined up to buy the aircraft, which is also suggestive of the F/A-18E/F's weaknesses. Countries that were asked about the Super Hornet made it clear that they regarded the plane largely as a 1970s design, not a newer generation of aircraft.

The F/A-18E/F has received considerable attention over the past year because of its wing-drop problem.[40] In fact, the problem seems to have been minor and has been corrected without major changes in wing design. But the real problem with the Super Hornet is that it adds little in the way of range to the F/A-18C/D model--barely 60 miles.[41] To achieve that range it carries 6,000 pounds of internal fuel next to the engines; the placement of that fuel escalates the risks of serious fire on the flight deck should an engine explode on run-up before launch.[42] The one significant advantage the F/A-18E/F has gained by redesign, and it is not an insignificant one, is that it can carry more stores and return to the carrier with more weight on board. Thus, it does not need to dump unexpended ordnance (and expensive precision-guided munitions) in the ocean.

Lack of range is the greatest weakness in the new design--as it was in the old. The U.S. Navy may soon confront increasing threats from cruise missiles, mines, and

diesel submarines in the areas immediately off enemy shores. Thus, carriers will need to operate at considerable distances from enemy shores, where they will not be directly threatened. The lack of range of F-18 variants is pulling the carriers in closer to shore, precisely at a time when the threats off coastal areas are rising. The distances that carriers will have to remain offshore mean fewer targets will be within reach, and air support for soldiers and Marines ashore will decrease.

In the long term, the lack of stealth could also be a problem. Nevertheless, Navy supporters of the Super Hornet are arguing that stealth is not all that significant. In particular, they have suggested that stealth is a "perishable" attribute in aircraft design because electronic engineers are going to be able to figure out effective countermeasures in the near future. (That argument flies in the face of the fact that the Navy spent over $5 billion developing the stealthy A-12 before that airplane was canceled; thus, at least an earlier generation of naval leaders regarded stealth quite highly.) Yet it is extremely unlikely that the kind of opponents the United States may confront, at least for the next several decades, will have either the resources or the technological know-how to deal effectively with the stealth threat. In fact, even with sophisticated air defense systems, they will have difficulty dealing with high-signature aircraft like the F/A-18, the F-15, or even the F-16. As the Air Force has discovered with the B-2, stealth can be difficult to maintain under the best of conditions, and carrier hangar decks hardly represent the best of conditions. In short, the Navy may be right that it does not need stealth aircraft, but for different reasons than it is putting forward.

The senior leadership of the Navy has not always been satisfied with the F/A-18E/F. As recently as 1993, a study by senior Navy leaders evaluated the Super Hornet against nine other aircraft. The fleet commanders involved in the study rated the aircraft as "poor" and recommended "canceling the program."[43] Yet, because of both political reasons and an unwillingness to face the consequences of its failures, the Navy has proceeded on the F/A-18E/F course. Part of the problem is that, without the Super Hornet (or the rapid development of a replacement aircraft), the Navy's fleet of aircraft will rapidly age. Thus, the Navy could run into difficulties in maintaining sufficient aircraft to fill the decks of its aircraft carriers. In short, the Navy is supporting the F/A-18E/F buy because it perceives an urgent need and

believes it has nothing else to fill that need at present.[44]

The F-22

In most respects, the F-22 represents a different problem than does the F/A-18E/F. The F-22 is on the leading edge of technology. Its development has not followed a path like the Super Hornet's. Rather it has emerged from the considerable research and development effort that the Air Force mounted in the 1980s during the Reagan buildup. Moreover, the Air Force decided on its procurement after a series of tests and after evaluating two competing designs. The F-22 will be by far the best fighter aircraft in the world.

The Russians--with their MiG-29s and Su-27s--have nothing that can possibly match the F-22. The Eurofighter, built by a consortium of the British, Italian, and German aerospace industries, and the French Rafale are the most modern aircraft that will soon be produced by the Europeans. Neither appears to have capabilities close to those of the F-22. One commentator has noted that

> the F-22 will dominate the airspace over any battlefield. The air force of any potential opponent will remain earthbound, as the Iraqi Air Force did during desert storm, or it will die in the air. In point of fact, nothing else the United States or any other nation on the planet has flying, or plans to manufacture, can produce the same results. As a result, everything envisioned by the revolution [in military affairs] will take place under the F-22's protective umbrella.[45]

The F-22 incorporates the latest developments in stealth and engine technology. Its stealth is an advance over that of the F-117, which managed to fly directly into the teeth of the Iraqi air defense system without the support of jamming aircraft and then to drop the crucial precision-guided munitions that shut down the Iraqi air defense system in the first hours of Desert Storm.[46] Like the F-117, the F-22 can carry two precision-guided munitions internally. But unlike the F-117, its primary mission is clearing the skies of enemy aircraft (air superiority) rather than attacking ground targets. Moreover, with its sophisticated engines it can cruise at supersonic speeds without using its afterburner. From the beginning,

the F-22 was designed as a fighter with an air-to-air mission rather than as a fighter-bomber with an emphasis on air-to-ground combat.

The F-22 will also have the most modern avionics packages with displays that are easy for the pilot to read and understand under the most trying circumstances.[47] Its avionics systems may also have the ability to download from satellites information on targets and threats. If produced, the F-22 will remain the dominant fighter for most, if not all, of the first half of the 21st century.

In every respect, the F-22 is by far the finest fighter in the world. It represents a significant improvement in capabilities over the F-15s that it will replace.

However, the F-22 has two difficulties: its cost and its potential usefulness, given the likely capabilities of enemy fighter aircraft and fighter pilots in coming decades. Despite DoD's optimistic forecasting, the F-22 will have per unit fly-away costs of $91 million compared to approximately $46 million for new F-15Es. The CBO suggests that the cost of the F-22 program will be approximately $70 billion.[48] Moreover, as the Senate Armed Services Committee has reported, the Air Force seems to be pushing the F-22 procurement before the aircraft has been sufficiently tested.[49] If serious problems occur in testing, the cost of the F-22 will significantly increase. As the history of previous generations of U.S. fighters suggests, considerable problems in development could lead to much higher costs.

But the largest problem with the F-22 is the distinct lack of a threat to U.S. air superiority. As this paper has suggested, the U.S. military is not likely to confront any serious peer or even regional competitor for at least the next several decades. The air power possessed by regional troublemakers like Iraq, North Korea, and Iran is so minuscule as to represent almost no threat at all to U.S. air operations. Not much is left of the Iraqi Air Force after the drubbing inflicted by coalition forces in the Gulf War. The Iranians possess 175 fighters, and much of that inventory was purchased by the shah's government before his downfall. And although the North Koreans possess approximately 700 aircraft, virtually their entire inventory consists of first- and second-generation aircraft designed and produced before 1975.[50]

Even more important than the technology or numbers of aircraft possessed by potential opponents are the capabili-

ties of the pilots flying the aircraft. Pilot training has been the crucial determinant in air-to-air missions over the past 74 years. The experience of the Richthoven flying circus in World War I; U.S. pilots in Europe and the Pacific in 1944 and MiG Alley in Korea in 1952 and 1953; and the Israelis over the Sinai in 1956, 1967, and 1973 makes it clear that the key factor in victory or defeat in the air is the training of the pilots. That factor continues to favor first-world air forces--particularly those of the United States. Conditions of training, hours flown, and realistic combat preparations give a one-sided advantage to U.S. air services, regardless of the technological capabilities of enemy aircraft. Thus, it is hard to envision a threat that the current inventory of Air Force fighters, especially in the hands of well-trained pilots, cannot handle--at least for the first decade of the 21st century. Nor does the F-22 add significantly to the capability of the F-117 to penetrate enemy air defenses over the course of the next decade.

The problems of the F-22 related to its cost and the lack of a significant threat suggest why the Air Force has been pushing production and deployment of the aircraft so vociferously. The vice chairman of the Joint Chiefs of Staff, Gen. Joseph Ralston (an Air Force officer), made the extraordinary assertion that the Russian-built Su-27 and MiG-29 are already "far superior to any airplane the [United States] has today."[51] Perhaps in the hands of highly trained fighter pilots those aircraft would represent a threat. But in the hands of pilots who receive minimal training hours per month, neither of those aircraft will represent a significant threat, particularly if the Air Force maintains its heavy emphasis on training its pilots in realistic conditions. It is hard to see anything that the Russians, the Chinese, or even the Europeans could manufacture as having much of a chance against an F-15E, with upgraded avionics and missiles, in the hands of a well-trained American pilot.

The Joint Strike Fighter

The JSF is the least distinct of the three fighter programs. It is still in the early stages of development, and Pentagon plans do not call for major production to begin until 2005, when the manufacturer delivers the first 12 aircraft to the services. Thereafter, yearly production will increase until it eventually reaches a high of 170 new aircraft per year. The JSF program will account for more than half of the fighters produced by the United States between 2002 and 2020, at least if the three pro-

curement programs remain on track. The Air Force, the Navy, and the Marine Corps are all participating in the research and development of the JSF. The program involves an ambitious effort to achieve commonality in fighter design and construction among the aircraft of the three services. The aim is to achieve approximately 80 percent commonality among the three designs.

If they achieve a common basic design, the services hope that the sizes of their orders can hold down production costs. The Marines are planning to replace their F/A-18C/Ds and AV-8B Harriers with the JSF--as a result of a congressional mandate that folded their advanced short-takeoff, vertical-landing (STOVL) program into the JSF program.[52] The Air Force will use the JSF largely to replace its F-16s, A-10s, F-117s, and F-15Es. The total buy of 3,000 aircraft is not to be complete until 2030.[53] The Navy views the JSF as a stealth aircraft to add to its carrier decks.

The possibility also exists that some foreign governments will replace aircraft bought in the 1980s with the JSF. The Royal Navy has expressed interest in using the JSF to fill the decks of the carriers it plans to build early in the next century. In addition, countries that bought the F-16--Belgium, Holland, Denmark, Norway, Taiwan, and South Korea, among others--all seem to be prime candidates to buy the JSF as a replacement aircraft. Consequently, the sheer number of aircraft to be produced, if the design is successful, would keep down per unit costs.

But the JSF program has problems. The three services are beginning from very different design concepts. The Air Force wants to build a low-cost (compared with the F-22) fighter that will provide the low-end portion of a high-low mix (similar to the F-16 of the F-15/F-16 force mix that it presently fields). But it also wants to replace its close air support aircraft, the A-10, with the JSF.[54] The fact that the Air Force is also planning to replace the F-117 and the F-15E with the JSF suggests how unclear the conception of the JSF is within just one service's program office. The Air Force would most likely want any replacement for the F-16 and A-10 to be relatively inexpensive and survivable (especially in view of the threat from the ground); yet any replacement of the F-15E is unlikely to be inexpensive. Thus, it is unclear just what kind of aircraft the JSF is supposed to be.

The Navy conceives of the JSF as a high-end stealth aircraft for its carrier decks. Nevertheless, the Navy

does not seem overly interested in procuring the JSF. As retired admiral Leon A. Edney has suggested about other alternatives to the F/A-18E/F buy, "The answer must be ‘no deal!' We have been down this path before with the A-6F, A-12, and AX, to the detriment of our nation's critical need for a superior carrier aviation war-fighting capability."[55] Although the Quadrennial Defense Review has reduced the buy of F/A-18E/Fs from 1,000 to 548, the Navy will be able to purchase an additional 232 Super Hornets, should the JSF run into delays or be canceled.[56]

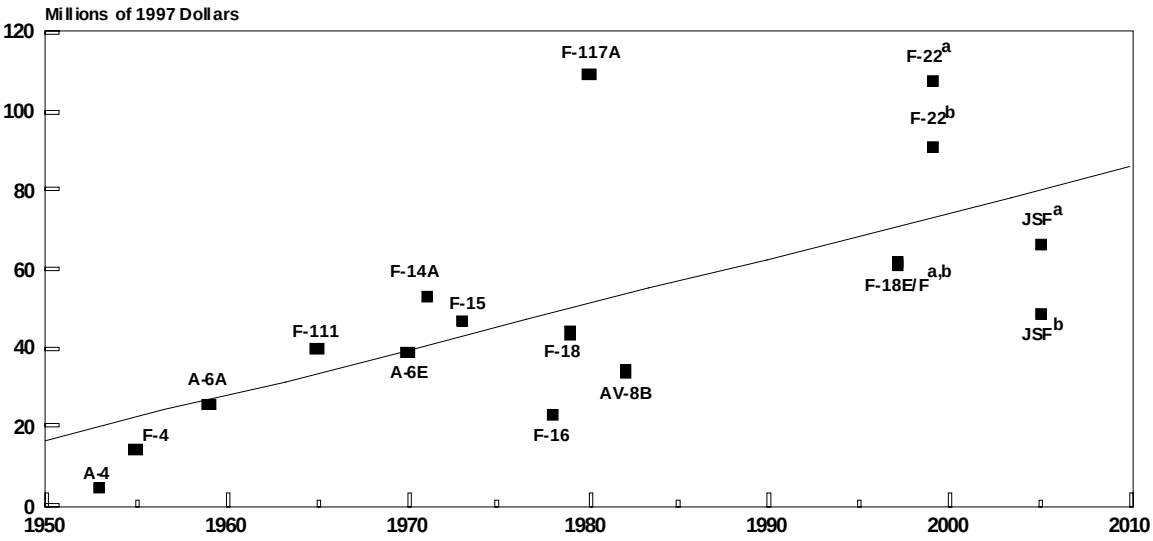
The Marine Corps clearly wants the JSF to fulfil its STOVL requirement--a more capable Harrier-like aircraft that can land on the decks of amphibious assault ships and use unimproved air fields in austere circumstances.[57]

The diverse conceptions of the JSF have raised considerable doubts among analysts. There would be serious difficulties in meeting the needs of just two of the services, but trying to achieve commonality among three such different conceptions is asking for trouble. As of January 1997, the JSF program office was estimating that the total acquisition costs for the aircraft would be only $169 billion. At the same time, the CBO estimated that the cost of the JSF would be $219 billion, nearly a third greater than the Pentagon's estimates.[58] The CBO also suggested that it is hard to understand how the JSF design will keep down costs for the Navy's stealth aircraft. The Air Force's experience in designing the F-117 and the B-2 to minimize their radar signatures rather than maximize aerodynamic performance is hardly reason for optimism about inexpensive aircraft. Thus far, experience in developing stealth aircraft suggests an expensive process; both the F-117 and the F-22 lie at the high end of aircraft per unit costs as shown in Figure 1.[59]

There are other differences among service designs as well. The Air Force indicated early in the design process that it was after a cheap, relatively lightweight aircraft; if the JSF did not represent such an aircraft, the Air Force was not interested in pursuing its design. General Ralston, then commander of Air Combat Command, made clear in 1995 that the Air Force could not afford a JSF aircraft "sized to meet Navy requirements."[60] But the Navy's desire for both stealth and range will need to dominate much of the JSF's design or the Navy will get neither stealth nor range.

The CBO's graph (Figure 1) of the per unit procurement costs for fighters during the past four decades suggests how far off the Pentagon's estimates may be. But

Figure 1
Unit Procurement Costs for Fighter and Attack Aircraft



Source: Lane Pierrot and Jo Ann Vines, A Look at Tomorrow's Tactical Air Forces (Washington: Congressional Budget Office, 1997), p. 37.
Note: The line is a linear regression of historical aircraft cost.
[a] CBO estimate.
[b] Pentagon estimate.

even the CBO's estimates are below trend lines for fighter procurement. As one commentator has noted about the persistent rise in the cost of aircraft procurement,

> The persistence of the growth in aircraft costs per pound over so many decades suggests that the underlying causes . . . are deeply rooted and structural in nature. In the final analysis, they appear to stem less from easily repaired defects in the Pentagon's acquisition system than from the complex politics of defense acquisition, including checks and balances built into the American political system. Regardless, it is clear that the Congress and its defense oversight committees, successive secretaries of defense, and civilian acquisition executives, the military services, and defense contractors have had virtually no appreciable success in arresting the overall trend since the onset of the Cold War.[61]

Thus, despite the best intentions of Pentagon program managers, the JSF is not likely to come in at a cost any-

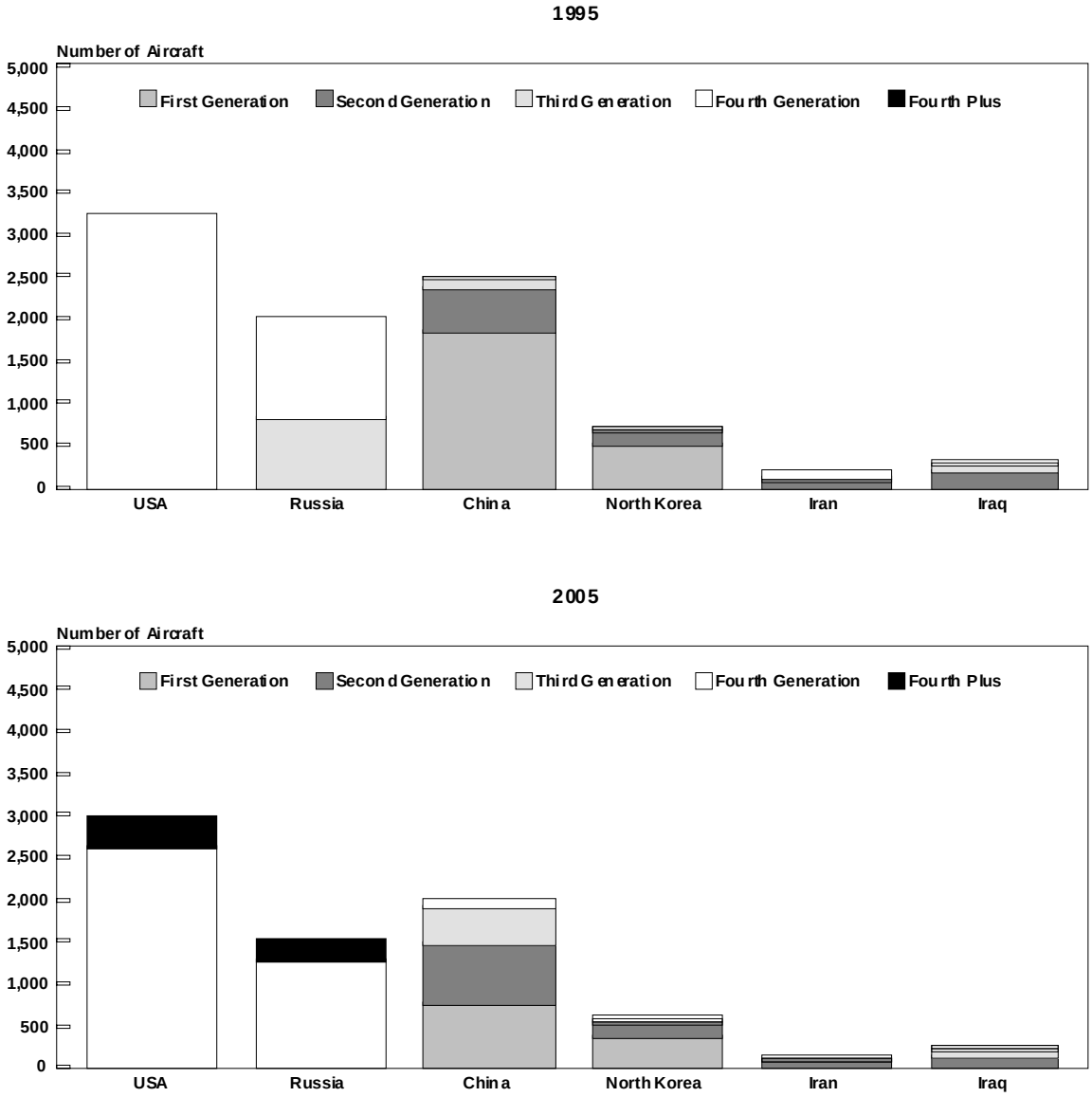
where close to the DoD's estimates. Given the three services' different conceptions of the aircraft, the cost per aircraft may be even higher than CBO estimates. Admittedly, the program is relatively new, and the possibility exists that design teams will make the three different conceptions congruent. The underlying point is that, given DoD's track record in estimating fighter procurement costs, the JSF will probably cost considerably more than the $28 million per fighter currently called for.

In many respects the JSF represents the linchpin of the U.S. fighter procurement program over the next three decades. If the JSF is not built, or if it is built in far fewer numbers, the fleet of U.S. tactical aircraft will not only significantly decrease in numbers but will age as well. The JSF's commonality of design, if achieved, will help meet its ambitious goals. Yet, in many ways, that challenge is even more daunting than that which confronted the developers of the F-111 in the 1960s. The F-111 program was supposed to provide a conventional strike-fighter aircraft for the Air Force and a fighter-interceptor for the Navy. But the Navy withdrew from the program, and the Air Force ended up building a medium-range nuclear bomber for the Strategic Air Command and a conventional bomber for U.S. Air Force Europe. Thus, the services did not achieve commonality, and the F-111 realized few of the savings that Secretary of Defense Robert Strange McNamara had so enthusiastically predicted.

The Likely Uses of Force

Air superiority will be the sine qua non of any military operation undertaken by the United States in the next century. But given the most probable strategic frameworks, how likely is it that potential opponents will contest control of the air against American fighters, even F-15Cs and Es or F/A-18C/Ds? The available fighter inventory figures for potential opponents through 2005 emphasize the considerable edge the United States has in the tactical air area in numbers of aircraft of various generations (Figure 2). Moreover, the qualitative superiority of U.S. fighter pilots to those of any potential opponent makes overall American superiority even greater than numbers of aircraft might suggest. (Although the Russians may possess some fourth-generation-plus aircraft by 2005, severe resource shortages have curtailed pilot training to 25 flying hours per year. The minimum flying time required to maintain flying skills is 120 hours per year. For comparison, NATO pilots receive 150 to 200 hours per year.)

Figure 2
Fighter Inventories 1995 and 2005



Source: Lane Pierrot and Jo Ann Vines, A Look at Tomorrow's Tactical Air Forces (Washington: Congressional Budget Office, 1997), p. 13, based on data from the Office of Naval Intelligence.
Note: Fourth Plus equals F-117s, F-22s, F-18E/Fs, and JSFs.

Thus, fighter aircraft will be more important for the tonnage and accuracy of the weapons they carry than as counters to enemy aircraft. In fact, as in the Gulf War, the essential role of fighter aircraft will be as fighter-bombers. For U.S. ground forces who have struck deep behind enemy lines, perhaps without heavy artillery or

tanks, the ability of U.S. fighter-bombers to loiter and provide accurate fire support will be a crucial enabler in any contest with enemy ground forces.[62] Moreover, U.S. forces will probably not be allowed to wage a sustained strategic air campaign of "distant punishment" unless an opponent makes the egregious political mistakes that Iraq did in the buildup to the Gulf War. The vain hope that distant punishment can be inflicted lies at the heart of many of the arguments put forward by air power advocates for more technology and sophisticated weapons systems.[63] Ironically, not only are substantial internal political pressures rising in America against the use of air power with its inevitable collateral damage,[64] but pressures are also rising throughout the world against aerial bombardment of civilian targets.[65]

The most probable interventions of the United States will be aimed at reestablishing stability in areas of vital interest. The least likely but most important contingencies will probably involve projecting substantial military forces to meet a regional threat. Such wars are likely to be the crucial missions for U.S. military forces--in conflicts the United States will most want to deter or to win. Regional opponents will undoubtedly attempt to deny American forces the use of air space by attacking them on the ground at their air bases with cruise missiles and intermediate-range missiles--a strategy of denial rather than a direct challenge to U.S. tactical air forces. Moreover, U.S. forces will at times confront the problem of a lack of access to bases in areas where the United States aims to project military power. Hence, the crucial first step may involve forced entry with air and naval forces to gain the ports, air bases, and facilities required to attack the enemy and augment the initial attack with reinforcements. In such cases, U.S. military forces might be projected in a fashion similar to the way German forces were in the invasion of Norway in April 1940. U.S. bombers flying out of the United States would strike critical communication targets either directly (with stealth aircraft) or by using cruise missiles. Airborne and air assault units would seize airfields, while naval forces would seize the ports and beaches required to bring in heavy equipment for sustained operations.

The major contingencies the United States could confront may demand swift responses by the American military before the political and diplomatic situations stabilize; such responses must be placed under the umbrella of U.S. air superiority. In most cases, gaining air superiority will be a relatively easy task. The complicated business will be the use of air power as an enabler to support the

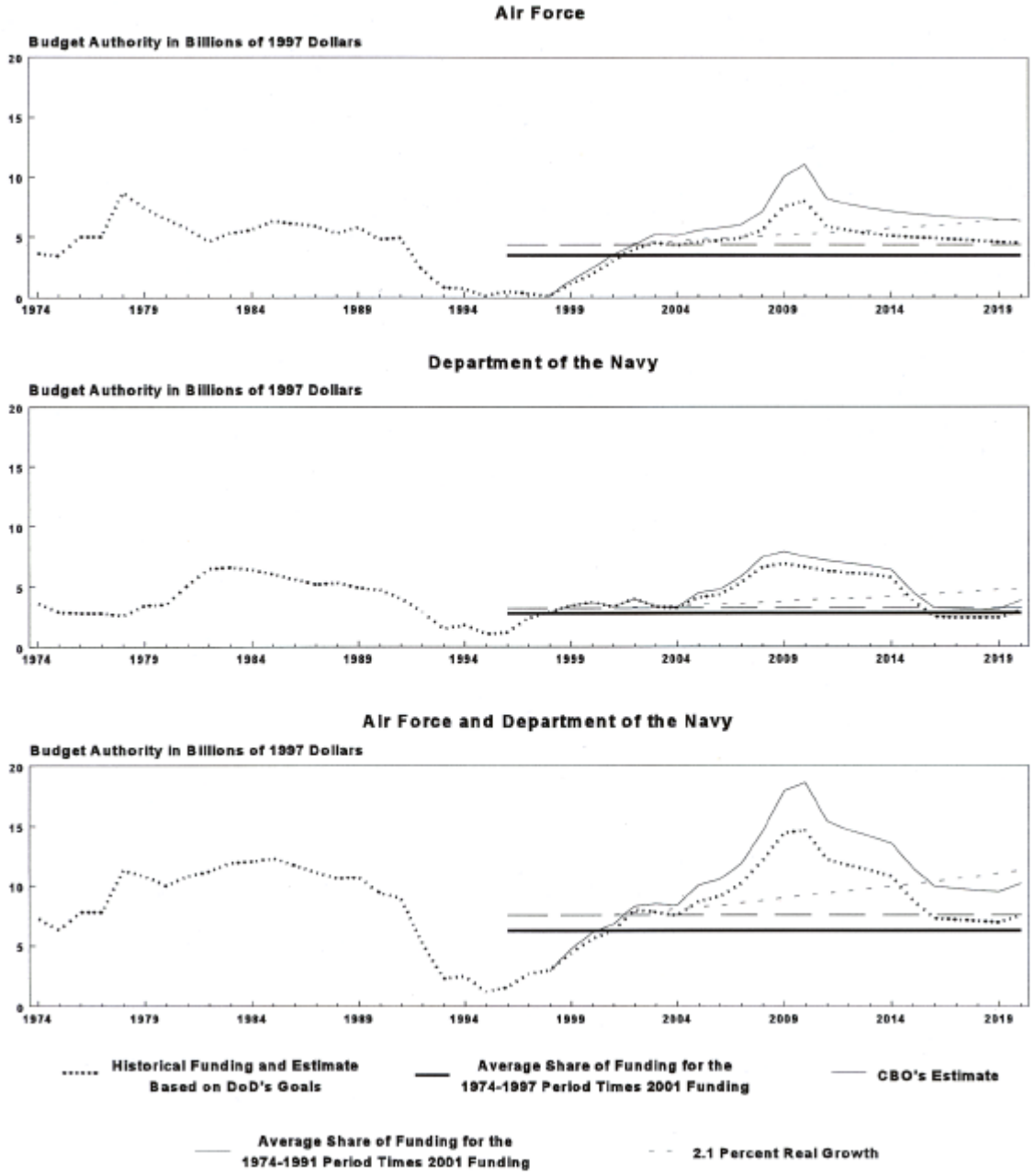
ground forces, and in most cases it will be the Marines and soldiers on the ground who translate military action into victory. The circumstances of any conflict will determine the combination of ground and air forces required to achieve political goals. Whatever Western military analysts may think about the achievements of air power, second-world and Third World societies will not be overly impressed.[66] As Lt. Gen. Paul Van Riper of the Marine Corps and Maj. Gen. Robert Scales of the Army have recently noted,

> In short, over-reliance on distant punishment ignores the psychology of an opponent's will to resist. There is an enormous difference between enduring distant attack, which however unpleasant must eventually end, and enduring the physical presence of a conquering army with all of its political and sociological implications. . . .
>
> Ground forces remain the indispensable foundation of . . . strategic versatility. . . .
>
> . . . [S]ituations in which distant punishment alone is likely to be effective are precisely those in which the issues in dispute are least fundamental.[67]

Opportunity Costs

If current programs continue unabated, production of the F/A-18E/F, F-22, and JSF will reach its high points between 2002 and 2020. The Navy and the Air Force will spend, on average, $9.6 billion per year for fighter aircraft, according to Pentagon estimates. But if those estimates turn out to be optimistic (which they traditionally do), then the bill will be substantially higher.[68] According to the CBO, acquisition spending on new aircraft could reach an average of $11.9 billion per year.[69] At the height of its procurement of new fighters (between 2009 and 2011), the Pentagon could be spending nearly $20 billion per year (Figure 3). What makes those numbers astonishing is that they represent nearly twice the average procurement levels for fighters over the last quarter of the 20th century (during most of which the Cold War raged) and are higher than peak spending for fighters even during the Reagan buildup. Given the political and strategic outlook for the next two decades, it is simply inconceivable that the services will end up spending at that level just to acquire new fighters. But the longer the Pentagon

Figure 3
Historical and Projected Funding for Fighter and Attack Aircraft (by fiscal year)



Source: Lane Pierrot and Jo Ann Vines, A Look at Tomorrow's Tactical Air Forces (Washington: Congressional Budget Office, 1997), p. 32.

delays making hard decisions, the more serious will be the waste of scarce acquisition dollars, and the greater will be the opportunity costs for a wide range of capabilities the services will need in the next century.

Procurement costs for the F/A-18E/F are already beginning to have a serious impact on the Navy. The cost of the F/A-18E/F--combined with the Navy's obsessive, almost ideological desire to maintain 12 carrier battle groups--is already affecting important naval capabilities. The Gulf War emphasized the general ineffectiveness of the Navy in handling the mine warfare threat. If anything, the Navy's capabilities have declined since then, particularly its ability to clear mines in shallow waters. Shallow-water mine clearing is a crucial capability for amphibious war. Given an increasing mine threat, the Navy's lack of capability is a serious vulnerability, especially if it plans to fight in coastal areas in support of Marine Corps and Army operations. Equally worrisome has been the decline in anti-submarine capabilities. Again, the problem lies in the coastal areas. Diesel submarines can operate in coastal areas with considerable impunity. Shipyards of first-world industrial powers have been selling quiet diesel submarines to nations worldwide for the past two decades. Without great range or adequate living conditions, such boats represent little threat on the high seas. But near shore they represent a serious threat to amphibious forces and naval vessels within their limited range.

Underlining the troubles confronting Navy procurement was the cancellation last year of the arsenal ship on which some in that service had placed high hopes. That action has been followed by the scaling back of development work on the CVX carrier that was to replace the Nimitz-class nuclear carriers (the last slated to begin construction in 2001).[70] According to Jane's Defence Weekly, "Due to budget constraints, the service earlier this year scaled back plans for an entirely new CVX design, including a stealthy hull, and instead will make incremental improvements to the current Nimitz-class design. A Navy official told Jane's Defence Weekly that the first CVX, to begin construction in about 2006, 'is probably going to be on a Nimitz-class hull, but won't be a Nimitz-class boat.'"[71] But it is not only future capabilities the Navy is busily engaged in surrendering; the removal of the ES-3As from carrier decks has removed much of the carriers' electronic intelligence capabilities. In effect, the Navy is mortgaging not only future but present capabilities to push F/A-18E/F and carrier procurement forward.

Procurement of the F/A-18E/F will make the procurement squeeze even worse than at present. At forecast procurement levels, the Navy will spend more on new fighter aircraft than it ever has in the past.[72] Given its other requirements--set forth in its strategy paper, "Forward from the Sea," which justifies future naval forces--this state of affairs is serious. Quite simply, not enough funding will be available to pay for the F/A-18E/F, much less the Navy's other needs. What the Navy has already given up in mine-clearing and anti-submarine capabilities could have serious consequences for the safety of the carrier battle groups, which are now forced to operate closer to enemy shores where the possibility of mines and diesel submarines has substantially increased.

Given the requirement of projecting and supporting Marine forces ashore, those weaknesses could seriously affect the strategic and operational possibilities open to U.S. forces. The Navy has obdurately set its present course to procure an airframe that gives little range to the aircraft flying off its carriers. The interesting question is what the Navy will choose after it has given up mine-clearing and anti-submarine capabilities--the F/A-18E/F or the new carrier scheduled to begin construction in 2001.

The Air Force does not confront choices as stark as the Navy's. But the F-22 poses significant opportunity costs for other Air Force capabilities. Those costs will emerge early in the next century. At present, Air Force spokesmen are arguing that a "Revolution in Military Affairs," evidenced by the stealth and precision-guided munitions of the Air Force, has already occurred.[73] In their view, the F-22 is the realization of that revolution. On the other hand, other advocates of air power are hyping improbable short-term military threats to U.S. interests, such as those posed by China.[74] The real issue here is, not the performance of the F-22, but whether the cost of that aircraft will use up funding for other capabilities essential to the overall effectiveness of the U.S. military.

For example, will the Air Force invest sufficient resources in the transport aircraft that might be necessary to project military power from the continental United States to protect vital U.S. interests? Given the possible strategic and political challenges confronting the United States, the ability to lift military forces from North America would seem crucial. Yet, at present, the C-141 fleet is rapidly reaching the end of its service life. The new C-17 is supposed to replace much of the C-141's

capability. However, the requirement for lift from the United States has increased significantly over the last decade, and there is every prospect that demands on air transport will continue to increase.

The issue is not just the projection of air power but the projection of military power as well. Surprisingly, the Air Force has shown little interest in procuring the C-130J, which would add significant new capabilities to an aging C-130 fleet. Here again, the pressure to buy the F-22 seems to be pushing out other crucial programs that may have greater relevance to actual military needs than does a fighter with no real competitor. Unfortunately, the emphasis on the F-22 seems to result more from the Air Force's organizational culture than from U.S. strategic or even operational requirements.

At present, the Air Force does not seem to be mortgaging its future to the same extent that the Navy is, but that may come when the full bill for the F-22 is due. In many ways, stockpiling sufficient precision-guided munitions seems to be an essential element in preparing the Air Force to achieve its aim of "Global Reach, Global Power." Nevertheless, although the Air Force has been the strongest proponent of precision-strike campaigns, it has not been purchasing the munitions to support such efforts. That is partly due to the cost of precision munitions. A 2,000-pound Mark-84 "dumb" bomb costs approximately $2,000. Even the cheapest precision weapons, such as the GBU-24 and GBU-27, are over 15 times as expensive ($35,000 each). Cruise missiles cost about $750,000 per copy, and the small quantities purchased provide little prospect for a decrease in price.

The Gulf War illustrates the high costs involved in precision warfare. That conflict is often depicted as the dawning of the age of precision-strike warfare. Yet, over a 43-day period during the war, U.S. forces used up 227,100 munitions, of which only slightly more than 4 percent were laser-guided bombs. An additional 4 percent were guided missiles, cruise missiles, and anti-radar missiles. Yet, of the $2.2 billion expended on munitions during the air campaign, precision munitions accounted for over $1.7 billion--approximately 80 percent.[75] Accuracy in hitting targets played a crucial role in the success of the air campaign. But the lesson seems to be that any major use of U.S. air power in the future will undoubtedly prove expensive. Now is the time the United States should be building the stocks required for the next war. As one commentator has noted,

> It is difficult, therefore, to escape the suspicion that current modernization plans reflect a "rubber-on-the-ramp" inclination to buy a new generation of fighter platforms and hope that precision weapons, surveillance, and information systems needed to make them useful in combat will be there when needed. . . . [The dates over which fighter procurement is scheduled to run as well as the cost of those programs] suggest that [precision-guided missiles] will have to fight their way into annual defense budgets for the foreseeable future.[76]

Perhaps the most serious consequence of an overemphasis on fighter procurement will be the Air Force's diminished long-range capabilities. The decline in U.S. bomber forces over the past three decades is the result of cultural as well as institutional factors. That decline has resulted in a force structure that depends on a workhorse B-52 that is older than most of its crews, a B-1 that barely bridges the gap between 1970s technology and 1980s technology, and 21 B-2s--aircraft from one of the few procurement programs canceled while production was under way.

Currently, the number of bombers the United States possesses seems adequate for the next 10 to 15 years. That was the position of the Long-Range Airpower Review Panel in April 1998. Also, bringing the B-2 back into production would be too costly. Northrop recently proposed building an additional nine aircraft at a cost of $14 billion. That sum is an impossible bill, given the current political situation and the minuscule capability that the aircraft would add to overall U.S. capabilities.

Gen. Larry Welsh, USAF (ret.), recently testified that the present force structure in bombers seemed sufficient to meet the challenges of the next 15 years.[77] The problem is that to have a replacement aircraft for the B-52 in 2015 (and perhaps the B-1 as well), the Air Force must begin a development program in the near future. At present, there is no bomber program under development (unless it has been kept secret), which suggests that acquisition costs for the F-22 are affecting other major areas as well. Moreover, when F-22 production goes into high gear, there probably will be little funding for development of a follow-on bomber. Forecasting the strategic requirements of the period after 2015 is very difficult. Nevertheless, given the need to project military power from North America--to use the Air Force's own public relations phrase, "Global Reach, Global Power"--the United States must possess long-range air power (i.e., bombers). How

little the F-22 would supply in that area was suggested in a recent war game when the F-22s flying out of Diego Garcia (in the Indian Ocean) required no fewer than seven refuelings to reach their targets.

The potential impact of the JSF on defense is harder to judge because production is not to go into high gear until well after 2005. Given the hybrid nature of the design, it seems likely that there will be significant development problems that could delay production until a later date. Thus, the present target of producing 12 prototypes for evaluation by the Air Force, Navy, and Marines in 2005 seems overly optimistic. Moreover, by the early years of the next century, if the F-22 and the F/A-18E/F are both in full production, there probably will be significant pressures both in the services and in Congress to delay the JSF. However, if either the F-22 or the Super Hornet is canceled or is produced in much smaller numbers, more funding may be available for JSF production. But whatever happens to the other programs, production runs on the level called for by present plans will probably exhaust acquisition funding. That funding shortage will severely affect all the services. Something will have to give. Clear-headed, long-range planning is needed to prevent a serious erosion of U.S. military capabilities.

Conclusion: What Is to Be Done

What is needed now is the creation of a committee in the DoD empowered to examine the strategic framework that will govern U.S. defense policy over the next decade.[78] The committee would frame a realistic set of acquisition choices to allow for development of balanced forces that could project U.S. forces to anywhere in the world from the North American homeland. Pending the creation of such a panel, this paper offers a procurement strategy that would at least form the basis for a more coherent acquisition of fighter aircraft. The fighter acquisition problem is only one piece of a far broader set of problems: first, the need to impose cross-service trade-offs among programs and, second, the need to balance near-term needs against long-term requirements. The CBO has suggested alternatives to the Pentagon's plans for procuring tactical fighters. Those alternatives are worth examining before we turn to a more radical proposal.

CBO Alternatives

The CBO's first alternative would favor the Air Force. Aircraft for the Navy would be limited to the F/A-18E/F, and the Navy and Marine versions of the JSF would be canceled. The JSF itself would be developed only as a lightweight replacement for the Air Force's F-16. But the annual procurement cost would still be quite high--$9.4 billion. The bill to the American taxpayer would be "$2.5 billion per year less than that for current plans, but still half again the cost of past funding shares."[79]

The CBO's second alternative would favor the Navy by buying the F/A-18E/F in planned quantities while at the same time developing and procuring stealth and STOVL versions of the JSF for the Navy and Marine Corps. Air Force funding for procurement would suffer severe cutbacks, with both the F-22 and the Air Force's version of the JSF being canceled. Instead, the Air Force would receive 900 F-16Cs and 500 F-15Es. Under this alternative, by 2020 the Air Force would have virtually no stealth fighter aircraft and, in effect, would be even less capable than it is at present. The most substantial advantage would be in cost: this alternative would be $2 billion less per year in procurement costs than the first CBO alternative.[80]

The CBO's third alternative is production of the F-22 and the F/A-18E/F, along with a maritime version of the F-22 for use off carriers. All versions of the JSF would be canceled, but the Air Force would buy a lighter version of the F-18E/F to replace its aging fleet of F-16s. The Marines would get the Army's Comanche helicopter for operating off flat-deck amphibious ships. Costs for this approach would be almost as high as those for the first alternative.[81]

The CBO's fourth alternative emphasizes the purchase, over coming decades, of aircraft in production. Beginning in 2001, the Air Force would purchase 240 F-22s, approximately half the number currently on order. The Pentagon would cancel the F/A-18E/F and buy a substantially increased number of F/A-18C/Ds (each at considerably lower cost); the Marines would purchase 60 Harriers to fill its need for close air support. The Air Force would buy substantial numbers of F-16Cs and F-15Es to keep its fleet of tactical fighters from aging too rapidly. The JSF's development would be delayed until 2003, much later than current plans call for. Considerable savings would result from using this approach, but the funding levels for acquisition would still be approximately 25 percent greater than the historical average.[82]

The CBO's fifth alternative will probably become reality unless the Pentagon's leadership is willing to make hard choices in the near future. This alternative would enable all of the planned programs to go forward as scheduled, but with major cuts in their funding levels as full production begins. The result would be substantially fewer aircraft bought at considerably greater cost. Producing smaller numbers of several types of aircraft leads to inefficient, shorter production runs and causes serious increases in cost. Eventually, as the tactical fighter inventory aged and suffered attrition, the force structure would shrink. By 2020 the Air Force might be able to field only 11 wings as opposed to the 20 that it now fields. The savings would be substantial, but so would the decline in numbers and capabilities.

Although the CBO proposals provide a good starting point for analyzing possible alternatives for aircraft procurement, they are limited because they remain largely within the current framework for tactical fighter procurement. Moreover, their emphasis remains largely on maintaining procurement over the coming decade. What is needed is a more radical approach that places fighter acquisition in the larger context of the strategic and operational challenges that will confront the United States in the first decades of the next century.

A Radical Proposal

Any rethinking of procurement must start with the F/A-18E/F because that aircraft has already reached its major production decision point. Given the small advantages that the F/A-18E/F offers in air-to-air capability and range over the F/A-18C/D model, the best course would be to cancel the aircraft entirely. Carriers will enable the United States to project military power far from its shores. They are unencumbered by the possibility that foreign nations may deny the use of land bases when they are most vital. Thus, there must be an alternative plan if the F/A-18E/F is to be canceled.

The fact that at present the F/A-18C/D remains in limited production would allow for procurement of that aircraft in numbers sufficient to keep F-18 numbers up on carrier decks. But the Navy clearly needs a replacement aircraft for the E/F. In the long run the JSF program (or a modification of that program) could supply both the numbers and the capabilities that the Navy may require after 2015, particularly if more serious threats arise on the international horizon. But for now the Navy needs rapid

development of a new long-range aircraft to fill the hole created by the A-6's retirement. Such development would afford an opportunity to validate reforms designed to streamline the procurement process and cut costs. Imaginative thinking is needed here, not a thoughtless grab for the most interesting and advanced technologies available.

The justification for the carriers over the next three decades must lie in their ability to stand off an enemy's coasts and strike enemy forces--in some cases enemy forces in contact with friendly ground forces. Thus, the Navy needs an aircraft that meets three simple requirements: range, payload, and survivability. Range is particularly important because Navy strike aircraft may have to travel considerable distances with heavy bomb loads to attack targets, and they may well have to loiter over ground forces to provide close air support. An aircraft with those capabilities would also have the capacity to serve as a tanker aircraft to extend the combat range of F/A-18C/Ds.

The crucial point here is that, for at least the next two decades (and probably longer), against the kind of opponent carriers are likely to face, the F/A-18C/D can handle any direct threat from enemy aircraft to the carrier battle group. For that period the Navy probably does not need a stealth aircraft. What it does need is an aircraft that can provide the bomb lift, range, and loiter capability to support U.S. or friendly ground forces, as well as the capacity to conduct a long-range air campaign from far offshore against the military and political infrastructure of an enemy nation. The F/A-18E/F does not provide those capabilities.

In some respects, the Air Force's situation is like the Navy's. The costs of building the F-22 may simply be too high, given the other immediate requirements of the Air Force. Yet one might reasonably argue that a limited buy of F-22s--considerably fewer than the CBO's proposed buy of 240--could provide some stealth capability and some experience that would be useful in developing the JSF. The advantage of a small buy would be its deterrent effect. It would suggest to a possible peer competitor that the United States possesses the production capability and the tactical experience to produce and use the F-22 in far larger numbers, should an arms race start. That experience might deter a potential peer competitor from undertaking an arms race.

Even if the option of buying a limited number of F-22s were chosen, they would need to be augmented with a far larger buy of F-15Es. A new production version of the F-15E could possess greater air-to-air capabilities, significantly augmented by the radar and other technologies developed for the F-22. Moreover, because of its current configuration, the F-15E has the advantage of carrying a second crew member.

Canceling the F-22 entirely and buying F-15Es in large numbers to replace the F-15C seems to be the best choice. Some of the savings from canceling the F-22 could be plowed back into Air Force or other service programs--particularly to develop a follow-on to the B-2.

Because of a relatively benign threat environment, U.S. air power is apt to remain dominant in the near and medium term. As a result, both the F-18E/F and the F-22 can be canceled. Although there is uncertainty about the emergence of a significant threat in the long term, the United States may eventually need to modernize its forces to maintain its predominance in air power. Thus, eventually, the services will probably need to procure the JSF in large numbers.

The JSF, as it is currently conceived, confronts a number of uncertainties. Many things need to occur if there are to be useful products at the end of the development phase. First, it is unreasonable to expect that the current program can produce 80 percent commonality among a lightweight fighter for the Air Force, a high-tech stealth fighter for the Navy, and a STOVL aircraft for the Marines. Second, the development and production schedules for the JSF program are too optimistic. Those factors seem to suggest that a delay in the production schedule is called for--a delay of at least five years and perhaps longer.

Also, less than the 80 percent commonality currently proposed might have to suffice. In the long term, the Navy probably will need a stealth aircraft to operate from carriers against the more sophisticated air defense systems that will surely emerge in the next century. But the Navy JSF can be delayed for the foreseeable future. Development funds can be diverted to an aircraft to replace the F/A-18E/F that would give the Navy the range it needs to attack ashore while the aircraft carrier remains a safe distance from the coast. The Navy should develop the low-cost replacement from scratch rather than be constrained by the limitations of the existing F-18 airframe. Whatever specific aircraft the Navy chooses to develop,

the service should have little difficulty surpassing the limited improvements to the F-18C/D that the expensive F-18E/F provides.

The Air Force and Marine versions of the JSF will be needed sooner than the Navy's stealth version. The Air Force and the Marines seem to be moving closer together, as the Air Force has recently displayed much greater interest in STOVL capabilities.

STOVL capabilities would enable Air Force aircraft to survive attacks on large, vulnerable air bases by dispersing to smaller makeshift airfields. The threat of cruise and ballistic missile attacks on air bases has undoubtedly played a role in changing the Air Force's thinking. The record of failure against Scud missiles during the Gulf War suggests that mobile enemy launchers will remain an almost unsolvable problem well into the next century. The cruise missile problem may never be solved, particularly given the fact that those weapons can be made stealthy--thus making them virtually impossible to destroy. They, too, will undoubtedly be launched from mobile launchers. Therefore, it may eventually be possible to consolidate the Air Force and Marine programs into one STOVL airframe that would be purchased by both services.

The delay in procuring the JSF for the Air Force and the Marines would also necessitate an interim solution. For the Air Force, the most recent block of F-16s seems adequate to handle the threats of the next decade. Similarly, the F/A-18C/D seems adequate to provide the Marines sufficient force structure and capabilities for the immediate future. Admittedly, these are interim solutions, but in a period of strategic pause, producing many new, technologically sophisticated aircraft at great cost does not make sense.

Instead, the U.S. military needs to make hard choices now. The Pentagon and Congress need to evaluate <u>all</u> of the major procurement programs that the services have put forward in light of the larger strategic and political framework the United States will confront in the first decades of the next century. What is required is a rethinking of the entire framework of American defense policy over the next three decades. Only then can decisionmakers ascertain what is realistically possible. Unless the tactical fighter programs fit into a coherent strategic conception, U.S. taxpayers are going to spend $100 billion a decade for the next 30 years for force structures in the air forces that are largely irrelevant.

Notes

1. U.S. Department of Defense, Report of the Quadrennial Defense Review (Washington: Government Printing Office, May 1997).

2. The Congressional Budget Office at least has been willing to look at what is possible. See Lane Pierrot and Jo Ann Vines, A Look at Tomorrow's Tactical Air Forces (Washington: CBO, 1997).

3. The Department of Defense's December 1995 Selected Acquisition Report shows $353 billion for all of DoD's major acquisition programs. The F/A-18E/F, F-22, and JSF total $96 billion, but no JSF production money is shown. So the percentage will undoubtedly be considerably higher, given the proposed production numbers for the JSF.

4. Dale Eisman, "Navy Says It Expects Super Hornet Wind-Drop Solution in 2 Weeks," Virginian-Pilot, February 26, 1998.

5. David A. Fulghum, "Flat Budgets to Drive New Base Closings," Aviation Week & Space Technology, February 9, 1998, p. 30.

6. Ibid.

7. Programs such as the Navy's A-12 proved difficult to kill even before they had reached the production stage. And the bill for the penalty that the Navy is going to pay the manufacturers for the A-12 cancellation suggests why this is so.

8. As a number of officers in different services have pointed out, there is a host of resource-wasting redundancies that eat up a substantial portion of the budget. Some of those result from external factors, such as the unwillingness of Congress to allow the services to close bases that are no longer needed. But much of the problem is caused by internal factors, such as the unwillingness to alter old-fashioned structures and methods of doing business. The Army is perhaps the worst in this regard, but the other services, with the possible exception of the Marines, are also contributing to the problem. For an example of the kind of thinking that needs to be done about structural reform and reorganization, see Douglas MacGregor, Breaking the Phalanx, A New Design for Landpower in the Next Century (Westport, Conn.: Praeger, 1997).

9. "An option of difficulties" was coined by the British general James Wolfe on the Plains of Abraham before Quebec fell to his troops.

10. National Defense Panel, Transforming Defense, National Security in the 21st Century (Arlington, Va.: NDP, December 1997), p. 23.

11. Such discussion is best exemplified by quotes from Adm. William Owens. See Thomas Duffy, "Breakthrough Could Give Forces Total Command of Future Battlefield," Inside the Navy, January 23, 1995; Peter Grier, "Preparing for 21st-Century Information War," Government Executive, August 1995; and William Owens, "System of Systems," Armed Forces Journal, January 1996, p. 47.

12. For the current condition of the Russian state and its military organizations as well as its prospects for the future, see Anatol Lieven, Chechnya, Tombstone of Russian Power (New Haven, Conn.: Yale University Press, 1998).

13. Arthur Waldron, "China," in Brassey's Mershon American Defense Annual, ed. Williamson Murray and Allan R. Millett (Washington: Brassey's, 1997), pp. 134-57.

14. See ibid., pp. 140-41.

15. To a great extent the Chinese economic miracle has run on the fact that the Chinese leadership in the late 1970s limited the resources devoted to the Peoples Liberation Army, the Chinese Navy, and the Chinese Air Force. Even when serious military weaknesses were exposed in the war with Vietnam in 1979, the Chinese did not deviate from that course.

16. See John J. Schulz, "China as a Strategic Threat: Myths and Verities," Strategic Review 26, no. 1 (Winter 1998): 5-16.

17. As a Center for Strategic and International Studies handout advertising a report suggested, "Currently, the [United States] is spending 3.0 [percent] of GDP [on defense] and we anticipate that the defense budget will decline to around 2.5 [percent] of GDP over the next five or six years." The handout advertised Center for Strategic and International Studies, Defense in the Early 21st Century: Avoiding a "Trainwreck" (Washington: CSIS, June 1998).

18. Don M. Snider, "The Coming Train Wreck . . .," Washington Quarterly 19, no. 1 (Winter 1996): 89-101.

19. The National Defense Panel's report underlines this factor. See National Defense Panel, p. 12.

20. The reaction of the Italian electorate to the recent incident in the Alps where an EA-6 "Prowler" cut the lines holding up a cable car full of skiers suggests the fragility in Europe of public opinion, on which continued basing of U.S. forces in that region depends.

21. CBS Interview (Dan Rather) with Saddam Hussein, August 29, 1990, transcript in FBS-N25-90-170.

22. Quoted in Norman Cigar, "Iraq's Strategic Mindset and the Gulf War: Blueprint for Defeat," Journal of Strategic Studies 15, no. 1 (March 1982): 19.

23. See, for example, Eliot Cohen et al., The Gulf War Air Power Survey (Washington: Government Printing Office, 1994). See also Williamson Murray, The Air War in the Persian Gulf (Baltimore, Md.: Nautical and Aviation Press, 1995); and Williamson Murray, "The Air War in the Gulf: The Limits of Air Power," Strategic Review 26, no. 1 (Winter 1998): 28-38.

24. The National Defense Panel makes clear that it does not believe that the conditions of the run-up to the next major regional war will look at all like those of the Gulf War. The report states, "The days of the six-month buildup and secure, large, rear-area bases are almost certainly gone forever." National Defense Panel, p. 42.

25. For some of the wilder claims along these lines, see Joseph S. Nye Jr. and William A. Owens, "America's Information Edge," Foreign Affairs 75, no. 2 (March-April 1996): 20-21. See also Alvin H. Bernstein and Martin Libicki, "High-Tech: The Future of War? A Debate," Commentary, January 1998.

26. Patrick J. Garrity, "Regional Powers and the Persian Gulf War," Washington Quarterly 16, no. 3 (Summer 1993): 159. One might also note that the National Defense Panel suggested further work on electromagnetic pulse (emp) weapons (in the context of information war). Conventional emp weapons are on the horizon. If we have them, so will our opponents, especially since the damage they might do to our electronic systems could be so devastating. National Defense Panel, pp. 44-45.

27. At a recent conference, communications experts from civilian companies made it clear that they had no intention of protecting their satellites from an emp burst,

given the cost that such protection would involve. That attitude makes the suggestion of Adm. William Owens, that the U.S. military rely on civilian communications networks, seem rather strange, to say the least.

28. In the Gulf War, the Iraqis had sophisticated air-to-air fighters--MiG-29s and Mirages. Nevertheless, the exchange ratio was 33 to 1 in favor of coalition air forces.

29. Anyone who has seen pictures of U.S. aircraft on the airfields of the Gulf states during the Cold War can attest to what one can only describe as a target-rich environment.

30. Even the National Defense Panel seems to have had qualms about the Pentagon's acquisition plans for the three fighter aircraft: "On the issue of tactical air, the Panel notes the cost over the lifetime of all three current programs and questions the total number of planned aircraft buys and the appropriate mix of systems in 2010-2020." National Defense Panel, p. 49.

31. Jim Saxton, Testimony before the Subcommittee on Military Procurement of the House Committee on National Security, Hearing on the Report of the Long-Range Airpower Review Panel, April 1, 1998.

32. See Chuck C. Spinney, "Fly Off F/A-18E vs. 18C," Naval Institute Proceedings, September 1992, pp. 41-46.

33. Norman Polmar, The Naval Institute Guide to the Ships and Aircraft of the U.S. Fleet, 15th ed. (Annapolis: Naval Institute, 1993), p. 401.

34. Part of the Navy's problem was caused by the fact that in the mid-1980s the Office of the Secretary of the Navy placed unrealistic constraints on the research and development costs for an upgraded, more sophisticated version of the A-6. Thus, there was no alternative to the A-12.

35. John A. Tirpak provides an excessively positive but generally factually accurate picture of the F/A-18E/F Super Hornet's development. John A. Tirpak "The Super Hornet," Air Force Magazine, March 1998, p. 34.

36. James P. Stevenson, "The F/A-18E/F: Scamming the Acquisition System," Business Executives for National Security Issue Brief, February 1996.

37. Steve Uehling, "The Latest F-18 Could Hurt the Navy," Air Force Times, October 2, 1995, p. 36.

38. For McDonnell Douglas the aircraft represents jobs for 7,000 workers in the main factory and 20,000 more jobs with subcontractors scattered in no fewer than 47 states. Dale Eisman, "The Navy Shows Off the First 'Super Hornet,'" Virginian-Pilot, September 19, 1995, p. 1.

39. Uehling, p. 36. Of course, F/A-18E/F test pilots at the Navy's Pax River Naval Air Testing Center would probably have a substantially different view of a comparison between the MiG-29 and the F-18E/F. But their view is not as impartial as is that of a disinterested Canadian pilot.

40. Chuck Spinney, Navy Times, February 2, 1998, p. 16.

41. The wing-drop problem is worrisome because the fix may have a negative impact on the F-18E/F's range. E-mail from Chuck Spinney, "E/F Approved, but Fix Will Have Range Impact," May 4, 1998.

42. Stevenson.

43. Uehling, p. 36.

44. Leon A. Edney, "Super Hornet Is the Bridge," Naval Institute Proceedings, September 1987, pp. 40-43.

45. Robert Gaskin, "A Revolution for the Millennium," in The Emerging Strategic Environment, ed. Williamson Murray (Westport, Conn.: Praeger, forthcoming 1999).

46. Williamson Murray, "Operations," in The Gulf War Air Power Survey, ed. Eliot Cohen (Washington: Government Printing Office, 1993), vol. 2, pp. 122-24.

47. Pierrot and Vines, p. 6.

48. Ibid., p. 7.

49. Ibid., p. 7.

50. Ibid., pp. 12-13.

51. Quoted in Richard J. Newman, "Where's the Target," U.S. News & World Report, October 7, 1996, p. 46. What Ralston failed to mention is that these aircraft have a substantially shorter range and far less capable avionics and have to throw their engines away after 200 hours--a maintenance factor that only the profligate military of

the Soviet Union could afford.

52. Pierrot and Vines, p. 8.

53. Ibid., p. 9.

54. Ibid., p. 23.

55. Edney seems to imply that the Navy has not been largely responsible for the troubles of those programs. Edney, p. 40.

56. Cohen, p. vii.

57. Ibid., p. 8

58. Pierrot and Vine, p. 9.

59. Ibid., p. 39.

60. Ibid., p. 49.

61. Watts, p. 14.

62. The movement of the 101st Airborne Division toward the Euphrates on the first day of the ground attack on the Iraqi army is an example of the kinds of movements U.S. forces may be asked to make in the future.

63. U.S. Air Force, New World Vistas: Air and Space Power for the 21st Century (Washington: U.S. Department of Defense, 1995). Strategic air campaigns of distant bombardment were also a major theme running through Air Force presentations at a Center for Strategic and International Studies conference, "Dueling Doctrines," sponsored by the Air Force in late June 1998.

64. Here one might note that if U.S. precision strike aircraft do not inflict significant collateral damage to provide sufficient gory footage to CNN, our opponents may well be ruthless enough to achieve that end with their own explosives. The effect of the Al Firdos bombing--in which a large number of civilians were killed in a command bunker that was also serving as an air raid shelter--will not be forgotten by the next generation of Saddam Husseins.

65. "Courting Disaster," New Republic, editorial, July 13, 1998, pp. 7-9.

66. See Lieven, chap. 3.

67. Paul Van Riper and Robert Scales, "Preparing for War in the 21st Century," Strategic Review 25, no. 3 (Summer 1997): 19.

68. For example, the 400th F/A-18C/D cost 68 percent more than predicted. Daniel E. Moore, "Naval Aviation Cannot Escape History," Naval Institute Proceedings, July 1996, p. 62.

69. Pierrot and Vines, pp. 31-32.

70. The National Defense Panel's comment on the importance of the CVX was that "the Navy should look closely at accelerating the transformation to the CVX class of carriers in lieu of procuring additional Nimitz class CVNs." National Defense Panel, p. 49.

71. "Next Class of US Navy Aircraft Carriers to Be Nuclear-Powered," Jane's Defence Weekly, October 2, 1998.

72. Pierrot and Vines, p. 33.

73. According to a lead editorial in Air Force Magazine, "It is generally agreed that a Revolution in Military Affairs is changing the way U.S. armed forces will fight in future wars, and that the key components of that revolution are information technology and precision strike, capabilities that are concentrated in air and space forces." "Global Force," Air Force Magazine, November 1997, p. 4.

74. See in particular Bill Gertz, "The Chinese Buildup Rolls On," Air Force Magazine, September 1997, pp. 77-83. Contrast this biased view with Schulz.

75. Watts, pp. 30-31.

76. Ibid., p. 36.

77. "The panel reviewed a wide variety of studies conducted by the Department of Defense and other people and arrived at the conclusion that, given that we bring the B-2 fleet to its full potential--and I think we know how to do that--and given that we get on [with] putting precision weapons on the B-2 and the rest of the bomber force and leverage the potential of that existing force, our conclusion was that we probably have adequate capabilities for the next fifteen years." Larry Welch, Testimony before the Military Procurement Subcommittee of the House Committee on National Security, April 1, 1998.

78. This is not an impossible task. During the Truman administration at the start of the Cold War, U.S. policy-makers undertook a number of such studies, and the U.S. government then used those studies to form the basis of its policy. The most famous of those studies was NSC68.

79. Pierrot and Vines, p. 62.

80. Ibid., p. 63.

81. Ibid., pp. 65-66.

82. Ibid., p. 69.

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