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GAO

Report to Congressional Committees

March 2007

DEFENSE ACQUISITIONS

Assessments of Selected Weapon Programs

GAO

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GAO-07-406SP

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Highlights

Highlights of GAO-07-406SP, a report to congressional committees

March 2007

DEFENSE ACQUISITIONS

Assessments of Selected Weapon Programs

Why GAO Did This Study

This report is GAO's fifth annual assessment of selected weapon programs. From 2001 to the present, the Department of Defense (DOD) has doubled its planned investment in new systems from approximately $750 billion to almost $1.5 trillion. While DOD expects these systems to transform military operations, their acquisition remains a high-risk area. GAO's reviews of weapons over three decades have found consistent cost increases, schedule delays, and performance shortfalls. The nation's growing long-range fiscal challenges may ultimately spur Congress to pressure DOD to cut spending on new weapons and to redirect funding to other priorities. In response, DOD might be compelled to deliver new weapon programs within estimated costs and to obtain the most from its investments.

This report provides congressional and DOD decision makers with an independent, knowledge-based assessment of selected defense programs, identifying potential risks and needed actions when a program's projected attainment of knowledge diverges from the best practices. Programs assessed were selected using several factors: high dollar value, acquisition stage, and congressional interest. This report also highlights issues raised by the cumulative experiences of individual programs. GAO updates this report annually under the Comptroller General's authority to conduct evaluations on his own initiative.

www.gao.gov/cgi-bin/getrpt?GAO-07-406SP.

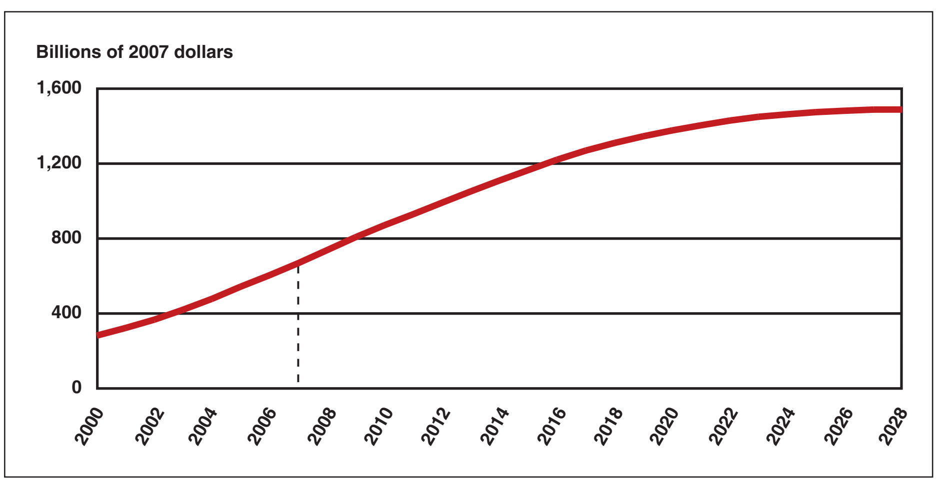
To view the full product, including the scope and methodology, click on the link above. For more information, contact Paul Francis (202) 512-4841 or FrancisP@gao.gov.

What GAO Found

GAO assessed 62 weapon systems with a total investment of over $950 billion, some two-thirds of the $1.5 trillion DOD plans for weapons acquisition (see below). Several of these programs will be developed without needed technology, design, and production knowledge, and will cost more and take longer to deliver. Progress in acquisitions is measured by passage through critical junctures, or knowledge points: Are the product's technologies mature at the start of development? Is the product design stable at the design review? Are production processes in control by production start? By these best practice measures, limited progress has been made by the programs GAO assessed. Fully mature technologies were present in 16 percent of the systems at development start—the point at which best practices indicate mature levels should be present. The programs that began development with immature technologies experienced a 32.3 percent cost increase, whereas those that began with mature technologies increased 2.6 percent. Furthermore, 27 percent of the assessed programs demonstrated a stable design at the time of design review and in terms of production, very few programs reported using statistical process control data to measure the maturity of production processes.

Effective program management and control are essential to executing a knowledge-based approach. However, DOD does not have an environment that facilitates effective program management. For example, key personnel are rotated too frequently. Further, DOD is increasingly relying on contractors to perform key management functions raising questions about the capacity of DOD to manage new weapon system programs.

Total Cumulative Planned Expenditures on Current Portfolio of Major Defense Acquisition Programs



Source: GAO analysis of DOD data.

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Related GAO Products

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Abbreviations

AMRAAM	AIM-120 Advanced Medium-Range Air-to-Air Missile
ASDS	Advanced SEAL Delivery System
ATIRCM/CMWS	Advanced Threat Infrared Countermeasure/Common Missile Warning System
BFVS	Bradley Fighting Vehicle System
CAVES WAA	conformal acoustic velocity sensor wide aperture array
CEC	Cooperative Engagement Capability
DOD	Department of Defense
FBCB2	Force XXI Battle Command Brigade and Below
FMTV	Family of Medium Tactical Vehicles
FY	fiscal year
GAO	Government Accountability Office
GBS	Global Broadcast Service
GPS	Global Positioning System
HIMARS	High Mobility Artillery Rocket System
JASSM	Joint Air-to-Surface Standoff Missile
JLENS	Joint Land Attack Cruise Missile Defense Elevated Netted Sensor System
JPATS	Joint Primary Aircraft Training System
JPEO	Joint Program Executive Office
JSOW	Joint Standoff Weapon
MDA	Missile Defense Agency
MDAP	Major Defense Acquisition Program
MEADS	Medium Extended Air Defense System
MIDS-LVT	Multifunctional Information Distribution System – Low Volume Terminal
MLRS	Multiple Launch Rocket System
MM III GRP	Minuteman III Guidance Replacement Program
MM III PRP	Minuteman III Propulsion Replacement Program
MP-RTIP	Multi-Platform Radar Technology Insertion Program
MUE	Modernized User Equipment
NA	not applicable
NAS	National Airspace System
NASA	National Aeronautics and Space Administration
R&D	research and development
RDT&E	Research, Development, Test and Evaluation
SAR	Selected Acquisition Report
SBX	Sea-Based X-Band
SDD	System Development and Demonstration
TBD	to be determined

TRL	Technology Readiness Level
UAS	Unmanned Aircraft System
USMC	U.S. Marine Corps
U.S.C.	United States Code

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Comptroller General
of the United States

United States Government Accountability Office
Washington, D.C. 20548

March 30, 2007

Congressional Committees

This is our fifth annual assessment of selected Department of Defense (DOD) weapon programs. The breadth of this assessment gives us insights into a broad range of programs as well as the overall direction of weapon system acquisitions. Our analysis of individual weapon systems is grounded in best practices for attaining high levels of product knowledge in the areas of technology, design, and production. We find that new programs continue to move through development without sufficient knowledge, thereby resulting in cost increases and schedule delays. The link between knowledge and cost is real and predictable. It provides three choices for decision makers: (1) accept the status quo, (2) demonstrate high knowledge levels before approving individual programs, or (3) increase cost estimates to accurately reflect the consequences of insufficient knowledge.

This report also provides decision makers with an analysis of cumulative DOD weapon system investment and buying power. Although DOD has doubled its planned investment in major weapon systems from $750 billion to $1.5 trillion since 2001, unanticipated cost growth has reduced the return on this investment. The investment level itself represents a significant policy choice, since during that same period, the government's total liabilities and unfunded commitments have increased from about $20 trillion to about $50 trillion. The nation's fiscal exposures increase every day due to known demographic trends, continuing operating deficits, and compounding interest costs. Given the federal fiscal outlook, what was once a desire to deliver high-quality products on time and within budget has become an imperative. DOD simply must maximize its return on investment to provide the warfighter with needed capabilities and the best value for the taxpayer. With over $880 billion remaining to invest in the current portfolio of major systems, the status quo is both unacceptable and unsustainable.

Recognizing this dilemma, DOD has embraced best practices in its policies, instilled more discipline in requirements setting, strengthened training for program managers, and reorganized offices that support and oversee programs. Yet this intention has not been fully implemented and it has not had a material effect on weapon system programs. To translate policy into better programs, several additional elements are essential, including having a sound business case for each program that focuses on real needs and embodies best practices, sound business arrangements, and clear lines of responsibility and accountability. DOD must think strategically, separate wants from needs, and make tough choices. Specifically, enforcing stated DOD policy on individual acquisitions will require DOD to have the will and the congressional support to say “no” to programs that do not measure up, to recognize and reward savings, and to hold appropriate parties accountable for poor outcomes. This does not mean that no risks should be taken or that all problems can be foreseen and prevented. Nor is it necessary for DOD to sacrifice its record of delivering the best weaponry in the world to U.S. forces. However, it is possible for DOD to continue to deliver the best weaponry at a reasonable cost and in a more timely manner. The taxpayers and our military forces deserve no less.

David M. Walker
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of the United States

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Washington, D.C. 20548

March 30, 2007

Congressional Committees

This report is GAO's fifth annual assessment of selected weapon programs. The Department of Defense (DOD) has doubled its planned investment in new weapon systems from approximately $750 billion in 2001 to almost $1.5 trillion in 2007. In the last 5 years, the number of major defense acquisition programs (MDAPs) in development has risen from 72 to 85, and systems are becoming increasingly complex in their interdependency and technological sophistication. Unfortunately, we have seen little change in acquisition outcomes over this same period. Although U.S. weapons are among the best in the world, the cost of developing a weapon system continues to often exceed estimates by tens or hundreds of millions of dollars. This, in turn, results in fewer quantities than initially planned for, delays in product delivery, and performance shortfalls. Not only is the buying power of the government reduced and opportunities to make other investments lost, but the warfighter receives less than promised. DOD is depending on the weapons currently under development to transform military operations for the 21st century. The size and scale of current planned investment necessitate better results than we have seen in the past.

The current fiscal environment presents challenges for DOD's plans to transform military operations. As the nation begins to address long-term fiscal imbalances, DOD is likely to encounter considerable pressure to reduce its investment in new weapons. DOD also faces pressures within its own budget as investment in new weapon systems competes with funds needed to replace equipment and sustain military operations in Iraq and Afghanistan. To make more efficient use of scarce investment dollars, DOD needs to adhere to a knowledge-based approach to product development that centers on attaining high levels of knowledge in three elements: technology, design, and production. Higher levels of knowledge at program start enable better estimates of how much weapon systems will cost to finish and improve the likelihood that a program will stay within cost and on schedule. Building upon this knowledge—as the product proceeds through design and into production—further increases the likelihood that a program will stay within cost and schedule targets and deliver promised capabilities, thus enabling DOD to buy what was originally budgeted. Lack of knowledge in individual programs is amplified when the program is part of an interdependent network, as cost overruns and schedule delays reverberate across systems of related programs. Additionally, successful acquisition outcomes require that program managers have the capacity to make knowledge-driven development decisions. In the larger context, DOD needs to make changes in its requirements and budgeting processes that are consistent with getting the desired outcomes from the acquisition process.

In this report, we assess 62 programs that represent an investment of over $950 billion.[1] Our objective is twofold: to provide decision makers with a cross-cutting analysis of DOD weapon system investment and also to provide independent, knowledge-based assessments of how well DOD has attained knowledge for individual systems.

Programs were selected for individual assessment based on several factors, including (1) high dollar value, (2) stage in acquisition, and (3) congressional interest. The majority of the 62 programs covered in the report are considered major defense acquisition programs by DOD.[2]

Better Acquisition Outcomes Needed to Accomplish DOD Transformation Objectives in Current Fiscal Environment

Without improved acquisition outcomes, achieving DOD's transformation objectives will be difficult given the current fiscal environment. DOD is currently investing in weapon systems that it is depending on to transform military operations. While these weapon systems are expected to provide unprecedented capabilities, the cost and complexity to develop these new systems will be exceptional. However, the nation's long-term fiscal imbalances will likely place pressure on the affordability of DOD's planned investments. Without better acquisition outcomes, there is greater risk that DOD will not be able to achieve its transformation objectives.

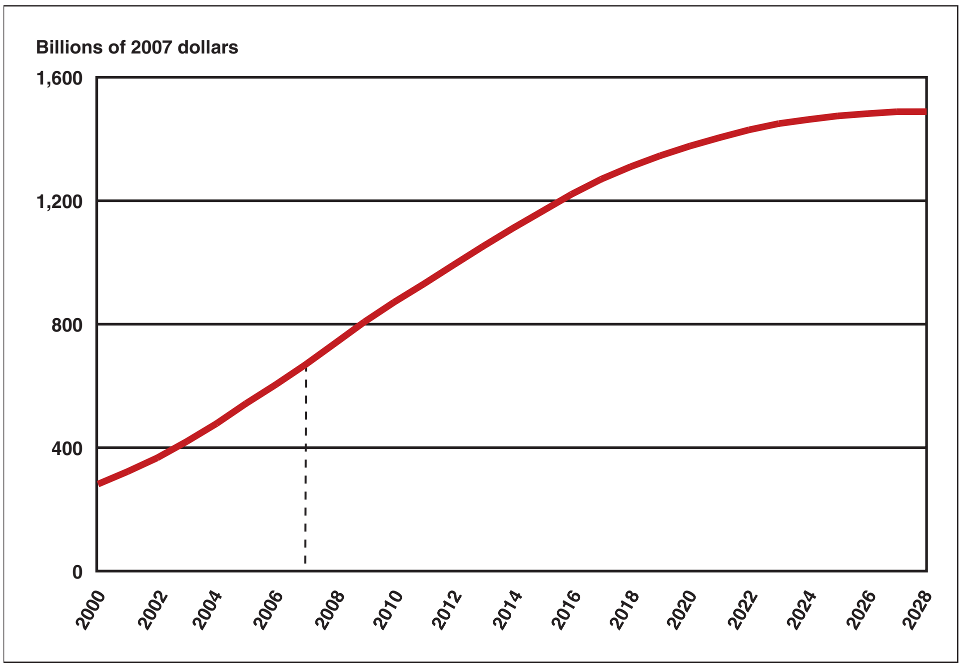
[1]This estimate includes total research, development, test and evaluation (RDT&E); procurement; military construction; and acquisition operation and maintenance appropriations to develop the weapon systems. The macro analyses contained in this report are based on data as of January 15, 2007, and may not reflect subsequent events.

[2]MDAPs are programs identified by DOD as programs that require eventual RDT&E expenditures of more than $365 million or $2.19 billion in procurement in fiscal year 2000 constant dollars.

DOD's Efforts to Transform Military Operations Expected to Be the Most Expensive and Complex Attempted

DOD is undertaking new efforts to fundamentally transform military operations that are expected to be the most expensive and complex ever. In the next 5 to 7 years, DOD plans to increase its investment in weapon systems that are key to this transformation. As figure 1 shows, DOD's total planned investment in major defense acquisition programs is almost $1.5 trillion (2007 dollars) for its current portfolio, with over $880 billion of that investment yet to be made.

Figure 1: Total Cumulative Planned Expenditures on Current Portfolio of Major Defense Acquisition Programs

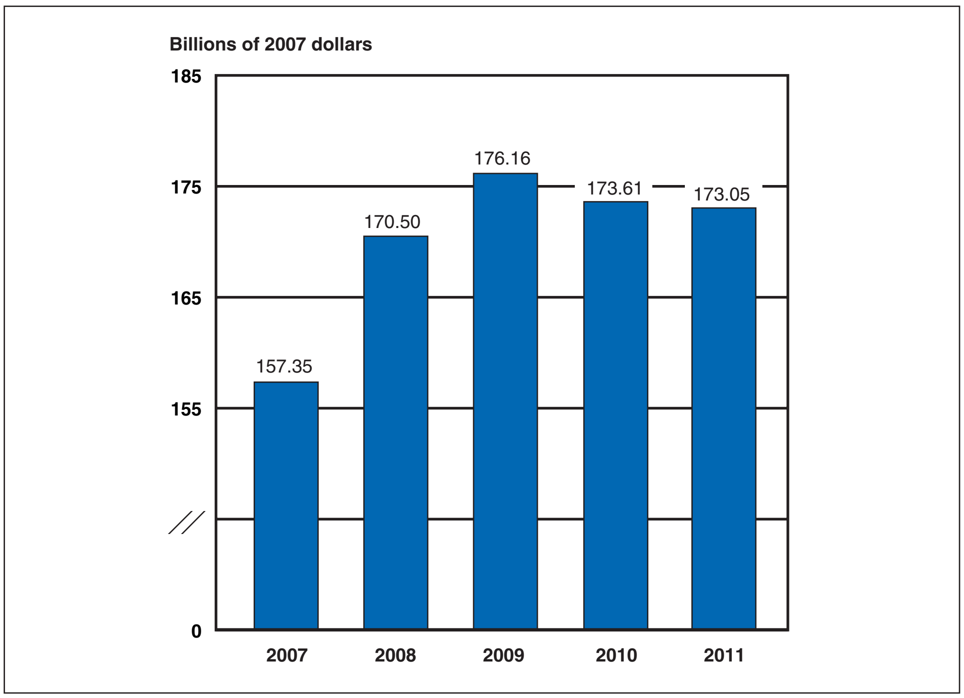


Source: GAO analysis of DOD data.

Note: The MDA portion of investment data only goes through fiscal year 2011 and does not include full cost of developing MDA systems.

DOD's annual investment in the research, development, test and evaluation (RDT&E) and procurement of major weapon systems is expected to rise from $157 billion in 2007 to $173 billion in 2011(see fig. 2), peaking at approximately $195 billion in 2013.[3]

Figure 2: DOD's Projected Annual Investment in Procurement and Research, Development, Test and Evaluation of Weapon Systems



Source: GAO analysis of DOD data.

The complexity of DOD's transformational efforts is especially evident in the development of several large megasystems, major weapon systems that depend on the integration of multiple systems—some of which are developed as separate programs—to achieve desired capabilities. This strategy often requires interdependent programs in concurrent

[3]Estimates for 2013 in constant 2007 dollars as reported by the Congressional Budget Office in "Long-Term Implications of Current Defense Plans: Summary Update for Fiscal Year 2007," pg. 13.

development to be closely synchronized and managed, as they may, for example, depend on integrated architectures and common standards as a foundation for interoperability. If dependent systems are not available when needed, then a program could face cost increases, schedule delays, or reduced capabilities. Furthermore, the larger scope of development associated with these megasystems produces a much greater fiscal impact when cost and schedule estimates increase. Table 1 describes three of the department's largest and most complex megasystems that are currently under way.

Table 1: Key Megasystems Currently in Development

Future Combat Systems (FCS)*	FCS* is a suite of manned and unmanned ground and air vehicles, sensors, and munitions linked by an information network that will enable warfighters to respond to threats with speed, precision, and lethality. FCS consists of 18 components and depends on numerous complimentary systems outside of FCS. For example, FCS is dependent on JTRS* and WIN-T* to provide key communication and networking capabilities that it requires to operate effectively. If these systems—which have both been fraught with cost, schedule, and performance problems of their own—are not available as planned, FCS may need to seek costly backup technologies, adjust its schedule, or accept reduced capabilities.
Ballistic Missile Defense System (BMDS)	BMDS consists of 10 elements that will work in concert to defeat enemy missiles launched from any range during any phase of their flight, including STSS*, GMD*, Aegis BMD*, ABL*, MKV*, KEI*, and THAAD*. While almost all of the elements will work separately, some sensor data must be shared among the elements for them to work in concert and for BMDS to provide full coverage against enemy missiles. For example, the Aegis BMD program provides long-range surveillance and tracking for the GMD system. While Aegis BMD's functionality has been successfully tested in several events, it has never been validated in an end-to-end flight test with the GMD system.
Global Information Grid (GIG)	The GIG is the cornerstone of DOD's net-centricity strategy. It is a system of interdependent systems that make up a secure, reliable network that enables users to access and share information at virtually any location and at any time. Five major programs are related to GIG's core network: TSAT*, JTRS*, GIG-Bandwidth Expansion, Network Centric Enterprise Services, and the Cryptography Transformation Initiative. Both JTRS* and TSAT* have recently been restructured due to—among other things—technical difficulties, complicating DOD's efforts to realize the GIG as planned.

Source: GAO.

Note: Programs with an asterisk are assessed in this report.

The Current Fiscal Environment Presents Challenges to Accomplishing DOD's Transformation Objectives

The nation's long-term fiscal imbalances will likely place pressure on the affordability of DOD's planned investment in major weapon systems, reducing the ability of budgets to accommodate typical margins of error in terms of cost increases and schedule delays. As entitlement programs like Social Security, Medicare, and Medicaid consume a growing percentage of available resources, discretionary programs—including defense—face competition for the increasingly scarce remaining funds. Sustaining real top line budget increases in any discretionary program will be difficult in this constrained resource environment.

DOD budget projections conform to this tightening framework by offsetting growth in procurement spending with reductions in RDT&E, personnel, and other accounts. The minimal real increases projected in defense spending through fiscal year 2011 depend on these offsets. However, as table 2 shows, these projections do not reflect recent experience, nor do they take into account higher than anticipated cost growth and schedule delays, which can compound the fiscal impact and affordability of DOD's planned investment.

Table 2: Average Annual Real Growth in Defense Spending Accounts

Account	2000-2006 (actual)	2007-2011 (projected)
Procurement	5.61%	6.46%
RDT&E	8.42%	-2.95%
Military personnel	3.67%	-0.68%
Operation and Maintenance	5.55%	1.00%
Other	5.18%	-3.85%
Total	**5.45%**	**0.90%**

Source: GAO analysis of DOD data.

Since 2004, total costs for a common set[4] of 64 major weapon systems under development have grown in real terms by 4.9 percent per year—costing $165 billion (constant 2007 dollars) more in 2007 than planned for in 2004. Over this same period, the funding needed to complete these programs has increased despite the significant investment that has already been made. Furthermore, as congressional leaders advise DOD to

[4]This common set refers to all programs that were reported as major defense acquisition programs in both the 2004 and 2007 assessment periods. This includes several programs whose knowledge attainment is not assessed in this report. The 64 programs that make up this common set are AEHF, AESA, AIM-9X, AMRAAM, ASDS, ATIRCM/CMWS, BFVS A3 Upgrade, C-130 AMP, C-130J, C-17, C-5 RERP, CEC, CH-47F, CVN-21, CVN-77, DDG 1000, DDG 51, E-2 AHE, E-2C REP, EELV, EFV, Excalibur, F-22A Raptor, F/A-18E/F, FBCB2, FCS, FMTV, GBS, Global Hawk, GOSHAWK, GPS II MSO Navstar, GPS II MUE Navstar, HIMARS, JASSM, Javelin, JDAM, JPATS, JSF, JSOW Baseline, JSOW, JTRS, Land Warrior, Longbow Apache Airframe Mods, LPD 17, MH-60R, MIDS-LVT, MLRS, MM III GRP, MM III PRP, NAS, NPOESS, Patriot PAC-3 Missile Segment, SBIRS High, SSGN, SSN 774, Stryker, T-AKE, Tomahawk, Trident II, UH-60M, USMC H-1 Upgrade, V-22, WGS, and WIN-T.

incorporate the costs of the war into the annual budget rather than into supplemental appropriations, trade-offs will likely be required among the resource demands of repairing or replacing those weapon systems damaged in Iraq and Afghanistan and future investments to modernize and transform the armed forces. If DOD cannot deliver its new weapon programs within estimated costs, difficult choices may have to be made regarding which investments to pursue and which to discontinue.

DOD Weapon Programs Consistently Experience a Reduced Return on Investment

While DOD is pursuing plans to transform military operations and committing more investment dollars to realize these new weapon systems, it regularly realizes a reduced return on their investment. DOD programs typically take longer to develop and cost more to buy than planned, placing additional demands on available funding. As shown in table 3, total RDT&E costs for a common set[5] of 27 weapon programs that we were able to assess since development began increased by almost $35 billion, or 33.5 percent, over the original business case (first full estimate). The same programs have also experienced an increase in the time needed to develop capabilities with a weighted average schedule increase of over 23 percent.[6]

Table 3: Cost and Cycle Time Growth for 27 Weapon Systems (billions of constant 2007 dollars)

	First full estimate	Latest estimate	Percent change
Total cost	$506.4	$603.1	19.1%
RDT&E cost	$104.7	$139.7	33.5%
Weighted average acquisition cycle time[a] (months)	137.9	170.2	23.5%

Source: GAO analysis of DOD data.

[5]This common set refers to 27 programs included in this report that we were able to assess since development began. The 27 program are AEHF, MUOS, NPOESS, WGS, Patriot/MEADS, ARH, Excalibur, FCS, Warrior UAS, EA-18G, EFSS, V-22, AESA, E-2D AHE, JTRS HMS, JTRS GMR, Land Warrior, WIN-T, ERM, CVN-21, C-5 AMP, C-5 RERP, F-22A Modernization, Global Hawk, JSF, Reaper, and P-8A MMA. We limited analysis to these 27 programs because all data including cost, schedule, and quantities were available for comparison between program estimates.

[6]A weighted average gives more expensive programs a greater value.

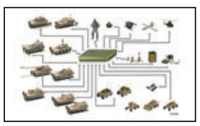
[a]This is a weighted estimate of average acquisition cycle time for the 27 programs based on total program costs at the first full and latest estimates. The simple average for these two estimates was 98.9 months for the first full estimate and 124.6 months for the latest estimate resulting in a 26.1 percent change.

The consequence of cost and cycle time growth is often manifested in a reduction of the buying power of the defense dollar. As costs rise and key schedule milestones are delayed, programs are sometimes forced to make trade-offs in quantities, resulting in a reduction in buying power. Quantities for 12 of the common set programs have been reduced since their first estimate.[7] Additionally, the weighted average program acquisition unit cost for 26 of the 27 programs increased by roughly 39 percent, meaning that each unit cost significantly more to buy than originally planned.[8] Table 4 illustrates 6 programs with a significant reduction of buying power. Some of these programs experienced higher costs for the same initial quantity.

[7]The programs are AEHF, NPOESS, Excalibur, EA-18G, V-22, JTRS GMR, C-5 AMP, C-5 RERP, F-22A Modernization, Global Hawk, JSF, and P-8A MMA.

[8]This estimate is a weighted average based on total program cost and does not include the Excalibur program because of its extreme unit cost growth. The simple average program unit cost increase for the same 26 programs is 34 percent. The weighted average, including the Excalibur, is 90 percent.

Table 4: Examples of Reduced Buying Power (constant 2007 dollars)

Program		Initial estimate	Initial quantity	Latest estimate	Latest quantity	Percentage of unit cost increase
Joint Strike Fighter		$196. 5 billion	2,866 aircraft	$223.3 billion	2,458 aircraft	32.8
Future Combat Systems		$85.5 billion	15 systems	$131.7 billion	15 systems	54.1
V-22 Joint Services Advanced Vertical Lift Aircraft		$36.9 billion	913 aircraft	$50.0 billion	458 aircraft	170.2
Evolved Expendable Launch Vehicle		$16.0 billion	181 vehicles	$28.6 billion	138 vehicles	134.7
Space Based Infrared System High		$4.2 billion	5 satellites	$10.4 billion	3 satellites	311.6
Expeditionary Fighting Vehicle		$8.4 billion	1,025 vehicles	$11.3 billion	1,025 vehicles	33.7

Source: GAO analysis of DOD data. Images sourced in their respective order: JSF Program Office; Program Manager, Future Combat Systems (BCT); V-22 Joint Program Office; (Left) © 2005 ILS/Lockheed Martin, (right) © 2003 The Boeing Company; Lockheed Martin Space Systems Company; General Dynamics Land Systems.

A Knowledge-Based Approach Can Lead to Better Acquisition Outcomes

Over the last several years, we have undertaken a body of work that examines weapon acquisition issues from a perspective centered on best practices in system development. We have found that leading commercial firms pursue an approach that is based in knowledge, where high levels of product knowledge are demonstrated at critical points in development. Programs take steps to gather knowledge that demonstrates that their technologies are mature, their designs are stable, and their production processes are in control. This knowledge helps programs identify risks early and address them before they become problems. The result of a knowledge-based approach is a product delivered on time, within budget, and with the promised capabilities. Based on our best practice work, we have identified three key knowledge points—junctures where programs need to display critical levels of knowledge to proceed. These knowledge points and associated indicators are defined as follows:

- **Knowledge point 1:** Resources and needs match. This point occurs when a sound business case is made for the product—that is, a match is made between the customer's requirements and the product developer's available resources in terms of knowledge, time, money, and capacity. Achieving a high level of technology maturity at the start of system development is an important indicator of whether this match has been made. This means that the technologies needed to meet essential product requirements have been demonstrated to work in their intended environment.

- **Knowledge point 2:** Product design is stable. This point occurs when a program determines that a product's design is stable—that is, it will meet customer requirements, as well as cost, schedule, and reliability targets. A best practice is to achieve design stability at the system-level critical design review, usually held midway through development. Completion of at least 90 percent of engineering drawings at the system design review provides tangible evidence that the design is stable.

- **Knowledge point 3:** Production processes are mature and the design is reliable. This point is achieved when it has been demonstrated that the company can manufacture the product within cost, schedule, and quality targets. A best practice is to ensure that all key manufacturing processes are in statistical control—that is, they are repeatable, sustainable, and capable of consistently producing parts within the product's quality tolerances and standards—at the start of production. Demonstration of a prototype that meets reliability and performance requirements prior to the production decision, can minimize production and post-production costs.

The attainment of each successive knowledge point builds upon the preceding one. If a program is falling short in one element, like technological maturity, it is harder to achieve design stability and almost impossible to achieve production maturity. In particular, separating technology development from product development can help reduce costs and deliver a product on time and within budget.

Most Programs Proceed with Low Levels of Knowledge at Critical Junctures

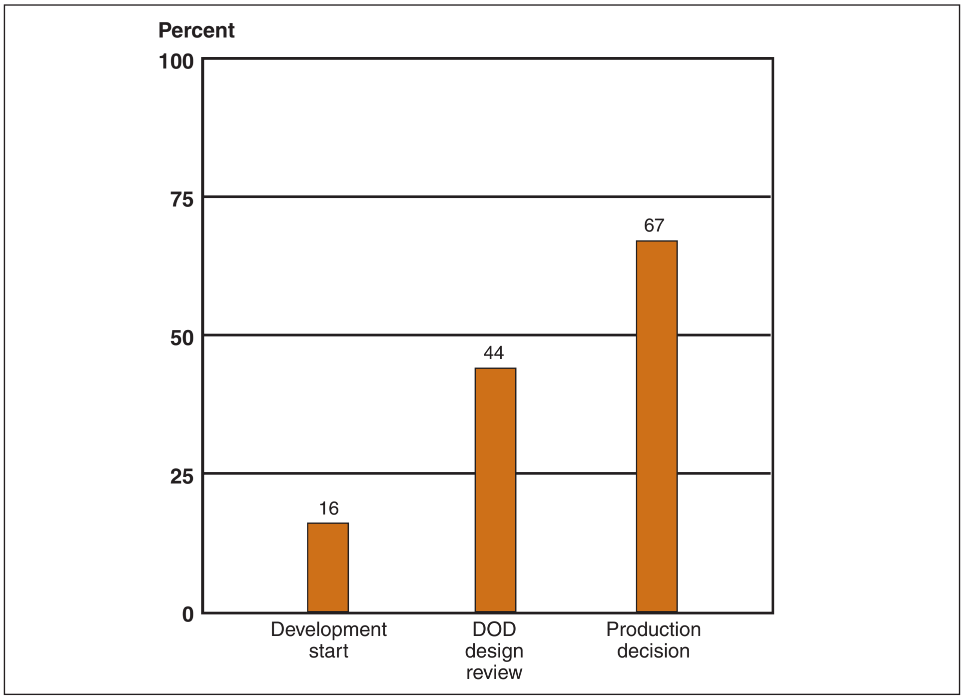
To get the most out of its weapon system investments, DOD revised its acquisition policy in May 2003 to incorporate a knowledge-based, evolutionary framework. However, DOD's policy does not incorporate adequate controls to ensure the effective implementation of a knowledge-based acquisition process. As we have reported in the past, most of the programs we reviewed this year proceeded with lower levels of knowledge at critical junctures and attained key elements of product knowledge later in development than specified in DOD policy. The cost and schedule consequences of delayed knowledge attainment are significant.

Programs That Enter System Development with Immature Technologies Cost More and Take Longer

Our 2007 assessment continues to show that very few programs start with mature technologies (see fig. 3). This initial knowledge deficit cascades through design and production, so that at each key juncture, decision makers have to rely on assumptions in lieu of knowledge. Only 16 percent of programs in our assessment demonstrated all of their critical technologies as mature at the start of development, meaning that the vast majority of programs failed to achieve knowledge point 1 when they should have. By design review, when programs should have attained knowledge point 2 by demonstrating a stable design, only 44 percent had attained knowledge point 1. In the past 2 years alone, several programs have passed through their development start or design review with immature technologies.[9] Without mature technologies, it is difficult to know whether the product being designed and produced will deliver the desired capabilities or, alternatively, if the design allows enough space for technology integration. Yet, 33 percent of the programs we assessed had still not attained knowledge point 1 by the time of their decision to start production.

[9]Since April 2005, CH-53K, ARH, JLENS, Warrior UAS, MKV, SSN 774 Technology Insertion, and Longbow Apache Block III programs have all entered development with immature technologies. Likewise, EA-18G, JSF, DDG 1000, E2D-AHE, Land Warrior, and Warrior UAS have all held design reviews since April 2005. All six programs passed through their design reviews with immature technologies.

Figure 3: Percentage of Programs That Achieved Technology Maturity at Key Junctures

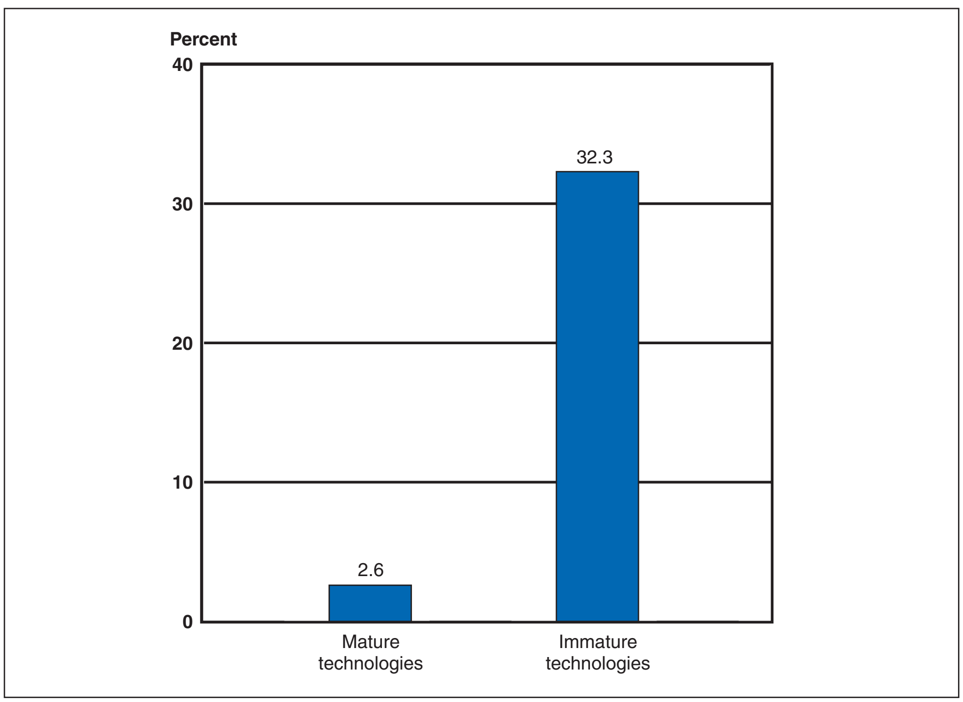


Source: GAO analysis of DOD data.

Over the next 5 years, many of the programs in our assessment plan to hold a design review or make a production decision without demonstrating the level of technology maturity that should have been seen before the start of development. Twenty-three of the programs we assessed plan to hold a design review in the next 5 years. Six of those 23 did not provide a projection of their expected technology maturity by that point. Of the remaining 17 programs, only 6 reported that they expect to have achieved technology maturity by the time of their design review. Similarly, 31 of the programs in our assessment plan to make a production decision in the next 5 years, but 12 programs did not provide a projection of the technology maturity at that point and 5 of the remaining 19 programs still expect to have immature technologies at that time—not having achieved any of the knowledge points (technology maturity, design stability, or production maturity) at production start.

Consequences accrue to programs that are still working to mature technologies well into system development, when they should be focusing on maturing system design and preparing for production. Programs that start with mature technologies experience less cost growth than those that start with immature technologies. Figure 4 shows that programs that start with mature technologies saw their research, development, test and evaluation cost estimates increase by 2.6 percent over the first full estimate.

Figure 4: Average Program RDT&E Cost Growth from First Full Estimate



Source: GAO analysis of DOD data.

In comparison, RDT&E costs for programs that began development with immature technologies increased by 32.3 percent over the first full estimate. Programs that started development with mature technologies also manage to stay on schedule, averaging less than a 1-month delay over their initial timetable. Alternatively, programs that began development with immature technologies have experienced average delays of more than 20 months over their original schedules. Furthermore, programs that enter development with all of their technologies mature tend to maintain their buying power, achieving their promised return on investment. Program acquisition unit costs increased by less than 1 percent for programs that reached knowledge point 1 by development start, whereas the programs that started development with immature technologies experienced an average program acquisition unit cost increase of 30 percent over the first full estimate.[10]

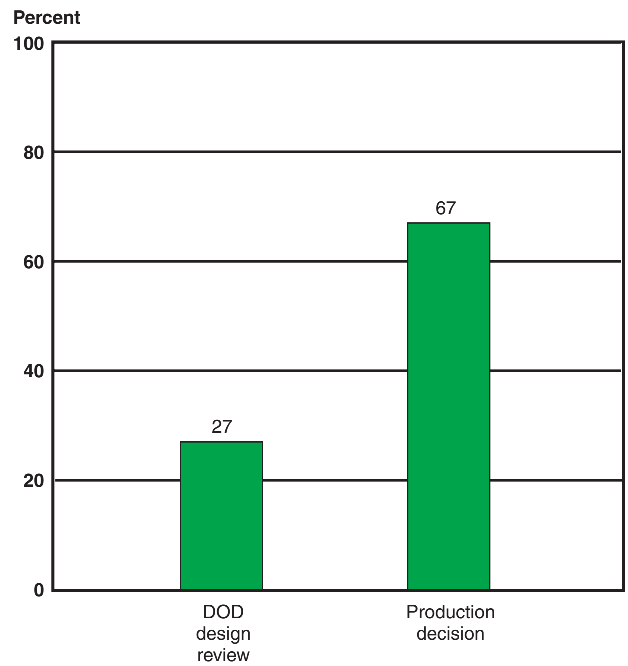
DOD's policy states that technologies should be demonstrated in at least a relevant environment before a program enters system development; whereas GAO utilizes the best practice standard that calls for technology to be assessed one step higher—demonstration in a realistic environment. If we applied DOD's lower standard, 32 percent of programs entered development with all of their technologies mature compared with 16 percent using the best practice standard. Using either standard, most programs still do not begin development with mature technology. There is a cost consequence of entering development with technologies at DOD's lower standard. Programs that meet DOD's technology maturity standard experience an average RDT&E cost growth of approximately 8.4 percent, whereas programs that enter development with all technologies at the higher standard specified by best practices saw their RDT&E cost estimates grow by 2.6 percent.

Programs Continue Past Design Reviews without Demonstrating a Stable Design

The majority of programs in our assessment that have held a design review did so without first achieving a stable design. As illustrated in figure 5, only 27 percent of programs in our assessment demonstrated that they had attained a stable design at the time of design review. Thirty-three percent of programs had still not achieved design stability by the time they decided to start production. Twenty-three programs in our assessment are currently scheduled to hold their critical design reviews by the year 2012. Only 5 of these programs expect to have achieved design stability by the time of their critical design reviews.

[10]These percentages are program cost weighted averages. The simple average increase for RDT&E costs is 7 percent for the programs that started development with mature technologies and 56 percent for the programs that started development with immature technologies. The simple average increase for program acquisition unit costs is 21 percent for programs that started development with mature technologies and 31 percent for the programs that started development with immature technologies.

Figure 5: Percentage of Programs That Achieved Design Stability at Key Junctures



Source: GAO analysis of DOD data.

Most Programs Do Not Collect Data to Measure Production Maturity

Only 2 of the 20 programs we assessed that are now in production reported using statistical process control data to measure the maturity of the production process, which is the data needed to demonstrate knowledge point 3.[11] Neither of these programs had reached production maturity—having all of the production processes under statistical control—by knowledge point 3.

In addition to ensuring that the program meets all knowledge points prior to starting production, prototypes should be constructed and tested to make sure that the weapons being produced meet performance and reliability requirements. For example, despite having achieved technology maturity and design stability, the Expeditionary Fighting Vehicle

[11]The two programs are ATIRCM/CMWS and Global Hawk.

discovered reliability failures during preproduction testing. As a result, the program has delayed production and is being restructured to incorporate improvements in the vehicle design. Thirty-two of the programs we assessed provided us information on when they had or planned to have first tested a fully configured, integrated production representative article (i.e., prototype) in its intended environment. Of those programs, 47 percent reported they have already conducted or planned to conduct a developmental test of a production representative article (i.e., prototype) before they make their initial production decision. GAO's work has shown that production and postproduction costs are minimized when a prototype is demonstrated to meet reliability and performance requirements prior to the production decision.

Effective Management Capacity and Control Are Essential to Successfully Executing a Knowledge-Based Approach

Effective program management and control are essential to facilitating a knowledge-based acquisition approach. The capacity to manage requirements, control funding, and oversee the contracted development of critical technologies, product designs, and production processes better ensures that programs stay within budget, keep on schedule, and deliver the capabilities originally promised. However, our past work has shown that DOD does not have an environment that facilitates effective program management. At the same time, DOD is increasingly relying on contractors to perform key management functions. In addition, inadequate knowledge development has resulted in the extended use of cost reimbursement contracts in some cases. Under these contracts, the government bears most of the cost risk.

DOD Does Not Provide Program Managers an Environment That Facilitates a Knowledge-Based Acquisition Approach

Our past work has shown that DOD does not have an environment that facilitates effective program management and programs have little incentive to pursue knowledge-based acquisition paths.[12] In particular, our work has shown that program managers are not empowered to execute weapons acquisition programs nor are they set up to be accountable for results. Program managers cannot veto new requirements, control funding, or control staff. In addition, DOD has not established effective controls that require decision makers to measure progress against specific criteria and ensure that managers capture key knowledge before moving to the next

[12] GAO, *Best Practices: Better Support of Weapon System Program Managers Needed to Improve Outcomes*, GAO-06-110 (Washington, D.C.: Nov. 30, 2005).

acquisition phase. Without effective controls that require program officials to satisfy specific criteria, it is difficult to hold decision makers or program managers accountable to cost and schedule targets. Moreover, the incentive structure of program managers—based primarily on maintaining program funding—contributes to the consistent underestimation of costs, optimistic schedules, and the suppression of bad news that could jeopardize funding. Furthermore, rather than lengthy assignment periods between key milestones as suggested by best practices, many of the programs we reviewed had multiple program managers within the same milestone. This promotes shortsightedness and reduces accountability for poor outcomes. Consequently, programs have little incentive to pursue knowledge-based acquisition paths as program funding is not tied to successfully reaching knowledge points before a program can proceed.

Contractors Increasingly Perform Key Program Management Functions

DOD is relying on contractors in new ways to manage and deliver weapon systems. While DOD has downsized its acquisition workforce by almost half in the last decade, DOD has increased its contract obligations for professional, administrative, and management support from $10.8 billion in 1996 to $28.3 billion in 2005 (both in constant 2005 dollars). Based on our work looking at various major weapon systems, we have observed that DOD has given contractors increased program management responsibilities to develop requirements, design products, and select major system and subsystem contractors. In part, this increased reliance has occurred because DOD is experiencing a critical shortage of certain acquisition professionals with technical skills related to systems engineering, program management, and cost estimation. The increased dependence on contractors raises questions about the capacity of DOD to manage new weapon system programs, an undertaking made more difficult when technology, design, and production knowledge are lacking.

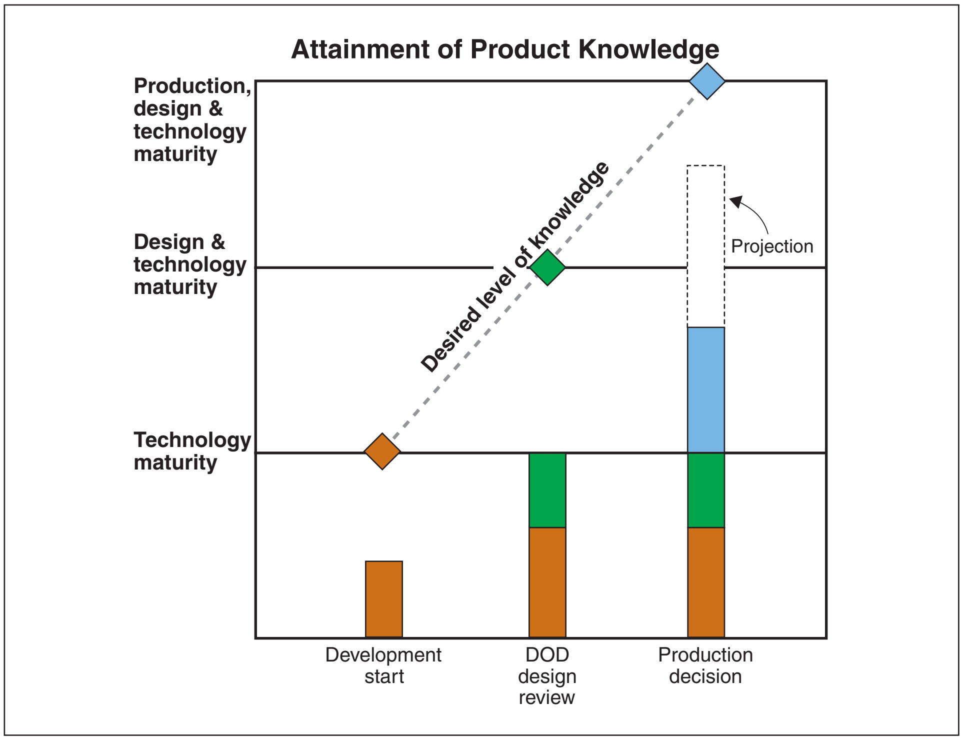
Inadequate Knowledge Development Has Resulted in the Extended Use of Cost Reimbursement Contracts in Some Cases

The extended use of cost reimbursement contracts may be a further consequence of inadequate knowledge attainment. Under a cost reimbursement contract, the government bears most of the cost risk—the risk of paying more than it expected. DOD typically uses cost reimbursement contracts for development and can use fixed price contracts for production and deployment. If technologies are mature, designs are stable, and production processes are in place, then production costs are more likely to be known. In these cases the program can more easily award a fixed price contract. However, we found several examples of programs extending the use of cost reimbursement contracts into production and deployment instead of using fixed price contracts, reflecting uncertainties in program development. While the extended use of cost reimbursement contracts may be appropriate under these circumstances, it is indicative of programs proceeding through the acquisition process with inadequate knowledge.

How to Read the Knowledge Graphic for Each Program Assessed

We assess each program in two pages and depict the extent of knowledge in a stacked bar graph and provide a narrative summary at the bottom of the first page. As illustrated in figure 6, the knowledge graph is based on the three knowledge points and the key indicators for the attainment of knowledge: technology maturity (depicted in orange), design stability (depicted in green), and production maturity (depicted in blue). A “best practice” line is drawn based on the ideal attainment of the three types of knowledge at the three knowledge points. The closer a program’s attained knowledge is to the best practice line, the more likely the weapon will be delivered within estimated cost and schedule. A knowledge deficit at the start of development—indicated by a gap between the technology knowledge attained and the best practice line—means the program proceeded with immature technologies and faces a greater likelihood of cost and schedule increases as technology risks are discovered and resolved.

Figure 6: Depiction of a Notional Weapon System's Knowledge as Compared with Best Practices



Source: GAO.

An interpretation of this notional example would be that the system development began with key technologies immature, thereby missing knowledge point 1. Knowledge point 2 was not attained at the design review, as some technologies were still not mature and only a small percentage of engineering drawings had been released. Projections for the production decision show that the program is expected to achieve greater levels of maturity but will still fall short. It is likely that this program would have had significant cost and schedule increases.

We conducted our review from June 2006 through March 2007 in accordance with generally accepted government auditing standards. Appendix II contains detailed information on our methodology.

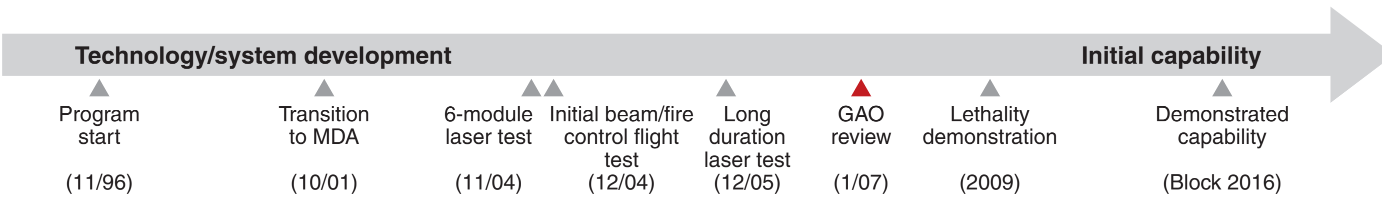
Assessments of Individual Programs

Our assessments of the 62 weapon systems follow.

Airborne Laser (ABL)

MDA's ABL element is being developed in capability-based blocks to destroy enemy missiles during the boost phase of flight. Carried aboard a modified Boeing 747 aircraft, ABL employs a beam control/fire control subsystem to focus the beam on a target, a high-energy chemical laser to rupture the fuel tanks of enemy missiles, and a battle management subsystem to plan and execute engagements. We assessed the Block 2004 design, which is being further developed in Block 2006, and is expected to lead to a lethality demonstration in 2009.

Source: Airborne Laser Program Office.



Program Essentials

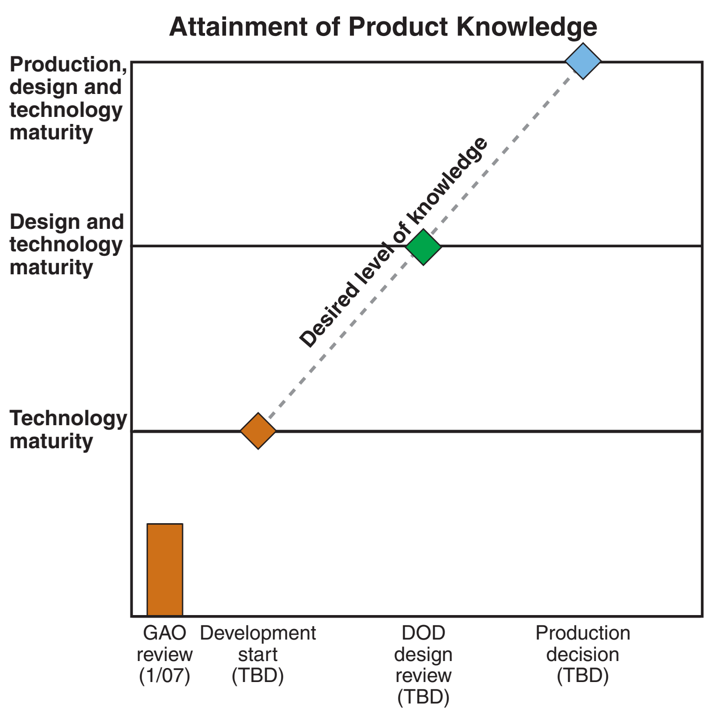
Prime contractor: Boeing
Program office: Kirtland AFB, N.M.
Funding FY07-FY11:
- R&D: $2,515.4 million
- Procurement: $0.0 million
- Total funding: $2,515.4 million
- Procurement quantity: NA

Program Performance (fiscal year 2007 dollars in millions)

	As of 09/2003	Latest 08/2006	Percent change
Research and development cost	$5,749.7	$5,449.2	-5.2
Procurement cost	$0.0	$0.0	0.0
Total program cost	$5,749.7	$5,449.2	-5.2
Program unit cost	NA	NA	NA
Total quantities	NA	NA	NA
Acquisition cycle time (months)	NA	NA	NA

Columns include all known costs and quantities from the program's inception through fiscal year 2009. Total known program cost through fiscal year 2011 is $6,435.6 million.

Program officials expected ABL to provide an initial capability during Block 2006, but this event was delayed and none of ABL's seven critical technologies are fully mature. During Block 2006, the program continues work on a prototype expected to provide the basic design for a future operational capability. Program officials expected to demonstrate the prototype's critical technologies during a flight test in late 2008, but recent testing problems delayed the test until fiscal year 2009. MDA released 100 percent of the engineering drawings for the prototype's design, but additional drawings may be needed if problems encountered during future testing force design changes. The program's prime contractor replanned future contract work in August 2004. However, the program continues to overrun its fiscal year cost and schedule budgets.



ABL Program

Technology Maturity

The program office assessed all seven of its critical technologies—the six-module laser, missile tracking, atmospheric compensation, transmissive optics, optical coatings, jitter control, and managing the high-power beam—as nearly mature. According to program officials, all of these technologies have been demonstrated in a relevant environment and are needed to provide the system with an initial operational capability.

Although the program office assessed jitter control as nearly mature, the technology will pose a high risk until it is demonstrated in flight tests. Jitter—a phenomenon pertaining to the technology of controlling and stabilizing the high-energy laser beam so that vibration unique to the aircraft does not degrade the laser's aimpoint—is critical to the operation of the laser. The ABL's laser beam must be stable enough to impart sufficient energy on a fixed spot of the target to rupture its fuel tank. Program officials told us that they will continue to refine jitter mitigation efforts and will learn more about jitter control in future tests.

Since our last assessment, the program office has reevaluated the maturity level for one of its critical technologies—managing the high-power beam. The technology was reported as fully mature, but has since been assessed as nearly mature as it has not yet been demonstrated in a realistic environment. The program plans to demonstrate all technologies in a realistic environment during a flight test of the system prototype, referred to as a lethal demonstration, in which ABL will attempt to shoot down a short-range ballistic missile. Challenges with integrating the laser and beam control/fire control subcomponents have delayed this test into 2008, and recent technical challenges associated with developing and testing the beam control/fire control software have caused further delays in the lethal demonstration.

Design Stability

We could not assess ABL's design stability because the element's initial capability will not be fully developed until the second aircraft is well under way. While the program has released 100 percent of its engineering drawings for the prototype, it is unclear whether the design of the prototype aircraft can be relied upon as a good indicator of design stability for the second aircraft. More drawings may be needed if the design is enhanced or if problems encountered during flight testing force design changes.

Production Maturity

The program is producing a limited quantity of hardware for the system's prototype. However, we did not assess the production maturity of ABL because MDA has not made a production decision.

Other Program Issues

In 2004, the ABL program restructured its prime contract to focus on near-term milestones and to provide a more realistic budget and schedule for the remaining work. The program further refined its work plan in 2005. However, recent technical challenges associated with the program's beam control/fire control ground test series are causing the contractor to experience further cost growth and schedule slip. As of June 2006, the program was overrunning its fiscal year 2006 budget by approximately $49 million and was unable to complete approximately $23 million of planned work.

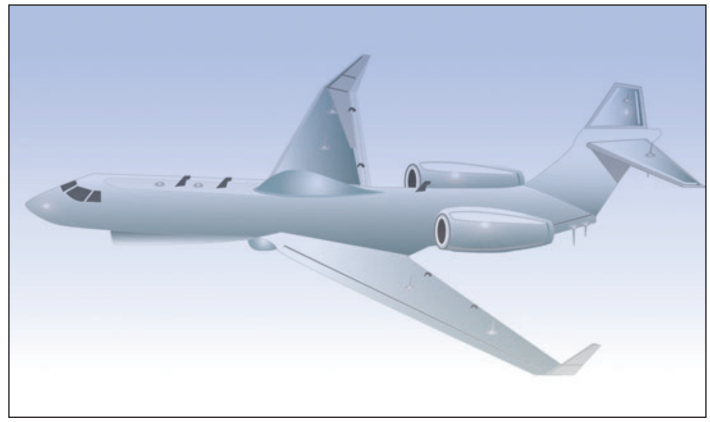
Additionally, the program has experienced a number of quality-related issues that may have impacted laser performance. During fiscal year 2006, several laser subcomponents failed or were found to be deficient. Program officials believe that a number of the deficiencies and failures were attributable to poor quality control and may have contributed to the laser achieving 83 percent of its design power, rather than the 100 percent originally planned. According to officials, the program will test the laser power again once all deficiencies are resolved.

Agency Comments

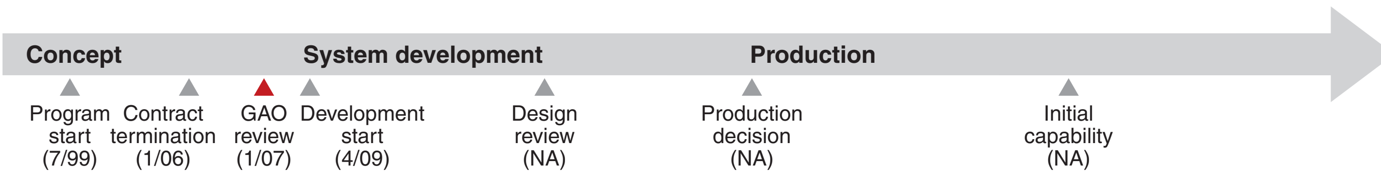
MDA provided technical comments, which were incorporated as appropriate.

Aerial Common Sensor (ACS)

The Army's ACS is an airborne reconnaissance, intelligence, surveillance, and target acquisition system and is being designed to provide timely intelligence data on threat forces to the land component commander. The ACS will replace the Guardrail Common Sensor and the Airborne Reconnaissance Low airborne systems. ACS will co-exist with current systems until it is phased in and current systems retire.



Source: Graphic artist rendering of generic Airborne ISR platform. No photo image available.



Program Essentials

Prime contractor: TBD
Program office: Fort Monmouth, N.J.
Funding needed to complete:
- R&D: $792.8 million
- Procurement: $11.9 million
- Total funding: $804.8 million
- Procurement quantity: 33

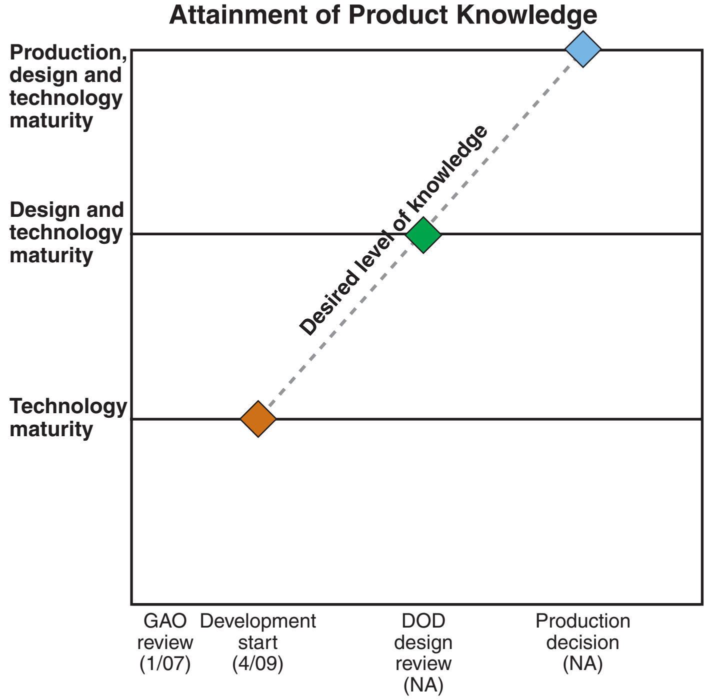
Program Performance (fiscal year 2007 dollars in millions)

	As of 07/2004	Latest 12/2005	Percent change
Research and development cost	$1,237.9	$1,158.9	-6.4
Procurement cost	$2,994.3	$12.0	-99.6
Total program cost	$4,236.6	$1,170.9	-72.4
Program unit cost	$111.489	$30.814	-72.4
Total quantities	38	38	0.0
Acquisition cycle time (months)	127	TBD	TBD

These costs and quantities are expected to change due to the ACS program restructuring, as is the acquisition timeline.

Due to a significant increase in ACS weight, the Army terminated the development contract. By the time the contract was terminated, three technologies had reached maturity and one more was nearing maturity. The Army expected to demonstrate the maturity of all but one critical technology by the original design review in December 2006. The program office estimated that 50 percent of drawings would have been releasable at that time. The Army is currently reassessing requirements for the program and plans to restart development in the third quarter of fiscal year 2009. The new date for design review has not been determined. Some requirements may be eliminated, moved to a future spiral, or assigned to another system. ACS system technologies maturity, design, cost, and schedule will likely be affected.

Attainment of Product Knowledge



ACS Program

Technology Maturity

Only one of ACS's six critical technologies was mature when the program initially started development in July 2004 and two more were nearing maturity. When the Army terminated the development contract, one additional technology was nearing maturity. The maturity of one of the remaining technologies was tied to the development of the airborne version of the Joint Tactical Radio System, which would not have been available until after ACS was fielded. The Army expected that all of the critical technologies except the one tied to the radios would be fully mature by December 2006. It is not currently clear which requirements might be eliminated or the resulting impact to the technology maturity. However, the Army plans to seek approval for development start only after all its critical technologies have reached maturity.

Design Stability

The program office estimated that 50 percent of the drawings expected for ACS would have been releasable by the original design review, which was scheduled for December 2006. However, in December 2004, 5 months after the program began development, the contractor informed the Army that the weight of the prime mission equipment had exceeded the structural limits of the aircraft. In September 2005, the Army ordered the contractor to stop all work under the existing contract and in January 2006 terminated the contract for system development. As a result, the new date for design review has not been determined, but it is unlikely that any of the original drawings will be relevant at the time of program restart due to technology obsolescence and program redefinition.

Other Program Issues

In December 2005, just prior to contract termination, the Deputy Secretary of Defense directed the Army and Navy, in coordination with the Air Force, Joint Staff, and others to conduct a study of joint multi-intelligence airborne ISR needs. The report findings, which were due to the Deputy Secretary of Defense by the end of July 2006, are still pending. Four options are being considered. One option would be to restart system development with most or all of the previous requirements intact. The second option would be to field a system that is more capable than those currently operating while deferring some requirements for future spirals. This option would probably still require a business jet or larger platform to permit growth. The third option would be to field two systems with some requirements on a manned platform and some on an unmanned platform. The fourth option would be to field an unmanned system. The Army expects to make a decision in time for it to be reflected in the fiscal year 2008 president's budget.

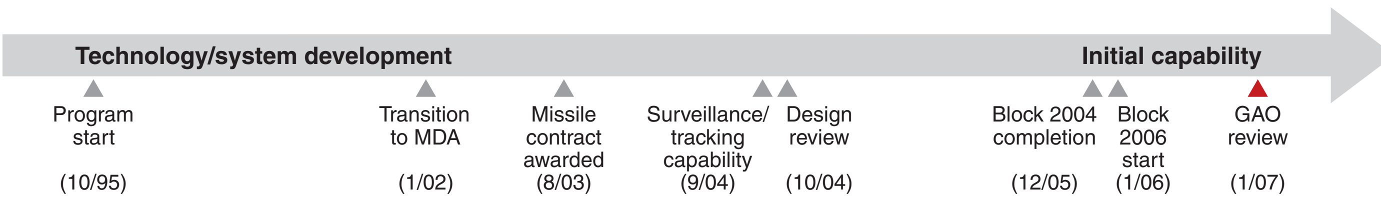
Agency Comments

In commenting on a draft of this assessment, the Army provided technical comments, which were incorporated as appropriate.

Aegis Ballistic Missile Defense (Aegis BMD)

MDA's Aegis BMD element is a sea-based missile defense system being developed in incremental, capability-based blocks to protect deployed U.S. forces, allies, and friends from short-to-medium-range ballistic missile attacks. Key components include the shipboard SPY-1 radar, hit-to-kill missiles, and command and control systems. It will also be used as a forward-deployed sensor for surveillance and tracking of intercontinental ballistic missiles. We assessed the missile to be delivered in Block 2006, the Standard Missile 3 (SM-3) Block 1A.

Source: Aegis BMD Program Office.



Program Essentials

Prime contractor: Lockheed Martin (WS), Raytheon (SM-3)
Program office: Arlington, Va.
Funding FY07-FY11:
- R&D: $4,553.3 million
- Procurement: $0.0 million
- Total funding: $4,553.3 million
- Procurement quantity: NA

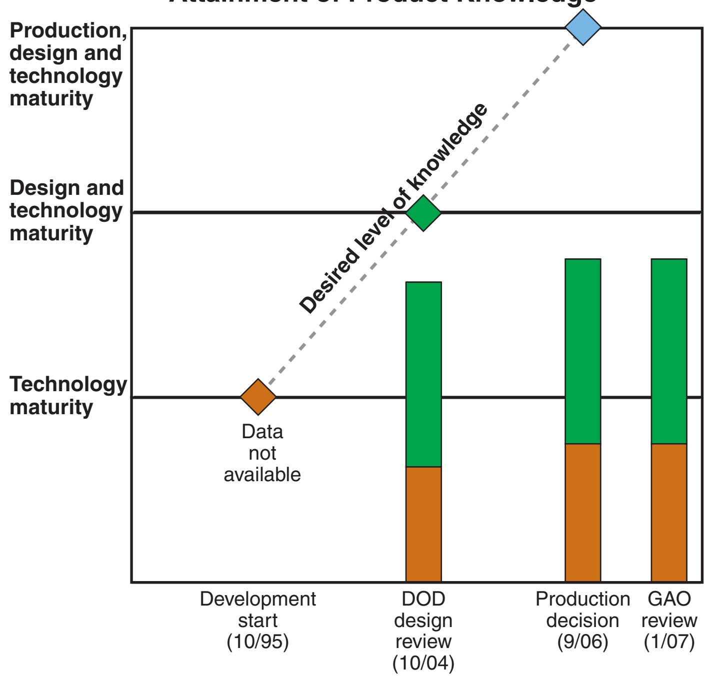
Program Performance (fiscal year 2007 dollars in millions)

	As of 11/2003	Latest 07/2006	Percent change
Research and development cost	$7,371.5	$9,038.8	22.6
Procurement cost	$0.0	$0.0	0.0
Total program cost	$7,371.5	$9,038.8	22.6
Program unit cost	NA	NA	NA
Total quantities	NA	NA	NA
Acquisition cycle time (months)	NA	NA	NA

Costs and quantities are for all known blocks from the program's inception through fiscal year 2009. Total known program cost through fiscal year 2011 is $10,688.5.

According to program officials, the Block 1A missile being fielded during 2006-2007 has mature technologies and a stable design. However, we believe that two critical technologies are less mature because full functionality of these two capabilities of the new missile has not been demonstrated in a realistic environment. If events occur that require the new capability, program officials believe the upgrades will perform as expected. Even without them, officials noted that the missile provides a credible defense against the Block 2004 threat set and some of the Block 2006 threat set. All drawings have been released to manufacturing. The program is not collecting statistical data on its production process of the Block 1A missile but is using other means to gauge production readiness.

Attainment of Product Knowledge



Aegis BMD Program

Technology Maturity

Program officials believe that all three technologies critical to the SM-3 Block 1A missile are mature. However, we believe that two of these critical technologies are less mature. The warhead's seeker has been fully demonstrated in flight tests and is mature. We believe two other technologies, which were upgraded to create the SM-3 Block 1A, are less mature: the Solid Divert and Attitude Control System (SDACS) and the Third Stage Rocket Motor. While some modes of these technologies have been demonstrated in flight tests, the "pulse mode" of the SDACS, which provides endgame divert for the kinetic warhead, and the "zero pulse mode" of the Third Stage Rocket Motor, which increases the missile's capability against shorter-range threats, have not been successfully flight-tested. The SDACS operation in pulse mode failed during a June 2003 flight test. According to program officials, the test failure was a result of multiple issues with the original design. The program has implemented changes to address these problems. While recent ground tests have demonstrated performance of the new configuration, the changes have not yet been flight tested. A flight test in December 2006 that would have partially demonstrated the pulse SDACS was not completed because the missile failed to launch. A flight test that will fully test the new SDACS design is not planned until 2008.

The Third Stage Rocket Motor is capable of three modes of operation, two of which have been added in Block 2006. While both new modes failed initial ground testing, one was later successfully flight tested in June 2006 after design changes. The second, zero pulse mode, has also undergone design changes. While program officials believe they have a working design and that the missile can use this mode if needed, it has not yet been flight-tested. The first flight-test that could demonstrate this capability is not scheduled until fiscal year 2009.

Design Stability

Program officials reported that the design for the SM-3 Block 1A missiles being produced during Block 2006 is stable with 100 percent of its drawings released to manufacturing. Although two upgrades to the SM-3 Block 1A missile have not been fully flight-tested, the program does not anticipate any additional design changes related to these upgrades.

Production Maturity

We did not assess the production maturity of the 22 SM-3 missiles being procured for Block 2006. Program officials stated that the contractor's processes are not yet mature enough to statistically track production processes. The Aegis BMD program is using other means to assess progress in production and manufacturing, such as tracking rework hours, cost of defects per unit, and other defect and test data.

Other Program Issues

The Aegis BMD element builds upon the existing capabilities of Aegis-equipped Navy cruisers and destroyers. Planned hardware and software upgrades to these ships will enable them to carry out the ballistic missile defense mission. In particular, the program is upgrading Aegis destroyers for long-range surveillance and tracking of intercontinental ballistic missiles. The program plans to complete the upgrade of 14 destroyers by the end of the Block 2006 period. In several events, this functionality has been successfully tested, but it has never been validated in an end-to-end flight test with the GMD system, for which it is providing long-range surveillance and tracking. Since our last assessment, Aegis BMD's planned budget through fiscal year 2009 increased by $362.4 million (4.2 percent), primarily in fiscal years 2008 and 2009.

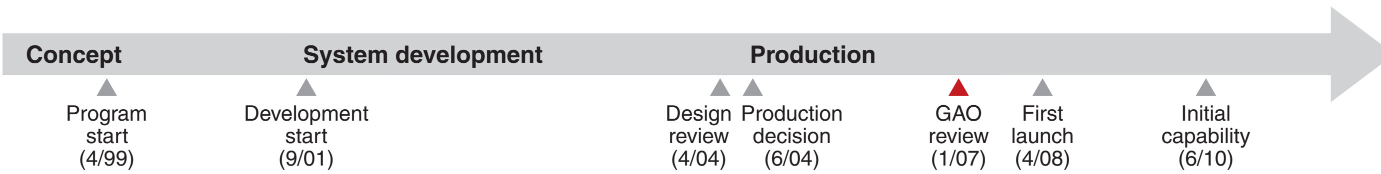
Agency Comments

The program office provided technical comments to a draft of this assessment, which were incorporated as appropriate.

Advanced Extremely High Frequency (AEHF) Satellites

The Air Force's AEHF satellite system will replenish the existing Milstar system with higher capacity, survivable, jam-resistant, worldwide, secure communication capabilities for strategic and tactical warfighters. The program includes satellites and a mission control segment. Terminals used to transmit and receive communications are acquired separately by each service. AEHF is an international partnership program that includes Canada, the United Kingdom, and the Netherlands. We assessed the satellite and mission control segments.

Source: Advanced EHF Program Office.



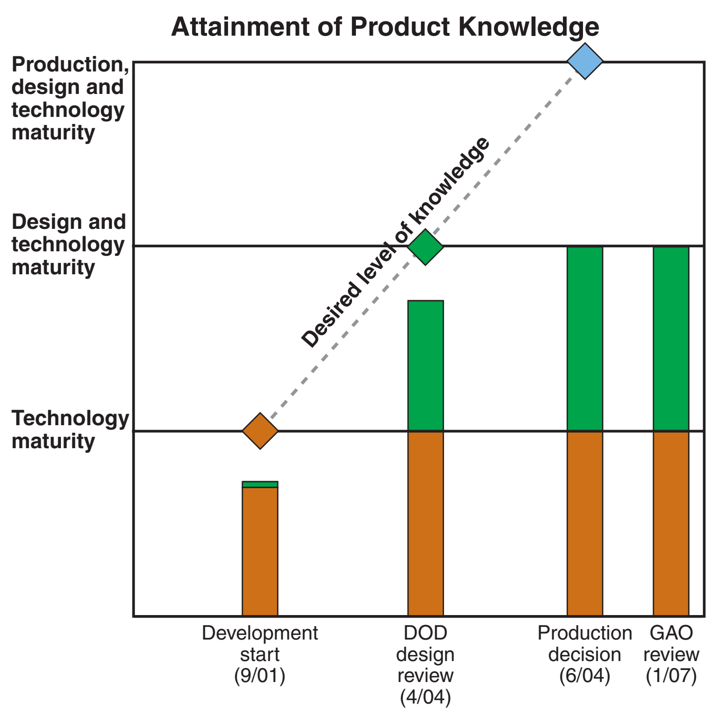
Program Essentials

Prime contractor: Lockheed Martin
Program office: El Segundo, Calif.
Funding needed to complete:
- R&D: $1,302.8 million
- Procurement: $76.3 million
- Total funding: $1,379.1 million
- Procurement quantity: 0

Program Performance (fiscal year 2007 dollars in millions)

	As of 10/2001	Latest 12/2005	Percent change
Research and development cost	$4,519.9	$5,588.0	23.6
Procurement cost	$1,336.8	$678.7	-49.2
Total program cost	$5,856.7	$6,266.7	7.0
Program unit cost	$1,171.333	$2,088.899	78.3
Total quantities	5	3	-40.0
Acquisition cycle time (months)	111	134	20.7

The AEHF program's technologies are mature and the design is stable. In late 2004, the program was delayed and restructured because key cryptographic equipment would not be delivered in time and to allow the program time to replace some critical electronic components and add testing. Schedule risk remained due to the continued concurrent development of two critical path items managed and developed outside the program. According to the program office, these issues have been resolved and the first satellite is entering into final integration and testing and is on schedule for first launch. Current plans are to meet full operational capability with three AEHF satellites and the first Transformational Satellite Communications System (TSAT) satellite.



AEHF Program

Technology Maturity

According to the program office, all of the 14 critical technologies are mature, having been demonstrated in a relevant environment. The technologies are being integrated into the first satellite and for final environmental testing.

Design Stability

AEHF's design is stable. All expected design drawings have been released. The program completed its system-level critical design review in April 2004.

Production Maturity

Production maturity could not be assessed, as the program office does not collect statistical process control data.

Other Program Issues

The program was restructured in October 2004, when the National Security Agency did not deliver key cryptographic equipment to the payload contractor in time to meet the launch schedule. The restructuring delayed the program 1 year to allow time to resolve the cryptographic delivery problems and other program issues including replacement of critical electronic components and additional payload testing. Resolving these issues added about $800 million to the program. Last year, we reported that the program still faced schedule risk due to concurrent development of two critical path items developed and managed outside the program: the cryptographic components developed and produced by the National Security Agency and the Command Post Terminal managed by another Air Force program office.

The program office reported all cryptographic hardware and components for the satellites were delivered, meeting all revised delivery milestones. In addition, the replacement of critical electronic components and additional payload testing was completed.

Since our assessment of the AEHF last year, the Command Post Terminal, a critical path item, was delayed. However, the program office will now use the test terminal that was originally built to provide end-to-end testing of the system to control the satellites. Program officials stated that utilizing the test terminal, developed by Lincoln Laboratories, will have no adverse schedule or operational impact on the satellites.

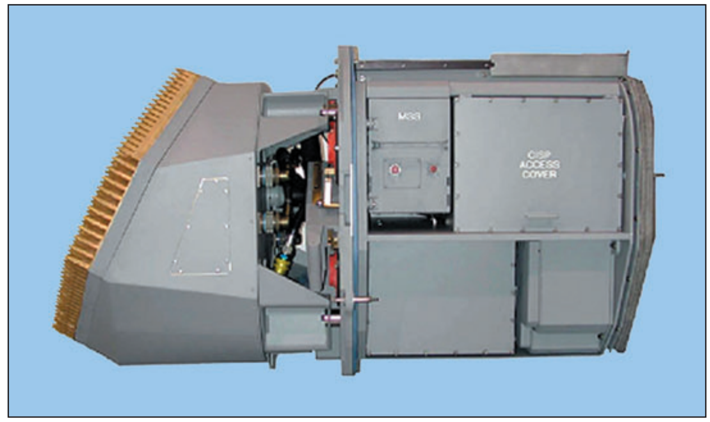
Program officials told us the mission control segment continues to meet or exceed its schedule and performance milestones. Three AEHF satellite launches are scheduled for 2008, 2009, and 2010 respectively. In the last year, the program completed most systems-level testing and started final integration and environmental testing on the first satellite. The program office stated that the program remains on schedule to meet the first launch date. The flight structure for the second satellite has been delivered for payload integration. The third satellite is on contract and includes procurement of long lead components. Full operational capability is planned with three AEHF satellites and the first TSAT.

Agency Comments

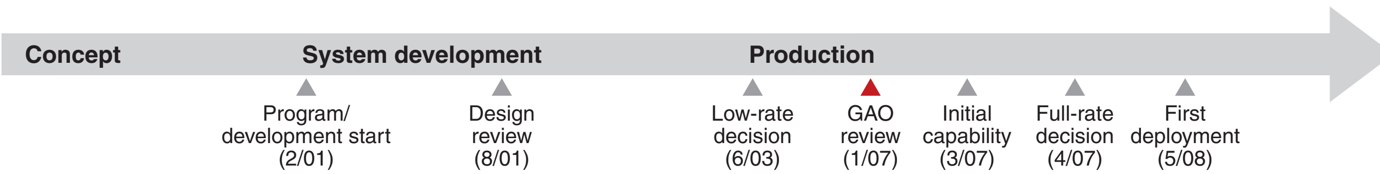
In commenting on a draft of this assessment, the Air Force stated that AEHF remains on track for a first launch date of April 2008 with events proceeding as expected in accordance with the December 2004 program replan. The Air Force further stated that the program is currently in fabrication and production of the first two satellites, and the third satellite will begin assembly, integration, and test in fiscal year 2009. It noted that the cryptographic chip development has remained on schedule since the January 2005 summit between the Air Force and the National Security Agency. In addition, the Air Force stated that all spacecraft flight cryptographic units were received on schedule and that chips for the ground terminals are due over the next couple of years to support terminal production schedules. Moreover, according to Air Force officials, DOD explored the option of adding a fourth AEHF satellite to mitigate the potential gap caused by schedule slips in the TSAT program, but decided to restructure the TSAT program baseline and not purchase a fourth AEHF satellite at this time.

Active Electronically Scanned Array Radar (AESA)

The Navy's AESA radar is one of the top upgrades for the F/A-18E/F aircraft. It is to be the aircraft's primary search/track and weapon control radar and is designed to correct deficiencies in the current radar. According to the Navy, the AESA radar is key to maintaining the Navy's air-to-air fighting advantage and will improve the effectiveness of the air-to-ground weapons. When completed, the radar will be inserted in new production aircraft and retrofitted into lot 26 and above aircraft.



Source: U.S. Navy.



Program Essentials

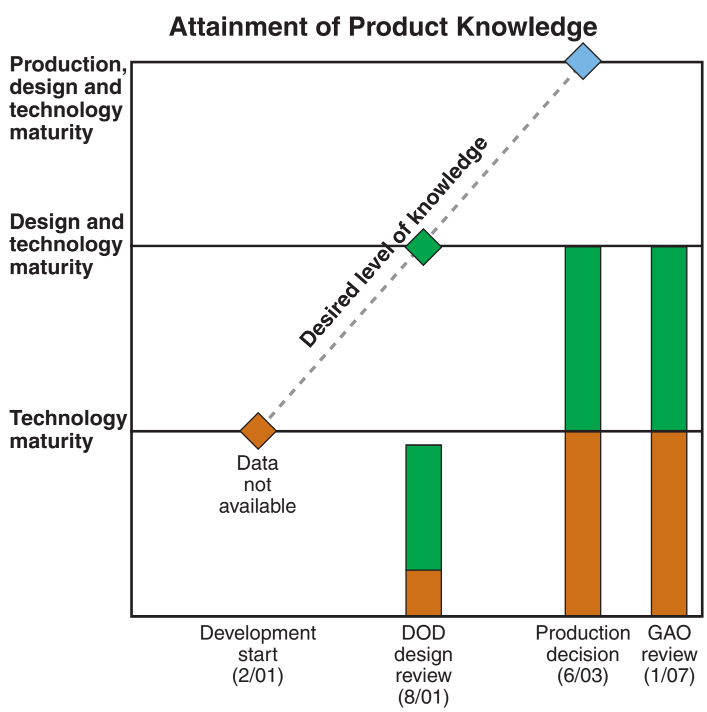
Prime contractor: McDonnell Douglas Corp.
Program office: Patuxent River, Md.
Funding needed to complete:
R&D: $9.1 million
Procurement: $1,310.6 million
Total funding: $1,319.7 million
Procurement quantity: 331

Program Performance (fiscal year 2007 dollars in millions)

	As of 02/2001	Latest 09/2006	Percent change
Research and development cost	$563.8	$627.7	11.3
Procurement cost	$1,809.0	$1,842.8	1.9
Total program cost	$2,372.8	$2,470.5	4.1
Program unit cost	$5.718	$5.953	4.1
Total quantities	415	415	0.0
Acquisition cycle time (months)	69	72	4.4

Procurement funding for the radar is included in the funding for the F/A-18E/F and EA-18G aircraft programs.

The AESA radar's critical technologies appear to be mature and the design appears stable, but radar development continues during production. According to the program office, there has been significant progress in radar maturation, performance, and stability. However, risks and problems remain. Software development continues to be a top challenge, and spurious radar emissions could require software and/or hardware changes. Development of design improvements is ongoing. The program also carries a challenging risk associated with the production rate. Although program costs appear somewhat stable, two key milestones—initial operational capability and full-rate production—have slipped by several months, and first deployment of the radar in a full squadron has been delayed by the carrier airwing schedule.



AESA Program

Technology Maturity
A fiscal year 2004 technology readiness assessment for the radar determined that the four critical technologies were mature. To further ensure technology maturity, a final technology assessment was held in November 2005. Program officials now consider critical technologies to work in their final form and under expected conditions.

Design Stability
Although the AESA design appears to be stable, development has continued during production. That development has been slowed by software immaturity, and the software has caused inconsistent radar performance. Several advanced radar capabilities were deferred to future software configurations, but program officials said it did not affect key performance parameters. Software hangups have forced radar restarts in each of the six AESA operational test aircraft. The problem is improving, but is still above the required rate.

Other deficiencies are being pursued, such as improving target breakout, track scheduling, and fault detection. Integrating AESA software capabilities and correcting deficiencies continue under a technical delivery order contract. Spurious radiated emissions may degrade performance of other subsystems, which could result in unacceptable weapon system performance. Redesign of radar modules and/or software changes may be required to reduce emissions. Officials said development of design improvements has been completed or is almost complete, but ongoing verification tests may require additional design changes.

Operational evaluation started later than planned due to delays in maturing air-to-air software, so it was not completed until November 2006, and the report is not expected until January 2007, resulting in a 5-month delay for initial operational capability. Follow-on tests are scheduled through fiscal year 2008 to test, for example, advanced air-to-air modes and integration with aircraft electronic warfare systems. Unsatisfactory results could result in system software changes.

Development of the radar's anti-tamper capability is on schedule according to officials. Operational testing of this capability is to be completed in fiscal year 2008. While the anti-tamper capability is required to have no effect on radar performance, operational tests of anti-tamper models may identify problems requiring design changes. By then, about 116 radars are to have been produced.

Production Maturity
We could not assess production maturity because statistical process control data are not being collected. Manufacturing processes continue to be monitored and controlled at each manufacturing center and laboratory. Twenty percent of the 415 radars have been approved for production now that the fourth and final low-rate production has been approved. Most of the 415 radars will be installed in F/A-18E/Fs on the aircraft production line, but 135 radars are to be retrofitted into existing aircraft. As of November 2006, 24 radars had been delivered and installed in aircraft. Long-lead funding for full production has been approved, but due to the testing delay, full-rate production has slipped by 3 months. The program has a challenging production risk. On-time delivery of radars is risky for the fourth low-rate production lot because production must increase from 2 to 4 radars per month, retrofit radars begin in fiscal year 2008, and foreign military sales follow. Thus, on-time delivery of aircraft could be affected by missing or late radars.

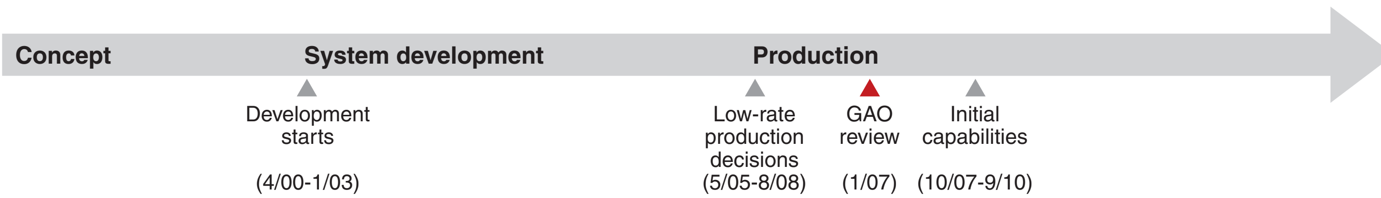
Other Program Issues
The first deployment of AESA radars in a full squadron has been delayed by 6 months due to a Navy decision on the carrier airwing schedule, not AESA problems, according to officials.

Agency Comments
In commenting on a draft of this assessment, the Navy stated AESA software development continues in a spiral fashion during production as planned. Operational evaluation was completed in December 2006 and is expected to support initial operational capability in March 2007 and full-rate production in April 2007, both within thresholds. Due to schedule delays, some advanced radar capabilities were deferred, as approved. Many of the deferred items for most of the deficiencies identified during operational evaluation have been incorporated in the next aircraft software build, and will undergo operational tests prior to first system deployment in 2008. Final advanced capabilities will be incorporated in the following year.

Airborne Mine Countermeasures (AMCM)

The Navy is developing new Airborne Mine Countermeasures (AMCM) systems that will be fielded with aircraft mission kits on MH-60S Block 2 helicopters. Together, these systems will provide carrier strike groups and expeditionary strike groups with organic airborne mine countermeasures capability. To successfully field this capability, the Navy must develop, test, and integrate 5 new mine countermeasures systems with a modified MH-60S airframe. We assessed the Navy's progress in developing the mine countermeasures systems.

Source: Naval Surface Warfare Center Panama City (PMA-299).



Program Essentials

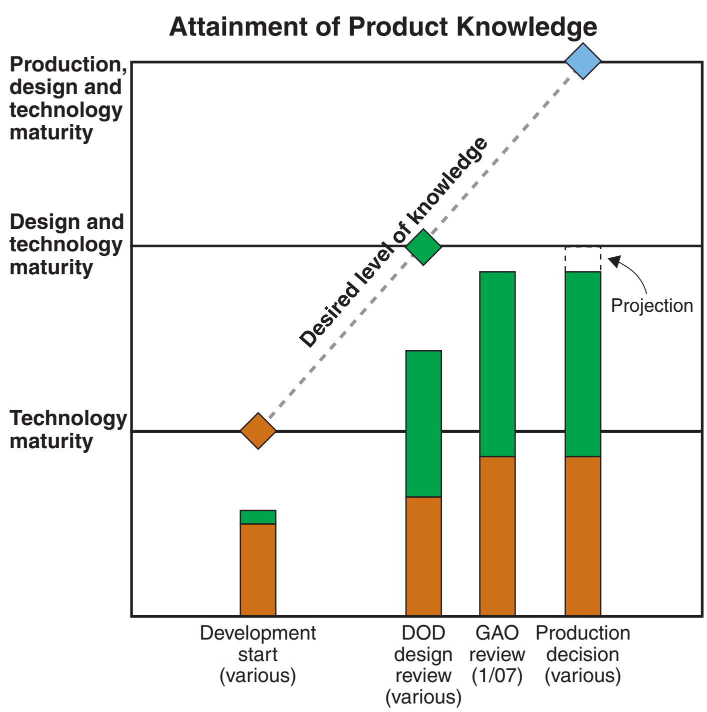
Prime contractor: Arete Associates, Boeing, EDO Defense Systems, Northrop Grumman, Raytheon
Program office: Washington, D.C.
Funding needed to complete:
R&D: $156.7 million
Procurement: $353.0 million
Total funding: $526.9 million
Procurement quantity: 77

Program Performance (fiscal year 2007 dollars in millions)

	As of (various)	Latest 01/2007	Percent change
Research and development cost	$444.9	$589.9	32.6
Procurement cost	$1,067.9	$699.5	-34.5
Total program cost	$1,522.9	$1,298.2	-14.8
Program unit cost	NA	NA	NA
Total quantities	231	144	-37.7
Acquisition cycle time (months)	NA	NA	NA

Costs and quantities are for the AN/AQS-20A Mine Detecting Sonar, Airborne Laser Mine Detection System, Organic Airborne and Surface Influence Sweep System, Rapid Airborne Mine Clearance System, and Airborne Mine Neutralization System.

The MH-60S Block 2 AMCM helicopter will rely upon 5 new mine countermeasures systems, the AN/AQS-20A Mine Detecting Sonar, Airborne Laser Mine Detection System, Organic Airborne and Surface Influence Sweep System, Rapid Airborne Mine Clearance System, and Airborne Mine Neutralization System. The Navy has not yet fully matured technologies for 3 of these systems, although it asserts a high degree of design stability in these programs. However, if technologies do not mature as planned, design changes for the affected systems may be required. In addition, the Navy is not collecting statistical process control data for the 2 systems in production, preventing us from assessing production maturity. The achievement of key product knowledge shown is for the Organic Airborne and Surface Influence Sweep System, Rapid Airborne Mine Clearance System, and Airborne Mine Neutralization System.



AMCM Program

Technology Maturity

Thirty-three of the 38 critical technologies comprising the 5 MH-60S mine countermeasures systems are fully mature, and the remaining five technologies are approaching maturity. Technologies supporting the AN/AQS-20A Mine Detecting Sonar and the Organic Airborne and Surface Influence Sweep System are all fully mature. However, the Airborne Laser Mine Detection System and the Rapid Airborne Mine Clearance System each have one immature technology, while the Airborne Mine Neutralization System has three technologies that have not been fully matured.

The Airborne Laser Mine Detection System is currently in production. This system detects, classifies, and localizes floating and near surface moored mines by firing a laser into the water and using cameras to capture water reflections to create images. One technology that enables this process is the system's active pixel sensor, which the Navy has not fully matured. Although the Navy has identified a mature backup technology for the active pixel sensor that will be used in the event problems are discovered during testing, this alternative will impose schedule delays upon the program as it will require integration into the existing system design.

The Rapid Airborne Mine Clearance System is currently in development, with initial production planned for August 2008. This system will use a 30 millimeter gun and targeting sensor to neutralize near-surface and surface (floating) moored mines. One technology critical to achieving full functionality of this system is its fire control system, which the Navy is still developing. The Navy plans to test the fire control system in a relevant environment in the second quarter of fiscal year 2007.

The Airborne Mine Neutralization System is currently in development and is scheduled to enter production in June 2007. This system will provide the capability to neutralize bottom and moored mines using an airborne delivered expendable mine neutralization device. The Navy has fully matured this system's neutralizer technology, and is approaching full maturity with its launch and handling subsystem, deployment subassembly, and warhead assembly technologies.

Design Stability

All 5 of the MH-60S mine countermeasures systems have completed design readiness reviews. To date, 98 percent of design drawings have been released for these systems, and the Navy anticipates that only the Airborne Mine Neutralization System and the Airborne Laser Mine Detection System will require completion of additional drawings. While the Navy considers the design for the Rapid Airborne Mine Clearance System to be complete, if this system's fire control system technology does not mature as planned, design changes could be required.

Production Maturity

Both the AN/AQS-20A Mine Detecting Sonar and Airborne Laser Mine Detection System are currently in production. Currently, the Navy is not collecting statistical process control data for these systems—an approach it attributes to the limited number of initial production units being procured. Consequently, we could not assess production maturity for either the AN/AQS-20A Mine Detecting Sonar or the Airborne Laser Mine Detection System.

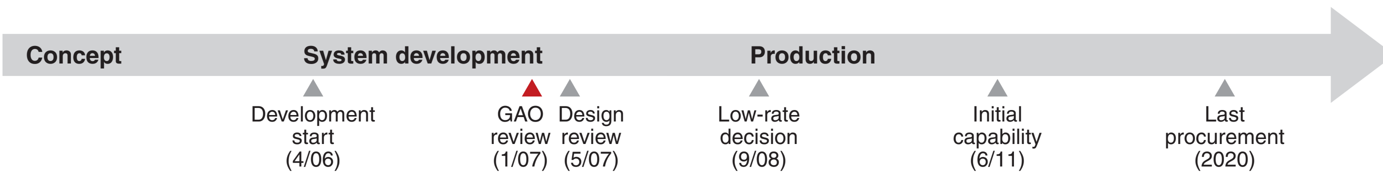
Agency Comments

In commenting on a draft of this assessment, the Navy provided technical comments, which were incorporated as appropriate.

Advanced Precision Kill Weapon System (APKWS) II

The Army's APKWS II is a precision-guided, air-to-surface missile designed to engage soft and lightly armored targets. The system is intended to add a new laser-based seeker to the existing Hydra 70 Rocket System and is expected to provide a lower cost, accurate alternative to the Hellfire missile. Future block upgrades are planned to improve system effectiveness. We assessed the laser guidance technology used in the new seeker.

Source: APKWS II Program Office, BAE Systems.



Program Essentials

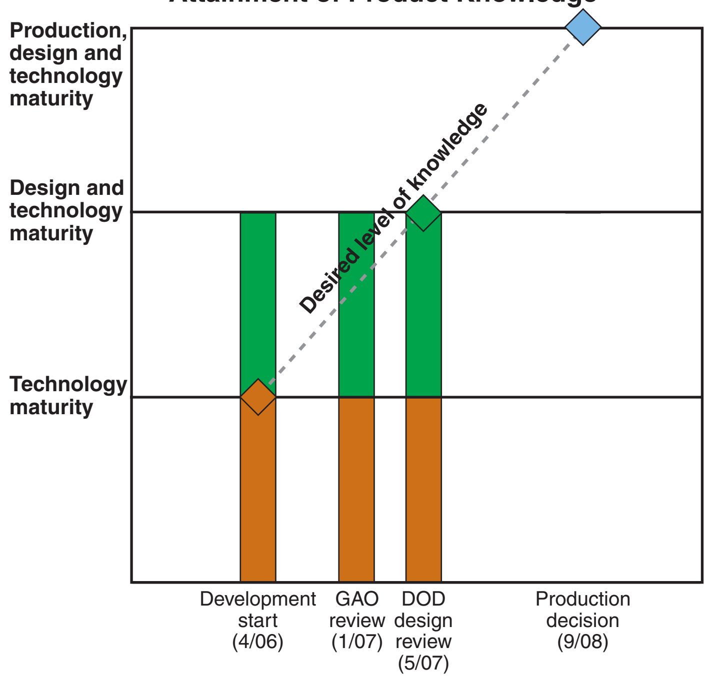
Prime contractor: BAE Systems
Program office: Huntsville, Ala.
Funding needed to complete:
R&D: $182.5 million
Procurement: $1,296.6 million
Total funding: $1,479.1 million
Procurement quantity: 71,565

Program Performance (fiscal year 2007 dollars in millions)

	As of 04/2006	Latest 08/2006	Percent change
Research and development cost	$208.4	$208.4	0.0
Procurement cost	$1,296.6	$1,296.6	0.0
Total program cost	$1,505.0	$1,505.0	0.0
Program unit cost	$.021	$.021	0.0
Total quantities	71,637	71,637	0.0
Acquisition cycle time (months)	62	62	0.0

The APKWS II program entered system development with its one critical technology mature and its design stable. Since our previous assessment, the Army restructured the program and, in April 2006, awarded a 2-year, $41.9 million system development and demonstration contract for the new APKWS II program. Last year, we reported that the combination of a number of problems, including the placement of the laser seeker on the fins rather than in the head of the missile, led to the Army's curtailment of the original APKWS contract in January 2005. Although the APKWS II laser guidance technology appears mature, its integration on the missile's fins still presents a risk since this design is essentially the same as the original APKWS. Due to funding uncertainty, the schedule for the design review slipped from June 2006 to May 2007 and flight tests were delayed from August 2006 to January 2007.

Attainment of Product Knowledge



APKWS II Program

Technology Maturity

Program officials consider the one APKWS critical technology, laser guidance, to be mature. However, on the original APKWS program, integration of the laser seeker and guidance proved to be more problematic than originally estimated, and this difficulty contributed to contract curtailment and program restructuring. The Army restructured the program under the same set of key performance parameters and, in April 2006, awarded the APKWS II contract to one of the original program participants using the same laser seeker and guidance technology as in the original program. According to program officials, the contractor funded its own work on the revised APKWS II during the 15-month period between the original program curtailment and contract award for the follow-on program. The contractor's effort focused on the problems that plagued the original program. Program officials stated that during the interim 15-month period, the contractor successfully addressed the original APKWS problems and also conducted three successful missile flights.

Design Stability

The number of engineering drawings increased from 115 to 160 from the original APKWS to the APKWS II program. According to program officials, the drawings now include guidance and telemetry section drawings. Program officials expect to have all the engineering drawings released by the design review in May 2007. Due to funding uncertainty, the system critical design review slipped from June 2006 to May 2007.

Production Maturity

According to program officials, key manufacturing processes have not yet been determined. However, officials stated that statistical process control will be employed and all key manufacturing processes will be placed under control during low-rate initial production.

Other Program Issues

Program officials expected to hold the APKWS II system critical design review in June 2006 and flight tests in August 2006. However, funding uncertainty has caused those schedules to slip. The Army requested that some of the procurement money originally slated for the first APKWS be reprogrammed to support the development of APKWS II. This request was followed by two additional requests from the Army to reprogram money from another source. However, Congress has not yet approved any reprogramming requests for APKWS II. Subsequently, in June 2006, the Army directed the prime contractor to take actions to manage the contract within current funding constraints and to execute the contract through November 2006 with existing funding. That has caused the schedule for the design review to slip to May 2007 and the flight test to January 2007. Due to the uncertainty of future funds, APKWS II program officials predict further schedule slippages and subsequent increased program costs related to replanning activities.

Agency Comments

In commenting on a draft of this assessment, program officials stated that having a design with the laser seeker on the wings was not an issue that led to the Army's curtailment of the original APKWS contract. Program officials further noted that this design presents no major difficulties to the ongoing integration of the APKWS laser seeker and guidance section into the Hydra-70 Rocket components. They believe the placement of the laser seeker provides significant advantages during extreme environmental operations and adjacent rocket firings. Also, program officials noted that the lack of required funding in fiscal years 2006 and 2007 resulted in moving the first flight to January 2007 and the design review to May 2007. Finally, they stated that efforts are ongoing to establish a revised, realistic baseline within current funding constraints and that they are confident the revised cost and schedule will not breach the current Acquisition Program Baseline.

The Army also provided technical changes, which were incorporated as appropriate.

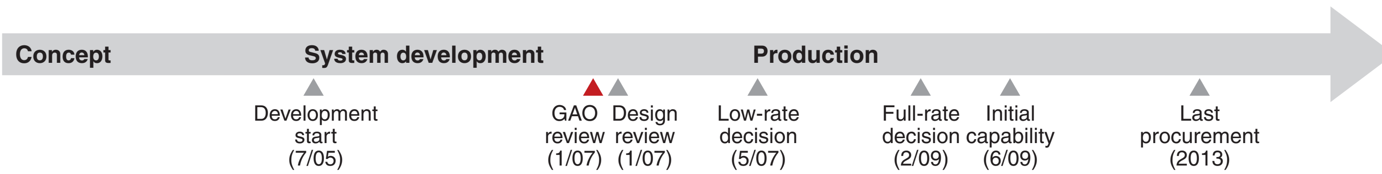
GAO Comments

Our prior work has shown that the placement of the laser seeker on the fins rather than in the head of the missile was problematic for the original APKWS program. The integration difficulty contributed to the cost overrun and protracted schedule, which subsequently led to program curtailment and restructuring.

Armed Reconnaissance Helicopter (ARH)

The Army's ARH is expected to provide reconnaissance and security capability for air and ground maneuver teams. The ARH combines a modified off-the-shelf airframe with a nondevelopmental item mission equipment package and is replacing the OH-58D Kiowa Warrior fleet. A streamlined acquisition strategy was proposed for the ARH program, as it will be fielded to support current military operations.

Source: ARH Prototype #1 Flight Testing at Bell Helicopter, ©2006 Bell Helicopter, A Textron Company.



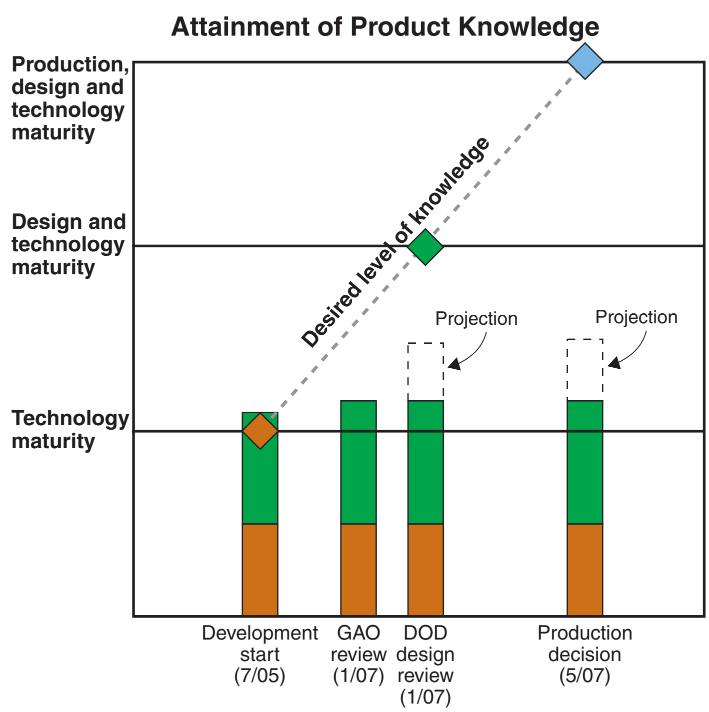
Program Essentials

Prime contractor: Bell Helicopter Textron, Inc.
Program office: Huntsville, Ala.
Funding needed to complete:
- R&D: $224.2 million
- Procurement: $2,911.4 million
- Total funding: $3,135.6 million
- Procurement quantity: 368

Program Performance (fiscal year 2007 dollars in millions)

	As of 07/2005	Latest 08/2006	Percent change
Research and development cost	$375.9	$398.4	6.0
Procurement cost	$2,923.0	$2,911.4	-0.4
Total program cost	$3,298.9	$3,309.8	0.3
Program unit cost	$8.964	$8.994	0.3
Total quantities	368	368	0.0
Acquisition cycle time (months)	47	47	0.0

The ARH program began system development without designating any technologies as critical. Since then, the program has identified two critical technologies—the sensor package and the engine—both of which are approaching full maturity. The ARH program is scheduled to hold its critical design review in January 2007, and it is not certain that the critical technologies will be mature by that time. The program has mandated that 85 percent of the drawings be released by the design review. About 88 percent have been released to date. The Army does not plan to collect statistical process control data in preparation for the production decision scheduled for May 2007. Rather, the Army will evaluate ARH's engineering and manufacturing readiness levels. Further, the Army's oversight of ARH may be compromised due to the decertification of the prime contractor's earned value management system.



ARH Program

Technology Maturity

The ARH program had not designated any technologies as critical at the time of development start. However, in October 2005 (90 days after contract award), two technologies were determined to be critical. Both technologies, the sensor package and the engine, are approaching full maturity. Although the sensor is a derivative of a currently fielded and flying system, it contains some updated components. The sensor was tested earlier this year in a prototype configuration and improvements are currently being incorporated into the design. The system will be retested in late calendar year 2006. The engine has recently completed the compressor rig test, the results of which will be critical in reducing the risk of the engine and increasing the maturity level. However, the program office is unsure if these technologies will be fully mature by critical design review, scheduled for January 2007.

Design Stability

According to the program office, the ARH is a limited design effort and will take an off-the-shelf aircraft and convert it to military use by incorporating existing military and commercial equipment. The ARH program office has imposed a critical design review entrance criterion of 85 percent drawing release. The review, currently scheduled for January 2007, will not be held until this entrance criterion is satisfied. Currently, the program has released 88 percent of the drawings.

Production Maturity

We could not assess production maturity because, according to the program office, it does not plan to collect statistical process control data. However, the program office stated that production is managed through the use of engineering and manufacturing readiness levels (EMRLs).To determine production capability, the ARH program stated it will conduct a production readiness review (including an assessment of the EMRL), review facility plans and limited tooling development, conduct an operations capacity analysis, and assess lean manufacturing initiatives such as design for six sigma. In addition, the program office stated that the production status of the ARH program will be evaluated by tracking the cost of repairs and rework.

Other Program Issues

In March 2006, the lead contractor lost its earned value management certification due to a recent compliance review that found lack of progress in addressing long-standing systemic deficiencies. Without certified earned value management data, the Army will not have timely information on the contractor's ability to perform work within estimated cost and schedule. According to the program office, the contractor did not make its first milestone detailed in the Defense Contract Management Agency's corrective action plans in efforts to obtain earned value compliance. Still, the contractor plans to be compliant by the end of August 2007, 3 months after ARH low-rate initial production is scheduled to begin.

According to program officials, the Army plans to start low-rate production in May 2007 and procure two lots of 18 and 20 to conclude in May 2008. However, the Army does not plan to start full-rate production until February 2009. This schedule creates a 10-month production break between low-rate initial production and full-rate production. During the production break, the program plans to purchase development and production needs such as support equipment, pilot and maintenance trainers, and spares. Further, according to program officials, the budget reduction of $39 million in fiscal year 2007 exacerbates the break issue which could be very disruptive. The program office's proposed solution to the production break is to increase low-rate production, but this would have to be approved by the Under Secretary of Defense for Acquisition, Technology, and Logistics. Another possible solution could be to extend low-rate production to three lots, as opposed to two, which would help the program ramp up production and fill the 10-month production break.

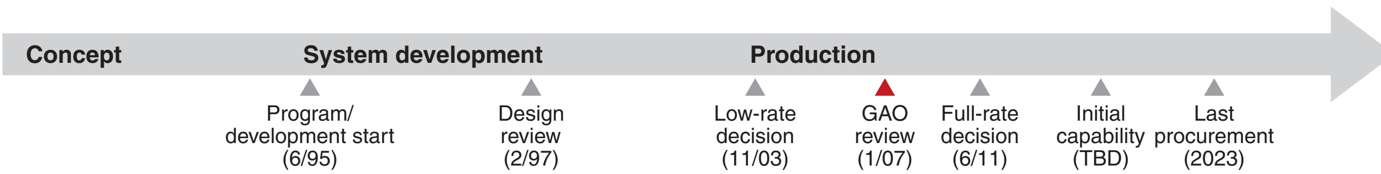
Agency Comments

In commenting on a draft of this assessment, the Army provided technical comments, which were incorporated where appropriate.

Advanced Threat Infrared Countermeasure/Common Missile Warning System

The Army's and Special Operations' ATIRCM/CMWS is a component of the Suite of Integrated Infrared Countermeasures planned to defend U.S. aircraft from advanced infrared-guided missiles. The system will be employed on Army and Special Operations aircraft. ATIRCM/CMWS includes an active infrared jammer, missile warning system, and countermeasure dispenser capable of loading and employing expendables, such as flares, chaff, and smoke.

Source: BAE Systems.



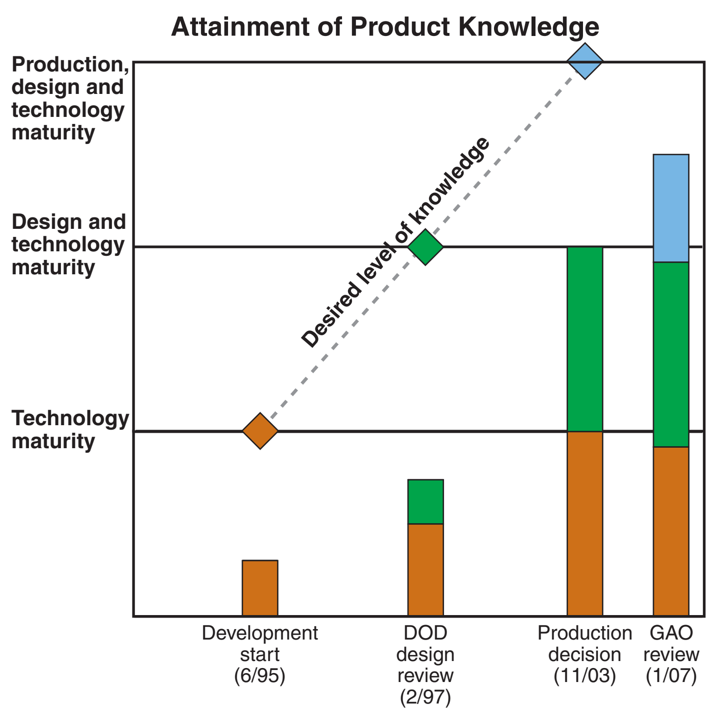
Program Essentials

Prime contractor: BAE Systems North America
Program office: Huntsville, Ala.
Funding needed to complete:
- R&D: $62.9 million
- Procurement: $3,525.3 million
- Total funding: $3,588.2 million
- Procurement quantity: 2,351

Program Performance (fiscal year 2007 dollars in millions)

	As of 03/1996	Latest 08/2006	Percent change
Research and development cost	$616.6	$673.2	9.2
Procurement cost	$2,521.8	$4,373.6	73.4
Total program cost	$3,138.4	$5,046.8	60.8
Program unit cost	$1.014	$1.406	38.6
Total quantities	3,094	3,589	16.0
Acquisition cycle time (months)	Classified	Classified	Classified

The ATIRCM/CMWS program entered production in November 2003 with technologies mature and designs stable. However, one of the five critical technologies was recently downgraded due to continued technical difficulties. Currently, the program's production processes are at various levels of control. The CMWS portion of the program entered limited production in February 2002 to meet urgent deployment requirements. However, full-rate production for both components was delayed because of reliability problems. Over the past several years, the program has had to overcome cost and schedule problems brought on by shortfalls in knowledge. Key technologies were demonstrated late in development, and only a small number of design drawings were completed by design review.



ATIRCM/CMWS Program

Technology Maturity

The program's five critical technologies were considered mature until a government/industry team recently downgraded the maturity level of the infrared jamming head due to technical issues. Additionally, the other four technologies did not mature until after the design review. Most of the early technology development effort focused on the application to rotary wing aircraft. When system development began in 1995, requirements were expanded to include Navy and Air Force fixed-wing aircraft. This change caused problems that contributed to cost increases of over 150 percent. The Navy and the Air Force subsequently dropped out of the program, but the Navy and the Army are currently pursuing future joint production planning.

Design Stability

The basic design of the system is complete with 100 percent of the drawings released to manufacturing. The design was not stable at the time of the design review, with only 22 percent of the drawings complete due to the expanded requirements. Two years after the design review, 90 percent of the drawings were released and the design was stable. This resulted in inefficient manufacturing, rework, additional testing, and a 3-year schedule delay. However, the number of drawings may be changing because the infrared jam laser and the infrared lamp will be replaced with a multi-band laser.

Production Maturity

According to program officials, the program has 26 key manufacturing processes in various phases of control. The CMWS production portion of the system has stabilized and benefited from increased production rates. Also, processes supporting both ATIRCM and CMWS will continue to be enhanced as data is gathered and lessons learned will be included in the processes.

The Army entered limited CMWS production in February 2002 to meet an urgent need. Subsequently, full rate production was delayed for both components due to reliability testing failures. The program implemented reliability fixes to six production representative subsystems for use in initial operational test and evaluation. These systems were delivered in March 2004. The full-rate production decision for the complete system was delayed until June 2011 due to ATIRCM performance issues.

Other Program Issues

The Army uses the airframe as the acquisition quantity unit of measure even though it is not buying an ATIRCM/CMWS system for each aircraft. When the program began, plans called for putting an ATIRCM/CMWS on each aircraft. Due to funding constraints, the Army reduced the number of systems to be procured and will rotate the systems to aircraft as needed. The Army is buying kits for each aircraft, which include the modification hardware, wiring harness, and cables necessary to install and interface the ATIRCM/CMWS to each platform. In May 2006, the quantity of ATIRCM/CMWS systems was increased from 1,710 to 2,752, and kits to use for aircraft integration was increased from 3,571 to 4,393. However, a new cost estimate for the additional systems has not been completed. Based on the number of systems before the May 2006 increase, the true unit procurement cost for each ATIRCM/CMWS system is more on the order of $2.95 million.

Agency Comments

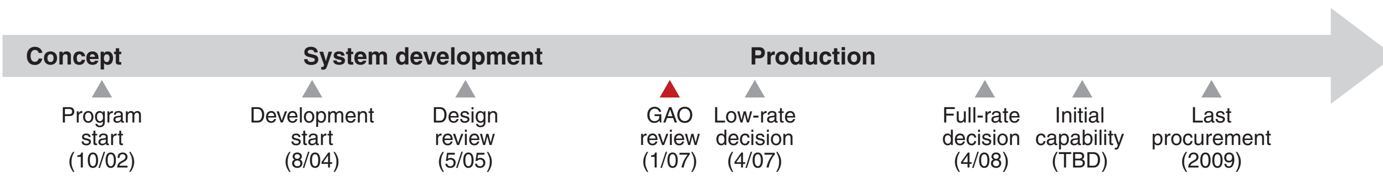
In commenting on a draft of this assessment, the Army stated that the ATIRCM/CMWS program continues to focus efforts on the Global War on Terrorism force protection requirements. In response to an Acting Secretary of the Army November 2003 memo to equip all Army helicopters to be deployed to the war zone with the most cost-effective defensive systems, the program office proposed accelerating the CMWS portion of ATIRCM. In July 2006, the CMWS was provided to each deployed aircraft with CMWS installation kits. These accelerated efforts provided the CMWS ahead of the planned schedule (February 2007). CMWS initial operational test and evaluation and full-rate production decision events were successfully completed during this reporting period.

The Army also stated that the ATIRCM funding was utilized to maintain the CMWS acceleration due to delays in receipt of reprogramming funding. The rebaselined ATIRCM program efforts are now continuing, with initial operational test and evaluation planned for November 2009. This rebaselined plan was presented and approved by the Army Acquisition Executive in December 2005.

B-2 Radar Modernization Program (B-2 RMP)

The Air Force's B-2 RMP is designed to modify the current radar system to resolve potential conflicts in frequency band usage. To comply with federal requirements the frequency must be changed to a band where the DOD has been designated as the primary user. The modified radar system is being designed to support the B-2 stealth bomber and its combination of stealth, range, payload, and near-precision weapons delivery capabilities.

Source: U.S. Air Force, U.S. Edwards Air Force Base, California.



Program Essentials

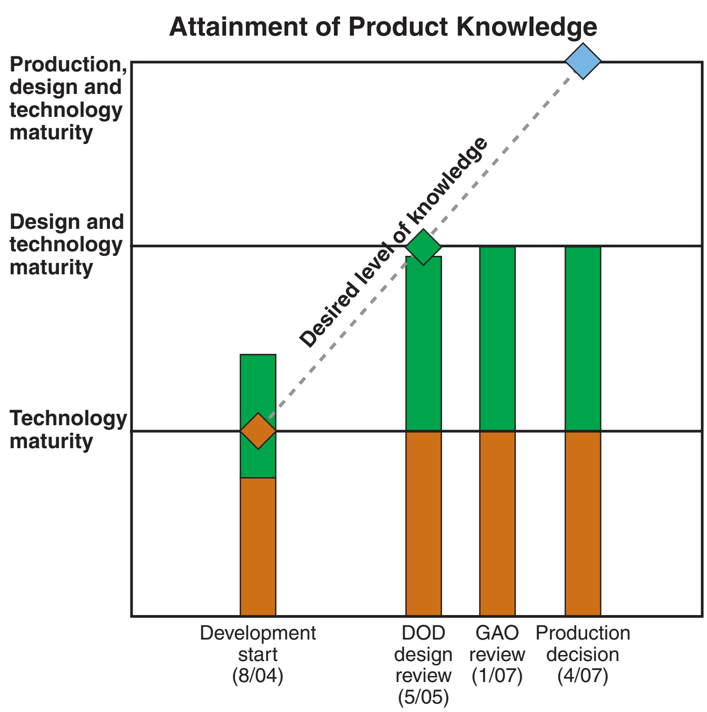
Prime contractor: Northrop Grumman
Program office: Dayton, Ohio
Funding needed to complete:
- R&D: $202.1 million
- Procurement: $545.4 million
- Total funding: $747.6 million
- Procurement quantity: 14

Program Performance (fiscal year 2007 dollars in millions)

	As of 08/2004	Latest 08/2006	Percent change
Research and development cost	$694.0	$607.9	-12.4
Procurement cost	$542.8	$545.4	0.5
Total program cost	$1,236.7	$1,153.4	-6.7
Program unit cost	$58.890	$54.921	-6.7
Total quantities	21	21	0.0
Acquisition cycle time (months)	63	TBD	TBD

The total quantity of 21 units includes 14 to be bought with procurement funds and 7 to be bought with R&D funds. All 21 units will eventually be placed on operational B-2 aircraft.

All four of the B-2 RMPs critical technologies are considered mature and 100 percent of the design drawings have been released. Production maturity metrics will be formulated as part of a production readiness review prior to the April 2007 start of production. However, the first of two radar antenna software sets will not complete operational testing until 2008. Further, the program will not begin tracking the radar's operational reliability until early 2007. Recent program flight-testing delays may lead to a delay in the planned start of production. Also, six operational B-2s will receive development radar units prior to the completion of flight testing. These units are necessary to obtain reliability and maintainability data and for crew training, but building them early in development may add to the risk of future design changes.



B-2 RMP Program

Technology Maturity

All four B-2 RMP critical technologies were considered mature at the design review in May 2005. While the program entered development in August 2004 with two of these four critical technologies mature and two approaching maturity, the receiver/exciter for the electronic driver cards and aspects of the antenna designed to help keep the B-2's radar signature low, all four are now considered mature.

Design Stability

The program currently has released 100 percent of its drawings and plans to maintain this 100 percent level by the planned start of production in April 2007. The program, however, does not use the release of design drawings as the sole measure of design stability but instead uses the successful completion of design events, such as subsystem design reviews, as its primary measure of design stability. The program has completed its design readiness review and at that time had released 85 percent of its design drawings.

Production Maturity

The program does not use manufacturing process control data as the sole measure of production maturity because of the small number of production units. However, the program has identified one key process related to the assembly of the radar antenna array. Instead of using manufacturing process control data, the program plans to formulate other metrics to measure progress toward production. The program plans to use these other metrics as part of a production readiness review prior to the start of production in April 2007.

The program plans to enter production in April 2007 and procure four radars at a cost of $160.7 million. However, recent flight-testing delays may lead to a reconsideration of April 2007 as the start of production and it will not be until the beginning of fiscal year 2008 when radar flight-testing has progressed to the point that the first of two planned radar antenna software sets are fully tested and certified. Furthermore, the program does not plan to track the operational reliability of the radar until January 2007. Also, an operational assessment of the radar was delayed from March 2006 to early 2007. This is an important schedule event leading up to production and its delay will impact when information will be available leading up to the start of production. Producing units before testing is able to demonstrate the design is mature and works in its intended environment increases the likelihood of future costly design changes.

The program plans to build six radar units during development to be used on B-2 aircraft to gather developmental reliability and maintainability data and provide for crew training and proficiency operations when the legacy radar frequency is no longer available. Last year, the Air Force plan was for six of these radar units to be placed on B-2 aircraft for this purpose, but because some B-2s are needed for other operations and will not be available, only two operational aircraft will initially be fitted with the new radars, with the remaining four to be fitted later in 2007. The Air Force and prime contractor have determined this will not affect training but will mean less radar reliability and maintainability data will initially be collected for analysis.

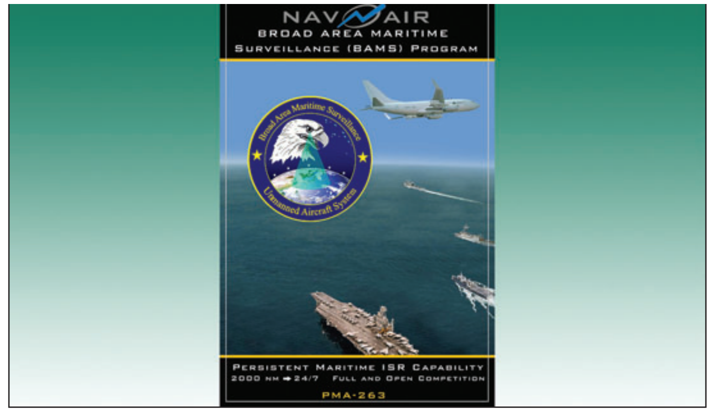
Agency Comments

The Air Force agrees that producing radar units before testing has been completed does increase the risk of future potentially costly design changes. However, they have decided the risk is low compared to the benefits gained by having operational production units in place to meet requirements.

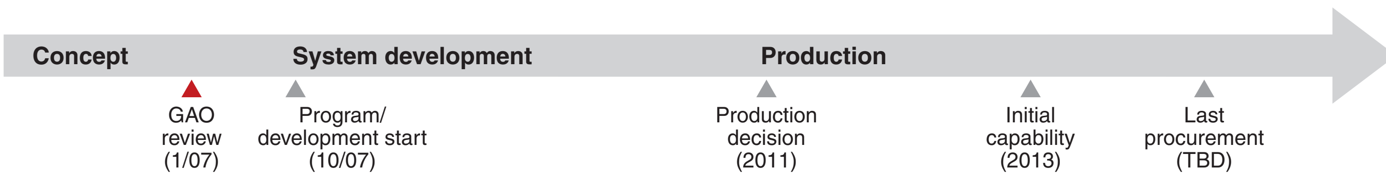
The Air Force also provided technical comments, which were incorporated as appropriate.

Broad Area Maritime Surveillance (BAMS)

The Navy's Broad Area Maritime Surveillance Unmanned Aircraft System (BAMS UAS) is to provide a persistent maritime intelligence, surveillance, and reconnaissance (ISR) capability. Along with the Multi-mission Maritime Aircraft and Aerial Common Sensor, BAMS UAS will be part of a broad area maritime surveillance family of systems integral to the Navy's recapitalization of its Maritime Patrol and Reconnaissance Force. DOD is negotiating international participation in the program.



Source: D.P. Associates, Inc./ Andrew Kirschbaum.



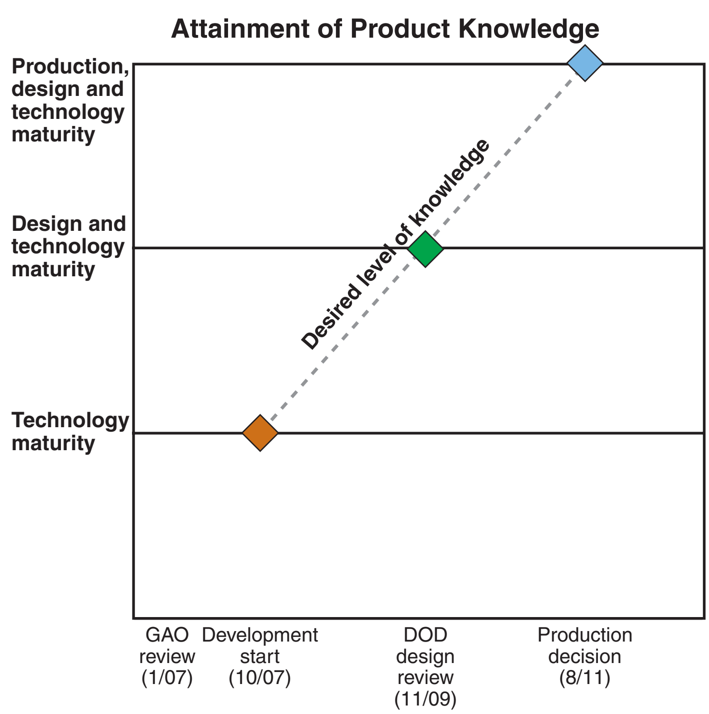
Program Essentials

Prime contractor: TBD
Program office: Patuxent River, Md.
Funding needed to complete:
- R&D: $779.3 million
- Procurement: $310.9 million
- Total funding: $1,190.7 million
- Procurement quantity: 4

Program Performance (fiscal year 2007 dollars in millions)

	As of NA	Latest 08/2006	Percent change
Research and development cost	NA	$819.6	NA
Procurement cost	NA	$310.9	NA
Total program cost	NA	$1,230.9	NA
Program unit cost	NA	TBD	NA
Total quantities	NA	TBD	NA
Acquisition cycle time (months)	NA	70	NA

The BAMS UAS program plans to begin system development in October 2007. The program previously planned to reach system development during the first quarter of fiscal year 2005. However, the Navy did not allocate funds to the program for fiscal year 2006, which delayed development start to 2007 and postponed the initial operational capability from fiscal year 2010 to 2013. Program officials have not currently identified any critical technologies, but contractor proposals will be required to identify critical technologies during the source selection period from April to September 2007. The program plans to conduct a technology readiness assessment in parallel with source selection and anticipates results by August 2007. According to program officials, each critical technology must be approaching maturity and demonstrated in a relevant environment prior to development contract award.



BAMS Program

Technology Maturity

BAMS UAS is taking steps to evaluate technologies prior to the start of program development. The Navy awarded four contracts using a broad agency announcement in conjunction with its Persistent Unmanned Maritime Airborne Surveillance (PUMAS) effort to engage industry in support of developing unmanned ISR mission performance metrics and capabilities within a family of systems as well as to gain insight into the state of industry research and technology. BAMS UAS has received the study results and is in the process of using the information to develop technical baselines and assess program risks. In addition, the Navy has acquired 2 Global Hawk Maritime Demonstration (GHMD) UAS to provide a rapid technology demonstration capability. GHMD data and test results are being used to refine BAMS UAS doctrine, concept of operations, tactics, techniques, and procedures.

Program officials have not currently identified any critical technologies, but contractor proposals will be required to identify critical technologies during the source selection, period from April to September 2007. According to program officials, critical technologies must be approaching maturity and demonstrated in a relevant environment prior to the start of development in October 2007.

Other Program Issues

As one component of a family of systems, BAMS UAS is intended to serve as an adjunct to the Multi-mission Maritime Aircraft (MMA). The program intends to colocate BAMS UAS mission crews with Maritime Patrol and Reconnaissance (MPR) Forces to allow operators to closely coordinate missions and utilize common support infrastructure. BAMS UAS will share its persistent intelligence, surveillance, and reconnaissance role with MMA. If the BAMS UAS does not develop as planned or continues to experience schedule delays, the MMA is its fallback, and according to the Navy, the overall cost of the MMA program would increase due to a need to procure additional aircraft.

The Navy's Aerial Common Sensor (ACS), a cooperative Army-led program, was the replacement for the Navy's current airborne intelligence platform, the EP-3. It, in conjunction with MMA and BAMS UAS is intended to constitute the MPR family of systems. Due to a significant increase in the weight of ACS, the Army terminated the development contract. According to BAMS UAS officials, problems with the ACS have not affected the BAMS UAS program and future spirals may include planned ACS capabilities such as signals intelligence.

The program is seeking government-to-government dialogue and exchange of information among allied and friendly nations that have common maritime surveillance needs. Program officials indicated that several nations have expressed interest in possible participation in the program.

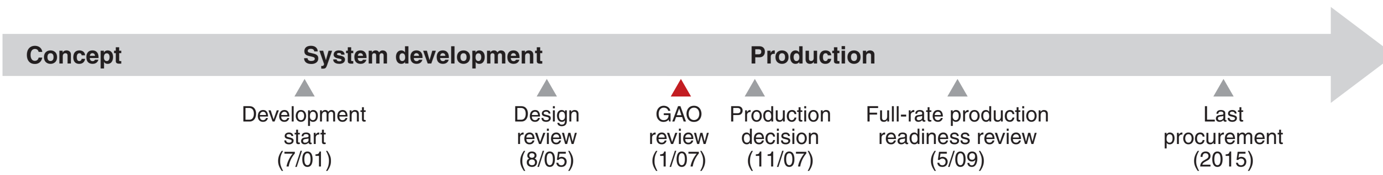
Agency Comments

The BAMS UAS program office provided technical comments, which were incorporated as appropriate.

C-130 Avionics Modernization Program (C-130 AMP)

The Air Force's C-130 AMP standardizes the cockpit configurations and avionics for 13 different mission designs of the C-130 fleet. It provides Navigation/ Safety modifications and Communication Navigation Surveillance/Air Traffic Management upgrades; installs a Terrain Avoidance Warning System; replaces weather avoidance radars, compass systems, and dual autopilots; installs dual flight mangement systems; and provides high frequency, ultra high frequency, and very high frequency datalinks.

Source: C-130 Avionics Modernization Program, System Program Office.



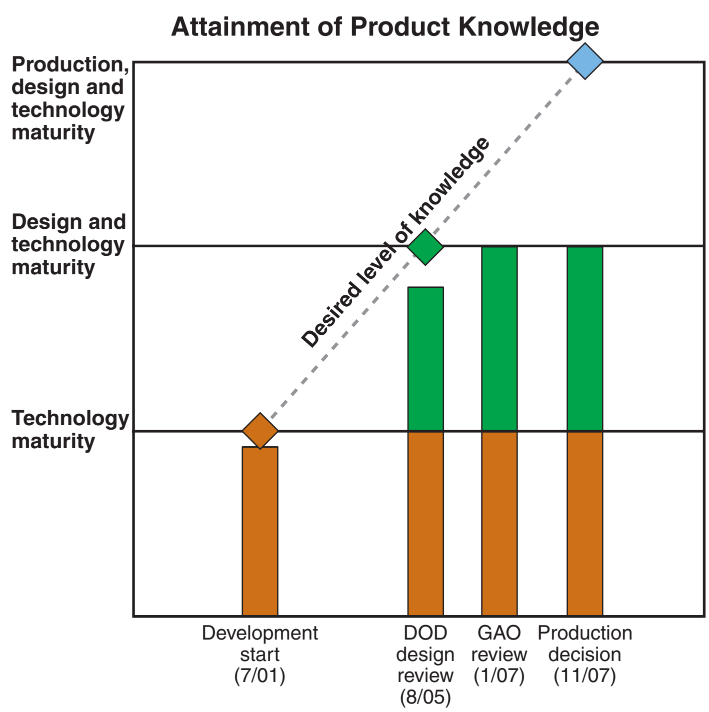
Program Essentials

Prime contractor: Boeing
Program office: Dayton, Ohio
Funding needed to complete:
R&D: $578.2 million
Procurement: $2,889.5 million
Total funding: $3,467.6 million
Procurement quantity: 424

Program Performance (fiscal year 2007 dollars in millions)

	As of 07/2001	Latest 12/2005	Percent change
Research and development cost	$712.9	$1,627.9	128.4
Procurement cost	$3,086.0	$2,909.9	-5.7
Total program cost	$3,798.9	$4,537.7	19.5
Program unit cost	$7.320	$10.456	42.8
Total quantities	519	434	-16.4
Acquisition cycle time (months)	TBD	TBD	TBD

According to the program office, the C-130 AMP technologies are mature and the design is stable for the basic combat delivery aircraft. However, production maturity is unknown because the program has not collected key manufacturing information and flight testing just began. The production decision has been delayed 17 months since last year's review. This allows time for more flight testing before making a production decision in November 2007. However, the program will have limited flight testing completed of a fully integrated, capable version of the basic configuration. Estimated costs for the program are expected to increase. In October 2006, the Air Force Cost Analysis Improvement Group estimated the total program cost at over twice the current cost estimate. An updated acquisition strategy reflecting the results of the program restructuring has yet to be approved.



C-130 AMP Program

Technology Maturity

All of the C-130 AMP's six critical technologies are fully mature.

Design Stability

The C-130 AMP basic configuration is stable with nearly all of the expected drawings released. The basic configuration is critical because it provides the foundation for all 13 mission system designs. The program completed its critical design review in August 2005 for the basic configuration. However, during installation trials to demonstrate system integration, program officials realized that they did not have a sound understanding of the installation complexity. As a result, drawings have been revised based on the lessons learned, and the program acknowledges that additional drawings or changes may be needed to incorporate the unique features of each variant.

Production Maturity

The program did not collect statistical process control data during development. Program officials stated that details on what data they will collect regarding manufacturing processes and quality control have yet to be defined for low-rate initial production. The Milestone B approved exit criteria established the production readiness review as one of the three criteria the C-130 AMP must meet to begin low-rate production in 2008. According to the program office, a low-rate production readiness review will be held in May 2007, and a full-rate production readiness review is scheduled for May 2009.

Since last year's review, the production decision has been delayed 17 months. The program office stated that the program will now have more than two-thirds of total development test points completed for the basic configuration before entering the production phase. However, the program will have only limited flight testing completed with a fully integrated, capable version. Future design variants are scheduled for demonstrations even later and will be done concurrently, leaving little time for corrections if problems arise. An official from the Office of the Director, Operational Test and Evaluation, expressed similar concerns about the level of concurrent flight testing and production.

Other Program Issues

The program has been undergoing a program restructure for some time, putting the program in a state of flux. Since GAO's last review of the C-130 AMP, the program has encountered several delays in its schedule, the quantities expected to be purchased have been reduced by 31 aircraft, and the Special Operations Command removed funding from the C-130 AMP for the Common Avionics Architecture for Penetration program from fiscal year 2008 forward. In October 2006, the Air Force Cost Analysis Improvement Group estimated the total program cost at over twice the current cost estimate. According to the program office, an updated acquisition strategy, program baseline, and test plan are expected to be approved prior to the production decision in fiscal year 2008.

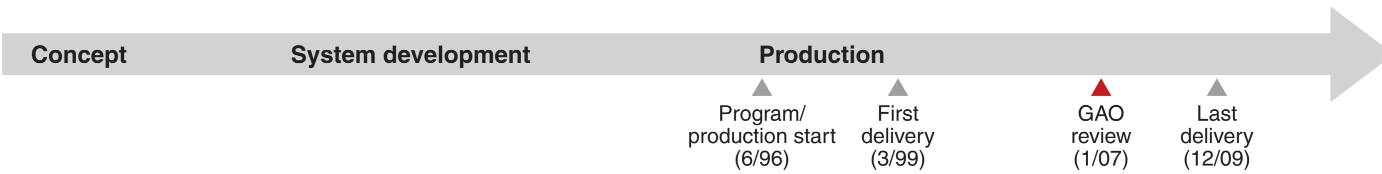
Agency Comments

The Air Force provided technical comments on a draft of this assessment, which were incorporated where appropriate.

C-130J Hercules

The C-130J is the latest addition to DOD's fleet of C-130 aircraft and constitutes a major upgrade for the aircraft series. The aircraft is designed primarily for the transport of cargo and personnel within a theater of operation. Variants of the C-130J are being acquired by the Air Force (e.g., Air Mobility Command and Special Operations Command), Marine Corps, and Coast Guard to perform their respective missions. We reviewed the Air Force's C-130J program.

Source: C-130J Program Office (657th AESS), U.S. Air Force.



Program Essentials

Prime contractor: Lockheed Martin Aeronautics Company - Marietta
Program office: Dayton, Ohio
Funding needed to complete:
R&D: $207.4 million
Procurement: $2,020.9 million
Total funding: $2,252.4 million
Procurement quantity: 18

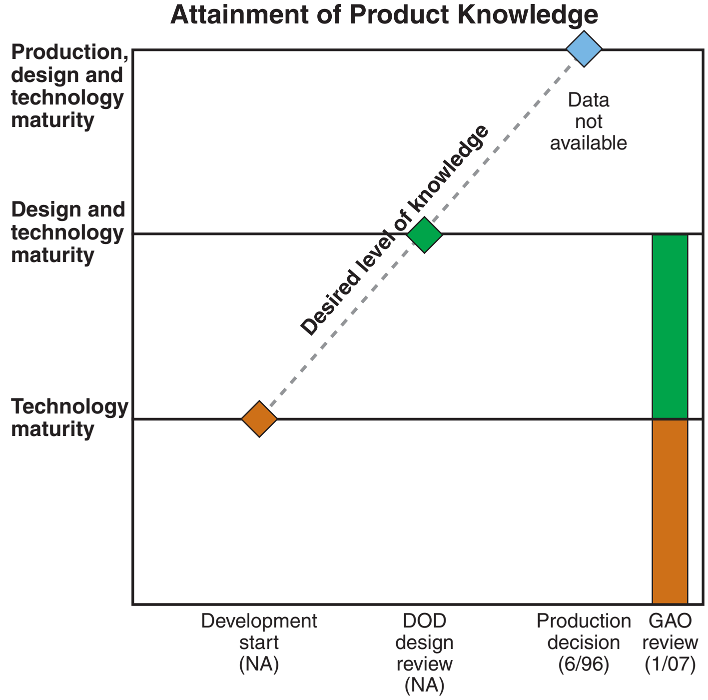
Program Performance (fiscal year 2007 dollars in millions)

	As of 10/1996	Latest 08/2006	Percent change
Research and development cost	$10.6	$262.9	2,380.2
Procurement cost	$861.9	$7,502.8	770.5
Total program cost	$872.5	$7,886.0	803.9
Program unit cost	$79.316	$99.822	25.9
Total quantities	11	79	618.2
Acquisition cycle time (months)	16	33	106.3

These figures only reflect the Air Force's procurement of the C-130J.

The C-130J program was initiated at production in June 1996. We did not access technology, design, or production maturity because the Air Force does not have the information necessary to do so. Officials stated this is because the C-130J was originally procured as a commercial item that precluded DOD from obtaining the information. The program uses other means, such as Defense Contract Management Agency oversight of production, to assess maturity. In September 2006, DOD declared initial operational capability for the C-130J aircraft despite being rated as only partially mission capable in some areas. Program officials stated that options to address these shortfalls have been developed. In October 2006, the program completed the transition to a noncommercial negotiated contract to provide full insight into cost and pricing data for the remaining procurement of 39 C-130J aircraft.

Attainment of Product Knowledge



C-130J Hercules Program

Technology Maturity

We did not assess the C-130J's critical technologies because, according to program officials, the technologies that make possible the major upgrades from earlier C-130 aircraft were assumed to be mature. Since the contractor initiated development of the C-130J at its own expense in the early 1990s, DOD took no responsibility for the system's technology maturity.

Design Stability

We did not assess the C-130J's design because, according to program officials, the Air Force does not have design drawings used to measure maturity. It believed the design was stable when the program was initiated, based on the fact that the C-130J was offered as a commercial item and evolved from an earlier C-130 design. However, when compared to earlier C-130 models the C-130J's development was approximately 70 percent new effort. Design changes provided major improvements such as a new propulsion system, an advanced integrated diagnostics system, a glass cockpit, digital avionics, and cargo compartment enhancements. Despite being considered a commercial development, the C-130J encountered numerous deficiencies early on that had to be corrected in order to meet minimum warfighter requirements. Other design shortfalls have recently been discovered which impact the aircraft's ability to meet its airdrop operations requirements. Program officials stated that options to address these shortfalls have been developed.

Production Maturity

We did not assess the production maturity of the C-130J because, according to program officials, the Air Force does not have data to show the total number of key product characteristics, the maturity of critical manufacturing processes, or capability indices. Program officials stated this is because the C-130J was originally procured as a Federal Acquisition Regulation (FAR) Part 12 commercial item, which limits DOD's access to the full range of contractor manufacturing process information. Further, officials stated that the program's recent conversion to a noncommercial FAR Part 15 (negotiated) contract did not increase their visibility into these types of production metrics. The program relies on oversight by the Defense Contract Management Agency at the contractor's facility to ensure that the C-130J aircraft is manufactured in accordance with applicable standards and contactor critical manufacturing process documents.

Other Program Issues

According to program officials, Air Mobility Command declared the aircraft's initial operational capability in September 2006. Yet, in April 2006, DOD testing officials reported several shortfalls with substantial operational impact resulting in the aircraft being rated as only partially mission capable. Program officials plan to address future Air Force needs and correct deficiencies identified during operational testing with ongoing modernization efforts funded by DOD and foreign military customers.

The program office was directed to change the acquisition of C-130J aircraft from a FAR Part 12 commercial item acquisition to a non-commercial Part 15 negotiated acquisition to provide full insight into cost and pricing of the aircraft. In response, a definitized contract was negotiated in October 2006 for the remaining procurement of 39 aircraft. Program officials estimate the Air Force will save approximately $168 million by converting to a noncommercial negotiated acquisition.

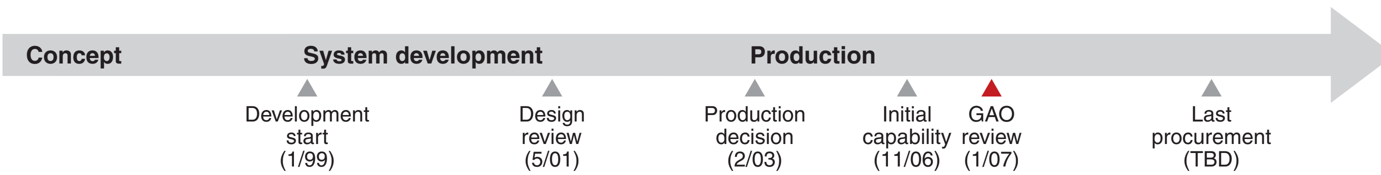
Agency Comments

In commenting on a draft of this assessment, the Air Force provided technical comments, which were incorporated as appropriate.

C-5 Avionics Modernization Program (C-5 AMP)

The Air Force's C-5 AMP is the first of two major upgrades for the C-5 to improve the mission capability rate, transport capabilities and reduce ownership costs. The AMP implements Global Air Traffic Management, navigation and safety equipment, modern digital equipment, and an all-weather flight control system. The second major upgrade, the C-5 Reliability Enhancement and Reengining Program (RERP), replaces the engines and modifies the electrical, fuel, and hydraulic systems. We assessed the C-5 AMP.

Source: Lockheed-Martin Aeronautics Company.



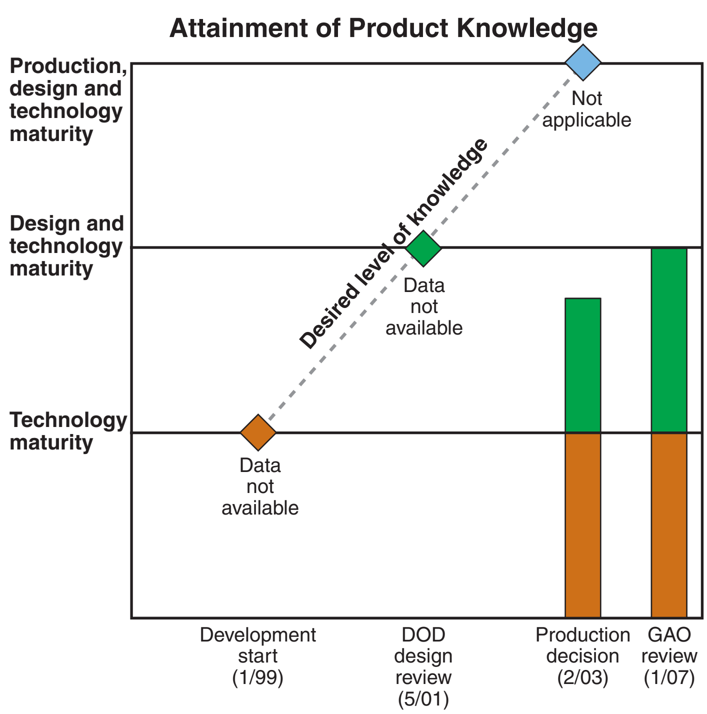
Program Essentials

Prime contractor: Lockheed Martin
Program office: Dayton, Ohio
Funding needed to complete:
- R&D: $0.0 million
- Procurement: $79.9 million
- Total funding: $79.9 million
- Procurement quantity: 5

Program Performance (fiscal year 2007 dollars in millions)

	As of 11/1998	Latest 06/2006	Percent change
Research and development cost	$368.9	$432.1	17.1
Procurement cost	$645.2	$478.9	-25.8
Total program cost	$1,014.0	$911.0	-10.2
Program unit cost	$8.048	$14.934	85.6
Total quantities	126	61	-51.6
Acquisition cycle time (months)	83	94	13.3

The program's technologies and design are considered mature. We could not assess production maturity as the components are commercial-off-the-shelf items that are installed in other commercial and military aircraft. However, according to a DOD test official the program has many maintenance issues including 240 deficiencies, the most severe include the autopilot disconnecting during flight, flight management system problems, and engine display issues that were identified during testing. The program has a contract in place to fix many deficiencies, while a block upgrade is being considered to address more significant deficiencies. An Air Force mobility study recommended modification of all 111 C-5 aircraft. However, according to program officials, they currently do not have the funds to modify 52 aircraft. Future budgets will address funding for the remainder of the fleet.



C-5 AMP Program

Technology Maturity

We did not assess the C-5 AMP's critical technologies because the program used commercial technologies that are considered mature.

Design Stability

The program reports that the contractor has released all of the drawings for the AMP. Last year we reported that the C-5 AMP had released 100 percent of its drawings; however, due to modifications in the design, 270 drawings were added. As a result, the program had completed only 54 percent of the total number of drawings for the system by the time of the production decision.

Production Maturity

We could not assess the production maturity because most components are readily available as commercial off-the-shelf items. This equipment is being used on other military and commercial aircraft. To ensure production maturity, the program office is collecting data regarding modification kit availability and the installation schedules.

The program still has not demonstrated that the system will work as intended and is reliable. In fiscal year 2006, officials halted the flight test program for over 6 months due to problems resulting mainly from maintenance technical orders and maturity issues. Testing activities were eventually resumed in April 2006 and operational testing was completed in June 2006. According to a test official, there are still many outstanding maintenance issues for the program, including 240 deficiencies. Among those deficiencies, the three most severe problems affect safety of flight and require corrective action, including the autopilot disconnecting during flight, flight management system problems, and engine display issues. The program office has a contract in place to fix many deficiencies as part of sustainment, and a block upgrade is being considered to address the more significant deficiencies. In addition, there are 14 requirements for the program that have been delayed for 2 years but should have been met by August 2005, two of which are major program requirements that concern takeoff and landing data. Some of the 14 requirements will be addressed by the RERP program and others may be addressed by the block upgrade program. According to the test official, the C-5 AMP officials consider development complete.

Other Program Issues

In February 2006, the C-5 AMP program was reclassified as a Major Defense Acquisition Program. Over the past 2 years, the program has run into significant problems while trying to complete software development that have impacted the cost and schedule of the program. Most notably, a software build was added to fix problems with AMP integration, flight management system stability, and system diagnostics. The added build caused a $23 million cost overrun, which was paid for by shifting funds from the RERP program and extended developmental testing to 10 months.

Last year we reported that the Air Force was conducting mobility studies to determine the correct mix of C-5 and C-17 aircraft it would need in the future. The study was issued in 2006 and recommended modification of all 111 C-5 aircraft. However, according to C-5 program officials they currently do not have the funds to modify the remaining 52 aircraft. To fund the modifications could cost nearly $800 million based on current unit cost.

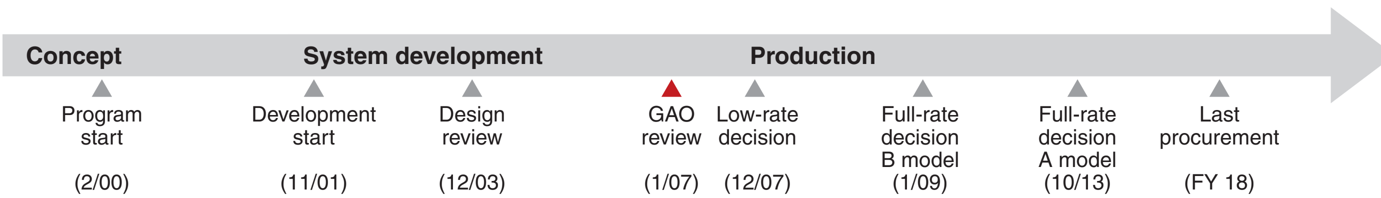
Agency Comments

The Air Force provided technical comments to a draft of this assessment, which were incorporated as appropriate.

C-5 Reliability Enhancement and Reengining Program (C-5 RERP)

The Air Force's C-5 RERP is one of two major upgrades for the C-5. RERP is designed to enhance the reliability, maintainability, and availability of the C-5 through engine replacement and modifications to subsystems, i.e., electrical and fuel, while the C-5 Avionics Modernization Program (AMP) is designed to enhance the avionics. The upgrades are part of a two-phased modernization effort to improve the mission capability rate, performance, and transport throughput capabilities and reduce total ownership costs. We assessed the C-5 RERP.

Source: Edwards AFB, CA. Photo taken by LM Aero.



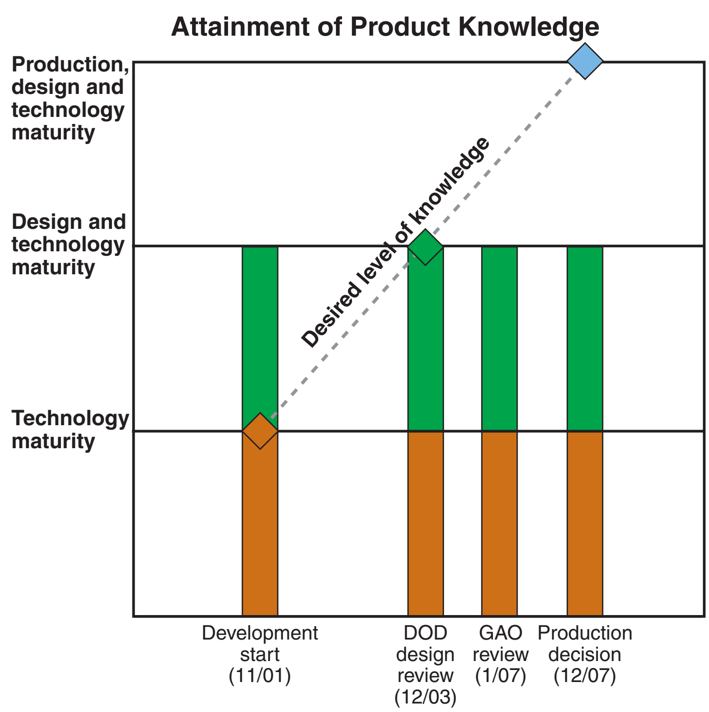
Program Essentials

Prime contractor: Lockheed Martin
Program office: Dayton, Ohio
Funding needed to complete:
- R&D: $198.9 million
- Procurement: $8,298.9 million
- Total funding: $8,497.7 million
- Procurement quantity: 109

Program Performance (fiscal year 2007 dollars in millions)

	As of 11/2001	Latest 08/2006	Percent change
Research and development cost	$1,611.1	$1,342.9	-16.6
Procurement cost	$8,410.4	$8,330.9	-0.9
Total program cost	$10,025.1	$9,673.7	-3.5
Program unit cost	$79.564	$87.150	9.5
Total quantities	126	111	-11.9
Acquisition cycle time (months)	100	125	25.0

The program's technologies are mature and the design is stable. We did not assess production maturity because the Air Force is buying commercially available items. The program recently delayed the low-rate initial production decision by 1 year because of cost pressures with the first production unit and Berry Amendment issues (requirement to use U.S. sources) with the engine. These issues contributed to a delay in awarding the long-lead contract for the first production unit. A major supplier has stated its unwillingness to bring their commercial manufacturing processes into Berry Amendment compliance. DOD is pursuing a waiver for this supplier. The Air Force expects to award the long-lead contract in April 2007, 14 months later than planned. This delay in production should allow the program more time for flight testing and to gain a better understanding of the kits' costs.



C-5 RERP Program

Technology Maturity

The C-5 RERP's technologies are mature based on an independent technology readiness assessment conducted in October 2001.

Design Stability

According to program officials, the basic design of the C-5 RERP is stable. At the design review, the program had more than 90 percent of its drawing released. However, since then, a redesign of the pylon/thrust reverser was needed to address overweight conditions and safety concerns for the engine mount area. According to program officials, the redesign, now complete, contributed to a 4-month delay to the program.

Production Maturity

We did not assess the C-5 RERP's production maturity because the Air Force is buying commercially available items.

The program had planned to enter low-rate initial production in late 2006 without demonstrating through flight testing that the RERP would work as intended. However, program officials stated that this decision has been delayed until December 2007 due to upward production cost pressures and Berry Amendment specialty metal issues (requirements to use U.S. sources) with the engine. The program has not yet awarded the initial contract to purchase the long-lead items for the first production unit, which was expected to be awarded in February 2006, because of supplier noncompliance with the Berry Amendment (10 U.S.C. 2533a). A major supplier has specifically stated its unwillingness to bring their commercial manufacturing process into compliance, citing increased costs in domestic specialty metals and the risk compliance poses to its competitiveness in the global marketplace. According to program officials, the Air Force considered several options and is now pursuing a waiver to resolve issues concerning Berry Amendment compliance. Program officials currently estimate the long-lead contract will be awarded in April 2007, 14 months later than originally planned. In addition, Air Force officials have indicated that cost pressures with the engine also contributed to this delay. This delay in production should allow the program more time for flight testing and to gain a better understanding of the production costs

Other Program Issues

The C-5 RERP is dependent on the C-5 AMP because the aircraft must undergo AMP modifications prior to RERP modifications. A recent DOD study on mobility recommended modification of all 111 C-5 aircraft. However, according to Air Force officials they currently do not have the funds to modify 52 C-5 AMP aircraft. In addition, the C-5 AMP has performance shortfalls that need to be fixed. According to the program office, it has a sustainment contract in place to fix some of the deficiencies, but a block upgrade program will be needed to fix the more significant deficiencies. The Air Force expects to request funds for the block upgrade program beginning in fiscal year 2010.

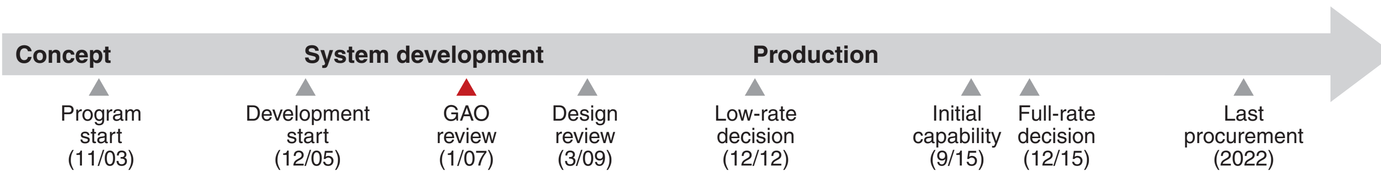
Agency Comments

In commenting on a draft of this assessment, the Air Force stated that the risk associated with entering production before flight testing has been completed is being partially mitigated by two operational assessments. The favorable results of the first operational assessment supports the long-lead production decision review by the Air Force. Other technical comments were provided and incorporated as appropriate.

USMC CH-53K Heavy Lift Replacement (HLR)

The Marine Corps' CH-53K system will perform the marine expeditionary heavy-lift assault transport of armored vehicles, equipment, and personnel to support distributed operations deep inland from a sea-based center of operations. The CH-53K program is expected to replace the current CH-53E helicopter with a new design to improve range and payload, survivability and force protection, reliability and maintainability, coordination with other assets, and overall cost of ownership.

Source: Sikorsky Aircraft Company, © 2003 Sikorsky Aircraft Company.



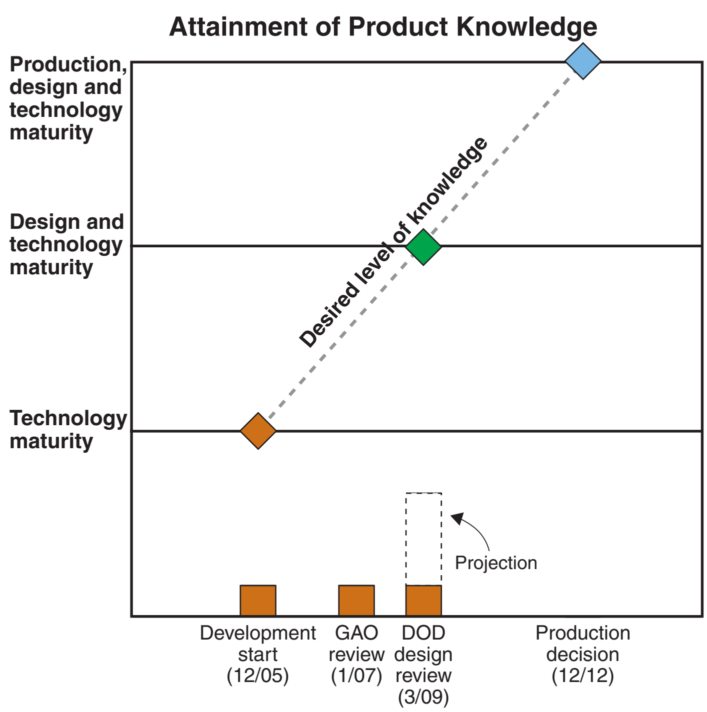
Program Essentials

Prime contractor: Sikorsky Aircraft Corporation
Program office: Patuxent River, Md.
Funding needed to complete:
R&D: $3,649.9 million
Procurement: $11,274.8 million
Total funding: $14,924.7 million
Procurement quantity: 152

Program Performance (fiscal year 2007 dollars in millions)

	As of NA	Latest 12/2005	Percent change
Research and development cost	NA	$4,031.8	NA
Procurement cost	NA	$11,274.8	NA
Total program cost	NA	$15,306.6	NA
Program unit cost	NA	$95.072	NA
Total quantities	NA	161	NA
Acquisition cycle time (months)	NA	117	NA

The CH-53K program entered system development in December 2005 without demonstrating that its 3 critical technologies had reached full maturity. The program expects one of these technologies to reach full maturity in 2009 and the remaining two technologies to be mature by 2012, three years after the program's design review. While an initial readiness assessment for the program identified 10 critical technologies, a subsequent assessment reduced that number to 3. Elements of the 7 eliminated technology areas, including the engines, are not considered critical, although they may still present challenges to the program as many of them are currently being developed or used by other programs and will be integrated later into the CH-53K.



CH-53K Program

Technology Maturity

The three critical technologies for the CH-53K program—the main rotor blade, the main gearbox, and the main rotor viscoelastic lag damper—are not fully mature. The viscoelastic lag damper, which serves to prevent excessive blade lagging, is expected to be fully mature by 2009, while the other two technologies are expected to be fully mature by 2012.

The main rotor blade will be 6 percent longer than that of the CH-53E and will require improved performance to meet the vertical lift requirement. Current testing of smaller-scale models of the rotor blades is expected to demonstrate increased maturity for the main rotor blade, with the actual sized main rotor blade achieving full maturity by 2012.

The main gearbox is not mature. While other helicopters have utilized similar technology for greater loads, they differed from the CH-53K in operational requirements. Tests of the gearbox later this year are expected to demonstrate increased maturity, while full maturity is expected by 2012.

A viscoelastic lag damper similar to that planned for use is currently in operation on other helicopters. However, while currently approaching full maturity, it must be resized for use on the larger CH-53K rotor head and will not reach full maturity until 2009. The viscoelastic lag damper is expected to result in improvements in maintainability and supportability over the hydraulic damper used on the CH-53E. Prototype dampers are currently being procured and testing of their damping characteristics is scheduled for later this year.

An assessment conducted in September 2004 reduced 10 original critical technologies to the 3 above. Of the 7 eliminated technologies, 2 are being developed by the CH-53K program and 5 are being developed by or used on other programs and will be integrated onto the CH-53K platform. While the program does not anticipate problems with the 5 technologies, they are dependent on the development and maturity schedules of the other programs.

Design Stability

We did not assess the design stability of the CH-53K because the total number of drawings expected is not known at this time.

Other Program Issues

Due to unexpected attrition of CH-53E aircraft, the need for an operational replacement has increased, resulting in the return of decommissioned CH-53Es to operational status. Supplemental funding has been provided to reclaim five aircraft, and funding has been requested to reclaim two more while the program continues to review the condition of remaining aircraft.

Currently deployed CH-53E aircraft have flown at three times the planned utilization rate. This operational pace is expected to result in higher airframe and component repair costs, including short-term fatigue repairs necessary to minimize CH-53E inventory reductions until CH-53K deliveries reach meaningful levels.

To address these challenges, the program intends to manufacture 29 of the 156 total helicopters (19 percent) during low-rate initial production and concurrent with initial operational testing. While concurrent production may help to field the systems sooner, it could also result in greater retrofit costs if unexpected design changes are required.

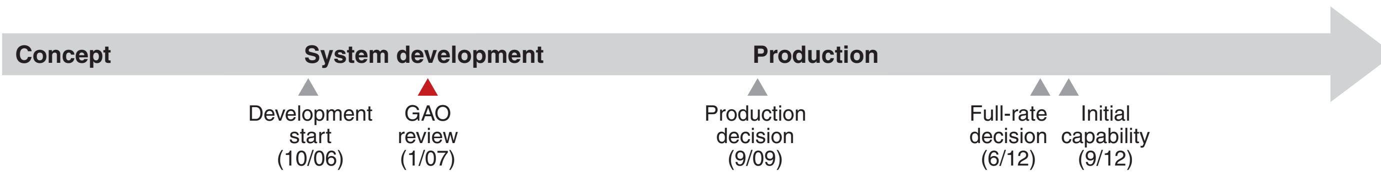
Agency Comments

In commenting on a draft of this assessment, the Navy stated that the CH-53K Program conducted a Technology Readiness Assessment in September 2004, which assessed 10 candidate technologies. Three of those technologies met the criteria for designation as critical technology elements (CTE): main rotor blade, main gearbox, and the visoelastic lag damper. According to the Navy's comments, the technology readiness level (TRL) of the visoelastic lag damper was assessed as a model or prototype demonstrated in a relevant environment and the main rotor blade and main gearbox were assessed as components in a lab environment. Further, the Navy stated that the CH-53K Program has a technical maturation plan to achieve maturity of these three CTEs by Milestone C in 2012, which is progressing as planned, and risk due to these CTEs is considered low. This plan was staffed through the Director of Defense Research and Engineering (DDR&E) and is reviewed semiannually by DDR&E.

Combat Search and Rescue Replacement Vehicle (CSAR-X)

The Combat Search and Rescue Replacement Vehicle (CSAR-X) is planned to provide the United States Air Force with a vertical take-off and landing aircraft that is quickly deployable and capable of main base and austere location operations for worldwide CSAR and personnel recovery missions. The CSAR-X will be developed in two blocks and will replace the aging HH-60G Pave Hawk helicopter fleet. We assessed CSAR-X Block 0, the first block to be developed.

Source: 669 AESS/TH CSAR-X Program Office.
Note: Photo is of the HH-60 Pavehawk, the aircraft the CSAR-X will replace.



Program Essentials

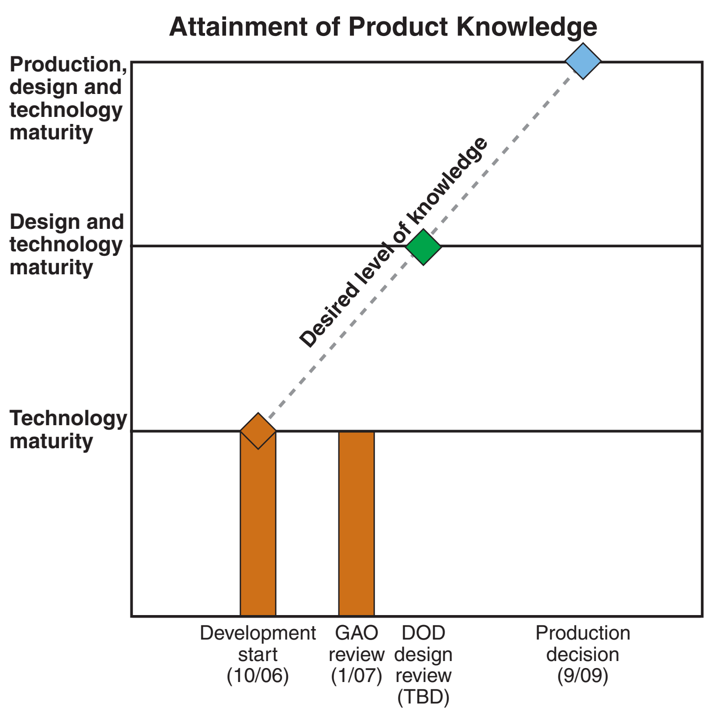
Prime contractor: Boeing Integrated Defense Systems
Program office: Dayton, Ohio
Funding needed to complete:
- R&D: $1,296.8 million
- Procurement: $7,046.5 million
- Total funding: $8,447.6 million
- Procurement quantity: 141

Program Performance (fiscal year 2007 dollars in millions)

	As of NA	Latest 10/2006	Percent change
Research and development cost	NA	$1,310.9	NA
Procurement cost	NA	$7,046.5	NA
Total program cost	NA	$8,461.6	NA
Program unit cost	NA	$58.761	NA
Total quantities	NA	144	NA
Acquisition cycle time (months)	NA	70	NA

Estimates are for CSAR-X Block 0 only and do not reflect the totals for the entire CSAR-X program.

CSAR-X program officials report that all of the critical technologies for Block 0 were mature before the program committed to product development in October 2006. The development contract was awarded to Boeing in November 2006, but a bid protest by competitors was filed with GAO and has required the program to suspend development activities. The protest was sustained in February 2007 and the Air Force is currently considering its response to the GAO recommendation. Information regarding design stability and production maturity was not available at the time of this review.



CSAR-X Program

Technology Maturity

CSAR-X program officials identified eight critical technologies for Block 0 and report that all eight were mature before development start. They also identified a number of other critical technologies expected to support Block 10, but did not provide data on their levels of maturity. These additional technologies will be assessed prior to the start of Block 10 development.

Other Program Issues

CSAR-X is being managed as an incremental development program. Block 0, the block assessed in this review, and Block 10 will be managed as separate programs, each with its own requirements, program baseline, and milestone reviews.

The initiation of CSAR-X Block 0 development has been delayed several times. According to program officials, the largest part of the schedule slip resulted from the Air Force adding $849 million to the program's future budget to move the beginning of Block 10 development ahead 2 years, from 2011 to 2009, to more closely align with the scheduled conclusion of Block 0 development. As a result of those changes, the program office went back to the competitors and asked them to incorporate the new Block 10 development plan and funding profile into their proposals.

The Air Force awarded the CSAR-X Block 0 development contract to Boeing in November 2006. However, a bid protest by competitors challenging the award was filed with GAO, requiring the Air Force to suspend the beginning of product development activities. In February 2007, GAO sustained the protest, recommending that the Air Force amend the solicitation and request revised proposals. If the new evaluation results in a determination that Boeing's proposal no longer represents the best value to the government GAO recommended that the Air Force terminate its contract. The Air Force is currently considering its response to the GAO recommendation.

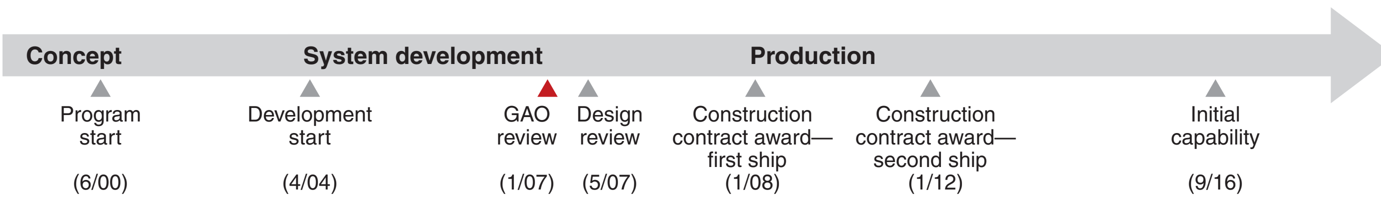
Agency Comments

The Air Force provided technical comments, which were incorporated as appropriate.

Future Aircraft Carrier CVN-21

The Navy's CVN-21 class is the successor to the Nimitz-class aircraft carrier and includes a number of advanced technologies in propulsion, aircraft launch and recovery, weapons handling, and survivability. These technologies are to allow for increased sortie rates and decreased manning rates as compared to existing systems. Construction of the first ship of the class—CVN 78—is scheduled to begin in January 2008.

Source: CVN-21 Program Office.



Program Essentials

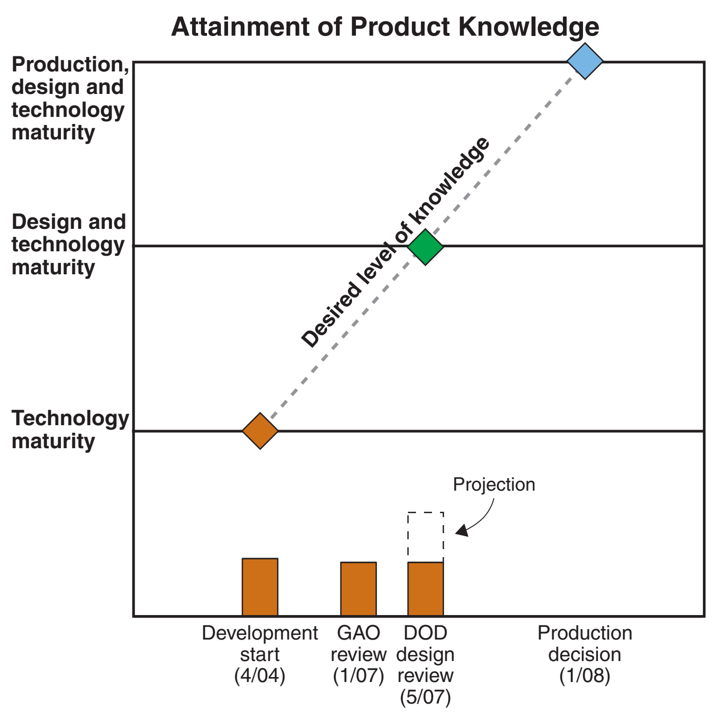
Prime contractor: Northrop Grumman Newport News
Program office: Washington, DC
Funding needed to complete:
- R&D: $2,000.5 million
- Procurement: $22,970.9 million
- Total funding: $24,971.4 million
- Procurement quantity: 3

Program Performance (fiscal year 2007 dollars in millions)

	As of 04/2004	Latest 12/2005	Percent change
Research and development cost	$4,415.8	$4,253.2	-3.7
Procurement cost	$28,288.4	$25,805.9	-8.8
Total program cost	$32,704.2	$30,059.1	-8.1
Program unit cost	$10,901.398	$10,019.713	-8.1
Total quantities	3	3	0.0
Acquisition cycle time (months)	137	149	8.8

Costs decreased due to a correction in the estimated costs for the second ship.

CVN 21 expects to have 6 of 17 current critical technologies fully mature and another 7 approaching maturity by critical design review now scheduled for May 2007. Program officials stated that the extended construction and design period allows further time for development. Fallback technologies still exist for 6 of 17 total critical technologies, but their use entails drawbacks, such as decreased performance and/or an increase in manpower requirements. While the design process appears on track, weight and stability issues have presented a challenge. In 2006 the Navy decided to delay awarding the contract for construction of the first two ships of the class by 1 year to meet other Navy priorities. The Navy expects to award the CVN 78 construction contract in January 2008.



CVN-21 Program

Technology Maturity

Only 4 of CVN 21's 17 current critical technologies are fully mature—the nuclear propulsion and electrical plant, a new desalination system, the Multi-Function Radar, and a high strength alloy steel. A plasma-arc waste destruction system and the Electromagnetic Aircraft Launching System (EMALS) are expected to be fully mature and 7 are expected to be approaching maturity prior to critical design review. A total of 9 are expected to be fully mature in time for construction contract award in 2008. The program reported 16 critical technologies at development start, with as many as 22 technologies in 2006. Since last year's assessment, the Navy eliminated a technology; and redefined another.

Programs other than CVN-21 are developing 6 of the critical technologies—the Advanced Arresting Gear (AAG), a missile; Multi-Function Radar, Volume Search Radar, an automated weapon information system; and a GPS-based landing system—known as JPALS. Progress in those programs could affect the CVN-21 schedule. Four of these technologies have mature alternate systems as backups. No backup is feasible for the radars without major ship redesign. While the Multi-function Radar demonstrated maturity through at-sea testing, the Volume Search Radar will not achieve maturity until 2014 after operational testing on the future destroyer. Program officials stated that they will most likely install AAG—even if it is not fully mature when a decision to use a backup must be made. CVN 78's optimal build sequence could be impacted, if AAG is not delivered on time.

EMALS will replace steam catapults and is expected to demonstrate maturity through land based testing. EMALS will not be tested at sea, but officials believe that this testing is the only alternative designed to approximate an aircraft carrier environment.

The Navy eliminated an integrated inventory system and intended to pursue materials aimed at reducing carrier weight. The materials were ultimately eliminated because the Navy believes that it can already achieve its goals for ship weight and stability. Only high-strength and toughness steel is expected to be used on CVN 78.

Four critical technologies will not be mature until after construction start in 2008. While a self-propelled weapons loading device is not required until ship delivery in 2015, an armor protection system is needed for installation starting in 2009—the same year it is expected to demonstrate maturity. Risks associated with the 1,100-ton air conditioning plants are considered low since the components are available and used today, but this size has never been installed on a ship. Finally, the advanced weapons elevators are not expected to reach maturity until after shipboard system testing just prior to delivery.

Design Stability

A design review is currently planned for May 2007, but program officials stated that the design is regularly reviewed. Since the program does not measure design stability by percentage of drawings completed, it was not assessed according to this metric. Rather, the program measures progress in developing the product model. According to program officials, the ship is meeting its design targets—in part because of a 1 year delay in the construction contract, which resulted in additional time to develop the design. However, since a number of systems are still in development, the final design could be impacted.

Meeting the ship's requirements for weight and stability has been a challenge. EMALS and AAG have exceeded their allocated weight margins and weight must be compensated elsewhere on the ship. Additional degradation of its weight allowance could occur as the final designs for critical technologies become known.

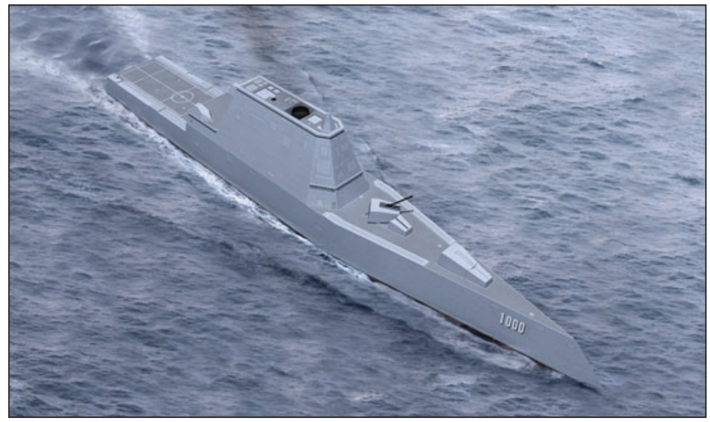
Agency Comments

The Navy concurred with our assessment, but emphasized that a lengthy construction period provides additional time to mature technologies. The Navy noted that technology readiness is closely managed through proven design processes, risk assessments, site visits, and contracting methods to ensure adequate maturity. Specific attention is given to requirements, legacy system availability, technology readiness, affordability, schedule, and return on investment. In addition, initial construction efforts aimed at validating new designs, tooling, and construction processes are already under way.

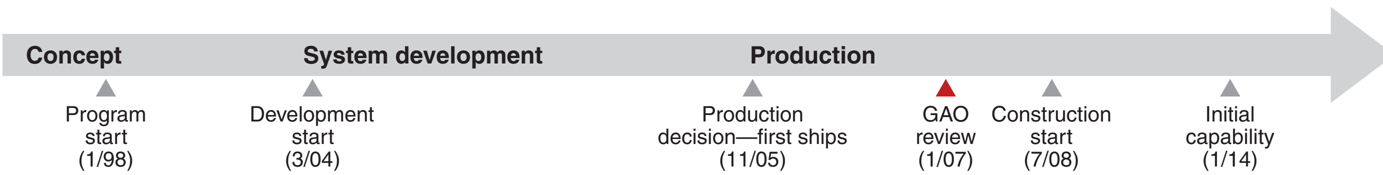
Finally, the Navy stressed that the decision to delay the program in 2006 was not related to technology maturity, weight, or stability issues.

DDG 1000 Destroyer

The Navy's DDG 1000—formerly known as DD(X)—destroyer is a multimission surface ship designed to provide advanced land attack capability in support of forces ashore and contribute to U.S. military dominance in littoral operations. The program awarded contracts for detail design and construction of two lead ships in August 2006. The program will continue to mature its technologies and design as it approaches construction start, currently planned for July 2008.



Source: PEO Ships (PMS 500), © 2006 DDG1000.com Northrop Grumman Ship Systems.



Program Essentials

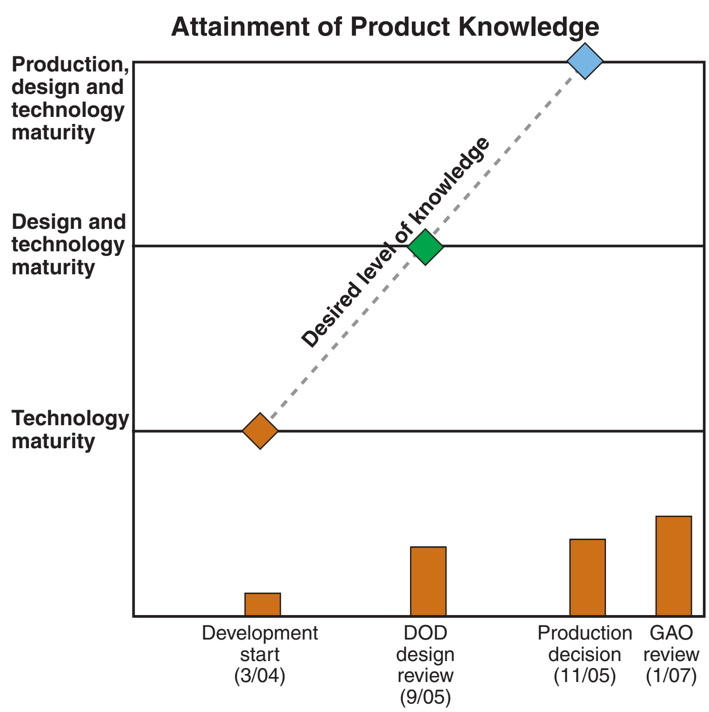
Prime contractor: BAE Systems, Bath Iron Works, Northrop Grumman Ship Systems, Raytheon
Program office: Washington, DC
Funding needed to complete:
R&D: $2,641.2 million
Procurement: $23,419.4 million
Total funding: $26,060.7 million
Procurement quantity: 10

Program Performance (fiscal year 2007 dollars in millions)

	As of 01/1998	Latest 08/2006	Percent change
Research and development cost	$2,094.3	$8,690.0	314.9
Procurement cost	$0.0	$24,409.7	NA
Total program cost	$2,094.3	$33,099.7	1,480.5
Program unit cost	NA	$3,309.973	NA
Total quantities	0	10	NA
Acquisition cycle time (months)	128	192	50.0

Costs increased due to changes in cost estimating, additional technology development, program restructuring, and quantity change.

Three of DDG 1000's 12 critical technologies are fully mature. While 7 other technologies are approaching full maturity, 5 of them will not be fully mature until after ship installation as testing in a realistic environment is not considered feasible. The 2 remaining technologies—the volume search radar and total ship computing environment—have only completed component level demonstrations and subsequently remain at lower levels of maturity. Concurrent with its efforts to mature ship technologies, the Navy has initiated detail design activities in the program. While the Navy is planning to complete at least 75 percent of DDG 1000's total detail design products ahead of lead ship construction, any challenges encountered in remaining technology development activities could place this target at risk.



DDG 1000 Program

Technology Maturity

Three of DDG 1000's 12 critical technologies are fully mature. Seven other technologies, including the advanced gun system and its projectile, hull form, infrared signature mockups, integrated deckhouse, integrated power system, and peripheral vertical launching system, are approaching full maturity. The Navy currently plans to complete development of the integrated deckhouse and peripheral vertical launching system prior to beginning construction on DDG 1000's two lead ships. However, practical limitations prevent the advanced gun system and its projectile, hull form, integrated power system, and infrared signature mockups from being fully demonstrated in an at-sea environment until after lead ship installation. Two other technologies—the volume search radar and total ship computing environment—remain at lower levels of maturity.

The volume search radar, along with the multi-function radar, together comprise DDG 1000's dual band radar system. While the multi-function radar has reached maturity, considerable testing remains for the volume search radar. The Navy is currently planning to install volume search radar equipment at a land-based test facility in March 2007. Following installation, the volume search radar will undergo land-based testing, which the Navy plans to complete by March 2008 in an effort to increase the radar's maturity prior to lead ship construction start in July 2008. However, full maturity of this technology will not occur until after ship installation. In addition, because the efforts are concurrent, there is risk that any delays or problems discovered in testing for the volume search radar could ultimately impact dual band radar production plans. According to Navy officials, in the event the volume search radar experiences delays in testing, it will not be integrated as part of the dual band radar into the deckhouse units that will be delivered to the shipbuilders. Instead, the Navy will have to task the shipbuilder with installing the volume search radar into the deckhouse, which program officials report will require more labor hours than currently allocated.

The Navy's total ship computing environment for DDG 1000 requires developing hardware infrastructure and writing and releasing six blocks of software code. Although development of the first three software blocks progressed in line with cost and schedule estimates, program officials report that changes in the availability of key subsystems developed external to the DDG 1000 program, introduction of nondevelopment items, and changes in program integration and test needs prompted the Navy to defer some of the functionalities planned in software release four to software blocks five and six, and full maturity of the integrated system will not be attained until after ship construction start.

Design Stability

The DDG 1000 program recently entered detail design phase. The Navy is now assessing design stability by reviewing detail design products, including system drawings, detail drawings, manufacturing drawings, and calculations and analyses. According to program officials, 175 of 3,723 (projected) detail design products for DDG 1000 have been completed. The Navy estimates that at least 75 percent of DDG 1000's total detail design products will be completed prior to start of lead ship construction in July 2008. Successfully meeting this target depends on maturing DDG 1000 technologies as planned.

Agency Comments

The Navy stated that our assessment was factually correct, but misleading in areas of technology maturity and program funding. According to the Navy, DDG 1000 critical technologies achieved technology readiness levels appropriate to gain authorization in November 2005 to enter detail design phase. Since that event, technologies have been further tested, and all are on track to meet cost and schedule targets. Also, given the unique nature of shipbuilding, with detail design and construction efforts spread over approximately 5 years, the Navy claimed that comparing DDG 1000 technology readiness levels to GAO-developed best practices criteria is not valid. Further, the Navy noted that GAO's cost comparison computing percent change from January 1998 to the current program baseline does not account for program progression through the acquisition cycle and may be misinterpreted as cost growth.

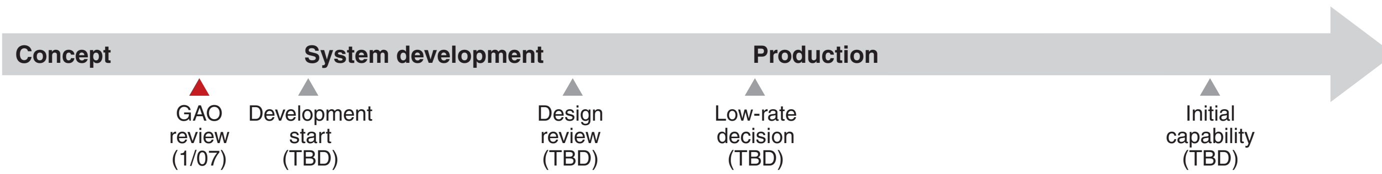
GAO Comments

Our approach is valid because our work has shown that technological unknowns discovered late in development lead to cost increases and schedule delays.

E-10A Wide Area Surveillance Technology Development Program (TDP)

The Air Force's E-10A, equipped with the wide-area surveillance variant of the Multi-Platform Radar Technology Insertion Program (MP-RTIP) radar, is intended to provide next-generation air and ground moving target detection capabilities and an imaging capability for surface surveillance. The system is also intended to provide a battle management capability that will integrate other intelligence, surveillance, reconnaissance, and weapons assets. The Boeing 767-400ER aircraft is being used as the TDP testbed.

Source: Northrop Grumman.



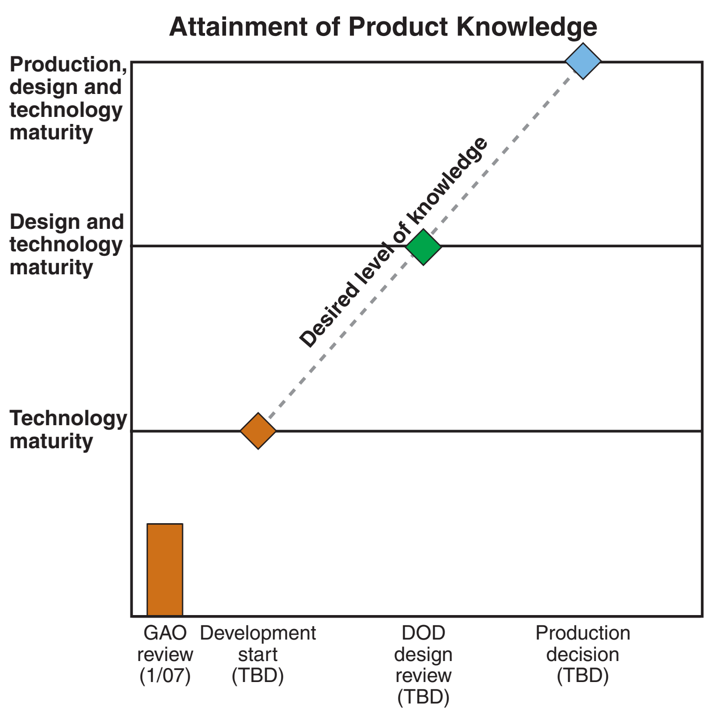
Program Essentials

Prime contractor: Northrop Grumman
Program office: Hanscom Air Force Base, Mass.
Funding needed to complete:
R&D: $1,294.5 million
Procurement: $0.0 million
Total funding: $1,294.5 million
Procurement quantity: 0

Program Performance (fiscal year 2007 dollars in millions)

	As of 12/2005	Latest 12/2005	Percent change
Research and development cost	NA	$2,057.6	NA
Procurement cost	NA	$0.0	NA
Total program cost	NA	$2,057.6	NA
Program unit cost	NA	$2,057.645	NA
Total quantities	NA	1	NA
Acquisition cycle time (months)	NA	NA	NA

The E-10A TDP has not yet started development. In May 2006, DOD approved the TDP acquisition, technology development, and test and evaluation strategies. The program has identified 18 critical technologies, five of which are currently assessed as being fully mature. The program projects that nearly all critical technologies will be fully mature by 2011—when the TDP demonstrations are scheduled for completion. The TDP demonstrations will include the live fire engagement of cruise missiles, the live fire engagement of ground targets, and the use of information services via internet protocol-enabled communication channels. The demonstrations constitute the TDP exit criteria. If an E-10A development program is initiated, capabilities will be acquired through an evolutionary acquisition process.



E-10A WAS TDP Program

Technology Maturity

Of the TDP's 18 critical technologies, 5 are fully mature, with the remaining 13 projected to be mature or approaching maturity by 2011. TDP technologies will be matured in two ways. In some cases, the technologies will be demonstrated on the E-10A testbed or in the system integration laboratory during the TDP test program. In other cases, the program office will monitor and leverage the advances made by other programs and agencies to mature relevant technologies.

Eight technologies will be matured directly by the TDP. The program projects that 7 of the 8 will be fully mature at the end of the TDP. The one critical technology that is projected to not reach full maturity is information assurance, which is projected to be approaching full maturity by the end of the TDP.

The other 10 critical technologies will be matured as part of program activities. For example, the narrowband communications critical technology is expected to be provided by the Joint Tactical Radio System, and the Wideband Beyond Line-of-Sight critical technology is expected to be provided by the Family of Advanced Beyond Line-of-Sight Terminals. The program projects that 9 of the 10 critical technologies will be fully mature at the end of the TDP; the remaining critical technology is projected to be either approaching full maturity or fully mature.

Other Program Issues

The E-10A's MP-RTIP radar is a modular, scalable, two-dimensional active electronically scanned radar. The MP-RTIP also supports the Global Hawk program. MP-RTIP will deliver a "large sensor" variant for the E-10A aircraft and a "small sensor" variant for the Global Hawk. The MP-RTIP development effort currently plans to provide two E-10A sensors and three Global Hawk sensors. The E-10A and Global Hawk programs will fund production of the MP-RTIP sensors for their respective operational platforms. The two E-10A MP-RTIP development sensors will be integrated into the E-10A system integration laboratory and testbed, and are scheduled for delivery in 2009 and 2010. The Global Hawk variants of the radar are scheduled for delivery in 2006, 2007, and 2008.

The MP-RTIP radar began development in 2003. The Global Hawk variant of the radar has 8 critical technologies and the E-10A has 1 additional critical technology (pulse compression unit) for a total of 9. The majority of the critical technologies have reached full maturity and the remaining critical technologies are approaching full maturity. Regarding design stability, all of the drawings expected are releasable for both variants of the MP-RTIP radar.

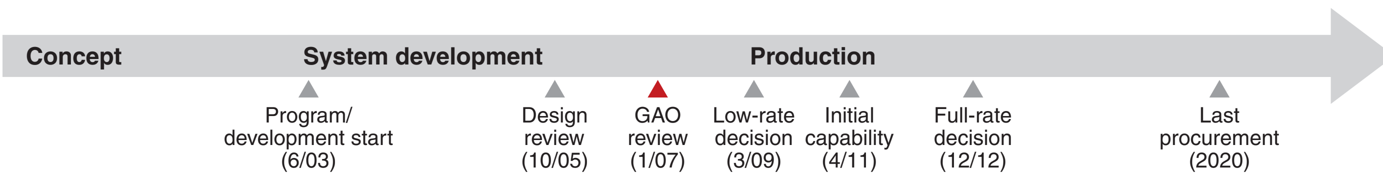
Agency Comments

In commenting on a draft of this assessment, the Air Force concurred with the information provided in this report.

E-2D Advanced Hawkeye (E-2D AHE)

The Navy's E-2D AHE is an all-weather, twin-engine, carrier-based, aircraft designed to extend early warning surveillance capabilities. It is the next in a series of upgrades the Navy has made to the E-2C Hawkeye platform since its first flight in 1971. The E-2D AHE is designed to improve battle space target detection and situational awareness, especially in littoral areas; support Theater Air and Missile Defense operations; and improve operational availability.

Source: Program Executive Office, Tactical Aircraft Programs (PMA-231).



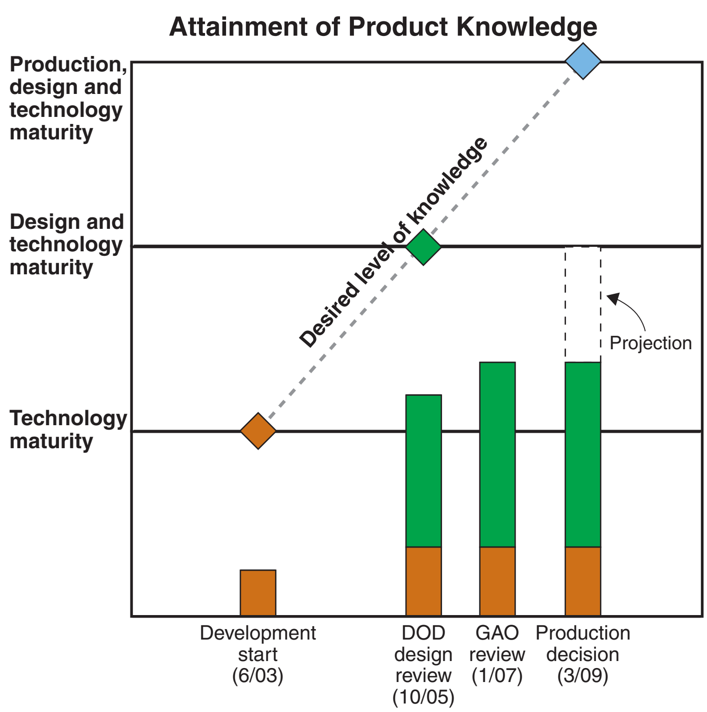
Program Essentials

Prime contractor: Northrop-Grumman Corp.
Program office: Patuxent River, Md.
Funding needed to complete:
- R&D: $1,820.8 million
- Procurement: $10,066.2 million
- Total funding: $11,887.1 million
- Procurement quantity: 69

Program Performance (fiscal year 2007 dollars in millions)

	As of 06/2003	Latest 12/2005	Percent change
Research and development cost	$3,531.2	$3,538.7	0.2
Procurement cost	$10,031.1	$10,066.2	0.4
Total program cost	$13,562.2	$13,605.0	0.3
Program unit cost	$180.830	$181.399	0.3
Total quantities	75	75	0.0
Acquisition cycle time (months)	95	94	-1.1

The E-2D AHE program entered system development in June 2003 with four immature critical technologies. Since that time, one of the program's four critical technologies has reached full maturity. Although the design met best practice standards at the time of the October 2005 design review, the total number of engineering drawings has subsequently increased. The program office reports that the design is almost 100 percent complete, but technology maturation and system integration may lead to more design changes or increased costs. We could not assess production maturity because the program does not plan to use statistical process controls.



E-2D AHE Program

Technology Maturity

One of the E-2D AHE's four critical technologies (the space time adaptive processing algorithms) is mature. More mature backup technologies exist for the three remaining technologies: the rotodome antenna, a silicon carbide-based transistor for the power amplifier to support UHF radio operations, and the multichannel rotary coupler for the antenna. These technologies were flown on a larger test platform in 2002 and 2003. However, use of the backup technologies would result in degraded system performance and would not support aircraft weight and volume contraints as well as accommodate future system growth. Flight testing, which will include the four critical technologies, is planned to begin in the fourth quarter of fiscal year 2007. The next AHE technology readiness assessment is to be performed prior to the low rate initial production decision in fiscal year 2009, and the program office anticipates that the remaining technologies will be mature at that time.

Design Stability

The program had completed 90 percent of planned drawings prior to the October 17, 2005 design review. However, the number of drawings required has since increased, driven primarily by underestimating total structural and wiring drawings, part discrepancies discovered during aircraft assembly, and rework associated with the prime contractor's new design software, which resulted in the need for unique drawings for suppliers. This increase in drawings means that the program had completed less than 75 percent of total drawings at design review. The program office reports that 99 percent of total drawings are complete and projects that 100 percent of the drawings will be complete by the planned start of production in March 2009. However, the technology maturation process may lead to more design changes.

The program office reported that the systems integration laboratory is being created this year and a fully integrated prototype will be delivered in 2007. Without the benefit of an integration laboratory or a prototype prior to entering the system demonstration phase, the program increases the likelihood that problems will be discovered late in development when they are more costly to address.

Production Maturity

The program expects a low-rate initial production decision in March 2009, but does not require the contractor to use statistical process controls to ensure its critical processes are producing high-quality and reliable products. According to the program, the contractor assembles the components using manual, not automated, processes that are not conducive to statistical process control. The program relies on postproduction data, such as defects per unit, to track variances and nonconformance. The program also conducts production assessment reviews every 6 months to assess the contractor's readiness for production. The program has updated the manufacturing processes that were established and used for the E-2C over the past 30 years. The program considers the single station joining tool; the installation of electrical, hydraulic, and pneumatic lines; and the installation of the prime mission equipment all critical manufacturing processes.

The program is currently building the first two development aircraft. According to the program office, there are no significant differences in the manufacturing processes for the development aircraft and the production aircraft.

Agency Comments

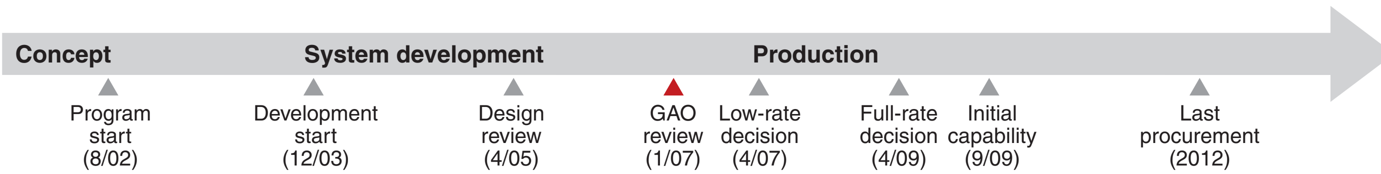
In commenting on a draft of this assessment, the Navy stated that the E-2D AHE program is executing the development contract and critical technologies do not represent a high risk to the program at present. The increase in drawings is due to some suppliers not using modern technology, so rework was necessary by the prime contractor to convert the drawings to support legacy manufacturing processes.

Flight testing, which will include the four critical technologies, is planned to begin in the fourth quarter of fiscal year 2007. The test program will demonstrate design maturity of all technologies and capabilities. A Technology Readiness Assessment will be conducted prior to the low-rate production decision. Integration of statistical process controls would require significant Navy investment to update the E-2D aircraft manufacturing process. The Navy has elected not to make this investment due to the maturity of the 30-plus-year E-2 production history.

EA-18G

The EA-18G Growler aircraft will replace the carrier-based EA-6B and provide electronic warfare capability to the Navy beginning in 2009. It is a combination of the Improved Capability (ICAP) III electronic suite and the F/A-18F platform. The EA-6B now provides support to the Navy as well as the Air Force and Marine Corps. Only 14 EA-6Bs have been funded to receive the ICAP III. Plans to develop a joint service airborne electronic attack system of systems have not developed as planned.

Source: ©2006 US Navy.



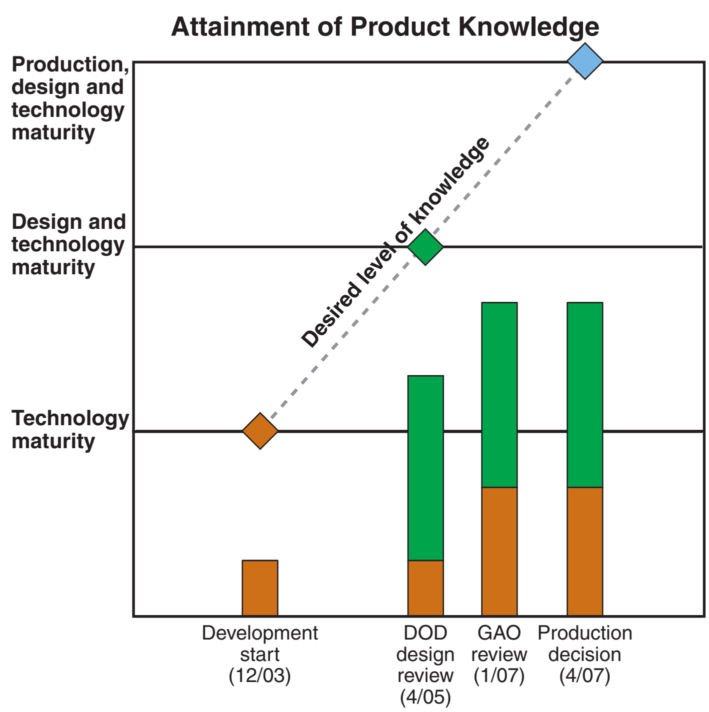
Program Essentials

Prime contractor: Boeing
Program office: Patuxent River, Md.
Funding needed to complete:
- R&D: $858.9 million
- Procurement: $6,354.5 million
- Total funding: $7,213.4 million
- Procurement quantity: 76

Program Performance (fiscal year 2007 dollars in millions)

	As of 12/2003	Latest 01/2007	Percent change
Research and development cost	$1,757.6	$1,840.3	4.7
Procurement cost	$6,494.2	$6,710.6	3.3
Total program cost	$8,251.8	$8,550.9	3.6
Program unit cost	$91.686	$106.887	16.6
Total quantities	90	80	-11.1
Acquisition cycle time (months)	70	69	-1.4

The EA-18G entered system development without demonstrating that its five critical technologies had reached full maturity, but has since made progress in maturing these technologies. However, all technologies are still not fully mature. The design appears stable, with almost all drawings complete. However, until all technologies demonstrate maturity, the potential for design changes remains. The program is executing a compressed development schedule to address an expected decline in the EA-6B inventory. However, upgrades have slowed the EA-6B inventory decline. The program now plans to reduce total procurement to 80 aircraft, but one third of the EA-18G aircraft will still be procured as low-rate initial production aircraft. Additional procurement and/or retrofit costs could occur if design deficiencies are discovered during the development and test phase.



EA-18G Program

Technology Maturity

None of the EA-18G's five critical technologies were mature when the program started development. Two of the critical technologies, the ALQ-99 pods and the F/A-18F platform, are mature. We assess the remaining three technologies—the ALQ-218 receiver system, the communications countermeasures set (CCS), and the tactical terminal system—as approaching full maturity. Software needed for full functionality of these technologies is not yet released. Tests to assess their performance will not occur until late fiscal year 2007.

The program considers the EA-18G development effort as low to medium risk because they consider the fielded F/A-18F aircraft and the ICAP III electronic suite mature. The program assessed all but the CCS mature because they include both what has been demonstrated as well as the level of development risk. We believe the assessment of the CCS is correct given that it will function on the EA-18G in a new environment with space constraints that will be a challenge. However, there are other technology form and fit challenges. The ALQ-218 receiver is being transferred from the EA-6B where it is housed in a larger pod on the vertical tail. For the EA-18G, the ALQ-218 has been redesigned to fit on the wing tips. This wing tip environment is known to cause severe under wing and wing tip noise and vibration that could degrade the performance of the receiver.

Design Stability

The design of the EA-18G appears to be stable. Program officials state that all drawings have been released and the design complete. However, flight tests are needed to verify the impact of loads on some of designs and whether redesign might be needed. In addition, the program continues to identify a number of risks that could impact eventual design and retrofit cost. One risk addresses the effect of vibration on reliability and performance of the wingtip pods for the ALQ-218 receiver. The effect of the wing tip environment on the performance and reliability of the ALQ-218 will not be known until flight tests are conducted. Currently all suitability performance measures and almost all ALQ-218 technical performance measures are based on calculated values. Actual values not are gathered until EA-18G flight tests are conducted. The first test EA-18G was delivered to the Navy for flight tests in September 2006. Schedules call for ALQ-218 flight performance tests to begin in February 2007 and operational tests in 2008. Initial operational capability for the EA-18G is planned for September 2009.

Production Maturity

We could not assess production maturity. The program does not collect statistical process control data. The program is executing a compressed development schedule to address an expected decline in EA-6B aircraft. Initial plans called for purchasing 90 EA-18Gs. The Navy/DOD is proposing to reduce the total quantity to 80 aircraft in the FY 2008 budget. The proposed reduction in procurement quantities from 90 to 84 is a result of re-evaluating inventory requirements in association with the Navy's proposed FY 2008 budget and the application of tiered readiness. A reduction totaling an additional 4 aircraft from the first low-rate initial production buy is also being considered, making the total procurement quantity 80 aircraft. Low-rate initial production aircraft will total one third of the total buy. This is significantly greater than the traditional DOD benchmark of 10 percent. Program officials state that the large initial production buy is driven in part by the scheduled replacement of the EA-6Bs due to the extensive flight hours on EA-6Bs, and the age of the existing inventory. However, in April 2006 we reported that EA-6B inventory levels were projected to meet the Navy's requirements at least until 2017.

Program officials state that EA-18G development continues to meet or exceed all cost, schedule and technical performance requirements. They also state that flight tests performed to date have shown the Advanced Electronic Attack system is very mature, and that software is being delivered ahead of schedule. However, the program also reports that post operational test and evaluation efforts have been funded to correct any deficiencies discovered during these tests. Also, the production and/or retrofit cost to correct design deficiencies discovered during the development and test phase are excluded from the production contract price and would require separate contract authorization.

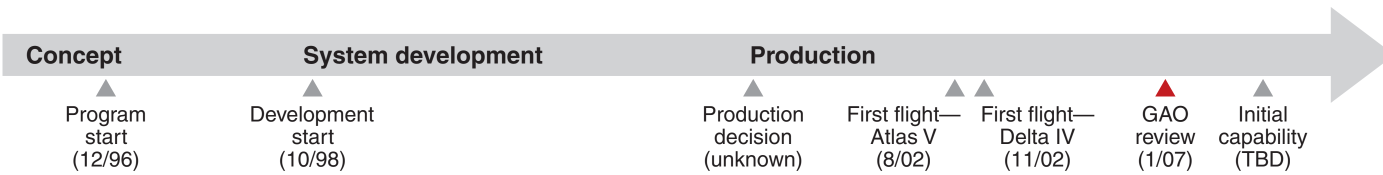
Agency Comments

In commenting on a draft of this report, the Navy provided technical comments, which were incorporated as appropriate.

Evolved Expendable Launch Vehicle (EELV) - Atlas V, Delta IV

The Air Force's EELV program acquires satellite launch services for military, intelligence, and civil missions from two families of launch vehicles—Atlas V and Delta IV. The program's goal is to preserve the space launch industrial base, sustain assured access to space, and reduce life cycle cost of space launches by at least 25 percent over previous systems. A number of vehicle configurations are available depending on the satellite vehicles weight and mission specifications. We assessed both the Atlas V and Delta IV.

Source: (Left) © 2005 ILS/Lockheed Martin; (right) © 2003 The Boeing Company.



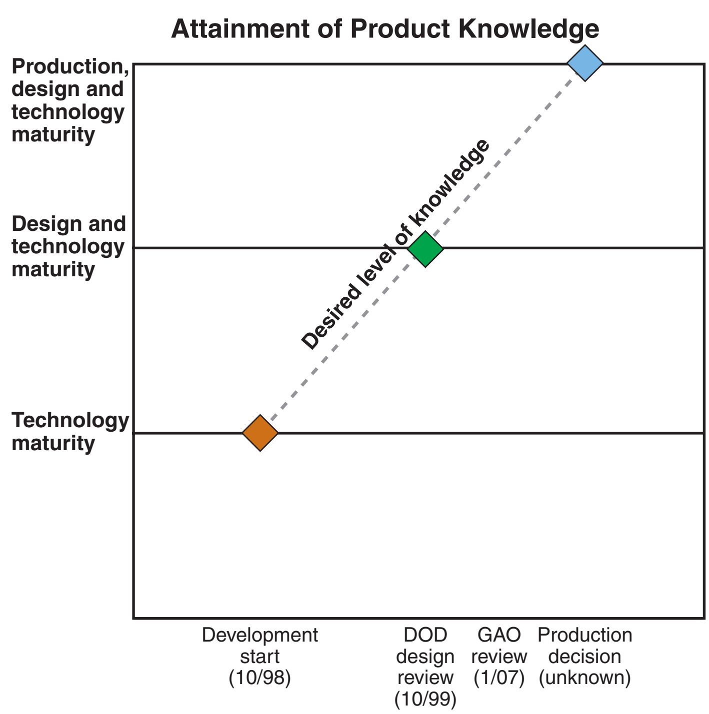
Program Essentials

Prime contractor: Boeing Launch Services, Lockheed Martin Space Systems
Program office: El Segundo, Calif.
Funding needed to complete:
- R&D: $18.3 million
- Procurement: $22,429.4 million
- Total funding: $22,447.7 million
- Procurement quantity: 110

Program Performance (fiscal year 2007 dollars in millions)

	As of 10/1998	Latest 12/2005	Percent change
Research and development cost	$1,636.8	$1,906.1	16.5
Procurement cost	$14,337.6	$26,673.9	86.0
Total program cost	$15,974.4	$28,580.0	78.9
Program unit cost	$88.256	$207.101	134.7
Total quantities	181	138	-23.8
Acquisition cycle time (months)	TBD	TBD	TBD

While the EELV program office now has access to technology, design, and production maturity information, such data is treated as proprietary due to the commercial nature of the existing launch services contracts. Three launches occurred since GAO's last assessment—one government, one NASA and one commercial bringing the total launches to 14. In May 2005, Boeing Launch Services and Lockheed Martin Space Systems announced an agreement to create a joint venture (United Launch Alliance, or ULA) that will combine production, engineering, test, and launch operations associated with U.S. government launches of Boeing Delta and Lockheed Martin Atlas rockets. In October 2006, the Federal Trade Commission announced its acceptance, subject to final approval, of an agreement containing a consent order with Boeing, Lockheed Martin, and ULA.



EELV Program

Technology Maturity

We could not assess the technology maturity of EELV because the Air Force has not formally contracted for information on technology maturity from its contractors.

Design Stability

We could not assess the design stability of EELV because the Air Force has not formally contracted for the information needed to conduct this assessment.

Production Maturity

We could not assess the production maturity of EELV because the Air Force has not formally contracted for information that would facilitate this assessment.

Other Program Issues

To meet national security space needs, congressional mandates, and national space transportation policy requirements for assured access to space, the government is sharing a level of risk with the launch providers through a new program strategy for EELV launches. Implemented in 2006, the strategy is expected to cover missions scheduled to launch starting in 2008. In 2005, the Air Force released requests for proposals for EELV launch services and EELV launch capabilities contracts. The Air Force awarded a cost plus award fee contract for launch capabilities to Lockheed Martin in February 2006 and to Boeing Launch Services in November 2006. The Air Force is currently negotiating a firm fixed price contract with a mission success incentive with Lockheed Martin for EELV launch services. The launch services contract with Boeing will follow.

As part of the proposed joint venture, the contractors expect to combine the Atlas V and Delta IV production at the Boeing plant in Decatur, Alabama, and engineering at the Lockheed Martin Facility in Denver, Colorado. The Federal Trade Commission has provisionally accepted a consent order regarding the joint venture. The proposed consent order was placed on public record for 30 days and addresses ancillary competitive harms that DOD has identified as not inextricably tied to the national security benefits of the proposed joint venture between Lockheed Martin and Boeing Launch Services. The Federal Trade Commission is currently reviewing public comments on the proposed consent order.

A 2006 congressionally mandated study on future launch requirements concluded that the EELV program can satisfy the nation's military space launch needs through 2020. However, the study noted that it is important to revalidate the requirements for heavy lift capability, assured access to space, the RL-10 upper stage, and the use of the Russian-built RD-180 engines in parallel with cost and performance assessments. According to EELV program officials, the program office is continually engaged on these issues, which under the new contract structure and the ULA joint venture can be more easily addressed.

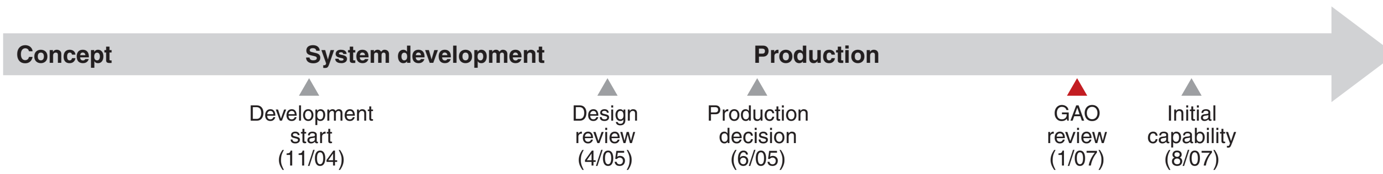
Agency Comments

In commenting on a draft of this assessment, the Air Force stated that the program is transitioning from a commercial services program, with limited insight, to a more traditional government program with full cost and program oversight. According to the Air Force, the transition will be completed in 2007 when both providers are awarded the EELV launch services contracts. Program officials also provided technical comments, which were incorporated where appropriate.

Expeditionary Fire Support System (EFSS)

The Marine Corps' EFSS includes a launcher, prime mover, ammo prime mover, and ammunition. It will be the primary fire support system for the vertical assault element of the Marine Corps' Ship to Objective Maneuver force and is designed to be internally transportable by the MV-22 and CH-53E. The EFSS prime mover is a variant of the Internally Transportable Vehicle (ITV), which is being developed in a separate program, but under common management with EFSS. We assessed all components of the EFSS.

Source: EFSS/ITV Program Office, Marine Corps Systems Command.



Program Essentials

Prime contractor: General Dynamics Ordnance and Tactical Systems
Program office: Quantico, Va.
Funding needed to complete:
- R&D: $31.1 million
- Procurement: $33.9 million
- Total funding: $86.1 million
- Procurement quantity: 60

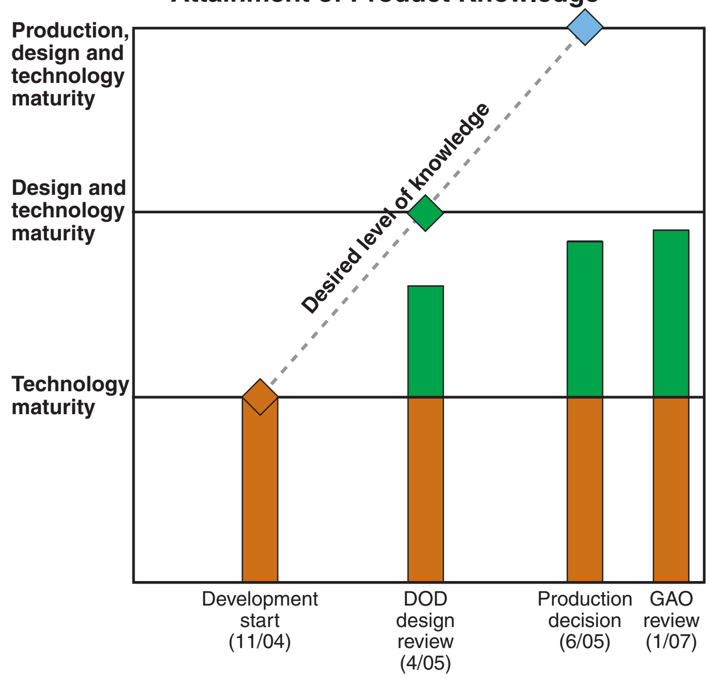
Program Performance (fiscal year 2007 dollars in millions)

	As of 11/2004	Latest 06/2006	Percent change
Research and development cost	$51.2	$67.8	32.4
Procurement cost	$580.9	$580.9	0.0
Total program cost	$727.7	$744.3	2.3
Program unit cost	$10.546	$10.634	0.8
Total quantities	69	70	1.4
Acquisition cycle time (months)	52	52	0.0

According to the program office, between 2004 and 2006 the program experienced requirements growth. Significant funding was used for ammunition development (for precision guided munitions) and certification efforts (to develop insensitive munitions).

While the EFSS is in production, we could not assess production maturity as the program is not collecting statistical data on its production processes. However, according to the program office, an ITV operational assessment revealed manufacturing problems. In addition, the EFSS passed its design review and entered production without having achieved design stability. Deficiencies were identified during EFSS developmental testing of selected requirements. Although 18 requirements were fully met, 3 were not. Also, while other variants of the ITV have received an interim flight certification for the V-22, CH-53, and C-130 aircraft during the ITV operational assessment, the EFSS vehicle has not yet been certified as it was not a part of that assessment. The EFSS program has, however, completed about 95 percent of the certification indicating it can safely transport munitions on Navy ships.

Attainment of Product Knowledge



EFSS Program

Technology Maturity

We have assessed the EFSS as having mature technologies. Program officials have stated that the EFSS is relying on existing technologies.

Design Stability

The EFSS design was not stable at the time of the EFSS design review as only an estimated 60 percent of the system drawings were complete at that point. Furthermore, EFSS entered production still short of having obtained design stability, though it was nearing stability with 84 percent of the drawings completed. During ongoing ITV operational testing, the vehicle's half shaft (an axle component) did not perform adequately and there were problems with some fuel flow gauges. While most of the EFSS components are modified commercial-off-the-shelf items, the half shaft used during the ITV operational test was a custom-built item. The program office is now replacing it with a stronger commercial one to address the operational shortfalls noted. The operational assessment also revealed problems with the accuracy of the fuel gauges. Fixes for these deficiencies are undergoing reliability testing. As these issues are resolved, the EFSS design is expected to change.

The EFSS is currently an unarmored vehicle. In fiscal year 2007, Congress added $8 million to the EFSS program for armor kits. Because the program is constrained by weight and size requirements (a key performance parameter is its ability to be transported internally by the MV-22 aircraft and CH-53E helicopter), the program office is designing two types of kits. The "A" kit will be permanently attached and add about 60 pounds to the vehicle. The "B" kit will be added after the vehicle exits the aircraft and is expected to add an additional 85 pounds. Also, the program office is installing blast-attenuating seats on the EFSS vehicles. These changes will result in additional design modifications, as many lessons are learned in the course of further testing.

Production Maturity

We could not assess EFSS production maturity as the program is not collecting statistical control data on its production processes. The program is currently in low-rate initial production and is on schedule to enter full-rate production by the third quarter of fiscal year 2007. According to the program office, during the ongoing operational assessment of the ITV, EFSS experienced 24 failures—18 of which were associated with 2 components. The remaining 6 failures were associated with assembly problems. For example, 3 vehicles did not have their fuel pumps set at the right setting for the type of fuel used. According to the program office, these manufacturing problems remain a challenge for the program.

Other Program Issues

While an EFSS developmental test revealed that 3 of the 24 tested requirements were not met, officials said that to date all but 1 have been resolved. When placed in a firing position and with a projectile ready to load, the system should be able to fire the first round within 30 seconds. The average first round response time was 57.3 seconds with live fire. In addition, the program office told us it has successfully reduced the vehicle weight by 180 pounds, completed 95 percent of the process designed to ensure that the system can safely carry munitions on-board Navy ships, and will meet insensitive munitions requirements. In addition, other ITV variants have received interim flight certification for the V-22, CH-53, and C-130 aircraft. However, the EFSS vehicles have not yet been flight certified. However, according to the program office, all EFSS vehicles are on track for final certification by April 2007.

In addition to the internal EFSS program issues discussed above, the space available on the MV-22 constrains the EFSS vehicle design and weight. As a result, if the MV-22 interior design is altered, it could adversely impact the EFSS program. The V-22 program office is aware of these contraints and is committed to them.

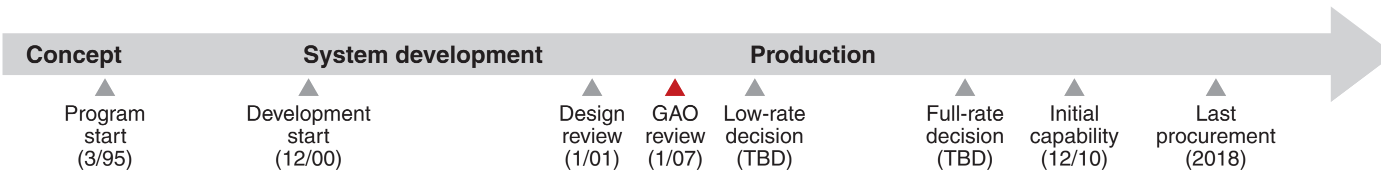
Agency Comments

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

Expeditionary Fighting Vehicle (EFV)

The Marine Corps' EFV is designed to transport troops from ships offshore to their inland destinations at higher speeds and from longer distances than the system it is designed to replace, the Assault Amphibious Vehicle 7A1 (AAV-7A1). The EFV will have two variants—a troop carrier for 17 combat-equipped Marines and 3 crew members and a command vehicle to manage combat operations in the field. We assessed both variants.

Source: General Dynamics Land Systems.



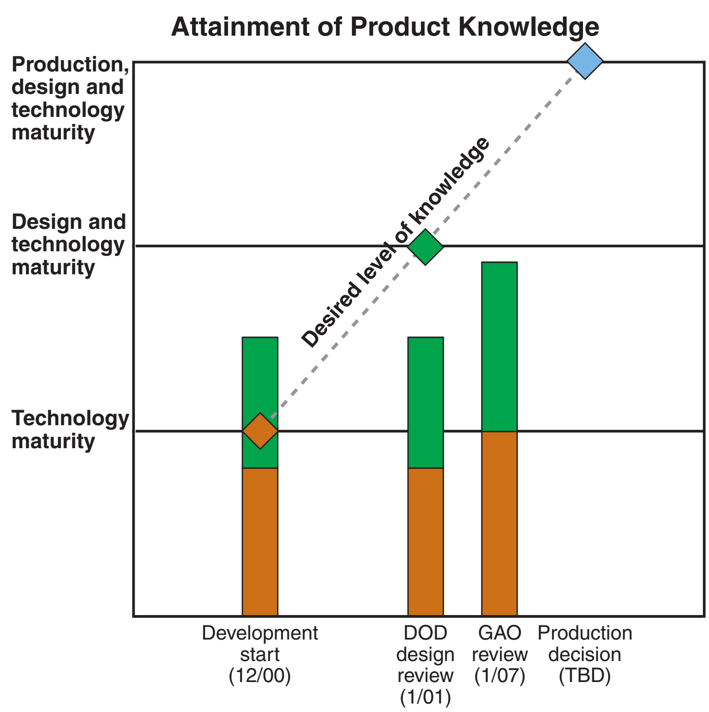
Program Essentials

Prime contractor: General Dynamics
Program office: Woodbridge, Va.
Funding needed to complete:
R&D: $502.3 million
Procurement: $8,546.8 million
Total funding: $9,107.5 million
Procurement quantity: 1012

Program Performance (fiscal year 2007 dollars in millions)

	As of 12/2000	Latest 08/2006	Percent change
Research and development cost	$1,518.9	$2,415.6	59.0
Procurement cost	$6,811.9	$8,748.5	28.4
Total program cost	$8,418.2	$11,254.9	33.7
Program unit cost	$8.213	$10.980	33.7
Total quantities	1,025	1,025	0.0
Acquisition cycle time (months)	138	189	37.0

The EFV's technologies are mature and the system design was thought to be stable. Given the recent discovery of problems associated with reliability, a decision on how to proceed is pending by the Marine Corps that could significantly impact the program cost, schedule, and quantity parameters. Congress recently zeroed out the EFV's fiscal year 2007 procurement budget request and directed that the EFV program extend its development phase. Further, growth in the number of lines of software code needed for the EFV vehicle continues and could contribute to the already escalating program cost growth.



EFV Program

Technology Maturity
All five of the EFV system's critical technologies are mature and have been demonstrated in a full-up system prototype.

Design Stability
The EFV has released 82 percent of its initial production design drawings to the manufacturer. The program had planned to release the remaining drawings before the production decision in December 2006. According to a program official, because of recent system reliability failures discovered during the early operational assessment (EOA) testing, the production decision has been delayed. During the recent EOA, the EFV failed to perform reliably and only achieved a fraction of the required operational goal of 43.5 hours of operations before maintenance was required.

Production Maturity
Congress recently zeroed out the EFV's fiscal year 2007 procurement budget request and directed that it extend its system development and demonstration phase. The Marine Corps is currently considering production options that could impact cost, schedule, and quantity parameters.

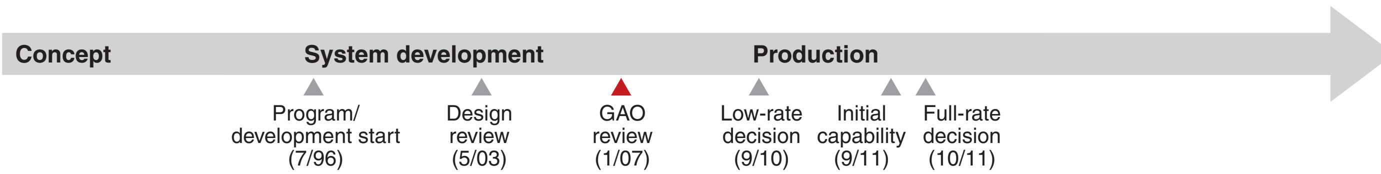
Other Program Issues
The EFV program relies on software to provide all electronic, firepower, and communication functions. The program is collecting metrics relating to cost, schedule, and quality and is using an evolutionary development approach. Nevertheless, software development continues to present a risk. The program continues to experience growth in the total lines of software code needed. Since development started in 2000, the total lines of software code required by the system has increased by about 238 percent, with approximately 36 percent of this amount being new code. Additionally, software planned for the EFV initial production version will be different from the software used in the SDD versions. Furthermore, software testing has identified 187 software defects. The Marine Corps testing agency identified software failure as a factor impacting the system's reliability. We believe that software issues could put the program at risk for cost growth. In addition, to the recently discovered reliability issues that will require some, yet, undisclosed system changes, the program is already planning changes to the EFV baseline program, which are driven by the Quadrennial Defense Review and the Strategic Planning Guidance.

Agency Comments
In commenting on a draft of this assessment, the Navy stated that the EFV program is being restructured as a result of proposed quantity reductions and to incorporate reliability performance improvements in the vehicle design. The Under Secretary of Defense for Acquisition, Technology, and Logistics was briefed on the program office's plans in October 2006, and has declined to make an acquisition decision. The Under Secretary has concurred with the Department of the Navy to convene an Independent Expert Program Review (IEPR) to examine the EFV program and recommend a path forward. The IEPR is scheduled for completion in December 2006, with a program review in the January-February 2007 time frame. After which, an acquisition path forward will be decided.

Extended Range Munition (ERM)

The Navy's ERM is a 5-inch, rocket-assisted projectile that will provide fire support to expeditionary forces operating near the littorals. ERM is being designed to fire to an objective range of 63 nautical miles using modified 5-inch guns onboard 32 Arleigh Burke class destroyers. ERM represents a continuation of the Navy's Extended Range Guided Munition program, which entered system development and demonstration in 1996. The Navy is currently restructuring the program to reflect an updated initial fielding date of 2011.

Source: Naval Gunnery Project Office, PEO IWS3C/Raytheon, ©2006 Raytheon.



Program Essentials

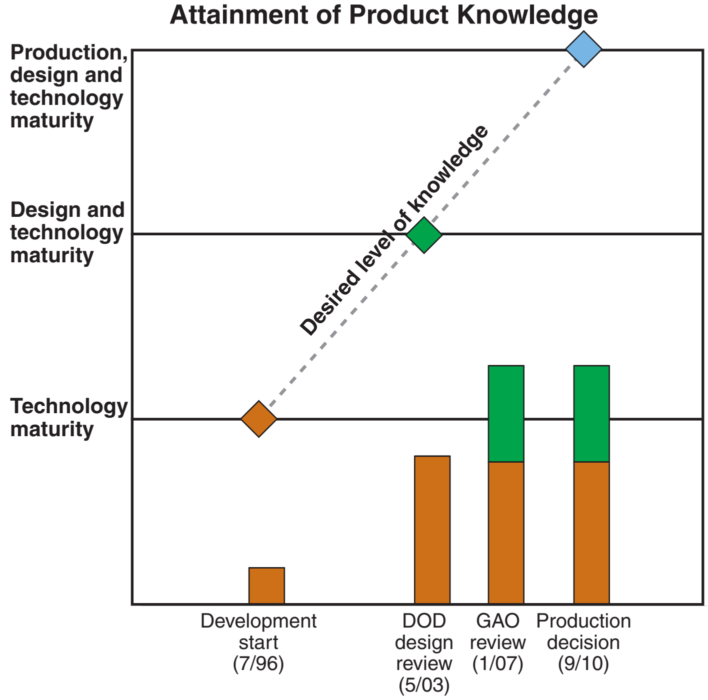
Prime contractor: Raytheon Missile Systems
Program office: Arlington, Va.
Funding needed to complete:
R&D: $130.9 million
Procurement: $862.5 million
Total funding: $993.4 million
Procurement quantity: 15,040

Program Performance (fiscal year 2007 dollars in millions)

	As of 04/1997	Latest 11/2006	Percent change
Research and development cost	$84.2	$520.6	518.5
Procurement cost	$332.5	$906.1	172.5
Total program cost	$416.7	$1,426.8	242.4
Program unit cost	$.049	$.094	94.3
Total quantities	8,570	15,100	76.2
Acquisition cycle time (months)	50	182	264.0

The Navy identifies 17 critical technologies for ERM, 11 of which have reached maturity. A series of flight tests in 2005 revealed reliability problems with several ERM components. The Navy continues to evaluate data from these flight tests, but anticipates that design changes for some technologies may be required. In addition, the Navy has identified a number of obsolete components in the ERM design. As a result, ERM is undergoing significant redesign, and 63 percent of the munition's design drawings have been released to date. According to program officials, the Navy continues to evaluate plans and identify resources required for completing development of the munition. Until these plans are approved and performance of redesigned components is validated through testing, uncertainty remains on whether the Navy's goal to begin fielding ERM in 2011 is realistic.

Attainment of Product Knowledge



ERM Program

Technology Maturity

Eleven of ERM's 17 critical technologies are fully mature. Four technologies—the anti-jam electronics, control actuation system, data communication interface, and safe/arm device and fuze—are approaching full maturity. However, the Navy's maturity assessment for two technologies may need to be reduced pending reports from failure review boards the Navy initiated after ERM flight test failures in 2005. According to program officials, these review boards have preliminarily identified ERM's control actuation system and rocket motor igniter as potential contributors to the test failures, which could require redesign of these components. In addition, the Navy has encountered obsolescence issues with ERM's global positioning satellite receiver and inertial measurement unit technologies. As a result, program officials report they have had to identify alternative components for these technologies and redesign the munition to accommodate these new components. Until these replacement components are integrated and tested with the munition, the global positioning satellite receiver and inertial measurement unit technologies will remain at lower levels of maturity. Although program officials report that the Navy continues to evaluate schedule and cost options for completing ERM system development, a comprehensive test plan for the munition has not been established.

Design Stability

The program has released approximately 63 percent of ERM's anticipated 140 production representative engineering drawings. None of these drawings were released in time for the munition's May 2003 design review. Instead, the Navy conducted this review with less mature drawings and used them to validate the design of the developmental test rounds. According to program officials, recent changes to ERM components to address obsolescence and reliability issues have required significant redesign of the munition. Program officials state that this redesign process for ERM will be complete before further developmental tests are initated for the munition. The completed design will then be reviewed and certified by a mission control panel within the Navy.

Production Maturity

The Navy plans to collect statistical process control data for ERM once hardware production begins. According to Navy officials, approximately 60 ERM units will be built during system development using process control methods developed in the Excalibur program. The Navy anticipates that this strategy will result in mature production processes for ERM at the beginning of low-rate production.

Other Program Issues

As a result of challenges in developing ERM, the Navy awarded a demonstration contract in May 2004 for the Ballistic Trajectory Extended Range Munition (BTERM). This munition's rocket motor caused test failures that led the Navy to abandon plans to recompete the development contract for ERM. According to a Navy official, the Navy concluded that ERM was a more viable option for fielding a tactical round by fiscal year 2011, and it is no longer requesting funding for BTERM. Navy officials state a competition could still occur in 2011 for ERM production.

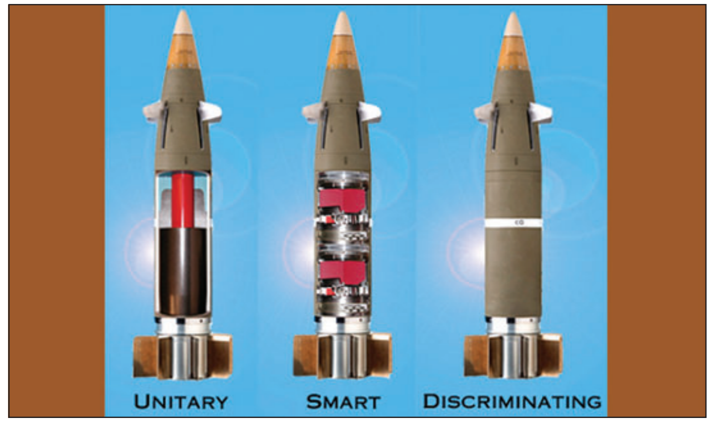
In August 2006, oversight of the ERM program was elevated by requiring that major programmatic decisions, such as approval of the Navy's estimate for resources needed for completion and the strategy for development and testing, be approved by the Under Secretary of Defense for Acquisition, Technology, and Logistics rather than by the Navy. While this restructuring has elevated oversight, program plans continue to evolve, and a comprehensive review of the program by the Under Secretary has not been performed.

Agency Comments

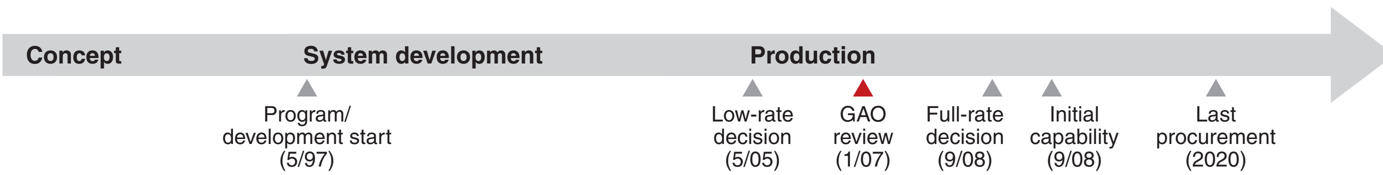
The Navy stated that a revised acquisition strategy and acquisition program baseline for ERM are under review by the Assistant Secretary of the Navy for Research, Development, and Acquisition. In addition, the prime contractor for ERM, Raytheon, has conducted an extensive trade study and downselect process to minimize technical risk for replacing obsolete components. The Navy is also updating ERM's test and evaluation master plan to include three development test phases of 20 rounds each in fiscal years 2008 through 2010 as well as a 40-round shipboard operational test series in fiscal year 2011. Each test series must be successfully completed as defined in annual continuation criteria certified by ERM's milestone decision authority. In addition, contractor production processes will be evaluated as part of an open competition for initial and full-rate production of ERM.

Excalibur Precision Guided Extended Range Artillery Projectile

The Army's Excalibur is a family of global positioning system-based, fire-and-forget, 155-mm cannon artillery precision munitions intended to improve the range and accuracy of cannon artillery. The Excalibur's near vertical angle of fall should reduce collateral damage area around the intended target, making it more effective in urban environments than the current projectiles. The Future Combat System's non-line-of-sight cannon requires the Excalibur to meet its required range. Only the unitary variant block is currently being developed.



Source: PM Excalibur and Raytheon.



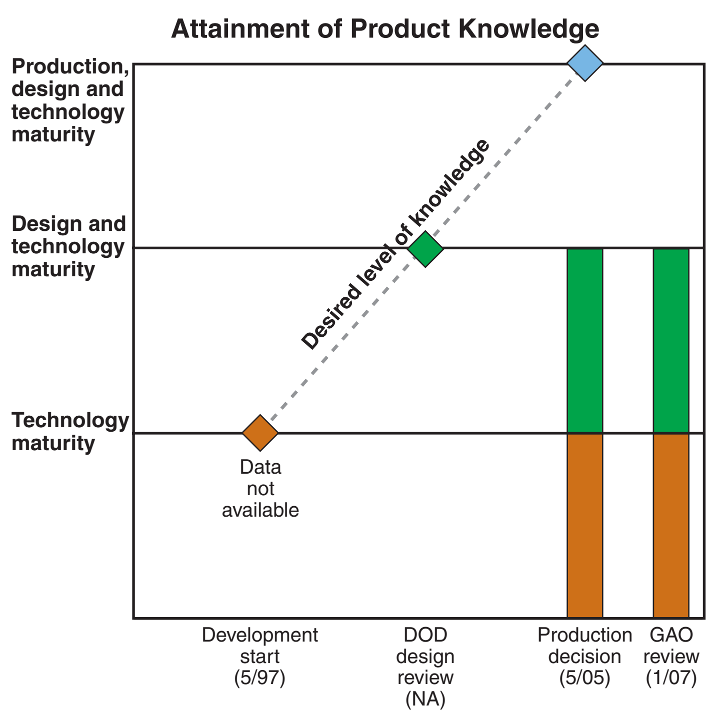
Program Essentials

Prime contractor: Raytheon, Tucson, Ariz.
Program office: Picatinny Arsenal, N.J.
Funding needed to complete:
R&D: $275.7 million
Procurement: $1,127.2 million
Total funding: $1,402.9 million
Procurement quantity: 29,665

Program Performance (fiscal year 2007 dollars in millions)

	As of 05/1997	Latest 12/2005	Percent change
Research and development cost	$64.6	$883.0	1,267.4
Procurement cost	$724.3	$1,180.7	63.0
Total program cost	$788.9	$2,063.7	161.6
Program unit cost	$.004	$.068	1,627.0
Total quantities	200,000	30,294	-84.9
Acquisition cycle time (months)	160	136	-15.0

The Excalibur program has begun early production to support an urgent early fielding requirement in Iraq for more accurate artillery that will reduce collateral damage. According to program officials, this early production run of the Excalibur's first incremental block will involve 500 rounds and fielding has been delayed due to test issues until sometime in the second quarter of fiscal year 2007. They also noted that Excalibur's critical technologies reached full maturity in May 2005, and all of its 790 drawings were completed in July 2005. The Excalibur unitary variant will be developed in three incremental blocks, which will incorporate increased capabilities and accuracy over time. Since development began in 1997, the program has encountered a number of significant changes including four major restructures, reduced initial production quantities and increased unit costs.



Excalibur Program

Technology Maturity

The Excalibur program is developing its unitary variant in three incremental blocks. All three of the unitary variant's critical technologies reached full technology maturity in May 2005 at the time of the Excalibur's design review. These technologies were the airframe, guidance system, and warhead.

Design Stability and Production Maturity

In May 2005, Excalibur held its design review and entered production. Excalibur's design appears to be stable. At the time of the design review, 750 of 790 design drawings were releasable. All 790 were complete for the first Excalibur block in July 2005. By August 2006, the number of releasable drawings had grown to 943.

We could not assess Excalibur's production maturity. The first block has entered limited production, to support an urgent fielding requirement in Iraq, with limited statistical control data. The program expects to begin collecting statistical control data for all key manufacturing processes starting in fiscal year 2007. Production of the second block is scheduled for fiscal year 2007 and the third block in fiscal year 2010.

Other Program Issues

Excalibur started as a combination of three smaller artillery programs with the intent to extend the range of artillery projectiles with an integrated rocket motor. It is expected to enable three different Army howitzers and the Swedish Archer howitzer to fire further away and defeat threats more quickly while lowering collateral damage and reducing the logistic support burden. The program has encountered a number of changes and issues since development began in 1997, including a decrease in planned quantities, a relocation of the contractor's plant, early limited funding, technical problems, and changes in program requirements. Since 1997, it has been restructured four times including when the program was merged, in 2002, with a joint Swedish/U.S. program known as the Trajectory Correctable Munition. This merger helped the Excalibur deal with design challenges, including issues related to its original folding fin design. Also in 2002, the program was directed to include the development of the Excalibur for the Army's Future Combat System's Non-Line-of-Sight Cannon. The net effect of these changes has been to lengthen the program's schedule and to substantially decrease planned procurement quantities. As a result, program overall cost and unit cost have dramatically increased.

The Excalibur plan currently focuses on developing its unitary version in three incremental blocks. In the first block, the projectile would meet its requirements for accuracy in a non-jammed environment and lethality and would be available for early fielding. In the second block, the projectile would be improved to meet its requirements for accuracy in a jammed environment, extended range, and increased reliability. It would be available for fielding to the Future Combat System's Non-Line-of-Sight Cannon in September 2008 or when the cannon is available. Finally, in the third block, the projectile would be improved to further increase reliability, lower unit costs, and would be available for fielding to all systems in late fiscal year 2011. The other two Excalibur variant blocks—smart and discriminating—would enter system development in fiscal year 2010.

In 2002, an early fielding plan for the unitary version was approved. According to the program office, test issues have now delayed its fielding to Iraq from the 2nd quarter of fiscal year 2006 until the second quarter of fiscal year 2007. Also, first article testing was completed with an intial reliability of over 80 percent. The program office also noted that the initial block will exceed the objective requirements for accuracy and effectiveness. A limited user test is scheduled for the second quarter of fiscal year 2007 prior to fielding in Iraq. Development of the second incremental block is ongoing.

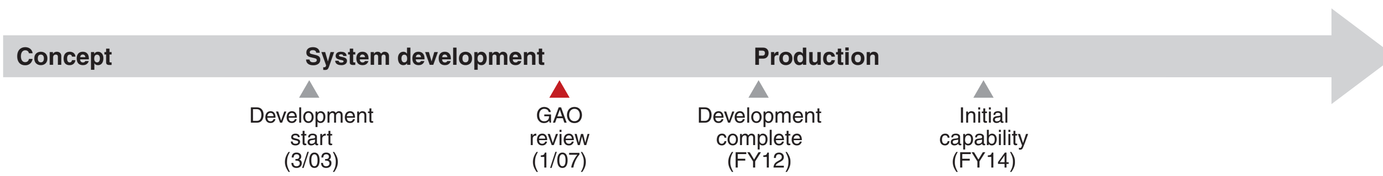
Agency Comments

In commenting on a draft of this assessment, the Army provided technical comments, which were incorporated as appropriate.

F-22A Modernization and Improvement Program

The Air Force's F-22A, originally planned to be an air superiority fighter, will also have air-to-ground attack capability. It was designed with advanced features, such as stealth characteristics, to make it less detectable to adversaries and capable of high speeds for long ranges. The F-22A's modernization and improvement program is intended to provide enhanced ground attack, information warfare, counterair, and other capabilities and improve the reliability and maintainability of the aircraft.

Source: F-22A System Program Office.



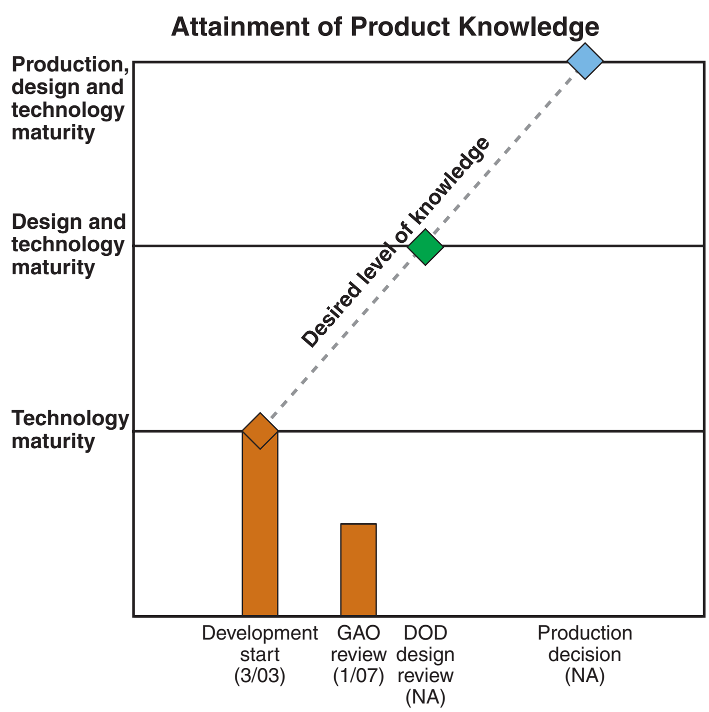
Program Essentials

Prime contractor: Lockheed Martin
Program office: Dayton, Ohio
Funding needed to complete:
- R&D: $1,938.0 million
- Procurement: $1,083.0 million
- Total funding: $3,021.0 million
- Procurement quantity: 0

Program Performance (fiscal year 2007 dollars in millions)

	As of 03/2003	Latest 09/2006	Percent change
Research and development cost	$2,984.0	$2,998.0	0.5
Procurement cost	$517.0	$1,287.0	148.9
Total program cost	$3,501.0	$4,285.0	22.4
Program unit cost	$12.824	$24.769	93.1
Total quantities	273	173	-36.6
Acquisition cycle time (months)	133	133	0.0

In 2003, the F-22A established a modernization program to add enhanced air-to-ground capabilities to aircraft. At that time, all three of the critical technologies needed were mature according to the program office. Since then, however, the program has added three additional critical technologies, all of which are not mature. The F-22A continues to fall short of its required reliability rates. The F-22A program implemented a reliability and maintainability maturation program to increase aircraft reliability rates to required levels. Although the F-22A program has made improvements to systems used to diagnose maintenance problems, these systems are still reporting inaccurate information 20 percent of the time.



F-22A Program

Technology Maturity

According to program officials, the F-22A modernization effort started development in 2003 with all three of its critical technologies mature. The three identified technologies involved 32-bit stores management system, processing memory, and cryptography. However, since the modernization started the program has added three additional critical technologies. These technologies involve smaller and more powerful radio frequency components, larger bandwidth, and radio frequency low observable features. At the time of our review, none of these technologies had been demonstrated in a realistic environment. Program officials characterized their current stages of development as laboratory settings demonstrating basic performance, technical feasibility, and functionality but not form and fit (size, weight, materials, etc.). Overall technology maturity is consequently lower now than when the modernization effort began. Program officials cited funding instability and new program requirements as contributors to slower progress than planned. However, according to program office officials, the F-22A has a disciplined systems engineering process in place that ensures the technology is developed and matured before integrating the technologies onto the system.

Other Program Issues

In an effort to improve the reliability and maintainability of the F-22A, the Air Force budgeted $102 million in fiscal years 2006 and 2007. The F-22A continues to be below its expected reliability rates. A key reliability requirement for the F-22A is a 3-hour mean time between maintenance, defined as the number of operating hours divided by the number of maintenance actions. This is required by the time it reaches 100,000 operational flying hours, projected to be reached in 2010. Currently the mean time between maintenance is less than 1 hour, or half of what was expected at the end of system development.

In November 2005, the F-22A completed follow-on operational test and evaluation. The purpose of this test was to evaluate the capability of the F-22A to execute the air-to-ground mission, evaluate deferred initial operational test and evaluation items, and support initial operational capability declaration. The F-22A was evaluated as mission capable to complete some limited air-to-ground missions such as accurate delivery of Joint Direct Attack Munitions (JDAMs).

The Air Force has identified deficiencies that may impact the F-22A's ability to complete planned operations. For example, problems with the thermal management system have impacted the F-22A's ability to operate in hot weather conditions. The Air Force implemented a modification to correct the thermal management problems in early 2006. The F-22A's diagnostics and health management system continues to report some inaccurate data. Although the technical order data fault isolation accuracy has improved, the maintenance jobs created for corrective maintenance actions to return an aircraft to flyable status are still reporting inaccuracies around 20 percent of the time.

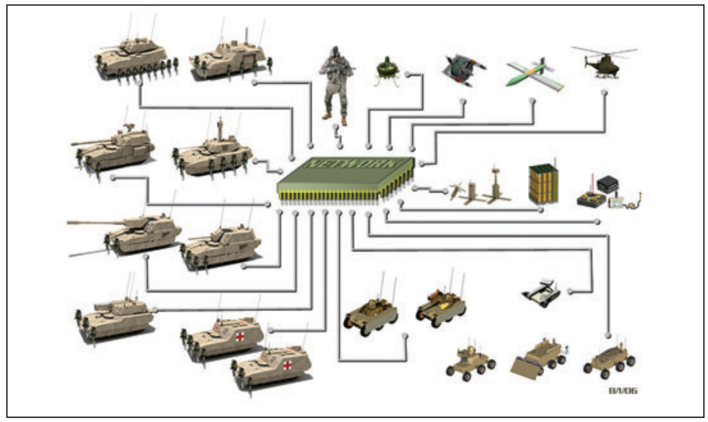
The Air Force identified structural cracks in two sections of the aircraft during fatigue testing that resulted in unplanned modifications to the F-22A. Fatigue testing identified cracks in the aircraft's aft boom where the horizontal tail attaches to the fuselage. The Air Force is planning modifications to strengthen the structure to get the 8,000-hour service life. These modifications are being implemented under the Structural Retrofit Program (SRP). The Air Force estimates the cost to modify 78 F-22As will be approximately $115 million. The modifications to correct this problem will not be fully implemented until 2010. The second structural problem involved cracking in "titanium casting" materials near the engine. Program officials stated that the problem with this titanium was a defect in the material from the subcontractor. The cost to correct this problem is not included in the SRP. The Air Force did not provide information on the cost to correct this problem.

Agency Comments

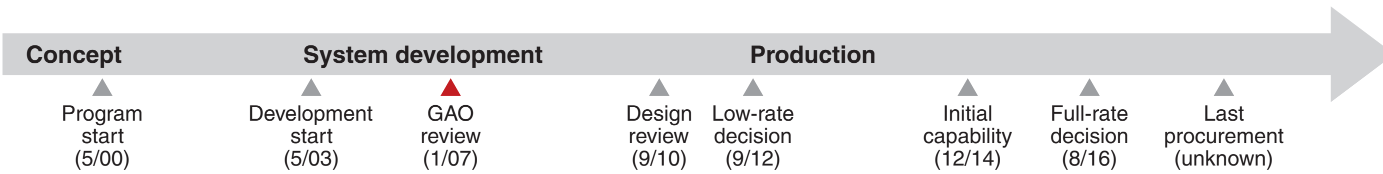
The Air Force provided technical comments, which were incorporated as appropriate.

Future Combat Systems (FCS)

The FCS program will equip the Army's new transformational modular combat brigades and consists of an integrated family of advanced, networked combat and sustainment systems; unmanned ground and air vehicles; and unattended sensors and munitions. Within a system-of-systems architecture, FCS features 18 major systems and other enabling systems along with an overarching network for information superiority and survivability. This assessment focuses on the full FCS program.



Source: Program Manager, Future Combat Systems (BCT).



Program Essentials

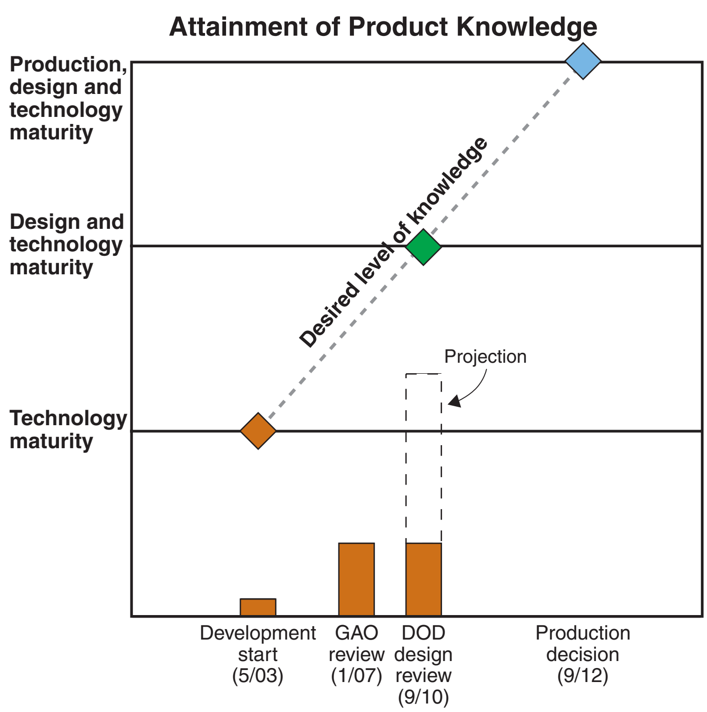
Prime contractor: Boeing
Program office: Hazelwood, Mo.
Funding needed to complete:
- R&D: $20,891.0 million
- Procurement: $101,920.0 million
- Total funding: $123,510.2 million
- Procurement quantity: 15

Program Performance (fiscal year 2007 dollars in millions)

	As of 05/2003	Latest 08/2006	Percent change
Research and development cost	$19,881.4	$29,043.9	46.1
Procurement cost	$64,916.5	$101,920.0	57.0
Total program cost	$85,456.9	$131,663.1	54.1
Program unit cost	$5,697.129	$8,777.541	54.1
Total quantities	15	15	0.0
Acquisition cycle time (months)	91	139	52.8

This assessment reflects the program of record. Since the conclusion of our review, the Army has announced program adjustments that will affect the architecture, program milestones, production quantities, and possibly other program areas.

The FCS program has made progress maturing critical technologies, but only 1 of the FCS' 46 critical technologies is fully mature. Technology maturation will continue throughout development, with an associated risk of cost growth and schedule delays. The Army does not expect to complete the definition of FCS' requirements until at least 2008. As FCS requirements continue to evolve, the Army anticipates making additional trade-offs. For example, a recent trade-off resulted in increased ballistic protection levels for manned ground vehicles but at an increased design weight. The Army anticipates that a high percentage of design drawings will be completed by the design review but that will not take place until 2010. FCS cost estimates have increased significantly as the Army has gained more product knowledge.



FCS Program

Technology Maturity

The FCS program has made progress maturing critical technologies in the last year, yet it still has not demonstrated the level of knowledge expected of a program entering development. Only 1 of the FCS' 46 critical technologies is fully mature. The program office provided its own updated critical technology assessment, which showed that 36 of 46 technologies are nearing full maturity. An independent assessment of FCS' critical technologies is expected before the preliminary design review in 2008.

The FCS program is not following the best practice standard of having mature technologies prior to starting system development. The program employs integration phases to facilitate incremental introduction of technologies into the FCS system of systems, and to allow for capability augmentation over time. The Army's approach, however, will allow technologies to be included in the integration phases before they approach full maturity. FCS officials insist fully matured technologies are not necessary until after the design readiness review in 2011, which is contrary to best practices and the intent of DOD acquisition policy.

The program has made progress defining FCS requirements, but the process may not be complete until the preliminary design review in 2008. In August 2006, the program documented the desired functional characteristics of FCS systems and the criteria for achieving those characteristics. Although a notable accomplishment, this event should have occurred before the start of development 4 years ago. Furthermore, if technologies do not mature as planned, Army officials say that they may trade off FCS capabilities. As the requirements process has proceeded, the Army has made key trade-offs, including one that increased the ballistic protection levels of the manned ground vehicles (to meet expected threats) and resulted in an increased design weight. The requirements definition process will continue at least until the preliminary design review in 2008 when the Army is expected to confirm the technical feasibility and affordability of the FCS system-level requirements.

Design Stability

The Army expects to conduct the preliminary design review in 2008—much later than recommended by best practices. However, it may be the point at which the FCS program finally approaches a match between requirements and resources. Beyond that, the FCS acquisition strategy includes a very aggressive schedule, with critical design review in 2010 and a Milestone C decision in 2012. Although it is early in the design process, the Army expects to release 95 percent of FCS's design drawings by 2010. Further, testing of the entire FCS concept will not occur until 2012, or just prior to an initial production decision, illustrating the late accumulation of key knowledge.

Other Program Issues

Program office estimates show that the FCS program's costs have increased substantially since the program began. The increases were primarily attributed to increased program scope and an extension of the development and procurement phases. Also, current cost estimates are built with greater program knowledge and are therefore more realistic and accurate. However, the most recent Army cost estimate does not yet reflect some recent requirements changes that increased the number and type of systems to be developed and procured. Further, recent independent cost estimates point out several major risk areas in the Army cost estimates. Although the program is working to reduce unit costs, those desired savings may not be realized until much later in the program, if at all.

Agency Comments

In commenting on a draft of this assessment, the FCS program manager stated that this assessment does not give the Army credit for the technical progress shown during recent demonstrations and experiments.

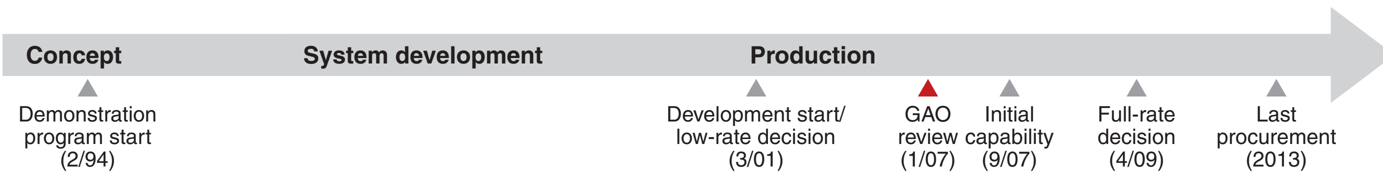
GAO Comments

While this assessment does not specifically focus on such demonstrations, they would be reflected to some extent in the Army's own technology assessments. Also, while some progress is being made on individual FCS systems, that progress is not consistent across the family of FCS systems and the information network.

Global Hawk Unmanned Aircraft System

The Air Force's Global Hawk system is a high altitude, long-endurance unmanned aircraft with integrated sensors and ground stations providing intelligence, surveillance, and reconnaissance capabilities. After a successful technology demonstration, the system entered development and limited production in March 2001. The acquisition program has been restructured several times. The current plan acquires 7 aircraft similar to the original demonstrators (the RQ-4A) and 47 of a larger and more capable model (the RQ-4B).

Source: Northrop Grumman Corporation.



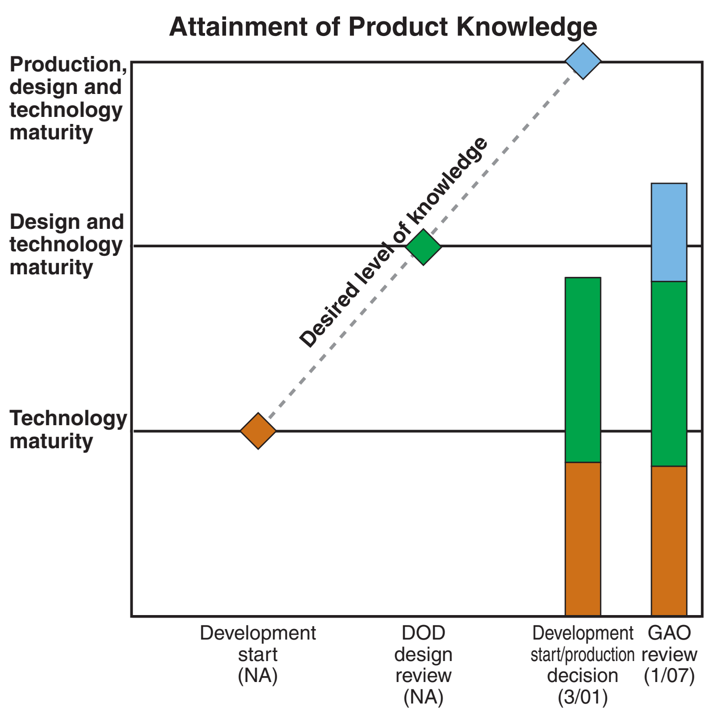
Program Essentials

Prime contractor: Northrop Grumman Corporation
Program office: Dayton, Ohio
Funding needed to complete:
- R&D: $1,614.1 million
- Procurement: $4,098.5 million
- Total funding: $5,791.8 million
- Procurement quantity: 35

Program Performance (fiscal year 2007 dollars in millions)

	As of 03/2001	Latest 09/2006	Percent change
Research and development cost	$957.6	$3,458.6	261.2
Procurement cost	$3,970.4	$5,485.6	38.2
Total program cost	$4,957.0	$9,083.2	83.2
Program unit cost	$78.683	$168.207	113.8
Total quantities	63	54	-14.3
Acquisition cycle time (months)	55	78	41.8

RQ-4A production is complete and two deployed in 2006 to support military operations. RQ-4B is in production with key technologies mostly mature. Representative prototypes of the two sensors driving the requirement for the larger aircraft are in flight test. Airframe design is now stable, but differences between the two models were much more extensive and complex than anticipated; these differences and ongoing support of military operations resulted in extended development times, frequent engineering changes, and significant cost increases. Statistical process controls are being implemented for some manufacturing processes, but delayed testing constrain efforts to mature processes. Dates for integrating and testing new technologies and for achieving initial operational capability have been delayed about 2 years. DOD is rebaselining the program with a substantial increase in cost.



Global Hawk Program

Technology Maturity

Critical technologies on the RQ-4B have made good progress during the last year with all 10 technologies mature or nearing maturity. This includes the advanced signals intelligence and improved radar sensors, the two key capabilities that drove the decision to develop and acquire the larger aircraft. Representative prototypes of both sensors are in flight tests.

Design Stability

The RQ-4B basic airframe design is now stable with 100 percent of engineering drawings released. During the first year of production, however, frequent and substantive engineering changes increased development and airframe costs and delayed delivery and testing schedules. Differences between the two aircraft models were much more extensive and complex than anticipated.

Production Maturity

The contractor has completed RQ-4A production. Four aircraft have been officially accepted into the operational inventory and three will be delivered in 2007. Completing the RQ-4A operational assessment has been delayed about 2 1/2 years and performance problems were identified in communications, imagery processing, and engines. Officials reported that the deficiencies have been addressed and the assessment will be completed by April 2007.

The first RQ-4B aircraft completed production in August 2006 and will soon start develomental flight testing. Another 11 are on order through the fiscal year 2006 buy. Statistical process controls are being implemented for some manufacturing processes. Officials have identified critical processes and started to collect data for demonstrating capability to meet cost, schedule, and quality targets. Other performance indicators such as defects and rework rates are also used to monitor quality.

Continuing delays in flight and operational tests may affect efforts to mature production processes. Performance and flight issues identified during tests could result in design changes, revised production processes, and rework. Completing operational tests to verify the basic RQ-4B design works as intended have been delayed more than 2 years to February 2009. By that time, the Air Force plans to have bought about one-half the entire fleet. Schedules for integrating, testing, and fielding the new advanced sensors have also been delayed, raising risks that these capabilities may not meet the warfighter's performance and time requirements.

Other Program Issues

We have previously reported significant cost, schedule, and performance problems for the Global Hawk program. Soon after its March 2001 start, DOD restructured the program from a low-risk incremental approach to a high-risk, highly concurrent strategy to develop and acquire the larger RQ-4B aircraft with advanced, but immature, technologies on a much accelerated production schedule. Since then, the development time has been extended another 3 years with a substantial contract cost overrun, production costs have increased, and software and component parts deliveries have slipped as have the schedules for many critical milestones and testing dates. The Air Force reported breaches of Nunn-McCurdy unit cost thresholds (10 U.S.C. 2433) and DOD had to certify the need for the program to Congress and establish improved cost controls. Due to the unit cost and schedule breaches, the Global Hawk program is being rebaselined for the fourth time since the March 2001 start. The revised average unit procurement cost estimate is 56.5 percent higher than the 2002 approved baseline.

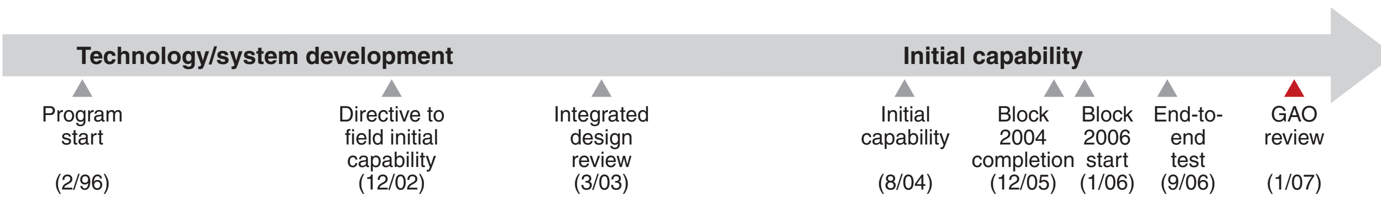
Agency Comments

In commenting on a draft of this assessment, the Air Force stated that the Global Hawk program is stronger today than it was last year. As noted above, technology, design, and production have progressed at the same time management, technical and risk management processes have improved. RQ-4A systems entered Global War on Terror operations providing warfighters with over 83,500 intelligence images, while other aircraft are currently being deployed to the user. The basic RQ-4B aircraft has completed development, entered production, and started testing. The advanced payload developers moved into early component testing, which is an important risk reduction milestone for integration. The program continues to focus on military operations and conducting comprehensive testing as that capability moves into production and deployment. Program challenges include software production, advanced sensors payload integration, and sustainment normalization.

Ground-Based Midcourse Defense (GMD)

MDA's GMD element is being developed incrementally to defend the United States against long-range ballistic missile attacks. Block 2006 provides a limited defensive capability and consists of a collection of radars and interceptors, which are integrated by a central control system that formulates battle plans and directs the operation of GMD components. We assessed the maturity of all technologies critical to the Block 2006 GMD element, but we assessed design and production maturity for the interceptors only.

Source: Department of Defense.



Program Essentials

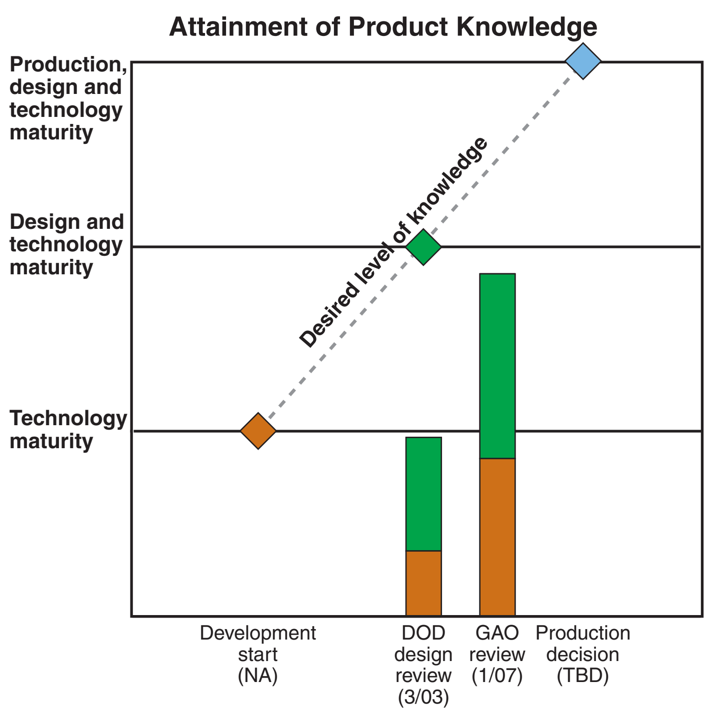
Prime contractor: Boeing Company
Program office: Arlington, Va.
Funding FY07-FY11:
R&D: $11,076.4 million
Procurement: $0.0 million
Total funding: $11,076.4 million
Procurement quantity: NA

Program Performance (fiscal year 2007 dollars in millions)

	As of 02/2003	Latest 08/2006	Percent change
Research and development cost	$23,776.5	$30,667.9	29.0
Procurement cost	$0.0	$0.0	0.0
Total program cost	$23,776.5	$30,667.9	29.0
Program unit cost	NA	NA	NA
Total quantities	NA	NA	NA
Acquisition cycle time (months)	NA	NA	NA

Columns include all known costs and quantities from the program's inception through fiscal year 2009. Total known program cost through fiscal year 2011 is $34,135.1

Even though only 9 of GMD's 13 critical technologies are fully mature, MDA released all hardware drawings to manufacturing and expected to have 14 interceptors available for operational use by December 2006. Ongoing efforts to mature remaining technologies, along with concurrent testing and fielding efforts may lead to additional design changes. Although MDA is producing hardware for operational use, it has not made a formal production decision. Additionally, we could not assess the stability of the production processes because the program is not collecting statistical data for them. As reported in our last assesment, we expect that the prime contract could overrun its target cost by $1.5 billion. According to program officials, the primary cost drivers are challenges with the EKV, testing, redesign of the BV+ booster, and maintenance and repair on the SBX platform.



GMD Program

Technology Maturity

Program officials assessed 9 out of 13 critical technologies as mature. The 4 remaining technologies have not been demonstrated in a realistic environment; therefore they do not meet the criteria for a full level of maturity. Mature technologies include the fire control software, the Block 2004 exoatmospheric kill vehicle (EKV) infrared seeker; EKV discrimination; the Orbital Sciences Corporation booster; the Cobra Dane radar; the Beale radar; the sea-based X-band radar, the guidance, navigation, and control subsystems, and the in-flight interceptor communications system. The remaining technologies, which are nearing maturity, are the Block 2006 version of the upgraded infrared seeker and onboard discrimination for the EKV units, and the BV+ booster, including its guidance, navigation, and control subsystem. These remaining technologies are due to be initially fielded in 2008.

Design Stability

The design of the Block 2006 ground-based interceptor appears stable with 100 percent of its drawings released to manufacturing. However, program officials acknowledge that changes to the interceptor's design and drawings may be necessary because the program is developing the interceptor in parallel with testing, fielding, and operations.

Production Maturity

Officials do not plan to make an official production decision as the program will evolve and mature interceptors through block capability enhancements as they are fielded for limited defensive operations. We could not assess the maturity of the production processes for these interceptors because the program is not collecting statistical control data. According to program officials, data are not tracked because current and projected quantities of GMD component hardware are low. Instead, the GMD program measures production capability and maturity with a monthly evaluation process called a manufacturing capability assessment that assesses critical manufacturing indicators for readiness and execution.

MDA had 10 interceptors ready for alert by December 2005 and expected to emplace 6 more by the end of December 2006 for a total of 16. However, at the time of our assessment, program officials estimated that only 14 interceptors would be fielded by that time. By the end of Block 2006, in December 2007, MDA plans to have 24 interceptors fielded. Fielding delays have occurred as the contractor increased the robustness of its quality assurance program. All interceptors fielded to date use the Orbital Science Corporation's OBV booster. The BV+ booster is continuing to mature and is expected to be ready for flight testing in fiscal year 2008.

Other Program Issues

The GMD test program was restructured in 2005 because of flight test failures and quality control problems. GMD successfully completed two flight tests utilizing operational interceptors in fiscal year 2006. Flight test 2 was an end-to-end test of one engagement scenario resulting in a target intercept. Flight test 3, scheduled for December 2006, planned to have a target intercept as an objective, but the test has been delayed until at least the third quarter of fiscal year 2007. Accordingly, further tests are needed before models and simulations that estimate GMD's performance can be relied upon.

As reported in our last assessment, we estimate that at the contract's completion the GMD prime contractor, Boeing, could experience a cost overrun of approximately $1.5 billion. Program officials, however, believe that this cost data is distorted because the work plan that the contractor is being measured against does not reflect ongoing work. The program is in the process of implementing a new plan that will reflect new quality control processes and the latest flight test plan. Since our last assessment, GMD's planned budget through fiscal year 2009 has increased by $860 million (2.9 percent).

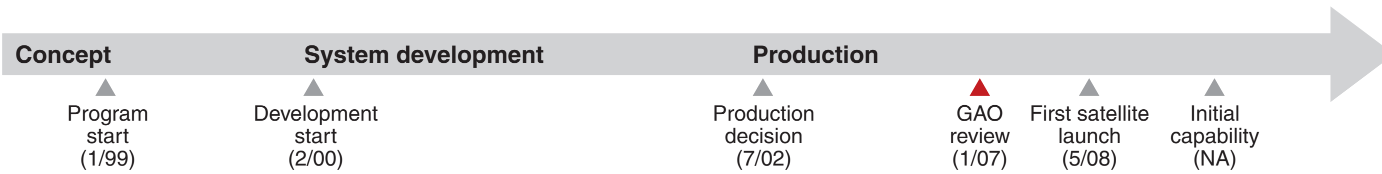
Agency Comments

MDA provided technical comments, which were incoporated as appropriate.

Navstar Global Positioning System (GPS) II Modernized Space/OCS

GPS is an Air Force-led joint program with the Army, Navy, Department of Transportation, National Geospatial-Intelligence Agency, United Kingdom, and Australia. This space-based radio-positioning system nominally consists of a 24-satellite constellation providing navigation and timing data to military and civilian users worldwide. In 2000, Congress approved the modernization of Block IIR and Block IIF satellites. In addition to satellites, GPS includes a control system and receiver units. We focused our review on the Block IIF.

Source: Navstar GPS Joint Program Office, Space and Missile Systems Center.



Program Essentials

Prime contractor: Boeing for IIF, Boeing for OCS, Lockheed Martin for IIR-M
Program office: El Segundo, Calif.
Funding needed to complete:
R&D: $437.4 million
Procurement: $984.4 million
Total funding: $1,421.8 million
Procurement quantity: 7

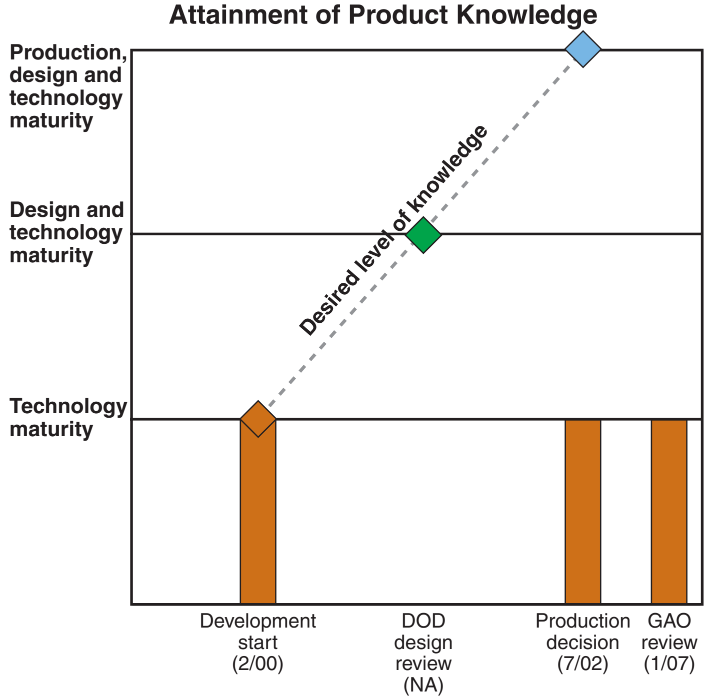
Program Performance (fiscal year 2007 dollars in millions)

	As of 02/2002	Latest 12/2005	Percent change
Research and development cost	$2,023.9	$2,439.7	20.5
Procurement cost	$3,691.2	$4,482.9	21.4
Total program cost	$5,715.1	$6,922.6	21.1
Program unit cost	TBD	TBD	TBD
Total quantities	33	40	21.2
Acquisition cycle time (months)	TBD	TBD	TBD

Unit cost has yet to be determined as the Air Force has not calculated costs based on the procurement of 7 fewer satellites. Cost and quantities include Block IIR, IIR-M and IIF satellites, and the Operational Control System (OCS).

Since our assessment of the GPS Block IIF effort last year, significant cost increases and schedule delays have occurred. The program has requested an additional $151 million to cover testing and production costs, did not award the contractor $21.4 million in award fees, and incurred an estimated 17-month delay in the launch of the first IIF satellite. According to the program office, the Block IIF technologies are mature. Since the start of the GPS program in 1973, GPS satellites have been modernized in blocks with the newer blocks providing additional capabilities. The contractor was not required to provide data on design drawings so design stability could not be assessed. Since these satellites are not mass-produced, statistical process control techniques are not used to monitor production.

Attainment of Product Knowledge



GPS Block II Modernization Program

Technology Maturity

The only critical technology on the Block IIF satellites is the space-qualified atomic frequency standards and it is considered mature.

Design Stability

We could not assess design stability because the Block IIF contract does not require that design drawings be delivered to the program. Last year design of the software for the Application Specific Integrated Circuit microcircuit chips and delays in security clearances resulted in $46 million in cost overruns.

Production Maturity

We could not assess production maturity because the contractor does not collect statistical process control data. The program office had relied on earned value management reports to monitor the contractor's production efforts, but discovered this past year that the contractor's earned value management reporting system was not accurately reporting cost and schedule performance data. According to program officials, they have addressed these reporting deficiencies and have requested separate audits to identify the root causes of the problems. In addition, the program office has increased its personnel at the contractor's facility to observe operations and to verify that corrective measures are being taken to address deficiencies.

Other Program Issues

The program office estimates that the planned launch of the first IIF satellite will be delayed 17 months from January 2007 to May 2008 due to schedule and testing delays. This past year, the contractor encountered a series of delays with the delivery of hardware components from subcontractors as well as the development of the software that runs equipment used to test payload and bus components. The concurrent development and production of the first three IIF satellites has led to significant cost increases and schedule delays. As a result, the program office has requested approximately $151 million in funds to be reprogrammed this year. This amount is based on the contractor's cost estimate to complete development and production of the first three satellites.

In June 2006 the program reported that 40 modernized GPS satellites (a combination of IIR, IIR-M and IIF satellites) would be procured. However, the program office now plans to procure 7 fewer satellites—meaning 12 IIF satellites are to be procured instead of 19. In order to sustain the GPS constellation, 12 IIF satellites are needed until the first GPS III satellite is launched in fiscal year 2013. If approved, the reduced number of IIF satellites and a possible increase in program funding will increase unit cost per satellite, potentially breaching Nunn-McCurdy thresholds.

The program office did not award the contractor $21.4 million in 2006 available award fees due to cost overruns and schedule delays. According to program officials, the $21.4 million will be used to cover a portion of the cost overruns. The procurement of the IIF satellites and control system used a contracting approach that gave the contractor full responsibility for the life cycle of the program and allowed parallel development and production efforts which resulted in cost overruns and schedule delays.

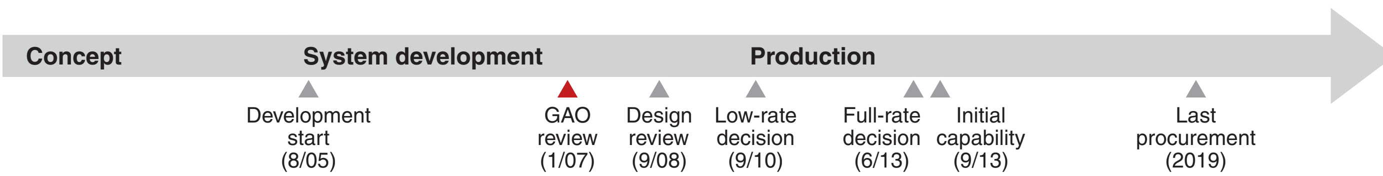
Agency Comments

The Air Force generally concurred with this assessment and provided technical comments, which were incorporated as appropriate.

Joint Land Attack Cruise Missile Defense Elevated Netted Sensor System

The Army's JLENS is designed to provide over-the-horizon detection and tracking of land attack cruise missiles and other targets. The Army is developing JLENS in two spirals. Spiral 1 is completed and served as a testbed to demonstrate initial capability. Spiral 2 will utilize two aerostats with advanced sensors for surveillance and tracking as well as mobile mooring stations, communication payloads, and processing stations. JLENS provides surveillance and engagement support to other systems, such as PAC-3 and MEADS. We assessed Spiral 2.

Source: Cruise Missile Defense Systems Project Office, JLENS Product Office.



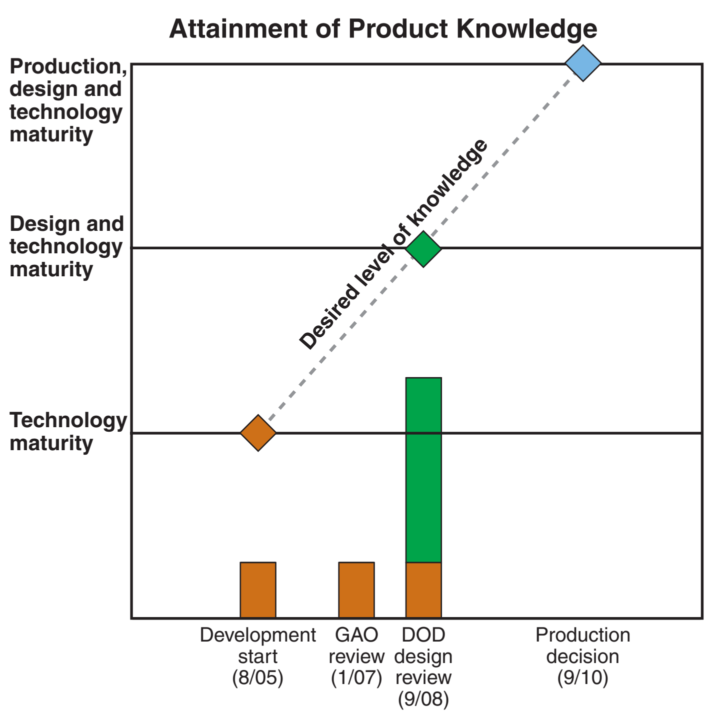
Program Essentials

Prime contractor: Raytheon
Program office: Huntsville, Ala.
Funding needed to complete:
- R&D: $1,781.4 million
- Procurement: $4,309.3 million
- Total funding: $6,156.6 million
- Procurement quantity: 14

Program Performance (fiscal year 2007 dollars in millions)

	As of 08/2005	Latest 12/2005	Percent change
Research and development cost	$1,843.7	$1,887.9	2.4
Procurement cost	$4,218.5	$4,309.3	2.2
Total program cost	$6,128.2	$6,262.8	2.2
Program unit cost	$383.014	$391.427	2.2
Total quantities	16	16	0.0
Acquisition cycle time (months)	97	97	0.0

The program began development in August 2005 with only one of its five critical technologies mature. Currently, of the four remaining technologies, one is near full maturity and the others are not expected to be mature until the production decision in September 2010. The size of the aerostat was increased to accommodate the weight load for detection and tracking equipment requirements. Although the program plans to release 90 percent of the engineering drawings by the design review in September 2008, the program faces risk of redesign until technologies demonstrate full maturity and weight issues are resolved. Furthermore, the program recently definitized its development contract in December 2006 after the program ordered a change to the contract in October 2005.



JLENS Program

Technology Maturity

JLENS entered system development in August 2005 with only one of its five critical technologies mature. The communications payload technology consisting of radios and fiber optic equipment is mature and the processing station technology—which serves as the JLENS operations center—is approaching full maturity. Both sensors—the fire control radar (formerly the precision track illumination radar) and the surveillance radar along with the platform—have not yet reached maturity. The program expects to integrate and demonstrate these technologies by the production decision in 2010.

The JLENS platform consists of the aerostat, mobile mooring station, power and fiber optic data transfer tethers, and ground support equipment. The aerostat, a buoyant aircraft used for payload attachment and support, has been increased in size from 71 meters to 74 meters—the length necessary to lift 7,000 pounds of total payload weight to an altitude that will allow the radar to meet detection and tracking requirements. The primary payload weight comes from the radar. However, additional fiber optic data cables to meet information assurance requirements increased the weight by 300 pounds. This is largely due, according to program officials, to the incorporation of the Navy's Cooperative Engagement Capability (CEC) into the system's design. CEC is a system that fuses high quality radar tracking data to create a single, common air picture. The addition of CEC adds a high-powered antenna to the aerostat and increases the number of aerostat fiber optic cables from 3 to 9 to accommodate the CEC and to provide spare cables for alternate JLENS payloads.

JLENS sensors support the system's primary mission to acquire, track, classify, and discriminate targets. According to the project office, many of the JLENS sensor technologies have legacy components. A majority of the surveillance radar components have been tested in an environment similar to the expected JLENS deployment environment and many of the fire control radar components have prototypes. However, these technologies will require physical modification and demonstration of subcomponents for use in the JLENS operational environment. Tests to characterize and integrate fire control radar and surveillance radar components are currently being conducted in the program's system integration laboratory.

Design Stability

The program estimates that 90 percent of its 6,230 drawings will be released by the design review in September 2008. However, until the maturity of the JLENS's critical technologies has been demonstrated the potential for design changes remains.

Other Program Issues

The JLENS product office ordered a change to the contract in October 2005. According to program officials, upon review of the proposal from the contractor, the government discovered that the contractor did not meet the JLENS funding profile provided with the change order. Furthermore, a review of the proposal found that several requirements had not been addressed in revisions that took place after August 2005—when the program entered product development. The contractor submitted a revised proposal in July 2006. According to program officials, negotiations and definitization of the contract that met the program's funding profile and requirements were completed in December 2006.

The JLENS program intends to hand over the task of making JLENS interoperable with other systems to an integrated air and missile defense (IAMD) program office. The IAMD program office will develop a standard set of interfaces between sensors such as JLENS and other sensors, weapons and battle management, command, control, communications, computers, and intelligence capabilities. According to program officials, the impact of IAMD requirements on the JLENS schedule are not currently known.

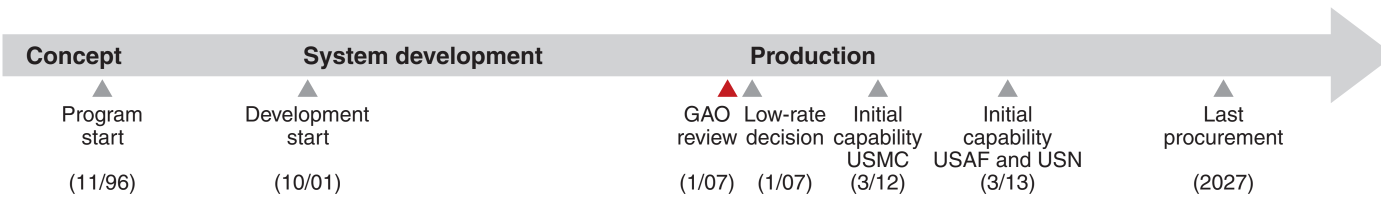
Agency Comments

In commenting on a draft of this assessment, the Army provided technical comments, which were incorporated as appropriate.

Joint Strike Fighter (JSF)

The JSF program goals are to develop and field a family of stealthy, strike fighter aircraft for the Navy, Air Force, Marine Corps, and U.S. allies, with maximum commonality to minimize costs. The carrier-suitable version will complement the Navy's F/A-18 E/F. The conventional takeoff and landing version will primarily be an air-to-ground replacement for the Air Force's F-16 and the A-10 aircraft, and will complement the F-22A. The short takeoff and vertical landing version will replace the Marine Corps' F/A-18 and AV-8B aircraft.

Source: JSF Program Office.



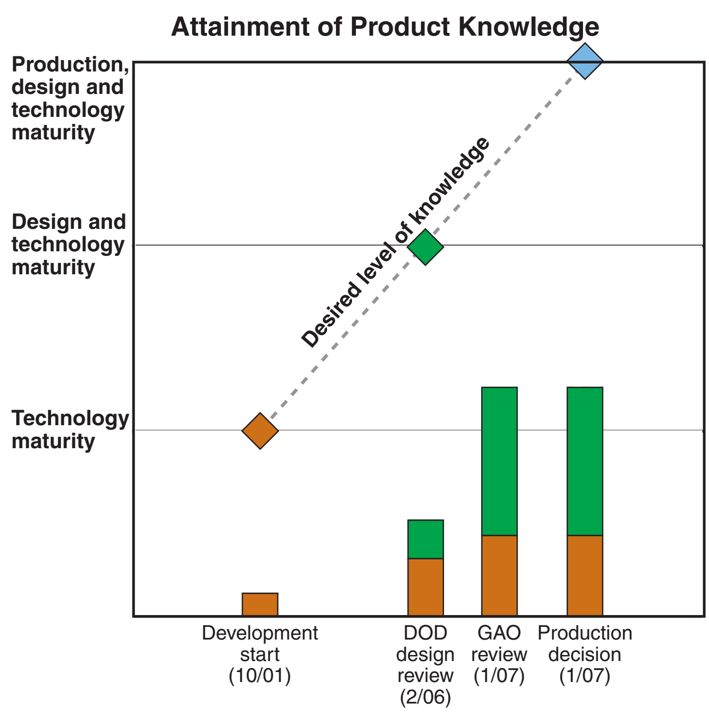
Program Essentials

Prime contractor: Lockheed Martin
Program Office: Arlington, Va.
Funding needed to complete:
R&D: $18,627.9 million
Procurement: $178,658.9 million
Total funding: $197,442.3 million
Procurement quantity: 2,443

Program Performance (fiscal year 2007 dollars in millions)

	As of 10/2001	Latest 12/2005	Percent change
Research and development cost	$35,833.2	$44,806.3	25.0
Procurement cost	$158,974.9	$178,776.6	12.5
Total program cost	$196,472.2	$223,795.7	13.9
Program unit cost	$68.553	$91.048	32.8
Total quantities	2,866	2,458	-14.2
Acquisition cycle time (months)	185	196	6.0

JSF program data indicates that two of the system's eight critical technologies are now mature, four are approaching maturity but two are immature despite being past the design review. Design stability was not reached by the design review, the two variants had released fewer drawings than suggested by best practices and the program had not demonstrated the successful integration of the system. The program plans to enter production in 2007 with little demonstrated knowledge about performance and producibility. All three variants will not be in flight testing until 2 years after production begins with a fully integrated aircraft in flight testing 4 years after it begins. DOD organizations have raised concerns with the program highlighting cost, schedule, and performance risks.



JSF Program

Technology Maturity

In 2001, the JSF entered development without its eight critical technologies being mature. Two are now mature, four are approaching maturity but two (mission systems integration and prognostics and health maintenance) are immature despite being past the design review.

Design Stability

As of October 2006, JSF officials report that 91 percent of the short takeoff and vertical landing variant and 46 percent of the conventional variant drawings have been released. At the February 2006 design review, the program reported that 46 and 3 percent of the drawings had been released respectively, less than the best practices standard. Also, the program had not prototyped the expected designs or demonstrated the successful integration of the system. The program projects it will have released 47 percent of the carrier variant drawings at its design review in 2007. Issues with stabilizing the design have impacted the delivery of the first production representative aircraft by about 2 ½ years.

Production Maturity

The program is collecting information on the maturity of manufacturing processes. However, because the design has not been proven to work, the potential for design changes during flight testing weakens efforts to mature processes. A change in design can also require a change in the manufacturing processes—a costly proposition once production begins. The development uncertainties still facing the program are reflected in DOD's plans to use cost reimbursement contracts for initial production orders. The 7-year flight test program began in late 2006 and a fully integrated variant is scheduled to fly in 2011 leaving a significant time period where changes could occur. By 2011, DOD expects to have invested more than $20 billion in production aircraft. Further, manufacturing processes currently planned have not been proven. The first test aircraft (nonproduction representative) encountered inefficiencies requiring 32 percent more manufacturing hours to date than planned. Since entering manufacturing, the aircraft design and the manufacturing processes have changed substantially.

Other Program Issues

Since the program rebaseline in 2004, costs have increased more than $30 billion (then year dollars), delivery of the key development aircraft has slipped as much as 10 months with other development activities slipping as well. The contractor's cost performance has also decreased. Internal DOD organizations have expressed concerns about the program. A February 2006 operational assessment noted risks with the flight test schedule, software development, maintainability and mission effectiveness. DOD cost analyst and contract management officials have expressed concerns that costs to complete the program will be higher than estimates.

Agency Comments

In commenting on a draft of this assessment, the JSF program office said that for the third year, GAO ignores F-35 successes, does not measure against the 2004 replan, and misapplies commercial best practices. F-35 is more mature than any comparable program at a similar development point. Advanced virtual prototyping tools ensure structure, avionics and propulsion fit together before production. The first test aircraft is complete with unprecedented assembly fit and quality, problem-free power-on, rapid execution of engine and secondary-power tests and actual weight within 1 percent of predictions. Ten development aircraft are now in manufacturing. Lab investment is substantially larger and earlier than in legacy programs promoting early risk burndown. The acquisition strategy provides the best balance of cost, schedule and risk via sequential development of variants and spiral blocks of mission capabilities. GAO's approach would result in multibillion-dollar cost increases and significant legacy fleet impact.

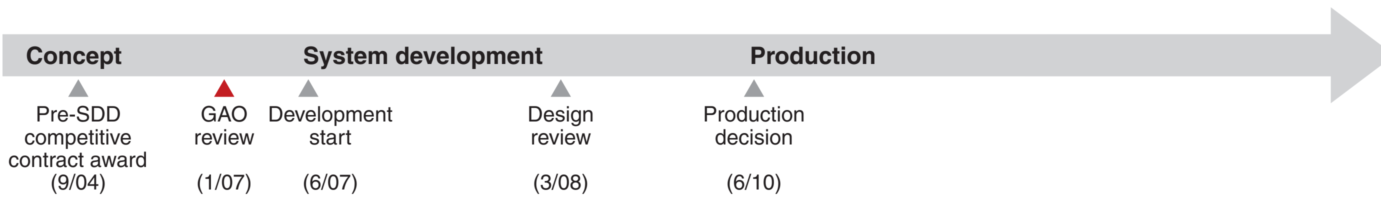
GAO Comments

In our evaluation we did consider all pertinent information including JSF progress and program office technical comments on this assessment and found the JSF program consistently proceeding through critical junctures with knowledge gaps that expose the program to significant risks. Like past programs that have followed this approach, the consequences have been predictable as the JSF has continually missed its cost and schedule targets—even after the 2004 replan. If the program were to follow a knowledge-based approach it would lower risks allowing for more realistic cost and schedule estimates.

Joint Tactical Radio System Airborne, Maritime, Fixed-Station (JTRS AMF)

The JTRS program is developing software-defined radios that will interoperate with existing radios and also increase communications and networking capabilities. A Joint Program Executive Office provides a central acquisition authority and balances acquisition actions across the services. Program/product offices are developing radio hardware and software for users with similar requirements. The AMF program will develop radios that will be integrated into nearly 100 different types of aircraft, ships, and fixed stations for all the services.

Source: JTRS AMF Program Office.



Program Essentials

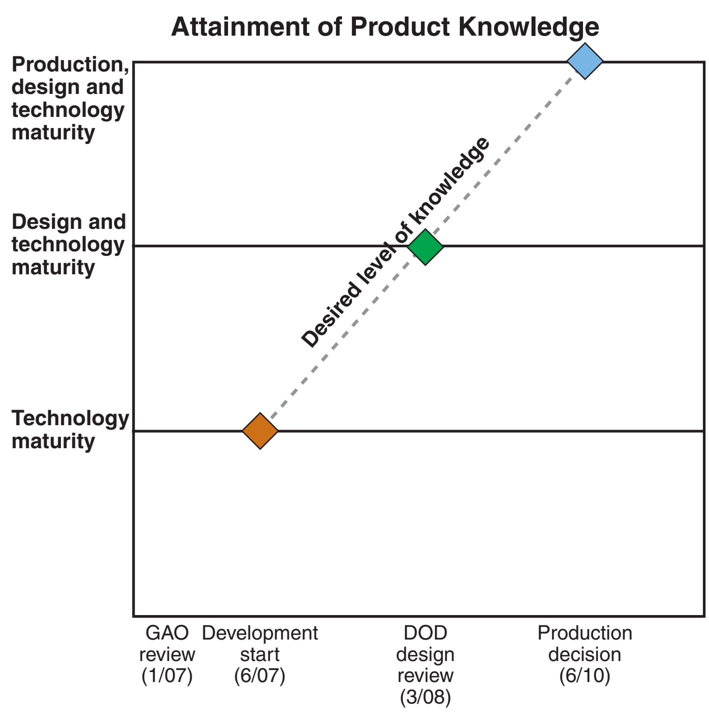
Prime contractor: TBD
Program office: Hanscom AFB, Mass.
Funding FY07-FY11:
R&D: $819.9 million
Procurement: $328.0 million
Total funding: $1,147.9 million
Procurement quantity: 1,097

Program Performance (fiscal year 2007 dollars in millions)

	As of 10/2001	Latest 01/2007	Percent change
Research and development cost	NA	$1,148.3	NA
Procurement cost	NA	$328.0	NA
Total program cost	NA	$1,476.2	NA
Program unit cost	NA	TBD	NA
Total quantities	NA	1,344	NA
Acquisition cycle time (months)	NA	NA	NA

Columns include costs and quantities budgeted through fiscal year 2011.

JTRS AMF has taken steps to develop knowledge prior to the start of system development. As part of the program's acquisition strategy, a presystem development phase started in September 2004 with the award of competitive system design contracts to two industry teams led by Boeing and Lockheed Martin. Through this acquisition strategy, program officials expect competitive designs that will help mitigate costs and other risks. While challenges remain, program officials noted that significant progress has been made by both industry teams in demonstrating technology and design maturity. The program is scheduled to enter system development in June 2007. The JTRS AMF system development program will be designed to introduce capabilities incrementally, consistent with the approved 2006 restructuring of the overall JTRS acquisition program.



JTRS AMF Program

Technology Maturity

To help mitigate technical risks and address key integration challenges, JTRS AMF awarded competitive predevelopment contracts to two industry teams led by Boeing and Lockheed Martin. In June 2007, after a full and open competition, a contracting team will be selected for the JTRS AMF system development. The program office will use an Army organization to prepare an independent Technology Readiness Assessment before entry into the system development and demonstration acquisition phase. The identification of critical technologies was completed by Boeing and Lockheed Martin in early 2006, and validated by the independent assessment team through the design work leading up to the preliminary design reviews. Both companies submitted self-assessment reports of their design's critical technologies to the program office and the independent assessment team. The independent assessment of the maturity of the program's critical technologies was completed by the independent assessment team in October 2006, and has been submitted to the Joint Program Executive Officer for review and completion of the Technology Readiness Assessment prior to the program Milestone B decision, scheduled for June 2007.

Both teams have demonstrated progress in developing key functions of the radio through in-lab and field demonstrations with representative hardware and software components of their designs. Preliminary design reviews were held in August 2005 for both teams, and program officials indicated that both preliminary designs met the National Security Agency's information assurance requirements for that stage of development. As the JTRS program was being restructured in late 2005 and early 2006, the JTRS AMF contracts were extended to continue risk reduction and design maturity work. These extensions to the contracts were completed in October 2006, with each company presenting its detailed preliminary designs during 3-weeks of reviews. These reviews focused on the design details necessary to meet the JTRS AMF Increment 1 requirements. Although the program is likely to face challenges as it proceeds through systems development and demonstration, program officials are confident that the program can enter the system development and demonstration phase in June 2007 with sufficiently mature technologies. This assurance is based on the independent technology maturity assessment results, the technical exchanges and design reviews held with the contractors, along with rigorous risk reduction and demonstration activities done by both the contractors and program office during the 2-year pre-system development and demonstration contracts.

Other Program Issues

The restructuring of the JTRS program under the Joint Program Executive Office is in place and its emphasis on an incremental approach will defer costly nontransformational requirements to later increments. The first increment has been defined and prioritizes development of high-priority networking waveforms and achieving interoperability with key legacy waveforms. For JTRS AMF, Increment 1 will include the development of a small radio variant for airborne platforms that will support the Wideband Networking Waveform, the Soldier Radio Waveform, the NATO Link 16/Tactical Digital Information Link J (TADIL-J) waveform, and the Mobile User Objective System (MUOS) waveform. Increment 1 will also include the development of a large radio variant for ships and fixed stations that will support MUOS and legacy UHF satellite communications (SATCOM).

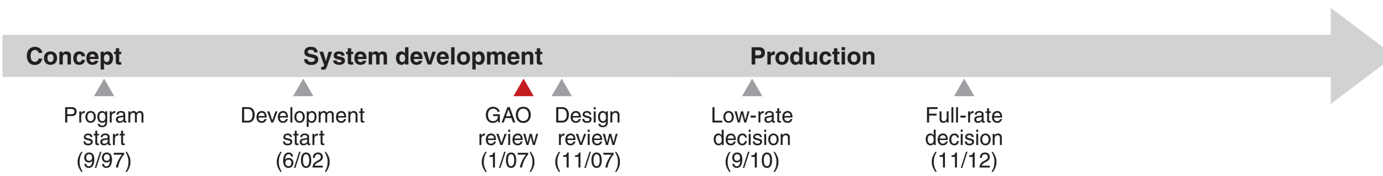
Agency Comments

In commenting on a draft of this assessment, the JTRS Joint Program Executive Office provided technical comments which were incorporated as appropriate.

Joint Tactical Radio System Ground Mobile Radio (JTRS GMR)

The JTRS program is developing software-defined radios that will interoperate with select radios and also increase communications and networking capabilities. A Joint Program Executive Office provides a central acquisition authority and balances acquisition actions across the services, while product offices are developing radio hardware and software for users with similar requirements. The JTRS Ground Mobile Radio (formerly Cluster 1) product office, within the JTRS Ground Domain program office, is developing radios for ground vehicles.

Source: PdM Ground Mobile Radio.



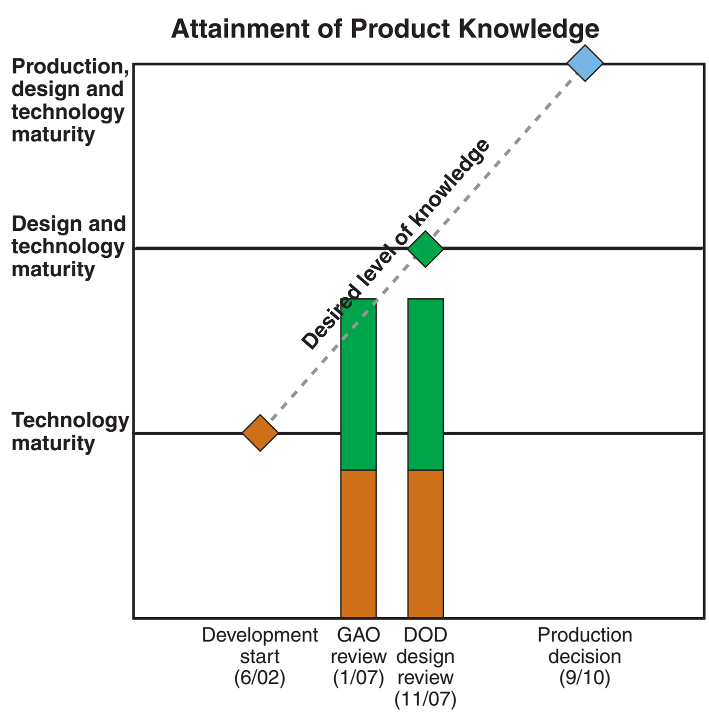
Program Essentials

Prime contractor: Boeing
Program office: San Diego, Calif.
Funding needed to complete:
R&D: $787.1 million
Procurement: $13,458.5 million
Total funding: $14,245.6 million
Procurement quantity: 104,285

Program Performance (fiscal year 2007 dollars in millions)

	As of 06/2002	Latest 09/2006	Percent change
Research and development cost	$937.5	$1,546.8	65.0
Procurement cost	$15,078.9	$13,460.1	-10.7
Total program cost	$16,016.4	$15,006.9	-6.3
Program unit cost	$.148	$.144	-2.7
Total quantities	108,388	104,425	-3.7
Acquisition cycle time (months)	55	117	112.7

The JTRS GMR program has recently been restructured due to significant cost and schedule problems that came to light in late 2004. Since development began in 2002, the program has struggled to mature and integrate key technologies and has been forced to make design changes. The program restructuring appears to put the program in a better position to succeed by emphasizing an incremental, more moderate risk approach to developing capabilities. The program reported that all but one of JTRS GMR's critical technologies are mature or approaching maturity. Nonetheless, several risks remain. The radio has only demonstrated limited networking capabilities and the program continues to reconcile size, weight and power requirements. In addition, the new JTRS joint management structure is new and untested.



JTRS GMR Program

Technology Maturity

The maturity of JTRS GMR critical technologies is questionable. The program reported that 13 of its 20 critical technologies were mature indicating that progress has been made since the program entered system development in 2002 when none of the program's critical technologies were mature. However, this progress is based on a series of contractor demonstrations conducted in spring 2005 that used only partially functioning prototypes. Among other things, the demonstrations did not show extensive Wideband Networking Waveform capabilities. For example, the demonstrated network only linked 4 users, far fewer than the required 250. The Wideband Networking Waveform represents the core of the JTRS networking capability and its integration is the most significant technical challenge to the radio's development, according to program officials. In addition, critical technologies such as the network bridging software are immature. The program expects to demonstrate the maturity of all critical technologies during a System Integration Test in early fiscal year 2010. This test will be conducted in an operational environment using fully functioning prototypes.

Design Stability

The program reported that 83 percent of its design drawings have been released to manufacturing. Although security requirements continue to be a challenge, the current design incorporates the security requirements that include the ability of the GMR system to be used in an open networked environment.

The program—in collaboration with the user community—also continues to reconcile size, weight, and power requirements. The delivery of new power amplifiers that were developed as part of a science and technology program could help address these concerns. Nonetheless, these challenges and the uncertainty of technology maturity raise concern about the program's design stability. The program will undergo a second design review in November 2007.

Other Program Issues

The restructuring appears to put the program in a better position to succeed, by emphasizing an incremental, more moderate risk approach to developing and fielding capabilities. The incremental approach defers the development for some of the more challenging requirements to later increments, allowing more time to mature critical technologies, integrate the components and test the radio system before committing to production. DOD also expects that the establishment of the JTRS Joint Program Executive Office and other management changes will improve oversight and coordination of the JTRS program.

While the restructuring appears to address many of the problems that affected JTRS in the past, the long-term technical challenges discussed previously must be overcome for the program to be successful. In addition, the JPEO is assessing different options to enable network interoperability between JTRS networks and anticipates that development of this effort will start in 2007.

Although the new joint management structure is an improvement over the previous fragmented structure, it is new and untested. Joint development efforts in DOD have often been hampered by an inability to obtain and sustain commitments and support from the military services. Some agency officials also expressed concern whether the services will have the budget capacity to fund integration costs once the radio sets were available for installation.

Agency Comments

In commenting on a draft of this assessment, the JTRS Joint Program Executive Office noted that the baseline information of June 2002—the start of development—should reflect the lower risk "Threshhold" values rather than the higher risk "Objective" values for both cost and schedule to more appropriately provide a medium-risk program comparison between the start of development in 2002 and GAO's assessment period in September 2006. The restructured program is medium risk. The JTRS Joint Program Executive Office also provided technical comments which were incorporated as appropriate.

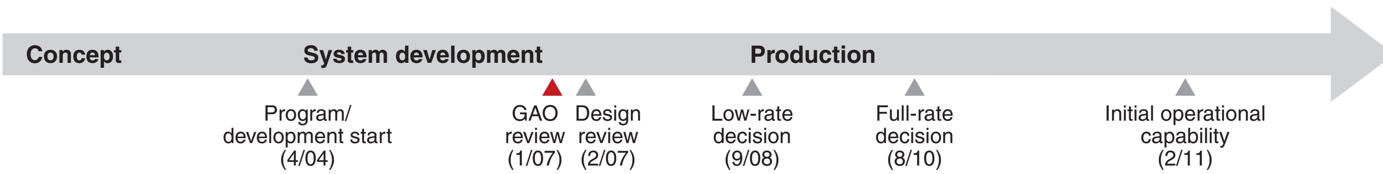
GAO Comments

We did not change the baseline cost and schedule information as suggested by the Joint Progarm Executive Office. We assess all programs in this report by their original development baseline.

JTRS Handheld, Manpack, Small Form Fit (JTRS HMS)

The JTRS program is developing software-defined radios that will interoperate with select radios and also increase communications and networking capabilities. A Joint Program Executive Office provides a central acquisition authority and balances acquisition actions across the services, while product offices are developing radio hardware and software for users with similar requirements. The JTRS HMS (formerly Cluster 5) product office, within the JTRS Ground Domain program office, is developing handheld, manpack, and small form radios.

Source: PdM Handheld, Manpack, Small Form Fit.



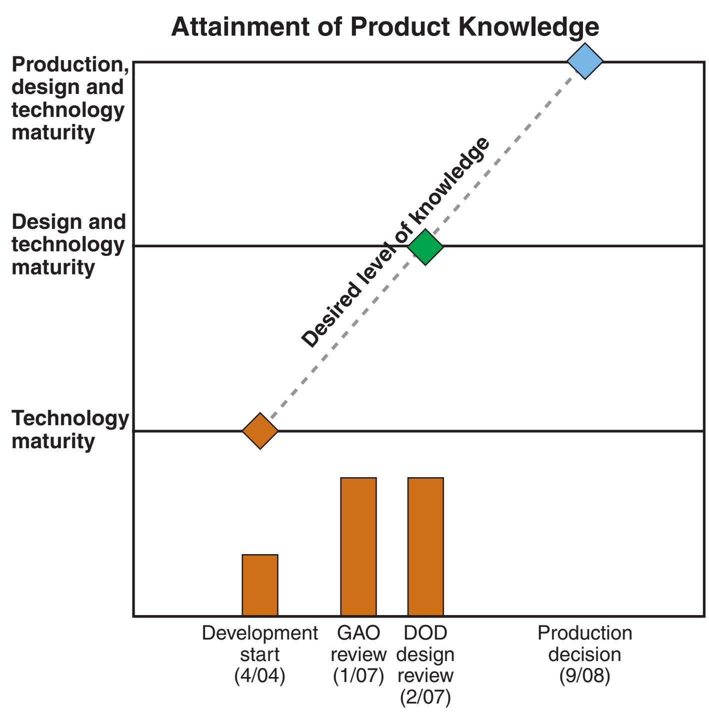
Program Essentials

Prime contractor: General Dynamics C4 Systems
Program office: Ft. Monmouth, N.J.
Funding needed to complete:
R&D: $398.1 million
Procurement: $8,727.1 million
Total funding: $9,125.2 million
Procurement quantity: 328,514

Program Performance (fiscal year 2007 dollars in millions)

	As of 05/2004	Latest 08/2006	Percent change
Research and development cost	$500.8	$673.3	34.5
Procurement cost	$8,727.1	$8,727.1	0.0
Total program cost	$9,227.9	$9,400.4	1.9
Program unit cost	$.028	$.029	1.9
Total quantities	329,574	329,574	0.0
Acquisition cycle time (months)	85	82	-3.5

The JTRS HMS program has recently been restructured, along with the entire JTRS Joint Program Executive Office enterprise. The program restructuring appears to put the program in a better position to succeed by emphasizing an incremental, more moderate risk approach to developing capabilities. The program reports that all of JTRS HMS's critical technologies are mature or appoaching maturity. Nonetheless, several risks remain. Meeting the radios' size, weight, and power requirements continues to be a challenge. In addition, while the key networking waveform has been integrated onto JTRS HMS radios, program officials expect that it will take additional effort to transition the waveform from a static laboratory environment to a realistic operational platform. Solutions enabling multinetwork interoperability are also still being developed.



JTRS HMS Program

Technology Maturity

The maturity of JTRS HMS critical technologies is questionable. The program reported that 3 of its 6 critical technologies were mature indicating that progress has been made since system development began in 2004 when only one of its critical technologies was mature. The remaining critical technologies are approaching maturity. However, in most cases, the reported maturity is not justified because the technologies either were not demonstrated in a realistic environment or they were not demonstrated using an adequately functioning prototype. Nonetheless, the program office believes that the delivery of early prototypes in late October 2006 indicates that significant progress has been made.

The restructuring of the program combined with requirements relief has allowed for the maturing of JTRS HMS critical technologies. The program expects that all 6 of its critical technologies will mature sufficiently to begin low-rate production deliveries of the small form radios by the end of fiscal year 2009 and for the manpack/handheld radios by the end of fiscal year 2010. However, meeting the requirements of the JTRS HMS radios will continue to be a challenge because of their small size, weight, and power constraints. Program officials expect that the requirements relief provided by the restructuring should help to address these issues. In particular, the restructuring reduces the number of JTRS HMS radio variants from 15 to 9. Reducing the number of variants provides relief in the hardware design and platform integration work. In addition, the restructuring reduces the number of waveforms from 19 to 5 required to operate on the various HMS radios, which is expected to reduce power demands, thereby reducing the size and weight demands.

Importantly, JTRS HMS radios will also not be required to operate the Wideband Networking Waveform. The Wideband Networking Waveform provides key networking capabilities to JTRS but carries with it a large power requirement. As an alternative, JTRS HMS radios will operate the Soldier Radio Waveform which is a low-power, short-range networking waveform optimized for radios with severe size, weight, and power constraints such as dismounted soldier radios and small-form radios. The initial version of the Soldier Radio Waveform has been successfully integrated onto early prototypes. While the waveform has demonstrated some functionality, program officials noted that it will take some effort to transition the waveform from a static laboratory environment to a realistic operational platform. In particular, program officials are concerned about the waveform's security architecture and how this may affect integrating it onto a JTRS radio. Given these concerns, the waveform's development schedule may be ambitious. The contract to further develop this waveform was awarded early in fiscal year 2007.

Design Stability

We did not assess the design stability of JTRS HMS because the total number of drawings is not known and there are currently no releasable drawings complete. Design review is scheduled for February 2007.

Other Program Issues

Although the production decision for HMS radios has been delayed for 2 years, the recent restructuring of the JTRS program appears to put the program in a better position to succeed by emphasizing an incremental, more moderate risk approach to developing and fielding capabilities. The success of the first "spin-out" of Future Combat Systems is dependent on the delivery of select JTRS HMS radios that operate the Soldier Radio Waveform.

While the restructuring reduces program risk, the long-term technical challenges discussed previously must be overcome for the program to be successfully executed. In addition, the JPEO is assessing different options to enable network interoperability between JTRS networks and anticipates that development of this effort will start in 2007.

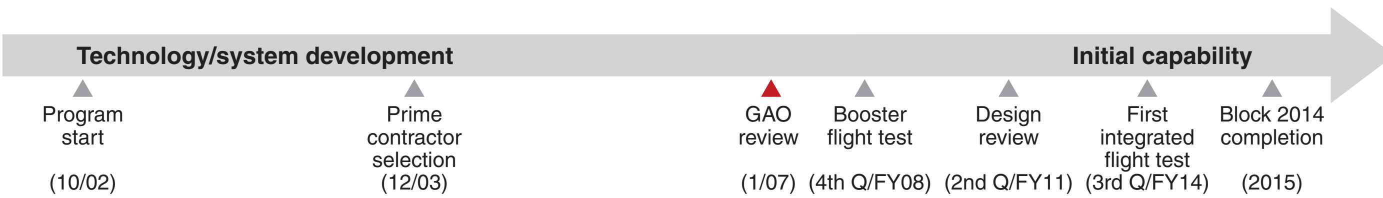
Agency Comments

In commenting on a draft of this assessment, the JTRS Joint Program Executive Office provided technical comments which were incorporated as appropriate.

Kinetic Energy Interceptors (KEI)

MDA's KEI element is a missile defense system designed to destroy medium, intermediate, and intercontinental ballistic missiles during the boost and midcourse phases of flight. Key components include hit-to-kill interceptors, mobile launchers, and fire control and communications units. We assessed the proposed land-based KEI capability, which according to program officials, could be available in 2014.

Source: Kinetic Energy Interceptors Program Office, Northrop Grumman.



Program Essentials

Prime contractor: Northrop Grumman
Program office: Arlington, Va.
Funding FY07-FY11:
- R&D: $4,190.4 million
- Procurement: $0.0 million
- Total funding: $4,190.4 million
- Procurement quantity: NA

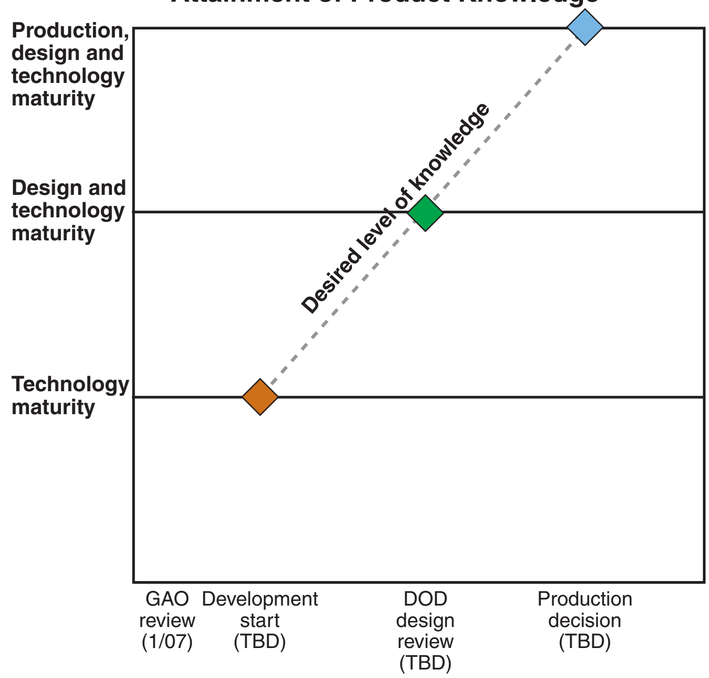
Program Performance (fiscal year 2007 dollars in millions)

	As of 09/2003	Latest 08/2006	Percent change
Research and development cost	$8,984.7	$2,334.8	-74.0
Procurement cost	$0.0	$0.0	0.0
Total program cost	$8,984.7	$2,334.8	-74.0
Program unit cost	NA	NA	NA
Total quantities	NA	NA	NA
Acquisition cycle time (months)	NA	NA	NA

Columns include all known costs and quantities from the program's inception through fiscal year 2009. Total known program cost through fiscal year 2011 is $4,931.13 million.

KEI's seven critical technologies are at a relatively low level of maturity, with two rated as high risk—the interceptor's booster motors and the algorithm that enables the kill vehicle to identify the threat missile's body from the luminous exhaust plume. During fiscal year 2006, program officials conducted a series of static fire tests and wind tunnel tests in preparation for a 2008 booster flight test. After the booster flight test, MDA will assess KEI's achievements and decide how the program should proceed. If a decision is made to move forward, MDA plans to finalize the design during the second quarter of fiscal year 2011. According to program officials, by that time 4 of the 7 critical technologies will be demonstrated in flight tests, but the other 3 will have only completed ground testing.

Attainment of Product Knowledge



KEI Program

Technology Maturity

All seven KEI critical technologies are at a relatively low level of maturity. During fiscal year 2006, program officials conducted several static fire tests and wind tunnel tests in an effort to mature the technologies. Each of the technologies is a part of the element's interceptor—the weapon component of the element consisting of a kill vehicle mounted atop a boost vehicle. Four of the seven technologies are critical to the performance of the boost vehicle, which propels the kill vehicle into space. Boost vehicle technologies include three stages of booster motors, an attitude control system, and a thrust vector control sytem. The remaining three technologies are related to the kill vehicle—its infrared seeker, divert system, and plume-to-hardbody algorithms. Backup technologies exist for all technologies, with the exception of the infrared seeker. However, these technologies are at the same low level of maturity as the critical technologies.

MDA plans to demonstrate three critical technologies—the thrust vector control system, attitude control system, and the three-stage booster motor—in two booster flight tests by the fourth quarter of fiscal year 2011. Other technologies will have been demonstrated in ground tests, such as hardware-in-the-loop tests. The integration of all critical technologies will be demonstrated in an element characterization test early in fiscal year 2013, a sea risk reduction flight test in mid-fiscal year 2013, followed by the first integrated flight test late in fiscal year 2013.

Design Stability

Program officials noted that they expect the design of the demonstration hardware to be the same as the design of the operational hardware. Therefore, integration and manufacturability issues are being addressed in the design of the demonstration hardware. According to program officials, KEI's operational design will be finalized in 2011. KEI officials estimate that KEI's design will incorporate about 7,500 drawings. The officials expect 5,000 of these drawings to be complete when it holds a critical design/production readiness review for the land-based capability in 2011. However, it is too early to make an accurate assessment of KEI's designs because not all of KEI's technologies are mature.

Other Program Issues

The KEI program is undergoing a rebaseline plan to compensate for funding reductions from fiscal year 2004 through 2006, and the addition of new requirements such as a larger booster, 2-color seeker, and development verification tests. Currently the KEI contract is scheduled to end in January 2012, however funding reductions forced program officials to delay the completion of its land mobile based capabilities—originally planned for Block 2012—to Block 2014. According to program officials, once the re-baseline is complete and negotiations are finished, the KEI contract will extend through June 2015. Additionally, program officials noted that the addition of new requirements, the reductions in funding, and the deferring of activities has increased the overall program cost by $1.5 billion.

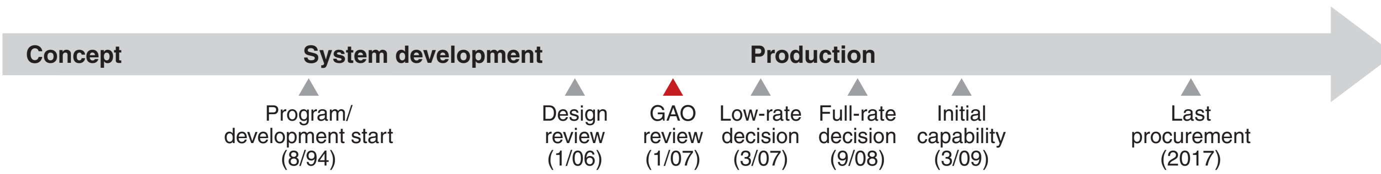
Agency Comments

The Program Office provided technical comments to a draft of this assessment, which were incorporated as appropriate.

Land Warrior

The Army's Land Warrior is a modular, integrated, soldier-worn system of systems intended to enhance the lethality, situational awareness, and survivability of dismounted combat and support soldiers. It consists of a wearable computer, a radio, a navigation module for friendly force tracking, a helmet-mounted display to provide a common operational picture, and power. We assessed Land Warrior in support of the Army's Stryker Brigades.

Source: Program Executive Office Soldier.



Program Essentials

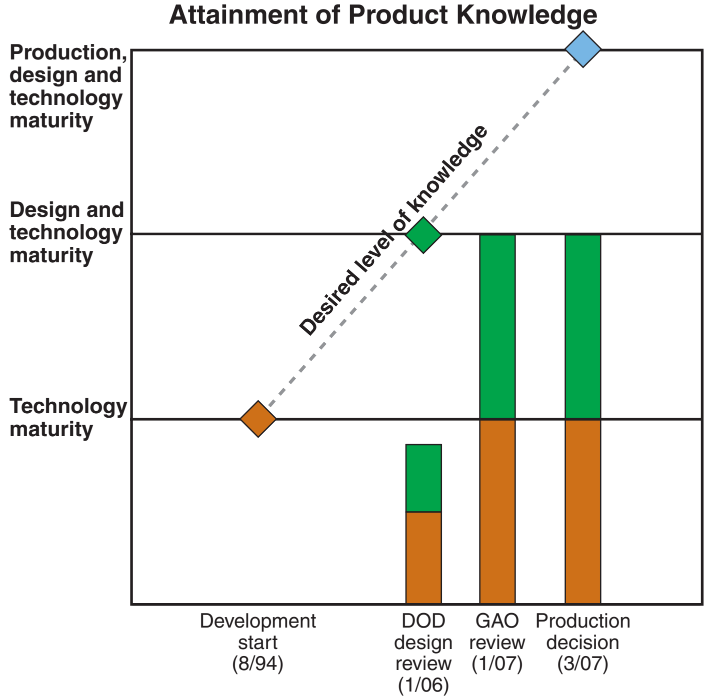
Prime contractor: General Dynamics C4 Systems
Program office: Fort Belvior, Va.
Funding needed to complete:
R&D: $419.6 million
Procurement: $2,395.3 million
Total funding: $2,814.9 million
Procurement quantity: 24,409

Program Performance (fiscal year 2007 dollars in millions)

	As of 02/2003	Latest 08/2006	Percent change
Research and development cost	$806.7	$1,059.1	31.3
Procurement cost	$1,886.1	$2,444.9	29.6
Total program cost	$2,692.8	$3,504.0	30.1
Program unit cost	$.168	$.141	-16.3
Total quantities	15,985	24,849	55.5
Acquisition cycle time (months)	145	175	20.7

In 2005, the Army terminated a spiral of Land Warrior—the Dismounted Battle Command System—intended to provide a limited, near-term capability to the current force, and it renewed its focus on the full Land Warrior system. The program office reports that the full system's three critical technologies (power, radio, and navigation module) are mature. In 2006, the program conducted a user representative assessment and a Limited User Test that were to inform the decision-maker regarding Land Warrior's entry into low-rate initial production in March 2007. According to the Army, test results indicate that Land Warrior is generally effective, suitable, and survivable. However, due to significant Army-wide resource challenges, the Army has decided to not pursue further development and production of Land Warrior.

Attainment of Product Knowledge



Land Warrior Program

Technology Maturity

The program office reports that Land Warrior's three critical technologies—a navigation module, radio, and power (rechargeable batteries)—are mature, and prototypes of these technologies have been tested in a realistic environment. Two backup technologies—disposable batteries and a navigation module with GPS only—are also mature. Since our last review, the program has focused on reducing the weight of subsystems and enhancing reliability by better integrating the subsystems and improving connections to the processor.

The Land Warrior system was to have used the JTRS radio (assessed elsewhere in this report), scheduled to be available in fiscal year 2011. In the meantime, the program is using a radio compatible with Stryker communications to provide voice, position, and command and control information at the team/squad level and higher.

The Stryker vehicle component of Land Warrior allows for battery recharging in the vehicle, communication between the dismounted soldier and vehicle using the radio, and access to the lower tactical internet through a gateway installed in the vehicle.

Design Stability

The program reported that 23 design drawings out of a total expected number of 70 were releasable at the January 2006 critical design review for Land Warrior, and that all 70 drawings are currently releasable.

Production Maturity

We could not assess the maturity of production processes for Land Warrior because the program does not collect statistical process control data during the system development phase. In the last quarter of fiscal year 2006, the Army Training and Doctrine Command conducted a user representative assessment of the system and the Army Test and Evaluation Command led a Limited User Test, both of which will inform a production decision in March 2007. According to the program office, General Dynamics plans to take lessons learned from the assessment to mature manufacturing processes.

Other Program Issues

The Land Warrior program has experienced significant challenges and delays in its 12-year history. The program restructured after contractor prototypes failed basic certification tests in 1998. Government testing revealed technical and reliability problems with Block I (Land Warrior-Initial Capability), which was subsequently terminated in 2003. Block II (Land Warrior-Stryker Interoperable) was restructured in 2004 in response to congressional direction to immediately field some Land Warrior capabilities to the current force. The restructured program—the Dismounted Battle Command System (DBCS)—was refocused in 2005 following a test event that concluded it had not demonstrated the necessary capabilities and was not mature. Elements of DBCS—such as a friendly force tracking capability—were modified and integrated into the next phase of the system, Land Warrior in support of Stryker.

The current program has been focused on developing an integrated Land Warrior capability in support of the Army's Stryker Brigades. Slightly less capable than Block II, this system was used to equip one Stryker battalion in fiscal year 2006 for assessment purposes. A program official reports that, following the assessment, the battalion decided to take the Land Warrior system with it to Iraq when it deploys in the third quarter of fiscal year 2007.

The Ground Soldier System—a future iteration of Land Warrior capability—will provide advanced capabilities. This future iteration is intended to provide a dismounted soldier capability to the Army's Future Combat Systems (FCS) and to units not associated with FCS.

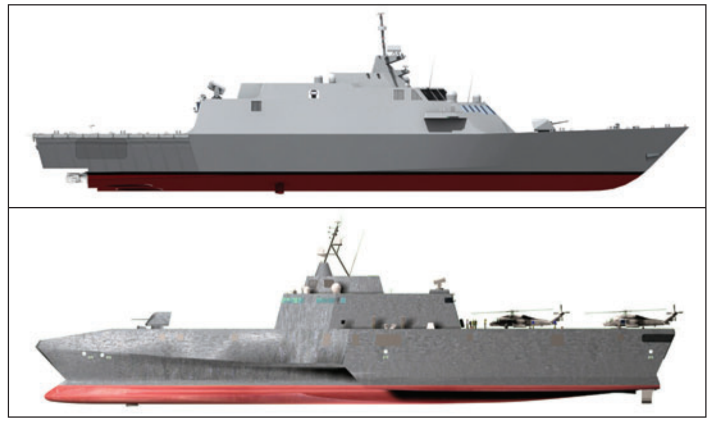
Due to significant Army-wide resource challenges, the Army has decided to not pursue further development and production of Land Warrior.

Agency Comments

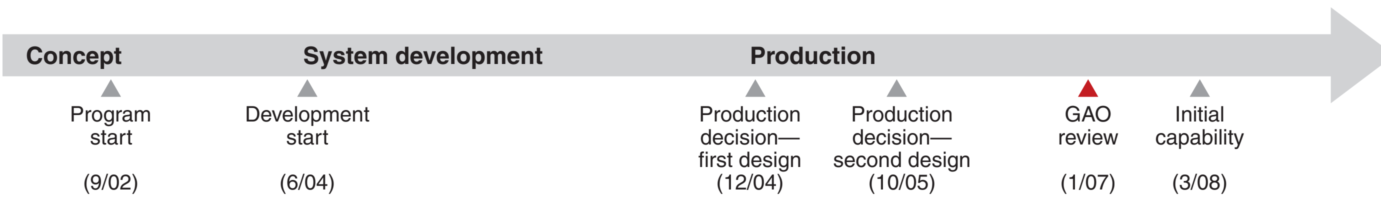
In commenting on a draft of this assessment, the Army provided technical comments which were incorporated as appropriate.

Littoral Combat Ship (LCS)

The Navy's LCS is a surface combatant optimized for littoral warfare with innovative hull designs and reconfigurable mission packages to counter threats in three mission areas: mine, antisubmarine, and surface warfare. The ship and mission packages are being developed in spirals with the first 15 ships, Flight 0, produced in two designs. The first ships of each design are currently under construction with deliveries expected in June and November 2007. We assessed only Flight 0 ships and their associated mission packages.



Source: (top) Lockheed Martin, (bottom) General Dynamics.



Program Essentials

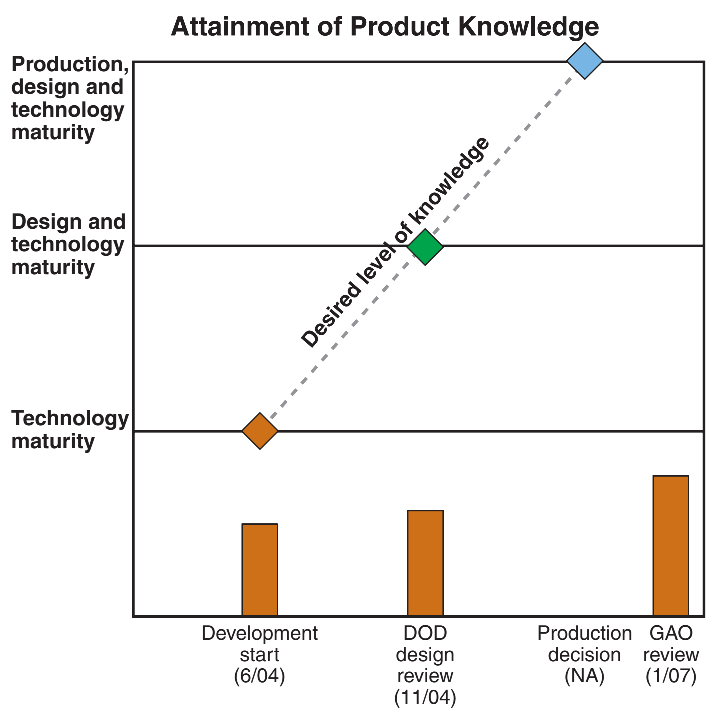
Prime contractor: General Dynamics, Lockheed Martin
Program office: Washington, D.C.
Funding needed to complete:
R&D: $463.0 million
Procurement: $5,504.1 million
Total funding: $5,967.0 million
Procurement quantity: 11

Program Performance (fiscal year 2007 dollars in millions)

	As of 05/2004	Latest 06/2006	Percent change
Research and development cost	$1,262.9	$1,718.5	36.1
Procurement cost	$0.0	$5,968.0	NA
Total program cost	$1,262.9	$7,686.5	508.7
Program unit cost	$631.434	$512.433	-18.9
Total quantities	2	15	650.0
Acquisition cycle time (months)	41	46	12.2

In 2005 the Navy expanded the planned purchase of Flight 0 to 15 ships. Two of the ships were procured through research and development funds. Quantity shown is for number of ships procured, mission packages will also be procured with funding shown.

The LCS program began production in December 2004 and recently began acquiring some elements of the mission packages. The program office identified 36 critical technologies for the mission packages and 21 technologies for the two ship designs. The Navy continues to test and mature technologies for the three mission packages, currently 22 of the 36 mission package technologies are fully mature; 9 are near full maturity; and 5 remain in development. The technologies that remain immature affect all three mission packages. All but one of the ship-specific technologies are fully mature or near maturity. Some cost and schedule growth has been experienced in ship construction due to issues in design and production.



LCS Program

Technology Maturity

Seven of the technologies under development for LCS are used in multiple applications or mission packages. Since these technologies are used on different platforms or environments, the program office chose to assess them in each setting separately, resulting in a total of 36 critical technologies, 22 of which are currently mature.

Delivery of the first mine warfare mission package will align with delivery of the first ship in June 2007. Of the 16 technologies currently used for mine warfare, only the organic airborne and surface influence sweep system, remains immature. Tests to demonstrate this technology in a relevant environment are scheduled for the first quarter of fiscal year 2007. Five other technologies are close to full maturity, while 10 others are fully mature.

The first antisubmarine and surface warfare packages will align with delivery of the second LCS in fiscal year 2008. Of the 13 technologies dedicated to antisubmarine warfare, 3 remain in development, including the advanced deployable system and two subsystems for the antisubmarine variant of the remote mine-hunting vehicle. While the program expects to demonstrate the two subsystems in a relevant environment in late fiscal 2007, plans to mature advanced deployable system are unclear. An additional 4 technologies are near full maturity, while the remaining 6 are fully mature. Of the 7 technologies dedicated to surface warfare, the non-line-of-sight missile system is the only one not fully mature. It is expected to be demonstrated in a relevant environment in mid-fiscal year 2007. Since our last review, the unmanned surface vehicle was removed from the surface warfare mission, although it is still used in other missions.

The majority of ship-specific technologies are mature or close to full maturity. The Lockheed Martin design, the first to enter production, currently has 9 of 10 technologies mature or close to full maturity, only a system used to launch and retrieve small boats is not mature. The General Dynamics design currently has all of its technologies mature or close to full maturity. Since our last review the program has reduced the number of critical technologies monitored to conform with DOD's definition of a critical technology—a new or novel technology used to meet key requirements. Although not designated as critical, these technologies remain in the ships' design.

Design Stability

Design of mission packages and ships are tracked in a unique manner. To ensure technologies used in mission packages will be compatible with LCS, the program has established interface specifications that each system must meet. Design stability is tracked by monitoring changes to the requirements documents, execution of engineering change proposals, and the completion of contract deliverables related to drawings, ship specifications, and independent certification of the design. Developing commercial design standards for military use has created some challenges, contributing to a 6 month delay in the delivery of the first ship.

Production Maturity

Rather than using statistical process controls to monitor production readiness, the LCS program uses a number of metrics to track production. The primary means of monitoring production is an earned value management system, additionally the program tracks hours spent on rework, deficiencies detected and corrected, and the number of test procedures performed. Delays in delivery of ship propulsion components have also contributed to schedule growth for the first ship.

Other Program Issues

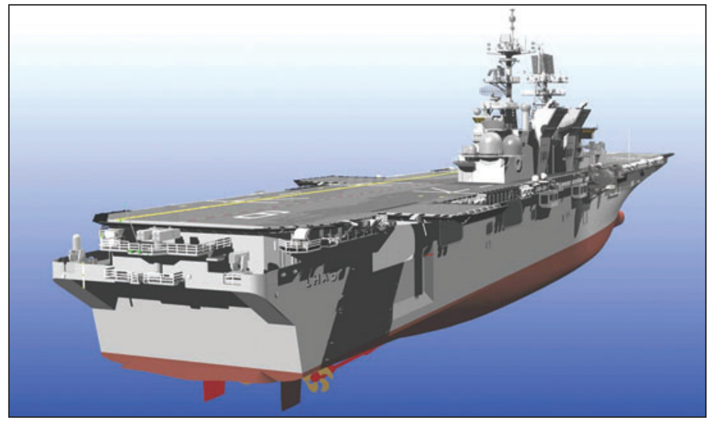
Costs for constructing Flight 0 ships have grown due to development of a formal cost estimate, incorporation of lessons learned in construction of the first ships, and the congressionally mandated addition of requirements for force protection and survivability.

Agency Comments

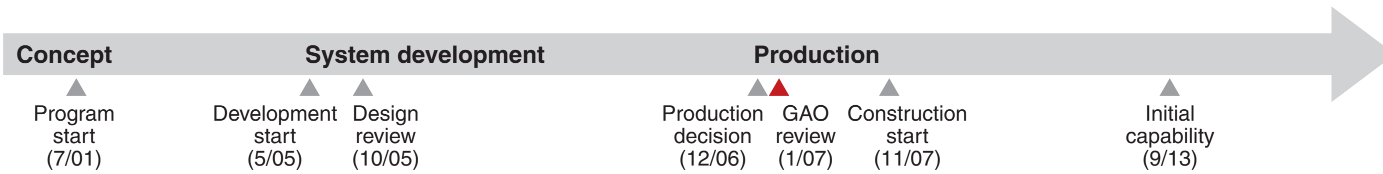
The Navy stated that the LCS modular open system architecture strategy decouples core seaframe design and construction from the phased delivery of focused mission package payloads. A robust risk management process tracks technologies under development to ensure they are matured and fulfill program requirements according to planned deployment timelines. The Navy continues to apply all available management tools to optimize unit cost and schedule through the challenges of first of class construction.

Amphibious Assault Ship Replacement Program (LHA 6)

The Navy's LHA 6 will replace aging Tarawa-class amphibious assault ships and is designed to embark, land, and support expeditionary forces. The LHA 6 design will feature enhanced aviation capabilities and is optimized to support new aircraft such as the V-22 Osprey and Joint Strike Fighter (JSF). LHA 6 is planned to be a modified variant of the LHD 8 amphibious assault ship currently under construction with delivery of the first ship expected in late 2011.



Source: LHA 6 Program Office, U.S. Navy.



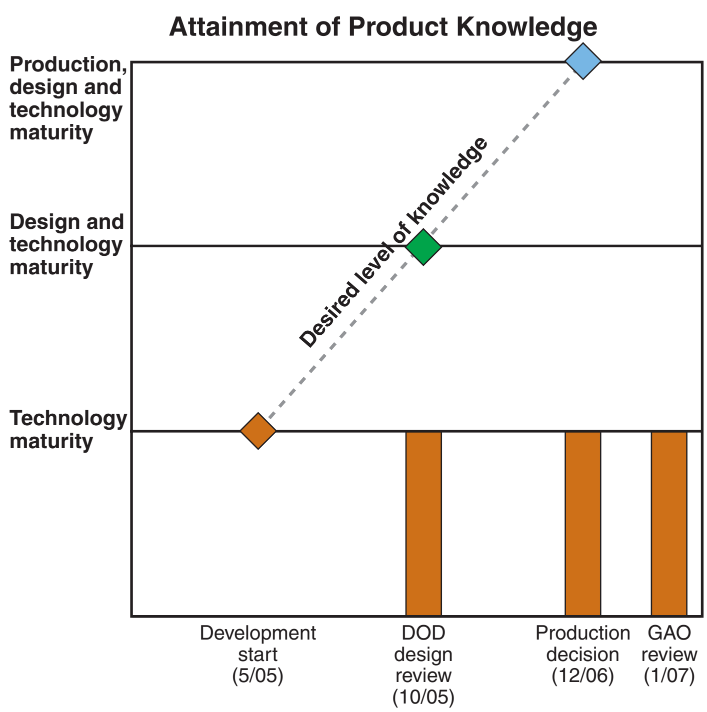
Program Essentials

Prime contractor: Northrop Grumman Ship Systems
Program office: Washington, D.C.
Funding needed to complete:
- R&D: $39.8 million
- Procurement: $2,443.2 million
- Total funding: $2,483.0 million
- Procurement quantity: 1

Program Performance (fiscal year 2007 dollars in millions)

	As of NA	Latest 12/2005	Percent change
Research and development cost	NA	$204.3	NA
Procurement cost	NA	$2,736.3	NA
Total program cost	NA	$2,940.6	NA
Program unit cost	NA	$2,940.623	NA
Total quantities	NA	1	NA
Acquisition cycle time (months)	NA	146	NA

In 2005, DOD and the Navy determined that the LHA 6 program had no critical development technologies because all of the ship's critical systems and equipment utilize technologies from existing Navy programs. However, the program office has identified six key subsystems needed to achieve the system's full capability, one of which is not mature. Almost 45 percent of LHA 6 is based on the design of the LHD 8 ship currently under construction. A design review of LHA 6 was conducted in October 2005, and the Navy determined that LHA 6's preliminary design was stable.



LHA 6 Program

Technology Maturity

In August 2005, the Navy concluded that all LHA 6 components and technologies are fully mature and that the program met technology requirements to enter system development. The Deputy Undersecretary of Defense for Science and Technology concurred and the program proceeded without a formal technology readiness assessment. However, the program office has identified six key subsystems needed to achieve LHA 6's full capability—five of which are mature. The Command, Control, Communications, Computers, and Intelligence suite (C4I); Ship Self Defense System (SSDS); Cooperative Engagement Capability (CEC); Rolling Airframe Missile (RAM); and Evolved NATO Sea Sparrow Missile (ESSM) are all mature technologies used on numerous Navy ships. According to program officials, these technologies will not be modified for LHA 6 and further development will not be required for ship integration. The 500 ton air conditioning (AC) plants modified for LHA 6 are undergoing testing to ensure functionality. Finally, the Joint Precision Approach and Landing System (JPALS)—a new GPS-based aircraft landing system—is not yet mature.

The AC plant is the only machinery/auxiliary technology that will differ from the LHD 8 ship, but according to program officials it will be a minor adaptation of plants used aboard Virginia-class submarines. Program officials state that first article testing of the plant is in progress and scheduled to continue through June 2007. According to program officials, the plant met all ship specifications during its initial testing.

JPALS will be used to support the all-weather landings of next-generation Navy aircraft, including the Joint Strike Fighter. The system, however, is not yet mature because its major components have not been tested together. JPALS has not yet started system development, but is expected to be fielded on other ships prior to its integration on LHA 6. Program officials state that the LHA 6 design has incorporated space for the system based on initial estimates of its specifications. Furthermore, the legacy aviation control system, SPN-41A, will serve as the backup technology in the event that JPALS development is delayed beyond LHA 6 deployment and the introduction of the JSF. According to the program office, JPALS is not needed to achieve the operational requirements of LHA 6 and SPN-41A is sufficient to land the JSF if the aircraft is fielded before JPALS.

Design Stability

The program does not measure design stability by percentage of engineering drawings completed, and therefore was not assessed according to this metric. However, the Navy certified that LHA 6 has a stable preliminary design based on the determination of an independent technical evaluation board during the critical design review in October 2005. The program office plans to award a detail design and construction contract to Northrop Grumman Ship Systems in December 2006. Program officials state that they will use the engineering drawing schedule to track design stability.

According to program officials, almost 45 percent of the design effort will be based on drawings from LHD 8. Over half of the ship will require newly created designs or drawings modified from LHD 8. Major adjustments made from the LHD 8 design include expansion of the ship's aviation hanger deck to create additional space for future aircraft, removal of the well deck to accommodate the increased hanger space and additional aviation fuel capacity, and updated warfare systems.

Other Program Issues

According to program officials, one area of risk for the ship is the development of new software code for a portion of the machinery control system. LHA 6 is dependent on LHD 8 to provide 75 percent of its machinery control system software, as well as the automated bridge and diesel generator control systems software. Program officials said that this software has not yet been tested or demonstrated. All other software will be used on other Navy systems prior to LHA 6's delivery. Program officials expect LHA 6's schedule will accommodate this software development.

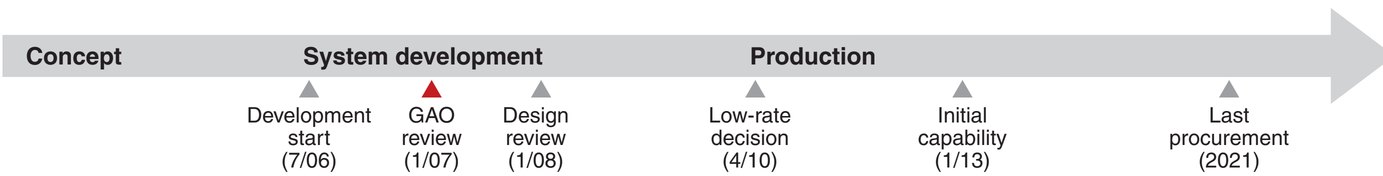
Agency Comments

In commenting on a draft of this assessment, the Navy concurred with the information provided in this report.

Longbow Apache Block III

The Army's AH-64D Longbow Apache can be employed day or night, in adverse weather and obscurants, and is capable of engaging and destroying advanced threat weapon systems. The primary targets of the aircraft are mobile armor and air defense units, with secondary targets being threat helicopters. Block III enhancements are to ensure the Longbow Apache is compatible with the Future Combat System architecture, is a viable member of the future force, and is supportable through 2030. We assessed the Block III portion of the Apache.

Source: Boeing; Army Systems Program Office; Huntsville, AL.



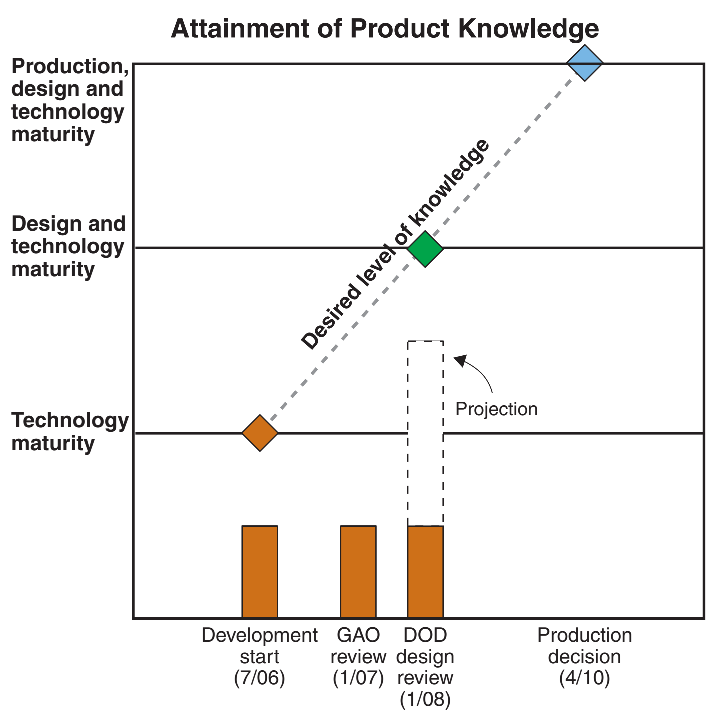
Program Essentials

Prime contractor: Boeing
Program office: Huntsville, Ala.
Funding needed to complete:
R&D: $901.5 million
Procurement: $5,628.4 million
Total funding: $6,529.9 million
Procurement quantity: 597

Program Performance (fiscal year 2007 dollars in millions)

	As of NA	Latest 08/2006	Percent change
Research and development cost	NA	$1,068.6	NA
Procurement cost	NA	$5,628.4	NA
Total program cost	NA	$6,697.0	NA
Program unit cost	NA	$11.125	NA
Total quantities	NA	602	NA
Acquisition cycle time (months)	NA	78	NA

The Apache Block III program entered the system development and demonstration phase in July 2006 with one critical technology, an improved drive system, approaching full maturity. The Apache Block III program plans to complete three phases of development and meet requirements through a series of technology insertions, each requiring integration, test, and qualification activities. The Army is reporting that at the start of development, these technology insertions were fully mature. Only the first phase of insertions will need to be installed at the factory; the others can be installed in the field. A production decision for the first phase is scheduled in 2010. Also, when it was approved for development, the Army was directed to extend the development schedule due to an aggressive test schedule, thereby increasing development cost.



Longbow Apache BLIII Program

Technology Maturity

The Army is reporting that the Apache Block III program entered system development in July 2006 with one critical technology, an improved drive system. That technology is approaching full maturity. The improved drive system technology will be used in a helicopter transmission for the first time. The technology improves the available power and increases reliability over the existing transmission. The drive system has been demonstrated in a relevant environment, and plans exist for flight testing in 2009 and 2010 to evaluate its full maturity.

The Army was reporting on 15 critical technologies prior to development start. However, as it reached development start, the Army opted to report on only 1 technology as critical. The remainder of the 15 technologies are not considered critical. The program plans to meet requirements through a series of technology insertions that will require integration, test, and qualification activities. The Army is reporting that at the start of development, these technology insertions were fully mature and will be incorporated into the system development and demonstration program in three phases. Each Apache aircraft will go to the factory for Block III modification only one time—for the first phase of insertions—and other modifications will be retrofitable in the field. A production decision for that initial phase of development is scheduled in 2010.

The technology insertions are divided into two primary categories: those related directly to processor upgrades and those independent of processor upgrades. The first phase of planned insertions addresses some of the processor upgrades and all of the nonprocessor upgrades. The processor-dependent insertions involve both hardware and software upgrades and are not field retrofitable. They include level IV unmanned aerial vehicle control, improved electronics/modular open system approach, aircraft survivability equipment, interim communications suite, modernized signal processor unit, instrument meteorological conditions/instrument flight rules hardware and software, and radar electronic unit. Those insertions that are independent of the processor include the improved drive system, engine enhancements, composite main rotor blades, airframe life extension, and training device concurrency. This phase is planned to be complete in 2014. The second and third development efforts are processor upgrades that are software modifications and are field retrofitable. Phase two is scheduled for completion in 2016 and includes the insertion of embedded diagnostics and a common data link. The final phase includes cognitive decision aids, image fusion, aided target, detection and classification, supportability improvements, multimode laser, fire control radar, and radio frequency interferometer improvements. The final phase will be completed after 2016.

According to program officials, the technical risk involved with these technologies is low even though no backup technology exists. If, for some reason, the technology is unavailable for insertion at its given time, the program would proceed with existing technology until the new technology can be incorporated. Further, cost impact for incorporating the technologies is expected to be minimal given the ability to add software changes in the field and because the helicopter would have to be returned to the production plant only once to accomplish upgrades.

Design Stability

Program officials estimate that 100 percent of its 1,546 drawings will be released by the design review scheduled for January 2008. However, until the maturity of critical technologies and technology insertions have been demonstrated, the potential for design changes remains.

Other Program Issues

The Apache Block III program was approved for system demonstration and development in July 2006. On approval, the Defense Acquisition Board directed the Army to extend the development schedule due to an aggressive test plan that resulted in a higher development cost for the program. Also, the Apache Block III's production decision slipped from March 2009 to April 2010.

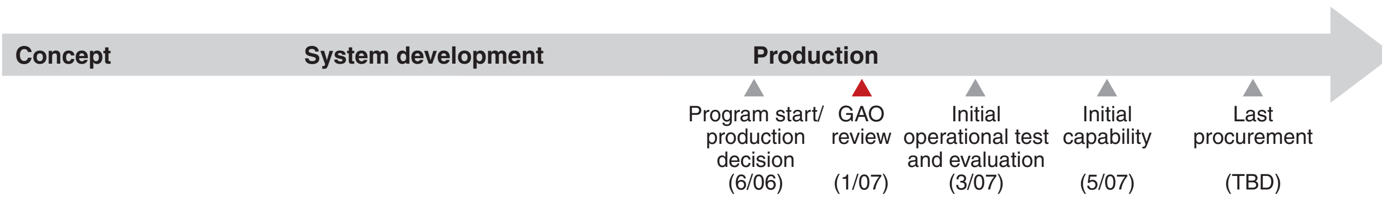
Agency Comments

The Army was provided an opportunity to comment on a draft of this assessment, but did not have any comments.

Light Utility Helicopter (LUH)

The Army's Light Utility Helicopter (LUH) is a new aircraft acquisition that will conduct exclusively noncombat missions in support of specific Army tasks to include homeland security support operations, disaster relief, search and rescue, general support, medical evacuation, and support for Army training and test centers. The Army is purchasing a commercially available helicopter for this mission rather than enter into a new development program. The commercial system has been in use as a medical evacuation helicopter.

Source: EADS North America Contract Photographer.



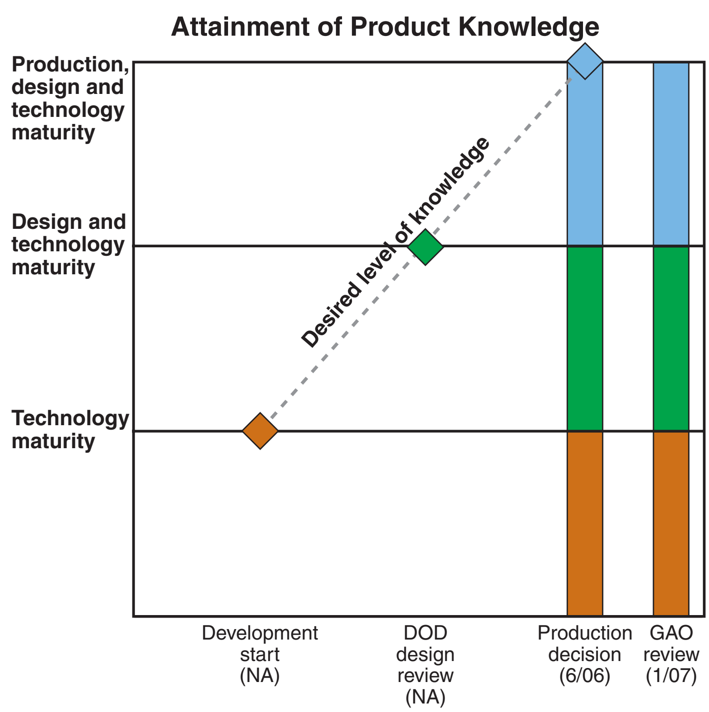
Program Essentials

Prime contractor: EADS North America Defense Co.
Program office: Huntsville, Ala.
Funding needed to complete:
- R&D: $0.0 million
- Procurement: $1,615.6 million
- Total funding: $1,615.6 million
- Procurement quantity: 314

Program Performance (fiscal year 2007 dollars in millions)

	As of 06/2006	Latest 09/2006	Percent change
Research and development cost	$0.0	$0.0	0.0
Procurement cost	$1,574.4	$1,671.0	6.1
Total program cost	$1,574.4	$1,671.0	6.1
Program unit cost	$4.889	$5.190	6.1
Total quantities	322	322	0.0
Acquisition cycle time (months)	10	11	10.0

The LUH is a commercial off-the-shelf procurement. No developmental efforts are planned, and the system's technology and design are mature. Production maturity is high since the selected system is a Federal Aviation Administration (FAA) certified aircraft, the Eurocopter-145, that is currently in use commercially. The contract for the system was awarded on June 30, 2006. The system is scheduled to undergo limited operational test and evaluation in March 2007 and its initial operational capability is planned for May 2007.



LUH Program

Technology Maturity

We did not assess the LUH's critical technologies because the LUH is an off-the-shelf procurement of a fully developed, FAA-certified commercial aircraft. As a result, the LUH program office states that the system's five critical technologies are mature. These critical technologies are (1) network-ready communications, (2) cabin size sufficient for 2 crew and 6 passenger seats, (3) force protection defined as the capability of the crew to operate all flight controls while wearing standard protection suits, (4) survivability defined as meeting FAA standards for crashworthy seats and fuel tanks, and (5) performance defined as the ability to carry 2 patients on litters with a medical attendant and equipment. Program officials state that no development efforts are to take place and that the aircraft will not be modified.

Design Stability

We did not assess the LUH's design stability because program officials said that the design of the LUH is stable, since the aircraft is already a fully developed commercial aircraft. Also, since the LUH is a currently flying, fully developed aircraft, the program office is not requiring the contractor to provide technical drawings for the system.

Production Maturity

Program officials state that production maturity is at a high level because the aircraft is a commercially available helicopter and production lines are already established. For this reason, they will not require statistical process control data on the system as it is produced. The system will undergo limited operational tests in March 2007 and be fielded shortly thereafter, in May 2007.

Other Program Issues

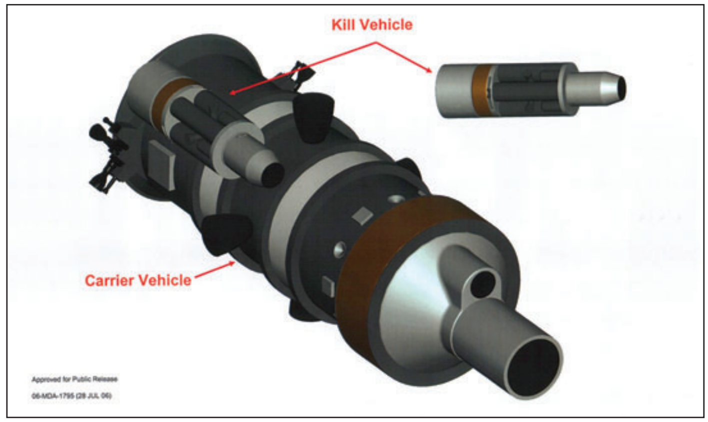
The Army awarded a low-rate initial production contract for up to 42 aircraft in June 2006, with full-rate production decision scheduled for May 2007. The Army plans to acquire a total of 322 aircraft. The program is an FAA-certified aircraft already being commercially produced and the contractor will provide total logistics support. The helicopter will not fly combat missions or be deployed into combat areas.

Agency Comments

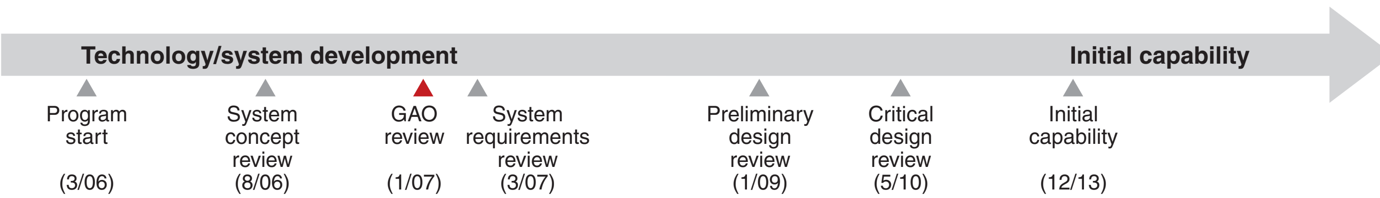
In commenting on a draft of this assessment, the Army provided technical comments, which were incorporated as appropriate.

Multiple Kill Vehicle (MKV)

MDA's MKV is being designed as an optional payload for midcourse defense systems. It will engage midcourse threat clusters with multiple small kill vehicles launched from a carrier vehicle. Key components to the system include the carrier and kill vehicles, payload communications, adapter, telemetry, and shroud. We assessed the carrier vehicle and kill vehicle capabilities currently under development and expected to be available in the Block 2012-2014 time frame.



Source: Lockheed Martin.



Program Essentials

Prime contractor: Lockheed Martin
Program office: Arlington, Va.
Funding FY07-FY11:
- R&D: $1,627.6 million
- Procurement: $0.0 million
- Total funding: $1,627.6 million
- Procurement quantity: NA

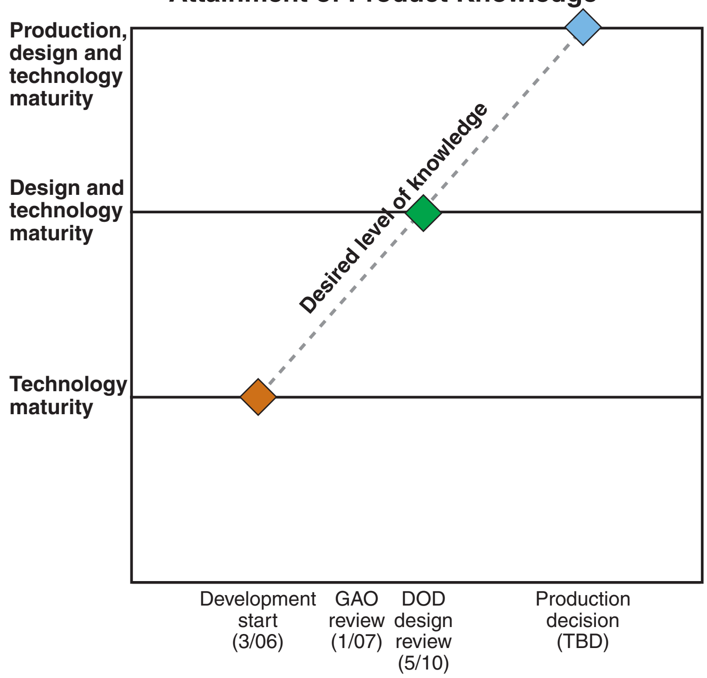
Program Performance (fiscal year 2007 dollars in millions)

	As of 02/2006	Latest 08/2006	Percent change
Research and development cost	$1,721.1	$1,721.1	0.0
Procurement cost	$0.0	$0.0	0.0
Total program cost	$1,721.1	$1,721.1	0.0
Program unit cost	NA	NA	NA
Total quantities	NA	NA	NA
Acquisition cycle time (months)	NA	NA	NA

Columns include all known costs and quantities from the program's inception through fiscal year 2011.

The MKV program transitioned from a technology development to system development in 2006 with, we believe, none of its 18 critical technologies mature. While the program assessed 14 of its 18 critical technologies as approaching maturity, these technologies have yet to demonstrate the form and fit required for the MKV. The program is trying to lower program risk by creating a decision point in 2009 to assess the maturity of its highest risk technology, engagement management algorithms. If the algorithms are not mature at that time, the program will consider continuing development of the carrier vehicle as a unitary kill vehicle without multiple kill vehicles. Additionally, we were unable to assess design stability because, according to program officials, the program has not yet selected a final concept that includes the number of kill vehicles on the carrier vehicle.

Attainment of Product Knowledge



MKV Program

Technology Maturity

According to our analysis, none of the program's 18 critical technologies are mature. The technologies on the carrier vehicle are the divert and attitude control system (DACS), cooler, inertial measurement units (IMU), kill enhancement device (KED), focal plane array (FPA), optics, power, processor, and carrier vehicle-ground datalink. The technologies on the kill vehicle are the DACS, seeker FPA, KED, cooler, optics, IMUs, power, processors, and carrier vehicle-to-kill vehicle datalink. According to the program, 14 of these technologies are approaching maturity and 4 are not mature—the FPA and optics on the carrier vehicle, and the KED on both the carrier vehicle and the kill vehicle. We disagree with the program's evaluation of the readiness of the 14 technologies assessed as approaching maturity. Although all of the critical technologies have been used in previous programs, the hardware has not been tested in a smaller form and with the correct fit for the MKV program. Program officials agreed that these technologies may need to be repackaged to properly fit on the MKV and further testing may be needed at that time to ensure the technology is mature. The KEDs are optional hardware, which the program will decide either to pursue or defer in the Block 2008 time frame.

The program assessed its top risk for the program to be payload system algorithm maturity. Without the maturity of these algorithms, the system will not be able to engage targets with the multiple kill vehicles. While the program has developed risk mitigation plans, program officials are also designing for low risk by developing the carrier vehicle prior to developing the kill vehicles. At a key decision point in 2009, the program will assess the maturity of the algorithms and, if they are still immature, consider whether to continue development of the carrier vehicle without multiple kill vehicles. Program officials say that if the program continues with a single carrier vehicle, multiple kill vehicles could be added at a later date. However, pursuing this option would make MKV very similar to the Ground-based Midcourse Defense System's Exoatmospheric Kill Vehicle, although program officials claim the unitary carrier vehicle would be more producible.

Design Stability

We were unable to assess the design stability of the MKV program because the program has not yet selected the final configuration of the MKV system. According to program officials, the configuration has been narrowed down to two main concepts with varying numbers of kill vehicles on the carrier vehicle. Program officials hoped to finalize the MKV concept by late October 2006. The program intends to use engineering and manufacturing readiness levels, technology readiness levels, and software readiness levels to assess the maturity of the MKV design leading up to the system critical design review scheduled for 2010.

Other Program Issues

Program officials are anticipating schedule delays for the program due to the $20 million cut in the fiscal year 2007 budget they received in September 2006. The officials stated that they expect that the system requirement reviews for the payload, carrier vehicle, and kill vehicle planned for summer 2007 will be postponed.

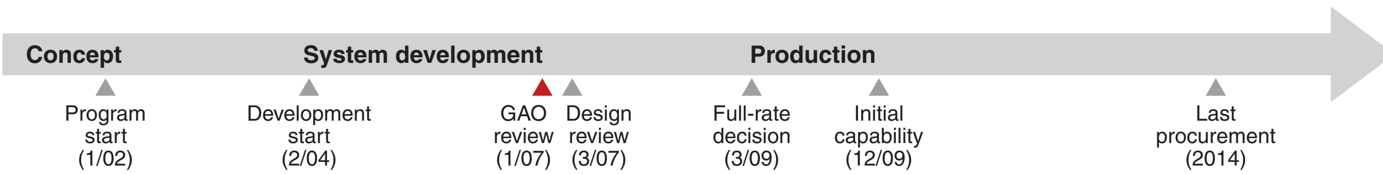
Agency Comments

The program office provided technical comments, which were incorporated as appropriate.

MQ-9 Reaper Unmanned Aircraft System

The Air Force's MQ-9 Reaper (formerly Predator B) is a multirole, medium-to-high altitude endurance unmanned aerial vehicle system capable of flying at higher speeds and higher altitudes than its predecessor, the MQ-1 Predator A. The Reaper is designed to provide a ground attack capability to find, fix, track, target, engage, and assess small ground mobile or fixed targets. Each system will consist of four aircraft, a ground control station, and a satellite communications suite. We assessed the first increment of the air vehicle.

Source: General Atomics-Aeronautical Systems, Incorporated.



Program Essentials

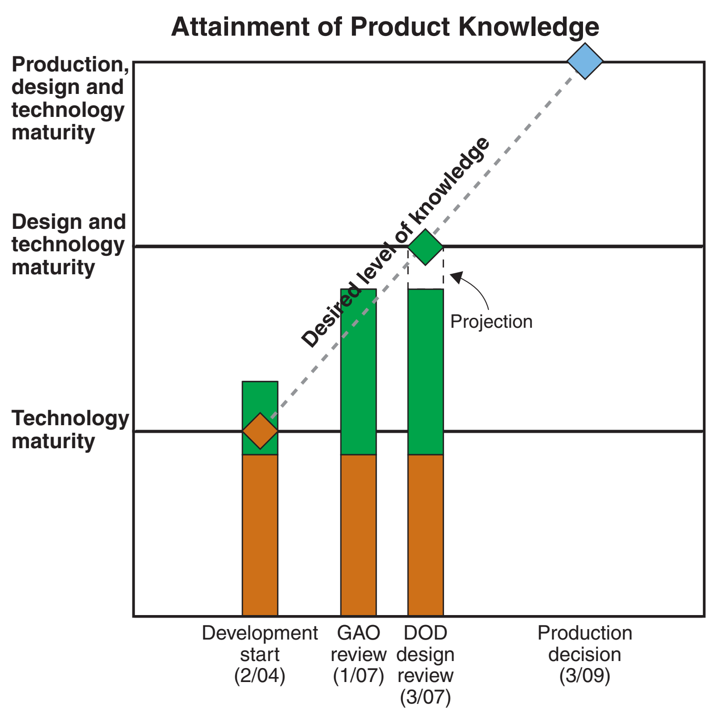
Prime contractor: General Atomics Aeronautical Systems Incorporated
Program office: Dayton, Ohio
Funding FY07-FY11:
- R&D: $130.3 million
- Procurement: $471.7 million
- Total funding: $601.9 million
- Procurement quantity: 30

Program Performance (fiscal year 2007 dollars in millions)

	As of 08/2004	Latest 08/2006	Percent change
Research and development cost	$186.0	$209.4	12.6
Procurement cost	$484.2	$572.8	18.3
Total program cost	$670.1	$782.2	16.7
Program unit cost	TBD	TBD	TBD
Total quantities	63	63	0.0
Acquisition cycle time (months)	70	70	0.0

Cost data are from all known costs from the program's inception through fiscal year 2009. Total estimated program cost is $1,317.2 million.

The Reaper entered system development in February 2004 with three of its four critical technologies mature. The fourth technology has experienced several delays, but it began weapons release testing in December 2006. Once mature, the technology will enable the program to perform its primary mission—to destroy enemy targets. The Air Force has completed over 80 percent of the design drawings for the first increment and projects that it will have achieved design stability by the 2007 critical design review. However, the program has already begun producing aircraft for an interim combat capability and plans to produce additional preproduction aircraft with improved interim capabilities without demonstrating production maturity. Initial operational testing is not scheduled to begin until 2008. At that point, nearly one-third of the quantity will be on contract or delivered.



MQ-9 (Reaper) Program

Technology Maturity

Three of the Reaper's four critical technologies—the synthetic aperture radar, the multispectral targeting system, and the air vehicle—are fully mature. The fourth technology, the stores management subsystem, is designed to integrate and store data necessary to launch munitions. This subsystem has experienced several delays; it was initially expected to be mature in 2004. The latest delay was a result of incorporating the Hellfire missile into the subsystem. It began weapons release testing in December 2006. Once mature, the technology will enable the Reaper to perform its primary mission, to destroy enemy targets. Subsequent increments may require other new technologies.

Design Stability

The program office currently reports that over 80 percent of the drawings for the first increment are complete. Since our last report, the program's critical design review has slipped about 4 months, primarily due to the requirement to incorporate the Hellfire missile. The program office expects 94 percent of the drawings for the first increment will be completed by the critical design review, now scheduled for March 2007. Program officials acknowledge that additional drawings will be needed for subsequent increments.

Production Maturity

The program does not plan to use statistical process controls to ensure product quality. Instead, it plans to use other quality control measures such as scrap, rework, and repair to track product quality. Production work on the Predator and Reaper and the Army's Warrior have greatly increased the contractor's business base and workforce requirements. OSD and Air Force officials have raised concerns about the contractor's production capacity to meet this expanded business base.

Other Program Issues

The Reaper program has undergone two significant changes over the past year. First, the requirement to add the Hellfire missile delayed the delivery of the interim combat capability aircraft by about 7 months. Second, the Air Force decided to provide an early fielding capability to the user. While these aircraft will be more capable than the interim combat aircraft, they will not have the full capability. According to program officials, the hardware in the early fielding aircraft will meet most of the required capabilities; subsequent aircraft will have upgrades to the radar and weapons as well as further software developments and technical orders.

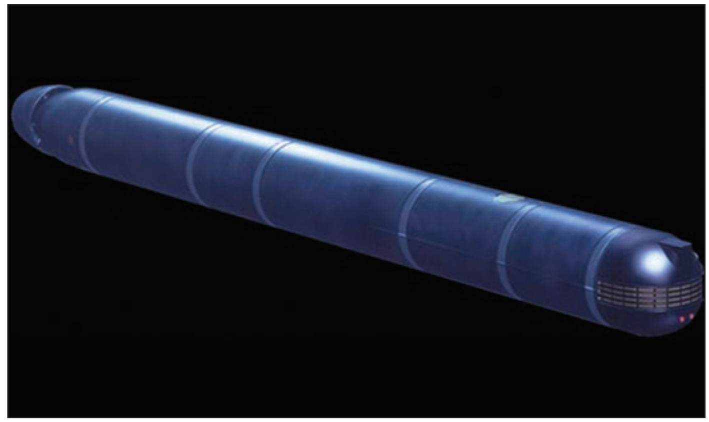
The Reaper's acquisition approach increases the risks of concurrent design and production. The Air Force will have already contracted for one-third of the total production aircraft quantity before it completes initial operational testing. Changes stemming from the test program would further cause a perturbation to the aircraft's cost, schedule, and manufacturing plan.

Agency Comments

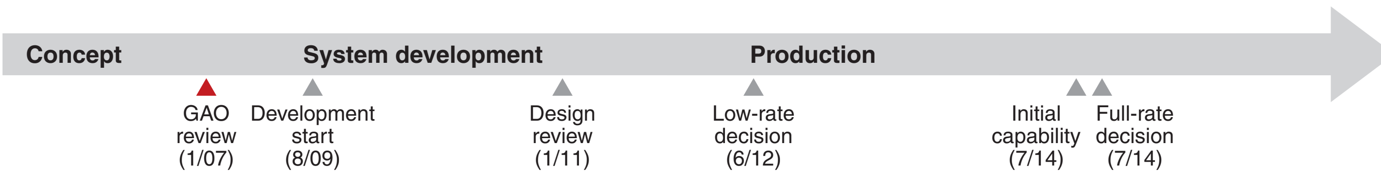
The Air Force provided technical comments, which were incorporated as appropriate.

21" Mission Reconfigurable Unmanned Undersea Vehicle System (MRUUVS)

Launched and recovered from submarine torpedo tubes, the Navy's 21" MRUUVS will independently perform a range of information-gathering activities. It supplants two related programs now limited to prototype development, the long-term mine reconnaissance system and the advanced development unmanned undersea vehicle. Each MRUUVS will include the vehicle, combat and control interfaces, and equipment for either mine countermeasure or intelligence, surveillance, and reconnaissance missions (ISR).



Source: Unmanned Undersea Vehicles Program Office.



Program Essentials

Prime contractor: TBD
Program office: Washington, D.C.
Funding FY07-FY11:
- R&D: $375.3 million
- Procurement: $0.0 million
- Total funding: $375.3 million
- Procurement quantity: 0

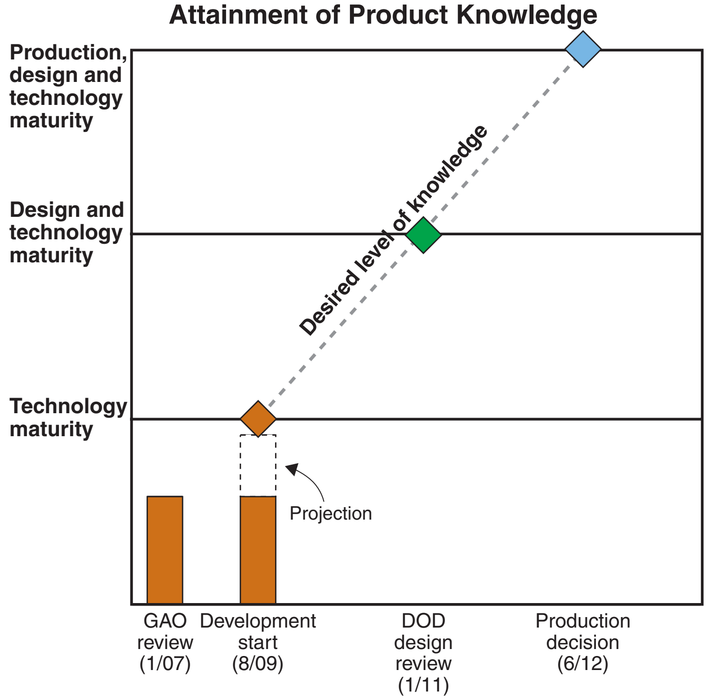
Program Performance (fiscal year 2007 dollars in millions)

	As of NA	Latest 10/2006	Percent change
Research and development cost	NA	$430.8	NA
Procurement cost	NA	NA	NA
Total program cost	NA	$430.8	NA
Program unit cost	NA	NA	NA
Total quantities	NA	NA	NA
Acquisition cycle time (months)	NA	59	NA

Columns include costs budgeted through fiscal year 2011.

One of the MRUUVS program's six critical technologies is currently mature and the remaining five are approaching maturity. While the program expects to have four of the remaining five critical technologies mature by development start—now scheduled for August 2009—the sonar is not expected to reach maturity until 2010. Although many technologies have undergone at-sea testing, the program plans to rely on development efforts in other programs to demonstrate full maturity of some of MRUUVS's critical technologies. As a result of program restructuring and budget reductions, the milestone review to authorize development start has slipped by over 2 years since last year's assessment.

Attainment of Product Knowledge



21" MRUUVS Program

Technology Maturity

One of six critical technologies is currently mature and the remaining five are approaching maturity. The program expects to have all but one critical technology fully mature by system development start—now planned for August 2009. In some cases the program plans to rely on development efforts in other programs to demonstrate maturity for MRUUVS technologies.

The maturity of software that provides MRUUVS's autonomous capability has been demonstrated. Commercial unmanned undersea vehicles (UUV) have demonstrated autonomy, and at-sea testing on a prototype vehicle in January 2006 demonstrated autonomous control and decision-making capabilities. Nevertheless, software development will continue, with incremental improvements added as they are developed.

Technology to manage the vehicle launch and recovery process involves acoustic signaling and mechanical activities. A predecessor vehicle on which MRUUVS is based has demonstrated homing, docking, and replacement into a model submarine hull. MRUUVS's launch capability was demonstrated in January 2006 during at-sea tests with a submarine. Due to a mechanical failure, however, the vehicle could not be recovered back into the submarine. A test is planned for 2007 to demonstrate end-to-end vehicle recovery with a submarine.

The Littoral Precision Undersea Mapping Array enables object identification and obstacle avoidance. An advanced development model has been developed, tested, and deployed on a 21" vehicle, thereby demonstrating its mine identification capability. The Navy had planned to test a more advanced, lighter-weight prototype, but has now eliminated this development based on budget cuts. Instead, the program believes it can achieve full maturity through modeling and simulation and demonstrations of the array—without a test vehicle.

ISR technology already exists and is operational on Navy unmanned aerial vehicles. However, packaging the required technology within the size, space, and weight constraints of MRUUVS will require miniaturized, highly compact, and lightweight components that can be adapted for an ocean environment. In 2006 the ISR suite was packaged into a 21" prototype for at-sea testing. While this demonstrated partial maturity, the program does not expect additional testing and development to occur until after a development contract is awarded. The program believes that maturity will be demonstrated by October 2008 through sensor development on other programs.

While conventional batteries that could support MRUUVS endurance requirements have successfully been demonstrated on other UUVs, the program office intends to leverage development of rechargeable batteries from the Advanced SEAL Delivery System program for use on MRUUVS. While these batteries have attained functional capability, further development is necessary to ensure fit into a small unmanned undersea vehicle.

In January 2006 the synthetic aperture sonar was tested at-sea using a larger UUV. The Navy eliminated further development of a final prototype due to cost growth and design failures. Full maturity of the sonar is not expected until fiscal year 2010—after a contract for MRUUVS development is awarded.

Other Program Issues

Since last year's assessment the program has undergone significant restructuring. In February 2006 the Navy implemented a new program strategy, which delayed development start from July 2006 to late 2008. According to program officials, program restructuring was necessary not only because of Navy-wide fiscal issues, but also because of technology immaturity and problems with system integration.

Additional changes resulted from the most recent appropriations, which reduced the program by $16.9 million in fiscal year 2007. As a consequence of this reduction, the acquisition and contracting strategies are again being revised. Program officials expect additional delays in the MRUUVS program, with development start slipping to 2009.

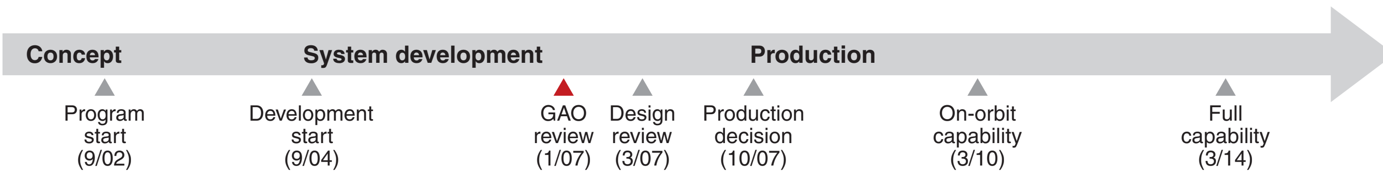
Agency Comments

The Navy provided technical comments to a draft of this assessment, which were incorporated as appropriate.

Mobile User Objective System (MUOS)

The Navy's MUOS, a satellite communication system, is expected to provide low data rate voice and data communications capable of penetrating most weather, foliage, and manmade structures. It is designed to replace the Ultra High Frequency (UHF) Follow-On satellite system currently in operation and provide support to worldwide, multiservice, mobile, and fixed-site terminal users. MUOS consists of a network of advanced UHF satellites and multiple ground segments. We assessed both the space and ground segments.

Source: Lockheed Martin Corporation, ©2006 Lockheed Martin Corporation.



Program Essentials

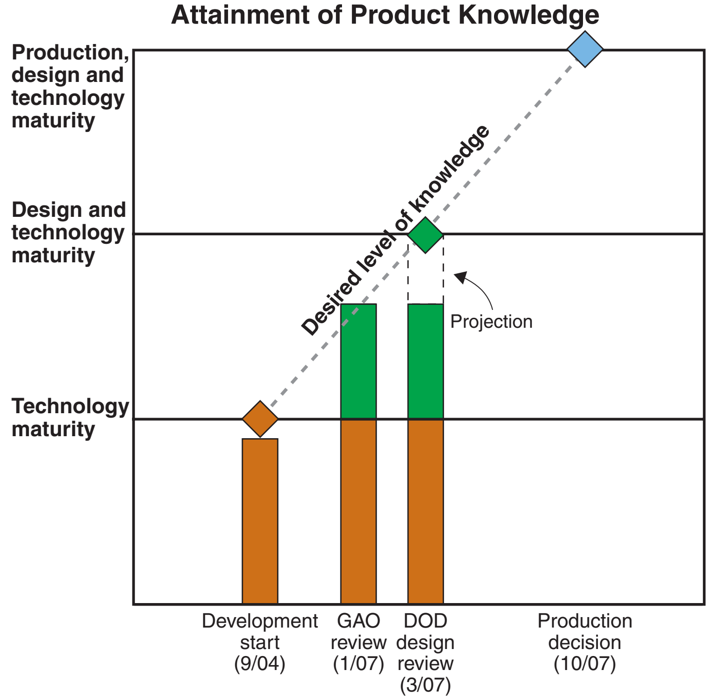
Prime contractor: Lockheed Martin Space Systems
Program office: San Diego, Calif.
Funding needed to complete:
- R&D: $2,097.5 million
- Procurement: $2,210.6 million
- Total funding: $4,355.7 million
- Procurement quantity: 4

Program Performance (fiscal year 2007 dollars in millions)

	As of 09/2004	Latest 08/2006	Percent change
Research and development cost	$3,353.4	$3,186.6	-5.0
Procurement cost	$2,790.2	$2,210.6	-20.8
Total program cost	$6,179.2	$5,459.2	-11.7
Program unit cost	$1,029.866	$909.864	-11.7
Total quantities	6	6	0.0
Acquisition cycle time (months)	91	91	0.0

In September 2004, the MUOS program was authorized to begin development. All seven of the program's critical technologies are mature. The program is ordering long lead items for the first two satellites before achieving a final design. This early procurement could lead to rework, causing cost increases and schedule delays if relevant designs change prior to critical design review. While the MUOS development has become time-critical due to the operational failure of two UHF Follow-On satellites, the program's ground software development represents significant cost and schedule growth risk. In addition, problems encountered under the Joint Tactical Radio System program may result in underutilization of MUOS capabilities.

Attainment of Product Knowledge



MUOS Program

Technology Maturity

Eight of nine critical technologies were mature at the development start decision in September 2004. The number of critical technologies has since varied due to continuing program analyses of required technologies. According to the program office, all seven of the program's critical technologies are mature.

Design Stability

The MUOS program is procuring long lead items for the first two satellites before achieving a final design. According to the program office, $71.9 million (constant 2007 dollars) in long lead items is to be ordered before critical design review in March 2007. Such procurement could lead to rework if relevant designs change prior to the system-level critical design review, causing program cost increases and schedule delays. According to the program office, delaying long lead procurement until after critical design review would cause the program schedule to slip. In addition, the program office noted that the majority of the long lead procurements are planned after respective segment-level critical design reviews (which precede the system-level critical design review) and that most are for standard commercial satellite bus components.

The program office estimates 3,020 drawings to be required for the MUOS design. The development contract requires 90 percent of the design drawings as a condition of conducting critical design review. As of September 2006, 1,692 drawings had been completed.

Other Program Issues

The importance of the first MUOS launch has increased due to the unexpected failures of two UHF Follow-On satellites, one in June 2005 and another in September 2006. As a result, communication capabilities are expected to degrade below those required in November 2007, almost 3 years earlier than estimated at MUOS development start. DOD is examining options for addressing a communications capability gap, including developing an integrated waveform to increase communications capacity provided by existing satellites and continuing to lease satellite communications capacity. According to the MUOS program manager, accelerating the MUOS schedule likely would increase program cost and schedule risks and options to develop new gap-filler satellites would not be viable due to the short development timeframes required.

According to the program office, development of MUOS ground software represents one of the highest risks to the program due to the size and complexity of the contractor's design. A 2006 independent program assessment also concluded that MUOS software development represents significant risk. The program office stated that the ground software is to be developed in three builds consisting of multiple increments to mitigate schedule risk. Additionally, the program intends to track and assess software development using numerous metrics we have found to be useful for program success, such as those for cost, schedule, defects, and quality. As of August 2006, early software development efforts are meeting cost and schedule goals. However, cost and schedule growth risks remain due to the concurrent development of the three builds. Specifically, during the approximate 4-year software development effort, about one-half of this period is to consist of concurrent development among the software builds. Such concurrency can increase the severity of software problems due to their cascading cost and schedule impacts on other builds.

Full utilization of MUOS capabilities is dependent on the fielding of terminals developed under the Joint Tactical Radio System (JTRS) program. However, development problems encountered under the JTRS program have resulted in deferrals of requirements and have increased risk that MUOS capabilities will be underutilized until MUOS-compliant terminals are fielded.

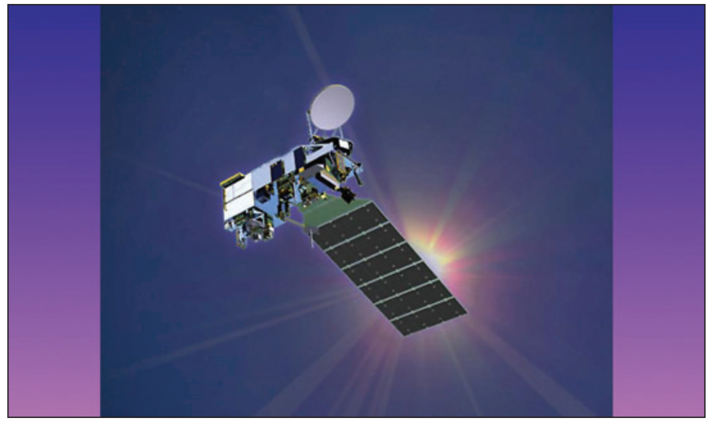
According to the program office, MUOS satellites can be launched, and their legacy payload capability can be used to support warfighter requirements if problems are encountered with MUOS ground software or JTRS synchronization.

Agency Comments

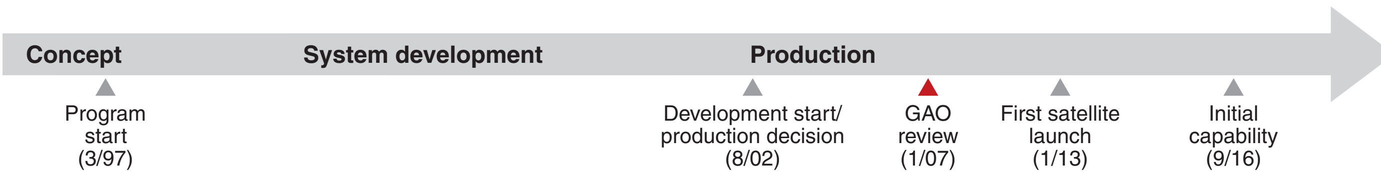
In commenting on a draft of this assessment, the Navy provided technical comments, which were incorporated as appropriate.

National Polar-orbiting Operational Environmental Satellite System (NPOESS)

NPOESS is a tri-agency National Oceanic and Atmospheric Administration (NOAA), DOD, and National Aeronautics and Space Administration (NASA) satellite program to monitor the weather and environment through the year 2026. Current NOAA and DOD satellites will be merged into a single national system. The program consists of five segments: space; command, control, and communications; interface data processing; launch; and field terminal software. We assessed all segments.



Source: NPOESS Integrated Program Office.



Program Essentials

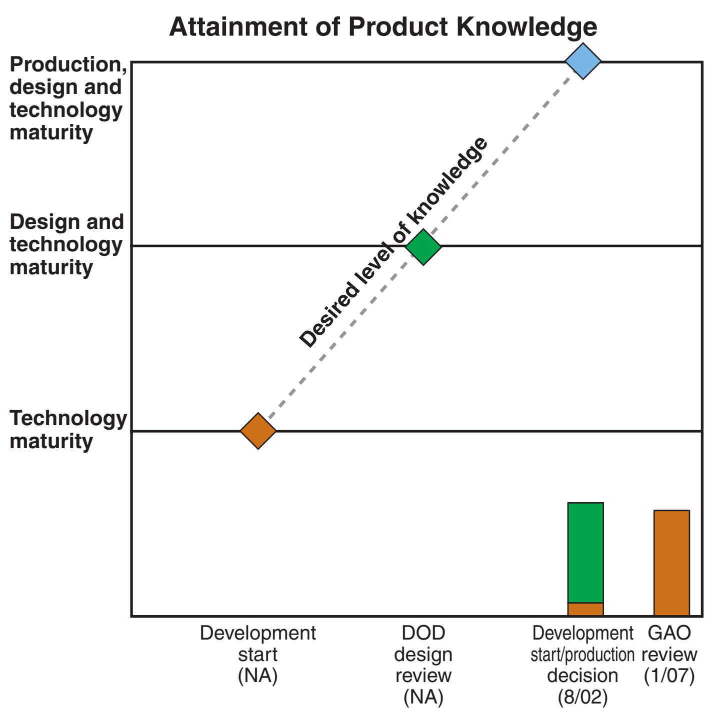
Prime contractor: Northrop Grumman Space Technology
Program office: Silver Spring, Md.
Funding needed to complete:
- R&D: TBD
- Procurement: TBD
- Total funding: TBD
- Procurement quantity: 2

Program Performance (fiscal year 2007 dollars in millions)

	As of 08/2002	Latest 10/2006	Percent change
Research and development cost	$4,883.2	$7,681.1	57.3
Procurement cost	$1,260.6	$2,755.9	118.6
Total program cost	$6,143.8	$10,437.0	69.9
Program unit cost	$1,023.963	$2,609.247	154.8
Total quantities	6	4	-33.3
Acquisition cycle time (months)	172	235	36.6

Funding needed to complete has yet to be determined and costs are expected to change as a part of a program restructuring.

Following our review last year, 7 of the original 14 critical technologies were removed from the NPOESS program. One was removed in 2005 and 6 more in June 2006 as part of the program's restructure due to a Nunn-McCurdy (10 U.S.C. 2433) unit cost breach at the 25 percent threshold. The 7 remaining technologies are expected to be mature by design review in January 2009. The program office is not collecting statistical process control data to assess production maturity because of the small number of satellites to be produced. As part of a mandatory certification process, the program was restructured and will only include the procurement of two satellites and the deletion of a critical sensor. The launch of the first satellite was delayed an additional 28 months to early 2013.



NPOESS Program

Technology Maturity

Only 1 of the program's 14 original critical technologies was mature at the production decision in August 2002. In 2005, 1 critical technology was deleted and 6 more were deleted in 2006. Four of the deleted technologies were associated with a major sensor, which was removed from NPOESS. Four of the 7 remaining technologies are mature, and the program projects that all 7 will be mature by the design review in January 2009. Only 3 of the remaining technologies have a backup technology.

The program undertook the NPOESS Preparatory Project, a demonstration satellite, to reduce risk and provide a bridging mission for NASA's Earth Observing System. This project is to provide data processing centers with an early opportunity to work with sensors, ground controls, and data-processing systems and allow for incorporating lessons learned into the four NPOESS satellites. Under the restructured NPOESS program, the satellite is to demonstrate the remaining three major sensors and one noncritical sensor in an operational environment and was scheduled for launch in May 2006. Since our assessment last year, the launch has been delayed from May 2006 until January 2010—a total of about 44 months.

Design Stability

In August 2002, the program committed to the fabrication and production of two satellites with operational capability before achieving design stability or production maturity. There are no drawing numbers available at this time due to the program restructure. Program officials indicated they are in the process of revising the design drawings to accommodate the deletion of a major sensor. These revisions could result in significant spacecraft design modifications. The design review date has been delayed 33 months to January 2009.

Production Maturity

We could not assess production maturity because, according to the program office, it does not collect statistical process control data due to the small number of satellites to be built. However, program officials stated that the contractors track and use various metrics to track subcomponent production, such as rework percentages and defect containment.

Other Program Issues

The launch of the first satellite has been delayed an additional 28 months to early 2013. The restructured NPOESS program includes two satellites funded using RDT&E appropriations, with the option in fiscal year 2010 for two additional satellites using the existing contract, funded with procurement appropriations. In addition, a deleted major sensor was to collect data to produce microwave imagery and other meteorological and oceanographic data. However, the program will now include developing a competition for a new replacement sensor coinciding with the second R&D satellite. The program restructure will also result in reduced satellite data collection coverage, requiring dependence on a European satellite for coverage during midmorning hours. Although the program has reduced the number of satellites it will produce, the program acquisition unit cost per satellite is about 23 percent above the 2005 approved program baseline.

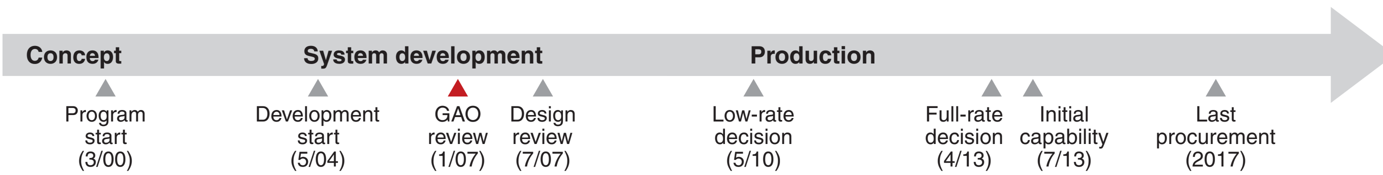
Agency Comments

In commenting on our draft, the Air Force generally concurred with our findings and offered technical comments for our consideration. We incorporated the technical comments where appropriate. In addition, the Air Force stated that the NPOESS program completed the Nunn-McCurdy (10 U.S.C. 2433) certification process on June 5, 2006. The Air Force noted that the Integrated Program Office is now tracking NPOESS development to an interim program plan and that the program office has increased contractor oversight through additional staff and processes. Moreover, according to Air Force officials, the program executive's office is establishing various independent review teams.

P-8A Multi-mission Maritime Aircraft (P-8A MMA)

The Navy's P-8A Multi-mission Maritime Aircraft (P-8A MMA) is the replacement for the P-3C Orion. Its primary roles are persistent antisubmarine warfare; antisurface warfare; and intelligence, surveillance, and reconnaissance capabilities. The P-8A shares an integrated maritime patrol mission with the Broad Area Maritime Surveillance Unmanned Aerial System (BAMS UAS). These two systems are intended to sustain and improve the Navy's maritime warfighting capability.

Source: The Boeing Company, ©2005 The Boeing Company.



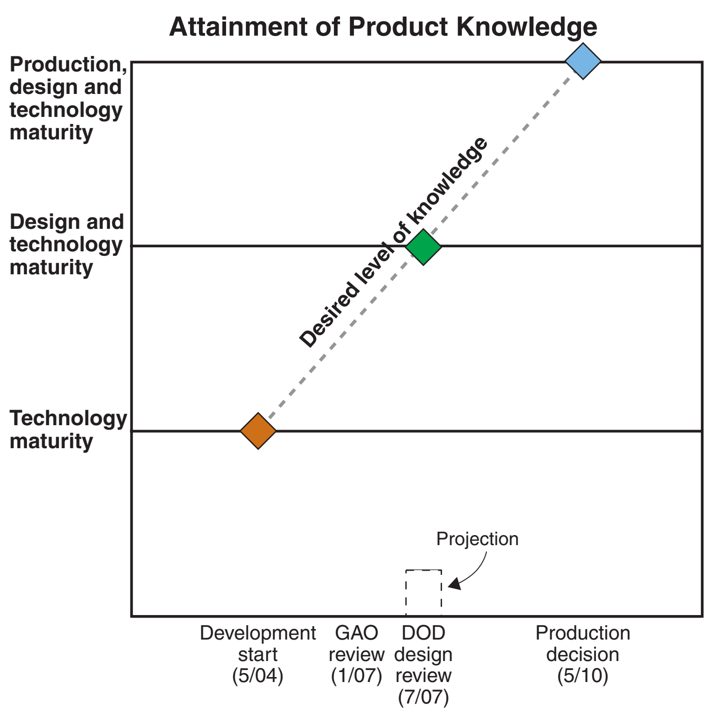
Program Essentials

Prime contractor: The Boeing Company
Program office: Patuxent River, Md.
Funding needed to complete:
R&D: $5,162.8 million
Procurement: $20,970.1 million
Total funding: $26,253.4 million
Procurement quantity: 108

Program Performance (fiscal year 2007 dollars in millions)

	As of 06/2004	Latest 12/2005	Percent change
Research and development cost	$6,924.0	$6,784.5	-2.0
Procurement cost	$21,480.6	$20,970.1	-2.4
Total program cost	$28,531.1	$27,880.7	-2.3
Program unit cost	$248.097	$244.567	-1.4
Total quantities	115	114	-0.9
Acquisition cycle time (months)	160	160	0.0

The P-8A program entered development with none of its four critical technologies mature. The program developed maturation plans and identified mature backup technologies for each of the critical technologies. According to program officials, the P-8A would lose some capabilities but still meet its minimum requirements if it used these backups. Since our assessment of the P-8A effort last year, the program has decided to use one of its backups. Two of the remaining three critical technologies are not anticipated to reach maturity until 2008 and 2009, at least 4 years later than recommended by best practices. The program office was unable to provide the number of drawings completed, but expects that 80 percent of the design drawings will be released by critical design review in 2007.



P-8A MMA Program

Technology Maturity

None of the P-8A's four critical technologies were mature when it entered development in May 2004. The program had previously expected all four technologies to be demonstrated in a relevant environment by design review in July 2007. Since our last assessment, the program has decided not to use the acoustic bellringer algorithms. They will instead use the backup technology, which is baseline signal processing without the bellringers. Bellringers are advanced signal-processing aids that provide sorting and identification of specific sounds. The backup is being used because an analysis of bellringer performance showed that it would not meet expectations. The bellringer algorithms were not required to meet baseline performance requirements, but had the potential to provide increased performance above the required capability.

None of the three remaining critical technologies—electronic support measures (ESM) digital receiver, data fusion, and integrated rotary sonobuoy launcher—are mature. These technologies have not moved beyond the laboratory environment, and have not matured since the beginning of development in May 2004. The program office stated that decisions on using backup technologies for the ESM digital receiver and the sonobuoy launcher may not be made until after design review.

The final production hardware is complete for the ESM digital receiver, a technology being leveraged from the EA-18G program. Technology maturity will be demonstrated by design review, 3 years later than recommended by best practices standards. The data fusion and the integrated rotary sonobuoy launcher have not been integrated into a prototype system, but are expected to reach maturity in 2008 and 2009 respectively, at least 4 years later than recommended by best practice standards.

Design Stability

The P-8A program office was unable to provide the number of drawings expected or currently completed. As a result, we could not assess current design stability. The program office expects that 80 percent of the design drawings will be released to manufacturing at critical design review in 2007.

Other Program Issues

As of June 2006, the P-8A program is on budget and on schedule. However, if the P-8A fails to develop as expected or experiences schedule slippage, the Navy would have to continue relying on its aging P-3C Orion fleet.

The P-8A shares the persistent intelligence, surveillance, and reconnaissance role with the BAMS UAS. The BAMS UAS development start was delayed 2 years until October 2007. If the BAMS UAS does not develop as planned or continues to experience schedule delays, the P-8A is its fallback and according to the Navy, the overall cost of the program would increase due to a need to procure additional P-8A aircraft.

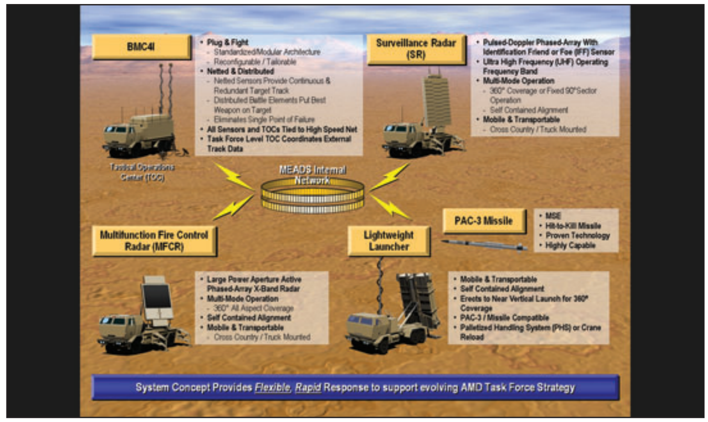
Another program that may impact the P-8A program is the Aerial Common Sensor (ACS). The ACS is intended to replace three current systems, including the Navy's EP-3. However, the Army terminated the ACS contract in January 2006 because the airframe selected could not accommodate the intended mission equipment. Decisions concerning the ACS program will determine whether the Navy participates in a future Army-led ACS program. One of the alternatives assessed by the Navy to replace the EP-3 included incorporating the ACS equipment onto the P-8A airframe.

Agency Comments

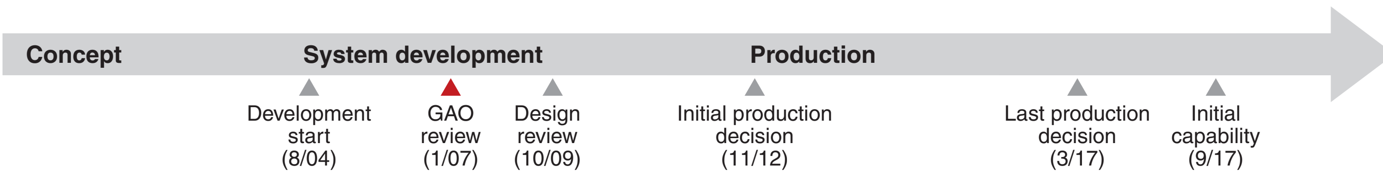
The Navy concurred with GAO's assessment of the P-8A MMA program. The Navy stated that the program continues to manage the three remaining critical technologies. Furthermore, the maturation of these technologies is on schedule and will be assessed at the critical design review planned for the third quarter of fiscal year 2007. The airplane design remains approximately 70 percent in common with that of the commercial 737-800 baseline. Over 25 percent of the detailed design drawings are now complete. The metrics for measuring drawing release are now defined and are being used as one critical measurement to assess design maturity for the critical design review. According to the Navy, the program continues to meet or exceed the cost, schedule, and performance parameters defined in the program baseline.

PATRIOT/MEADS Combined Aggregate Program (CAP) Fire Unit

The Army's Patriot/MEADS Combined Aggregate Program is the process by which the Patriot missile system transitions to the MEADS. The MEADS mission is to provide low-to-medium altitude air and missile defense with the capability to counter, defeat, or destroy tactical ballistic missiles, cruise missiles, and other air-breathing threats. MEADS is a codevelopment program among the United States, Germany, and Italy. We assessed the MEADS fire unit portion of the program.



Source: Lower Tier Project Office, Combined Aggregate Program (LTPO-CAP).



Program Essentials

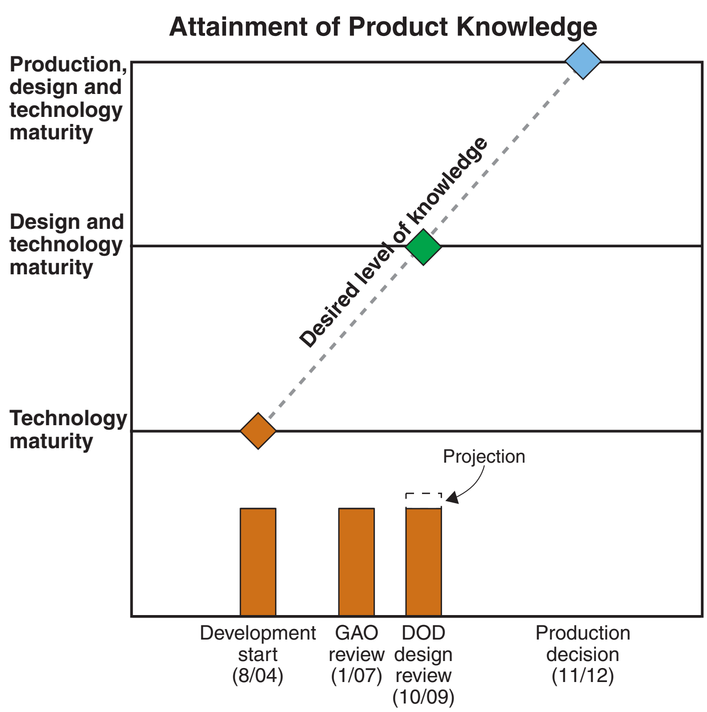
Prime contractor: MEADS International
Program office: Huntsville, Ala.
Funding needed to complete:
R&D: $4,271.3 million
Procurement: $12,557.0 million
Total funding: $16,828.2 million
Procurement quantity: 48

Program Performance (fiscal year 2007 dollars in millions)

	As of 08/2004	Latest 09/2006	Percent change
Research and development cost	$4,879.8	$4,747.9	-2.7
Procurement cost	$12,921.7	$12,557.0	-2.8
Total program cost	$17,801.5	$17,304.9	-2.8
Program unit cost	$370.865	$360.518	-2.8
Total quantities	48	48	0.0
Acquisition cycle time (months)	158	157	-0.6

The MEADS fire unit began development in 2004 with two mature critical technologies, three critical technologies nearing maturity, and one immature critical technology. The technologies remain at these levels. Program plans call for a system design review in 2009, but officials estimate that only one of the six fire unit technologies will be more mature at that time than at development start. The program office anticipates that all critical technologies will be fully mature by the start of production in the first quarter of fiscal year 2013.

Current plans call for the insertion of MEADS components into Patriot Fire Units beginning in 2008 and continuing in 2010 and 2013. However, this could change because plans for these insertions are under review.



PATRIOT/MEADS CAP Fire Unit Program

Technology Maturity

Only two of the six critical technologies—launcher electronics and Patriot Advanced Capability (PAC)-3 missile integration—are mature. Three other critical technologies—the low noise exciter that manages the radars' frequencies, the cooling system for the radars, and a slip ring that carries power and coolants to the radars—are nearing maturity. The remaining critical technology—the transmit/receive module that transmits/receives signals for the fire control radar—is immature.

The project office estimates that the maturity level of the low noise exciter, the radar cooling system, and the slip ring will remain unchanged when product development begins and that the transmit receive module will be near full maturity. The office expects all critical technologies to be fully mature by the start of production in late 2012. There are no backup technologies for any of the MEADS critical technologies.

Design Stability

We could not assess the design stability of MEADS because the number of releasable drawings and total drawings expected were not available. The program office expects to know the total number of releasable drawings at the design review in 2009.

Other Program Issues

MEADS is being developed to employ the current PAC-3 missile and the future PAC-3 missile segment enhancement variant. The missile segment enhancement is a U.S.-funded effort to improve on the current PAC-3 missile capability. Program estimates indicate that the Army plans to develop and procure missiles at a cost of approximately $6.1 billion. We did not assess the missile and the missile segment enhancement, and the associated costs are not included in our funding information.

The MEADS program has adopted an incremental acquisition approach wherein MEADS major items are incrementally inserted into the current Patriot force. The first of the three insertions is to begin in 2008, with another in 2010, and the final in 2013. The program office plans for each increment to introduce new or upgraded capability into the program. The 2008 and 2010 increments are under review as the Office of the Secretary of Defense and the U.S. Army consider the means to consolidate and align multiple Air and Missile Defense command and control development efforts. The Army's objective is to provide a joint integrated network-centric architecture for common Battle Management Command, Control, Communications, Computers, and Intelligence. The 2013 increment is not effected by the potential realignment and the Army expects MEADS to achieve initial operating capability in 2017 with four units.

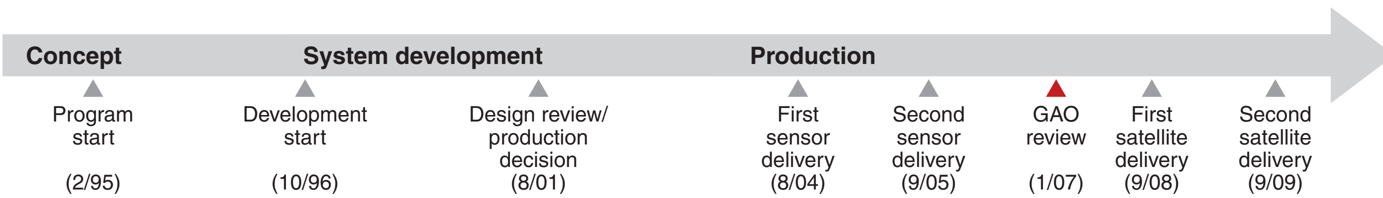
Agency Comments

The Army concurred with this assessment.

Space Based Infrared System (SBIRS) High

The Air Force's SBIRS High program is a satellite system intended to meet requirements in the missile warning, missile defense, technical intelligence, and battlespace characterization missions. A replacement for the Defense Support Program, SBIRS High was to consist of four satellites (plus a spare) in geosynchronous earth orbit (GEO), two sensors on host satellites in highly elliptical orbit (HEO), and fixed and mobile ground stations. In 2005, the number of GEO satellites was reduced to three. We assessed the sensors and satellites.

Source: Lockheed Martin Space Systems Company.



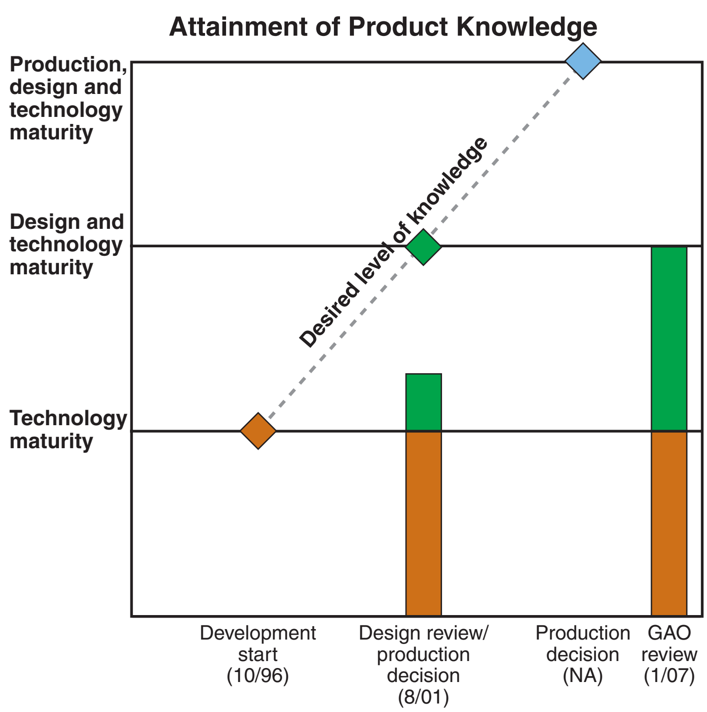
Program Essentials

Prime contractor: Lockheed Martin Space Systems Company
Program office: El Segundo, Calif.
Funding needed to complete:
- R&D: $2,573.3 million
- Procurement: $1,532.1 million
- Total funding: $4,184.8 million
- Procurement quantity: 1

Program Performance (fiscal year 2007 dollars in millions)

	As of 10/1996	Latest 12/2005	Percent change
Research and development cost	$4,023.5	$8,547.2	112.4
Procurement cost	$0.0	$1,635.4	NA
Total program cost	$4,225.9	$10,436.4	147.0
Program unit cost	$845.183	$3,478.789	311.6
Total quantities	5	3	-40.0
Acquisition cycle time (months)	TBD	TBD	TBD

The SBIRS High program's critical technologies and design are now mature. Production maturity could not be determined because the contractor does not collect production statistical process control data. After delays of 18 and 21 months, both HEO sensors have now been delivered. According to program officials, early HEO 1 sensor performance on-orbit confirms the sufficiency of the payload design and workmanship. In 2005, the program incurred two Nunn-McCurdy (10 U.S.C. 2433) unit cost breaches and made a decision not to buy two satellites. Although program officials acknowledge that the GEO satellites are orders of magnitude more complex than the HEO sensors, they believe a more realistic program schedule has been developed. The first GEO satellite delivery is scheduled for late 2008.



SBIRS High Program

Technology Maturity

The SBIRS High program's three critical technologies—the infrared sensor, thermal management, and onboard processor—are mature. However, program officials stated that flawed initial systems engineering created first-time integration and test risk associated with the complex GEO satellite. According to program officials, early test results of the scanning and staring sensors are positive. The staring sensor is to have the ability to stare at one earth location and then rapidly change its focus area, representing a significant leap in capability over the current system.

Design Stability and Production Maturity

The program's design is considered stable since almost all drawings have been released, but design-related problems may arise. Design problems led to delayed delivery of both HEO sensors, which were accepted for operations without meeting all program specifications. Given the greater complexity of the GEO satellites over the HEO sensors, the probability is high that major design flaws will be discovered on the GEO satellites as well.

Program officials are using 10 milestones to indicate progress. Four have been completed so far. Key events remaining include delivery of flight software to support the payload testing, payload delivery, ground software deliveries, and system ground connectivity tests.

Although the contractor does not collect statistical process control data, the program office tracks and assesses production maturity through detailed monthly test data and updates. According to program officials, about 95 percent of flight hardware for the first GEO satellite and 85 percent for the second have been delivered. Some testing is complete for the first GEO satellite, including the payload engineering thermal-vacuum test and testing to verify that the spacecraft will operate as intended in conditions comparable to those it will encounter on-orbit.

Other Program Issues

Given the high probability of design flaws, costly redesigns that further delay GEO delivery are possible. According to program officials, tests have been added to identify design issues and reduce the likelihood of significant schedule impacts. The program office has identified four focus areas that are most likely to impact the program, including flight software development and test, database development, resource contention between ground operations and software test and development, and human error in manufacturing.

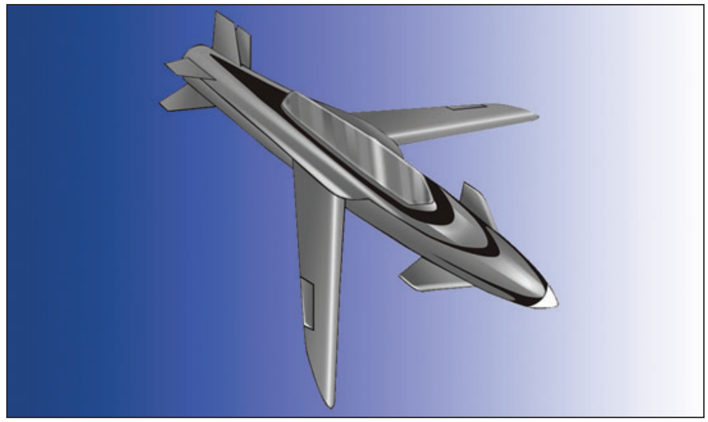
In July 2005, the program reported its third and fourth Nunn-McCurdy unit cost breaches (10 U.S.C. 2433). As part of the mandatory program certification process, the program was restructured in late 2005. The resulting Acquisition Decision Memorandum certified the program to complete the GEO 1 and 2 development activity and allowed for the option to procure one additional GEO satellite. In December 2005, the Air Force was directed to begin efforts to develop a viable competing capability in parallel with the SBIRS program, known as the Alternative Infrared Satellite System (AIRSS). The Air Force recently awarded contracts to Raytheon and SAIC for sensor assembly development for AIRSS. AIRSS is being designed in part to provide an alternative to the SBIRS GEO 3 satellite.

Agency Comments

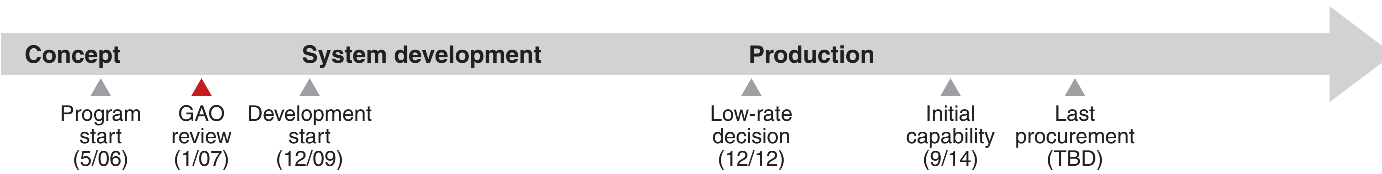
In commenting on a draft of this assessment, the Air Force stated that the GEO payload and spacecraft have successfully completed several risk reduction activities and appear mature and stable. It noted however, that if unforeseen difficulties arise during the GEO integration and test sequence, current direction from the Office of the Secretary of Defense is to maintain schedule, even at the sacrifice of performance. The Air Force stated that in the interest of preserving schedule, it may delay full capability. The Air Force expects GEO 1 payload delivery in the summer of 2007 for integration with the spacecraft bus. It further noted that integrated system test activities will be the focus of GEO 1 efforts in 2008, with the first GEO satellite launch anticipated late that year. The Air Force expects that the GEO 2 payload and bus will undergo integration and test activities in 2008 in anticipation of a launch in late 2009. Technical comments were provided and incorporated as necessary.

Small Diameter Bomb (SDB), Increment II

The Air Force's Small Diameter Bomb Increment II will provide the capability to attack mobile targets from stand-off range in adverse weather. The program builds on a previous increment that provided capability against fixed targets. SDB II will also provide capability for multiple kills per pass, multiple ordnance carriage, near-precision munitions, and reduced munitions footprint. The weapon will be installed on the Air Force's F-15E and the Navy's Joint Strike Fighter and is designed to work with other aircraft, such as the F-22A and B-1.



Source: SDB II Program Office.



Program Essentials

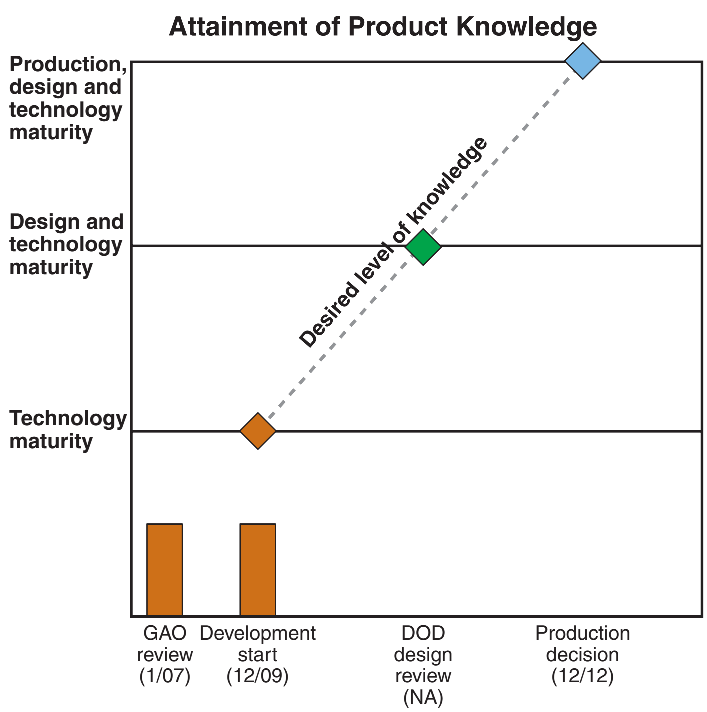
Prime contractor: Boeing, Raytheon
Program office: Eglin AFB, Fla.
Funding needed to complete:
R&D: $815.5 million
Procurement: $0.0 million
Total funding: $815.5 million
Procurement quantity: 12,000

Program Performance (fiscal year 2007 dollars in millions)

	As of NA	Latest 08/2006	Percent change
Research and development cost	NA	$858.3	NA
Procurement cost	NA	$0.0	NA
Total program cost	NA	$858.3	NA
Program unit cost	NA	TBD	NA
Total quantities	NA	12,000	NA
Acquisition cycle time (months)	NA	100	NA

The unit price will remain unknown until a contractor is selected at the end of the risk reduction phase.

Two of SDB II's five critical technologies are mature and are currently in use on the SDB I program. The remaining technologies are expected to be nearly mature by development start in December 2009. SDB II awarded two risk reduction phase contracts to Boeing and Raytheon in May 2006. The risk reduction phase will last 42 months, at the end of which Boeing and Raytheon will compete for the system development and demonstration contract to be awarded in December 2009. The risk reduction approach is said to allow higher risk and less mature technologies to be fielded in an evolutionary fashion. First SDB II delivery is expected in 2014.



SDB II Program

Technology Maturity

Two of the five critical technologies—the airframe and the guidance and control system—are considered mature. These two technologies were leveraged from legacy Air Force and Navy weapons. Three others, the multi-mode seeker, net-ready data link, and payload (warhead and fuze) need further development. The seeker is currently the least mature, and according to program officials, will be the most challenging technology to demonstrate due to the complexity of the algorithms it will require and the need to package the multimode seeker into a small volume. The program expects that each critical technology will be mature or approaching full maturity when the program begins system development and demonstration in December 2009.

According to program officials, the strategy for maturing these technologies is to "test early, test often," using modeling and simulation techniques, and relying on other programs that have used the same or similar technologies. Each contractor will conduct these activities separately. At the down select point, the program plans to evaluate the contractors on the level of technology maturity they achieved during the risk reduction phase.

Other Program Issues

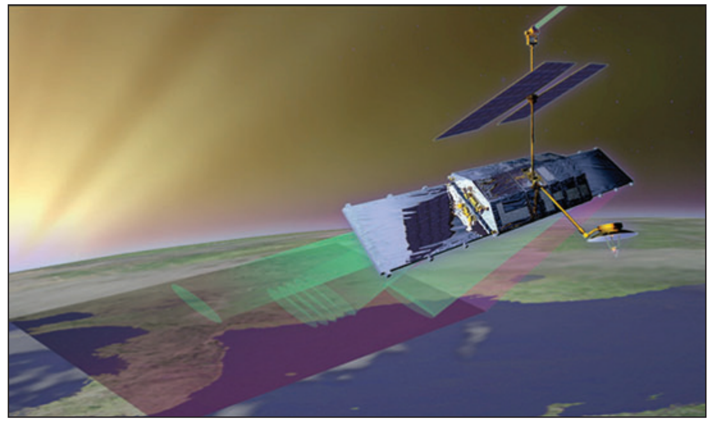
The government plans to procure the SDB II based on contractor-developed and government-approved system performance specifications, which will become contractually binding at down select in 2009. The contractor will be accountable for system performance. Accordingly, the contractor is responsible not only for the design of the weapon system, but also for planning the developmental test and evaluation program to verify the system performance. The government will assess the contractor's verification efforts for adequacy before three major decision points: award of low-rate production contract, declaration that the system is ready for dedicated operational test, and award of full-rate production after the beyond low rate production assessment.

Agency Comments

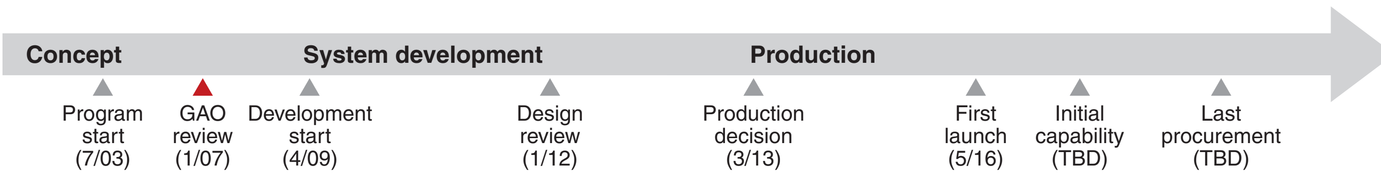
In commenting on a draft of this assessment, the Air Force concurred with the information presented and provided technical comments, which were incorporated as appropriate.

Space Radar (SR)

SR is an Air Force-led, joint DOD and intelligence community program to develop a satellite system to provide persistent, all-weather, day and night surveillance and reconnaissance capabilities in denied areas. As envisioned, SR would generate volumes of radar imagery data for transmission to ground-, air-, ship-, and space-based systems. We assessed the space segment.



Source: Space Radar Integrated Program Office.



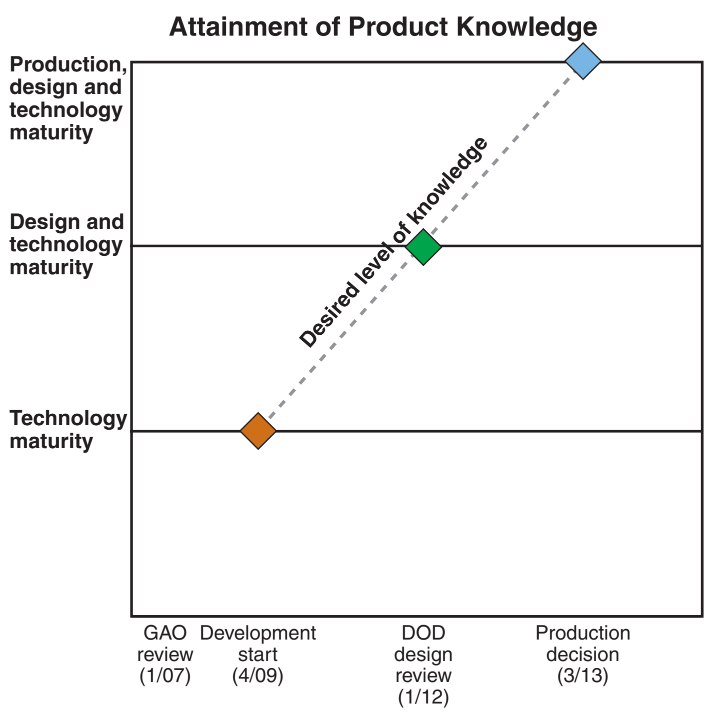
Program Essentials

Prime contractor: Lockheed Martin Space Systems Co., Northrop Grumman Space and Mission Systems Corp.
Program office: Chantilly, Va.
Funding needed to complete:
R&D: $10,841.4 million
Procurement: $4,878.7 million
Total funding: $17,528.5 million
Procurement quantity: 8

Program Performance (fiscal year 2007 dollars in millions)

	As of 01/2006	Latest 08/2006	Percent change
Research and development cost	$9,605.0	$11,305.4	17.7
Procurement cost	$10,110.1	$4,878.7	-51.7
Total program cost	$23,326.3	$17,992.6	-22.9
Program unit cost	$1,060.285	$1,799.257	69.7
Total quantities	22	10	-54.6
Acquisition cycle time (months)	TBD	TBD	TBD

Five critical technologies will support the SR program, and they are still being matured. The program office is focusing its efforts on technology risk reduction and concept definition activities. The Air Force has made several changes to the acquisition approach, including schedule and cost changes, to address concerns about the affordability of SR. The program also recently revised its development start date from the last quarter of 2008 to the third quarter of 2009, an 8-month extension. Launch of the first fully operational SR satellite is scheduled for fiscal year 2016. Design and production maturity could not be assessed because SR has not begun product development.



SR Program

Technology Maturity

The program office recently revised its critical technologies. It assessed the integrated radio frequency assembly, advanced analog/digital converters, surface moving target indication processing algorithms, open ocean surveillance processing algorithms, and low earth orbit laser communication terminals as the critical technologies needing further development. The program office also stated that critical technology identification is an ongoing process and that technologies could be removed or additional technologies could be added as studies, requirements, and performance analyses are further refined. The program office expects almost all of the technologies to be mature when it begins the product development phase.

Other Program Issues

For fiscal year 2007, the Appropriations Conferees reduced the program's requested budget by $80 million. DOD and other SR users have created a new path for developing a single space radar system to meet user needs. As a result, the Air Force has restructured the program and is evaluating the SR schedule and associated costs. The new path includes several changes to the SR acquisition approach. First, in early 2005, a new Space Radar Integrated Program Office was established in Chantilly, Virginia, to work more closely with the intelligence community, DOD and other users, senior Air Force leadership, and the Congress. Second, the new SR senior leadership established a framework with overarching guidance for maturing the critical technologies, emphasizing use of more mature and less risky technology in a block development approach. For example, the program office recently employed this approach by deferring high-risk technologies, such as onboard processing and more advanced solar cells and batteries, from the first block of satellites to be developed. The program office plans to incorporate these technologies as they mature. Third, a team of program office personnel and mission partners established a new plan to drive fiscal year 2006 risk reduction activities and revised cost estimates. Finally, the SR development approach reduced the total number of satellites to be acquired from 22 to 10. While this reduction decreases recurring costs, it does not decrease research and development costs. In fact, with the decrease in total quantity, research and development costs are amortized over fewer satellites, resulting in an increase in the average unit cost. While DOD and the intelligence community in January 2005 committed to pursue a single space radar capability, a cost-share agreement between DOD and the intelligence community for this effort has yet to be established.

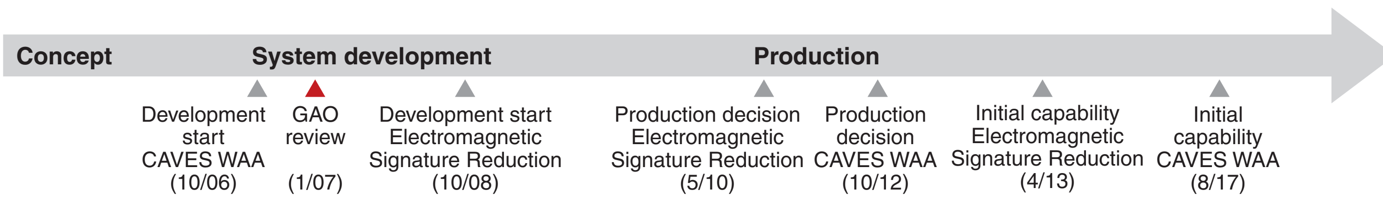
Agency Comments

In commenting on a draft of this report, the Air Force stated that it is still coordinating plans for demonstrating the maturity of one technology (advanced analog/digital converters). It has established an initial test program but needs to resolve whether or not testing is required at a higher level of assembly to meet the standard for demonstrating technology maturity. In any case, the program office intends to demonstrate adequate maturity for all critical technologies before it begins the product development phase.

SSN 774 Technology Insertion Program

The Navy is seeking to enhance the performance and lower the cost of the Virginia class submarine by inserting new technologies, like those for electromagnetic signature reduction and sensors for CAVES WAA, and improving its production processes and design. The Navy seeks to lower the cost of two submarines per year to $2 billion each (2005 dollars) by 2012, a reduction of about $400 million. We assessed the maturity of the technologies planned for insertion, and discuss some of the design and production improvements.

Source: Northrop Grumman Newport News.



Program Essentials

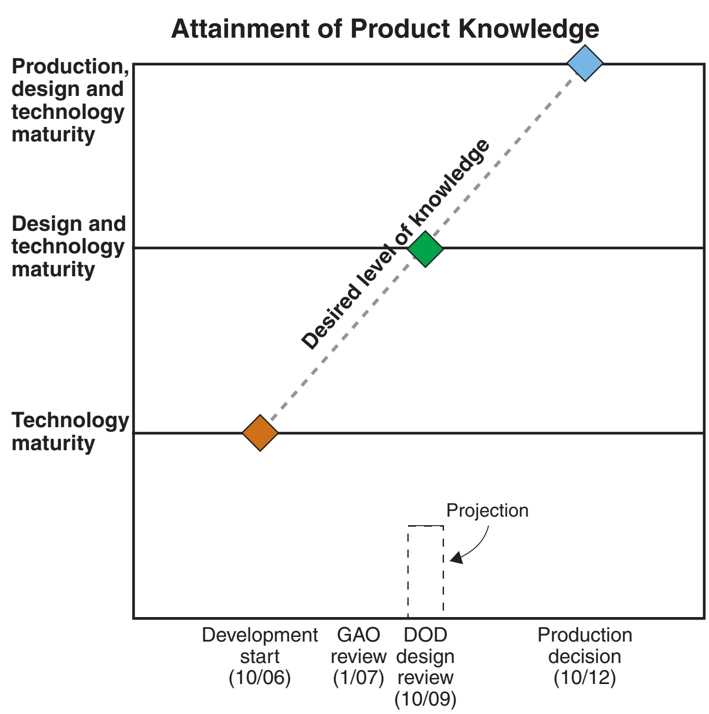
Prime contractor: General Dynamics Electric Boat
Program office: Washington, D.C.
Funding needed to complete:
- R&D: $83.4 million
- Procurement: $556.0 million
- Total funding: $639.4 million
- Procurement quantity: 0

Program Performance (fiscal year 2007 dollars in millions)

	As of NA	Latest 08/2006	Percent change
Research and development cost	NA	$85.2	NA
Procurement cost	NA	$556.0	NA
Total program cost	NA	$641.2	NA
Program unit cost	NA	TBD	TBD
Total quantities	NA	TBD	TBD
Acquisition cycle time (months)	NA	TBD	TBD

There is no procurement cost associated with software for electromagnetic signature reduction. Procurement costs presented are for sensor technologies and, according to program officials, represent a $12 million savings over existing sensors.

The program office identified three critical technologies for insertion into the Virginia-class submarine beginning in 2010, including one software package for electromagnetic signature reduction and two technologies for sensor arrays. Development start for the array technologies occurred in October 2006, while development start for software will occur in October 2008. Currently all three technologies are immature. The achievement of key product knowledge shown is for the sensor technologies. Prior to 2010 the program office is making additional changes to the submarine's design and production processes to reduce cost or enhance capabilities. According to program officials, one of these changes, the introduction of the advanced sail, was recently deferred from 2009 to 2014.



SSN 774 Tech Insertion Program

Technology Maturity

The Virginia class submarine program is developing three new technologies for insertion into submarines beginning in 2010. The first of these is a software package containing improved algorithms to monitor and, if necessary, reduce the submarine's electromagnetic signature. This software will be installed in submarines under construction in 2010 and 2011, SSN-781 through SSN-786, as well as all future submarines. Program officials state that after the software is installed, at-sea testing and calibration are required to ensure full functionality. Similar software has been demonstrated in British submarines, but due to alterations and additional testing needed for use with Virginia-class submarines, the software is considered immature. The other two technologies selected for insertion will be integrated to form the conformal acoustic velocity sensor wide aperture array (CAVES WAA), a sensor designed to replace existing systems and lower the cost of construction while maintaining or improving performance. The two technologies, fiber optic sensors and the integrated panels that contain the sensors and manage their signature, are both immature. Currently rough models of both technologies are being tested in a laboratory environment. If the fiber optic sensors do not develop as expected, a more mature ceramic sensor may be used to preserve cost savings and performance. If both technologies encounter difficulties in development, the program will continue to use the existing systems.

Design Stability

While the program office will track the stability of design for these new technologies, it will use metrics other than the engineering drawings. In addition to these new technologies, the program office will introduce a series of design changes beginning with the submarine authorized for construction in 2008. Redesign could include anything from new lighting systems to replacing the front section of the submarine. The program office is also investigating replacing some hydraulic systems with lower-cost electric systems and simplifying other components like the propulsion lubrication system. Eventually the program office hopes to achieve savings of $100 million per submarine by 2012 through changes to technology and design. According to program officials, one of these design changes, the introduction of the advanced sail, was recently deferred from 2009 until 2014 to allow further design development and risk reduction. Near term funding for this effort has been reallocated to take advantage of other cost reduction opportunities. When implemented, this design change will replace the existing sail, the structure that sits atop the main body of the submarine, with one that provides expanded space for sensor systems or equipment for special forces teams. The advanced sail will be constructed of composite materials whose feasibility has already been demonstrated under a separate development program.

Other Program Issues

The Navy is also attempting to reduce cost in the Virginia-class submarine program by improving production processes. The program office seeks to reduce construction time by up to 24 months through improvements to construction efficiency. Some of the methods proposed include increasing the size and weight of the sections of the submarine while decreasing the number of sections produced, installing more equipment in the sections prior to assembling them, and performing hull treatments prior to delivery. These changes will be assisted by the construction of new, more efficient equipment and facilities at the shipyards, an initiative funded by the Navy and enabled by contract incentives. The Navy anticipates per-submarine savings of $65 million to $110 million through these initiatives, but acknowledges the significant increase in maturity of construction processes required to achieve these savings.

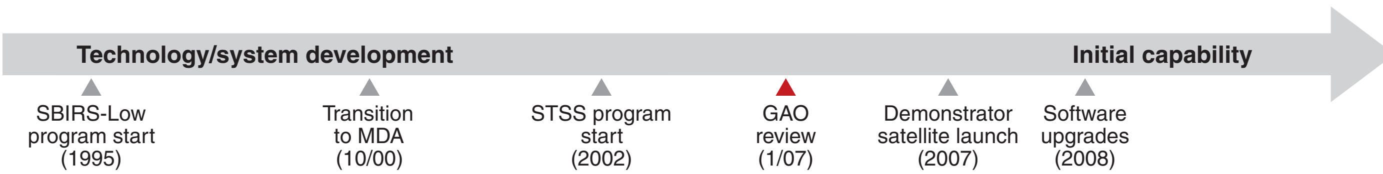
Agency Comments

The Navy provided technical comments, which were incorporated as appropriate.

Space Tracking and Surveillance System (STSS)

MDA's STSS element is being developed in incremental, capability-based blocks designed to track enemy missiles throughout their flight. The initial increment is composed of two demonstration satellites built under the Space Based Infrared System Low program. MDA plans to launch these satellites in 2007 to assess how well they work within the context of the missile defense system. MDA is also studying improvements to the STSS program, and it will be building next-generation satellites. We assessed the two demonstration satellites.

Source: STSS Program Brief.



Program Essentials

Prime contractor: Northrop Grumman Space Technology
Program office: El Segundo, Calif.
Funding FY07-FY11:
- R&D: $3,186.3 million
- Procurement: $0.0 million
- Total funding: $3,186.3 million
- Procurement quantity: NA

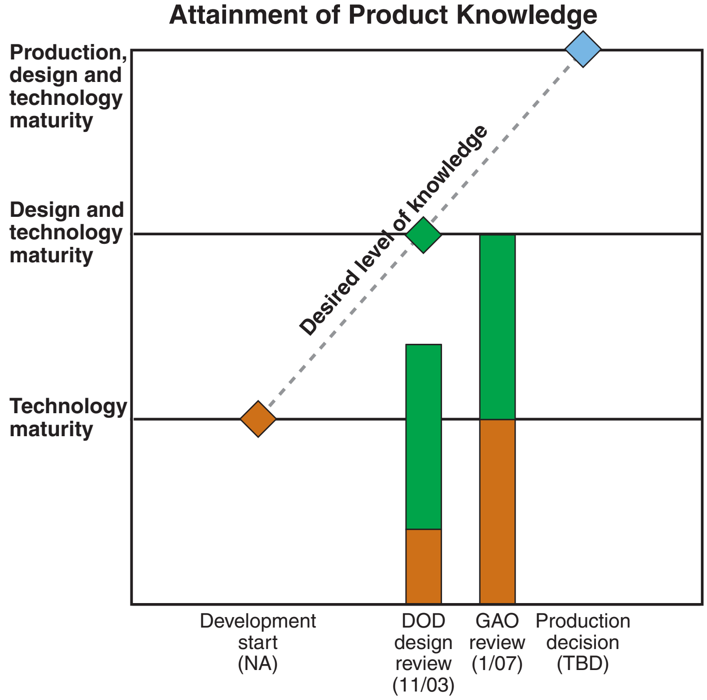
Program Performance (fiscal year 2007 dollars in millions)

	As of 02/2004	Latest 02/2006	Percent change
Research and development cost	$3,461.2	$4,682.9	35.3
Procurement cost	$0.0	$0.0	0.0
Total program cost	$3,461.2	$4,682.9	35.3
Program unit cost	NA	NA	NA
Total quantities	NA	NA	NA
Acquisition cycle time (months)	NA	NA	NA

Columns include all known costs and quantities from the program's inception through fiscal year 2009 for all parts of STSS—Blocks 2006, 2008, 2010, and 2012. Total known program cost through fiscal year 2011 is $6,366.4 million.

All of the STSS program's five critical technologies are mature. The STSS design appears otherwise stable, with all drawings released to manufacturing. Both satellites' acquisition and tracking sensors, which are the satellites' payloads, were delivered in 2006. However, continuing quality and workmanship problems with the first satellite's payload as well as space vehicle integration and test issues, according to MDA, caused the contractor to overrun its fiscal year 2006 budget and experience schedule delays. This and a funding reduction have caused a 5-month slip in the launch date for the demonstration satellites. The launch is now scheduled for December 2007.

Attainment of Product Knowledge



STSS Program

Technology Maturity

All five critical technologies—satellite communication cross-links, onboard processor, acquisition sensor, track sensor, and the single-stage cryocooler—are mature. The last two technologies—track sensor and the single-stage cryocooler—reached maturity when the thermal vacuum testing on the first satellite's payload was completed in February 2006.

Design Stability

The STSS program's design is stable, with all drawings released to manufacturing. When the STSS program started in 2002, design drawings and the satellite components for the partially built satellites from the Space Based Infrared System Low effort were released to manufacturing. By the time STSS went through its design review in November 2003, the program office had released all subsequent design drawings.

Other Program Issues

The payload for the first satellite was delivered on February 28, 2006, and has been integrated onto the satellite. The second satellite's payload completed thermal vacuum testing and was delivered on December 19, 2006. The payload was supposed to be delivered in August 2006, but an issue surfaced with higher than expected friction on the elevation gimbal that restricted movement of the track sensor to above-the-horizon viewing. This was resolved and a full range of motion was demonstrated in a thermal vacuum test. The STSS ground segment activities have progressed well. The first part of the ground acceptance test was successfully completed, and the last part is expected to be conducted in January 2007. In addition, the ground segment operations and training-related materials have been turned over to system test personnel.

The program experienced quality and workmanship problems with its payload subcontractor over the past several years, particularly with the first satellite's payload. More recently, the prime contractor tightened its inspection and supervision of the subcontractor's processes, and an education effort was undertaken to ensure that all personnel on the program knew and understood the program instructions. The subcontractor's performance with respect to the payload for the second satellite improved significantly as a result of these more recent actions.

The program office is in the process of negotiating a contract change that will move the contract launch date from July 2007 to December 2007. There are two reasons for the change in contract and forecast launch date. First, the program office directed additional testing of the first satellite's track sensor and a second thermal vacuum test of its payload because the test data from the original tests were ambiguous. The tests added a couple of months to the program schedule. Second, MDA received a $200 million funding cut that placed the STSS program under tight financial restrictions in fiscal year 2006, allowing no funds for contingencies and forcing the program office to push some work into fiscal year 2007. The program was unable to shift the deferred work into fiscal year 2007 and still make the July 2007 launch date. Thus, the program office expects that the two demonstration satellites will be launched in December 2007.

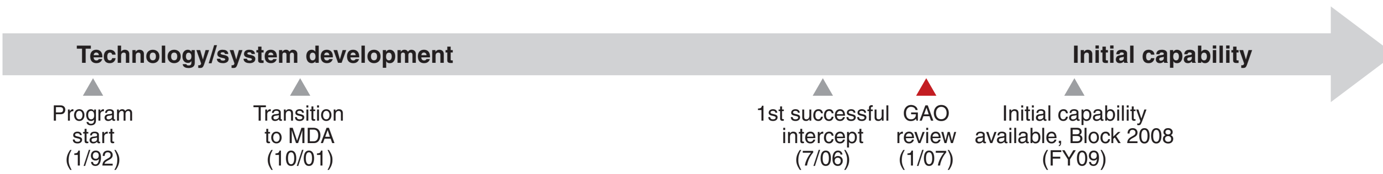
Agency Comments

MDA provided technical comments on a draft of this assessment, which were incorporated as appropriate.

Terminal High Altitude Area Defense (THAAD)

MDA's THAAD element is being developed in incremental, capability-based blocks to provide a ground-based missile defense system able to defend against short- and medium-range ballistic missile attacks. THAAD will include missiles, a launcher, an X-band radar, and a fire control and communications system. We assessed the design for the Block 2008 initial capability of one fire unit that MDA plans to hand off to the Army in fiscal year 2009 for limited operational use.

Source: THAAD Project Office.



Program Essentials

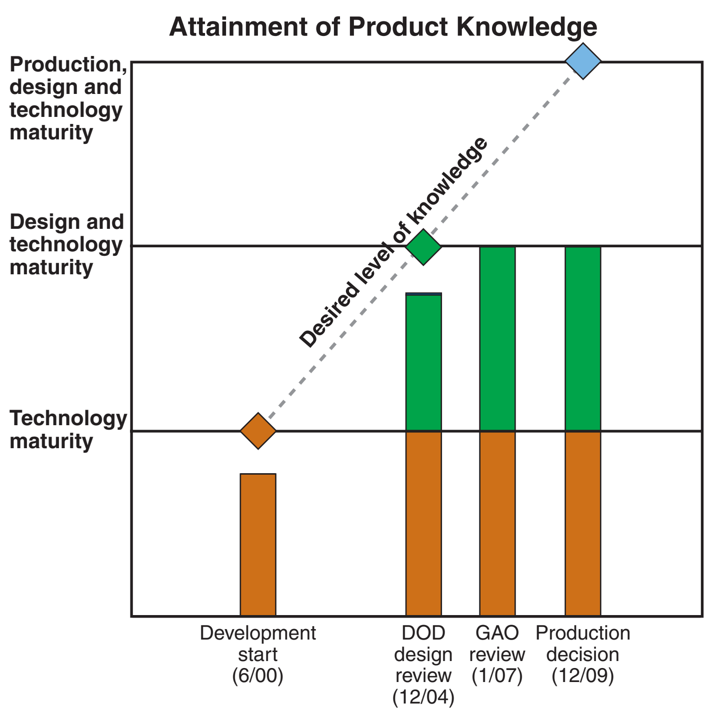
Prime contractor: Lockheed Martin
Program office: Huntsville, Ala.
Funding FY07-FY11:
- R&D: $3,279.8 million
- Procurement: $0.0 million
- Total funding: $3,279.8 million
- Procurement quantity: NA

Program Performance (fiscal year 2007 dollars in millions)

	As of 01/2006	Latest 08/2006	Percent change
Research and development cost	$12,309.7	$12,455.0	1.2
Procurement cost	$0.0	$0.0	0.0
Total program cost	$12,309.7	$12,455.0	1.2
Program unit cost	NA	NA	NA
Total quantities	NA	NA	NA
Acquisition cycle time (months)	NA	NA	NA

Columns include all known costs and quantities from the program's inception through fiscal year 2009. Total known program cost through fiscal year 2011 is $13,432.3.

Program officials assessed THAAD's technologies as mature and its design as generally stable, with 93 percent of its design drawings released. During Block 2006, the program is continuing to mature THAAD's design and expects to deliver a limited operational capability during Block 2008. In fiscal year 2006, the program successfully conducted three of five scheduled tests. One of the tests that was not successfully completed was Flight Test 4. During this test, the target malfunctioned, causing program officials to call this a "no test." The program does not plan to conduct this test at a later date. Rather, the objectives of this test will be rolled into a later flight test, allowing the program to gain the knowledge, but at a later date.



THAAD Program

Technology Maturity
Program officials assessed all of THAAD's critical technologies as mature. All of these technologies are included in four major components: the fire control and communications component; the interceptor; the launcher; and the radar.

Program officials made changes in the execution of the THAAD program that allowed it to make progress in maturing critical technologies. Officials placed more emphasis on risk reduction efforts, including adopting technology readiness levels to assess technological maturity.

Design Stability
THAAD's basic design is nearing completion with approximately 93 percent of the 13,010 drawings expected to be available at the start of production. The number of drawings increased from the approximately 9,850 reported last year primarily due to design changes that testing identified as being needed.

Production Maturity
We did not assess THAAD's production maturity because the program is only delivering test units until fiscal year 2009. MDA plans to purchase two fire units while simultaneously conducting developmental activities. The first will be delivered in fiscal year 2009, with a second expected to become available during fiscal year 2010. Prior to a production decision, the program office plans to assess production maturity using risk assessments and verification reviews for assurance of the contractor's readiness to proceed with repeatable processes and quality.

Other Program Issues
THAAD officials expected to complete five flight tests prior to the end of fiscal year 2006 but were only able to conduct four tests. During flight tests 1 and 2 program officials demonstrated missile performance, divert attitude control system operations, and kill vehicle control. While conducting integrated system flight test 3, the seeker demonstrated the ability to locate a target in the high endo-atmosphere—the primary objective of the test—and successfully intercepted a target. During flight test 4—which was scheduled to be the program's first objective intercept attempt—the target malfunctioned shortly after launch and forced program officials to destroy the target. As a result of the malfunction, program officials were forced to declare flight test 4 a "no-test." Program officials are planning to add the objectives from flight test 4 into a later flight test, which will allow them to gain the knowledge they initally planned on receiving from this test at a later date.

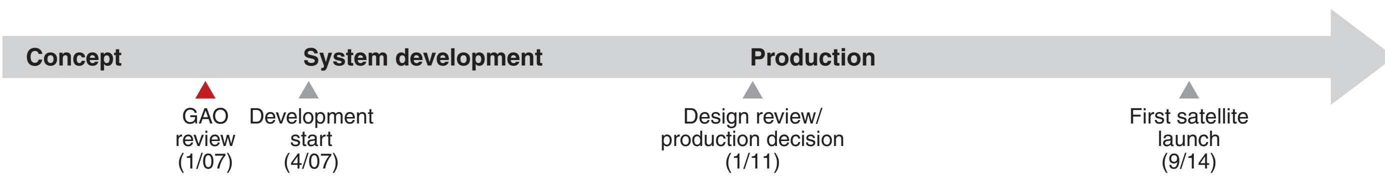
Additionally, hardware issues and technical problems are causing the program's prime contractor to experience negative cost and schedule variances. The variances can primarily be attributed to the missile, launcher, and THAAD fire control and communications components. As of September 30, 2006 the THAAD program was behind schedule in completing $38.2 million of fiscal year 2006 work and overruning its fiscal year 2006 cost budget by $89.2 million.

Agency Comments
MDA provided technical comments, which were incorporated as appropriate.

Transformational Satellite Communications System (TSAT)

The Air Force's TSAT system is the spaceborne element of the Global Information Grid that will provide high data rate military satellite communications services to DOD users. The system is designed to provide survivable, jam-resistant, global, secure, and general-purpose radio frequency and laser cross-links with other air and space systems. The TSAT system will consist of a constellation of five satellites, plus a sixth satellite to ensure mission availability. We assessed the six satellites.

Source: TSAT Program Office.



Program Essentials

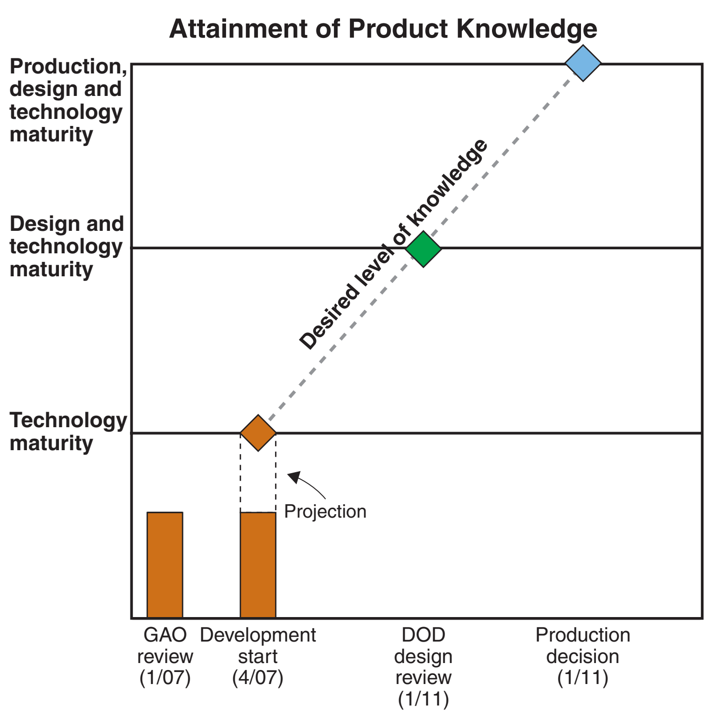
Prime contractor: SE&I: Booz Allen Hamilton, TMOS: Lockheed Martin Integrated Systems Solutions
Program office: El Segundo, Calif.
Funding needed to complete:
R&D: $11,931.2 million
Procurement: $3,948.4 million
Total funding: $15,906.9 million
Procurement quantity: 4

Program Performance (fiscal year 2007 dollars in millions)

	As of 04/2007	Latest 08/2006	Percent change
Research and development cost	$13,740.0	TBD	TBD
Procurement cost	$3,948.4	TBD	TBD
Total program cost	$17,715.7	TBD	TBD
Program unit cost	$2,952.6	TBD	TBD
Total quantities	6	TBD	TBD
Acquisition cycle time (months)	147	TBD	TBD

The above data reflects costs and quantities as of the 2006 assessment; latest figures on cost and quantities are unavailable.

Since our last assessment, DOD rescinded the approval to begin preliminary design activities and restructured the TSAT program strategy to align program activity with the December 2004 National Security Space Acquisition Policy 03-01 into an incremental development approach. Each increment will incorporate available mature technology to lower program risk and improve confidence in launching TSAT satellites according to schedule. DOD also directed the Air Force to ensure that all critical technologies are mature and Systems Design Review is complete prior to seeking preliminary design development approval for the space segment. According to program officials, a new acquisition strategy is being developed, which will result in a new program baseline.



TSAT Program

Technology Maturity

In June 2006, DOD rescinded the prior approval for TSAT to enter the preliminary design phase to align the program with current national security space acquisition policy. The program is now in the concept development phase. Currently, four of the program's seven technologies are mature.

Of the seven technologies, four technologies—packet processing payload, communication-on-the-move antenna, information assurance space for internet protocol encryption and information-assurance for transmission security—are mature. The other three—dynamic bandwidth and resource allocation, protected bandwidth efficient modulation waveforms, and single access laser communication—are scheduled to reach maturity before development start, currently scheduled for April 2007. All of the technologies are needed to be mature prior to entering the preliminary design phase again.

The wide-field of view multi-access laser communication technology was part of the original TSAT baseline program. However, it is no longer part of the baseline due to the lower risk incremental approach. The program is currently budgeting $16.7 million for maturation of this technology which could be inserted into future increments, according to the program office.

Other Program Issues

According to program officials, the TSAT program has spent about $1 billion to date. However, given that the program is in the concept development phase, information on cost, design stability, production maturity, or software development for satellite production is not yet available. According to DOD officials, a request for proposals for the space segment is expected to be released in May 2007, and the contract is expected to be awarded in December 2007.

The program awarded a contract in January 2006 to develop the TSAT Mission Operations System (TMOS) that will provide network management, and to develop the overall network architecture. The program awarded this contract first to allow the competing space contractors to focus their satellite designs on a single architecture and mission operations system, thereby reducing program complexity. According to the TSAT program office, TMOS will include software development that will take place in four increments, with a projected 5.2 million total lines of code in the final system.

The June 2004 program baseline showed a first satellite launch scheduled for October 2011. The date was later moved to October 2013, and then to September 2014, due to TSAT appropriations reductions in fiscal years 2005 and 2006, according to the program office. Congress made these reductions due to concerns about the maturity of critical technologies and an aggressive acquisition schedule. Congress continues to express concerns about the program. For fiscal year 2007, the Appropriations conferees reduced the program's requested budget by $130 million. According to the program office, the initial launch date is now October 2014 due to the latest reduction. While encouraged by changes to the program's acquisition strategy, the Senate Appropriations Committee noted that even with reduced funding, the program budget was still significantly higher than the prior year. The committee stated that excessive cost growth across a short time span facilitates inefficiencies that can create future program management and cost overrun problems.

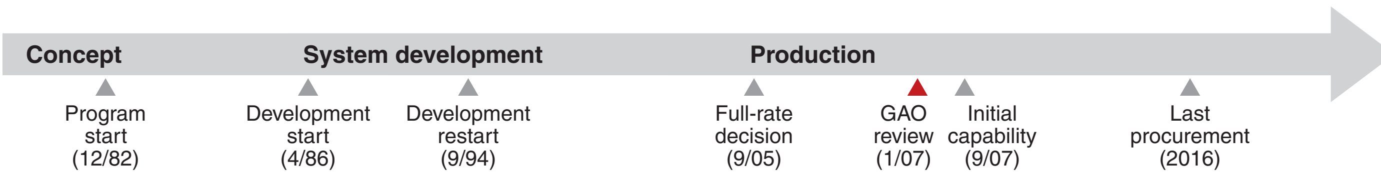
Agency Comments

The Air Force provided technical comments to a draft of this assessment, which were incorporated as appropriate.

V-22 Joint Services Advanced Vertical Lift Aircraft

The V-22 Osprey is a tilt rotor aircraft developed by the Navy for Marine Corps, Air Force, and Navy use. As of fiscal year 2006, 85 Marine Corps MV-22s and 7 Air Force CV-22s were procured. The MV-22 will replace the Marine Corps CH-46E and CH-53D helicopters. There currently are two versions of the MV-22, the Block A, which incorporates safety-related changes, and Block B, which is built upon the Block A to provide enhanced maintainability. We assessed Block A but have comments concerning Block B, the version that will be deployed.

Source: V-22 Joint Program Office.



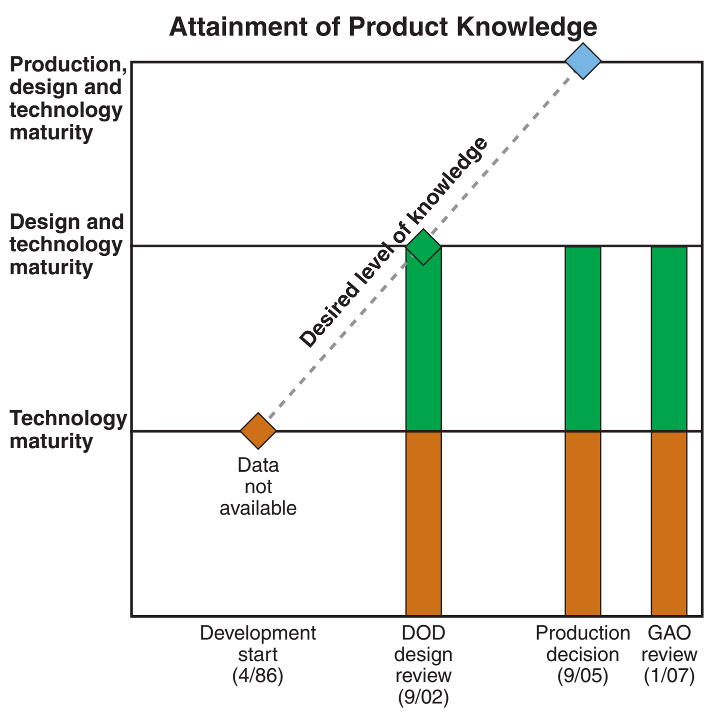
Program Essentials

Prime contractor: Bell-Boeing JPO
Program office: Patuxent River, Md.
Funding needed to complete:
- R&D: $821.7 million
- Procurement: $25,848.8 million
- Total funding: $26,860.5 million
- Procurement quantity: 364

Program Performance (fiscal year 2007 dollars in millions)

	As of 04/1986	Latest 12/2005	Percent change
Research and development cost	$3,904.3	$12,082.0	209.5
Procurement cost	$32,741.8	$37,640.9	15.0
Total program cost	$36,863.7	$49,974.1	35.6
Program unit cost	$40.376	$109.114	170.2
Total quantities	913	458	-49.8
Acquisition cycle time (months)	117	293	150.4

While the design of Block A is considered stable, Block A will not be deployed in combat. Design stability of Block B—the deployed configuration—will be better known after its limited operational assessment in late 2007. Design changes are possible in order to address any deficiencies identified during this test and those identified during prior Block A tests as well as to lower production costs, and to field future upgrades. Fuselage structural design changes are possible if improved troop seat crash retention capability is directed. The current budget reinstated a funding shortfall from last year's budget submittal, and as a result, adequate funding to fully procure 185 aircraft exists. However, a bearing defect has been found in some critical assemblies of production aircraft and is being addressed.



V-22 Program

Design Stability

The design of the MV-22 Block A is considered stable and mature. The Block B version, which will be the deployed version, is built upon the Block A to provide enhanced maintainability. Its maturity will be better known after operational tests planned prior to its initial operational capability in September 2007. Further design changes to Block B may be needed to address deficiencies identified during this assessment and the 2005 operational tests of Block A, to lower the production cost, and to field future upgrades.

The Navy desires to increase the crashworthiness capability of the troop seat and fuselage structure above the current specification requirements. A new improved troop seat has been purchased for the V-22 aircraft, a medium risk has been accepted for the new troop seat installation with the current fuselage structure, and the program is evaluating engineering change alternatives to add crashworthiness capability to the fuselage structure to further enhance crashworthiness capability. Improved troop seats may, in some crash conditions, impart higher loads into the airframe than originally intended due to new higher qualification standards.

According to program officials, engineering change proposals may be used to lower unit recurring flyaway cost to a level contractors believe is needed to generate foreign military sales of the aircraft. The government has invested and intends additional investments in cost reduction. At an initial meeting program officials stated that on cost type contracts most engineering change proposals are usually done at the government's expense even if the change is within the scope of the contract. However, when providing written technical comments the program office stated that the contractor has made and continues to make corporate investments as well to drive recurring flyaway costs down.

Production Maturity

We could not assess production maturity because statistical process control data were not available. In September 2005, DOD approved the V-22 for full-rate production after conducting a production readiness review. The review identified program management, production engineering and planning, and material and procured parts as high-risk areas requiring intense management attention. A number of initiatives were proposed to reduce these risks including the approval of a multi-year procurement contract in order to achieve a low product cost—one of the components of the high program management risk areas. Congress recently authorized the program to enter into a multiyear procurement contract. Initially program officials did not believe they could buy the number of aircraft proposed in the multi-year justification because of a reduction in program funding levels. This reduction was the result of the milestone decision authority adopting a lower independent cost estimate than the program estimate. However, according to the Navy, the current budget reinstated the funding shorfall from last year's budget submittal and adequate funding exists to fully procure the 185 aircraft in the multiyear buy.

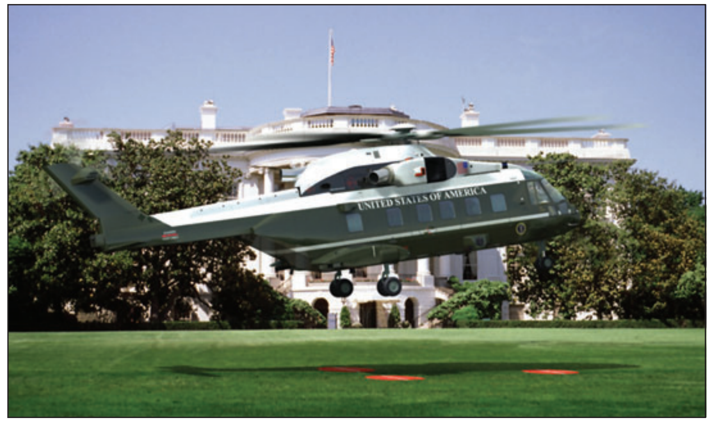
Production aircraft continue to be accepted with numerous deviations and waivers. Program officials stated that this practice will continue due to the time needed to address these items. Analysis of the acceptance documentation for the latest three aircraft delivered before November 2006, revealed several potentially serious defects such as the aircraft being conditionally accepted with bearing assemblies that contain a thin dense chrome plating/coating that did not meet contract requirements for two assemblies inside the proprotor gearbox. One of these assemblies is in a critical area. Program officials state that this deficiency has been addressed by (1) stripping chrome plating from bearings and replating in accordance with improved manufacturing processes, and (2) qualifying newly manufactured bearings for use without the chrome plating. Program officials state that these bearing assemblies may not meet the contract requirements in two critical assemblies.

Agency Comments

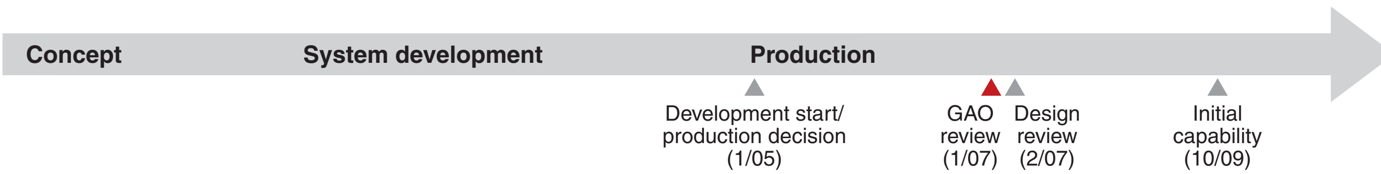
In commenting on a draft of this report, the Navy provided technical comments, which were incorporated as appropriate.

VH-71 Presidential Helicopter Replacement Program

The Navy's VH-71 will be a dual-piloted, multi-engine, helicopter employed by Marine Helicopter Squadron One to provide safe, reliable, and timely transportation for the President and Vice President of the United States, heads of state, and others in varied and at times adverse climatic and weather conditions. When the President is aboard, the VH-71 will serve as the Commander in Chief's primary command and control platform. The system will replace the VH-3D and VH-60N. It will be developed in two increments. We assessed increment one.



Source: Presidential Helicopters Program Office.



Program Essentials

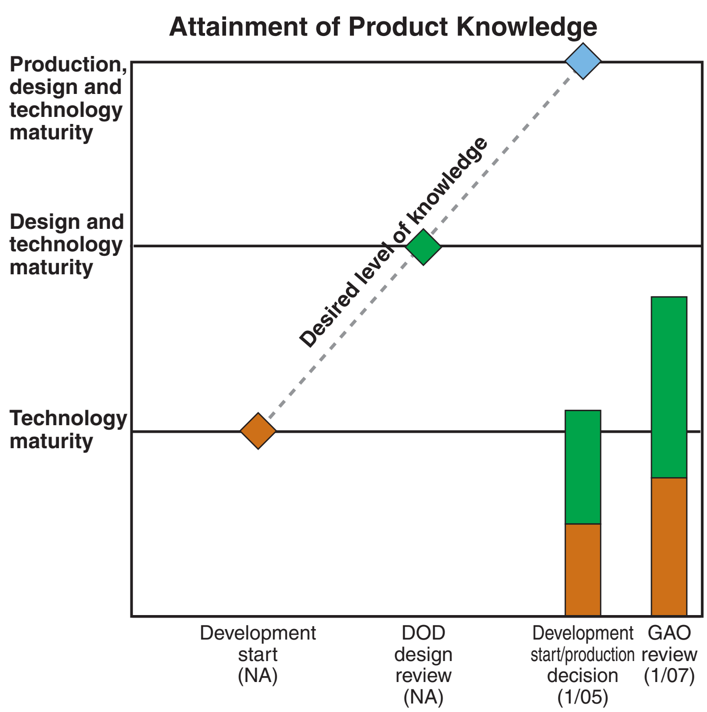
Prime contractor: Lockheed Martin Systems Integration
Program office: Patuxent River, Md.
Funding needed to complete:
R&D: $1,994.0 million
Procurement: $2,332.3 million
Total funding: $4,337.9 million
Procurement quantity: 15

Program Performance (fiscal year 2007 dollars in millions)

	As of NA	Latest 02/2006	Percent change
Research and development cost	NA	$3,703.1	NA
Procurement cost	NA	$2,332.3	NA
Total program cost	NA	$6,210.0	NA
Program unit cost	NA	$270.001	NA
Total quantities	NA	23	NA
Acquisition cycle time (months)	NA	57	NA

Program costs include costs for increments one and two. Increment one and two development and increment one production are funded with research and development funding.

In January 2005, the VH-71 program began system development and committed to production without fully maturing technologies, achieving design stability, or demonstrating production maturity due to an aggressive high-risk schedule driven by White House needs. The program is approaching technology maturity and design stability for increment one. However, this design may not be useable to meet increment two performance requirements. The range requirement in the prime contract was reduced because the estimated weight of the aircraft is over 1,200 pounds more than the original limit. The program is also reassessing the requirements for increment two and considering cost, schedule, and performance trade-offs because the current program may not be executable. Concurrency in development, design, and production continues to put the program at risk for cost growth and schedule delays.



VH-71 Program

Technology Maturity

The VH-71 program's two critical technologies were nearing maturity when the program began development and committed to production in January 2005. Since then, one of those technologies, the 10-inch cockpit control displays, matured. A prototype of the other critical technology, the Communication and Subsystem Processing Embedded Resource Communications Controller, is not projected to be demonstrated in a realistic environment until 2007. The program's design review and ongoing technology readiness assessment efforts identified no significant technology risk for increment one. The critical technologies for increment two have not been identified. The program is reassessing the requirements for increment two and considering cost, schedule, and performance trade-offs because it may not be affordable and executable within the current program schedule.

Design Stability and Production Maturity

In January 2005, the VH-71 program committed to the production of five aircraft without a final design or fully defined production processes. The program's August 2006 design review was held ten months later than planned and did not meet the Navy's criteria for a successful system-level review. An additional design review is planned for February 2007. In August 2006, 87 percent of the program's drawings were releasable to manufacturing with the remaining drawings primarily related to installation. The program obtained customer agreement to reduce the range requirement in the prime contract and is working to stabilize the weight of the aircraft. The program also obtained customer agreement to defer several other requirements to increment two, including those related to the auxiliary power unit and rotor track and balance technology.

Concurrency in development, design, and production continues to drive the risk of cost growth and schedule delays on the program. Design development will continue through low-rate initial production as the program concurrently develops its manufacturing processes, increasing the likelihood that components being procured may have to be reworked to meet the final design. The program will not collect statistical process control data to demonstrate production maturity, but it will monitor indicators, such as number of non-conforming products, quality notifications, hours per process, and scrap and rework rates.

Other Program Issues

Program officials told us that the five increment one aircraft will have a limited service life and its design may not be usable for increment two. Changes to the main gear box, drive train, engines, tail unit, and main rotor blades are required to meet increment two performance requirements. Program officials anticipate that five additional increment two aircraft will be produced to support full operational capability in 2015 rather than modifying increment one aircraft to the increment two configuration. This scenario is included in the program's overall cost.

Earned value data show a potential increase of $341 million or 18 percent, in the estimated cost to complete the current prime contract. While the program indicates that this increase is supported by its current budget, there is the potential for future program cost increases as the program reexamines requirements, schedules, and costs for increment two. The magnitude of any cost increase will likely not be known until after DOD's 2008 budget is submitted.

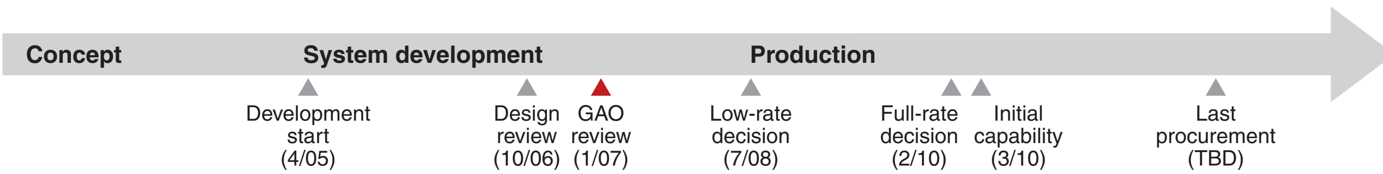
Agency Comments

In commenting on a draft of this assessment, the Navy concurred with the information provided in this report.

Warrior Unmanned Aircraft System (UAS)

The Army expects its Extended Range Multi-Purpose Unmanned Aircraft System, Warrior, to fill what it terms a capability gap for an unmanned aircraft system at the division level. A Warrior system will include 12 aircraft, ground control stations, ground and air data terminals, automatic take-off and landing systems, and ground support equipment. The Army plans for Warrior to operate alone or with other platforms such as the Apache helicopter and perform missions including reconnaissance, surveillance, and target acquisition and attack.

Source: UAVS Project Office.



Program Essentials

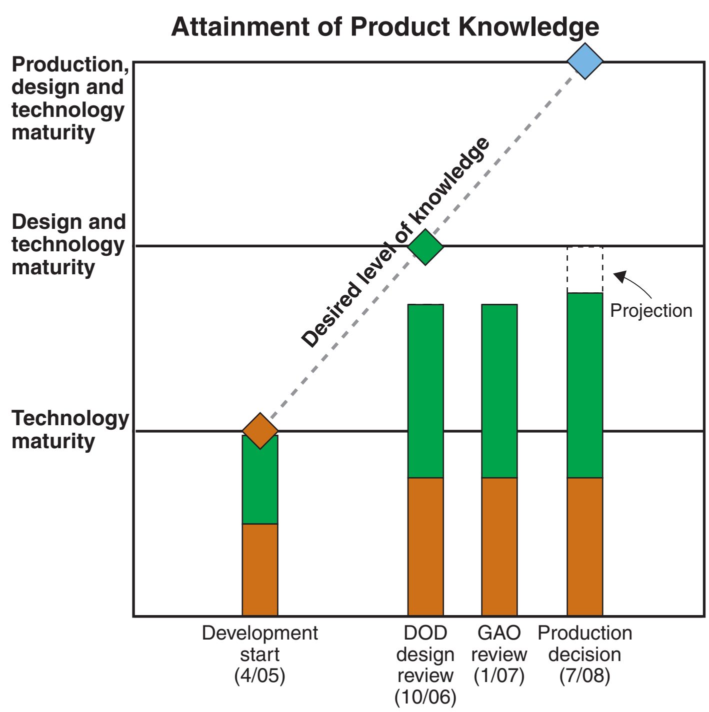
Prime contractor: General Atomics
Program office: Huntsville, Ala.
Funding needed to complete:
R&D: $229.4 million
Procurement: $1,440.2 million
Total funding: $1,669.6 million
Procurement quantity: 11

Program Performance (fiscal year 2007 dollars in millions)

	As of 04/2005	Latest 11/2006	Percent change
Research and development cost	$317.0	$384.8	21.4
Procurement cost	$616.3	$1,440.2	133.7
Total program cost	$933.3	$1,825.0	95.5
Program unit cost	$186.668	$152.085	-18.5
Total quantities	5	12	140.0
Acquisition cycle time (months)	50	59	18.0

Costs and quantities shown are from program inception through fiscal year 2015. The Army has not yet decided on quantities beyond 2015.

Currently, two of Warrior's four critical technologies are mature. Although the remaining two technologies were immature in early 2006, the Army reports that they were nearing maturity as of the design review in late 2006. The Army anticipates that they will be mature by the time of the Warrior production start, currently scheduled for August 2008. While there are backup technologies available for both if they do not mature as the Army expects, these backups would result in a less capable Warrior system than the Army originally planned. The program office indicated that about 92 percent of the Warrior design drawings were released to manufacturing as of the design review.



Warrior UAS Program

Technology Maturity

Two of Warrior's four critical technologies—the heavy fuel engine and the automatic takeoff and landing system—are considered to be mature. According to the program office, representative configurations of these two technologies have been integrated onto an unmanned aircraft. However, there is still some risk because neither the engine nor the complete takeoff and landing system have been integrated onto an unmanned aircraft using exactly the same configuration as planned for Warrior. Further, the Army reported that the engine requires some additional modification in order to perform at the flight altitudes planned for Warrior.

The two remaining critical technologies—the airborne ethernet and the multi-role tactical common data link—were not mature at the time the Army awarded the Warrior system development and demonstration contract in August 2005 and remained immature in early 2006. As of the design review in late 2006, the Army reported that they are nearing maturity and expects they will be fully mature by the time of the production start planned for August 2008. The airborne ethernet is expected to provide real-time communications capabilities among Warrior's internal aircraft components, including the avionics, payloads, and weapons. Similarly, the multirole tactical common data link is being developed to provide communications between Warrior aircraft and ground control stations as well as interoperability with other Army aviation platforms. While the contractor has integrated an airborne ethernet into an unmanned aircraft, neither it nor the data link has been integrated onto an umanned aircraft exactly as they are to be used on Warrior.

The Army has technologies in place as backups for the ethernet and data link, but these technologies would result in a less capable system than the Army originally planned. In particular, the backups for the data link suffer from slower data transmission rates or are not yet mature.

Design Stability

The Warrior program office stated that about 92 percent of the design drawings were released to manufacturing as of the design readiness review. In last year's assessment, the Army anticipated that the review would occur in June 2006. However, the review slipped until late 2006 as a result of the Army's decision to field an early model of the Warrior, known as Block 0.

Production Maturity

We could not assess Warrior's production maturity because the Warrior contractor does not use statistical process control as its metric. Instead, the contractor employs global technology standards per the International Standards Organization as its method for monitoring, controlling, and improving processes. The Warrior program office stated that this approach is acceptable to the Army because Warrior production is relatively low-volume and the contractor generally employs nearly 100 percent testing of all critical items. Since May 2006, Warrior's low-rate and full-rate production decision dates both have slipped by about 3 months due to the Army's decision to field the Block 0 version of Warrior.

Other Program Issues

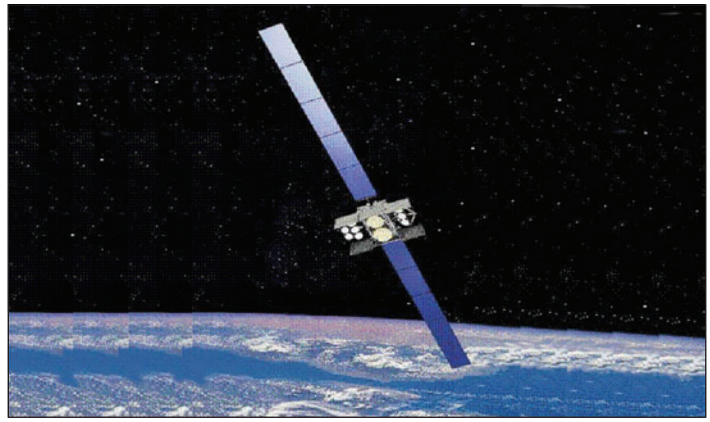
The Army expects to buy 1 developmental system with 17 aircraft and 11 complete production systems with a total of 132 production aircraft through 2015. However, the Army has not yet decided on the number of systems it might buy beyond that date.

Agency Comments

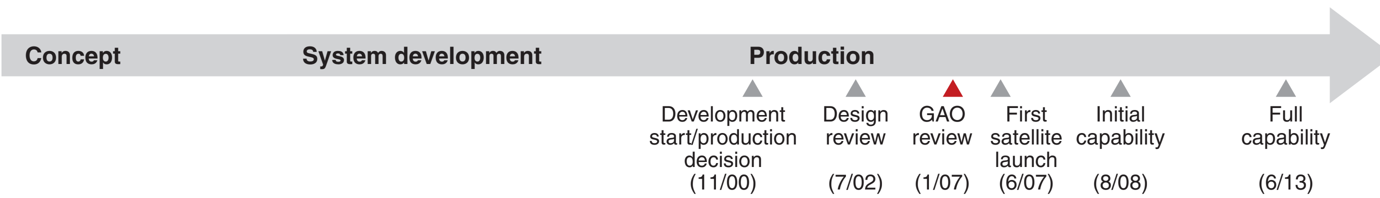
In commenting on a draft of this assessment, the Army provided updated program information as well as technical comments, which were incorporated as appropriate. The program office also provided a more detailed description of the Warrior's planned capabilities and roles, including information on such characteristics as the aircraft system's control by division commander, payload flexibility, communications relay capability, ability to change missions in flight, and operation and maintenance by soldiers.

Wideband Global SATCOM (WGS)

WGS is a joint Air Force and Army program intended to provide essential communications services to U.S. warfighters, allies, and coalition partners during all levels of conflict short of nuclear war. It is the next generation wideband component in DOD's future Military Satellite Communications architecture and is composed of the following principal segments: space segment (satellites), terminal segment (users), and control segment (operators). We assessed the space segment.



Source: WGS Program Office.



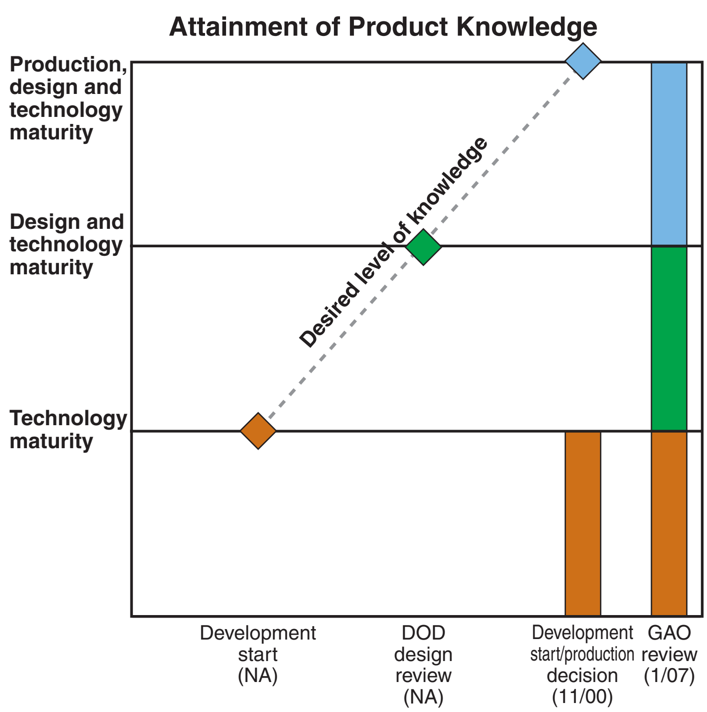
Program Essentials

Prime contractor: Boeing Satellite Development Center
Program office: El Segundo, Calif.
Funding needed to complete:
- R&D: $30.6 million
- Procurement: $890.3 million
- Total funding: $920.9 million
- Procurement quantity: 2

Program Performance (fiscal year 2007 dollars in millions)

	As of 12/2000	Latest 12/2005	Percent change
Research and development cost	$196.6	$332.7	69.2
Procurement cost	$899.8	$1,680.5	86.8
Total program cost	$1,096.4	$2,013.2	83.6
Program unit cost	$365.466	$402.639	10.2
Total quantities	3	5	66.7
Acquisition cycle time (months)	50	93	86.0

The WGS program's technology and design are mature. We did not review production maturity data because of the commercial nature of the WGS acquisition contract, but unit-level manufacturing for WGS is complete. The program made progress in integrating and testing the first satellite, which is to be launched in June 2007. For example, rework on improperly installed fasteners is complete, contractors have redesigned computers to rectify data transmission errors, and environmental tests were successful. The Air Force is considering a three-block approach for WGS. Block 1 includes the first three satellites. Block 2 includes two satellites, with an unfunded option for a third satellite, which will transfer data at higher rates than those in the initial block. The Air Force has awarded a $1.07 billion contract for the Block 2 satellites and has begun studying the possibility of a WGS Block 3.



WGS Program

Technology Maturity

WGS has two technologies that are vital to program success: the digital channelizer and the phased array antenna. According to program officials, both technologies were mature when the program made a production decision in November 2000.

Design Stability

The design for WGS is mature, as the program office has released all the expected drawings to manufacturing. Each of the initial three satellites is at some level of assembly, integration, or testing.

Production Maturity

The commercial nature of the WGS acquisition contract precludes the program office from having access to production process control data. Manufacturing processes for WGS are complete, as all units for the first satellite have been delivered.

Other Program Issues

The program made progress in integrating and testing the first satellite. For example, rework due to incorrect installation of fasteners is complete and the contractors have redesigned computers to correct data transmission errors. In addition, no significant problems were identified during space-like environmental testing or tests in which the contractors shook the satellite to simulate launch conditions and demonstrate the quality of workmanship on the satellite. During these tests, the program office also conducted low-level signal testing associated with satellite launch. Interoperability testing on the first satellite was completed in December 2006, in preparation for satellite launch, which is still scheduled for June 2007. Satellites 2 and 3 are to launch in December 2007 and May 2008, respectively.

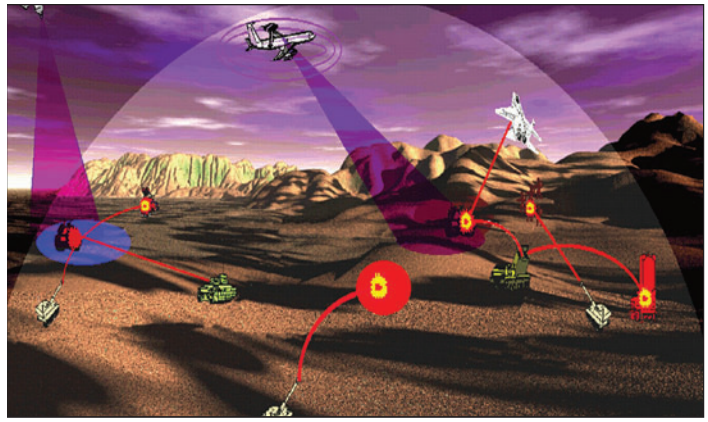
To address DOD's growing communication needs, the Air Force is considering a three-block approach for WGS. Block 1 includes the first three satellites. Block 2 includes satellites 4 and 5, with an unfunded option for satellite 6. These satellites will transfer data at higher rates than those in the initial block, and the Air Force has awarded a $1.07 billion contract for the three satellites. The Air Force also has begun studying the possibility of including enhanced capability in a WGS Block 3 for added airborne intelligence, surveillance, and reconnaissance support.

Agency Comments

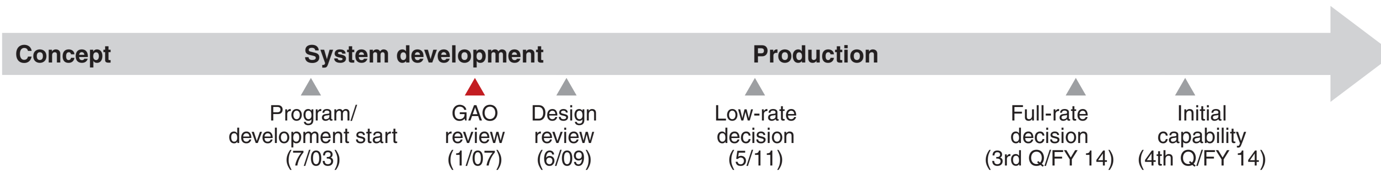
In commenting on a draft of this assessment, the Air Force stated that in October 2006 it awarded a fixed price incentive fee with firm target contract to Boeing Satellite Systems for WGS satellites 4 and 5, with an unfunded option for WGS 6. The fourth and fifth satellites will complete the currently planned WGS constellation and will be modified to provide more capacity for airborne intelligence, surveillance, and reconnaissance users.

Warfighter Information Network-Tactical (WIN-T)

WIN-T is the Army's high-speed and high-capacity backbone communications network. It is to provide reliable, secure, and seamless video, data, imagery, and voice services, allowing users to communicate simultaneously at various levels of security. WIN-T is to connect Army units with higher levels of command and provide Army's tactical portion of the Global Information Grid. In addition, it will provide key communications elements for the Army's Future Combat System (FCS), the linchpin of the transformation to a lighter, more capable force.



Source: PM WIN-T.



Program Essentials

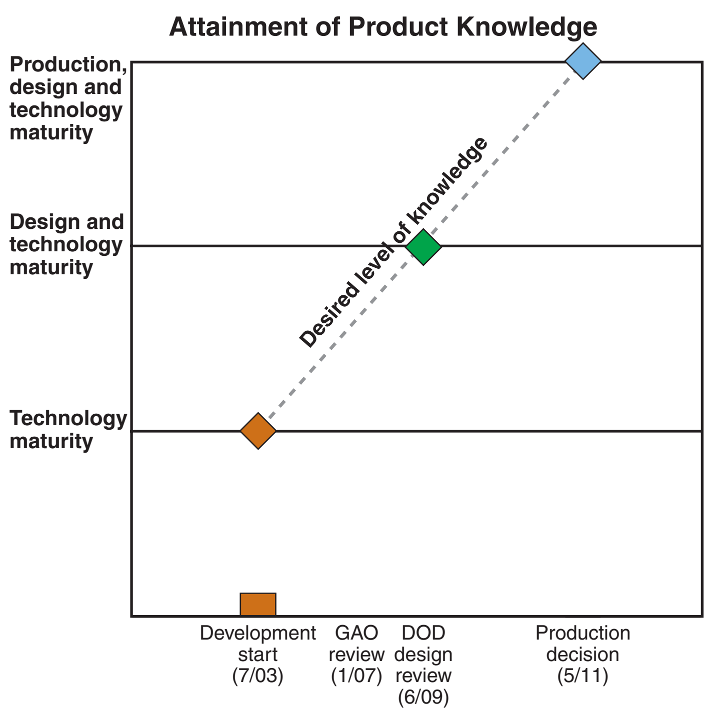
Prime contractor: General Dynamics Government Systems Corp.
Program office: Ft. Monmouth, N.J.
Funding needed to complete:
- R&D: $906.1 million
- Procurement: $10,241.0 million
- Total funding: $11,147.1 million
- Procurement quantity: 1

Program Performance (fiscal year 2007 dollars in millions)

	As of 07/2003	Latest 10/2006	Percent change
Research and development cost	$781.7	$1,260.5	61.3
Procurement cost	$10,054.0	$10,341.1	2.9
Total program cost	$10,835.8	$11,601.6	7.1
Program unit cost	$10,835.786	$11,601.604	7.1
Total quantities	1	1	0.0
Acquisition cycle time (months)	78	133	70.5

This assessment reflects the program of record. Since the conclusion of our review, the Army has informed the defense committees that since July 2003, WIN-T's program unit cost has grown by approximately 33%, triggering a Nunn-McCurdy breach.

WIN-T is currently being restructured to meet emerging FCS requirements and a shift in the Army's funding priorities. The proposed restructuring will provide the program with more time to complete system development. WIN-T entered system development in August 2003 with 3 of its 12 critical technologies nearing maturity. According to the Army, a November 2005 developmental test/operational test demonstrated all of WIN-T's critical technologies in a relevant environment. In August, the Army completed a revised technology readiness assessment that supports the WIN-T program office's position. However, the Office of the Secretary of Defense did not fully concur with this assessment. While design stability is evaluated during WIN-T's design reviews, it cannot be assessed using our methodology because the program office does not track the number of releasable drawings.



WIN-T Program

Technology Maturity

WIN-T entered system development with 3 of its 12 critical technologies close to reaching full maturity. The program office maintains that the maturity of these technologies was demonstrated in a relevant environment during a November 2005 developmental test/operational test event. A March 2006 system assessment, prepared by the Army Test and Evaluation Command, concluded that a WIN-T prototype demonstrated the potential to provide communications both "on the move" and "at the halt" in a limited network. According to WIN-T program office and other Army representatives, this test event demonstrates the viability of the WIN-T system architecture and progress in maturing WIN-T's critical technologies. However, this test was limited in scope, and the system assessment report did not explicitly address the extent to which WIN-T's critical technologies had matured. In late August, to support WIN-T's restructuring, the Assistant Secretary of the Army for Acquisition, Logistics and Technology submitted a revised Technology Readiness Assessment to the Office of the Secretary of Defense, concurring that WIN-T's critical technologies had been demonstrated in a relevant environment. The Office of the Secretary of Defense's Director of Defense Research and Engineering did not concur with the Army's assessment for two of these technologies. In order to gain the Director's concurrence, the WIN-T program office is updating data to reaffirm its ratings for WIN-T's critical technologies and is submitting plans to achieve full technology maturity by the start of production.

Design Stability

Design stability could not be assessed because the program office does not plan to track the number of releasable drawings as a design metric. According to the program, WIN-T is not a manufacturing effort, but primarily an information technology system integration effort. Consequently, the government does not obtain releasable design drawings for many of WIN-T's components, particularly commercial components. Instead, design stability is evaluated at the preliminary and critical design reviews using the exit criteria developed by the government. According to DOD, the WIN-T design will evolve using performance-based specifications and open systems design and is to conform to an architecture that specifies the minimum set of standards and guidance for the acquisition of all DOD information systems.

Other Program Issues

The Army has also taken action to synchronize its FCS networking needs and WIN-T's planned capabilities, largely by restructuring the WIN-T program. The FCS program office led the Army's development of a study that examined ways to better synchronize the Army's communications programs, including WIN-T and FCS. The study concluded that the WIN-T program needed to make significant changes to both the hardware and software items it planned to deliver to FCS. For example, the size, weight, and power of the WIN-T elements that are needed to support FCS platforms had to be reduced significantly. These requirements were not part of the original WIN-T program, and, according to WIN-T program office representatives, additional time and funding will be required to address these new requirements. During this time, the Army was also looking for ways to address shortfalls in funding for high-priority items needed to support the Global War on Terrorism. To fund these shortfalls, the Army proposed cutting $655 million from WIN-T for fiscal years 2007 through 2011, which DOD approved. Recognizing that WIN-T could no longer be executed within its established costs and schedule, the Army determined that the program needed to be restructured.

The Army's proposed restructuring of WIN-T would extend the program's development for about 5 years, and thereby delay the production decision from 2006 until 2011. DOD intends to complete a program review in the third quarter of fiscal year 2007 for which the Army must prepare a revised acquisition strategy, cost estimate, and technology assessment. On November 6, 2006, the Joint Requirements Oversight Council approved the WIN-T Capability Development Document.

Agency Comments

In commenting on a draft of this assessment, the Army provided technical comments, which were incorporated as appropriate.

Agency Comments

DOD did not provide general comments on a draft of this report, but did provide technical comments. These comments, along with agency comments received on the individual assessments, were included as appropriate. (See app. I for a copy of DOD's response).

Scope of Our Review

For the 62 programs, each assessment provides the historical and current program status and offers the opportunity to take early corrective action when a program's projected attainment of knowledge diverges significantly from the best practices. The assessments also identify programs that are employing practices worthy of emulation by other programs. If a program is attaining the desired levels of knowledge, it has less risk—but not zero risk—of future problems. Likewise, if a program shows a gap between demonstrated knowledge and best practices, it indicates an increased risk—not a guarantee—of future problems. The real value of the assessments is in recognizing gaps early, which provides opportunities for constructive intervention—such as adjustments to schedule, trade-offs in requirements, and additional funding—before cost and schedule consequences mount.

We selected programs for the assessments based on several factors, including (1) high dollar value, (2) stage in acquisition, and (3) congressional interest. The majority of the 62 programs covered in this report are considered major defense acquisition programs by DOD. A program is defined as major if its estimated research and development costs exceed $365 million or its procurement costs exceed $2.19 billion in fiscal year 2000 constant dollars.

We are sending copies of this report to interested congressional committees; the Secretary of Defense; the Secretaries of the Army, Navy, and Air Force; and the Director, Office of Management and Budget. We will also make copies available to others upon request. In addition, the report will be available at no charge on the GAO Web site at http://www.gao.gov.

If you have any questions on this report, please contact me at (202) 512-4841. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. Major contributors to this report are listed in appendix IV.

Paul L. Francis
Director
Acquisition and Sourcing Management

List of Congressional Committees

The Honorable Carl Levin
Chairman
The Honorable John McCain
Ranking Member
Committee on Armed Services
United States Senate

The Honorable Daniel K. Inouye
Chairman
The Honorable Ted Stevens
Ranking Member
Subcommittee on Defense
Committee on Appropriations
United States Senate

The Honorable Ike Skelton
Chairman
The Honorable Duncan Hunter
Ranking Member
Committee on Armed Services
House of Representatives

The Honorable John P. Murtha, Jr.
Chairman
The Honorable C.W. Bill Young
Ranking Member
Subcommittee on Defense
Committee on Appropriations
House of Representatives

Comments from the Department of Defense

OFFICE OF THE UNDER SECRETARY OF DEFENSE
3000 DEFENSE PENTAGON
WASHINGTON, DC 20301-3000

ACQUISITION, TECHNOLOGY AND LOGISTICS

MAR 07 2007

Mr. Paul Francis
Director, Acquisition and Sourcing Management
U.S. Government Accountability Office
441 G Street, N.W.
Washington, D.C. 20548

Dear Mr. Francis:

This is the Department of Defense response to the GAO Draft Report, GAO-07-406SP, "DEFENSE ACQUISITIONS: Assessments of Selected Weapon Programs," dated February 9, 2007 (GAO Code 120565).

We have enclosed technical comments that should be considered as you prepare the final report.

My point of contact is Mr. Skip Hawthorne, 703.692.9556, or e-mail: skip.hawthorne@osd.mil.

Sincerely,

for Richard Ginman

Shay D. Assad
Director, Defense Procurement
and Acquisition Policy

Enclosure:
As stated

Scope and Methodology

In conducting our work, we evaluated performance and risk data from each of the programs included in this report. We summarized our assessments of each individual program in two components—a system profile and a product knowledge assessment. We did not validate the data provided by the Department of Defense (DOD). However, we took several steps to address data quality. Specifically, we reviewed the data and performed various quality checks, which revealed some discrepancies in the data. We discussed the underlying data and these discrepancies with program officials and adjusted the data accordingly. We determined that the data provided by DOD were sufficiently reliable for our engagement purposes after reviewing DOD's management controls for assessing data reliability.

Macro Analysis

Data for the total planned investment of major defense acquisition programs were obtained from funding stream data included in DOD's Selected Acquisition Reports (SAR) or from data obtained directly from the program offices and then aggregated across all programs in base year 2007 dollars.

The number of weapon systems in development for the 2003 and 2007 assessment periods encompasses all programs with SARs on December 31, 2001, (2003 assessment period) and December 31, 2005, (2007 assessment period) with the exception of the Ballistic Missile Defense System and the Chemical Demilitarization programs.

The data presented in figure 2 on page 6 were obtained from table 6-1 "Department of Defense Total Obligational Authority by Title, Constant fiscal year 2007 Dollars" in the National Defense Budget Estimates for fiscal year 2007. Likewise, the data presented in table 2 were drawn from table 6-1, "Department of Defense Total Obligational Authority by Title, Constant fiscal year 2007 Dollars" in the National Defense Budget Estimates for fiscal year 2007. The average annual real growth rate was calculated using the compound annual growth rate formula.

To assess the total cost growth of major weapon systems between 2004 and 2007 presented on page 8, we identified the common set of 64 major defense acquisition programs since 2004, with the exception of the Ballistic Missile Defense System and the Chemical Demilitarization programs. Figures for the total cost of these programs were obtained from funding stream data included in SARs or from data acquired directly from the program offices, and then aggregated across all programs in base year 2007 dollars for the 2004 and 2007 assessment periods. To calculate the average annual rate of cost growth for this common set of programs, we applied the compound annual growth rate formula using the total funding data points for assessment periods 2004 and 2007.

To assess the total cost, schedule, and quantity changes of the programs included in our assessment presented in table 3 and on page 9, it was necessary to identify those programs with all of the requisite data available. Of the 62 programs in our assessment, 27 constituted the common set of programs where data were available for cost, schedule, and quantity at the first full estimate, generally milestone B, and the latest estimate. We excluded programs that had planning estimates as their first full estimate and if the first full estimate and latest estimate fell within a 1-year period of each other. Data utilized in this analysis were drawn from information contained in SARs or data provided by program offices as of January 15, 2007. We summed the costs associated with research, development, test and evaluation (RDT&E) and total costs consisting of RDT&E, procurement, military construction, and acquisition operation and maintenance. The schedule assessment is based on the change in the average acquisition cycle time, defined as the number of months between program start and the achievement of initial operation capability or an equivalent fielding date.

The weighted calculations of acquisition cycle time and program acquisition unit cost for the common set of programs were derived by taking the total cost estimate for each of the 27 programs and dividing it by the aggregate total cost of all 27 programs in the common set. The resulting quotient for each program was then multiplied by the simple percentage change in program acquisition unit costs to obtain the weighted unit cost change of each program. Next, the sum of this weighted cost change for all programs was calculated to get the weighted unit cost change for the common set as a whole. To assess the weighted average acquisition cycle time change, we multiplied the weight calculation by the acquisition cycle time estimate for each corresponding program. A simple average was then taken to calculate the change between the first full estimate and the latest estimate. We believe these calculations best represent the overall progress of programs by placing them within the context of the common set's aggregate cost.

To assess the percentage of programs with technology maturity, design stability, and production maturity at each key juncture presented in figure 3 and figure 5 and on pages 14 and 17, we identified programs that had actually proceeded through each key juncture—development start, system design review, and production start—and obtained their assessed maturity. The percentages in figures 3, 4, and 5 on pages 14, 15, and 17 include programs in the 2007 assessment only. The population size for the technology maturity at development start is 37 programs, design review is 25 programs, and production start is 18 programs. The population size for the design stability at design review is 22 programs, and 12 programs at production start. The population size for production maturity at production start is 20 programs. This information was drawn from data provided by the program office as of January 15, 2007. For more information, see the product knowledge assessment section in this appendix.

Data on the date each program plans to conduct development tests of a production representative article (i.e., prototype) was obtained from program offices, and was then compared to the scheduled production decision. The population size for this analysis is 32 programs.

System Profile Data on Each Individual Two-Page Assessment

In the past 6 years, DOD has revised its policies governing weapon system acquisitions and changed the terminology used for major acquisition events. To make DOD's acquisition terminology more consistent across the 62 program assessments, we standardized the terminology for key program events. In the individual program assessments, "program start" refers to the initiation of a program; DOD usually refers to program start as milestone I or milestone A, which begins the concept and technology development phase. Similarly, "development start" refers to the commitment to system development that coincides with either milestone II or milestone B, which begins DOD's system development and demonstration phase. The "production decision" generally refers to the decision to enter the production and deployment phase, typically with low-rate initial production. Initial capability refers to the initial operational capability, sometimes also called first unit equipped or required asset availability. For shipbuilding programs, the schedule of key program events in relation to milestones varies for each individual program. Our assessments of shipbuilding programs report key program events as determined by each program's individual strategy. For the Missile Defense Agency programs that do not follow the standard Department of Defense acquisition model, but instead develop systems in incremental capability-based blocks, we identified the key technology development efforts that lead to an initial capability for the block assessed.

The information presented on the funding needed to complete from fiscal year 2007 through completion, unless otherwise noted, draws on information from SARs or on data from the program office. In some instances the data were not yet available, and we annotate this by the term “to be determined” (TBD), or “not applicable,” annotated (NA). The quantities listed refer only to procurement quantities. Satellite programs, in particular, produce a large percentage of their total operational units as development quantities, which are not included in the quantity figure.

To assess the cost, schedule, and quantity changes of each program, we reviewed DOD’s SARs or obtained data directly from the program offices. In general, we compared the latest available SAR information with a baseline for each program. For programs that have started product development—those that are beyond milestone II or B—we compared the latest available SAR to the development estimate from the first selected acquisition report issued after the program was approved to enter development. For systems that have not yet started system development, we compared the latest available data to the planning estimate issued after milestone I or A. For systems not included in SARs, we attempted to obtain comparable baseline and current data from the individual program offices. For MDA systems for which a baseline was not available, we compared the latest available cost information to the amount reported last year.

All cost information is presented in base year 2007 dollars using Office of the Secretary of Defense-approved deflators to eliminate the effects of inflation. We have depicted only the programs’ main elements of acquisition cost—research and development and procurement. However, the total program costs also include military construction and acquisition operation and maintenance costs. Because of rounding and these additional costs, in some situations the total cost may not match the exact sum of the research and development and procurement costs. The program unit costs are calculated by dividing the total program cost by the total quantities planned. These costs are often referred to as program acquisition unit costs. In some instances, the data were not applicable, and we annotate this by using the term “NA.” In other instances, the current absence of data on procurement funding and quantities precludes calculation of a meaningful program acquisition unit cost, and we annotate this by using the term “TBD.” The quantities listed refer to total quantities, including both procurement and development quantities.

The schedule assessment is based on acquisition cycle time, defined as the number of months between the program start, usually milestone I or A, and the achievement of initial operational capability or an equivalent fielding date. In some instances, the data were not yet available, and we annotate this by using the term “TBD,” or were classified.

The intent of these comparisons is to provide an aggregate or overall picture of a program’s history. These assessments represent the sum total of the federal government’s actions on a program, not just those of the program manager and the contractor. DOD does a number of detailed analyses of changes that attempt to link specific changes with triggering events or causes. Our analysis does not attempt to make such detailed distinctions.

Product Knowledge Data on Each Individual Two-Page Assessment

To assess the product development knowledge of each program at key points in development, we submitted a data collection instrument to each program office. The results are graphically depicted in each two-page assessment. We also reviewed pertinent program documentation, such as the operational requirements document, the acquisition program baseline, test reports, and major program reviews.

To assess technology maturity, we asked program officials to apply a tool, referred to as technology readiness levels, for our analysis. The National Aeronautics and Space Administration originally developed technology readiness levels, and the Army and Air Force science and technology research organizations use them to determine when technologies are ready to be handed off from science and technology managers to product developers. Technology readiness levels are measured on a scale of 1 to 9, beginning with paper studies of a technology’s feasibility and culminating with a technology fully integrated into a completed product. (See app. III for the definitions of technology readiness levels.) Our best practices work has shown that a technology readiness level of 7—demonstration of a technology in a realistic environment—is the level of technology maturity that constitutes a low risk for starting a product development program. In our assessment, the technologies that have reached technology readiness level 7, a prototype demonstrated in a realistic environment, are referred to as mature or fully mature and those that have reached technology readiness level 6, a prototype demonstrated in a relevant environment, are referred to as approaching or nearing maturity and are assessed as attaining 50 percent of the desired level of knowledge. Satellite technologies that have achieved technology readiness level 6 are assessed as fully mature due to the difficulty of demonstrating maturity in an operational environment—space.

In most cases, we did not validate the program offices' selection of critical technologies or the determination of the demonstrated level of maturity. We sought to clarify the technology readiness levels in those cases where information existed that raised concerns. If we were to conduct a detailed review, we might adjust the critical technologies assessed, the readiness level demonstrated, or both. It was not always possible to reconstruct the technological maturity of a weapon system at key decision points after the passage of many years.

To assess design stability, we asked program officials to provide the percentage of engineering drawings completed or projected for completion by the design review, the production decision, and as of our current assessment. In most cases, we did not verify or validate the percentage of engineering drawings provided by the program office. We sought to clarify the percentage of drawings completed in those cases where information existed that raised concerns. Completed engineering drawings were defined as the number of drawings released or deemed releasable to manufacturing that can be considered the "build-to" drawings.

To assess production maturity, we asked program officials to identify the number of critical manufacturing processes and, where available, to quantify the extent of statistical control achieved for those processes. In most cases, we did not verify or validate this information provided by the program office. We sought to clarify the number of critical manufacturing processes and percentage of statistical process control where information existed that raised concerns. We used a standard called the Process Capability Index, which is a process performance measurement that quantifies how closely a process is running to its specification limits. The index can be translated into an expected product defect rate, and we have found it to be a best practice. We sought other data, such as scrap and rework trends, in those cases where quantifiable statistical control data were unavailable.

Although the knowledge points provide excellent indicators of potential risks, by themselves, they do not cover all elements of risk that a program encounters during development, such as funding instability. Our detailed reviews on individual systems normally provide for a fuller treatment of risk elements.

Technology Readiness Levels

Technology Readiness Level	Description	Hardware Software	Demonstration Environment
1. Basic principles observed and reported.	Lowest level of technology readiness. Scientific research begins to be translated into applied research and development. Examples might include paper studies of a technology's basic properties	None (paper studies and analysis)	None
2. Technology concept and/or application formulated.	Invention begins. Once basic principles are observed, practical applications can be invented. The application is speculative and there is no proof or detailed analysis to support the assumption. Examples are still limited to paper studies.	None (paper studies and analysis)	None
3. Analytical and experimental critical function and/or characteristic proof of concept.	Active research and development is initiated. This includes analytical studies and laboratory studies to physically validate analytical predictions of separate elements of the technology. Examples include components that are not yet integrated or representative.	Analytical studies and demonstration of nonscale individual components (pieces of subsystem).	Lab
4. Component and/or breadboard. Validation in laboratory environment.	Basic technological components are integrated to establish that the pieces will work together. This is relatively "low fidelity" compared to the eventual system. Examples include integration of "ad hoc" hardware in a laboratory.	Low-fidelity breadboard. Integration of nonscale components to show pieces will work together. Not fully functional or form or fit but representative of technically feasible approach suitable for flight articles.	Lab
5. Component and/or breadboard validation in relevant environment.	Fidelity of breadboard technology increases significantly. The basic technological components are integrated with reasonably realistic supporting elements so that the technology can be tested in a simulated environment. Examples include "high fidelity" laboratory integration of components.	High-fidelity breadboard. Functionally equivalent but not necessarily form and/or fit (size, weight, materials, etc.). Should be approaching appropriate scale. May include integration of several components with reasonably realistic support elements/subsystems to demonstrate functionality.	Lab demonstrating functionality but not form and fit. May include flight demonstrating breadboard in surrogate aircraft. Technology ready for detailed design studies.

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Technology Readiness Level	Description	Hardware Software	Demonstration Environment
6. System/subsystem model or prototype demonstration in a relevant environment.	Representative model or prototype system, which is well beyond the breadboard tested for TRL 5, is tested in a relevant environment. Represents a major step up in a technology's demonstrated readiness. Examples include testing a prototype in a high-fidelity laboratory environment or in simulated realistic environment.	Prototype—Should be very close to form, fit, and function. Probably includes the integration of many new components and realistic supporting elements/subsystems if needed to demonstrate full functionality of the subsystem.	High-fidelity lab demonstration or limited/restricted flight demonstration for a relevant environment. Integration of technology is well defined.
7. System prototype demonstration in a realistic environment.	Prototype near or at planned operational system. Represents a major step up from TRL 6, requiring the demonstration of an actual system prototype in a realistic environment, such as in an aircraft, vehicle, or space. Examples include testing the prototype in a test bed aircraft.	Prototype. Should be form, fit, and function integrated with other key supporting elements/subsystems to demonstrate full functionality of subsystem.	Flight demonstration in representative realistic environment such as flying test bed or demonstrator aircraft. Technology is well substantiated with test data.
8. Actual system completed and "flight qualified" through test and demonstration.	Technology has been proven to work in its final form and under expected conditions. In almost all cases, this TRL represents the end of true system development. Examples include developmental test and evaluation of the system in its intended weapon system to determine if it meets design specifications.	Flight-qualified hardware	Developmental Test and Evaluation (DT&E) in the actual system application
9. Actual system "flight proven" through successful mission operations.	Actual application of the technology in its final form and under mission conditions, such as those encountered in operational test and evaluation. In almost all cases, this is the end of the last "bug fixing" aspects of true system development. Examples include using the system under operational mission conditions.	Actual system in final form	Operational Test and Evaluation (OT&E) in operational mission conditions

Source: GAO and its analysis of National Aeronautics and Space Administration data.

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Source: GAO.

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