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Is Defense Transformation Affordable?
Cost Escalation in Major Weapons Programs

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Executive Summary

While the Department of Defense (DoD) has laid out an ambitious agenda for transforming and modernizing the US military for the post-Cold War world, key transformation programs have been fraught by massive cost escalation, schedule delays, a failure to foresee future requirements, and unfulfilled promises of effectiveness. The DoD's inability to match its transformational goals with affordable programs or to efficiently plan and manage its key programs comprises perhaps the most serious form of "overstretch" within the department's control. As such, the problems the US faces in Iraq are far less serious than the need to deal with cost containment in terms of both the sharply rising personnel costs of its all professional military and the DoD's failure to effectively manage virtually all of its key procurement programs.

While transformation has focused predominantly on new weapons and technology as the key tools of future warfighting, the very real benefits of these force enablers threaten to be lost by a massive procurement agenda that has become a cost escalation nightmare. The Army's Future Combat Systems (FCS) and its Modularity Program broadly illustrate these trends. Between April 2003 and September 2004, the total program costs for FCS escalated 35.2 percent, and research and development costs increased by 50.8 percent. During the same period, the acquisition timeline increased by 52.7 percent to 139 months. By 2005, the Army estimated that the total cost of FCS could easily reach $145 billion, some $53 billion more than originally estimated. Chronic problems in the development of the FCS communications network prompted the Government Accountability Office (GAO) to predict that these systems would not be ready by 2008 as planned.

The Army's modularity program has exhibited similar problems. In March 2005, the Army's estimate of the program's total cost from FY 2005-FY 2011 increased by 71 percent from the previous year, from $28 billion to $48 billion. At the same time, while Congress has largely supported the Army's modularity program, it has not been pleased with the DoD's and the Army's inability to plan and budget costs and will not look favorably on further DoD and Army efforts to fund modularity through supplemental appropriations

US Air Force and Navy/Marine Corps tactical aviation programs present particularly egregious examples of the DoD's inability to contain costs and deliver new capabilities on schedule. Of all major weapons programs, the F-22A Raptor program has experienced one of largest reductions in buying power. Since the program's inception in 1986, the cost per unit has increased by 189 percent to $345 million per aircraft as the quantity to be procured has decreased by 72 percent to 183 aircraft. The addition of air-to-ground strike capabilities to what was originally designed as an air superiority fighter have contributed significantly to the program's ever increasing costs, adding an estimated $11.7 billion through 2018. While additional modernizations are anticipated, neither their content or costs have been determined or included in budgets. Nor has the Air Force prepared a new business plan for the F-22A that justifies the resources needed to implement the proposed modernizations. Moreover, considerable controversy surrounds the utility of an air superiority platform like the Raptor as warfare becomes increasingly irregular and asymmetric.

The Joint Strike Fighter (JSF) is the largest defense acquisition program in history. Despite the best cost-saving intentions embedded in the program's modular design, the JSF program appears to have followed a flawed program management track similar to that of the F-22A. The program's estimated cost in 2001 was $183.6 billion for 2,866 aircraft. The DoD revised these figures in March 2006 to $276.5 for 2,458 aircraft. The GAO has repeatedly pointed out that the JSF depends heavily on a business case that invests heavily in production before testing has

demonstrated acceptable performance of the aircraft. For example, by 2010 the DoD expects to have procured 126 aircraft with only 35 percent of the flight test program complete. The program has also been plagued by controversy surrounding the DoD's decision in February 2006 to abandon investments to develop an alternative engine for the JSF.

Modernizing and/or replacing the Air Force's aging tanker fleet has been a point of contention for more than a decade, and the DoD faces difficult choices regarding desired capabilities, force structure, and budget options. After a series of studies finally reached the consensus that the KC-135 fleet suffered from severe corrosion problems, a tanker leasing scandal coupled with political infighting in Congress have stymied efforts to resolve the tanker problem. In the meantime, as studies dispute the urgency with which the KC-135 fleet must be replaced, the fleet continues to age and will take progressively more time and money to maintain and operate.

Achieving optimal lift for the US military requires procuring, modernizing, and maintaining the right mix of C-5 Galaxy, C-17 Globemaster, and C-130 Hercules aircraft. However, these platforms face either maintenance (C-5), procurement (C-17), or cost problems (C-130). The C-5 has the lowest mission capable rate (55 percent) of all US airlifters and is undergoing a modernization program to improve its mission capable rate to at least 75 percent. While the C-17 has been touted as the best inter-theater airlifter that the Air Force has ever bought, a controversial 2005 Air Force Mobility Capabilities study concluded that the military was better served, both strategically and fiscally, by ending C-17 procurement at 180 aircraft, 42 aircraft short of the 222 planes that lawmakers had planned. The C-130 program has been fraught with cost overruns and technical problems. On the whole, the entire airlifter program suffers from a disconnect between the DoD's proposed strategies its budgeted resources.

The Navy's long-term shipbuilding plan faces major hurdles in bringing available resources in line with transformational goals. Considerable uncertainty surrounds the ultimate composition and size of the Navy's future fleet—in 2005, Admiral Vernon Clark testified that the Navy may require a fleet anywhere between 243 and 325 ships—and Navy officials constantly cite the potential for new technologies to drive manpower reductions and contain costs. Nonetheless, because of cost escalation and program management problems, the Navy's program portfolio requires considerable attention.

The CVN-21 next generation carrier program is a 3-ship program that in 2004 the Navy estimated would cost $36.1 billion, or an average of about $12 billion per ship. This has since been revised upward so that the total estimated acquisition cost of the first CVN-21 could reach $13.7 billion, or about $2 billion more than the Navy's 2004 estimate. The costs surrounding the acquisition of the CVN-21 have forced a shift in procurement of the first CVN-21 back one year to FY 2008. This has put the acquisition of new carriers and the planned retirement of other carriers at odds with the congressional recommendation to maintain 12 operational carriers.

Designed to meet a capability gap in littoral waters, the Littoral Combat Ship (LCS) is a key component of the Navy's future force plans. A March 2005 Navy report to Congress showed potential 260-325 ship fleets by FY 2035 that would include between 63 and 82 LCSs, with a predicted total acquisition cost between $25.3 billion and $32.7 billion. However, the FY 2007 budget submission revised these figures upward. A Navy Budget Item Justification Sheet that accompanied the 2007 defense budget request indicated that the Navy plans to procure two LCSs each in FY 2006 and FY 2007, three in FY 2008 and then six each year from FY 2009 through FY 2011. This updated procurement plan showed the average cost per hull breaching the Navy's self-imposed $220 million ceiling after FY 2006 with costs rising by 49 percent to $328.2

million in 2008. Realistically, the LCS's procurement costs will remain uncertain until the Navy settles on its future force structure.

The cost of the first DD(X) destroyer has increased by approximately 18 percent, from $2.8 billion in 2004 to $3.291 billion as of May 2005. In July 2005, CBO analyst Michael Gilmore testified that the cost of the first DD(X) could be as high as $4.7 billion, above the Pentagon's upper limit for the first DD(X) of between $4 billion and $4.5 billion. Other military and defense experts say that the price of the first ship could be as high as $7 billion. Furthermore, a 2005 GAO report found that many of the DD(X)'s new technologies are still immature. If these core technologies do not become fully mature on schedule, the challenges associated with demonstrating capabilities, developing software, and integrating subsystems must be pushed into the later stages of DD(X) design and construction when the cost of work and delays is much higher and the schedule less forgiving.

The Marine Corps has not been immune from program management challenges in its own weapons portfolio. The V-22 Osprey program now seems to be more an example of a program that will be funded in spite of delays, cost-escalation, and performance failures than a program whose future remains uncertain. The original estimated cost of the program was $48.025 billion. The total cost of the program is now approximately $74.1 billion. Beyond the Osprey's rising costs, critics argue that the platform is inherently risky and unreliable in combat situations and that alternative platforms like the MH-60S helicopter offer a more reliable combat and amphibious assault aircraft at one-fifth the cost of the V-22.

The Marine Corps relies heavily on the Navy's amphibious warfare and prepositioning ships. According to the CBO, the Navy's FY 2005 plan for amphibious and maritime prepositioning forces costs an average of $2.4 billion a year (in FY 2005 dollars), or more than twice as much per year, on average, as the Navy spent on amphibious and maritime prepositioning ships since 1980. The cost of building the first and second San Antonio Class amphibious transport docks (LPD-17 and LPD-18) surged from a Congressionally approved $1.7 billion to an estimated $2.7 billion. The CBO has proposed four different fleet structures that incorporate amphibious ships differently depending on the Navy's transformation goals. The mounting cost of amphibious capability should force the Navy, defense officials, and lawmakers to reassess their priorities for transforming the Navy's fleet.

The national security space sector has become another cost-performance crisis. Virtually every next generation constellation being developed has encountered unanticipated cost growth, schedule slippage and technical difficulties. A prime example, the SBIRS-High satellite has breached congressionally-mandated cost escalation limits four times in five years as costs have risen from $4 billion to over $10 billion. According to the 2006-2011 FYDP, funding for development and procurement of major unclassified space systems would grow by more than 40 percent in 2006 and would double by 2011. Historically, according to the CBO, RDT&E costs for DoD space systems have grown by an average of 69 percent from their original development estimates, and procurement costs have risen by an average of 19 percent. Given these trends in the DoD's space portfolio, congressional procurement of future space systems remains uncertain.

Taken together, the consistent pattern of problems in procurement programs is more than a basic failure in management. It strongly suggests that the Department of Defense has been locked into a "liar's contest" at the level of defense contractors, program managers, every military service, and the Office of the Secretary of Defense where no one is really held accountable. Program survival and advocacy have become more important than the truth in terms of real world cost, performance, and schedule.

The state of these transformational programs also calls for making trade-offs and hard decisions, not for procurement reform. There are many ways in which the US might create better procurement experts, better program managers, and more efficient procedures. The level of failure in today's programs, however, represents a basic failure to make hard choices at the level of the Secretary of Defense, Deputy Secretary, Service Secretaries, Chairman of the Joint Chiefs, and Service Chiefs of Staff. All of these issues are also a further caution that the US cannot afford the luxury of planning for what it cannot get. In fact, they show that the most critical single challenge the Department of Defense faces in force transformation is to learn how to plan, manage, and execute force transformation on a program by program basis.

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Introduction

The inability of the Department of Defense (DoD) to match its transformational plans with affordable programs or to plan or manage its key programs with efficiency comprises perhaps the most serious form of “overstretch” within the department’s control. Its plans and goals have been well intentioned, but the reality has often been an awkward mix of delays, massive cost escalation, failing to foresee real-world future requirements, and unfulfilled promises of effectiveness.

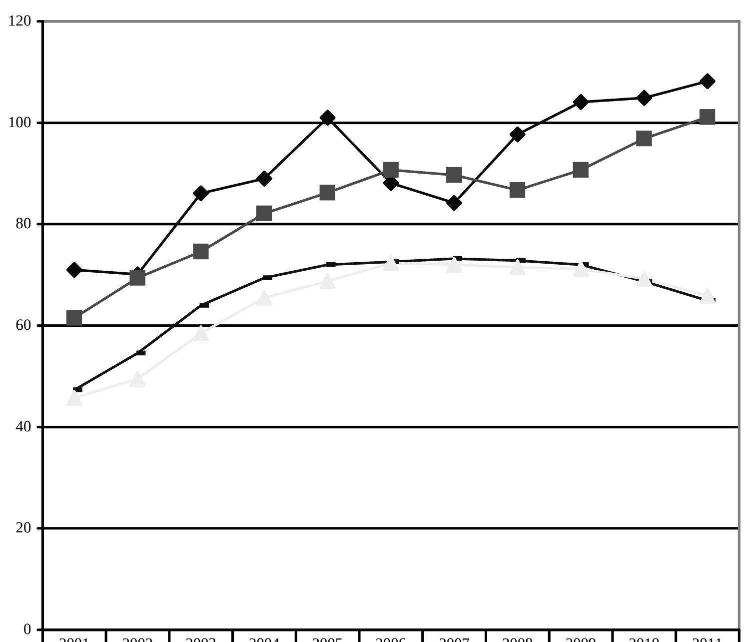
The Department of Defense essentially fakes a transformational procurement budget by another form of “dancing to the right,” deferring spending to future years and to future governments. Figure 1 shows this trend.

- Procurement spending increased by 22% in Budget Authority (BA) from FY2007 to FY2011, appearing to fund major programs, but only by 12% in Budget Outlays (BO). Instead of taking hard decisions, the QDR and FYDP stretch out and maintain unaffordable programs, minimize their impact on measures of the balanced budget, and stick President Bush’s successor with burden of either taking hard decisions or a funding nightmare.

- The technology base is underfunded, and not because it is really hard to predict the cost of future programs. The FYDP increases RDT&E funding by 28% between FY 2005 and FY 2009, from $144 billion to $185 billion. It then mysteriously drops by 10% between FY2009 and FY2011—evidently to allow a shift of funds into procurement.

Figure 1 - Dancing to the Right: Projected Defense Procurement and RDT&E Expenditures: FY 2001 to FY2011

(In Constant FY2007 Billions)



	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
BA-Procurement	71	70.1	86.1	89	101	88.1	84.2	97.7	104.1	104.9	108.2
BA -RDT&E	47.3	54.6	64	69.4	72	72.6	73.2	72.8	72	68.7	64.9
BO-Procurement	61.5	69.4	74.6	82.1	86.2	90.7	89.7	86.7	90.7	96.9	101.1
BO-RDT&E	45.7	49.5	58.5	65.5	68.8	72.3	72	71.5	71.2	69.2	65.9

Source: FY2007 Green Book: 115 and 133.

These problems will almost certainly grow worse in the near future. The DoD is deferring and ignoring many of the costs of the Iraq War and faces serious, unfunded outyear costs in terms of massive backlogs in repairs and maintenance, paying for the replacement of worn out equipment on an accelerated schedule, and dealing with the impact of deferred training. The same is true of the cost of deferred facilities, including military housing and social services.

In short, the problems raised by Iraq have so far been far less serious than the need to deal with cost containment in terms of both the sharply rising personnel costs of its all professional military and the Department of Defense's failure to effectively manage virtually all of its key procurement problems—including virtually every program in every service that is necessary for effective force transformation.

Force Death by Major Program

The US focus on new weapons and technology as key aspects of force transformation has so far created as many problems as solutions. The very real advantages of technology and modernization threaten to be lost by a massive procurement program that is a cost escalation nightmare, that forces constant cuts in both the active force and the numbers of new systems to be procured, and which can only be financed—even on paper—by cutting the funds for technology in the outyears as well as limiting other key expenditures like operations and maintenance costs and manpower.

There is nothing new about the DoD's failure to execute proper program management and to enforce the development of programs the Department can actually produce, make properly effective, and afford. The DoD has been a growing management disaster for decades. Program after program has died in the process. "Success" has meant paying for massive cost-escalation, slipping plans years beyond their planned dates, making major cuts in the numbers procured, keeping existing equipment for years to decades beyond the planned retirement decade, and taking additional years and billions of dollars to modify and fix new systems once they enter service.

The problem is that simply throwing time and money at management failures is no longer affordable, particularly when technology has become the putative solution to force transformation. A March 2005 study by the Government Accountability Office (GAO) was particularly critical of such trends in DoD acquisition programs. The report stated that:[1]

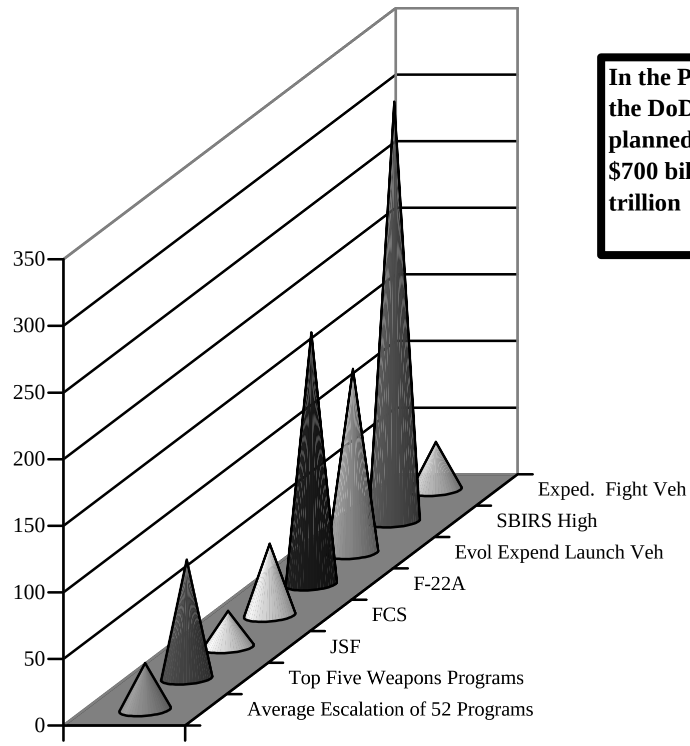
> *Although U.S. weapons are the best in the world, the programs to acquire them often take significantly longer and cost significantly more money than promised and often deliver fewer quantities and other capabilities than planned. It is not unusual for estimates of time and money to be off by 20 to 50 percent.*

The GAO's March 2006 report titled "Assessments of Selected Major Weapons Programs" showed that just five years ago, the top five weapon systems were projected to cost about $291 billion combined. As of March 2006, in the same base year dollars, the top five weapon systems are projected to cost about $550 billion.

The GAO report also found that the DoD had doubled its planned investments in new weapon systems from about $700 billion in 2001 to nearly $1.4 trillion in 2006. Figures 2 and 3 illustrate this escalation and highlight a few key programs.

Figure 2 - Procuring Defense to Death: The Wonderful World of "Transformational" Cost Escalation: 2001-2005

(Measured as Percent Rise in Unit Cost by Program)



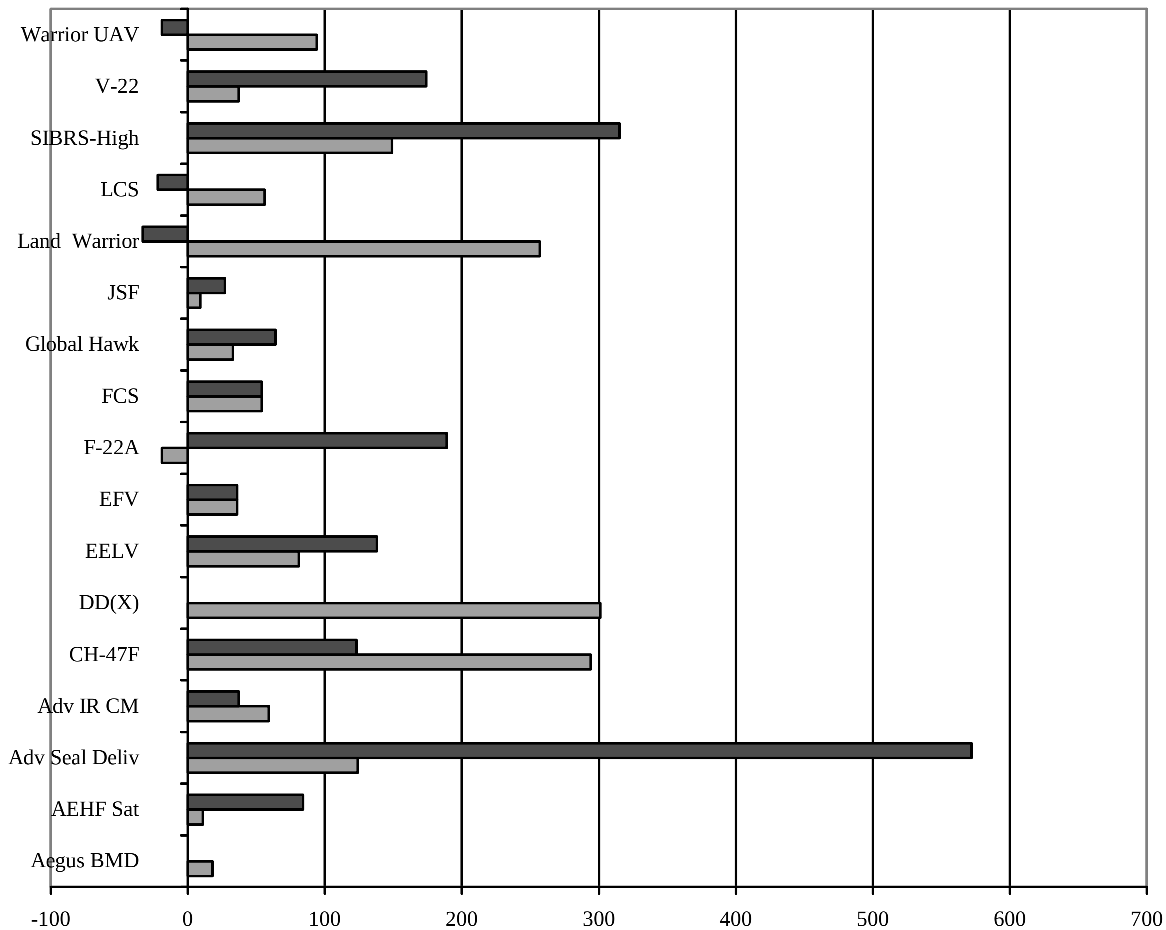
In the Past Five Years, the DoD has doubled its planned investments from $700 billion to $1.4 trillion

Average Escalation of 52 Programs	35
Top Five Weapons Programs	89
JSF	27
FCS	54
F-22A	189
Evol Expend Launch Veh	138
SBIRS High	315
Exped. Fight Veh	36

Source: Government Accountability Office, "Defense Acquisitions: Assessments of Selected Weapons Systems," GAO-06-391, March 2006.

Figure 3 - Short-Term (2001 or Later) Cost Escalation As of July 2005

(Percent in Constant FY2006 Dollars)



	Aegus BMD	AEHF Sat	Adv Seal Deliv	Adv IR CM	CH-47F	)DD(X	EELV	EFV	F-22A	FCS	Global Hawk	JSF	Land Warrior	LCS	-SIBRS High	V-22	Warrior UAV
Unit Cost	-	84	572	37	123	-	138	36	189	54	64	27	33-	22-	315	174	19-
Program Cost	18	11	124	59	294	301	81	36	19-	54	33	9	257	56	149	37	94

Source: Author's compilation based on the President's FY2007 budget request, CBO analysis of budget and economic outlook for FY2007-FY2016, and primarily on the range of extrapolations in Congressional Budget Office, and The Long Term Budget Outlook, December 2005. For additional analysis, see US Government Accountability Office, "21st Century Challenges: Reexamining the Base of the Federal Government," GAO-05-325SP, February 2005.

The GAO projected that Research, Development, Testing, and Evaluation (RDT&E) costs would rise from $147 billion in FY 2006 to $178 billion in FY 2011, an increase of 21 percent. According to the GAO, maximizing the returns from this investment has proved challenging for three reasons.[2]

- The DoD's investment in weapon systems comprises one of the largest discretionary items in the federal budget, so the DoD's budget faces mounting pressure from increases in mandatory federal spending, such as social security, Medicare, and Medicaid. The GAO anticipated that (1) federal deficits will average $250 billion through 2009; (2) budgetary demands stemming from demographic trends will extend beyond that timeline; and (3) discretionary spending will decrease to 33 percent from 39 percent of the federal budget by 2009. As such, the DoD will find it increasingly difficult to increase its budget share to cover cost increases in weapon programs.

- The DoD faces competing demands within its own budget from, among other things, operations in Afghanistan and Iraq. The DoD has required $158 billion in supplemental appropriations to support the global war on terrorism since September 2001. Moreover, ongoing military operations cause faster wear on existing weapons, which will need refurbishment and replacement sooner than planned. All of these budget implications increase the demand on the defense dollar and, therefore, on investment in new weapons programs.
- DoD programs typically take longer to develop and cost more to buy than planned, placing additional demands on available funding. Weapons programs must compete for resources and are often forced to make trade-offs in quantities, resulting in a reduction in buying power. Consequently, funds are not available for competing needs, and programs yield fewer quantities for the same, if not higher cost.

Figure 4, adapted from the 2006 GAO report, illustrates six programs—some of them discussed later in this paper—with the greatest reductions in buying power.

Figure 4 - Examples of Key Program Management Failures

Program	Initial Investment	Initial Quantity	Latest Investment	Latest Quantity	% unit cost increase	% quantity decrease
Joint Strike Fighter	$189.8 billion	2,866 aircraft	$206.3 billion	2,458 aircraft	26.7	14.2
Future Combat Systems	$82.6 billion	15 systems	$127.5 billion	15 systems	54.4	0
F-22A Raptor	$81.1 billion	648 aircraft	$65.4 billion	181 aircraft	188.7	72.1
Evolved Expendable Launch Vehicle	$15.4 billion	181 vehicles	$28.0 billion	138 vehicles	137.8	23.8
Space Based Infrared System High	$4.1 billion	5 satellites	$10.2 billion	3 satellites	315.4	40
Expeditionary Fighting Vehicle	$8.1 billion	1,025 vehicles	$11.1 billion	1,025 vehicles	35.9	0

Source: Adapted from “Defense Acquisitions: Assessments of Selected Major Weapons Programs.” Government Accountability Office Report to Congressional Committees. 31 March 2006:8. Note that the “Latest Investment” and the “Latest Quantity” do not necessarily reflect the latest projections of the total program costs or the total program’s procurement quantities.

The GAO’s 2006 assessment showed that the majority of weapons programs cost far more and take far longer to develop than initially forecast. Total RDT&E costs for 26 common set weapons programs increased by nearly $44.6 billion, a 37 percent increase over their initial estimates. The same programs also experienced an increase in the time needed to develop capabilities; the weighted average schedule increase for these programs was nearly 17 percent.[3] The GAO found that critical cost, performance, and delivery schedule problems have mortgaged the force transformation plans of every service and threaten the ability of force transformation to deal with its problems of “overstretch.”

The Army’s Cost-Escalation and Program Management Challenges

Each of the services faces major problems in transforming its programmatic hopes into actual force transformation. In the Army’s case, this is particularly true of its future combat systems.

Future Combat Systems Program Costs

The US Army's Future Combat System (FCS) is both the Army's key platform for force transformation and its most expensive acquisition project. The program is an ambitious effort to develop a suite of new manned and unmanned ground and air vehicles, sensors, and munitions linked by a new information network that will revolutionize warfighting. The Army has called the FCS "the greatest technology and integration challenge the Army has ever undertaken" and considers the platform key to creating a lighter, more agile, and more capable combat force.

The FCS dominates future investment accounts and faces serious funding problems. Between April 2003 and September 2004 total program costs for FCS escalated 35.2 percent, and research and development costs increased by 50.8 percent. In addition, during the same period, the FCS acquisition cycle time increased 52.7 percent to 139 months. The Army has deferred actual procurement of FCS for roughly a decade to pay for core elements of net-centric intelligence, surveillance, and reconnaissance (IS&R) systems and upgrades/retention of its legacy systems.[4]

The Department of the Army's FCS program office initially estimated total research and development costs in FY 2005 dollars of $28 billion and procurement costs for 15 units of action of around $79.9 billion. This meant that the first phase of FCS would equip about one-third of the total force and cost at least $108 billion. The Army then updated its research and development cost estimate to $30.3 billion in 2005 dollars.

By 2004, the FCS program faced major resource constraints. According to a December 2004 report in *Defense News*, the Office of the Secretary of Defense (OSD) considered cutting $1.4 billion from the program each year from then until 2011.[5] The Army's FCS request in the FY 2006 budget was $3.045 billion, which was $200 million more than the previous year. The increase in price was partly due to the Army's plan to start incorporating FCS capabilities in two year increments.[6] The GAO predicted that fully equipping the entire force would cost between $3 billion and $9 billion each year.[7]

In 2005, the cost of the FCS program was so high that the GAO reported that "FCS is at significant risk for not delivering required capability within budgeted resources…Nearly 2 years after program launch and with $4.6 billion invested, requirements are not firm and only 1 of over 50 technologies is mature."[8] The Army estimated the total cost could easily reach $145 billion, or some $53 billion more than originally estimated. In July 2004, the FCS program underwent a restructuring. As a result, the Army expected an additional four-year delay in fielding the first complete FCS brigade—until 2014.

On September 21, 2005, Army Secretary Francis Harvey estimated that the program would now cost $125 billion over 20 years.[9] According to the FY 2006 Department of Defense Budget, the Army's FCS FY 2005 research and development costs were $2.8 billion, a 75 percent increase from FY 2004. The Army requested $3.4 billion for the program in FY 2006, a 21 percent increase from the previous year. As such, FCS comprised 65 percent of the Army's proposed spending on system development and demonstration programs and 35 percent of the Army's proposed spending on all RDT&E.[10]

The FCS has suffered from more than cost escalation. The program calls for 18 networked new weapons and robotic systems for 18 brigades. The goal of FCS is to create a system of lighter, smaller vehicles without compromising lethality. It is also designed to collect and disseminate intelligence and communications information. It is a complex, interdependent system facing financial, managerial, and technological challenges. The requirements of the program, network, and software are all still in their developmental stages. The program has been given about 9.5 years to complete the development phase and begin production.

However, there already have been significant cutbacks and delays. The first major deployment of FCS-related equipment is scheduled to take place in FY 2008. In 2005, the GAO reported that each of the programs for developing the FCS's communications network was at risk of not delivering its intended capabilities by this deadline:[11]

- The Joint Tactical Radio System (JTRS) Cluster 1 program—tasked with developing radio for ground vehicles and helicopters and slated to be the backbone of the FCS network—has been fraught with immature technologies, schedule delays, and a lack of clearly defined and stable requirements. As such, the program has struggled to mature and integrate key technologies and has been forced to make major design changes without a corresponding boost in intended capabilities. These factors contributed to significant cost and schedule problems that led the Army in December 2004 to propose restructuring the program by adding $458 million and 2 years to the development effort.

- In January 2005, the prime contractor estimated that the total costs for the Cluster 1 development would be $531 million than what was originally budgeted, reaching about $898 million. Subsequently, the GAO reported that "A recent review of the [Cluster 1] program concluded that the current program structure is not executable, and in April 2005, DOD directed the Army to stop work and notify the contractor that it was considering terminating the contract."[12]

- JTRS Cluster 5 program—tasked with developing small radios, including those that soldiers carry—has also faced technical challenges and program changes that have impeded progress. For example, the smallest of the Cluster 5 radios will not be able to provide the power and cooling needed for the Wideband Networking Waveform that will serve as the main conduit of information to and from Army tactical units. In light of unresolved issues with the Cluster 1 program, in 2005, the DoD initiated an assessment to restructure the Cluster 5 program that could further delay implementation.

- The GAO estimated in 2005 that none of the critical technologies for the Warfighter Information Network-Tactical (WIN-T) program would be fully mature at the time production began in March 2006.

- The System of Systems Common Operating Environment (SOSCOE)—being developed as the operating software that integrates the communications network—faces the dual challenge of a software development that is high-risk and evolving requirements. Army program officials have said that SOSCOE software may not reach the necessary technical maturity level required to meet program milestones.

The 2006 QDR and the accompanying budget submission for FY 2007 left FCS intact and continued the program's spending binge. The budget requested $3.7 billion for FCS, a 20 percent increase from FY 2006 and a 50 percent increase from FY 2005.

Force Modularity Program Costs

Similar problems have arisen in near-term Army transformation efforts. In March 2005, the Army estimated that its modularity program would cost $48 billion from FY 2005 – FY 2011 to complete, a 71 percent increase from its 2004 estimate of $28 billion.[13] The GAO believed that these cost estimates were unrealistic and would be revised upward, as the Army had yet to fully identify its requirements and costs associated with modularizing the Army. Moreover, some military analysts contended that the Modularity Program would face growing affordability issues because it was being undertaken at the same time that the Army was supporting the Global War on Terrorism, engaged in ongoing operations in Afghanistan and Iraq, and developing new technologies and capabilities (including FCS) that demanded high levels of resources.

While Congress supported the Army's modularity program, it viewed the DoD's FY 2005 Supplemental Request for an additional $5 billion for Army modularization with considerable reservation. The House Appropriations Committee directed the Secretary of Defense to submit to the congressional defense committees a report detailing the DoD's long-range plan for executing and funding Army modularization, specifically identifying the personnel and equipment requirements, unit restructuring timelines, and the associated costs.[14]

Moreover, the Senate cautioned the DoD and Army in S. Rept. 109-52 on the FY 2005 Emergency Supplemental. "The Department has now had ample time to incorporate requirements to support Modularity into its annual budget requests. The Committee is unlikely to regard supplemental appropriations as an appropriate vehicle for future efforts supporting modularity."[15] The Congress made it clear that it was not pleased with the DoD's and the Army's inability to plan and budget costs and would not look favorably on further DoD and Army efforts to fund modularity through supplemental appropriations.[16]

USAF and Naval Aviation Program Management Challenges

Air Force and Naval/Marine Corps aviation are mortgaged to a range of major new programs and systems, including the F-22A, JSF, tankers, lift replacements, and special assets. Two of the Air Force's largest programs are the F-22A Raptor and the Joint Strike Fighter. Both are examples of how the failure to manage cost escalation can help create a form of overstretch. In fact, they illustrate the risk that "force multipliers" pose when they are so expensive that they create force-planning problems and become "force cripplers."

These programs have also been in existence long enough to be time urgent. If they continue to slip or be cutback, existing systems must be rebuilt or supplemented with unfunded additional production. The average age of the B-52 (41 years) often gets attention. But the average F-15 is 18 years old, and the average KC-135 Stratotanker is 46 years old. Other systems are simply worn.

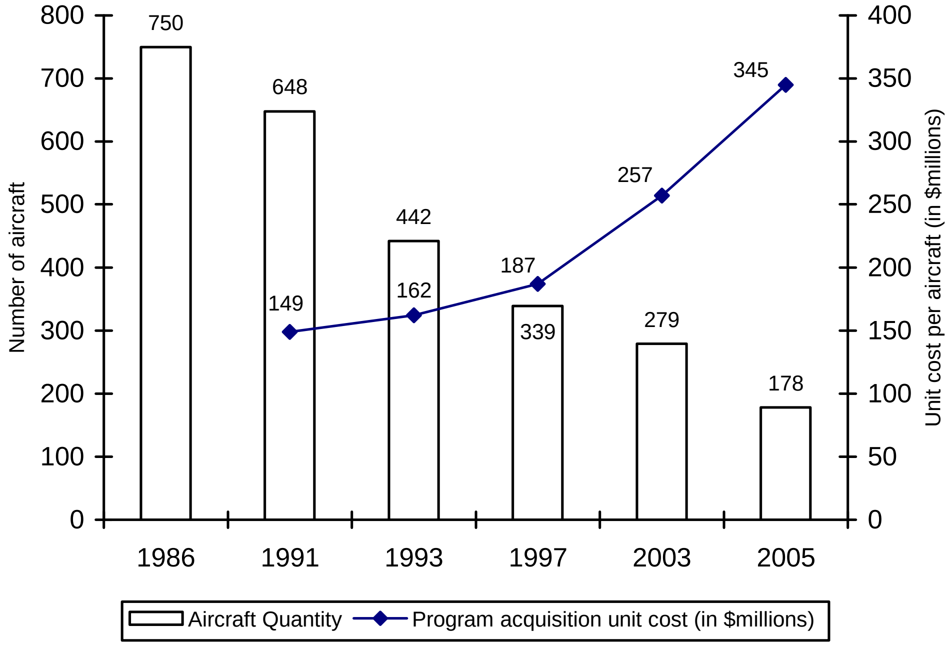
The F-22A Raptor

The F-22A Raptor has become a cost escalation nightmare. The OSD restructured the $72 billion program's acquisition schedule twice between 2004 and 2006. In December 2004, the OSD issued Program Budget Decision (PBD) 753 which reduced F-22A funding by $10.5 billion and cut the procurement quantity from 277 to 179 aircraft. (Subsequently, the Air Force transferred one production aircraft to testing, reducing the procurement quantity to 178.) PBD 753 also planned to terminate F-22A procurement in 2008.

The DoD changed the Raptor program again in December 2005. This time the DoD added $1 billion to the program to extend its production for two years through 2010. The move was designed to ensure that a next-generation fighter aircraft production line remained in operation in case the Joint Strike Fighter experienced delays or problems. The change also froze the Raptor's design at its present configuration allowing for the procurement of four additional aircraft for a total planned procurement of 183 F-22As.[17]

But even 183 aircraft is 198 aircraft below the Air Force's current stated need for 381 Raptors to satisfy original air-to-air missions and recently added requirements for more robust air-to-ground attack and intelligence-gathering capabilities. Put simply, because of past cost overruns and current budget constraints, the DoD can afford only 183 aircraft. And as the procurement goal has fallen significantly over the life of the program, the cost per aircraft has escalated dramatically, from $149 million in 1991 to $345 million in 2005. Figure 5 illustrates the program's unit cost increase by year.

Figure 5 – Quantity and Program Acquisition Unit Cost of F-22A



Source: Adapted from "Tactical Aircraft: Air Force Still Needs Business Case to Support F/A-22 Quantities and Increased Capabilities." Government Accountability Office Report to Congressional Committees. 15 March 2005.

The history of the F-22 program partially explains its massive cost escalation. Begun in 1986, the original F-22 program was intended to replace the F-15 with a state-of-the-art, air-to-air superiority fighter that would counter large numbers of advanced Soviet fighter aircraft. At the time, the DoD planned to develop the F-22 over 9 years and achieve operational capability by March 1996. However, over the nearly two decades of the Raptor's development, the threat of advanced Soviet fighter aircraft never materialized, and adversarial threats against US aircraft changed.

Consequently, in 2002 the Air Force decided to give the F-22 more robust air-to-ground strike capabilities to increase the utility of the aircraft and to justify continued funding for the program. Redesignated the F/A-22, with the "A" representing the aircraft's expanded ground attack capabilities—the F/A-22 was renamed the F-22A in December 2005—the program embarked on a time-phased modernization program that the OSD's Cost Analysis Improvement Group estimated in 2003 would cost an additional $11.7 billion through 2018. This estimate included costs for development, procurement, and retrofit of modernized aircraft.[18] As of March 2006, the Air Force estimated that modernization costs from 2007 through 2016 would be about $4.3 billion. Additional modernization costs are anticipated, but the content and costs have not been determined or included in the budget.[19]

The modernization and acquisition timeline for the Raptor has become steadily more uncertain as a result of these developments. According to the 2005 timeline, modernization would extend from 2007 to 2015, as summarized in Figure 6.[20]

Figure 6 – Planned Modernization Enhancements for the F-22A Program

	Examples of Capabilities to be Added

2007	**Air-to-air plus limited air-to-ground**: Improved capability to launch Joint Direct Attack Munition at fast speeds; upgrade air-to-air capabilities.
2011	**Air-to-ground:** Add improved radar to seek and destroy advanced surface-to-air missile systems; integrate additional air-to-ground weapons.
2013	**Additional air-to-ground:** Increase capability to suppress or destroy full range of air defenses and improve speed and accuracy of targeting.
2015	**Enhanced intelligence data gathering:** Add integrated intelligence, surveillance, and reconnaissance capabilities.

Source: Adapted from "Tactical Aircraft: Air Force Still Needs Business Case to Support F/A-22 Quantities and Increased Capabilities." Government Accountability Office Report to Congressional Committees, 15 March 2005.

However, the Air Force has not prepared a new business plan for the F-22A to justify the resources needed to implement the proposed modernizations. According to the GAO, the uncertainty surrounding the ongoing modernization program coupled with the 198-aircraft gap between the Air Force's stated need and what the acquisition process is able to deliver have made the F-22As business case untenable. "The business case for the program has changed radically—threats have changed, requirements have been added, costs have increased, funds have been added, planned quantities have been reduced, and deliveries of the aircraft to the warfighter have been delayed."[21] Moreover, the GAO argued that "the modernized F/A-22 would differ so significantly from the original aircraft in capabilities and missions that it should have been developed in an entirely separate acquisition program."[22] If the F-22A is essentially a new program—retired USAF Col. Everest E. Riccioni wrote that "only the engines, the canopy, and the fuselage reference line will be common and interchangeable" with the original F-22—then one can expect that implementation of the modernization plan has a good likelihood of causing new delays and problems that are similar to those that a new aircraft program may encounter.[23]

These feared delays and problems were realized in Spring 2006 when the Air Force discovered structural flaws affecting nearly 100 Raptor aircraft. Raptor program officials found weaknesses in structures that attach the wing and tail to the plane's fuselage and corrosion in the aircraft's panels. Officials estimated that testing for and fixing these problems could cost around $1 billion.[24]

The GAO has repeatedly asked the DoD to write a new business case for the Raptor program that addresses the need for the aircraft and the quantities required and affordable. The DoD did not comply with a March 2004 GAO recommendation to this effect, writing that "The Department evaluates the F/A-22 business case, program progress, need for the aircraft, and quantities required, as part of our routine acquisition and budget processes."[25] Of course, the GAO did not agree that the DoD's routine processes provided sufficient analysis to justify future investments in the new capabilities added by the modernization program, especially considering the prevailing uncertainties surrounding the program issues.[26]

In March 2005, the GAO again recommended that the Air Force develop a new business case that justified additional investments in modernizing the aircraft to include greater ground attack and intelligence-gathering capabilities before moving forward. The Pentagon responded by writing that the forthcoming QDR (released February 2006) would analyze requirements for the F-22A and make program decisions. The 2006 QDR was not forthcoming in addressing these points, as described in March 2006 in testimony before the Subcommittee on Tactical Air and Land Forces of the House Armed Services Committee.[27]

> *It is not clear from the [2006] QDR report...what analyses were conducted to determine the gaps in capability, the alternatives considered, the quantities needed, or the costs and benefits of the F-22A program. Therefore, questions about the F-22A program remain:*
>
> - *What capability gaps exist today and will exist in the future (air superiority, ground attack, electronic attack, intelligence gathering)?*
> - *What alternatives besides the F-22A can meet these needs?*
> - *What are the costs and benefits of each alternative?*
> - *How many F-22As are needed?*
> - *What capabilities should be included?*
>
> *Until these questions are answered and differences are reconciled, further investments in the program—for either the procurement of new aircraft or modernization—cannot be justified.*

Even beyond the question of whether the F-22A has an executable business case, the program has been criticized on other fronts.

- The Raptor is more expensive than the JSF; it is less versatile; and presently, it is only an air-to-air combat aircraft, in spite of modernization plans to give the aircraft Global Strike Full and Enhanced Intelligence, Surveillance, and Reconnaissance capabilities.
- Even if the modernization plan is implemented, the utility of the Raptor as a ground attack aircraft is questionable, considering that the JSF, the A-10 and the F-18E were designed to have or already have this capability.
- An air-to-air fighter is obsolete in this new age of irregular warfare, considering that the program began in 1986 with the intention of it being capable of fighting Soviet fighters. If the aircraft is in fact obsolete, then the program's remaining budget dollars could be better invested in enhancing current air assets and in acquiring new and more transformational capabilities that will allow the DoD to meet the evolving threats from asymmetric warfare. As the GAO described the situation, "when DoD's weapon systems, such as the [F-22A], require more time and money than originally anticipated, the extra investment needed to solve problems takes funding away from other priorities, slows DoD's overall modernization effort, delays capabilities, for the warfighter, and forces unplanned—and possibly unnecessary—trade-offs among DoD's many priorities."[28]
- The 2006 QDR shifted the Pentagon's traditional two major theater war strategy to one that accounts for the possibility of waging a conventional campaign and a large-scale, long-duration irregular campaign. The new strategy placed a greater emphasis on homeland defense and counterterrorism. Theoretically, such a shift in strategy should decrease the importance of warplanes like the Raptor.[29]

Proponents of the F-22A program argue that the US requires fifth-generation tactical aircraft like the Raptor to ensure air superiority in the event of a conflict with China, North Korea or Iran. This argument, however, requires the USAF to be able to fund a suitably large force. Col. Everest E. Riccioni, USAF Ret., argued in his paper, "Description of our Failing Defense Acquisition System as Exemplified by the History, Nature, and Analysis of the USAF F-22 Raptor Program," that this might not be practical. "Operationally, acquiring only 150-180 aircraft means the USAF will use some 70-80 aircraft for training and home defense, 40-50 for the European theater, and 40-50 for the Pacific theater. These numbers combined with the usual low maintenance readiness for flight of complex stealthy aircraft reduces the operational availability of the fleet to insignificance."[30]

The Joint Strike Fighter

The F-35 Joint Strike Fighter (JSF) is another high cost acquisition program led by the US and co-financed by eight allied countries. The program evolved in the late 1990s in response to the high cost of tactical aviation, the need to deploy fewer types of aircraft to reduce acquisition and operating costs, and projections of future threat scenarios and enemy capabilities. To these ends, the JSF program is a joint-service project to develop a next-generation multi-role aircraft that can be produced in affordable variants to meet the different operational requirements of the Air Force, the Navy, and the Marine Corps. The three primary variants in the JSF family of aircraft—a conventional take-off and landing (CTOL) aircraft, a carrier-capable (CV) aircraft, and a short take-off vertical landing (STOVL) aircraft—employ a modular mix of components, systems, and technologies with commonality projected at 70 to 90 percent in terms of production cost. Many high cost components, such as engines, avionics, and major structural components of the airframe, are common between the three variants.[31] As former Secretary of Defense William Cohen stated, the JSF's joint approach to procurement "avoids the three parallel development programs for service-unique aircraft that would have otherwise been necessary, saving at least $15 billion."[32]

Despite the best cost-saving intentions of the program, however, the relatively short history of problems with the JSF is all too similar to that of the F-22A Raptor program. As the GAO wrote in a March 2006 report, "the JSF appears to be on the same path as the F-22A program. After being in development for 9 years, the JSF program has not produced the first test aircraft, has experienced substantial cost growth, has reduced the number of planned aircraft, and has delayed delivery of the aircraft to the warfighter."[33]

- The JSF is the largest defense acquisitions program in history. When its ten year System Development and Demonstration (SDD) Phase began in 2001, the program's estimated cost was $183.6 billion for 2,866 aircraft, or about $64.1 million per aircraft.[34] According to a DoD selected acquisition report (SAR) released March 7, 2006, the cost of the program increased to $276.5 billion for 2,458 aircraft, or about $112.5 million per aircraft. The total program cost has escalated 51 percent, while the cost per aircraft has escalated nearly 76 percent.
- The JSF program is heavily dependent on a business case that invests heavily in production before testing has demonstrated acceptable performance of the aircraft. The program expects to begin low-rate initial procurement in 2007, with less than 1 percent of the flight test program completed and no production representative prototypes built for the three JSF variants. Moreover, technologies and features critical to the JSF's operational success, such as a low observable and highly common airframe, advanced mission systems, and maintenance prognostics systems, will not have been demonstrated in a flight test environment when production begins.[35]
- By 2010, the DoD expects to have procured 126 JSF aircraft with only 35 percent of the flight test program completed. The program expects the first fully integrated and capable development JSF to fly in 2011. By that time, the DoD will have already committed to buy 190 aircraft at an estimated cost of $26 billion. The DoD's low-rate initial production quantities are expected to increase from 5 aircraft a year in 2007 to 133 a year in 2013, when development and initial operational testing are complete. By then, the DoD will have already procured 424 aircraft at an estimated cost of $49 billion. At the same time, spending for monthly production activities is expected to be about $1 billion, an increase from $100 million a month when production is scheduled to begin in 2007. As the GAO described the situation, "concurrently testing and procuring the aircraft adds to the program's costs and schedule risks, further weakening DoD's buying power and jeopardizing its ability to recapitalize its aging tactical air force in a timely and efficient manner."[36]

The DoD made a controversial move to curb the JSF's mounting cost escalation in February 2006 by abandoning investments to develop an alternative engine for the JSF. The DoD had already invested $1.2 billion to develop the alternative F-136 engine, to the current F-135 engine, through FY 2006, and by cancelling the program, the DoD expected to save $1.8 billion through FY 2011. In the past, fighter aircraft programs like the F-15 and the F-16 adopted the practice of developing alternative engines. The practice may help maintain the industrial base for fighter engine acquisition and spare parts, result in price competition in the future for engine acquisition and spare parts, instill incentives to develop a more reliable engine, and ensure an operational alternative should the current engine develop a problem that would ground the entire fleet of aircraft.[37]

Defense analysts criticized the Pentagon's decision to go sole source without the support of a strong business case analysis.[38] Christopher Bolkcom of the Congressional Research Service (CRS) explained the DoD's decision. "The argument is that a single engine manufacturer making more engines will climb the learning curve faster and save more money than two manufacturers making fewer engines each...What must also be considered, however, is the innovation and savings that can be derived from competition between two manufacturers, which is lost in a sole source environment." Loren Thompson, a defense analyst and CEO of the Lexington Institute, was less sympathetic to the Pentagon's reasoning. "The only learning curve here will be that a contractor will learn how much it can charge for an engine."[39]

The JSF program has also encountered difficulties in accommodating its international partners due to DoD reluctance to share critical technologies. In March 2006, Britain, the US's principal foreign partner in the program, indicated that it could not buy the aircraft without the requisite technology transfer. Five other partner countries—Norway, Italy, Turkey, Denmark, and the Netherlands—in the program echoed Britain's reservations about remaining in the program at all.[40]

In addition to the JSF's cost escalation and program management challenges, the JSF, like the F-22A, has faced criticism regarding the need for next-generation tactical aircraft. Some experts have asked whether future threat scenarios require the combat capabilities of the JSF. The implication is that the continued production of modified versions of the Air Force F-16, the Marine Corps AV-8B, and the Navy F/A-18E/F along with the Air Force's B-2 stealth bombers and F-22A fighters and in conjunction with sea-launched missiles and the precision guided munitions would probably cover most combat scenarios.[41] Moreover, US air dominance during the Gulf War and subsequently in Bosnia, Kosovo, Afghanistan, and Iraq suggests that next-generation aircraft may not be required for US forces to achieve their military objectives in future conflicts.

Proponents of the JSF retort that acquiring next-generation aircraft would be more cost effective than upgrading current aircraft to perform effectively beyond 2010. Existing planes would require major modifications at considerable cost and would be less effective in combat than a new JSF family of tactical aircraft. This perspective anticipates that the proliferation of Russian and other advanced surface-to-air and air-to-air missiles to hostile countries is likely to continue, posing a more serious threat to US and allied aircraft than they faced during the 1991 Gulf War.

Others have argued that many of the existing operational aircraft will be twenty or more years old and will need to be replaced by the time the JSF is estimated to reach full production in the 2010s. Advocates of the JSF program have also suggested reducing procurement of F-22As and F/A-18E/Fs in order to fund the JSF program.[42] However, this argument is problematic considering that the Air Force often cites the complementary roles of the F-22A and the JSF as analogous to the complementary roles of the F-15 and the F-16. In a March 16, 2006 statement before the House Armed Service Committee, Lt. General Carrol H. "Howie" Chandler, Deputy Chief of Staff for Air Force Air, Space, and Information Operations, Plans, and Programs, said that "The [JSF and the F-22A] are very complementary to each other because of the optimization of the F-22A for air-to-air (combat), and its ability to suppress or defeat enemy air defenses. The Joint Strike Fighter is optimized for air-to-surface and its ability to strike hard."[43]

The difficulties in accurately predicting the future threat environment, how combat-effective JSF aircraft would be, and what it would cost to develop, procure, and operate F-35 aircraft leave any assessments of military requirements, combat effectiveness, and budgetary costs open to a range of conjecture and debate.[44] But it is precisely these uncertainties that the GAO recommended the DoD address with a new analytically-based business plan for its tactical aircraft programs. As with the F-22A, the Pentagon's reliance on the 2006 QDR to provide the requisite analytic detail did not live up to expectations. As the GAO pointed out, the 2006 QDR "did not present a detailed investment strategy for tactical aircraft systems that addressed needs, capability gaps, alternatives, and affordability. Lacking a strategy that identifies capability gaps and affordable alternatives, the DoD cannot reasonably ensure that new tactical air capabilities will be delivered to the warfigher within cost and schedule targets."[45]

The Air Force Tanker Problem

Modern military air operations require refueling aircraft, or tankers like the KC-135, that extend the range of fighters, bombers, and other aircraft, increase the deployment times of combat and surveillance aircraft, and boost combat aircraft lethality. The Air Force has estimated that it will need around 600 KC-135-like aircraft. But the need for aerial refueling is likely to increase in the future for two reasons. Over the past several years, the US has reduced by two-thirds the number of forward bases from which it can operate, and major overseas en route air bases have declined by 69 percent. So to maintain the same level of engagement capabilities, US forces will be forced to deploy more frequently over greater distances.[46]

Currently, the Air Force's tanker fleet is large and effective, but it is old and requires modernization. The Air Force owns 531 Boeing KC-135 Stratotankers, including 114 E and 417 R models. At an average age of over 46 years, the "Eisenhower Era" KC-135 fleet is the oldest combat weapon system in the Air Force, and the Stratotanker platform is expected to fly until 2040. The Air Force also owns 59 Boeing KC-10A Extenders, with nearly twice the fuel capacity of the KC-135. The average KC-10 has an age of 20.5 years, and the Air Force also plans for the KC-10 to remain active through 2040.[47]

Modernizing or replacing the tanker fleet has been a point of contention for more than a decade, and the DoD faces difficult choices regarding desired capabilities, force structure, and budget options. In 1996, a report by the General Accounting Office (GAO) argued that the long-term viability of the KC-135 fleet was questionable because as the fleet ages, it will take progressively more time and money to maintain and operate. In response to the GAO's recommendation to study replacement options, the DoD countered that KC-135 airframe hours were low and that the fleet was sustainable for another 35 years.[48] The Air Force reiterated this position in its 2001 Economic Service Life Study (ESLS). The ESLS found that the KC-135 would incur "significant cost increases" between 2001 and 2040, but "no economic crisis is on the horizon...there appears to be no run-away cost-growth," and "the fleet is structurally viable to 2040."[49]

The Air Force then reversed this position. Subsequent Air Force studies determined that the ESLS was conceptually flawed because it failed to predict fatigue and corrosion problems in the tanker fleet. The Aging Aircraft Study, released in November 2002, found that corrosion, rather than the number of flight hours flown or the mission assigned to the KC-135, had the most significant impact on the expected life span of each airframe. The May 2003 KC-135 Business

Case Analysis (BCA) reinforced these findings and determined that corrosion, increased operating costs, and other operating uncertainties justified a decision to retire 44 KC-135s in FY 2004. Moreover, in a letter dated September 22, 2003, to Senators John Warner and Carl Levin, Deputy Secretary of Defense Paul Wolfowitz noted that between 1991 and the date of his letter, KC-135E corrosion-related depot maintenance increased more than three times, and that 30 percent of the tanker's heavy maintenance man-hours were now devoted to the mitigation of corrosion damage.[50]

However, while most experts finally agreed that the KC-135E fleet suffers from severe corrosion problems, what to do about them has been wrought with scandal and political infighting.[51]

- The FY 2002 Defense Authorization Act (P.L. 107-117), authorized the Air Force to lease 100 Boeing KC-767 aircraft to replace the oldest KC-135Es. This proved controversial because it appeared to subvert the traditional acquisition process and weaken congressional oversight. It then turned out that leasing the aircraft would cost more than procuring the aircraft outright. The controversy over the lease proposal was fueled further by four congressional debates and, ultimately, by alleged and admitted ethical violations by government and industry representatives involved in the proposal.

- The FY 2004 Defense Authorization Act (P.L. 108-136, Sec. 135) attempted to reconcile the differences between opponents and proponents of the KC-767 by allowing the Air Force to lease 20 tanker aircraft and purchase no more than 80 aircraft. The legislation also mandated that the Air Force conduct an aerial refueling Analysis of Alternatives (AoA) and that an independent assessment be conducted on the condition of the KC-135E fleet.

- The DoD did not authorize any funds for FY 2005 either to lease 20 or procure 80 aircraft even though it had the statutory authority to proceed. Pentagon leaders deferred executing either action until the completion of the independent assessment, tasked to the Defense Science Board (DSB), and an internal investigation by the DoD Inspector General (IG) on potential improprieties by Boeing Company executives negatively affecting the tanker lease program.

- In April 2004, Darleen A. Druyan, the former lead Air Force negotiator on the tanker lease program, pleaded guilty to one count of criminal conspiracy for secretly negotiating an executive job with the Boeing company while still overseeing the $23 billion deal between the Air Force and Boeing.

- Air Force Secretary James Roche submitted his resignation in November 2004 amid allegations of wrongdoing in the tanker lease deal. In February 2005, the *Washington Post* reported that the DoD IG found that Air Force Secretary James Roche misused his office when he lobbied the Office of Management and Budget (OMB) to support the lease proposal.[52]

- The IG's final report found that four other senior DoD officials were guilty of evading OMB and DoD acquisition regulations. The IG determined that senior DoD officials knowingly misrepresented the state of the KC-135 fleet and aerial refueling requirements.[53] In a June 7, 2005 hearing before the Senate Armed Services Committee, DoD IG Joseph Schmitz testified that the US Attorney's Office may file criminal charges.[54]

Despite the fallout from the biggest Pentagon procurement scandal in more than two decades, the Air Force's tanker problem still requires resolution. Given that the FY 2005 Defense Authorization Act (P.L. 108-375) terminated the leasing authority granted in the FY 2004 Defense Authorization Act, the DoD and Congress again must consider alternatives to modernizing or replacing the Air Force aerial refueling fleet.

The Defense Science Board (DSB) released its independent analysis of the KC-135E fleet in May 2004. In addition to rebutting Air Force claims that the tanker fleet urgently needed to be replaced, the study recommended that "serious consideration be given" to purchasing and converting used aircraft for aerial refueling (especially the DC-10), re-engining some KC-135s, and increasing the use of commercial aerial refueling services. The DSB also pointed out that a tanker fleet composed of two different types of aircraft—large, long-range tankers and smaller, tactical tankers—would likely be most prudent and effective.[55]

Like the DSB study, the RAND Corporation's long-awaited Analysis of Alternatives (AoA) on the Air Force fleet of tankers, completed in January 2006, also argued that the need to replace the tanker fleet was less pressing than the Air Force claimed and that replacement may not need to begin for six to eight years. Rather, the 1,500-page report, classified as secret, advocated that the Air Force weigh budget constraints and other considerations before purchasing new aircraft. Nonetheless, the AoA focused mainly on the question of buying new commercial planes to replace the existing KC-135s. The AoA found that it would cost between $109 billion and $200 billion to buy new planes to replace the existing fleet. It recommended that the Air Force buy new medium or large commercial aircraft—such as Boeing's 767, 777, 787, and 747 or Airbus's A330 and A340—to replace its KC-135 tankers and dismissed recommendations by the DSB and by the CRS to consider leasing tankers, re-engining existing tankers, and converting planes like DC-10s for the job.[56]

Loren Thompson of the Lexington Institute argued strongly against the AoA's recommendations.[57]

> *The absurdity of saying you don't need new tankers until some date in the future lies in an inability to predict when the current fleet will begin incurring structural problems...Nobody has ever operated jets for this long, so we can't know when these will become dangerous.. They are saying there is plenty of fatigue life in the aircraft, but that's not the problem. Corrosion is, and you can't precisely model that. Each time they open one of these aircraft, they find how inaccurate their models were. This is the oldest fleet of jets operating.*

In testimony before the Projection Forces Subcommittee of the House Armed Services Committee on February 28, 2006, Air Force Lt. General Christopher Kelly, Vice Commander, Air Mobility Command, reinforced these points with concrete dollar figures.

> *The KC-135 fleet is over 46 years old, and it has exhibited major technical difficulties with increased costs of operation and decreased aircraft availability, which in turn increases operation risk. The Fleet Viability Report identifies a window for replacing the KC-135 fleet by the 2023-2030 timeframe. [Air Force Mobility Command] depot forecasts show that an additional $46.8 billion will be needed to sustain the current KC-135 fleet through the year 2040 without addressing the identified gaps and shortfalls that exist today...Affordability is an area of concern. Today our total obligation authority will allow us to buy 12-15 new aircraft per year at costs ranging between $150 million - $200 million per aircraft. At 12 aircraft per year, it would take over 38 years to replace the KC-135 fleet capability to meet the minimum Mobility Capabilities Study requirement, with an annual procurement outlay of $1.9 billion - $3.2 billion. This annual funding outlay increases with every year we delay the replacement program decision.*

General Kelly also noted that retiring 114 of the oldest tanker models by 2010 would save the Air Force $6.1 billion, about the cost of 50 new tanker aircraft that would have significantly higher capability than the current KC-135E tankers.

The FY 2007 budget submission included plans to spend $204 million to launch a competition to replace the aging tanker fleet. Dubbed the "KC-X" initiative, the Air Force sought $203.9 million in RDT&E funds and another $36.1 million in procurement dollars.[58]

Joint Lift Platforms

For the same reasons that effective US force projection requires a capable tanker fleet, the US military needs a comparable airlift capability. Global tensions have shifted from places like Europe, where the US had large combat units permanently stationed, to places where the US military presence is much smaller and less welcome. The areas to which the US must project its forces are increasingly far from the ocean, in locations that are simply not accessible by sea-based forces—sealift alone cannot accommodate forces in Afghanistan. Moreover, as outlined in various strategy documents, the military as a whole is shifting away from forward-deployed forces to US-based expeditionary warfare units that require the capability to surge overseas quickly when threats arise.[59]

Achieving optimal lift for the US military requires procuring, modernizing, and maintaining the right mix of C-5 Galaxy, C-17 Globemaster, and C-130 Hercules aircraft. However, major procurement and cost problems exist in the development of these lift platforms and "joint force enablers."

The C-5 entered service in 1970 and is the biggest airlifter in the US inventory. The C-5 can carry 50 more tons of cargo than the C-17, but the Galaxy requires much longer runways than the C-17 to takeoff and land and is far less maneuverable on the ground.[60] The C-5 has always been a challenge to maintain—a typical Galaxy has a mission capable rate around 55 percent.[61] The Air Force plans to modernize 125 older C-5 transport aircraft at a cost of around $90 million each to achieve a mission capable rate of at least 75 percent.[62] However, defense planners will not know the viability of the modernization program until 2008, so it is far from certain that upgrading the C-5 fleet with new engines and other reliability improvements will achieve the desired airlifter availability.[63] Moreover, Thomas P. Christie, the Pentagon's director of operational test and evaluation, said that the C-5 avionics upgrade program suffered from "unrealistic schedules" and "unstable" or "immature" software systems. Christie recommended that the Air Force devise a new acquisition strategy to ensure the program's success.[64]

The C-17 Globemaster has been touted as the best inter-theater airlifter that the Air Force has ever bought. Designed to carry heavy or outsized payloads to remote airfields and maneuver in tight spaces on the ground, the C-17 is incredibly reliable with a mission capable rate of 92 percent. Each C-17 costs approximately $200 million which translates to $2.4 billion for each year of production. The C-17 was phased gradually into the airlifter fleet, ultimately taking on most of the responsibilities of the aging C-141 Starlifter.

As of September 2004, all 270 C-141s built in the 1960s were retired from active duty, but the DoD plans to buy only 180 C-17s to replace them.[65] Despite the undeniable success of the Globemaster, the Pentagon's Mobility Capability Study (MCS), released in Fall 2005, concluded that the military was better served, both strategically and fiscally, by ending procurement at 180 C-17s, 42 aircraft short of the 222 planes that lawmakers had planned. This meant that the DoD would stop purchases of the C-17 after the 180th aircraft is produced in 2008, a move prime contractor Boeing has warned would force the company to close its C-17 production line.

The DoD's MCS and the corresponding decision to end the C-17 production line have been highly controversial in the defense community and on the Hill.

- Loren Thompson, CEO of the Lexington Institute and consultant to the Pentagon and defense contractors, sharply criticized the MCS. He said that "The Mobility Capability Study (MCS) was the latest in a series of deeply flawed [DoD] analyses reflecting both inadequate methodology and poorly constructed guidance." As such, he continued, the MCS "came to conclusions that violate common sense concerning future airlift requirements...It is senseless to terminate the C-17 production line and disband a unique workforce on the basis of airlift requirements early in the next decade when said requirements could double or triple in subsequent years due to [changing] circumstances."[66]

- Senator Jim Talent (R-MO), chairman of the Senate Armed Services seapower subcommittee, expressed his reservations about the MCS during an April 4, 2006 hearing. "I note with concern the variance between the underlying assumptions of the mobility capability study and the more demanding conditions experienced by our lift forces as they adapt to uniquely stressing mission profiles and unplanned loading scenarios." Following the hearing, Talent concluded that as Pentagon officials conducted the MCS, "there were assumptions made [about intra-theater needs] that were incorrect or inadequate."[67]

- A September 2005 study by the Defense Science Board (DSB) recommended that the Pentagon maintain the option to acquire additional C-17 airlifters beyond the 180 programmed. The report stated that "The [DSB] task force's concern is that production of the C-17 ends in 2008, and a decision to terminate production at the force level of 180 means that the department will live with the fleet of 100 aging C-5s and 180 C-17s...for many years to come in an environment of great uncertainty."[68]

- In December 2005, US Transportation Command chief General Norton Schwartz said that he would prefer to keep the C-17 production line "warm" after the 180th Globemaster is built, to give the Air Force "insurance" in the event that the Air Force's C-5 modernization program is not as successful as engineers anticipate.[69]

- In March 2006, General Schwartz recommended buying an additional 20 C-17s to account for the extensive use of C-17s to support ongoing inter- and intra-theater operations worldwide. But he acknowledged that the DoD simply did not have the funding for these additional aircraft without impacting other strategic airlift programs. General Schwartz emphasized the trade-off between buying additional C-17s versus building a more versatile, multi-role tanker aircraft. He said that "From a requirement point of view, from the combatant command point of view, if I had to make a judgment, the first KC-X [the Air Force's next-generation tanker], I think, gives this nation greater payback than does the 181st C-17, the 201st or certainly the 221st."[70]

- A winter 2006 study by the Commerce Department's bureau of industry and security found that C-17 termination contradicts the 2006 QDR's underlying cost savings assumptions. The study estimated the cost of terminating the C-17 production line at $1.26 billion; the estimated cost of reopening the line was $3.2 billion. Thus, the total cost of closing the production line and subsequently reopening it would cost $4.46 billion. However, the Air Force could procure all 42 of the additional C-17s it requires for around $2.5 billion more than it currently plans to spend.[71]

The C-130 Hercules is the most ubiquitous airlifter in the US fleet. Unlike the C-5 and the C-17, the Hercules is propeller-driven and can fly in places jets cannot. This puts the C-130 in high demand by the Air Force, the Marines, and the special operations community for everything from aerial refueling to counter-insurgency firepower to electronic warfare.[72] To meet these demands, the Air Force is both acquiring new C-130Js to replace older aircraft and modernizing older C-130s via the C-130 Avionics Modernization Program and center-wing box replacement programs. The newest C-130Js can fly roughly as far as a C-5 or a C-17 but with less cargo. They also can deliver more cargo in a shorter time than older C-130s and have improved combat capability as well as lower operation and sustainment costs.[73]

Nonetheless, the C-130 program has been riddled with cost overruns and technical problems.

- In 1964, C-130 aircraft cost around $1.5 million each. Adjusted for inflation, that cost is about $11.8 million today.[74] When the Air Force first ordered the latest C-130Js in 1995, they were expected to cost $34 million each. By 2004, the cost per aircraft had escalated to $66.5 million.[75] As of February 2006, the DoD's budget request for FY 2007 slated $826.3 million to procure 9 C-130Js—that is, $91.8 million per aircraft.

- In 2004, the DoD Inspector General's office said 50 C-130Js delivered to the Air Force did not meet requirements. The IG reported that "the C-130J aircraft does not meet contract specifications and therefore cannot perform its operational mission." Among the plane's problems, the IG reported, were "inadequate range and payload, immature software, lack of an automated mission planning system, and difficulties in cold weather operations."[76]

- A report by the DoD's Operational Test and Evaluation office, sent to Congress in January 2005, stated that the C-130J aircraft still had "hardware deficiencies, software and technical order deficiencies, manufacturing quality, subsystem reliability" and other problems."[77]

- In December 2004, DoD Program Budget Decision No. 753 planned to end further procurement of C-130J aircraft in FY 2006.[78] The decision was supposed to save the Pentagon $4.2 billion through FY 2011. After strong opposition from lawmakers on Capitol Hill and estimated costs of between $500 million and more than $2 billion to get out of the deal with Lockheed Martin, the C-130J program was ultimately restored in the FY 2006 Defense Appropriations Act.[79]
- The Air Force listed among its list of unfunded priorities submitted to Congress in February 2006 a request for $37.7 million to buy items to fix C-130s currently grounded due to cracks in their center wing boxes.[80]

On the whole, the entire airlift program suffers from a disconnect between proposed strategies and resources. DoD strategy documents, including the 2006 QDR, suggest that US military roles in fighting increasingly asymmetric and irregular wars, conducting international and domestic humanitarian missions, maintaining a surge capability to rapidly deploy forces worldwide, and waging conventional wars will require more airlift in the future. However, the FY 2007 budget request simply does not support these airlift demands. As Loren Thompson of the Lexington Institute said, "There is a mismatch between what the QDR says about troop mobility and what's in the budget. The QDR says air transport is really important, and the budget kills it off."[81]

The US Navy Fleet Program

While the US Navy's procurement programs have come a long way since the "600 ship Navy" of the Reagan years, they continue to sink the Navy's force plans. In keeping with transformation goals, the Navy would like to change the composition of its fleet by increasing the number of ships capable of navigating littoral areas and decreasing the number of deep water patrolling ships. However, schedule delays and escalating costs have made it clear that the Navy will not be able to acquire the fleet that it needs. In April 2005, Admiral Vernon Clark told Congress that shipbuilding costs "have spiraled out of control," rising so high that "we can't build the Navy that we believe that we need in the 21st century."[82]

Navy ambiguity regarding fleet size has further compounded persistent schedule delays and cost escalation. While it did not explicitly mention a total number of ships, the September 2001 report on the 2001 QDR, officially approved and published by the Office of the Secretary of Defense, was generally understood as a plan for a fleet of 310 ships. From around February 2002 until February 2004, Navy leaders mentioned and referred to an alternative proposal for a 375-ship Navy. But during a February 5, 2003 House Armed Services Committee hearing, Secretary of Defense Donald Rumsfeld explicitly declined to endorse a 375-ship fleet as an official DoD goal. In 2005, Admiral Vernon Clark testified that the Navy in future years may require between 260 and 325 ships, or possibly between 243 and 302 ships, depending on how much of the Navy employs new technologies.[83] In December 2005, when the total size of the US fleet comprised 281 ships, Admiral Michael Mullen, Chief of Naval Operations, and other senior service officials briefed members of Congress and key Pentagon officials on a new assessment that indicated that the Navy needs 313 ships.[84]

Numerous defense analysts have described the 313-ship goal as unrealistic given recent trends in naval procurement. While the Navy indicated that its new fleet plan would require spending an average of $13.4 billion annually (in FY 2005 dollars), the Congressional Budget Office (CBO) estimated in December 2005, that the Navy would need to spend an average of $18.3 billion a year (in FY 2005 dollars) on new-ship construction to achieve a 313-ship fleet by 2035. The CBO's estimate is much higher than the $10.2 billion (in FY 2005 dollars) average that the DoD spent on construction of new ships between 2000 and 2005, according to Ronald O'Rourke of the Congressional Research Service (CRS). O'Rourke wrote that the Navy's 313-ship plan "appears to depend in large part on the Navy's ability to substantially increase annual funding for construction of new ships and to constrain ship procurement costs."[85] Moreover, Eric Labs, principal Navy analyst for the CBO pointed out that if the Navy is unable to fund shipbuilding beyond its five year average, the size of the fleet likely would shrink to about 200 ships. The Navy would require around $14.7 billion annually just to sustain its current fleet of 281 ships.[86] Given these CBO and CRS projections, Senator John McCain said that "There's not a snowball's chance in Gila Bend, Arizona that we're going to be able to maintain this 313-ship Navy [under the current plan]...It's not going to happen."[87]

Despite the Navy's attempt to defuse ambiguity in the Congress and in industry regarding its projected fleet size, that the 2006 QDR did not endorse the Navy's plan only extended the uncertainty surrounding the future size and structure of the Navy. At the Pentagon, the comptroller's office may not believe that the Navy's plan is affordable, or defense policy officials may disagree with the Navy's fleet size.[88] In either case and regardless of the ultimate size of the Navy's fleet, the Navy's program management and cost escalation problems require considerable attention.

The CVN-21

The Navy's problems become even clearer when they are considered on a programmatic basis. The CVN-21 is the next generation carrier slated to replace the USS Enterprise (CVN-65) when it retires in 2012-2014. In August 2004, the DoD began characterizing the CVN-21 program as a 3-ship program encompassing the CVN-21, also known as the CVN-78, and two similar follow-on ships (CVN-79 and CVN-80) to be procured in later years. At the same time, the DoD reported that the estimated development cost for the 3-ship program had increased by $728 million, to $4.33 billion. The estimated total acquisition cost for the 3-ship program was $36.1 billion ($4.33 billion for development and $31.75 billion for procurement), or an average of about $12 billion per ship.[89]

Congress has been providing advance procurement funding for the CVN-21 since FY 2001, and the Navy's proposed FY 2007 budget requested $784 million in advance procurement funding and $309 million in RDT&E funding for CVN-78, the lead ship in the CVN-21 program. In June 2005, Ronald O'Rourke of CRS estimated that the total acquisition cost of the CVN-21 would reach about $13.7 billion, or about $2 billion more than the Navy's 2004 estimate.[90]

About $400 million of this cost increase resulted from shifting procurement of the first CVN-21 by one year to FY 2008, with follow-on ships beginning construction in 2012 and 2016. However, this move actually posed more significant fleet management problems beyond mere cost escalation. Shifting procurement to FY 2008 means that the lead ship will not enter service until 2015. Given that the 2006 QDR called for reducing the number of carriers from 12 to 11 and that the Navy preempted this proposal by deciding to retire the USS Kennedy earlier than projected, delaying procurement until FY 2008 creates a minimum one-year gap between the retirement of the Enterprise in 2012-2014 and its replacement by CVN-21 in 2015.[91] This will temporarily reduce the size of the carrier force by one ship to 10 carriers, as another carrier is slated for retirement around 2013.[92]

Despite the fact that retiring the USS Kennedy would save the Pentagon an estimated $2 billion through FY 2011, the House Armed Services Committee opposed the impending drop in the size of the carrier fleet. The report that accompanied the House version of the FY 2007 defense authorization bill, approved by the House May 11, 2006, described its position.[93]

> *According to the Navy's long range shipbuilding plan, if the Navy retires the Kennedy, then the aircraft carrier force will drop to 11 between now and 2012, and then drop to 10 in 2013 and*

> *2014. With the commissioning of CVN-78 in 2015, the aircraft carrier force increases to 11 and the back to 12 in 2019 and beyond...It is apparent to the committee that the decision to allow the force structure to fall to 10 in the near future is fiscally rather than operational driven...The committee believes that the Navy should continue to maintain no less than 12 operational aircraft carriers in order to meet potential global commitments. The committee believes that a reduction below 12 aircraft carriers puts the nation in a position of unacceptable risk.*

Disregarding the carrier's procurement entanglements, the CVN-21 and follow on ships will feature several warfighting benefits over Nimitz class carriers. These include:

- Increased sortie generation rate.
- Improved ship self-defense capability.
- Increased launch and recovery capability/flexibility.
- Increased operational availability.
- Increased flexibility to support future upgrades.

All of these features will be supported by a new nuclear propulsion plant that will enable the CVN-21 to operate for 23 years before refueling. The Energy Department's National Nuclear Security Administration, which is responsible for funding efforts to give the Navy safe and reliable nuclear propulsion plants for surface ships and submarines, described the new plant in its FY 2007 budget request for the Energy Department's National Nuclear Security Administration. "The new high-energy reactor design for CVN-21 represents a critical leap in capability. The CVN-21 reactor will have increased core energy, nearly three times the electric plant generating capability, and will require half of the reactor department sailors when compared to today's operations aircraft carriers. The extra energy will support high operational tempos and longer reactor life."[94]

Moreover, according to Captain Michael Schwartz, the CVN-21 program manager, the new carrier will require 1,000 to 1,200 fewer personnel compared to Nimitz-class carriers currently in the fleet, and the CVN-21's operating costs may be $5 billion less over the ship's lifetime than those of Nimitz-class carriers.[95]

Nonetheless, there remains debate over whether the three carriers in the CVN-21 program would be affordable and cost effective. As Ronald O'Rourke of CRS wrote, "Supporters could argue that in spite of their cost, carriers are flexible platforms that in recent years have proven themselves highly valuable in various US military operations, particularly where US access to overseas bases has been absent or constrained...Supporters could also argue that Congress is already heavily committed to procuring CVN-21, having approved more than $3.8 billion of the ship's total acquisition cost from FY 2001 through FY 2005."[96]

On the other hand, skeptics have argued that there may be cost effective alternatives to CVN-21. Possibilities include:

- Smaller carriers, closer in size to the LHA-6 amphibious assault ship which may cost around $3 billion to procure.
- Carriers designed to embark air wings comprised mainly of unmanned aerial vehicles (UAVs) and unmanned air combat vehicles (UCAVs).
- Small carriers, such as high-speed ships large enough to embark a small number of manned tactical aircraft each.

To the argument that more than $3.8 billion has already been appropriated for CVN-21, opponents have argued that not all of these funds have been spent and that if large carriers are not cost effective based on comparisons with alternative platforms, Congress need not "throw good money after bad" by continuing to fund the program.[97]

Other Surface Combatants: The Littoral Combat Ship

As the costs of the Navy's next generation surface combatant ships continue to rise, the DoD and Congress will have to either approve the current programs, sacrifice capabilities for cost, or end the programs altogether. The LCS and the DD(X) are the two most expensive surface combatant platforms and make up a considerable portion of the Navy budget and shipbuilding program.

The Navy identified a capability gap in littoral areas, including penetrating surf zones occupied by enemy mines, shallow water submarines, and fast attack craft. The Littoral Combat Ship (LCS) was tasked to fill this gap for operations in enemy waters and for conducting homeland security missions. Proponents of the program say that the LCS will meet these requirements in keeping with other transformation programs, such as modularity, net-centric warfare, and the use of unmanned vehicles (UVs).

The LCS is a key element of the Sea Shield component of *Sea Power 21*. The LCS was designed to be small, agile, and stealthy, enabling it to operate in the littoral waters that older, larger ships could not navigate effectively or at all. The seaframe is made up of the hull, command and control systems, launch and recovery systems, radar, and other core systems. Moreover, the LCS is a modular weapons platform that can take one of three different "mission packages" to adapt to the specific threats it faces. The specific threats the LCS packages are designed to meet include: mine warfare, shallow water submarine warfare, and "swarm boat" or small boat attacks. The LCS will also have intelligence, surveillance and reconnaissance capabilities and will provide support for special operations missions. The LCS's mission packages will use either helicopters and UVs, including unmanned air vehicles (UAVs), unmanned combat air vehicles, and unmanned underwater vehicles, in order to counter mines, small boat attacks and submarines. This will allow the ship to keep its distance from the actual targets of attack.

Supporters of the LCS program cite its relative affordability and versatility due to its various mission packages. The program received $646.2 million between FY 2003 and FY 2005, and the Navy's Future Years Defense Plan for FY 2006 to FY 2011 called for $8,801 billion for the entire program. The Navy also placed a $150 million to $220 million cost limit on the seaframe (not including mission packages). In order to meet this range, the Navy is prepared to trade off certain capabilities for less expensive systems without abandoning performance requirements.

A March 2005 Navy report to Congress on potential future Navy force levels showed potential 260-325 ship fleets by FY 2035 that would include between 63 and 82 LCSs, with a predicted total acquisition cost between $25.3 billion and $32.7 billion.[98] However, the FY 2007 budget submission revised these figures upward. According to a US Navy Budget Item Justification Sheet that accompanied the 2007 defense budget request in February 2006, the Navy plans to procure two LCSs each in FY 2006 and FY 2007, three in FY 2008 and then six each year from FY 2009 through FY 2011. This updated procurement plan showed the average cost per hull breaching the $220 million ceiling after FY 2006 and rising by 49 percent to $328.2 million in 2008. Figure 7 shows the projected cost escalation by year.[99]

Figure 7 – Projected LCS Cost Escalation by Year

	2006	2007	2008	2009	2010	2011
Number of ships	2	2	3	6	6	6
Total cost (in $millions)	440.0	533.4	984.5	1,834.7	1,869.2	1,947.7
Cost per ship (in $millions)	220.0	266.7	328.1	305.8	311.5	324.6

Source: Adapted from "US Navy LCS Costs To Soar, 49%." *Defense News,* March 6, 2006.

Even though these projections translate into an average cost of $317.6 million for each of the 54 planned ships in the class, the LCS is still the least expensive major ship-building program in the Navy's long-term shipbuilding plan.[100] Realistically, the program's total procurement costs remain unclear, mainly because the total number of LCSs to be acquired has not yet been determined, nor has the ratio of each of the mission packages to the number of seaframes.

The problems with the LCS program bear important resemblances to acquisition programs in the Army and Air Force. Critics of the LCS point to both the program acquisition process and to the strategic value of the ship. They feel that the Navy has been aggressive, perhaps prematurely, in its acquisition process:

- The Navy announced the LCS program in November 2001 and set up a LCS program office in 2002. Before the announcement of the program, the Navy had not analyzed the cost effectiveness of the LCS in comparison to other alternatives, including, manned aircraft, submarines carrying UVs, larger surface ships carrying UVs, or non-combat littoral support craft carrying UVs.[101] Between April 2002 and January 2004, the Navy conducted further analysis. According to a March 2005 GAO report on the LCS, in early 2004 "the Office of the Secretary of Defense and the Joint Staff were concerned that the Navy's focus on a single solution did not adequately consider other ways to address littoral capability gaps."[102]

- As a result, later in 2004, the Navy conducted a formal analysis of alternatives to the LCS, but only "after concluding that the LCS concept was the best option to address challenges of operating US forces in the littorals."[103] Critics referred to the process as "analysis by assertion."

- Even though the Navy emphasized the importance of the LCS's capabilities against small combat boats, the Navy's analysis of surface threats facing US forces in littoral waters "did not include consideration of the potential impact of all threats the LCS is likely to face...the LCS could face threats larger than small boats in littoral waters, including missile-armed warships."[104] These threats may increase the risk to LCS operations when no other US forces are available to help. "Navy officials agreed that the surface threat was focused exclusively on swarms of small boats," even though the LCS is designed to operate independently as well as with larger surface warships.[105]

- The Navy largely agreed with a March 2005 GAO report that found that the LCS program has various manning, logistics, communications, command and control, computer and intelligence gathering issues that have the potential of putting the program at risk if they are not dealt with before Flight 0. In addition, the GAO identified immature technology in the LCS's mission packages that could lead to development cost increases and schedule delays.[106]

- When Gordon England testified in front of the Senate Committee on Appropriations' Subcommittee on Defense, he noted that one of the key benefits to the new ships including the LCS and DD(X) is that they require smaller crews—in the case of the LCS, between 15 and 50 core crew members not involved with operating the mission packages. However, the GAO noted that "reduced manning…may not be achievable because maintaining and operating the ship's mission packages, such as the MH-60 helicopter, may require more sailors than the current design allows."[107] If it is determined that this is the case when testing the Flight 0 ships, then the design may have to undergo changes before the Flight 1 ships are built, thereby causing further complications, delays and cost increases.

- The GAO also recommended that "the Navy revise its acquisition strategy to ensure that it has sufficiently experimented with Flight 0 ships and mission packages before selecting the design for Flight 1."[108]
- Ronald O'Rourke of CRS wrote in an April 2005 report that due to the uncertainty surrounding the Navy's force structure goals, "Critics could argue that...the Navy has no approved force-structure basis for proposing a program to build any significant number of LCSs."[109]

The Navy established a risk management board to address these problems that put the LCS program at risk, and the GAO determined that the challenges are not "insurmountable, given enough time and other resources to address them."[110]

But questions persist about even the mission capabilities of the LCS. From a strategic standpoint, mission packages consisting of helicopters and UVs give the LCS its distinctive anti-submarine, anti-mine, and anti-small surface boat attack capabilities. These packages also allow the seaframe to keep a safe distance from its targets.

However, critics argue that larger ships in deeper waters could launch the UVs and helicopters from a safer distance. Taking previous conflicts into consideration, such as Kosovo, Afghanistan, and Iraq, these critics argue that littoral area domination is not an immediate priority. Moreover, the Navy's proposal to use the LCS in homeland security operations is questionable because the Coast Guard is already in the process of procuring the Deepwater cutter whose operational costs, the Coast Guard claims, will be lower than those of the LCS.[111]

The DD(X)

The DD(X) destroyer is the Navy's next generation, multi-mission surface combatant with an emphasis on naval surface fire support. The mix of 12 new and old technologies being incorporated into the ship's design would provide the following capabilities:

- Carry up to 80 Tomahawk cruise missiles.
- Two 155 millimeter Advanced Gun Systems (AGS) would have precision strike capabilities from distances of up to 96 miles, a greater range and accuracy than anything that naval gunfire has previously been able to achieve.
- Stealth technology that makes it look 50 times smaller than the DDG-51, about the size of a small fishing boat.[112]
- Mine avoidance
- Anti-submarine warfare capabilities (ASW), similar to those of the Arleigh Burke DDG-51
- Air defense
- Support Marine Corps land attacks and Special Operation Forces
- Highly automated functions that reduce manning to 125-175 persons, versus 300 on current destroyers and cruisers. Admiral Vernon Clark, Chief of Naval Operations, said that the crew size would be between 95 and 120. He also said that if it were not highly automated, the DD(X) would require between 400 and 500 more soldiers.[113] In testimony before the House Armed Services Committee on July 19, 2005, Kenneth J. Krieg, the Under Secretary of Defense for Acquisition, Technology, and Logistics, said that the DD(X) would require a crew of about 110 where the DDG-51 requires a crew of between 200 and 300.
- Like the LCS, the DD(X) carries unmanned vehicles and helicopters.
- The DD(X) will be about 50 percent larger than the cruisers and destroyers the Navy is operating today. It will also be larger than all Navy destroyers and cruisers since the Long Beach cruiser, which was procured in 1957.[114]

Figure 8 summarizes the 12 key technologies that are being incorporated into the ship's design.

Figure 8 – Description of Engineering Development Models

Engineering Development Models	**Description**
Advanced gun system	Will provide long-range fire support for forces ashore through the use of unmanned operations and the long-range land attack projectile.
Integrated deckhouse and apertures	A composite structure that integrates apertures of radar and communications systems.
Dual band radar	Horizon and volume search improved for performance in adverse environments.
Integrated power system	Power system that integrates power generation, propulsion, and power distribution and management.
Total ship computing environment	Provides single computing environment for all ship systems to speed command while reducing manning.
Peripheral vertical launch system	Multipurpose missile launch system located on the periphery of the ship to damage to ship systems.
Integrated undersea warfare system	System for mine avoidance and submarine warfare with automated software to reduce workload.
Infrared mockup	Seeks to reduce ship's heat signature in multiple areas.
Hull form	Designed to significantly reduce radar cross section.
Autonomic fire suppression system	Intended to reduce crew size by providing a fully automated response to fires.

Source: Adapted from testimony by Paul L. Francis, Director Acquisition and Sourcing Management, GAO before the Subcommittee on Projection Forces, House Committee on Armed Services, July 19, 2005.[115]

In order to minimize risk in the DD(X) program, the Navy has created 10 separate engineering development models for the ship's most critical subsystems. Within each of these models, the subsystems are being designed, developed and tested simultaneously. Testing has shown that while some of these technologies are mature, others have technical problems that could put a strain on the ship's tight procurement schedule. The models being tested are also not exact replicas of those that will be incorporated into the actual ship, and therefore may have to be altered in size.[116]

In a June 2005 report, the GAO found that many of these technologies are still immature. "While progress has been made, the level of technology maturity demonstrated remains below what is recommended by best practices."[117] As described a month later in testimony by Paul L. Francis, Director of Acquisition and Sourcing Management at the GAO, if these core technologies do not become fully mature on schedule, the challenges associated with demonstrating capabilities, developing software, and integrating subsystems must be pushed into the later stages of DD(X) design and construction when the cost of work and delays is much higher and the schedule less forgiving.[118]

Escalating costs in the later stages of development are especially problematic given that the Navy must compete for funding with other programs and support existing platforms and deployments at a time when the discretionary budget is stretched thin. In light of the risks associated with pursuing the DD(X) program, the GAO recommended that decision makers consider trade-offs in reduced mission performance, increased costs, delayed shipyard work, and/or additional manning before constructing the first ship.[119]

Above all, cost control has been the critical issue. The cost of the first DD(X), as reported by the Navy, has increased by approximately 18 percent, from $2.8 billion in 2004 to $3.291 billion, as of May 2005.[120] In July 2005, CBO analyst Michael Gilmore told members of the House Armed Services Projections Subcommittee that the cost of the first DD(X) could be as high as $4.7 billion, above the Pentagon's upper limit for the first DD(X) of between $4 billion and $4.5 billion.[121] Other military and defense experts say that the price of the first ship could be as high as $7 billion.[122]

The cost of the second and subsequent ships has also escalated. The Navy estimated in 2004 that the second DD(X) would cost $2.053 billion. As of May 2005, this estimate increased 49 percent to $3.061 billion, and the FY 2007 budget request, submitted in February 2006, included $3.4 billion for each of the first two DD(X) destroyers. Funding for the ships will be split between FY 2007 and FY 2008.[123] The estimated cost of subsequent DD(X)s also increased roughly 45 percent, from between $1.5 billion and $1.8 billion each in 2004 to between $2.2 billion and $2.6 billion each as of May 2005.[124] The Cost Analysis Improvement Group (CAIG) within the Office of the Secretary of Defense reportedly estimated that the cost of DD(X) procurement may be 20 to 33 percent higher than the Navy's estimates. The CAIG's estimate for the cost of the lead DD(X) might be $4.1 billion, while its estimate for the fifth DD(X) might be $3.0 billion.[125] If the CAIG projections are accurate, the DD(X) program will certainly breach the $2.3 billion cost cap on the fifth and subsequent DD(X) ships that Congress imposed in December 2005.[126]

Due in part to these increasing costs—and likely also due to changes in operational requirements—the Navy scaled down the number of DD(X) destroyers that it intends to procure from between 16 and 24 ships to between 8 and 12 ships. The Navy's procurement schedule to meet this requirement has also changed significantly. While the 2005 FYDP indicated that the Navy would procure the first DD(X) in FY 2005, none in FY 2006, and two per year beginning in FY 2007, under the 2006 FYDP, the Navy would purchase the DD(X) at a rate of only one per year through 2011.[127] This schedule changed again in November 2005 when the Defense Acquisition Board approved the Navy's so-called dual-lead ship acquisition plan to procure two DD(X)s in FY 2007. Proposed in May 2005 as an effort to reduce costs, the move involves a dual-shipyard construction strategy whereby Northrop Grumman and General Dynamics would build the first two destroyers at the same time. The Navy would then evaluate the shipbuilders and could choose to have all subsequent ships built in one shipyard. The Navy hopes this strategy will increase competition between the shipbuilders and bring down or maintain construction costs.[128]

Despite the program's ever increasing costs and its shifting procurement schedule, defense experts argue that pursing the DD(X) program is worthwhile.

- Paul L. Francis, Director of Acquisition and Sourcing Management at the GAO testified before the Projection Forces Subcommittee of the House Armed Services Committee, that "the total ship computing environment, which accounts for a large portion of the software [for the DD(X)], will provide a common architecture for major ship systems to facilitate integration and to speed command and control while reducing manning."[129]

- The technologies used in the DD(X) will be spiraled into future ships, including the CG(X) and the CVN-21. As Secretary of the Navy, Gordon England told the Senate Appropriations Committee in March 2005 that the "investment [in the DD(X)] will pay dividends to other surface ship procurements," including the CVN-21, the LHA(R), and the CG(X) cruiser.[130]

- The replacement of manned functions with automated/computerized functions, such as the AGS and fire suppression, allow for a decreased crew size that would help decrease the Navy's end strength requirements and the DD(X)'s operating costs. The current goal is to decrease the crew size to less than half that of the Arleigh Burke destroyer.
- With smaller crews and improved shore support, 10 DD(X)s' operating costs over the course of 25 years would be $4.2 billion lower than the costs of a similar number of DDGs.
- According to Vice Admiral Joseph Sestak, deputy chief of naval operations for warfare requirements and programs, the Navy's analysis indicated that losses due to enemy attacks could be reduced by 31 percent if a DD(X), rather than several DDGs, is present.
- The extended range of the AGS could reduce the need for Marine artillery by 65 percent.
- With better signal processing and radar optimized for a littoral environment, the DD(X) can engage more targets in a coastal region.
- The DD(X) would be more capable in littoral areas. It is about 15 percent more effective than existing surface combatants against attacks from swarming surface craft and is well suited for combating Iranian Boghammers.[131]

Critics of the DD(X) program claim that the Mission Need Statement (MNS) of the DD(X) is outdated and has problems with procurement and operational costs and tactical relevance.

- The DD(X) Mission Need Statement (MNS) was written in 1994 for the DD(X)'s predecessor, the DD-21 destroyer. However, the combination of ongoing military transformation and the Global War on Terror may make the 1994 MNS obsolete. For example, the DD(X) will carry two Advanced Gun Systems (AGS). The AGS will be an important feature of the DD(X) because (1) ship-mounted guns are more cost effective than ship-launched missiles; (2) AGS ammunition is more economical than missiles; (3) ship-mounted guns can replace air support strikes when aircraft are not ready; and (4) AGS is more reliable in inclement weather. However, taking the wars in Kosovo, Afghanistan and Iraq as examples of potential future combat situations, there may not be a great need for high-volume fire support when using small ground force units, and the use of missiles may be more effective, as most of the ground operations in Iraq and Afghanistan were beyond the AGS's firing range (approximately 96 miles). Additionally, in keeping with transformational trends, UAVs equipped with precision-guided munitions may be capable of delivering ground support instead.
- *Defense News* reported in July 2005 that military and financial analysts questioned the necessity of the DD(X)'s firepower and stealth capabilities, proposing instead that the Navy pursue a more scaled down next-generation destroyer.[132] Robert Work, a senior analyst at the Center for Strategic and Budgetary Assessments, argued in the same *Defense News* article that the DD(X) ship-based missile attacks were unnecessary because the Navy already has the necessary capabilities.[133]
- The LCS also has anti-submarine warfare and anti-submarine capabilities, raising the question as to what the DD(X) contributes that other ships do not, other than gunfire support? "If gunfire support is the DD(X)'s primary mission, and if the DD(X) is no longer to be the sole platform for replacing the capabilities resident in the DD-963s and FFG-7s, should requirements for the non-gunfire mission capabilities of the DD(X) design be reduced further? How much further might the cost of the DD(X) design be reduced if its non-gunfire capabilities are reduced and the ship's design is modified to make the ship more of a pure naval gunfire support platform?"[134]
- Michael Gilmore, the Assistant Director of the National Security Division at the CBO, testified before the House Armed Services Projections Subcommittee on July 20th 2005 that the DD(X) may in fact not be less expensive to operate in the long run.
- If the Navy keeps its plan to produce one DD(X) a year, according to Ronald O'Rourke of CRS, the procurement rate "might not be enough to introduce the planned new DD(X) technologies in sufficient numbers."[135]

Other critics question whether the Navy needs to have the DD(X) and its package of new technology at all, given overall US maritime superiority and the high capabilities of existing ships. If the Navy's discretionary budget is already constrained, how can the DD(X)'s costs continue to grow against the backdrop of two wars, efforts to recapitalize the Navy with Virginia class submarines, CVN-21 carriers, Littoral Combat Ships, LHR amphibious ships, the JSF, as well as the remaining Arleigh Burke destroyers. Ultimately, the DD(X) may prove to take up too large a portion of the Navy's shipbuilding budget, especially considering the debate surrounding the true necessity of the ship's capabilities.

US Marine Corps' Cost-Escalation and Program Management Challenges

The US Marine Corps faces procurement challenges that are just as serious as those faced by the other services.

The Osprey

The Osprey program now seems to be more an example of a program that will be funded in spite of delays, cost-escalation, and performance failures than a program whose future remains uncertain. Its real world transformational effect, however, remains questionable. The program was conceived to meet the provisions of the 1995 Joint Multi-Mission Vertical Aircraft (JMVX) Operational Requirements Document (ORD) for an advanced vertical lift aircraft. The JMVX ORD called for an aircraft that would provide the Marine Corps (MV-22) and Air Force (CV-22) with the ability to conduct amphibious assault support and long-range, high-speed missions requiring vertical takeoff and landing capabilities.

The V-22 Osprey was developed as a vertical lift tilt-rotor aircraft designed for the amphibious transport of troops, equipment, and supplies from assault ships and land bases. The rotors point upward to fly like a helicopter and forward to fly like a plane. The MV-22 was designed to ultimately replace the CH-46E and CH-53D helicopters. The Osprey has been primarily a Marine Corps program funded by the Navy.

The Marine Corps has faced massive cost, performance, and delay problems with the Osprey during its 16 year development. It has had to reduce many aspects of its original specifications and mission capabilities, including reductions in its potential firepower, survivability and range payload.

Since its first flight in March 1989, the Osprey has experienced four significant failures during testing—a crash in 1991, a second in 1992 that killed seven, a third in April 2000 that killed 19, and a fourth in December 2000 that killed four. The Marine Corps grounded the Osprey in 2000 following the December crash but reinstated the program in 2002.

The Osprey has also had a major cost impact. The Corps may well only be able to buy the Osprey if it does not fund its other lift, and amphibious programs, and must plan to borrow firepower and other assets from the Army in a major contingency. This has occurred at the same time that the Marine Corps has become more dependent on a high-risk vertical take-off and landing (VTOL) version of the Joint Strike Fighter.

- The V-22 Osprey's program costs have soared. The original estimated cost of the program was $48.025 billion. If one holds constant the FY 2006 procurement objective of 458 aircraft (360 MV-22 for the Marine Corps, 50 CV-22 for USSOCOM, and 48 HV-22 for the Navy) and the FY 2006 average cost per aircraft, the total cost of the program is now approximately $74.1 billion.[136]

- The FY 2006 defense budget priced each MV-22 at $126.8 million, a 10 percent increase from FY 2005 and a 34 percent increase from FY 2004. Including RDT&E costs, the FY 2006 per unit cost rises to $149.8 million, an increase of only 1.4 percent from FY 2005 but an increase of 11.5 percent from FY 2004. [137]
- The CV-22's per unit costs have risen even higher, partly due to the fact that USSOCOM does not require as many aircraft. Between FY 2004 and FY 2006, the cost per aircraft increased by 25 percent from $145.25 million to $181.1million. Including RDT&E, between FY 2005 and FY 2006, the cost per aircraft increased also by 25 percent from $172.13 million to $215.75 million.[138]

Marine generals have consistently defended the merits of the program in spite of these problems. They continue to express sufficient confidence in the future of the Osprey program to discuss the possibility of a four-engine tilt-rotor aircraft with four wings and four tilting rotors called the Quad Tiltrotor whose cost is as yet unknown. Where the standard V-22 Osprey has two wingtip rotors that swivel and is designed to carry 24 troops or 10 tons of cargo, plans for the Quad Tiltrotor envision a plane with four swiveling wingtip rotors that can carry 20 tons of cargo or 132 people up to 1,000 miles at 350 miles per hour.[139]

Critics, however, have stressed the following mission risks:

- Combat helicopters—and therefore, V-22 Ospreys—remain vulnerable to low-tech, small arms ground fire.[140]
- The V-22 has an inherently unreliable maneuvering capability.
- The V-22 is larger and weighs four times as much as US helicopters with comparable capabilities.
- The V-22 costs more than four times more than other US combat helicopters.[141]

Some feel that the Navy's MH-60S Knighthawk presents a viable alternative amphibious assault aircraft to the V-22. It is nearly identical to the already well known and combat-tested UH-60L Blackhawk currently in production for the Army. The MH-60S weighs about one third as much as the V-22, but can carry nearly the same payload. It has room for only 13 soldiers compared to 18 for the V-22. But unlike the V-22, the MH-60S can also carry machine guns, rockets, and Hellfire missiles.[142] The FY 2006 budget requests 26 MH-60S aircraft at a cost of only $22.7 million per aircraft and only $24.2 million per aircraft including RDT&E. That is, the DoD could purchase 5 MH-60S helicopters for each MV-22 that it buys.[143]

Amphibious Ships

The Marine Corps relies heavily on the Navy's amphibious warfare ships to carry Marines and their equipment, and on new prepositioning ships to provide logistical support to Marine expeditionary forces. Amphibious, or L-class, ships currently make up 12 percent of the Navy's fleet, or 35 out of 293 ships. These 35 ships currently provide the lift (transport capacity) to carry roughly 1.9 Marine expeditionary brigades (MEBs), or about 27,000 troops and their equipment. This is about 75 percent of the Navy's stated goal of 2.5 MEBs worth of lift.

The Navy and Marine Corps plan to make fundamental changes to this fleet by implementing the concept the Navy calls Sea Basing. The Navy plans to replace its fleet of amphibious ships over the next 30 years and also buy a new class of logistics ships called Maritime Prepositioning Forces (Future), or MPF(F).

Ultimately, the Navy would like to build a 375 ship fleet that includes 36 amphibious ships and 16 sea-basing ships. Its plan for these forces includes purchasing: (1) 10 amphibious assault ships of a new class designated LHA(R) that would carry and support more aircraft than the existing LHD class ships; (2) 12 LPD-17 San Antonio class amphibious transport docks; (3) 12 dock landing ships of a new class designated LSD(X); and (4) up to 21 MPF(F) ships.

These plans raise serious cost concerns.[144]

- According to the CBO, the Navy's FY 2005 plan for amphibious and maritime prepositioning forces cost an average of $2.4 billion a year (in 2005 dollars), or more than twice as much per year, on average, as the Navy spent on amphibious and maritime prepositioning ships since 1980.
- Including the costs of operating and supporting those ships, the average annual cost of the Navy's plan from 2005-2035 may increase to $5.4 billion (in 2005 dollars).
- The CBO estimates that building the proposed 375 ship fleet alone would cost an average of $19 billion annually through 2035, a more than 58 percent increase from the $12 billion average annual funding since 1980. Under the proposed 375 ship plan, amphibious and maritime prepositioning forces comprise about 12 percent of the total shipbuilding costs, up from an average of 9 percent between 1980 and 2004.
- As of March 2006, the cost of building the first and second San Antonio Class amphibious transport docks (LPD-17 and LPD-18) had surged from a Congressionally approved $1.7 billion to an estimated $2.7 billion.[145]

The CBO has proposed four alternative plans for the future of amphibious and maritime prepositioning forces that would decrease the burden the Navy faces with its shipbuilding budget as a whole and with those forces in particular. All four plans would result in a smaller amphibious fleet than exists today, and some would result in a smaller prepositioning force as well. Each option takes a different approach to modernizing the amphibious fleet and the maritime prepositioning force given existing budget constraints. Each illustrates the problems the Marine Corps faces in sustaining and improving its amphibious capabilities. Figure 9 summarizes the options proposed by the CBO.[146]

Figure 9 - The Amphibious and Maritime Prepositioning Forces in 2035 Under Alternative Force Structures

Force Structure	Average Annual Procurement Cost (in $billions	Lift Capacity (number of MEBs)		Number of Ships		Number of Forward-Deployed ESGs		Number of Marine Infantry Battalions Ashore After		
		All Ships	Amphibious Ships Only	All Ships	Amphibious Ships Only	Using Current Crewing	Using Crew Rotation	4 Weeks	6 Weeks	10 Weeks
Navy's Plan	2.4	5.5	2.3	57	36	2.7	3.6	8	12	15
Option 1	1.1	3.3	1.3	31	18	1.8	2.4	4	6	9
Option 2	1.1	4.3	1.8	39	27	2.2	3.0	2	5	12
Option 3	1.5	2.7	1.7	32	24	2.1	2.8	5	7	7
Option 4	1.5	5.0	2.0	45	30	2.4	3.2	2	5	14
Current Force	n.a.	4.9	1.9	51	35	2.7	3.6	2	6	15

Source Adapted from "The Future of the Navy's Amphibious and Martime Prepositioning Forces." Congressional Budget Office, November 2004.

Notes: MEB = Marine expeditionary brigade; ESG = expeditionary strike group.

Space for vehicles and troops is in relatively short supply on amphibious ships. The Navy has excess capacity in other categories of amphibious lift, such as space for cargo, landing craft, and helicopters.

The Navy does not employ crew rotation on expeditionary strike groups, although it is planning to experiment with it. This number is shown only for comparability.

- The first option is to buy fewer, more capable ships whose costs lie within the historical spending level for construction of those vessels (an average of about $1.1 billion per year in 2005 dollars). This approach would gradually reduce the number of expeditionary strike groups by half and reduce the number of prepositioning squadrons from three to two. The Navy's acquisition plans would change as follows: purchase 4 LHA(R) amphibious assault ships through 2035, instead of 10; purchase 7 LPD-17 amphibious transport docks, rather than 12; purchase 5 new LSD(X) dock landing ships, rather than 12; purchase one squadron of 8 MPF(F) ships, instead of 16; and purchase one squadron of 5 conventional cargo ships.
- The second option is to buy more, less capable, ships also within historical spending levels. In this option, the number of expeditionary strike groups would be cut from 12 to 9; the number of maritime prepositioning ships would be cut to just over half a squadron rather than by a whole squadron. Amphibious assault ships would be replaced by ships of similar size and capabilities to existing classes, and maritime prepositioning forces would be replaced by modern cargo ships without sea basing capabilities. The Navy's acquisition plans would change as follows: purchase 6 LHA(R)s that would replicate the current fleet of amphibious assault ships rather than offer enhanced aviation capabilities as the Navy plans; purchase 9 LPD-17 ships, rather than 12; and purchase 9 LSD(X)s, rather than 12, that are similar in size and capabilities to existing dock landing ships. By 2035, the Navy would have a fleet of 39 amphibious and maritime prepositioning vessels, and the amphibious force would number 27 ships.
- A third option is to create a more survivable sea basing force that is better able to withstand attack than the force envisioned by the Navy, at a cost below that of the Navy's current plan but above the historical spending level. Currently, MPF(F)s would have little or no ability to defend themselves from attack and

would have difficulty operating if they were damaged, even though they would be the largest (except for aircraft carriers), the most detectable, and the most targetable ships in the Navy's theater of operations. To deal with this problem, under this third approach, the Navy would purchase MPF(F)s that were closer in survivability to L-class amphibious ships. Because more survivable MPF(F)s are more expensive, the Navy would purchase only one squadron of 8 ships. Accordingly, the LHA(R) program would acquire 6 ships through 2035 and would not begin until 2022, rather than in 2007. The Navy would purchase 8 LPD-17s instead of 12. And the LSD(X) program would acquire only 8 ships rather than 12. The amphibious warfare force would decline fairly rapidly through 2024, and the fleet of amphibious and maritime prepositioning ships would ultimately total 32. In all, the Navy would spend an average of $1.5 billion a year on ship construction between 2005 and 2035, compared with $2.4 billion a year under the Navy's current plan.

- The fourth option deemphasizes sea basing in favor of forward presence, also at a cost below that of the Navy's current plan but above the historical spending level. In effect, this alternative forgoes the sea basing concept altogether, but it provides for a greater overseas presence than any of the previous alternatives. It would delay the start of the LHA(R) program from 2007 until 2013 and purchase 8 ships through 2035 rather than 10. The LPD-17 program would stop at 10 ships instead of 12. The LSD(X) program would be delayed from 2020 until 2022 and purchase only 10 ships rather than 12. The MPF(F) program would consist of three full squadrons of 8 ships, but none would have sea basing capabilities. The amphibious warfare force would remain at around 35 ships through 2012 and then quickly level off at 30 ships. By 2035, the total fleet of amphibious and maritime prepositioning ships would total 45. Given these changes, the Navy would spend $1.5 billion a year between 2005 and 2035 building amphibious and maritime prepositioning ships.[147]

The mounting cost of amphibious capability is another reason the Navy, defense officials, and lawmakers may have to reassess their priorities for transforming the Navy's fleet. If sea basing is essential to future operations, the Navy could procure it without increasing its historical funding level by decreasing the number of amphibious warfare ships (Option 1). Increasing the average funding by only 36 percent could achieve some of the sea basing capability and make the ships that possess that capability less vulnerable to attack (Option 3). Alternatively, if decision makers determine that the size of the force and its forward presence should take precedence over sea basing, the Navy could have an amphibious warfare force of about 27 ships by 2035 without an increase in funding (Option 2). Or, with the same funding increase as in Option 3, the Navy could retain a force of at least 20 L-class ships through 2035.[148]

Defense Agency, Satellite, and Space Cost-Escalation and Program Management Challenges

Many key aspects of military transformation rely on the promise of linking new technologies to appropriate revisions in doctrine and organization to achieve revolutionary progress in warfighting performance. This is particularly true in the space sector as key officials at the DoD tout the capacity for orbital systems to offer unique advantages in providing military forces with real time intelligence, precise targeting, and robust communications.

Although ambitious plans for the future of national security space programs have gained support among policymakers, the space sector has become another cost-performance crisis. Virtually every next generation constellation being developed has encountered unanticipated cost growth, schedule slippage and technical difficulties.[149]

Consider an excerpt from the section titled "Problems in DoD Space Programs" in the June 10, 2005 Report of the House Appropriations Committee on the Department of Defense Appropriations Bill, 2006.[150]

> *In 2002, DoD leadership saw unsettling trends in the management of these [space] programs and commissioned a Defense Science Board (DSB) task force to conduct an independent review. In 2003, the task force reported numerous systemic problems, including a strong bias towards unrealistic cost estimates, an undisciplined process for requirements definition, and a serious*

> *erosion in government management and engineering expertise. Since publication of the DSB report, the programs have collectively gotten worse, with virtually every major space acquisition program under the cloud of a Nunn-McCurdy cost breach. One notable example, the Space Based Infrared High (SBIRS HIGH) satellite, has experienced three Nunn-McCurdy breaches in just four years. SBIRS High costs have grown from $4 billion to over $10 billion.*

To further compound matters, the SBIRS HIGH program experienced a fourth Nunn-McCurdy breach for the final quarter of FY 2005 when its overall costs swelled by 10.7 percent, from $9.6 billion to $10.6 billion.[151]

The Nunn-McCurdy oversight law represents a key congressional attempt to force the DoD to learn how to manage and contain its costs. It requires that the Pentagon notify Congress when a major acquisition program's costs grow by 15 percent. If cost growth reaches 25 percent, Nunn-McCurdy requires the Pentagon to justify continuing the program based on three criteria: its importance to national security; the lack of a viable alternative; and evidence that the problems that led to the cost growth are under control.

The Nunn-McCurdy breaches in the Air Force's space portfolio have become so endemic that the House version of the 2006 Defense Authorization Act passed on May 25, 2005 would amend Nunn-McCurdy so as to require the Pentagon to submit to Congress an analysis of alternatives to a given program if its costs grew by 15 percent. The analysis would have to include the costs associated with completing the program with no changes; completing it with some design, requirements, or manufacturing changes; and building alternative systems.[152]

By the Spring of 2005, the cost escalation in the DoD's space acquisition portfolio led the congressional committees reviewing defense budget requests for the next fiscal year to threaten to terminate or drastically cut back several of the Pentagon's most important space initiatives.[153] These included the nation's next generation of missile warning systems, its next generation of photoreconnaissance satellites, its next generation of secure communications satellites, and its first ever constellation of space-based radars.[154]

- The Department of Defense's total budget request for both classified and unclassified space programs was $22.12 billion for 2005 (in 2006 dollars) and $22.66 billion for 2006. While this is an increase of only about 2.5 percent, the investment portion for unclassified programs is 43 percent higher, and investment spending for unclassified programs grew from 22 percent of the DoD's total space budget in 2005 to 31 percent in 2006. Total DoD spending on space programs is expected to rise to at least $25 billion by FY 2009, an increase of about $11 billion in 2000.

- According to the Future Years Defense Plan (FYDP) for 2006 through 2011, funding for development and procurement of major unclassified space systems grew by more than 40 percent in 2006 (to $6.9 billion from $4.9 billion in 2005) and will double by 2011.[155]

- Historically, according to the CBO, RDT&E costs for DoD space systems have grown by an average of 69 percent from their original development estimates, and procurement costs have risen by an average of 19 percent. If costs grew at these rates in the future, investment needs would peak at $14.4 billion in 2010, rather than at $10.0 billion under the current FYDP.[156]

- The unclassified data on the five satellites in the Space-Based Infrared System-High (SBIRS) program have escalated from $3.9 billion eight years ago to $9.9 billion, or by $1.2 billion a satellite. As of July 2005, updating the language in the June 10, 2005 House Appropriations Report quoted above, the SBIRS-High program actually breached Nunn-McCurdy cost growth limits *four* times in as many years.[157] Although the DoD received the full $756 million it requested for FY 2006 for the SBIRS-High program, the House Appropriations report called the program "extremely troubled."[158]

- Unclassified space-control programs have also encountered cost overruns. Focused on developing ground- and space-based sensors to enhance situational awareness in space and on developing technology to disrupt, deny, degrade or destroy enemy space systems, these programs include Spacetrack, the Space-Based

Surveillance System, the Rapid Attack Identification, Detection, and Reporting System, and the Counter Communications System. Under the 2006 FYDP, according to the CBO, RDT&E funding for space-control systems would increase from $195 million in 2006 to $768 million in 2011.[159]

- A 2003 report titled "The Full Costs of Ballistic Missile Defense" by Economists for Peace and Security estimated the life-cycle costs for the missile defense program to total $1.2 trillion. The study estimated that the completion date for three of the four major systems planned—that is, the land-based, sea-based, and air-based systems—is 2015.[160] Adhering to this schedule requires a steep spending path. Annual spending for missile defense would have to be about $25 billion in 2005 and $50 billion in 2007. That is, the amount being spent on missile defense is far below what would need to be spent to achieve the DoD's objectives for missile defense.[161]

While the Bush administration's forthcoming National Space Policy, will likely endorse the DoD's already articulated strategy to fight "in, from and through space," Congressional procurement funding for such future space programs remains uncertain. As Theresa Hitchens of the Center for Defense Information has stated:[162]

> *Space is an exceedingly expensive place. To fully implement the capabilities necessary to fight 'in, from and through' space, hundreds of billions would have to be dedicated to developing new weapons, launching thousands of new on-orbit assets, and maintaining those systems once they are deployed. With launch costs remaining at $22,000 per kilogram, and current satellites in Leo weighing up to 4,000 kilograms, the price tag rapidly becomes exorbitant---hundreds and hundreds of billions of dollars. For one thing, Congress is already expressing concerns about the costs of today's Air Force space programs that have nothing to do with controversial ASAT or space-strike systems. Programs such as the Transformational Satellite system designed to replace current military communications satellites, and the space Radar to replace aging U.S. early warning satellites, are years behind schedule and tens of millions of dollars over budget. Congressional reaction to Air Force budget requests for new space weapons programs based on unproven and yet undeveloped technologies may well not be all that favorable.*

The Broader Problem: Turning Force Transformation into a "Liar's Contest"

The US faces many serious problems in bringing its strategy and force plans into balance with resources. This summary history of transformational programs is a warning that cost escalation is being dealt with by repeated efforts to downsize the force to pay for new systems—which are then still expected to be both force multipliers and force compensators—somehow enhancing existing capability and compensating for force cuts at the same time.

Taken together, the consistent pattern of problems in such programs is more than a basic failure in management. It strongly suggests that the Department of Defense has been locked into a "liar's contest" at the level of defense contractors, program managers, every military service, and the Office of the Secretary of Defense where no one is really held accountable. Program survival and advocacy have become more important than the truth in terms of real world cost, performance, and schedule.

The state of these transformational programs also calls for making trade-offs and hard decisions, not for procurement reform. There are many ways in which the US might create better procurement experts, better program managers, and more efficient procedures. The level of failure in today's programs, however, represents a basic failure to make hard choices at the level of the Secretary of Defense, Deputy Secretary, Service Secretaries, Chairman of the Joint Chiefs, and Service Chiefs of Staff. None of these problems could arise without a broad abdication of leadership responsibility throughout the Department. Forcing hard choices on the system is the reason senior positions exist. Tolerating systematic failure is simply cowardice. All of these issues are also a further caution that the US cannot afford the luxury of planning for what it cannot get. In fact, they show that the most critical single challenge the Department of Defense faces in force transformation is to learn how to plan, manage, and execute force transformation on a program by program basis.

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