

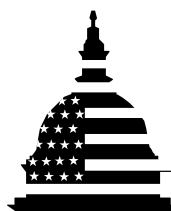
March 2013

DEFENSE ACQUISITIONS

Assessments of Selected Weapon Programs

To access this report electronically, scan this QR Code.

Don't have a QR code reader? Several are available for free online.



G A O

Accountability ★ Integrity ★ Reliability

Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE MAR 2013		2. REPORT TYPE		3. DATES COVERED 00-00-2013 to 00-00-2013	
4. TITLE AND SUBTITLE Defense Acquisitions: Assessments of Selected Weapon Programs				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Government Accountability Office, 441 G Street NW, Washington, DC, 20548				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 190	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

Why GAO Did This Study

This is GAO's annual assessment of DOD weapon system acquisitions, an area that has been on GAO's high-risk list for more than 20 years. The report responds to the mandate in the joint explanatory statement to the DOD Appropriations Act, 2009. It includes observations on (1) the cost and schedule performance of DOD's 2012 portfolio of 86 major defense acquisition programs, including the Missile Defense Agency's Ballistic Missile Defense System; (2) the knowledge attained at key junctures in the acquisition process for 40 major defense acquisition programs that were selected because they were in development or early production; and (3) key acquisition reform initiatives and program concurrency. Major defense acquisition programs are DOD's costliest weapon system development and procurement programs.

To develop the observations, GAO analyzed cost, schedule, and quantity data from DOD's Selected Acquisition Reports and collected data from program offices on technology, design, and manufacturing knowledge; the use of knowledge-based acquisition practices; and the implementation of DOD's acquisition policy and acquisition reforms.

In commenting on a draft of this report, DOD agreed that the cost reductions in its portfolio over the past year were largely due to exiting programs and reductions in procurement quantities. However, DOD stated that the metrics used did not adequately address program performance or answer the questions of when, why, and how changes occurred. GAO believes the report addresses these concerns.

View [GAO-13-294SP](#). For more information contact Michael J. Sullivan at (202) 512-4841 or sullivanm@gao.gov.

March 2013

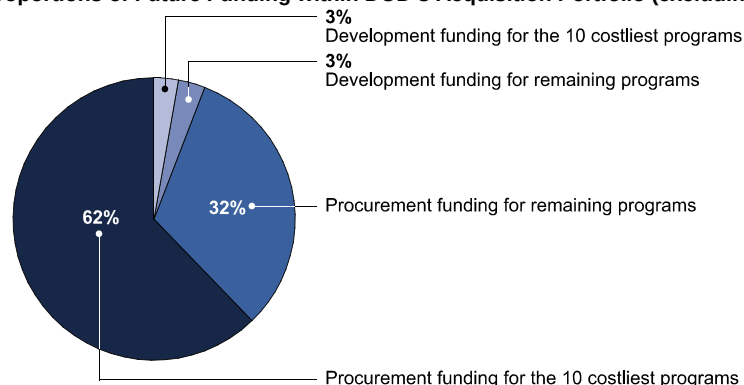
DEFENSE ACQUISITIONS

Assessments of Selected Weapon Programs

What GAO Found

The Department of Defense (DOD) 2012 portfolio of 86 major defense acquisition programs is estimated to cost a total of \$1.6 trillion, reflecting decreases in both size and cost from the 2011 portfolio. Those decreases are largely the result of more programs exiting than entering the portfolio, as well as reductions in procurement quantities due to program cancellations and restructurings. Notably a majority of programs in the portfolio gained buying power in the last year as their acquisition unit costs decreased. DOD's 10 costliest programs, excluding the Missile Defense Agency's Ballistic Missile Defense System (BMDS), drive most of the portfolio's cost performance and funding needs. The majority (65 percent) of the funding that DOD estimates it will need to complete its current programs is associated with those 10 programs, and almost all of that funding is for procurement (see figure).

Proportions of Future Funding within DOD's Acquisition Portfolio (excluding BMDS)



Source: GAO analysis of DOD data.

Continuing a positive trend over the past 4 years, newer acquisition programs are demonstrating higher levels of knowledge at key decision points, although many programs are still not fully adhering to a knowledge-based acquisition approach. Of the 32 programs that provided GAO with technology maturity, 5 reached full maturity while another 14 were near maturity when they began development. Four of the 5 programs with fully mature technologies started in the last 5 years. Less than one-third of the programs providing design data achieved design stability at their critical design review. Many of the programs are capturing critical manufacturing knowledge prior to production, but their methods vary.

Implementation of key selected acquisition initiatives varies among the programs GAO assessed, and programs continue to accept risks associated with concurrently conducting developmental testing and production. Many of the programs reported that they had established affordability requirements and noted that they were meeting those requirements. Most programs in this year's assessment have also conducted "should cost" analyses, and have identified cost savings as a result. Most programs GAO assessed reported that they had completed or planned to complete development testing while in production, a approach that risks costly retrofits of systems already built and fielded.

Contents

Foreword	1
----------	---

Letter	3
Observations on the Cost Performance of DOD's 2012 Major Defense Acquisition Program Portfolio	5
Observations from Our Assessment of Knowledge Attained by Programs at Key Acquisition Junctures	19
Observations about DOD's Implementation of Key Acquisition Reform Initiatives and Program Concurrency	30
Assessments of Individual Programs	36
How to Read the Knowledge Scorecard for Each Program Assessed	38
Two-Page Assessments of Individual Programs	
AH-64E Apache Remanufacture (AH-64E Remanufacture)	41
AIM-9X Block II Air-to-Air Missile (AIM-9X Block II)	43
Air and Missile Defense Radar (AMDR)	45
AN/TPS-80 Ground/Air Task Oriented Radar (G/ATOR)	47
BMDS: Aegis Ballistic Missile Defense Standard Missile-3 Block IB	49
BMDS: Ground-Based Midcourse Defense (GMD)	51
CH-53K Heavy Lift Replacement (CH-53K)	53
DDG 1000 Zumwalt Class Destroyer	55
E-2D Advanced Hawkeye (E-2D AHE)	57
Evolved Expendable Launch Vehicle (EELV)—Atlas V, Delta IV	59
Excalibur Precision 155mm Projectiles	61
F-22 Increment 3.2B	63
F-35 Joint Strike Fighter (JSF)	65
Family of Advanced Beyond Line-of-Sight Terminals (FAB-T)	67
Gerald R. Ford Class Nuclear Aircraft Carrier (CVN 78 Class)	69
Global Positioning System III (GPS III)	71
GPS III OCX Ground Control Segment (GPS OCX)	73
HC/MC-130 Recapitalization Program	75
Integrated Air and Missile Defense (IAMD)	77
Integrated Defensive Electronic Countermeasures (IDECM) Block 4	79
Joint Air-to-Surface Standoff Missile Extended Range (JASSM-ER)	81
Joint High Speed Vessel (JHSV)	83
Joint Light Tactical Vehicle (JLTV)	85
Joint Precision Approach and Landing System (JPALS) Increment 1A	87
Joint Tactical Radio System (JTRS) Handheld, Manpack, and Small Form Fit (HMS) Radios	89
KC-46 Tanker Modernization Program	91

LHA 6 America Class Amphibious Assault Ship	93
Littoral Combat Ship (LCS)—Seaframes	95
Littoral Combat Ship (LCS)—Mission Modules	97
Mobile User Objective System (MUOS)	99
MQ-1C Unmanned Aircraft System Gray Eagle	101
MQ-4C Triton Unmanned Aircraft System (MQ-4C Triton)	103
MQ-9 Unmanned Aircraft System (UAS) Reaper	105
Navy Multiband Terminal (NMT)	107
P-8A Poseidon	109
Paladin FAASV Integrated Management (PIM)	111
RQ-4A/B Global Hawk Unmanned Aircraft System	113
Ship to Shore Connector (SSC)	115
Small Diameter Bomb Increment II	117
Space Based Infrared System High Component (SBIRS High)	119
Space Fence	121
Standard Missile-6 (SM-6)	123
Vertical Takeoff and Landing Tactical Unmanned Aerial Vehicle— MQ-8 Fire Scout (VTUAV)	125
Warfighter Information Network-Tactical (WIN-T) Increment 2	127
Warfighter Information Network-Tactical (WIN-T) Increment 3	129
One-Page Assessments of Individual Programs	
Airborne and Maritime/Fixed Station Joint Tactical Radio System (AMF JTRS)	131
Amphibious Combat Vehicle (ACV)	132
Armored Multi-Purpose Vehicle (AMPV)	133
B-2 Defensive Management System (DMS) Modernization	134
BMDS: Precision Tracking Space System (PTSS)	135
BMDS: Terminal High Altitude Area Defense (THAAD)	136
Combat Rescue Helicopter (CRH)	137
Common Infrared Countermeasures (CIRCM)	138
DDG 51 Destroyer	139
Enhanced Polar System (EPS)	140
Ground Combat Vehicle (GCV)	141
Joint Air-to-Ground Missile (JAGM)	142
Joint Land Attack Cruise Missile Defense Elevated Netted Sensor System (JLENS)	143
Military GPS User Equipment (MGUE), Increment 1	144
Ohio-Class Replacement	145
Patriot/Medium Extended Air Defense System (MEADS) Combined Aggregate Program (CAP) Fire Unit	146
Presidential Helicopter (VXX)	147
Three-Dimensional Expeditionary Long-Range Radar (3DELRR)	148

Unmanned Carrier-Launched Airborne Surveillance and Strike (UCLASS) System	149
Agency Comments and Our Evaluation	150

Appendixes

Appendix I: Scope and Methodology	153
Appendix II: Current and First Full Estimates for DOD's 2012 Portfolio of Major Defense Acquisition Programs	164
Appendix III: Changes in DOD's 2012 Portfolio of Major Defense Acquisition Programs over 5 Years and Since First Full Estimates	169
Appendix IV: Knowledge-Based Acquisition Practices	170
Appendix V: Technology Readiness Levels	172
Appendix VI: Major Defense Acquisition Programs' Individual Subcontracting Reports in the Electronic Subcontracting Reporting System	174
Appendix VII: Comments from the Department of Defense	177
Appendix VIII: GAO Contact and Acknowledgments	178

Related GAO Products	181
-----------------------------	-----

Tables

Table 1: Changes in DOD's Portfolio of Major Defense Acquisition Programs from 2011 to 2012	7
Table 2: Changes since First Full Estimates for the 14 Programs That Exited the Portfolio	9
Table 3: Changes in DOD's 2012 Portfolio of 86 Major Defense Acquisition Programs	10
Table 4: Change in Procurement Cost Due to Quantity Changes and Other Factors	11
Table 5: Cost Changes in DOD's 10 Costliest Programs over the Past Year (excluding BMDS)	16
Table 6: Programs That Entered Development with Technologies Fully Mature or Nearing Maturity	24
Table 7: Comparison of Preliminary Design Review and Development Start for 38 Weapons Programs	26
Table 8: Implementation of Knowledge-Based Practices at the Critical Design Review for 36 Programs	27

Table 9: Use of Various Methods for Capturing Manufacturing Knowledge Prior to Production Start	29
Table 10: Current Cost Estimates and First Full Estimates for DOD's 2012 Portfolio of Major Defense Acquisition Programs	164
Table 11: Cost and Schedule Changes for Programs in DOD's 2012 Portfolio	169
Table 12: Best Practices for Knowledge-based Acquisitions	170
Table 13: Defense Acquisition Programs' Individual Subcontracting Reports in the Electronic Subcontracting Reporting System	174

Figures

Figure 1: Comparison of the Cost Performance of DOD's 2011 and 2012 Portfolios	15
Figure 2: Proportions of Future Funding within DOD's Acquisition Portfolio (excluding BMDS)	18
Figure 3: DOD's Acquisition Cycle and GAO Knowledge Points	21
Figure 4: Type of Cost Savings Reported by the 35 Programs with Should Cost Analysis	34
Figure 5: Illustration of Program Two-Page Assessment	37
Figure 6: Examples of Knowledge Scorecards Statement on Small Business Participation	39

Abbreviations

BMDS	Ballistic Missile Defense System
DAMIR	Defense Acquisition Management Information Retrieval
DOD	Department of Defense
eSRS	Electronic Subcontracting Reporting System
MDA	Missile Defense Agency
MDAP	major defense acquisition program
MRL	manufacturing readiness level
NA	not applicable
OMB	Office of Management and Budget
PDR	preliminary design review
SAR	Selected Acquisition Report
TBD	to be determined
TRL	technology readiness level

This is a work of the U.S. government and is not subject to copyright protection in the United States. The published product may be reproduced and distributed in its entirety without further permission from GAO. However, because this work may contain copyrighted images or other material, permission from the copyright holder may be necessary if you wish to reproduce this material separately.

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

March 28, 2013

Congressional Committees

I am pleased to present GAO's 11th annual assessment of the Department of Defense's (DOD) major defense acquisition programs. This report offers observations on the performance of the DOD's current \$1.602 trillion portfolio of 86 major defense acquisition programs. In the current fiscal environment, agencies like DOD that rely heavily on acquisitions to carry out their missions cannot afford to pass up opportunities to address inefficiencies and free up resources for higher priority needs. Over the past several years, consistent with our past recommendations, Congress and DOD have taken meaningful steps to address long-standing problems with DOD weapon system acquisitions—an area that is on GAO's high-risk list.

Our analysis shows that the size and estimated cost of DOD's portfolio of major defense acquisition programs decreased by 10 programs and more than \$152 billion from 2011 to 2012 as more programs exited the portfolio than entered. In addition, our assessment of the 86 programs that make up the 2012 portfolio found that those programs reported a net cost decrease over the past year, nearly all of which is attributable to quantity reductions stemming from program cancelations and restructurings. For the first time we are including the Missile Defense Agency's Ballistic Missile Defense System in our assessment of the total cost of DOD's portfolio. We further observed that over the past year a majority of programs in the portfolio experienced increased buying power; the percentage of programs meeting cost growth targets discussed by GAO, DOD, and the Office of Management and Budget increased; and nearly all of the 10 largest programs in the portfolio with program baselines reported reductions in total estimated cost. However, similar to what we have observed in prior assessments, we found that the implementation of knowledge-based acquisition practices varied across the portfolio, though those programs that began over the past 5 years were more likely to adhere to knowledge-based principles. In addition, we found that many programs are implementing key acquisition reforms focused on affordability and cost savings, although DOD continues to accept the inherent risks in allowing programs to begin production before completing developmental testing.

Given the increasing budgetary pressures facing the federal government, it is imperative that DOD continue to find ways to improve the efficiency of its major weapon systems portfolio while still delivering the capabilities

required by the warfighters. Much of the cost reductions over the past year have come from program cancelations and quantity reductions. Procurement funding makes up more than 90 percent of the remaining funding needs and DOD faces difficult trade-offs if additional savings are to be realized in the future.

A handwritten signature in black ink, reading "Gene L. Dodaro". The signature is fluid and cursive, with a large, stylized "D" and a long horizontal stroke at the end.

Gene L. Dodaro
Comptroller General
of the United States



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

March 28, 2013

Congressional Committees

In response to the mandate in the joint explanatory statement to the Department of Defense Appropriations Act of 2009, which requires us to perform an annual assessment, this report provides a snapshot of how well the department is planning and executing its \$1.602 trillion portfolio of major weapon programs.¹ Although the total projected cost of the portfolio remains significant, that cost has declined since peaking at \$1.75 trillion in 2010 and is currently at its lowest point in over 5 years. In addition, the number of programs in the portfolio has decreased from 98 programs in 2010 to 86 programs in 2012. Department of Defense (DOD) weapon system acquisition—an area that has been on GAO’s high-risk list for more than 20 years—still represents one of the largest areas of the government’s discretionary spending. Since we began issuing this annual report in 2003, Congress and DOD have made meaningful improvements in the statutory and policy frameworks that govern weapon system acquisitions by mandating and encouraging a more knowledge-based approach to the development and production of major systems. We have noted in the past that practice has lagged behind policy in certain areas and commensurate improvements in program outcomes have not been evident. However, the changes in DOD’s portfolio over the past few years indicate that some improvements are being realized. With the likelihood of decreased defense budgets looming in the near future, it is imperative that DOD continue to find ways to reduce cost and improve efficiency.

This report includes observations on (1) the cost and schedule performance of DOD’s 2012 portfolio of 86 major defense acquisition programs, including the Missile Defense Agency’s (MDA) Ballistic Missile Defense System (BMDS), (2) the knowledge attained at key junctures in the acquisition process for 40 weapon programs in development or early

¹See Explanatory Statement, 154 Cong. Rec. H 9427, 9526 (daily ed., Sept. 24, 2008), to the Department of Defense Appropriations Act Fiscal Year 2009, contained in Division C of the Consolidated Security, Disaster Assistance, and Continuing Appropriations Act, 2009, Pub. L. No. 110-329.

production, and (3) key acquisition reform initiatives and program concurrency.²

Our observations in this report are based on three sets of programs:

- We assessed all 86 major defense acquisition programs in DOD's 2012 portfolio for our analysis of cost and schedule performance. To develop our observations, we obtained cost, schedule, and quantity data from DOD's December 2011 Selected Acquisition Reports (SAR) and from the Defense Acquisition Management Information Retrieval Purview system. In order to fully reflect the total size and cost of DOD's portfolio, we included the cost of BMDS—as of DOD's fiscal year 2013 budget submission—in this year's assessment of the changes in the overall cost and size of the portfolio over the past year. However, the program was excluded from the remainder of our analyses because no acquisition program baseline exists. In our prior assessments BMDS was excluded from all of our observations. Appendix I contains further information on our scope and methodology.
- We assessed 40 major defense acquisition programs that were mostly between the start of development and the full-rate production for our analysis of knowledge attained at key junctures and the implementation of acquisition reforms. To develop our observations, we obtained information on the extent to which the programs follow knowledge-based practices for technology maturity, design stability, and production maturity using a data-collection instrument. We also submitted a survey to program offices to collect information on systems engineering reviews, design stability, manufacturing planning and execution, and the implementation of specific acquisition reforms. We received survey responses from all of the programs from August to November 2012.
- In addition, we assessed 17 future major defense acquisition programs in order to gain additional insights into the implementation of key

²Major defense acquisition programs are those identified by DOD that require eventual total research, development, test, and evaluation (RDT&E) expenditures, including all planned increments, of more than \$365 million, or procurement expenditures, including all planned increments, of more than \$2.19 billion, in fiscal year 2000 constant dollars. DOD has a list of programs designated as pre-major defense acquisition programs (pre-MDAP). These programs have not formally been designated as MDAPs; however, DOD plans for these programs to enter system development, or bypass development and begin production, at which point they will likely be designated as MDAPs. We refer to these programs as future major defense acquisition programs throughout this report.

acquisition reform initiatives. To develop our observations, we submitted a survey to program offices to collect information on program schedule events, costs, and numerous acquisition reforms, and received responses from all 17 future programs from August to October 2012.

In addition to our observations, we present individual assessments of 64 weapon programs. Selection factors included major defense acquisition programs in development or early production, future programs, and recently cancelled programs.

We conducted this performance audit from July 2012 to March 2013 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings based on our audit objectives.

Observations on the Cost Performance of DOD's 2012 Major Defense Acquisition Program Portfolio

The overall size and estimated cost of DOD's portfolio of major defense acquisition programs decreased over the past year, while the average time to deliver initial capability to the warfighter increased by 1 month. Our analysis of DOD's 2012 portfolio allows us to make the following nine observations.

Cost performance Observations

1. DOD's 2012 portfolio of major defense acquisition programs contains 86 programs with a combined total estimated cost of \$1.602 trillion, which is a reduction of 10 programs and more than \$152 billion from 2011 levels. This represents the smallest portfolio in more than 5 years.^a
2. The total estimated acquisition cost of the 86 programs in the 2012 portfolio decreased by \$44 billion over the past year while the delivery of initial operating capability slipped by 1 month on average.^b When assessed against first full estimates, the total cost of the portfolio has increased by over \$400 billion, including more than \$90 billion in development cost growth and nearly \$290 billion in procurement cost growth, with an average delay of 27 months in the delivery of initial operating capability.^c
3. Program cancellations and restructurings account for nearly all of the cost reduction over the past year.
4. Long-term progress of the Missile Defense Agency's \$133 billion Ballistic Missile Defense System cannot be assessed because insight into future program costs is limited to the 5 years covered by the budget, and the program was not required to establish an acquisition program baseline when it began.
5. More than 60 percent of the programs in the 2012 portfolio increased buying power over the past year—as measured by a decrease in program acquisition unit cost—a notable improvement when compared to last year, when more than 60 percent of the programs in the portfolio lost buying power.
6. When measured against cost growth targets discussed by DOD, the Office of Management and Budget (OMB), and GAO, the portfolio's performance has improved. Only 15 percent of programs exceeded the 1-year target—down from 40 percent last year—and smaller percentages of programs exceeded targets for growth both in the past 5 years and since first full estimates.
7. Eight of the 10 costliest programs in DOD's portfolio, excluding BMDS, reported cost reductions over the past year totaling nearly \$5 billion—about 10 percent of the portfolio's total cost reduction.
8. DOD has invested more than \$805 billion in its 2012 portfolio, leaving over \$660 billion remaining to be funded, excluding BMDS. More than 90 percent of the remaining funding is for procurement, with more than 60 percent of that amount associated with the 10 costliest programs in the portfolio, most prominently the Joint Strike Fighter.
9. Around 40 percent of the funding needed to complete the programs in the portfolio represents cost growth since first full estimates.

^aAll dollar figures are in fiscal year 2013 constant dollars, unless otherwise noted.

^bIn addition to research and development and procurement costs, total acquisition cost includes acquisition-related operation and maintenance and system-specific military construction costs. Details on program costs used for this analysis are provided in app. II.

^cOur discussion of cost growth since first full estimates does not include the Ballistic Missile Defense System, as the program was not required to establish an acquisition program baseline when it began. See GAO, *Missile Defense: Opportunity Exists to Strengthen Acquisitions by Reducing Concurrency*, [GAO-12-486](#) (Washington, D.C.: Apr. 20, 2012) for an assessment of the Missile Defense Agency's cost, testing, and performance progress in developing the system.

Additional details about each observation follow.

1. **The overall size and estimated cost of DOD's portfolio of major defense acquisition programs are currently at their lowest points in over 5 years.** With 86 programs and an estimated total cost of \$1.602 trillion, the 2012 portfolio of major defense acquisition programs contains 10 fewer programs and is estimated to cost more than \$152 billion less than the 2011 portfolio, which represents the smallest portfolio in more than 5 years. The reductions over the past year are largely attributable to more programs exiting the portfolio than entering. As shown in table 1, 14 programs with a combined total cost of \$168 billion left the portfolio and only 4 programs with an estimated total cost of \$59 billion entered, resulting in net decreases of 10 programs and \$109 billion. In addition, the 82 programs that remained in the portfolio from 2011 to 2012 reported a combined cost decrease of \$44 billion.

Table 1: Changes in DOD's Portfolio of Major Defense Acquisition Programs from 2011 to 2012

Fiscal year 2013 dollars in billions	
2011 Portfolio (96 programs)	\$1,754
Less cost of 14 exiting programs	-168
Plus estimated total cost of 4 entering programs	+59
Less net cost changes of 82 remaining programs	-44
2012 portfolio (86 programs)	\$1,602

Source: GAO analysis of DOD data.

Note: To fully reflect the total size and cost of DOD's portfolio, this analysis includes the cost of BMDS. Our previous annual assessments excluded BMDS due to the lack of comparable cost and quantity data. Some numbers may not sum due to rounding.

Several of the programs that left the portfolio were poor performers that had been in the portfolio for a long time. Of those programs, nearly two-thirds reported development cost growth—a key indicator of poor program performance—greater than 15 percent from the first full estimates, while more than one-third reduced quantities by more than 25 percent, and half

reported at least one Nunn-McCurdy unit cost breach.³ The F-22 stealth fighter is the most prominent of those programs, and at a cost of more than \$80 billion, represents about half of the total cost of the exiting programs.⁴ At the time the F-22 exited, it had been part of DOD's portfolio for nearly 20 years, and had encountered significant problems, ultimately experiencing development cost growth of more than 60 percent, a quantity reduction of more than 70 percent, and an increase in acquisition unit cost of nearly 200 percent.⁵ Table 2 identifies the 14 programs that left the portfolio between 2011 and 2012, and identifies the changes in quantity and development cost each program experienced while in the portfolio, the extent to which each program changed their scheduled delivery of initial operational capability, and notes whether the programs reported a Nunn-McCurdy unit cost breach. In addition, the table lists the total cost of each program—in millions of fiscal year 2013 dollars—as reported in their final SAR.

³Enacted in 1982, the Nunn-McCurdy statutory provision requires DOD to notify Congress whenever a major defense acquisition program's unit cost experiences cost growth that exceeds certain thresholds. This is commonly referred to as a Nunn-McCurdy breach. 10 U.S.C. § 2433.

⁴The F-22A exited the portfolio following the issuance of the program's December 2010 SAR, in which the Air Force noted that the program had expended more than 90 percent of its total funding and delivered more than 90 percent of its total quantity. SARs are key recurring summary status reports to the Congress on the cost, schedule, and performance of DOD's major defense acquisition programs. 10 U.S.C. § 2432.

⁵The total quantity of F-22 aircraft was reduced from 648 to 188. These are the quantities used to calculate the change in program acquisition unit cost along with the changes in development and procurement costs. Considering only procurement quantities and costs, F-22 average procurement unit cost increased 52 percent.

Table 2: Changes since First Full Estimates for the 14 Programs That Exited the Portfolio

Fiscal year 2013 dollars in millions

Program	Percent quantity change	Percent change in development cost	Change in delivery of initial capability (months)	Nunn-McCurdy unit cost breach	Total acquisition cost
Joint Mine Resistant Ambush Protected Vehicle	73	182	0	No	\$42,790
Expeditionary Fighting Vehicle	-98	109	--	Yes	3,812
AH-64D Longbow Apache	0	67	-5	Yes	15,203
F-22 Raptor	-71	62	27	Yes	81,454
Airborne Signals Intelligence Payload	0	59	--	No	570
Force XXI Battle Command Brigade and Below	51	41	4	Yes	4,268
Advanced Threat Infrared Countermeasures /Common Missile Warning System	-32	24	0	Yes	4,995
Increment 1 Early-Infantry Brigade Combat Team	-67	24	--	Yes	1,314
C-5 Avionics Modernization Program	-37	21	16	No	1,319
Large Aircraft Infrared Countermeasures	0	14	0	No	472
Space Based Space Surveillance Block 10	0	11	4	No	1,000
Lewis and Clark Class Dry Cargo / Ammunition Ship	17	0	7	No	6,797
B-2 Radar Modernization Program	-5	-7	29	No	1,321
C-27J Spartan	-51	-9	10	Yes	2,326

Source: GAO analysis of DOD data.

Note: The change in delivery of initial capability for three programs could not be calculated. The Expeditionary Fighting Vehicle program was canceled, the Increment 1 Early-Infantry Brigade Combat Team program was truncated, and the Airborne Signals Intelligence Payload program was a development effort only. As a result, the programs did not report comparable initial operating capability data to be used in this analysis.

2. **The total estimated cost of the 86 programs in DOD's 2012 portfolio decreased by \$44 billion, or nearly 3 percent, over the past year.** This cost decrease was the net result of a reduction in procurement cost of \$45.9 billion, or almost 4 percent, offset slightly by increases of \$400 million in development cost and \$1.3 billion in other acquisition cost. When measured against first full estimates, however, the portfolio has experienced total acquisition cost growth of

\$402.5 billion, or 38 percent.⁶ In addition, 12 programs delayed the delivery of their initial capabilities resulting in an average increase of nearly 1 month across the portfolio. The average delay in delivering initial capability is 27 months when measured against first full estimates. Table 3 shows the decreases in programs' estimated cost as well as the increase in the average delay over the past year, while appendix III presents our analysis of cost growth and schedule delays over the past 5 years and against first full estimates.

Table 3: Changes in DOD's 2012 Portfolio of 86 Major Defense Acquisition Programs

Fiscal year 2013 dollars in billions

	Estimated portfolio cost in 2011	Estimated portfolio cost in 2012	Change since 2011	Percentage change since 2011
Total estimated research and development cost	\$406.7	\$407.1	\$0.4	0.1%
Total estimated procurement cost	1,201.9	1,155.9	-45.9	-3.8
Total estimated acquisition cost ^a	1,646.0	1,601.8	-44.2	-2.7
Average delay in delivering initial capabilities	—	—	0.8 months	0.9%

Source: GAO analysis of DOD data.

Note: To fully reflect the total size and cost of DOD's portfolio, this analysis includes the cost of BMDS. Our previous annual assessments excluded BMDS due to the lack of comparable cost and quantity data. Some numbers may not sum due to rounding.

^aIn addition to research and development and procurement costs, total acquisition cost includes acquisition-related operation and maintenance and system-specific military construction costs. Details on program costs used for this analysis are provided in app. II.

3. **Nearly all of the cost reduction in the portfolio over the past year can be attributed to program cancelations and restructurings.** Of the \$45.9 billion reduction in procurement cost, \$31.7 billion, or almost 70 percent, is attributable to a net reduction in quantities across 27

⁶Although the cost changes over the past year include the cost of BMDS, the portfolio cost growth measured from first full estimates does not, because the BMDS was not required to establish a program baseline when it began.

programs.⁷ Thirteen programs reported quantity increases which resulted in a net procurement cost increase of \$6.4 billion. More than half of that increase was driven by three programs—Integrated Air and Missile Defense; Joint Tactical Radio System Handheld, Manpack, and Small Form Fit Radios; and Stryker Family of Vehicles. Fourteen programs decreased procurement quantities resulting in a net procurement cost decrease of \$38.2 billion. Nearly all of this decrease is attributable to the cancelation or restructuring of the Joint Tactical Radio System Ground Mobile Radios, Joint Land Attack Cruise Missile Defense Elevated Netted Sensor System, C-130 Avionics Modernization Program, Airborne and Maritime/Fixed Station Joint Tactical Radio System, and Global Hawk programs. The remaining \$14.2 billion in procurement cost reductions, not attributable to quantity changes, include a \$4.2 billion reduction in the estimated cost of Joint Strike Fighter support equipment and spare parts.⁸ Table 4 shows how procurement costs changed across the portfolio over the past year due to changes in planned procurement quantities and other factors.

Table 4: Change in Procurement Cost Due to Quantity Changes and Other Factors

Fiscal year 2013 dollars in billions

	Number of programs	Actual cost change	GAO calculated cost change attributable to quantity changes	GAO calculated cost change not attributable to quantity changes
Programs with quantity increases	13	\$5.7	\$6.4	-\$0.8
Programs with quantity decreases	14	-\$39.8	-\$38.2	-\$1.7
Programs with no change in quantity	59	-\$11.8	0.0	-\$11.8
Totals	86	-\$45.9	-\$31.7	-\$14.2

Source: GAO analysis of DOD data.

Note: Some numbers may not sum due to rounding.

⁷To calculate the portion of procurement cost change attributable to quantity changes, we compared a program's quantities from the December 2010 SAR with its quantities from the December 2011 SAR. When quantities changed, we multiplied the change by the previous year's average procurement unit cost, using the December 2010 SAR estimate where available, to determine the cost difference that could be reasonably attributed to those quantity changes. See app. I for additional information on our scope and methodology.

⁸Although Joint Strike Fighter's estimated procurement cost decreased by \$4.2 billion over the past year, increases in the program's estimated development and military construction costs more than offset that decrease, which resulted in a net total cost increase of \$101 million.

-
4. **The Missile Defense Agency expects to spend more than \$130 billion on the Ballistic Missile Defense System through fiscal year 2017, but without a program baseline progress cannot be assessed.** MDA has spent \$97 billion since 2002 to develop and field the BMDS—a highly complex system of systems including land-, sea-, and space-based sensors as well as interceptors and battle management systems—and plans to spend at least \$36 billion more through fiscal year 2017. Although BMDS is a large part of DOD’s major defense acquisition program portfolio, the Secretary of Defense granted MDA significant management flexibility when it initiated the program in 2002.⁹ At that time, the Secretary chose to delay the entry of the BMDS program into DOD’s traditional acquisition process. Consequently, the program was not required to establish an acquisition program baseline like other major defense acquisition programs.¹⁰ Instead, it was allowed to project funding needs over a 5- to 6-year period—the period covered by the future years defense program—with each budget request. Recent laws have directed MDA to establish baselines for the program elements that make up the BMDS.¹¹ However, we recently found that the underlying cost estimates for the baselines that have been established are generally not reliable or accurate. In addition, the overall BMDS program still lacks an integrated long-term baseline. The absence of an integrated long-term baseline and limited insight into the program’s future costs hinder oversight and accountability and prevent us from assessing the program’s cost progress or comparing it to other major defense acquisition programs. As a result the program is excluded from the remainder of our observations.
5. **More than 60 percent of the programs that reported acquisition unit cost data realized an increase in buying power over the past year, which is a notable improvement over last year, when we found that more than 60 percent of the programs in the 2011 portfolio had lost buying power.** In general, buying power can be defined as the amount of a good or service that can be purchased

⁹A Presidential directive required DOD to deliver an initial set of missile defense capabilities by 2004.

¹⁰Generally, major defense acquisition programs establish an acquisition program baseline before development start. 10 U.S.C. § 2435(c).

¹¹10 U.S.C. § 225.

given a specified level of funding. Over time, we have used changes in the program acquisition unit cost of DOD's weapon systems to measure increases or decreases in buying power.¹² Of the 84 programs or program elements in DOD's portfolio that reported program acquisition unit cost data, 52 expect to deliver capabilities at lower unit costs than they were projecting a year ago, while the remaining 32 experienced unit cost increases.¹³ On average the unit cost reduction for the 52 programs was 3.4 percent, while the average unit cost increase of the 32 programs was slightly higher at 4.3 percent. Because unit costs are sensitive to the number of end-items being purchased, it is reasonable to expect quantity increases to result in unit cost decreases and vice versa. However, 42 of the 52 programs with unit cost decreases had no change in quantity. This indicates that the increase in buying power for those programs was due to actual development or procurement cost reductions that are attributable to increased efficiency, changes in requirements, or other non-quantity-related program changes. We did not examine whether programs delivered a lower or higher level of performance than initially promised.

Nearly all of the ship programs in the portfolio increased buying power without any changes in quantity. The *Virginia*-class Submarine, DDG 51 Destroyer, DDG 1000 Destroyer, LHA 6 Amphibious Assault Ship, and Littoral Combat Ship—Seaframes programs reported increased buying power over the past year without changes in quantity. The cost reductions in the *Virginia*-class, DDG 51, and Littoral Combat Ship—Seaframes programs were largely the result of significant decreases in procurement cost—more than \$1 billion in each case—with no corresponding reductions in quantity. The LHA 6 also realized increased buying power due to a procurement cost reduction of \$239 million. According to program SARs, the bulk of the cost changes

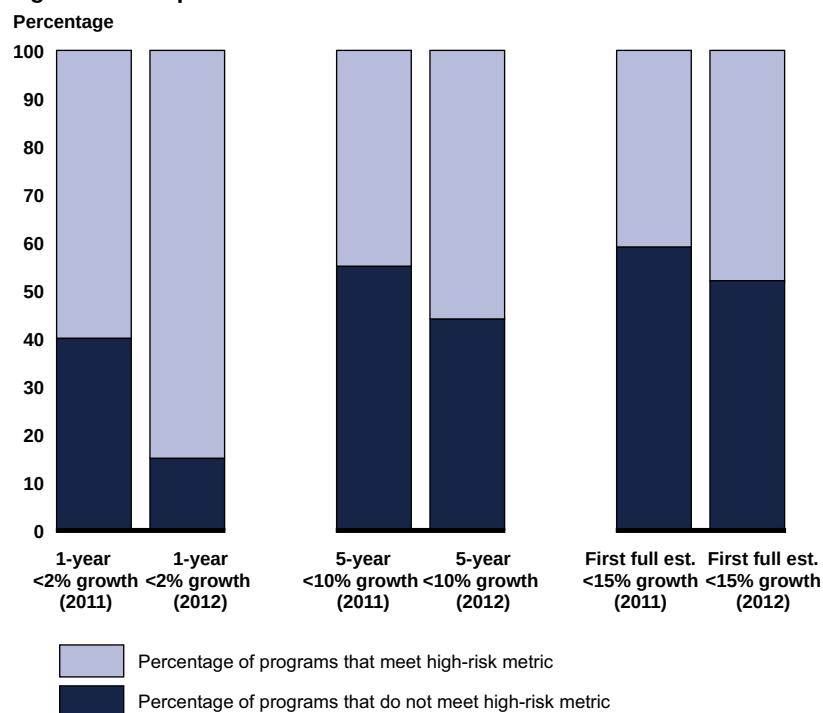
¹²Program acquisition unit cost is the total cost for development, procurement, acquisition operation and maintenance, and system-specific military construction for the acquisition program divided by the total number of items to be procured.

¹³DOD's 2012 portfolio contains 86 programs with SARs. However, DOD's SAR summary tables break 4 of these programs into 2 smaller elements each, for a total of 90 programs and elements. Our analysis does not include the Joint Tactical Radio System Ground Mobile Radios, Joint Land Attack Cruise Missile Defense Elevated Netter Sensor System, C-130 Avionics Modernization Program, or National Polar-orbiting Operational Environmental Satellite System because these programs were canceled. In addition, the Patriot / Medium Extended Air Defense System Combined Aggregate Program Fire Unit, and Ballistic Missile Defense System programs were excluded because comparable cost and quantity data were not available.

reported by these ship programs over the past year are attributed to reductions in requirements, and adjustments to key cost estimating assumptions, most notably inflation rates. In contrast, the DDG 1000 increased buying power as a result of decreased development cost stemming from a decision to remove a radar subsystem from the ship's design, revise the program's test and evaluation requirements, and ultimately only build three ships.

6. **An increased percentage of programs are meeting cost performance metrics used to measure DOD's progress in addressing GAO's weapon system acquisition high-risk area.** In December 2008, DOD, OMB, and GAO discussed a set of metrics and goals to evaluate DOD's progress in improving program cost performance for the purpose of updating GAO's annual high-risk report. The metrics are intended to measure total program cost-performance on a percentage basis over three time-periods: the preceding year, the preceding 5 years, and the period since first full program estimates. The percentage of programs meeting the metrics within each time period has increased since our last assessment, as shown in figure 1. The greatest improvement occurred in the percentage of programs reporting cost growth of less than 2 percent over the preceding year. In our last assessment we found that 60 percent of the portfolio met this 1-year cost performance metric, while this year 85 percent did. The programs in this year's assessment that exceeded the 1-year metric were smaller programs, representing less than 10 percent of the portfolio's total estimated cost and, on average, costing about half as much as the programs that met the metric. Although the percentage of programs exceeding the metrics for 5-year cost performance and cost performance from first full estimates has also decreased, the improvement in these categories has been less significant and around half of the portfolio is still exceeding the metrics. While the improvements over the past year are promising, DOD must continue to be committed to following sound, knowledge-based principles and holding programs accountable for meeting cost and schedule goals for this progress to be sustained.

Figure 1: Comparison of the Cost Performance of DOD's 2011 and 2012 Portfolios



Source: GAO analysis of DOD data.

7. **Eight of the 10 costliest programs in DOD's portfolio—excluding BMDS—reported cost decreases over the past year.** As we have emphasized in the past, the cost performance of DOD's portfolio is principally driven by a small number of high-cost programs. The 10 largest programs in the current portfolio that have a program baseline account for 57 percent of the total estimated cost, which is 2 percent more than the top 10 programs accounted for in last year's portfolio.¹⁴ In addition, the 10 programs in this year's portfolio account for more than half of the total cost growth when measured against first full estimates. However, over the past year those programs reported a combined net total cost decrease of \$4.9 billion, which is more than 10

¹⁴The top 10 programs in last year's portfolio included the F-22 Raptor and the Joint Mine Resistant Ambush Protected Vehicle, both of which are no longer in the portfolio. The 2012 portfolio includes two programs that were not in the top 10 last year the KC-46 Tanker, a new program in the portfolio, and the Littoral Combat Ship—Seaframes.

percent of the portfolio's overall cost decrease of \$44 billion. Eight programs reported cost decreases while 2 programs—the Joint Strike Fighter and CVN 78 Class aircraft carrier—reported cost increases. Interestingly, none of the decreases were due to quantity reductions. In several cases—notably the ship programs—the cost decreases were due to changes in program estimating assumptions. Only 1 of the 8 programs, the Navy's F/A-18E/F Super Hornet, reported any quantity change over the past year, and in that case the number of aircraft actually increased. Despite the cost of buying nine additional aircraft, the Navy was able to realize a net cost decrease because of savings from a multi-year procurement contract and other efficiencies. Table 5 identifies the changes in total acquisition cost for each the top 10 programs in the 2012 portfolio over the past year.

Table 5: Cost Changes in DOD's 10 Costliest Programs over the Past Year (excluding BMDS)

Fiscal year 2013 dollars in millions

Program	Total estimated acquisition cost last year	Current total estimated acquisition cost	Change in total acquisition cost over past year
Joint Strike Fighter	\$336,023	\$336,124	\$101
DDG 51 Destroyer	104,780	103,166	-1,614
Virginia-class Submarine	86,189	84,779	-1,410
F/A-18E/F Super Hornet	59,486	59,379	-108
V-22 Osprey	58,874	58,610	-265
Trident II Missile	54,782	54,613	-169
KC-46 Tanker	45,097 ^a	44,780	-318
CVN 78 Class	34,982	35,515	533
P-8A Poseidon	33,928	33,638	-290
Littoral Combat Ship—Seaframes	33,823	32,429	-1,395
Total	\$847,966	\$843,032	-\$4,934

Source: GAO analysis of DOD data.

Note: Some numbers may not sum due to rounding.

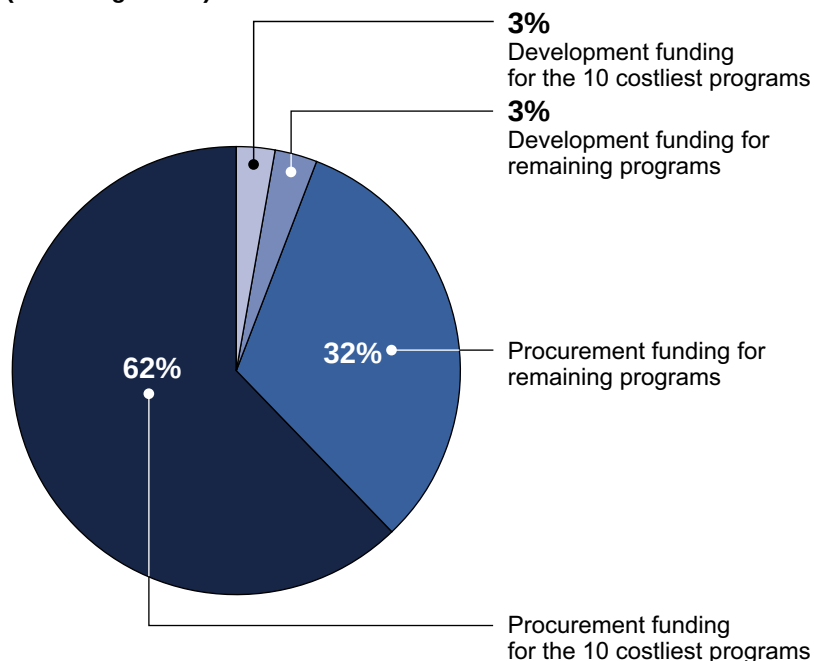
^aThe KC-46 Tanker program began in February 2011 so the program did not report a December 2010 SAR. However, the program established a first full estimate in August 2011, and we used that data to represent total estimated acquisition cost from last year.

8. Nearly all of the funding needed to complete the programs in the portfolio is for procurement, of which more than half is

associated with the 10 costliest programs, excluding BMDS. DOD has invested a total of more than \$805 billion in its 2012 portfolio and currently estimates that \$664 billion is needed to complete those programs for which cost baselines exist.¹⁵ More than 90 percent of that remaining funding is for procurement; therefore, any additional cost savings from these programs will likely require quantity reductions, unless programs are able to increase efficiency or gain savings in other ways. Procurement for the 10 costliest programs in the portfolio, including the Joint Strike Fighter, DDG 51 Destroyer, *Virginia* Class Submarine, and KC-46 Tanker, represents 62 percent of the portfolio's total remaining cost. Figure 2 illustrates the large proportion of the remaining funding associated with those 10 programs.

¹⁵In addition to research and development and procurement costs, total acquisition cost includes acquisition-related operation and maintenance and system-specific military construction costs. Costs associated with the BMDS are not included in this analysis because the program does not have an acquisition program baseline. However, through fiscal year 2012 DOD has invested a total of \$97 billion in BMDS and based on its fiscal year 2013 budget request expects to invest an additional \$36 billion in the program through fiscal year 2017.

Figure 2: Proportions of Future Funding within DOD's Acquisition Portfolio (excluding BMDS)



Source: GAO analysis of DOD data.

9. **Around 40 percent of the funding needed to complete the programs in the portfolio represents cost growth from first full estimates.** Comparing the first full and current funding profiles for all of the programs in the portfolio highlights changes in the cost of the portfolio on a year-by-year basis.¹⁶ Based on this comparison we found that \$393 billion of the portfolio's remaining cost was anticipated when the programs established their first full estimates while \$271 billion was not. Nearly 90 percent, or \$237 billion, of this cost growth is in procurement while the remaining amount, about \$34 billion, represents growth in development and other acquisition costs. These added costs represent future funding that will not be available to support other government priorities.

¹⁶To conduct this analysis we identified the SAR for each program in which the program's first full estimate matched the total funding identified in the SAR funding stream. In some cases, the sum of the SAR funding stream data differed slightly from the first full estimate. This analysis does not include BMDS because the program was not required to establish a first full estimate or acquisition program baseline against which to measure cost growth.

We recognize that some portion of the procurement cost growth is attributable to changes in quantity. We have reported on annual procurement cost growth due to quantity changes since our 2011 assessment and found that, on average, just over half of the changes in procurement cost could be attributable to quantity changes, which generally represents a good use of additional funds, but also indicates that nearly half of the growth is related to negative factors such as production problems, inefficiencies, or flawed initial cost estimates. Growth in development and other acquisition costs are not typically impacted by quantity changes and are therefore indications of poor program planning or performance.¹⁷

Observations from Our Assessment of Knowledge Attained by Programs at Key Acquisition Junctures

Our 2013 assessment continues to demonstrate both progress and a significant need for programs to better follow a knowledge-based approach reducing gaps in technology, design, and production knowledge. Knowledge in these three areas builds over time—a knowledge deficit early in a program can cascade through design and production leaving decision makers with less knowledge to support decisions about when and how best to move into subsequent acquisition phases that commit more budgetary resources. Our analysis of data from 40 major defense acquisition programs that we surveyed allows us to make three observations.

Knowledge Point Observations

1. Many of the programs that began in the last 5 years had mature technologies and held a preliminary design review prior to the start of development (knowledge point 1), providing a better foundation to avoid future cost and schedule problems.
2. Less than one-third of the programs that provided data on design drawings released actually reported having a stable design at their critical design review (knowledge point 2), and the use of other knowledge-based practices to ensure design stability at this critical juncture varied.
3. Many of the programs we assessed have taken or plan to take steps to capture critical manufacturing knowledge prior to the start of production (knowledge point 3), although the methods used varied.

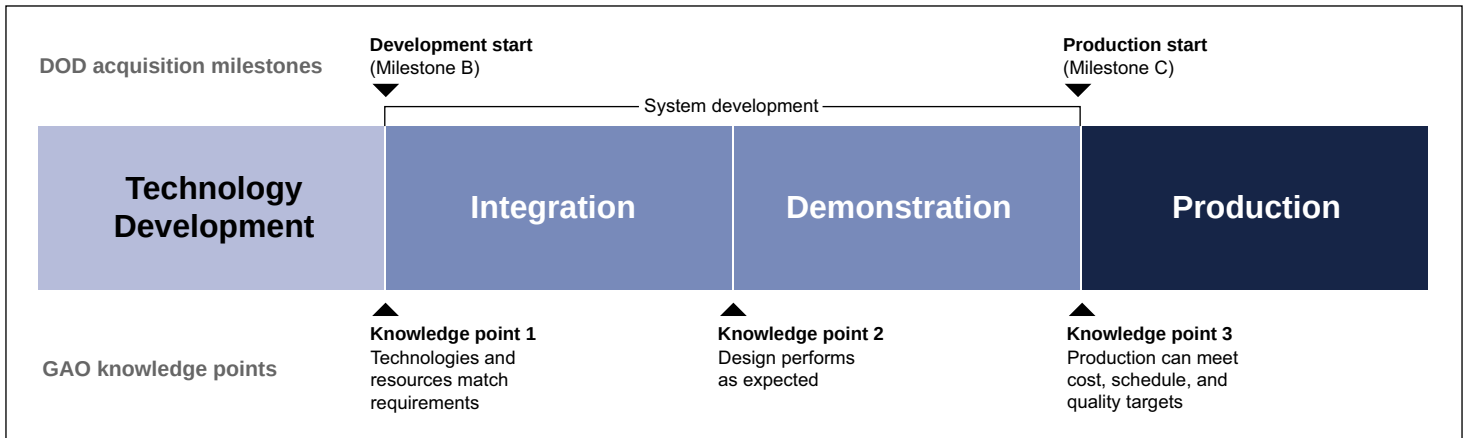
¹⁷Our analysis reflects program cost changes as of the December 2011 SAR submissions. Although additional changes in the costs of many programs are likely to occur, we did not attempt to calculate or project those future changes.

Positive acquisition outcomes require the use of a knowledge-based approach to product development that demonstrates high levels of knowledge before significant commitments are made. In essence, knowledge supplants risk over time. In our past work examining weapon acquisition and best practices for product development, we have found that leading commercial firms and successful DOD programs pursue an acquisition approach that is anchored in knowledge, whereby high levels of product knowledge are demonstrated by critical points in the acquisition process.¹⁸ On the basis of this work, we have identified three key knowledge points during the acquisition cycle—development start, critical design review, and production start—at which programs need to demonstrate critical levels of knowledge to proceed.¹⁹ Figure 3 aligns the acquisition milestones described in DOD's primary acquisition policy with these knowledge points. In this report, we refer to DOD's engineering and manufacturing development phase as system development. Production start typically refers to a program's entry into low-rate initial production.

¹⁸GAO, *Best Practices: DOD Can Achieve Better Outcomes by Standardizing the Way Manufacturing Risks Are Managed*, [GAO-10-439](#) (Washington, D.C.: Apr. 22, 2010); *Best Practices: High Levels of Knowledge at Key Points Differentiate Commercial Shipbuilding from Navy Shipbuilding*, [GAO-09-322](#) (Washington, D.C.: May 13, 2009); *Defense Acquisitions: A Knowledge-Based Funding Approach Could Improve Major Weapon System Program Outcomes*, [GAO-08-619](#) (Washington, D.C.: July 2, 2008); *Best Practices: Capturing Design and Manufacturing Knowledge Early Improves Acquisition Outcomes*, [GAO-02-701](#) (Washington, D.C.: July 15, 2002); *Best Practices: Better Matching of Needs and Resources Will Lead to Better Weapon System Outcomes*, [GAO-01-288](#) (Washington, D.C.: Mar. 8, 2001); and *Best Practices: Better Management of Technology Development Can Improve Weapon System Outcomes*, [GAO/NSIAD-99-162](#) (Washington, D.C.: July 30, 1999).

¹⁹For shipbuilding programs, we have identified two key knowledge points during the acquisition cycle—contract award and fabrication start.

Figure 3: DOD's Acquisition Cycle and GAO Knowledge Points



Source: GAO.

The building of knowledge consists of information that should be gathered at these three critical points over the course of a program:

Knowledge point 1 (KP1): Resources and requirements match.

Achieving a high level of technology maturity by the start of system development is one of several important indicators 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. In addition, the developer should complete a series of systems engineering reviews culminating in a preliminary design of the product that shows the design is feasible. Constraining the development phase of a program to 5 to 6 years is also recommended because it aligns with DOD's budget planning process and increases funding predictability. For shipbuilding programs, critical technologies should be matured into actual system prototypes and successfully demonstrated in a realistic environment before a contract is awarded for detail design of a new ship.

Knowledge point 2 (KP 2): Product design is stable. This point occurs when a program determines that a product's design 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 system development. Completion of at least 90 percent of engineering drawings at this point provides tangible evidence that the product's design is stable, and a prototype demonstration shows that the design is capable of meeting performance

requirements. Shipbuilding programs should demonstrate design stability by completing 100 percent of the basic and functional drawings as well as the three-dimensional product model by the start of construction for a new ship. Programs can also improve the stability of their design by conducting reliability growth testing and completing failure modes and effects analyses so fixes can be incorporated before production begins. At this point, programs should also begin preparing for production by identifying manufacturing risks, key product characteristics, and critical manufacturing processes.

Knowledge point 3 (KP 3): Manufacturing processes are mature. This point is achieved when the developer has demonstrated that it can manufacture the product within cost, schedule, and quality targets. A best practice is to ensure that all critical 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. Demonstrating critical processes on a pilot production line is an important initial step in this effort. In addition, production and postproduction costs are minimized when a fully integrated, capable prototype is demonstrated to show that the system will work as intended in a reliable manner before committing to production. We did not assess shipbuilding programs for this knowledge point due to differences in the production processes used to build ships.

A knowledge-based acquisition approach is a cumulative process in which certain knowledge is acquired by key decision points before proceeding. Demonstrating technology maturity is a prerequisite for moving forward into system development, during which the focus should be on design and integration. A stable and mature design is likewise a prerequisite for moving forward into production where the focus should be on efficient manufacturing. Additional details about key practices at each of the knowledge points can be found in appendix IV.

For this report, we assessed the knowledge attained at key junctures in the acquisition process for 40 individual weapon programs, which are mostly in development or early production.²⁰ Not all programs included in our review of knowledge-based practices provided information for every

²⁰Because knowledge points and best practices differ for shipbuilding programs, we exclude the six shipbuilding programs from some of our analysis related to knowledge point 2 and knowledge point 3.

knowledge point or had reached all of the knowledge points—development start, design review, and production start—at the time of this review.

Additional detail about these observations follows.

1. Many of the programs that began in the last 5 years had mature technologies and held a preliminary design review (PDR) prior to the start of system development (knowledge point 1), providing a better foundation to avoid future cost and schedule problems.

Knowledge-based acquisition practices recommend and DOD policy requires that programs fully mature technologies and demonstrate them in a relevant or, preferably, an operational environment prior to entering system development, to gain additional knowledge about the technologies' form, fit, and function as well as the effect of the intended environment on those technologies.²¹ Achieving technology maturity at system development start makes it easier to reach the remaining two knowledge points. Thirty-two of the programs we surveyed had reached knowledge point 1 and provided technology maturity data. Of those programs, 5 reported that all of their critical technologies were fully mature to best practice standards when they began development.²² Another 14 programs reported that their critical technologies were nearing maturity at the start of development, in accordance with DOD policy and statutory requirements.²³ The

²¹Demonstration in a relevant environment is Technology Readiness Level (TRL) 6. Demonstration in a realistic environment is TRL 7. See app. V for a detailed description of TRLs.

²²The MQ-9 Reaper program also reported that all of its critical technologies were fully mature at development start. However, that technology assessment reflects the most recent Reaper block (Block 5) and not the original program. Our historical data shows that the Reaper began in 2004 with one critical technology that was nearing maturity but not fully mature. Although the TRL data for the Reaper program now indicates that all of their technologies were fully mature when development began, our historical data shows that one of those technologies was actually at TRL 6—nearing maturity—at that time, so we have used the historical data and include the Reaper in the “nearing maturity” group.

²³According to DOD policy, in order to be considered mature enough to use in product development, technology shall have been demonstrated in a relevant environment or, preferably, in an operational environment. See Department of Defense Instruction 5000.02, *Operation of the Defense Acquisition System*, enc. 2, para. 5.d(4) (Dec. 8, 2008) (hereinafter cited as DODI 5000.02 (Dec. 8, 2008)). In addition, a major defense acquisition program may not receive milestone B approval until the milestone decision authority certifies that the technology in the program has been demonstrated in a relevant environment. 10 U.S.C. § 2366b(a)(3)(D).

remaining 13 programs reported having one or more immature technologies at the start of development. Fourteen of the 19 programs with critical technologies either mature or nearing maturity started development in the last 5 years. In contrast, all 13 programs that reported having at least one immature technology at development start began more than 5 years ago. More than half of these programs were still working to mature their critical technologies at knowledge point 2, a point when programs should be focusing on demonstrating a stable design instead of addressing technology maturity issues. Table 6 identifies the 19 programs that entered development with fully mature or nearly mature technologies and notes their knowledge point 1 date.

Table 6: Programs That Entered Development with Technologies Fully Mature or Nearing Maturity

Program	Knowledge point 1	Technology maturity
Programs fully mature technologies by knowledge point 1 date		
Ship to Shore Connector	July 2012	Fully Mature
Excalibur	September 2009	Fully Mature
HC/MC-130 Recapitalization	November 2008	Fully Mature
Global Positioning System III	May 2008	Fully Mature
LHA 6	June 2007	Fully Mature
Programs with technologies nearing maturity by knowledge point 1 date		
Global Positioning Satellite OCX	November 2012	Nearing Maturity
Joint Light Tactical Vehicle	August 2012	Nearing Maturity
KC-46 Tanker	February 2011	Nearing Maturity
Small Diameter Bomb II	July 2010	Nearing Maturity
Integrated Air and Missile Defense	December 2009	Nearing Maturity
Joint High Speed Vessel	November 2008	Nearing Maturity
Joint Precision Approach and Landing System Increment 1A	July 2008	Nearing Maturity
MQ-4C Triton	April 2008	Nearing Maturity
WIN-T Increment 2	June 2007	Nearing Maturity
AH-64E Apache Remanufacture	July 2006	Nearing Maturity
Standard Missile 6	June 2004	Nearing Maturity
MQ-9 Reaper Unmanned Aircraft System	February 2004	Nearing Maturity
WIN-T Increment 3	July 2003	Nearing Maturity
RQ-4A/B Global Hawk	December 2001	Nearing Maturity

Source: GAO analysis of DOD data.

As we have reported in the past, programs that are working to mature technologies after the start of development while concurrently attempting to mature a system's design and prepare for production are at higher risk of experiencing cost growth and schedule delays. We have also observed that those programs tend to have higher cost growth than programs that start system development with mature technologies.²⁴ Our analysis indicates that the average rate of development cost growth for those programs that started with immature technologies is 86 percent, while the average growth rate for development costs is about half that amount for programs that began with their critical technologies at least nearing maturity.

In addition to ensuring that technologies are mature by development start, knowledge-based acquisition best practices suggest and statute requires, that programs hold systems engineering events, such as a preliminary design review, before development start to ensure that requirements are defined and feasible, and that the proposed design can meet those requirements within cost, schedule, and other system constraints.²⁵ Our assessment of the 40 programs in this year's review shows that overall, 38 programs held a preliminary design review, but only 11 programs held this review prior to the start of development. About half of these 11 programs did so after the Weapon Systems Acquisition Reform Act of 2009 made it a statutory requirement that a preliminary design review be held before the start of system development.²⁶ For the other programs that had not completed a preliminary design review prior to the start of development, the period after the start of development until the review was completed or was planned to be completed averaged 24 months (see table 7). In addition, our analysis also indicates that, on average, the time between knowledge point 1 and preliminary design review for programs that started

²⁴GAO, *Defense Acquisitions: Assessments of Selected Weapon Programs*, [GAO-12-400SP](#) (Washington, D.C.: March 29, 2012); *Defense Acquisitions: Assessments of Selected Weapon Programs*, [GAO-11-233SP](#) (Washington, D.C.: March 29, 2011); *Defense Acquisitions: Assessments of Selected Weapon Programs*, [GAO-09-326SP](#) (Washington, D.C.: March 30, 2009); and *Defense Acquisitions: Assessments of Selected Weapon Programs*, [GAO-08-467SP](#) (Washington, D.C.: March 31, 2008).

²⁵A major defense acquisition program may not receive milestone B approval until the program has held a preliminary design review and the milestone decision authority has conducted a formal post-preliminary design review assessment and certified on the basis of such assessment that the program demonstrates a high likelihood of accomplishing its intended mission. 10 U.S.C. § 2366b(a)(2).

²⁶Pub. L. No. 111-23, § 205(a).

in the past 5 years was shorter than it was for those that started more than 5 years ago.

Table 7: Comparison of Preliminary Design Review and Development Start for 38 Weapons Programs

	Programs that held a PDR before development start	Average months PDR preceded development start	Programs that held a PDR after development start	Average months from development start to PDR
Number of programs	11	18	27	24

Source: GAO analysis of DOD data.

2. **Less than one-third of the programs that provided data on design drawings released actually reported having a stable design at their critical design review (knowledge point 2), and the use of other knowledge-based practices to ensure design stability at this critical juncture varied.** Knowing a product's design is stable before system demonstration reduces the risk of costly design changes occurring during the manufacture of production-representative prototypes—when investments in acquisition become more significant. Just as programs that enter system development with immature technologies cost more and take longer to provide their operational capabilities to the warfighter, programs that hold their critical design review before achieving a stable design also experience higher average costs and longer schedule delays. Overall, 29 of the 40 programs we assessed provided design maturity data at knowledge point 2 and only 8 programs reached the best practices standard of 90 percent or more of their expected design drawings released at the critical design review.²⁷

Thirty-six of the programs we assessed had reached their critical design review and several reported that they had used other knowledge-based practices to increase confidence in the stability of their product's design. Those practices include the identification of key product characteristics and critical manufacturing processes; conducting producibility assessments to identify manufacturing risks; completing failure modes and effects analysis to identify potential failures and early design fixes; and establishing a reliability growth

²⁷For ship-building programs, a stable design is demonstrated by completing 100 percent of their three-dimensional design models prior to the start of fabrication.

curve to uncover design problems so fixes can be incorporated before production begins. The use of these practices varied. More than half the programs reported that they had implemented one or more of the practices, while only 12 reported they had implemented all five practices. Of those 12 programs only 5 had also released 90 percent or more of their design drawings by knowledge point 2, which is the best practice standard. Table 8 identifies the number of programs reporting the use of each of these practices at critical design review. Many programs we assessed are reflected in more than one category.

Table 8: Implementation of Knowledge-Based Practices at the Critical Design Review for 36 Programs

	Key product characteristics identified	Critical manufacturing processes identified	Producibility assessments conducted	Failure modes and effects analysis completed	Reliability growth curve established
Number of programs	32	27	30	26	17

Source: GAO analysis of DOD data.

The use of early system prototypes during development is another useful practice for demonstrating that a system's design is stable, and that the system can be built and will work as intended. While 27 out of the 34 non-shipbuilding programs included in our assessment reported that they had tested or planned to test a system-level integrated prototype during development, only 2 of those programs noted that that prototype testing occurred before their design review. For the remaining programs that have tested or plan to test an integrated prototype after their design review, the test occurs about 2 years after, on average.

3. **Many of the programs we assessed have taken or plan to take steps to capture critical manufacturing knowledge prior to the start of production (knowledge point 3), although the methods used varied.** Capturing critical manufacturing and testing knowledge before entering production helps ensure that a weapon system will work as intended and can be manufactured efficiently to meet cost, schedule, and quality targets. This knowledge can be captured and demonstrated through the use of various proactive methods including the use of statistical process control data, pilot production lines, Manufacturing Readiness Levels, and prototype testing. Eight of the non-ship programs we assessed identified statistical process control

data as a method for tracking production maturity.²⁸ Only 15 programs we surveyed reported that they had demonstrated or planned to demonstrate critical manufacturing processes in a pilot production line environment before beginning production, as emphasized in DOD policy.²⁹ Three of the programs we surveyed entered production in 2012, and only one of those programs did so after satisfying this policy requirement. Overall, a total of 19 programs either said that they have no plans to demonstrate their manufacturing processes in a pilot-line environment before making a production decision or reported that such a demonstration is not applicable for their program.

According to DOD, Manufacturing Readiness Levels (MRL) provide a measurement scale and vocabulary for assessing and discussing manufacturing maturity and risk. While not institutionalized to the degree that technology readiness levels are within DOD, the acceptance of MRLs has grown among some industry and DOD components, and their use is encouraged by DOD. Although DOD policy requires the assessment of manufacturing processes and risks before proceeding into production, it does not require programs to use MRLs in conducting that assessment. Twenty-one of the programs we surveyed are using or are planning to use MRLs to assess manufacturing readiness. Only 3 of those programs have committed to or plan to commit to production with an MRL 9 or higher for process capability and control—the level at which we believe programs have achieved manufacturing process maturity—while another 9 programs reported that they had achieved or planned to achieve an MRL 8.

Production and postproduction costs are also minimized when a fully integrated, production-representative prototype is demonstrated to show that the system will work as intended in a reliable manner. Since 2008, DOD policy has also required that a system be demonstrated in its intended environment using a production-representative article before entering production, which has led to an increase in the number and percentage of programs doing so.³⁰ A total of 29 programs included in our assessment have demonstrated or plan to demonstrate a production-representative prototype but only 18 have done so or plan to do so before

²⁸The six shipbuilding programs we surveyed were excluded from this portion of our analysis due to the differences in the production processes used to build ships.

²⁹DODI 5000.2, enc. 2, para. 6(c)(6)(d) (Dec. 8, 2008).

³⁰DODI 5000.2, enc. 2, para. 6(c)(6)(d) (Dec. 8, 2008).

committing to production.³¹ Ten of those 18 programs have already done their prototype testing and committed to production while the other 8 programs have not yet made a production decision. For the other programs that have or plan to complete the prototype testing after committing to production, five were initiated in the past 5 years, two of which are incremental upgrades to existing systems. Of the three programs that made a production decision in 2012, only one reported that they had tested a production-representative prototype before reaching this key juncture, although the other two programs tested prototypes within 6 months of their production decision.

Table 9 identifies the number of programs included in our assessment that reported the use or planned use of various proactive methods for capturing manufacturing knowledge prior to the start of production. While our analysis included 34 non-ship programs, some of those programs reported using multiple methods and are therefore represented in more than one group. Four programs did not report the use of any of these methods.

Table 9: Use of Various Methods for Capturing Manufacturing Knowledge Prior to Production Start

	Use of statistical process control	Use of a pilot production line	Use of manufacturing readiness levels	Use of a production- representative prototype
Number of programs	8	15	21	18

Source: GAO analysis of DOD data.

Our past work has found that quality problems—which often cause significant cost and schedule problems—stem in part from poor control of manufacturing processes and materials, as well as poor part design, design complexity, and inattention to manufacturing risks.³² Fourteen of the programs we assessed at knowledge point 3 reported that they had experienced quality problems with parts, materials, or processes during production. Eleven of these programs reported one or more impacts that included cost increases, schedule delays, or degradation in system

³¹We did not assess shipbuilding programs against this best practice as testing a system-level prototype before the critical design review in these programs may not be practical.

³² GAO, *Best Practices: Increased Focus on Requirements and Oversight Needed to Improve DOD's Acquisition Environment and Weapon System Quality*, [GAO-08-294](#) (Washington, D.C.: Feb. 1, 2008).

performance with the other 3 programs reporting that quality problems had no impact. The most common impacts reported were cost increases and program delays which were both reported by more than half the programs, while only five programs reported degraded system performance.

Observations about DOD's Implementation of Key Acquisition Reform Initiatives and Program Concurrency

Over the past several years, the Congress and DOD have instituted multiple initiatives aimed at improving the way the department does business by driving down acquisition costs and ensuring that programs are more affordable: specifically the Weapon Systems Acquisition Reform Act of 2009, the reissuance of DOD Instruction 5000.02, and multiple "Better Buying Power" memorandums issued by the Under Secretary of Defense for Acquisition, Technology and Logistics.³³ We analyzed survey data collected from 40 current major defense acquisition programs—the same programs reflected in our knowledge point analysis—and 17 programs identified by DOD as future major defense acquisition programs, regarding the implementation of key aspects of these reform initiatives. We focused our analysis on the aspects of DOD's "Better Buying Power" initiatives and the Weapon Systems Acquisition Reform Act of 2009 aimed at ensuring program and portfolio affordability, controlling cost growth, and promoting competition throughout the acquisition life-cycle.³⁴ In addition, we assessed the amount of concurrency between developmental testing and

³³Pub. L. No. 111-23. DODI 5000.2 (Dec. 8, 2008). Office of the Under Secretary of Defense, Acquisition, Technology and Logistics Memorandum: "Better Buying Power: Mandate for Restoring Affordability and Productivity in Defense Spending" (June 28, 2010). Office of the Under Secretary of Defense, Acquisition, Technology and Logistics Memorandum: "Better Buying Power: Guidance for Obtaining Greater Efficiency and Productivity in Defense Spending" (Sept. 14, 2010). Office of the Under Secretary of Defense, Acquisition, Technology and Logistics Memorandum: "Implementation Directive for Better Buying Power - Obtaining Greater Efficiency and Productivity in Defense Spending" (Nov. 3, 2010). Office of the Under Secretary of Defense, Acquisition, Technology and Logistics Memorandum: "Better Buying Power 2.0: Continuing the Pursuit for Greater Efficiency and Productivity in Defense Spending" (Nov. 13, 2012).

³⁴In December 2012, we reported on DOD's implementation of the Weapon Systems Acquisition Reform Act of 2009, and noted that DOD had taken steps to implement fundamental provisions of the Act, and that DOD was taking additional steps to further strengthen its policies and acquisition capabilities. We also reported, however, that DOD still faced organizational, policy, and cultural challenges to implementing acquisition reform. GAO, *Weapons Acquisition Reform: Reform Act Is Helping DOD Acquisition Programs Reduce Risk, but Implementation Challenges Remain*. [GAO-13-103](#) (Washington, D.C.: Dec. 14, 2012).

production for those current programs beyond knowledge point 3.³⁵ We have consistently emphasized the importance of completing developmental testing before entering production, and pointed out the increased risks associated with concurrent testing and production. Our current analysis allows us to make the following five observations concerning key acquisition reform initiatives and program concurrency.

Acquisition Reform and Concurrency Observations

1. The implementation of several key initiatives in the Weapon Systems Acquisition Reform Act of 2009 aimed at increasing program knowledge at development start varied among the future major defense acquisition programs we surveyed.
2. Around half of the current and future programs we assessed have established affordability requirements and many are meeting those requirements.
3. Almost 90 percent of the current major defense acquisition programs we assessed have conducted “should cost” analysis and most of those programs noted that they had realized or expected to realize cost savings as a result.
4. Although DOD recognizes the need for and benefits of competition in weapon system acquisitions, and the Weapon Systems Acquisition Reform Act of 2009 requires programs to have competitive acquisition strategies, many of the programs we assessed did not have such strategies in place.
5. Nearly 80 percent of the programs we surveyed that were in production, reported that 30 percent or more of their developmental testing had been or was going to be done during production despite the increased risk that design changes and costly retrofits will need to be made.

Additional information about these observations follows.

1. **Implementation of several key initiatives in the Weapon Systems Acquisition Reform Act of 2009 aimed at increasing program knowledge at development start varied among the future major defense acquisition programs we surveyed.** The Weapon Systems Acquisition Reform Act of 2009 introduced a requirement for a preliminary design review to be held for all major defense acquisition programs before the start of system development. Ten of the 17 future major defense acquisition programs in our assessment indicated that

³⁵This analysis reflects 18 non-ship programs, of the 40 total, for which we have a knowledge point 3 date identified. Ships are excluded from this analysis because we do not assess knowledge point 3 for ships.

they intend to conduct such a review in accordance with the Act, while 2 programs are planning to hold their preliminary design reviews after the start of development. The 5 remaining programs have not yet established a date for the start of development.

The Weapon Systems Acquisition Reform Act of 2009 also requires that guidance be modified to ensure that the acquisition strategies for major defense acquisition programs provide for use of competitive prototypes before a program is approved to enter system development, which can provide a program with an opportunity to reduce technical risk, refine requirements, validate designs and cost estimates, and evaluate manufacturing processes. According to the results of our survey, 11 of the 17 future programs in our assessment intend to develop prototypes of the proposed weapon system or key subsystems before development start. Five programs do not intend to use prototyping, and intend instead to seek waivers from the prototyping requirement as allowed by the Act. One program, the Amphibious Combat Vehicle, has not determined if competitive prototyping will be used.

2. **Around half of the current and future programs we assessed have established affordability requirements and many are meeting those requirements.** In September 2010, the Under Secretary of Defense for Acquisition, Technology and Logistics issued a memorandum directing programs to consider affordability a key program requirement, parallel to traditional performance requirements to be treated like a design parameter and not to be sacrificed or compromised without specific Office of the Secretary of Defense (OSD) approval. Affordability is the ability to conduct a program at a cost constrained by the resources DOD can allocate. The memorandum mandates the establishment of an affordability target at the start of technology development at milestone A. As a program moves through the technology development phase, that initial affordability target is refined as systems engineering trade-off analysis is completed and cost, schedule, and performance trade-offs are made. Prior to beginning product development programs are required to present their systems engineering trade-off analysis and the resulting affordability requirement to the acquisition decision authority for approval at milestone B. As one senior DOD acquisition official has noted, affordability assessments must answer two key questions: (1) "How likely is it that future costs will exceed projected resources?" and (2) "What must be given up, or traded off, in order to

buy the system or capability being considered?”³⁶ This increased emphasis on affordability is in line with many of our prior recommendations and has the potential to improve program outcomes. However, DOD must be willing to make difficult trade-offs if program costs increase or if available funding levels are lower than projected.

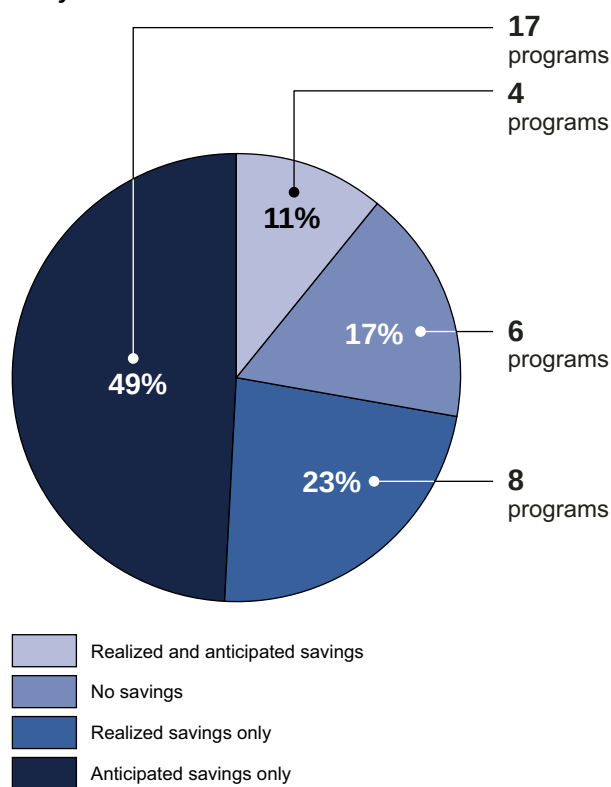
According to our analysis of survey responses, 12 of the 17 future major defense acquisition programs we assessed have established affordability targets, and 19 of the 40 current programs have established affordability requirements. Of the 19 programs with an affordability requirement, 16 noted that they were meeting their requirements. The Ship to Shore Connector was the only program not meeting its requirement, while the Joint Strike Fighter and DDG 1000 Destroyer programs did not know if their requirements were being met.

3. **Almost 90 percent of the current major defense acquisition programs we assessed have conducted “should cost” analysis and most of those programs noted that they had realized or expected to realize some cost savings as a result.** In addition to establishing affordability requirements, the DOD’s better buying power initiatives emphasize the importance of driving cost improvements during contract negotiation and program execution. In accordance with direction provided in the September 2010 memorandum, each program must conduct a should-cost analysis justifying each element of the program, with the aim of reducing negotiated prices for contracts. According to the Under Secretary’s memo, program managers are expected to set cost targets below independent cost estimates and manage with the intent to achieve the lower cost. DOD noted that success in implementing this should cost initiative will be measured by the annual savings realized when comparing actual program costs against the program baseline. According to our analysis of survey responses, 35 of the 40 current major defense acquisition programs we assessed indicate that they have completed this type of analysis, with 29 of those programs identifying cost savings—realized savings, future savings, or some combination of the two. Figure 4

³⁶Dr. Nancy L. Spruill, Director, Acquisition Resources and Analysis, Office of the Under Secretary of Defense for Acquisition, Technology and Logistics, *NPS Defense Affordability Panel* (briefing), 2012.

provides a more detailed look at the 35 programs based on the type of cost savings they reported, if any.

Figure 4: Type of Cost Savings Reported by the 35 Programs with Should Cost Analysis



Source: GAO analysis of DOD data.

4. **Although DOD recognizes the need for and benefits of competition in weapon system acquisitions, and the Weapon Systems Acquisition Reform Act of 2009 requires programs to have competitive acquisition strategies, many of the programs we assessed did not have such strategies in place.** DOD has implemented initiatives emphasizing competition and creating and maintaining a competitive environment throughout the acquisition lifecycle. The Under Secretary's better buying power initiative stresses the importance of competition and encourages programs to present a competitive strategy at each milestone. In addition, the Weapon Systems Acquisition Reform Act of 2009 included a requirement for

major defense acquisition programs to have acquisition strategies that ensure competition or the option of competition throughout the acquisition life cycle. We have noted in the past that the use of competition throughout a program's life cycle can help to reduce program costs. Measures to ensure competition or the option of competition may include developing competitive prototypes, using modular open architectures to enable competition for upgrades, and holding periodic system or program reviews to address long-term competitive effects of program decisions. However, according to our analysis of program survey data, most of the programs we assessed do not have competitive acquisition strategies in place. Only 17 of the 40 (43 percent) current major defense acquisition programs and 7 of the 17 (41 percent) future programs we assessed reported that they have acquisition strategies that call for the use of competition throughout product development—that is, from milestone B to the end of production. Likewise, only 13 of the 40 (33 percent) current programs and 10 of 17 (59 percent) future programs have used or plan to use competitive prototyping prior to the start of product development.

5. **Nearly 80 percent of the programs we surveyed that were in production reported that they had done or were planning to do a large amount of developmental testing while in production.** Beginning production before demonstrating that a design is mature and that a system will work as intended increases the risk of discovering deficiencies during production that could require substantial costly modifications to systems already built and fielded. The intent of developmental testing is to demonstrate the maturity of a design and to discover and fix design and performance problems before a system enters production. However, 16 of the 18 programs that we surveyed that were beyond knowledge point 3 began production with 30 percent or more of their developmental testing remaining.³⁷ The Vertical Takeoff and Landing Tactical Unmanned Aerial Vehicle program began developmental testing in 2006 but due to program delays was unable to identify a date for the end of developmental testing so no percentage could be calculated. The Joint Air-to-Surface Standoff Missile-Extended Range, which is an incremental upgrade to the Joint Air-to-Surface Standoff Missile, was

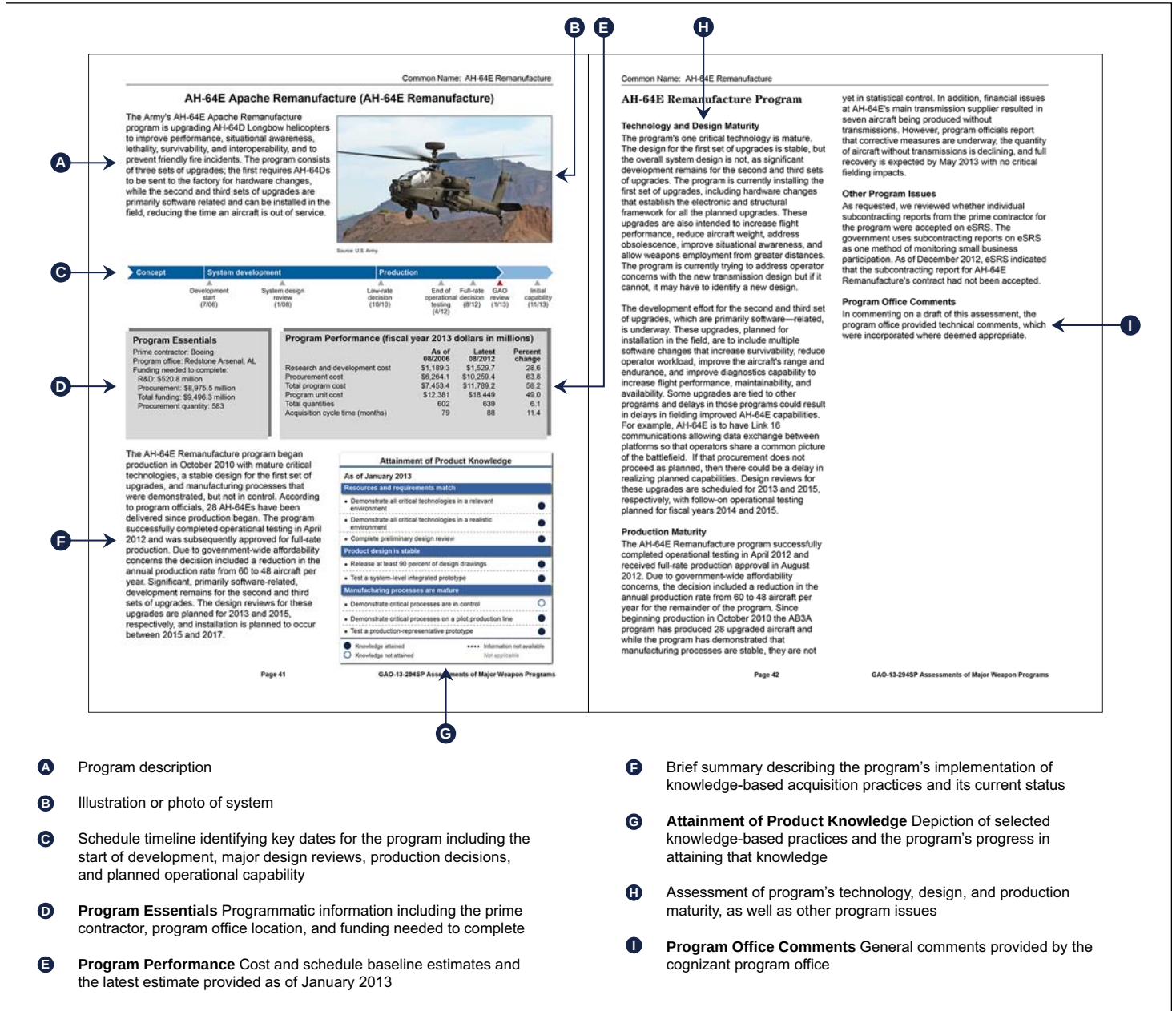
³⁷Ship programs are excluded from this analysis because they do not have a knowledge point 3 date.

the only program that had completed all of its developmental testing before committing to production. The program's 2010 test plan notes that, due to commonality with the baseline missile, developmental testing of the extended range missile was only required to address changes in the baseline system design.

Assessments of Individual Programs

This section contains assessments of individual weapon programs. Each assessment presents data on the extent to which programs are following a knowledge-based acquisition approach to product development, and other program information. In total, we present information on 64 programs. For 45 programs, we produced two-page assessments discussing the technology, design, and manufacturing knowledge obtained, as well as other program issues. Each two-page assessment also contains a comparison of total acquisition cost from the first full estimate for the program to the current estimate. The first full estimate is generally the cost estimate established at development start; however, for a few programs that did not have such an estimate, we used the estimate at production start instead. For shipbuilding programs, we used their planning estimates if those estimates were available. For programs that began as non-major defense acquisition programs, we used the first full estimate available. Thirty-five of these 45 two-page assessments are of major defense acquisition programs, most of which are in development or early production; 2 assessments are of elements of MDA's BMDS; and 8 assessments are of programs that were projected to become major defense acquisition programs during or soon after our review. See figure 5 for an illustration of the layout of each two-page assessment. In addition, we produced one-page assessments on the current status of 19 programs, which include 13 future major defense acquisition programs, 1 major defense acquisition program that is well into production, 2 elements of MDA's BMDS, and 3 major defense acquisition programs that were recently cancelled or curtailed.

Figure 5: Illustration of Program Two-Page Assessment



Source: GAO analysis.

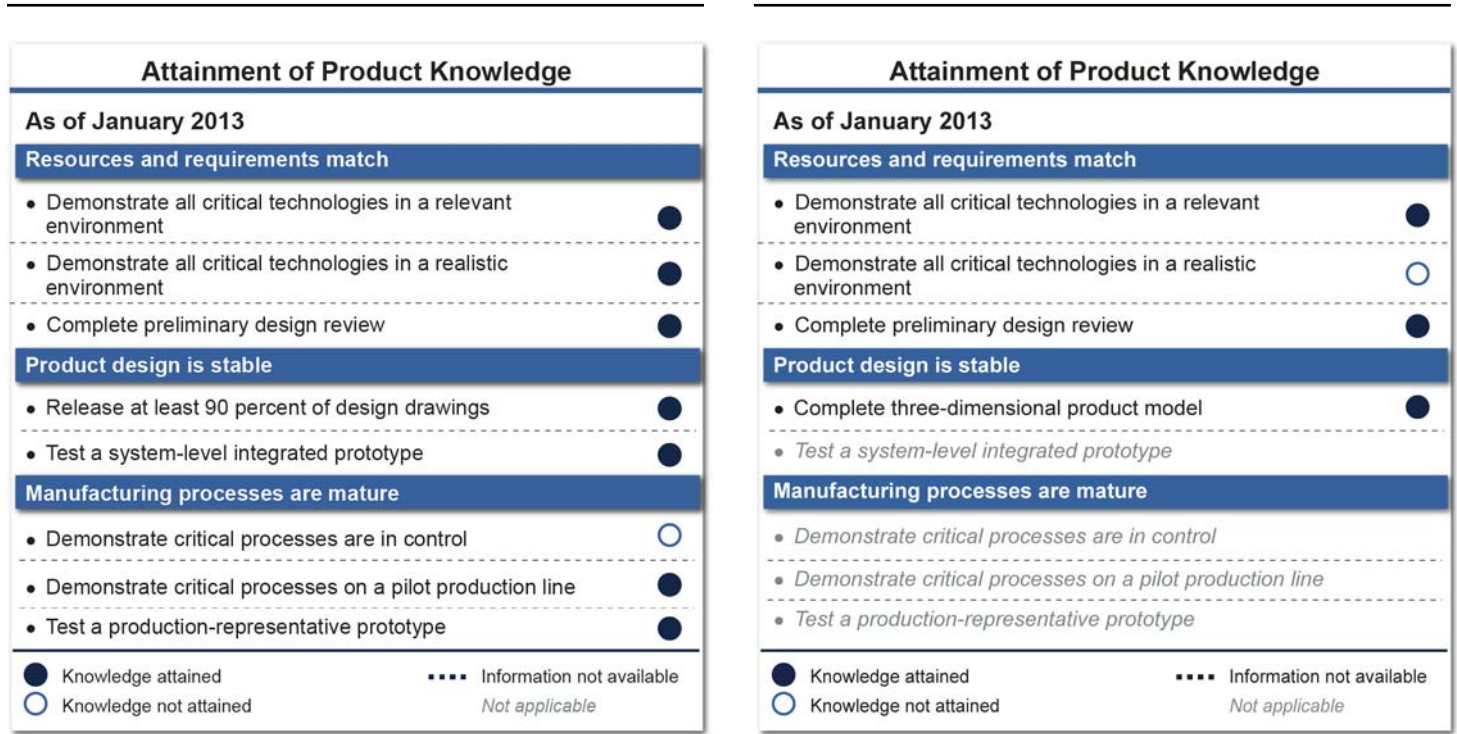
How to Read the Knowledge Scorecard for Each Program Assessed

For our two-page assessments, we depict the extent of knowledge gained in a program by the time of our review with a scorecard and narrative summary at the bottom of the first page of each assessment. As illustrated in figure 5 above, the scorecard displays eight key knowledge-based acquisition practices that should be implemented by certain points in the acquisition process. The more knowledge the program has attained by each of these key points, the more likely the weapon system will be delivered within its estimated cost and schedule. A knowledge deficit means the program is proceeding without sufficient knowledge about its technologies, design, or manufacturing processes, and faces unresolved risks that could lead to cost increases and schedule delays.

For each program, we identify a knowledge-based practice that has been implemented with a closed circle. We identify a knowledge-based practice that has not yet been implemented with an open circle. If the program did not provide us with enough information to make a determination, we show this with a dashed line. A knowledge-based practice that is not applicable to the program is grayed out. A knowledge-based practice may not be applicable to a particular program if either the point in the acquisition cycle when the practice should be implemented has not yet been reached, or if the particular practice is not relevant to the program. For programs that have not yet entered system development, we show a projection of knowledge attained for the first three practices. For programs that have entered system development but not yet held a critical design review, we assess actual knowledge attained for these three practices. For programs that have held a critical design review but not yet entered production, we assess knowledge attained for the first five practices. For programs that have entered production, we assess knowledge attained for all eight practices.

We make adjustments to both the key points in the acquisition cycle and the applicable knowledge-based practices for shipbuilding programs. For shipbuilding programs that have not yet awarded a detailed design contract, we show a projection of knowledge attained for the first three practices. For shipbuilding programs that have awarded this contract but not yet started construction, we would assess actual knowledge attained for these three practices. For shipbuilding programs that have started construction, we assess the knowledge attained for the first four practices. We do not assess the remaining four practices for shipbuilding programs. See figure 6 for examples of the knowledge scorecards we use to assess these different types of programs.

Figure 6: Examples of Knowledge Scorecards Statement on Small Business Participation



Source: GAO.

As requested, we reviewed whether individual subcontracting reports from a program's prime contractor or contractors were accepted on the Electronic Subcontracting Reporting System (eSRS). We reviewed this information for 41 of the major defense acquisition programs, and two elements of the Ballistic Missile Defense System, in our assessment using the contract information reported in available Selected Acquisition Reports. The contract numbers for each program's or element's prime contracts were entered into the eSRS database to determine whether the individual subcontracting reports from the prime contractors had been accepted by the government. The government uses individual subcontracting reports on eSRS as one method of monitoring small business participation, as the report includes goals for small business subcontracting. Not all prime contracts for major defense acquisition programs are required to submit individual subcontracting reports. For example, some contractors report small business participation at a

corporate level as opposed to a program level and this data is not captured in the individual subcontracting reports.

AH-64E Apache Remanufacture (AH-64E Remanufacture)

The Army's AH-64E Apache Remanufacture program is upgrading AH-64D Longbow helicopters to improve performance, situational awareness, lethality, survivability, and interoperability, and to prevent friendly fire incidents. The program consists of three sets of upgrades; the first requires AH-64Ds to be sent to the factory for hardware changes, while the second and third sets of upgrades are primarily software related and can be installed in the field, reducing the time an aircraft is out of service.



Source: U.S. Army.



Program Essentials

Prime contractor: Boeing
 Program office: Redstone Arsenal, AL
 Funding needed to complete:
 R&D: \$520.8 million
 Procurement: \$8,975.5 million
 Total funding: \$9,496.3 million
 Procurement quantity: 583

Program Performance (fiscal year 2013 dollars in millions)

	As of 08/2006	Latest 08/2012	Percent change
Research and development cost	\$1,189.3	\$1,529.7	28.6
Procurement cost	\$6,264.1	\$10,259.4	63.8
Total program cost	\$7,453.4	\$11,789.2	58.2
Program unit cost	\$12.381	\$18.449	49.0
Total quantities	602	639	6.1
Acquisition cycle time (months)	79	88	11.4

The AH-64E Remanufacture program began production in October 2010 with mature critical technologies, a stable design for the first set of upgrades, and manufacturing processes that were demonstrated, but not in control. According to program officials, 28 AH-64Es have been delivered since production began. The program successfully completed operational testing in April 2012 and was subsequently approved for full-rate production. Due to government-wide affordability concerns the decision included a reduction in the annual production rate from 60 to 48 aircraft per year. Significant, primarily software-related, development remains for the second and third sets of upgrades. The design reviews for these upgrades are planned for 2013 and 2015, respectively, and installation is planned to occur between 2015 and 2017.

Attainment of Product Knowledge

As of January 2013

Resources and requirements match

- Demonstrate all critical technologies in a relevant environment ●
- Demonstrate all critical technologies in a realistic environment ●
- Complete preliminary design review ●

Product design is stable

- Release at least 90 percent of design drawings ●
- Test a system-level integrated prototype ●

Manufacturing processes are mature

- Demonstrate critical processes are in control ○
- Demonstrate critical processes on a pilot production line ●
- Test a production-representative prototype ●

● Knowledge attained

○ Knowledge not attained

.... Information not available

Not applicable

AH-64E Remanufacture Program

Technology and Design Maturity

The program's one critical technology is mature. The design for the first set of upgrades is stable, but the overall system design is not, as significant development remains for the second and third sets of upgrades. The program is currently installing the first set of upgrades, including hardware changes that establish the electronic and structural framework for all the planned upgrades. These upgrades are also intended to increase flight performance, reduce aircraft weight, address obsolescence, improve situational awareness, and allow weapons employment from greater distances. The program is currently trying to address operator concerns with the new transmission design but if it cannot, it may have to identify a new design.

The development effort for the second and third set of upgrades, which are primarily software-related, is underway. These upgrades, planned for installation in the field, are to include multiple software changes that increase survivability, reduce operator workload, improve the aircraft's range and endurance, and improve diagnostics capability to increase flight performance, maintainability, and availability. Some upgrades are tied to other programs and delays in those programs could result in delays in fielding improved AH-64E capabilities. For example, AH-64E is to have Link 16 communications allowing data exchange between platforms so that operators share a common picture of the battlefield. If that procurement does not proceed as planned, then there could be a delay in realizing planned capabilities. Design reviews for these upgrades are scheduled for 2013 and 2015, respectively, with follow-on operational testing planned for fiscal years 2014 and 2015.

Production Maturity

The AH-64E Remanufacture program successfully completed operational testing in April 2012 and received full-rate production approval in August 2012. Due to government-wide affordability concerns, the decision included a reduction in the annual production rate from 60 to 48 aircraft per year for the remainder of the program. Since beginning production in October 2010 the program has produced 28 upgraded aircraft and while the program has demonstrated that manufacturing processes are stable, they are not yet in statistical

control. In addition, financial issues at AH-64E's main transmission supplier resulted in seven aircraft being produced without transmissions. However, program officials report that corrective measures are underway, the quantity of aircraft without transmissions is declining, and full recovery is expected by May 2013 with no critical fielding impacts.

Other Program Issues

As requested, we reviewed whether individual subcontracting reports from the prime contractor for the program were accepted on eSRS. The government uses subcontracting reports on eSRS as one method of monitoring small business participation. As of December 2012, eSRS indicated that the subcontracting report for AH-64E Remanufacture's contract had not been accepted.

Program Office Comments

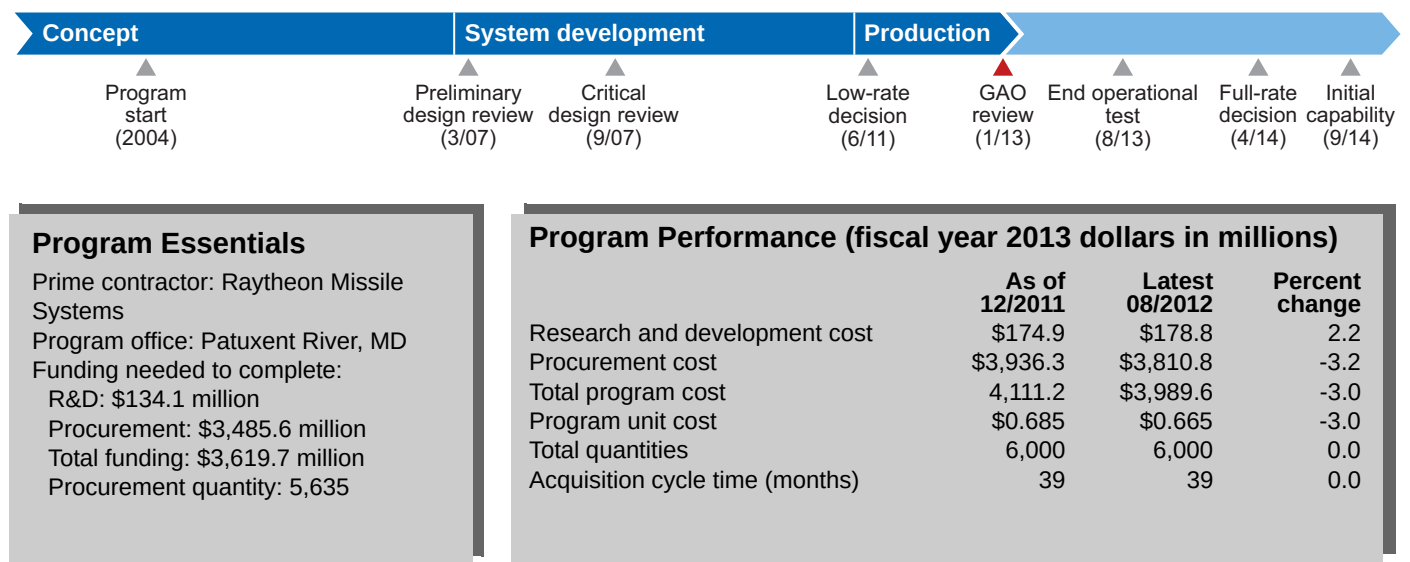
In commenting on a draft of this assessment, the program office provided technical comments, which were incorporated where deemed appropriate.

AIM-9X Block II Air-to-Air Missile (AIM-9X Block II)

The AIM-9X Block II is a Navy-led program to acquire short-range air-to-air missiles for the F-35, the Navy's F-18, and the Air Force's F-15, F-16, and F-22A fighter aircraft. It is designed to detect, acquire, intercept, and destroy a range of airborne threats. Block II includes hardware and software upgrades expected to improve the range from which the AIM-9X can engage targets, target discrimination, and interoperability. It was designated a major defense acquisition program in June 2011.



Source: PMA-259 Air-to-Air Missiles Program Office.



The AIM-9X Block II entered production in June 2011 with mature critical technologies, a stable design, and production processes that had been demonstrated on a pilot production line, but were not in control. The program plans to demonstrate that its processes are in control prior to its full-rate production decision, which is expected to occur in April 2014. According to the Director, Operational Test and Evaluation (DOT&E), the reliability of the AIM-9X Block II is tracking slightly beneath the growth curve needed to meet the system's reliability requirements; as of December 2012, the Air Force and Navy have not reported any weapon system deficiencies. The program expects to realize over \$595 million in cost savings over the life of the program by implementing "should cost" initiatives, such as improvements to the design and production of key missile components.

Attainment of Product Knowledge	
As of January 2013	
Resources and requirements match	
• Demonstrate all critical technologies in a relevant environment	●
• Demonstrate all critical technologies in a realistic environment	●
• Complete preliminary design review	●
Product design is stable	
• Release at least 90 percent of design drawings	●
• Test a system-level integrated prototype	●
Manufacturing processes are mature	
• Demonstrate critical processes are in control	○
• Demonstrate critical processes on a pilot production line	●
• Test a production-representative prototype	●
● Knowledge attained	●●●● Information not available
○ Knowledge not attained	Not applicable

AIM-9X Block II Program

Technology and Design Maturity

The AIM-9X Block II critical technologies are mature and its design is stable. The Block II began as a pre-planned product improvement and various component development and integration efforts have been ongoing since 2004. According to the Navy's May 2011 technology readiness assessment, the Block II involves the integration of mature technologies; these technologies include a new active optical target detector/datalink, an upgraded electronics unit, and new operational flight software, among others. These hardware and software upgrades improve the missile's two-way communication capabilities, its tracking and targeting, its range, and its accuracy. The program estimates that 85 percent of Block II components are unchanged from Block I. Hardware and software development are complete and the upgrades are currently being evaluated in operational testing.

Production Maturity

The AIM-9X Block II began production in June 2011 with manufacturing processes that had been demonstrated on a pilot production line, but were not in control. Prior to its production decision, the program concluded that its manufacturing readiness was at the level recommended by DOD guidance, but its manufacturing readiness level did not indicate that processes were in control. According to the program office, a production readiness review and manufacturing readiness assessment will occur prior to the full-rate production decision scheduled for April 2014 and manufacturing processes will be in control at that time.

Other Program Issues

According to DOT&E, the reliability of the AIM-9X Block II is tracking slightly beneath the growth curve needed to meet the system's reliability requirements. DOT&E will track reliability through operational testing. Additionally, according to the December 2012 DOT&E annual report, the Air Force and Navy have not reported any weapon system deficiencies to date.

The AIM-9X Block II expects to realize over \$595 million in savings over the life of the program through its application of "should cost" management. The program office estimated that it has already realized \$21 million in savings on the

first low-rate initial production contract. To achieve these savings, the program office analyzed cost drivers and prioritized opportunities to reduce cost by considering factors such as the up-front investment costs, ease of implementation, time to realize savings, and magnitude of the unit cost benefits. The program has implemented technical initiatives, such as active optical target detector design and production improvements and non-technical initiatives, such as accelerated production rates.

As requested, we reviewed whether individual subcontracting reports from the prime contractor for the program were accepted on eSRS. The government uses subcontracting reports on eSRS as one method of monitoring small business participation. As of December 2012, eSRS indicated that none of the subcontracting reports for program's two contracts have been accepted.

Program Office Comments

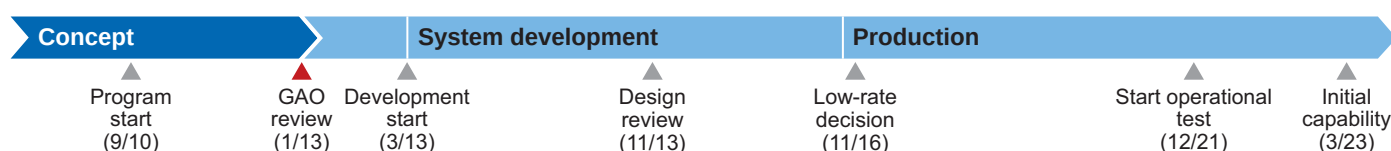
According to program officials, the AIM-9X Block II program is exceeding warfighters' expectations in every way, specifically in the areas of cost, schedule, and performance. The AIM-9X Block II program has consistently delivered missiles on schedule for over 10 years. The AIM-9X Block II is expected to complete operational testing in time to deliver additional capability in the beyond visual range air-to-air missile employment. The program office also provided technical comments, which were incorporated where deemed appropriate.

Air and Missile Defense Radar (AMDR)

The Navy's Air and Missile Defense Radar (AMDR) will be a next-generation radar system designed to provide ballistic missile defense, air defense, and surface warfare capabilities. AMDR will consist of an S-band radar for ballistic missile defense and air defense, X-band radar for horizon search, and a radar suite controller that controls and integrates the two radars. AMDR will initially support DDG 51 Flight III. The Navy expects AMDR to provide the foundation for a scalable radar architecture that can be used to defeat advanced threats.



Source: U.S. Navy.



Program Essentials

Prime contractor: Lockheed Martin, Northrop Grumman, Raytheon
 Program office: Washington, DC
 Funding needed to complete:
 R&D: \$1,195.9 million
 Procurement: \$4,595.5 million
 Total funding: \$5,791.3 million
 Procurement quantity: 22

Program Performance (fiscal year 2013 dollars in millions)

	As of	Latest 09/2012	Percent change
Research and development cost	NA	\$1,973.1	NA
Procurement cost	NA	\$4,595.3	NA
Total program cost	NA	\$6,597.5	NA
Program unit cost	NA	\$299.884	NA
Total quantities	NA	22	NA
Acquisition cycle time (months)	NA	150	NA

AMDR plans to enter system development in March 2013 for the S-band and radar suite controller after demonstrating all of its technologies in a relevant environment. A new X-band portion will be developed under a separate program at a later date, with AMDR initially using an upgraded SPQ-9B radar in its place. The Navy plans to award a contract for the system development phase in March 2013 after a full and open competition. The Navy and shipbuilders have determined that a 14-foot active radar is the largest that can be accommodated by the existing DDG 51 though AMDR is also being developed as a scalable design.

Attainment of Product Knowledge

Projected as of January 2013

Resources and requirements match

- Demonstrate all critical technologies in a relevant environment ●
- Demonstrate all critical technologies in a realistic environment ○
- Complete preliminary design review ●

Product design is stable

- Release at least 90 percent of design drawings
- Test a system-level integrated prototype

Manufacturing processes are mature

- Demonstrate critical processes are in control
- Demonstrate critical processes on a pilot production line
- Test a production-representative prototype

Knowledge attained
 Knowledge not attained
 Information not available
 Not applicable

AMDR Program

Technology Maturity

According to the program office, all four of AMDR's critical technologies are approaching maturity. Testing on scaled-down prototypes was conducted with the three contractors during the summer of 2012 as part of their technology development contracts. The program previously had six critical technologies; two are still tested but no longer considered critical.

According to the program, two technologies previously identified as the most challenging—digital-beam-forming and transmit-receive modules—have been demonstrated in a relevant environment. Program officials stated that no significant issues were identified at the preliminary design review with the digital beamforming technology necessary for AMDR's simultaneous air and ballistic missile defense mission. The transmit-receive modules—the individual radiating elements key to transmitting and receiving electromagnetic signals—are a new design which utilizes gallium nitride semiconductor technology instead of the legacy gallium arsenide technology. The new technology has the potential to provide higher efficiency with smaller power and cooling demands. While gallium nitride has never been used in a radar as large as AMDR, and long-term reliability and performance of this newer material is unknown, the preliminary design reviews concluded that the contractors have demonstrated good power and efficiency thus far. The other two critical technologies, related to software and digital receivers and exciters, were also successfully demonstrated.

According to program officials, software development for AMDR will require a significant effort. A series of software builds are expected to deliver approximately 1 million lines of code, with additional testing assets also being developed. Software will be designed to apply open system approaches to commercial, off-the-shelf hardware. Integration with the SPQ-9B radar, and later the AMDR-X radar, will require further software development.

Other Program Issues

The AMDR program is scheduled to enter system development in March 2013 with award of a cost-plus-incentive fee contract after a full and open competition around March 2013. The X-band portion of AMDR will be comprised of an upgraded version of an existing rotating radar (SPQ-9B), instead of the new design initially planned. The new radar will instead be developed as a separate program at a later date and integrated with the 13th AMDR unit. According to the Navy, the SPQ-9B radar fits better within the Flight III DDG 51's sea frame and expected power and cooling. While program officials state that the upgraded SPQ-9B radar will have capabilities equal to the new design for current anti-air warfare threats, it will not perform as well against future threats. Additional software development will be required to integrate the S-band and SPQ-9B radars.

The Navy plans to install a 14-foot variant of AMDR on Flight III DDG 51s starting in 2019. According to draft AMDR documents, a 14-foot radar is needed to meet threshold requirements, but an over 20-foot radar is required to fully meet the Navy's desired integrated air and missile defense needs. However, the shipyards and the Navy have determined that a 14-foot active radar is the largest that can be accommodated within the existing DDG 51 deckhouse. Navy officials stated that AMDR is being developed as a scalable design but a new ship would be required to host a larger version of AMDR.

Program Office Comments

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

AN/TPS-80 Ground/Air Task Oriented Radar (G/ATOR)

The Marine Corps' Ground/Air Task Oriented Radar (G/ATOR) is an active electronic scanned array three-dimensional short/medium range multi-role radar designed to detect cruise missiles, air breathing targets, rockets, mortars, and artillery. It replaces five different legacy radar systems. G/ATOR is an incremental/block acquisition with capability procured in blocks, air defense/surveillance, counter-battery/target acquisition, aviation radar tactical enhancements, and air traffic control. The later blocks are primarily software upgrades.



Source: G/ATOR Program Office.



Program Essentials

Prime contractor: Northrop Grumman
 Program office: Quantico, VA
 Funding needed to complete:
 R&D: \$353.6 million
 Procurement: \$2,132.6 million
 Total funding: \$2,492.3 million
 Procurement quantity: 57

Program Performance (fiscal year 2013 dollars in millions)

	As of 08/2005	Latest 06/2012	Percent change
Research and development cost	\$364.3	\$893.1	145.1
Procurement cost	\$1,144.1	\$2,135.1	86.6
Total program cost	\$1,508.4	\$3,034.3	101.2
Program unit cost	\$23.569	\$53.233	125.9
Total quantities	64	57	-10.9
Acquisition cycle time (months)	66	132	100.0

G/ATOR technologies are nearing maturity having been demonstrated in a relevant environment. A change in semiconductor technology is expected to achieve significant savings when this technology is inserted in later production units, according to program officials. It will also save weight and result in additional power margin. Design of the G/ATOR is mature with 100 percent of drawings released. Two developmental prototypes have undergone contractor integration and testing, and government developmental testing began in July 2012. Design changes have reduced the expeditionary capability of the system. The expected increase in capability of the G/ATOR over legacy radars, as well as other factors, has allowed for a reduction in the total production quantity.

Attainment of Product Knowledge

As of January 2013

Resources and requirements match

- Demonstrate all critical technologies in a relevant environment ●
- Demonstrate all critical technologies in a realistic environment ○
- Complete preliminary design review ●

Product design is stable

- Release at least 90 percent of design drawings ●
- Test a system-level integrated prototype ●

Manufacturing processes are mature

- Demonstrate critical processes are in control
- Demonstrate critical processes on a pilot production line
- Test a production-representative prototype

● Knowledge attained

○ Knowledge not attained

.... Information not available

Not applicable

G/ATOR Program

Technology Maturity

According to the program office, all six critical technologies are approaching full maturity. Program officials state that the maturity of these critical technologies is to be further demonstrated during the ongoing developmental testing, scheduled to end in February 2013, and during four upcoming operational assessments scheduled to begin in March 2013. The program expects these technologies to reach full maturity upon completion of this testing. The active electronic scanned arrays of the initial G/ATOR production units will use gallium arsenide in the transmit/receiving modules. The program plans to incorporate modules using gallium nitride after the cost, development, and reliability risks of those modules are retired. Currently, the program anticipates saving as much as \$500 million from this change in modules, according to the program manager. It is also anticipated that the module change will lower G/ATOR weight and power demand.

Design Maturity

The design is considered mature, with 100 percent of design drawings released, and a system-level prototype is being tested. The contractor is assuming a 5 percent increase in total drawings between now and the completion of production.

Initial plans to integrate the G/ATOR onto a High Mobility Multipurpose Wheeled Vehicle were abandoned when the weight of additional armor for the vehicle combined with G/ATOR exceeded the limits of the chassis and drive train. As a result, G/ATOR will now be towed by a Medium Tactical Vehicle Replacement truck. This truck cannot be moved by helicopter, which limits the expeditionary capability of the system.

Production Maturity

Low-rate production for G/ATOR is scheduled to start in 2013. Prior to the program's designation as a major defense acquisition program, plans called for producing 81 units to achieve a one-for-one replacement of the legacy radars. Based on the increased capabilities of G/ATOR over the legacy radars it's replacing, as well as other factors, quantities were reduced to 64 in 2005, and to 57 units currently. According to the program office, this reduction will save between \$2 billion and \$3 billion

over the life of the program. In addition, multiple areas of production are being evaluated to further lower production cost.

Other Program Issues

In 2005, G/ATOR began development and was designated as an acquisition category (ACAT) II or non-major defense acquisition program. As a result of increased cost the program was re-designated as a major defense acquisition, or ACAT I, program in October 2011.

Performance requirements for the G/ATOR have increased. Initially the program had five key performance parameters, but has now increased to 16. Program officials do not see this as a challenge since they see the increase as more of a clarification of performance required rather than an increase in requirements.

As requested, we reviewed whether individual subcontracting reports from the prime contractor for the program were accepted on eSRS. The government uses subcontracting reports on eSRS as one method of monitoring small business participation. As of December 2012, eSRS indicated that the associated subcontracting report for G/ATOR's one contract has not been accepted.

Program Office Comments

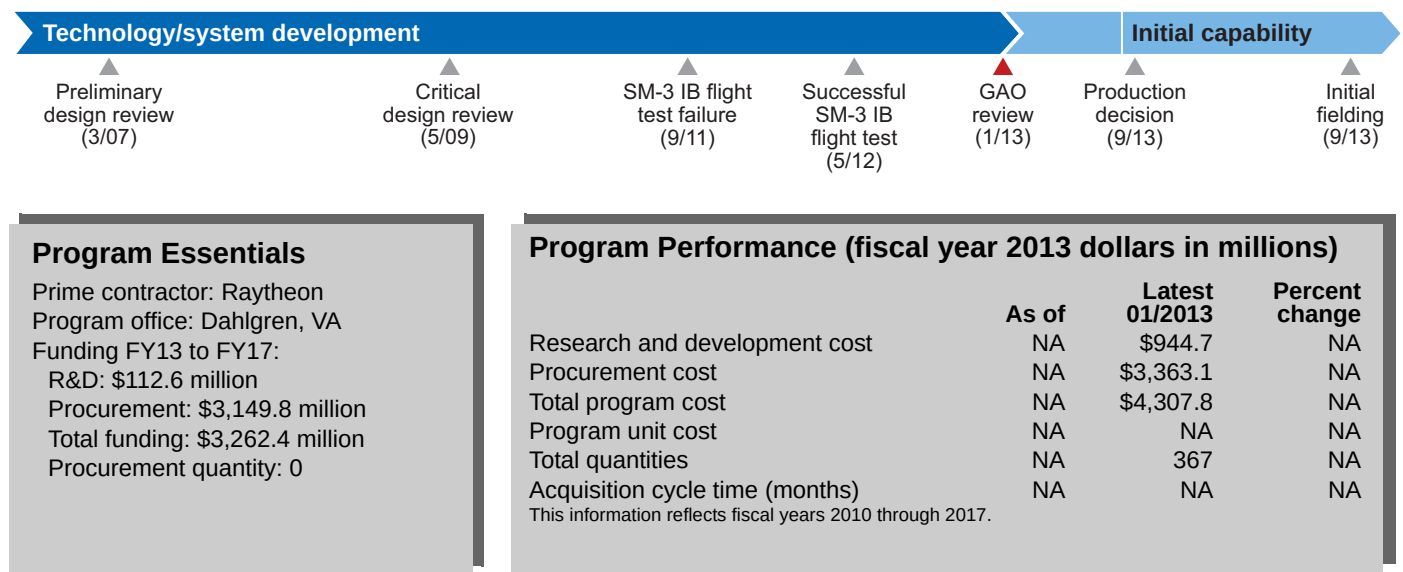
According to the program manager, in 2009, the U.S. Marine Corps and the Assistant Secretary of the Navy for Research, Development, and Acquisition acknowledged G/ATOR's emergent cost and schedule growth, and the program was rebaselined in 2010. Since then G/ATOR has remained on schedule, and total estimated program cost has come down. Also, in commenting on a draft of this assessment, the program office provided technical comments, which were incorporated where deemed appropriate.

BMDS: Aegis Ballistic Missile Defense Standard Missile-3 Block IB

MDA's Aegis Ballistic Missile Defense is a sea- and land-based system that employs the Aegis Weapons System and radar to intercept ballistic missiles with the Standard Missile-3 (SM-3) missiles. We reviewed the SM-3 Block IB (SM-3 IB), which is planned to intercept short through intermediate range ballistic missiles, improving on the fielded SM-3 Block IA (SM-3 IA). Initial operational deployment is scheduled for fiscal year 2014. The SM-3 IB also will be deployed for Aegis Ashore in phase two of the European Phased Adaptive Approach.



Source: Aegis BMD 4.0.1/SM-3 BLK IB Program Office.



Following a flight test failure and a separate flight test anomaly caused by one of its critical technologies in 2011, the program was reprogrammed to fund failure investigations, additional tests and redesigns. This issue disrupted planned production, causing the program to reduce planned fiscal year 2012 SM-3 IB procurement, buying only the quantities necessary to maintain the production line, and to restart manufacturing of SM-3 IA missiles, which share many components with the SM-3 IB. During fiscal year 2012 and early 2013 the program completed failure investigations, incorporated fixes, and successfully executed two out of three planned intercept flight tests, delaying one due to challenges with qualification of a key component. While it has made progress, these issues contributed to significant program schedule delays, production disruptions, and cost growth.

Attainment of Product Knowledge	
As of January 2013	
Resources and requirements match	
• Demonstrate all critical technologies in a relevant environment	●
• Demonstrate all critical technologies in a realistic environment	●
• Complete preliminary design review	●
Product design is stable	
• Release at least 90 percent of design drawings	●
• Test a system-level integrated prototype	●
Manufacturing processes are mature	
• Demonstrate critical processes are in control	●
• Demonstrate critical processes on a pilot production line	●
• Test a production-representative prototype	●
● Knowledge attained	■■■■ Information not available
○ Knowledge not attained	Not applicable

BMDS: SM-3 Block IB Program

Technology and Design Maturity

According to the program, all five of its critical technologies—the third-stage rocket motor, throttleable divert attitude control system (TDACS), reflective optics, two-color warhead seeker, and kinetic warhead advanced signal processor—are mature. However, while the program completed TDACS qualification in February 2013, after many delays and additional cost, its flight test program continues to experience disruptions. In 2011, the program observed two anomalies with the third-stage rocket motor during flight tests, including the failure of the first flight test, which led to a reassessment of the program's cost and schedule and failure investigations. Since then, the program has concluded the investigations, determining that it needed to redesign a component of the rocket motor and institute a software change in the Aegis weapon system. Both changes have been implemented, but only one successfully fight tested. The flight test of the Aegis software change was delayed because of challenges with the qualification of the TDACS. Initial assessments of the software change indicate minimal effect on the operational performance. A full resolution of the issue would require a redesign of the third-stage rocket motor—which is currently unfunded. The cost of the investigations and subsequent modifications caused by last year's failures is estimated at \$149 million.

Production Maturity

Following anomalies with the third-stage rocket motor, the program delayed SM-3 IB procurement decisions by about a year and slowed acceptance of both SM-3 IA and SM-3 IB missiles already in production until failure investigations were completed and a redesign introduced. Additionally, the program reduced SM-3 IB procurement quantities in fiscal year 2012 in order to free up funding to investigate the failures, develop solutions, and confirm those solutions in ground and flight tests. As a result, rather than the planned 46 missiles, the program bought only 14 SM-3 IB missiles in fiscal year 2012, adjusting its production quantities for the third time in three years. The program also purchased additional 14 SM-3 IA missiles, again delaying plans to cancel production of that variant. The program conducted the SM-3 IB manufacturing readiness review in May 2012, which

resulted in a conditional pass, largely due to issues with the qualification of the TDACS. Continued challenges with the qualification of that component delayed a key test until the third quarter of fiscal year 2013. In order to avoid further disruptions to the production line, the program seeks permission to award the next production contract for some components of the next order of up to 29 additional missiles in February 2013—before a flight test can verify the recent software modifications. The program currently plans to begin operational missile production in fiscal year 2013 if four more intercept tests are completed successfully.

Other Program Issues

The program is developing an improved SM-3 IB missile, designed to intercept additional complex threats. The software upgrade will be available in 2014, and cost an additional \$86.6 million over the course of five years.

As requested, we reviewed whether individual subcontracting reports from the prime contractor for the program were accepted on eSRS. The government uses subcontracting reports on eSRS as one method of monitoring small business participation. As of December 2012, eSRS indicated that neither of the subcontracting reports for SM-3 IB's two contracts had been accepted.

Program Office Comments

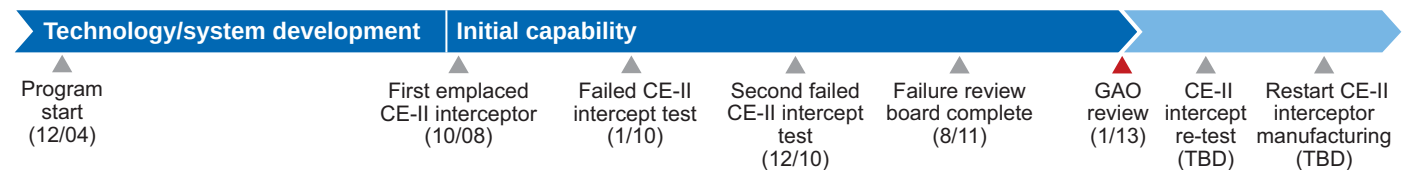
In commenting on a draft of this assessment, the program office provided technical comments, which were incorporated where deemed appropriate.

BMDS: Ground-Based Midcourse Defense (GMD)

MDA's Ground-Based Midcourse Defense (GMD) is being fielded to defend against limited long-range ballistic missile attacks during their midcourse phase. GMD consists of an interceptor with a three-stage booster and kill vehicle and a fire control system, which formulates battle plans and directs components that are integrated with BMDS radars. We assessed the maturity of all GMD critical technologies and the design of the Capability Enhancement II (CE-II) configuration of the Exoatmospheric Kill Vehicle (EKV).



Source: Missile Defense Agency, Ground-Based Midcourse Defense.



Program Essentials

Prime contractor: Boeing Company
 Program office: Huntsville, AL
 Funding FY13 to FY17:
 R&D: \$4,431.9 million
 Procurement: \$0.0 million
 Total funding: \$4,457.8 million
 Procurement quantity: TBD

Program Performance (fiscal year 2013 dollars in millions)

	As of	Latest 08/2012	Percent change
Research and development cost	NA	\$40,694.5	NA
Procurement cost	NA	\$0.0	NA
Total program cost	NA	\$40,926.1	NA
Program unit cost	NA	NA	NA
Total quantities	NA	NA	NA
Acquisition cycle time (months)	NA	NA	NA

Costs are from program inception through fiscal year 2017.

MDA has used a highly concurrent development, production, and fielding strategy for CE-II EKV's, which carried significant risks, some of which were realized after the latest flight test failure. Although 12 CE-II EKV's have been manufactured and delivered, both attempts to verify CE-II EKV's capability in flight have failed, most recently in December 2010 due to a failure in the guidance system. This failure has resulted in design changes, which are taking longer to incorporate than anticipated. MDA plans to verify the fixes through two flight tests, one in fiscal year 2013 and the other yet to be scheduled. Additionally, MDA has halted the final integration of the remaining CE-II EKV's until it does so. The estimated cost of correcting the CE-II test failures, including failure review costs, testing costs, redesigns, and retrofits could exceed \$1.2 billion.

Attainment of Product Knowledge

As of January 2013

Resources and requirements match

- Demonstrate all critical technologies in a relevant environment ●
- Demonstrate all critical technologies in a realistic environment ○
- Complete preliminary design review ●

Product design is stable

- Release at least 90 percent of design drawings ●
- Test a system-level integrated prototype ●

Manufacturing processes are mature

- Demonstrate critical processes are in control
- Demonstrate critical processes on a pilot production line
- Test a production-representative prototype ○

● Knowledge attained

○ Knowledge not attained

.... Information not available

Not applicable

BMDS: GMD Program

Technology Maturity

All nine technologies in the GMD operational configuration are mature, but two technologies in the enhanced CE-II interceptor—an upgraded infrared seeker and onboard discrimination—are only nearing maturity. Although the program has manufactured and delivered 12 CE-II EKV, its capability has yet to be demonstrated due to the failed tests.

Design and Production Maturity

The GMD program has released all of its expected design drawings and delivered 12 interceptors; however, flight test failures revealed the need for a redesign of the guidance system. Risk of additional design changes remain until the program completes its flight test program in 2022. We did not assess the maturity of production processes for the GMD interceptors. According to the program, the low number of planned quantities does not provide sufficient data to track statistical production information and demonstrate its manufacturing processes are in statistical control.

Other Program Issues

In fiscal year 2012, MDA continued their effort to resolve the failure in its December 2010 flight test. This work has already experienced significant delays and cost increases and is at risk for more due to its highly concurrent approach of development, manufacturing, and testing.

As a result of the December 2010 failure, MDA convened a failure review board and concluded a new design was necessary. MDA intended to demonstrate this new design in two flight tests—the first without and the second with a target. MDA planned to resume manufacturing if the first test was successful in fiscal year 2011. However, this test was postponed to January 2013, no longer utilized the fully upgraded design, and did not provide the basis to resume manufacturing. The second test, which was expected to be conducted in fiscal year 2013, has also experienced delays and, according to a GMD program official, has yet to be rescheduled.

MDA has incurred significant costs to correct CE-II deficiencies. Based on estimates provided by MDA, the costs to verify the CE-II have grown from about

\$236 million to more than \$1.2 billion. Further cost growth is possible if the remaining corrections, including flight tests, lead to any discoveries, as has occurred in all GMD flight tests to date.

As requested, we reviewed whether individual subcontracting reports from the prime contractor for the program were accepted on eSRS. The government uses subcontracting reports on eSRS as one method of monitoring small business participation. As of December 2012, eSRS indicated that both the subcontracting reports for GMD's two contracts had been accepted.

Program Office Comments

According to program officials, GMD is in the "limited fielding product development phase." This enables MDA to develop a small number of fielded assets without significant production runs, thereby delivering quick capability releases to warfighters. GMD will continue to follow a capability-based acquisition strategy that emphasizes testing, development, and evolutionary acquisition through incremental development and rapid fielding of capability to the warfighter. The acquisition strategy provides for component upgrades to improve both system performance and interceptor reliability, while retaining homeland defense capability. To mitigate concurrency of development, test, and fielding while executing this rapid incremental strategy, MDA developed and continues to use a set of critical program knowledge points and milestones, guaranteeing adequate development and testing is conducted before procurement, manufacturing, and release of capabilities.

GAO Response

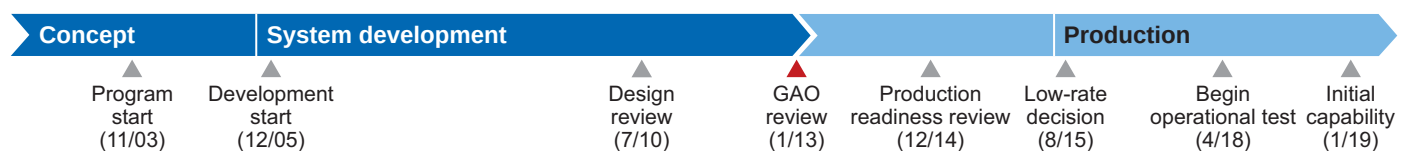
Committing to production and fielding before development is complete is a high-risk strategy that often results in performance shortfalls, unexpected cost increases, schedule delays, and test problems. High levels of concurrency will continue for GMD as flight testing stretches until well after the production of the interceptors is scheduled to be completed.

CH-53K Heavy Lift Replacement (CH-53K)

The Marine Corps' CH-53K heavy-lift helicopter is intended to transport armored vehicles, equipment, and personnel to support operations deep inland from a sea-based center of operations. The CH-53K is expected to replace the legacy CH-53E helicopter and provide increased range and payload, survivability and force protection, reliability and maintainability, and coordination with other assets, while reducing total ownership cost.



Source: 2012 Sikorsky Aircraft Corporation.



Program Essentials

Prime contractor: Sikorsky Aircraft Corporation
 Program office: Patuxent River, MD
 Funding needed to complete:
 R&D: \$2,698.0 million
 Procurement: \$16,971.3 million
 Total funding: \$19,687.9 million
 Procurement quantity: 196

Program Performance (fiscal year 2013 dollars in millions)

	As of 12/2005	Latest 12/2011	Percent change
Research and development cost	\$4,506.4	\$6,182.9	37.2
Procurement cost	\$12,532.9	\$16,971.3	35.4
Total program cost	\$17,039.2	\$23,172.8	36.0
Program unit cost	\$109.226	\$115.864	6.1
Total quantities	156	200	28.2
Acquisition cycle time (months)	119	157	31.9

The CH-53K program continues to move forward toward production, but has not yet fully matured its critical technologies or demonstrated that its design can perform as expected. As a result, the risk of design changes remains. Flight testing is expected to begin in 2014 and the program expects to demonstrate its critical technologies in a realistic environment by its August 2015 production decision. According to program officials, the program has delivered its first test aircraft, and continues to build follow-on test aircraft, which should help demonstrate its manufacturing processes before production begins. However, problems with the main gear box test stand have resulted in a delay of testing the first aircraft. According to program officials, this delay will not affect the dates of the production decision or initial operational capability.

Attainment of Product Knowledge

As of January 2013

Resources and requirements match

- Demonstrate all critical technologies in a relevant environment ●
- Demonstrate all critical technologies in a realistic environment ○
- Complete preliminary design review ●

Product design is stable

- Release at least 90 percent of design drawings ●
- Test a system-level integrated prototype ○

Manufacturing processes are mature

- Demonstrate critical processes are in control
- Demonstrate critical processes on a pilot production line
- Test a production-representative prototype

● Knowledge attained
 ○ Knowledge not attained

.... Information not available
 Not applicable

CH-53K Program

Technology Maturity

The CH-53K program began system development in 2005 with immature critical technologies. After 4 years in development, the program's two current critical technologies—the main rotor blade and the main gearbox—were determined to be nearing maturity in February 2010 after demonstrations in a relevant environment. The program expects these technologies to be demonstrated in a realistic environment by its planned August 2015 production decision. Flight testing is expected to begin in 2014.

Design Maturity

The CH-53K design appears stable, but it has not been demonstrated using a system-level prototype to show that it will perform as expected. This will not occur until at least 2013, more than 2 years after the design review. According to the program office, all of the CH-53K's expected design drawings are releasable. However, the continuing maturation of the critical technologies could result in design changes as testing progresses.

Production Maturity

Production of the ground test vehicle began in July 2011 and the first of four engineering development models entered the production line in January 2012. According to program officials, the contractor has delivered the ground test vehicle, but expects testing to be delayed due to problems with a test stand that arose during testing of the main gear box. Production of the test articles is taking place in the same facility where production of the CH-53K is currently planned.

Other Program Issues

The CH-53K development contract increased in cost and several key events have been delayed. Program officials reported that in July 2011, the contract's estimated cost increased by \$724 million to \$3.4 billion. According to Defense Contract Management Agency (DCMA) officials, the costs increased due to several factors including the need for additional flight test hours and spare parts, increased material costs, and design complexity. The contract changed in April 2011, from cost-plus award fee to cost-plus incentive fee for the remaining period of performance. The incentive fees are tied to specific cost and schedule goals. In August 2011, the contract's schedule was

rebaselined and several key production and testing events were delayed. For example, the delivery dates for engineering development models were moved back and the first flight was delayed from 2013 to 2014. According to program officials, these changes will not affect the dates for the CH-53K's production decision or delivery of an initial operational capability.

As part of their force structure review completed in March 2011, the Marine Corps determined the requirement for 200 aircraft is still valid despite the proposed 2015 reduction of the Corps by 20,000 Marines.

As requested, we reviewed whether individual subcontracting reports from the prime contractor for the program were accepted on eSRS. The government uses subcontracting reports on eSRS as one method of monitoring small business participation. As of December 2012, eSRS indicated that the subcontracting report for CH-53K's contract has not been accepted. According to program officials, in February 2012 DCMA rated Sikorsky's small business program as acceptable. While Sikorsky did not meet all goals, they demonstrated good faith and met a number of goals in multiple categories.

Program Office Comments

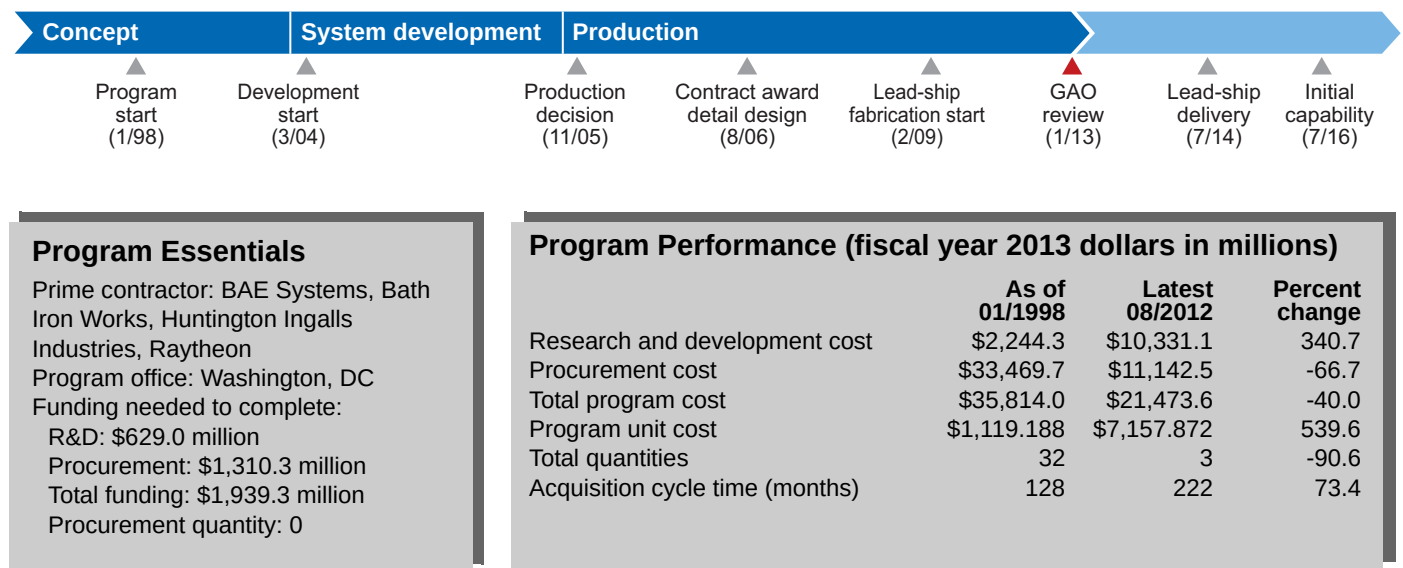
According to program officials, development of the CH-53K helicopter has continued and shows a technically sound design that is maturing as planned, and is currently projected to meet requirements. Costs remain stable, and the program is on track to award the low-rate production contract in fiscal 2016 following achievement of Milestone C, which is currently scheduled for late fiscal 2015. Within the next year, the program is scheduled to begin or complete major sub-system qualification testing, ground test vehicle shakedown testing, and engine qualification testing. In addition, delivery of the first flight vehicle is expected for fall 2013. The program office also provided technical comments, which were incorporated where deemed appropriate.

DDG 1000 *Zumwalt* Class Destroyer

The Navy's DDG 1000 destroyer is a multimission surface ship designed to provide advanced land-attack capability in support of forces ashore and littoral operations. The Navy is the lead integrator with Bath Iron Works building the hullform for all three ships in this class and other key segments being built by Huntington Ingalls Industries, BAE Systems, and Raytheon. Fabrication has begun on all three ships, and the program is finalizing the contracts for the third ship.



Source: © 2012 General Dynamics Bath Iron Works.



The DDG 1000 design is stable and all three ships are in fabrication. However, most critical technologies will not be fully mature and demonstrated in a realistic environment until ship installation. The Navy redesigned its rocket motor for the advance gun system's long-range land-attack projectile—one of the critical technologies—and conducted successful tests. Releases 1 to 5 of the total ship computing environment software are complete and certified; release 6 has begun integration and testing; and the development of the follow-on spiral which activates the mission systems is under contract. As of December 2012, the first two ships were 80 and 48 percent complete respectively, and the third ship began fabrication in April 2012. The Navy is using a joint inspection process with prime contractors to manage the transfer of class products.

Attainment of Product Knowledge	
As of January 2013	
Resources and requirements match	
• Demonstrate all critical technologies in a relevant environment	●
• Demonstrate all critical technologies in a realistic environment	○
• Complete preliminary design review	●
Product design is stable	
• Complete three-dimensional product model	●
• Test a system-level integrated prototype	
Manufacturing processes are mature	
• Demonstrate critical processes are in control	
• Demonstrate critical processes on a pilot production line	
• Test a production-representative prototype	
● Knowledge attained	■■■■ Information not available
○ Knowledge not attained	Not applicable

DDG 1000 Program

Technology Maturity

Three of the program's 11 critical technologies are mature; the remaining 8 technologies will not be demonstrated in a realistic environment until after ship installation. Program officials stated that the Navy received the lead ship's deckhouse in October 2012 and its integration onto the hull was completed in December 2012. Cost and schedule impacts from Ingalls not completing cabling, piping, and foundations prior to delivery are being assessed. Officials reported successful completion of land-based testing to verify compatibility and interoperability with the integrated power system and engineering control system in March 2012. Raytheon completed software coding and started integration and testing for release 6 of the total ship computing environment, and a follow-on software spiral is now under contract. Releases 1 to 5 are complete and certified. Program officials stated that the gun system's long-range land-attack projectile's motor redesign has been successfully tested under various environmental conditions, and other subcomponents will be evaluated during fiscal year 2013 guided flight tests.

Design and Production Maturity

As of December 2012, the first two ships were 80 percent and 48 percent complete respectively, and third ship fabrication began in April 2012. While there have been few design changes resulting from lead ship construction, the rework rate for the lead ship composite deckhouse was 17 percent.

Other Program Issues

In December 2011, the Under Secretary of Defense for Acquisition, Technology, and Logistics (AT&L) delegated the authority for future acquisition decisions to the Navy. The program attributed this shift to cost oversight and risk reduction, noting that average procurement unit cost has decreased \$690 million from the 2010 estimate.

The program relies on products, such as the aft peripheral vertical launching system and deckhouse, being transferred from one prime contractor to another. As the integrator, the Navy is responsible for ensuring on-time delivery of products and bears the costs if schedule delays affect another contractor. In 2010 the Navy introduced a joint inspection process whereby the

primes and the Navy validate the level of completeness of products prior to integration with the hull. Program officials believe that this reduces the risk of integration issues and rework because the program office, the Gulf Coast and Bath Supervisors of Shipbuilding, and contractors have a common understanding of the quality of the delivered product.

The Navy has awarded contracts for all elements for the first two ships. Contracts for the third ship deckhouse, hangar, aft peripheral vertical launching system, and mission systems equipment are not yet finalized. Program officials note the Navy continues to leverage actual cost data from the first two ships and other similar programs to inform contract pricing and is considering cost efficient alternatives. The Navy is assessing alternative deckhouse materials, such as steel, which both shipyards report is a feasible alternative to composite.

As requested, we reviewed whether individual subcontracting reports from the prime contractor for the program were accepted on eSRS. The government uses subcontracting reports on eSRS as one method of monitoring small business participation. As of December 2012, eSRS indicated that one of the subcontracting reports for DDG 1000's six contracts have been accepted.

Program Office Comments

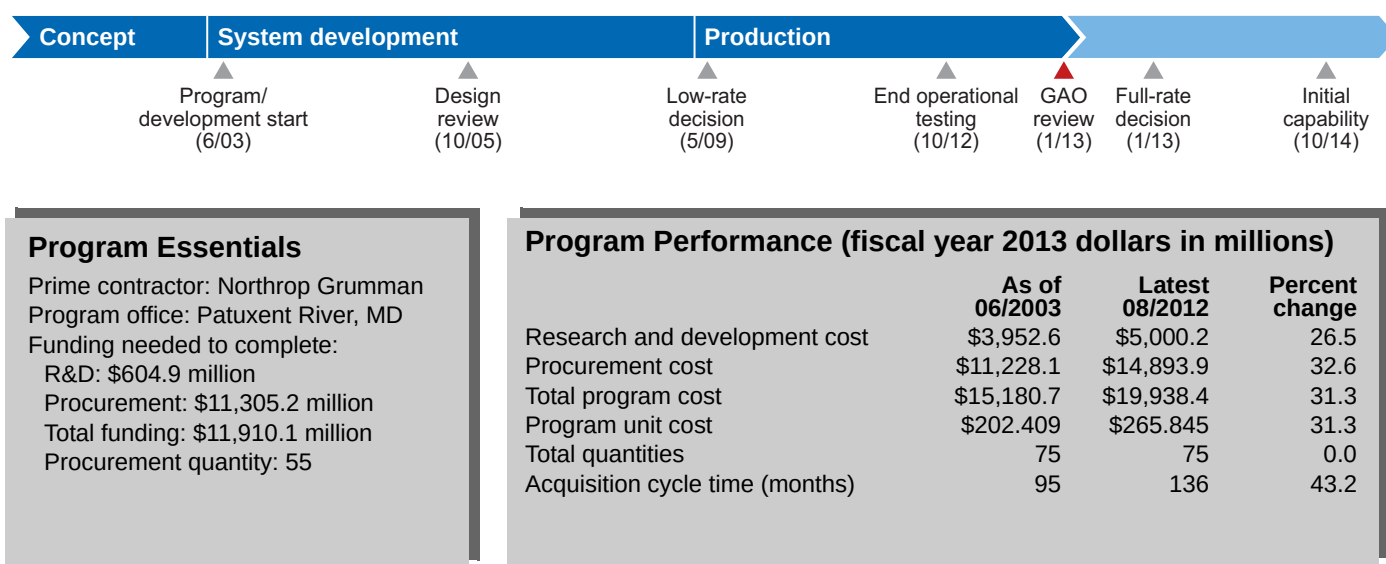
The President's fiscal year 2011 budget submission reduced the quantity of the DDG 1000 program to three ships and caused a Nunn-McCurdy breach. AT&L recertified the restructured program in June 2010 and adjusted initial operating capability to 2016. Since then, the Navy has awarded ship construction contracts and advanced gun systems contracts for all three ships and all required software. All critical technologies have at least been demonstrated in a relevant environment. More than 90 percent of the software has completed design, code, unit test, and integration, and it is aligned to ship activation. AT&L stated in a December 2011 acquisition decision memorandum that the Navy is executing the Nunn-McCurdy certified program while recognizing, addressing, and retiring risks. A July 2011 Office of Performance Assessment and Root Cause Analyses review also found that the Navy has taken steps in managing risks. The program office also provided technical comments, which were incorporated as appropriate.

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 key objectives of the E-2D AHE are to improve target detection and situational awareness, especially in the littorals; support theater air and missile defense operations; and provide improved operational availability for the radar system.



Source: PMA- 231 E-2D Program Office.



The E-2D AHE's critical technologies are mature, its design is stable, and its production processes are in control. The contractor is performing well on a variety of production metrics and recent aircraft deliveries have been on time. The program has completed initial operational testing, but the Director, Operational Test and Evaluation could not fully assess the E-2D AHE's theater air and missile defense capabilities because the Cooperative Engagement Capability (CEC), which is critical to that mission, was not ready in time for initial testing. CEC testing will not be completed until March 2013—after the program's planned full-rate production decision. In response to planned reductions in the defense budget, the Navy has decreased the rate of production for the program, which has increased its total estimated cost by \$1.3 billion.

Attainment of Product Knowledge	
As of January 2013	
Resources and requirements match	
• Demonstrate all critical technologies in a relevant environment	●
• Demonstrate all critical technologies in a realistic environment	●
• Complete preliminary design review	●
Product design is stable	
• Release at least 90 percent of design drawings	●
• Test a system-level integrated prototype	●
Manufacturing processes are mature	
• Demonstrate critical processes are in control	●
• Demonstrate critical processes on a pilot production line	●
• Test a production-representative prototype	●
● Knowledge attained	 Information not available
○ Knowledge not attained	Not applicable

E-2D AHE Program

Technology and Design Maturity

According to the Navy, all five E-2D AHE critical technologies are mature and its design is stable. Program officials told us that an increase in design drawings over the last year was primarily due to changes made to address issues identified during developmental testing. According to the program, none of the test discoveries resulted in major changes to the design.

Production Maturity

The E-2D AHE's production processes have been demonstrated and are in control. According to the program office and Defense Contract Management Agency (DCMA) officials, the contractor is performing well on a variety of production metrics, such as defect and rework rates, in low-rate initial production. DCMA officials also reported that recent aircraft deliveries have been on time.

Other Program Issues

The full-rate production decision for the E-2D AHE has been delayed from December 2012 until January 2013, due primarily to issues related to operational testing. The Director, Operational Test and Evaluation could not fully assess the E-2D AHE's theater air and missile defense capabilities because the CEC was not ready in time for initial operational testing. The CEC, which integrates information from multiple sources to track potential targets, was developed by a separate program office and was introduced into the E-2D AHE after the aircraft's development. Additional follow-on operational testing of the E-2D AHE with CEC is scheduled to be complete in March 2013. The program also reported that it continues to make incremental improvements to E-2D AHE's radar, which demonstrated some performance issues in initial operational testing when tracking targets in challenging environments as part of the theater air and missile defense mission. Radar reliability, a long-standing concern on the program, has improved and reached the requirement in the E-2D AHE's test plan.

Changes to the E-2D AHE's production schedule increased the program's estimated cost by \$1.3 billion in the fiscal year 2013 budget compared to the fiscal year 2012 budget. In response to planned reductions in the defense budget, the Navy's fiscal

year 2013 budget request reflected several changes to the E-2D AHE program. The Navy decreased the average number of aircraft being acquired each year, extended production by 2 years, and did not include anticipated savings from a multi-year procurement strategy. The program reported that, in line with the acquisition decision memorandum approved at its 2009 production decision, it is working on obtaining Navy and DOD approval to pursue a multi-year procurement strategy for 32 aircraft between fiscal years 2014 and 2018, as part of the fiscal year 2014 budget process. In the last year, the E-2D AHE's research and development costs have exceeded the program's baseline because of efforts to add new capabilities, including in-flight refueling, to the system. The program office plans to revise the baseline at the full-rate production decision.

As requested, we reviewed whether individual subcontracting reports from the prime contractor for the program were accepted on eSRS. The government uses subcontracting reports on eSRS as one method of monitoring small business participation. As of December 2012, eSRS indicated that one of the subcontracting reports for E-2D AHE's three contracts has been accepted.

Program Office Comments

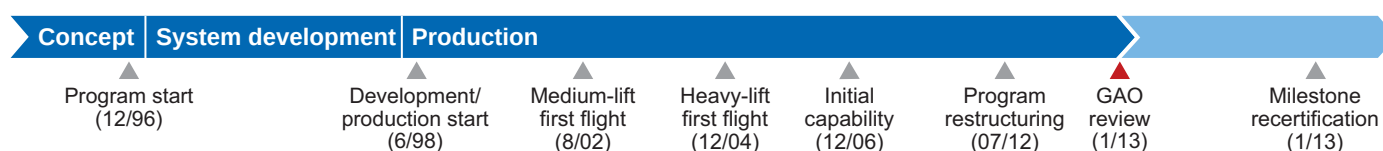
In commenting on a draft of this assessment, the program office provided technical comments, which were incorporated where deemed appropriate.

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

The Air Force's EELV program is the primary provider of launch vehicles for U.S. military and intelligence satellites. EELV acquires launch services to ensure affordable access to space for government satellites. The program consists of two families of commercially owned launch vehicles—United Launch Alliance's Atlas V and Delta IV. It also includes manufacturing, launch site facilities, and ground support systems. We assessed only the Atlas V and Delta IV vehicles.



Source: © 2012 United Launch Alliance.



Program Essentials

Prime contractor: United Launch Services, LLC
 Program office: El Segundo, CA
 Funding needed to complete:
 R&D: \$15.5 million
 Procurement: \$16,990.0 million
 Total funding: \$17,005.6 million
 Procurement quantity: 35

Program Performance (fiscal year 2013 dollars in millions)

	As of 10/1998	Latest 03/2012	Percent change
Research and development cost	\$1,832.3	\$2,329.0	27.1
Procurement cost	\$16,049.9	\$32,726.9	103.9
Total program cost	\$17,882.2	\$35,055.9	96.0
Program unit cost	\$98.797	\$381.042	285.7
Total quantities	181	92	-49.2
Acquisition cycle time (months)	NA	120	NA

Latest cost data do not fully account for cost and schedule changes resulting from the program's critical Nunn-McCurdy unit cost breach.

We assessed Atlas V and Delta IV technology as mature with 54 successful launches to date. We could not assess design or production maturity using our best practices. However, according to an Aerospace Corporation measure, most vehicle variants have not proven production maturity, as only two variants—the Atlas V 401 and the Delta IV Medium—have demonstrated maturity through seven or more launches. In March 2012, the program was re-designated as a major defense acquisition program resulting in two critical Nunn-McCurdy breaches of unit cost. In July 2012, the restructured EELV program was certified to continue with total program cost estimated at over \$69 billion through 2030. The program also developed a new acquisition program baseline and is completing assessments to inform its negotiating position for an upcoming contract award.

Attainment of Product Knowledge

As of January 2013

Resources and requirements match

- Demonstrate all critical technologies in a relevant environment
- Demonstrate all critical technologies in a realistic environment
- Complete preliminary design review

Product design is stable

- Release at least 90 percent of design drawings
- Test a system-level integrated prototype

Manufacturing processes are mature

- Demonstrate critical processes are in control
- Demonstrate critical processes on a pilot production line
- Test a production-representative prototype

● Knowledge attained
 ○ Knowledge not attained
 ■■■ Information not available
 Not applicable

EELV Program

Technology, Design, and Production Maturity

While EELV's technology is mature, we could not assess design and production maturity by our best practices metrics as the Air Force does not formally contract for information that would facilitate this assessment. According to the Aerospace Corporation's measurement known as the "3/7 reliability rule," once a vehicle configuration is launched successfully three times its design can be considered mature. Similarly, if a vehicle is successfully launched seven times, both the design and production process can be considered mature. Based on this rule, only 2 of the 14 EELV configurations have demonstrated production maturity. Each of the nine Atlas V variants and the five Delta IV variants has flown at least once. Eight of the Atlas and Delta variants have flown at least three times but only 2 of the 14 variants have flown at least seven times. Until a launch vehicle configuration demonstrates design and production maturity, problems with fleetwide designs or production processes may go undiscovered, which could cause significant cost and schedule risk. The program has experienced problems that, according to officials, led to a launch delay. Air Force officials stated that the contractor is looking into these issues.

Other Program Issues

Following re-designation as a major defense acquisition program in March 2012, the EELV program reported two critical Nunn-McCurdy unit cost breaches, which resulted in a reassessment of the program. The estimate of the acquisition costs for the restructured EELV program is \$69.6 billion based on the need for 150 launches through 2030. This estimate is \$34.6 billion more than the current cost estimate reported in the Selected Acquisition Report of March 2012 which estimated costs up to the year 2020. The program identified several causes for this cost growth including extension of the program life-cycle from 2020 to 2030, procurement of additional launch vehicles—from 91 to 150, the inherently unstable nature of the demand for launch services, and industrial base instability. The program was certified to continue in July 2012 and as a result developed a new acquisition program baseline, which was approved in early 2013.

A new EELV acquisition strategy, developed to stabilize the industrial base and prevent further cost escalation, was finalized in November 2011 with contract award planned for early 2013. On September 28, 2012, the Air Force awarded the contractor a \$1.2 billion cost-plus-incentive-fee and cost-plus-fixed-fee contract for Atlas V and Delta IV launch infrastructure and labor, to minimize disruption to the launch schedule while the program works to gather and evaluate information prior to a contract award in 2013.

The Air Force recently ordered an accident investigation board to determine why an upper stage engine did not perform as expected during a launch on October 4, 2012. As a result, the launch schedule is under review. Two Air Force missions—Orbital Test Vehicle 3 (OTV-3) and Wideband Global SATCOM 5—and one NASA mission were delayed. OTV-3 was successfully launched on December 11, 2012.

As requested, we examined whether there were accepted individual subcontracting reports from the prime contractor for the program. The government uses subcontracting reports on eSRS as one method of monitoring small business participation. As of December 2012, eSRS indicated that 3 of the associated subcontracting reports for EELV's 10 contracts have been accepted.

Program Office Comments

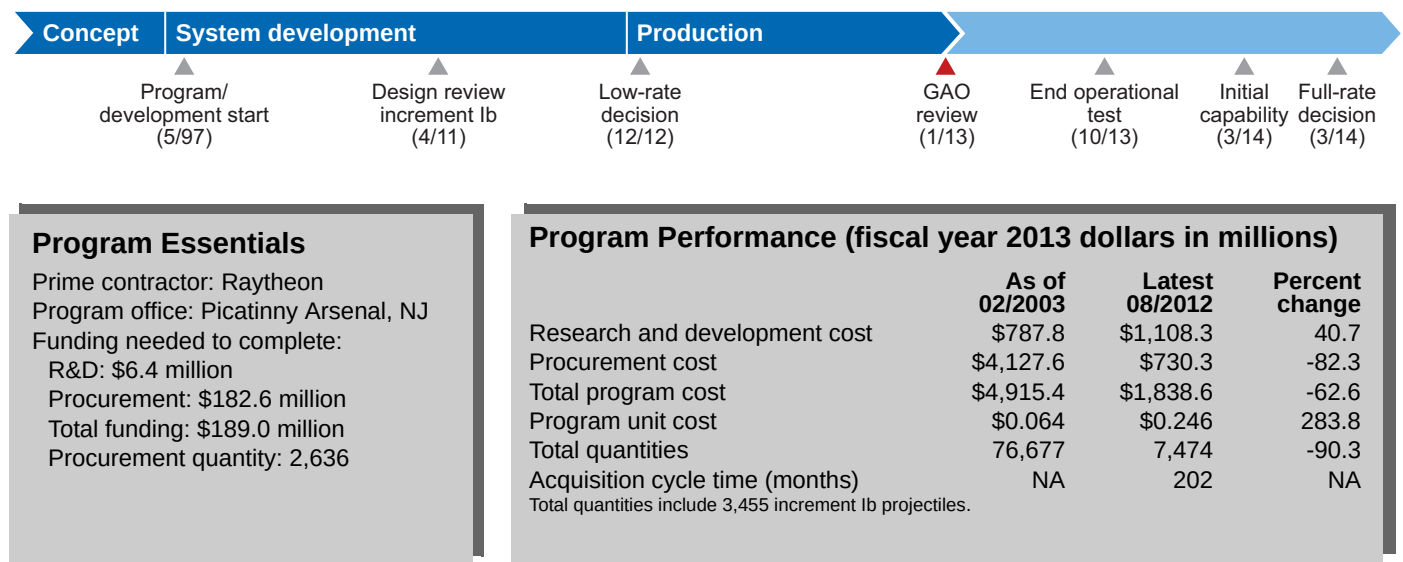
In commenting on a draft of this assessment, the program office provided technical comments, which were incorporated where deemed appropriate.

Excalibur Precision 155mm Projectiles

The Army's Excalibur is a family of global positioning system-based, fire-and-forget, 155 mm cannon artillery precision munitions intended to provide improved range and accuracy. The near-vertical angle of fall is expected to reduce collateral damage, making it more effective in urban environments. The Army is using an incremental approach to deliver capabilities. Increment Ia-1 is fielded, Ia-2 is in production, and Ib, which is expected to increase reliability and lower unit costs, will begin production in 2012. We assessed increment Ib.



Source: U.S. Army.



The Excalibur program has resolved several design issues ahead of its December 2012 low-rate production decision. The design has stabilized since our last review; however, further changes may be necessary to meet as yet unmet reliability requirements. The program is re-using some components from the increment Ia-2 round to alleviate issues surrounding the increment Ib design, and began testing the new design in May 2012. The new design is also expected to decrease unit costs.

Attainment of Product Knowledge	
As of January 2013	
Resources and requirements match	
• Demonstrate all critical technologies in a relevant environment	●
• Demonstrate all critical technologies in a realistic environment	●
• Complete preliminary design review	●
Product design is stable	
• Release at least 90 percent of design drawings	●
• Test a system-level integrated prototype	●
Manufacturing processes are mature	
• Demonstrate critical processes are in control	○
• Demonstrate critical processes on a pilot production line	●
• Test a production-representative prototype	●
● Knowledge attained	 Information not available
○ Knowledge not attained	Not applicable

Excalibur Program

Technology and Design Maturity

The Excalibur program has fully matured all of its critical technologies and resolved several increment Ib design issues that were previously identified as impediments to stability. All of the increment Ib design is complete and all of the program's current design drawings have been released. The program reported that it has completed the designs of the three projectile subassemblies—the base assembly, fuze safe and arm device, and tactical telemetry module—that were incomplete as of our last review. Program officials stated that the munition now meets requirements related to range and fuze setting time. Although the design appears stable, the program does not currently meet requirements related to insensitive munitions—ensuring that a munition will not detonate under any condition other than its intended mission. Ensuring compliance with this requirement could require design changes and the program is uncertain of the total number of drawings that will ultimately be required.

The program performed developmental testing to prepare for the December 2012 production decision for increment Ib. The design for increment Ib reuses some components of increment Ia-2 and has undergone testing in realistic environments. In 2012 the program decided to use the increment Ia projectile base, which would alleviate reliability, performance, and design issues related to the Ib base design. The first test of this design occurred in May 2012 and approximately 70 rounds of this configuration have been fired to date. A production representative prototype was successfully demonstrated in June 2012. All performance and safety requirements are expected to be met before the production decision, but reliability testing will not be complete until after production has begun.

Production Maturity

The prior instability of system design prevented demonstration of the level of manufacturing maturity for increment Ib expected for a program preparing to enter production. The increment Ib will use similar manufacturing processes as the increment Ia, which the program assesses as mature. According to the program, while several component suppliers do utilize statistical process controls, those controls have not been expanded significantly at the system level due to low quantities and non-continuous

production. However, the program states that all suppliers passed production readiness reviews and are producing production representative hardware for the system qualification rounds that are being tested.

Other Program Issues

Program officials explained that the majority of the hardware unit costs for increments Ia and Ib were in the guidance section of the projectile and that increment Ib uses a guidance section that has been redesigned with a lower unit cost. As a result of this and other improvements the program is expecting the average procurement unit cost to be about 42 percent less than Ia rounds.

As requested, we reviewed whether individual subcontracting reports from the prime contractor for the program were accepted on eSRS. The government uses subcontracting reports on eSRS as one method of monitoring small business participation. As of December 2012, eSRS indicated that none of the associated subcontracting reports for Excalibur's two contracts have been accepted.

Program Office Comments

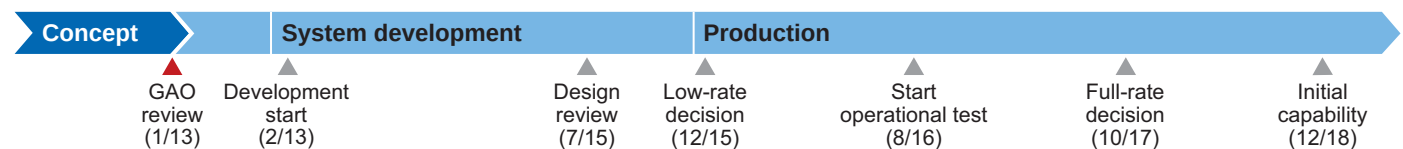
In commenting on a draft of this assessment, program officials stated that regarding insensitive munitions, the energy-releasing material in Ib rounds is the same as Ia rounds. The insensitive munitions board has requested additional testing due to updated test standards since Ia qualification. Program management will monitor ongoing development of insensitive munitions explosive fills for potential use in future production. Some reliability failures observed during system qualification testing can be attributed to control of critical processes. They are being addressed via failure investigations, and corrective actions to improve process control are being implemented. Additionally, the design used in system qualifications is a production representative prototype using the same design, processes, and facilities that will be used during low-rate production. Minor design and process changes are being made to improve system reliability. The program also provided technical comments, which were incorporated as appropriate.

F-22 Increment 3.2B

The Air Force's F-22A Raptor is an air-to-air and air-to-ground fighter/attack aircraft that integrates stealth; supercruise; and advanced avionics, maneuverability, and weapons in one platform. The Air Force established the F-22A modernization and improvement program in 2003 to add enhanced air-to-ground, information warfare, reconnaissance, and other capabilities and to improve the reliability and maintainability of the aircraft. Increment 3.2B is the fourth increment of the F-22A modernization program.



Source: U.S. Air Force.



Program Essentials

Prime contractor: Lockheed Martin
 Program office: WPAFB, OH
 Funding needed to complete:
 R&D: \$544.6 million
 Procurement: \$330.1 million
 Total funding: \$874.7 million
 Procurement quantity: 143

Program Performance (fiscal year 2013 dollars in millions)

	As of	Latest 01/2013	Percent change
Research and development cost	NA	\$1,199.3	NA
Procurement cost	NA	\$338.6	NA
Total program cost	NA	\$1,538.0	NA
Program unit cost	NA	\$10.118	NA
Total quantities	NA	152	NA
Acquisition cycle time (months)	NA	69	NA

Increment 3.2B is an enhancement to the F-22A bringing upgraded electronic protection, geo-location, and intra-flight data link capabilities, and integration of AIM-9X Block II and AIM-120D missiles. The Air Force plans to begin Increment 3.2B development in fiscal year 2013, after receiving the approval from DOD to initiate this effort as a new major defense acquisition program. The one reported critical technology is nearing maturity, but has not yet been demonstrated in a realistic environment. The program has identified several risks that must be mitigated for new Increment 3.2B capabilities to be delivered as planned.

Attainment of Product Knowledge

Projected as of January 2013

Resources and requirements match

- Demonstrate all critical technologies in a relevant environment ●
- Demonstrate all critical technologies in a realistic environment ○
- Complete preliminary design review ●

Product design is stable

- Release at least 90 percent of design drawings
- Test a system-level integrated prototype

Manufacturing processes are mature

- Demonstrate critical processes are in control
- Demonstrate critical processes on a pilot production line
- Test a production-representative prototype

Knowledge attained
 Knowledge not attained
 Information not available
 Not applicable

F-22 Inc 3.2B Program

Technology and Design Maturity

Program officials expect to begin system development for Increment 3.2B with the geo-location technology demonstrated in a relevant environment, in accordance with DOD policy and statutory requirements. However, knowledge-based acquisition practices recommend, and DOD policy prefers, that programs fully mature technologies and demonstrate them in a realistic or operational environment prior to entering system development. The Air Force reported that as of December 2012, 258 design drawings are currently releasable, or 92 percent of the 280 drawings expected at the critical design review in July 2015.

Other Program Issues

The program believes there is a significant risk that AIM-9X Block II may not be developed in time to support Increment 3.2B operational testing in 2016 or initial fielding in 2018. Other risks include a lack of test resources to verify electronic protection and geo-location capabilities and a risk that the software lab at Ogden Air Logistics Center will not be accredited. If the lab is not accredited, its usefulness would be limited and the program would have to fly an additional 75 flight test sorties. Additionally, because of concurrency with updates to F-22A flight software, additional Increment 3.2B software delays may occur.

Program officials indicated the Air Force has concluded its investigation of hypoxia-like physiological symptoms experienced by some F-22A pilots, an issue identified as being significant starting in 2008 and which received increased scrutiny following the fatal crash of an F-22A in November 2010. The officials said the Air Force has taken the required safety precautions and is in the process of implementing required mitigations. Five life support system improvements have been completed and two more are in progress. The F-22A fleet has returned to operational status; however, if the problems recur or other problems arise, flight restrictions could be put in place again and upgrades, such as Increment 3.2B, could potentially experience delays.

An independent assessment, completed by the National Aeronautics and Space Administration's Engineering Safety Center at the request of the Air

Force, identified several actions that could be taken. These actions include establishing post-incident medical protocols and conducting end-to-end testing of the F-22A life support system, environmental control system, and aircrew flight equipment to characterize their actual capacity, margins and vulnerabilities. The assessment noted these tests should have been conducted during initial aircraft testing as well as whenever changes to these systems occur.

Program Office Comments

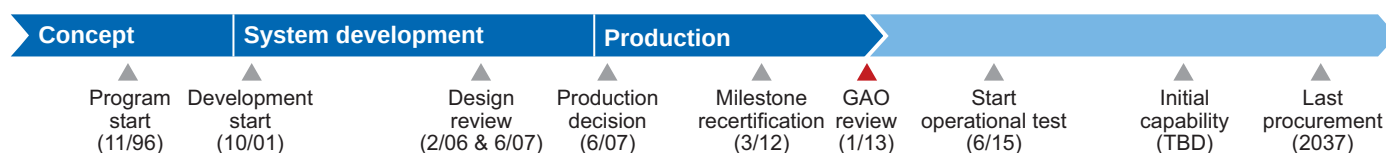
In commenting on a draft of this assessment, the Air Force said Increment 3.2B's critical technology has been demonstrated in a relevant environment, and will be demonstrated through test and evaluation during system development, which is appropriate at this point in the acquisition process. The Air Force also provided technical comments, which were incorporated as appropriate.

F-35 Joint Strike Fighter (JSF)

DOD's F-35 Joint Strike Fighter program is developing a family of stealthy, strike fighter aircraft for the Navy, Air Force, Marine Corps, and U.S. allies, with the goal of maximizing commonality to minimize life-cycle costs. The carrier-suitable variant will complement the Navy F/A-18E/F. The Air Force variant will replace the air-to-ground attack capabilities of the F-16 and A-10, and will complement the F-22A. The short take-off and vertical landing variant will replace the Marine Corps F/A-18 and AV-8B aircraft.



Source: F-35 Joint Program Office.



Program Essentials

Prime contractor: Lockheed Martin, Pratt and Whitney
 Program office: Arlington, VA
 Funding needed to complete:
 R&D: \$8,272.9 million
 Procurement: \$242,644.0 million
 Total funding: \$253,989.4 million
 Procurement quantity: 2,322

Program Performance (fiscal year 2013 dollars in millions)

	As of 10/2001	Latest 03/2012	Percent change
Research and development cost	\$40,109.3	\$60,690.8	51.3
Procurement cost	\$177,946.1	\$271,194.8	52.4
Total program cost	\$219,918.0	\$336,124.4	52.8
Program unit cost	\$76.733	\$136.803	78.3
Total quantities	2,866	2,457	-14.3
Acquisition cycle time (months)	116	TBD	TBD

Extensive restructuring actions by defense officials should result in more achievable and predictable outcomes for the JSF program. Officials provided more time and funding for system development and reduced near-term annual procurement quantities, deferring aircraft to future years. Still, billions have already been invested and 121 production aircraft ordered while gaps in product knowledge persist. Four critical technologies are not fully mature and design changes, though declining, are still higher than expected. Developmental testing is progressing but is far from complete and will likely drive more changes in design and manufacturing processes. Just over a third of critical manufacturing processes are judged to be in control and capable of consistently producing quality parts.

Attainment of Product Knowledge

As of January 2013

Resources and requirements match

- Demonstrate all critical technologies in a relevant environment ☐
- Demonstrate all critical technologies in a realistic environment ☐
- Complete preliminary design review ☒

Product design is stable

- Release at least 90 percent of design drawings ☒
- Test a system-level integrated prototype ☒

Manufacturing processes are mature

- Demonstrate critical processes are in control ☐
- Demonstrate critical processes on a pilot production line ☒
- Test a production-representative prototype ☒

☒ Knowledge attained
☐ Knowledge not attained

.... Information not available
 Not applicable

JSF Program

Technology and Design Maturity

JSF began system development in 2001 with none of its eight critical technologies mature. Four technologies are still not fully mature. In particular, the helmet-mounted display, integral to mission systems integration, has not been validated as meeting requirements. An alternate helmet is being developed while efforts continue to fix the original. Efforts are also underway to correct problems with the Autonomic Logistics Information System, key to managing maintenance functions in order to reduce life-cycle costs.

Aircraft designs were not stable at the critical design reviews in 2006 and 2007. All the expected engineering drawings have since been released. However, design changes, while declining in number, are still more than expected for a program in its seventh year of production. Development and operational testing will continue to drive changes through 2019.

Production Maturity

DOD invested about \$28 billion in procuring 121 aircraft through the 2012 buy. While initial F-35 production overran target costs and delivered late, there are encouraging signs indicating better outcomes in the coming years. For example, the first four procurement contracts overran target costs by a total of \$1.2 billion, but the latest data shows that manufacturing and supply operations are improving—labor hours and times to build aircraft are decreasing as the work force gains experience and work processes mature. Also, the 39 aircraft delivered through 2012 were late an average of 11 months, but the delivery rate is improving as the last two aircraft were each late by two months.

There are other signs of improvement: the manufacturing line is maturing, parts shortages are declining, and quality metrics are showing positive trends. The aircraft contractor is using statistical process control to bring critical manufacturing process under control. Just over one-third of the processes are currently judged capable of consistently producing quality parts at the best practice standard. The contractor has a plan in place to achieve the standard by the start of full-rate production in 2019.

Other Program Issues

In March 2012, DOD approved a new F-35 acquisition baseline that incorporated recent restructuring actions, including more funding and time for development and deferred procurement of more than 400 aircraft. The program is now more achievable, but aircraft will cost more and delivery of combat capability is slowed. The total acquisition cost is now estimated at \$396 billion—about 40 percent more than the prior 2007 baseline—and completing development and starting full rate production are delayed 5 and 6 years, respectively. Because of F-35 delays and uncertainties, the services have not reset target dates for fielding combat forces and are procuring and modernizing legacy aircraft to fill projected fighter shortfalls. The F-35 program's cost and schedule setbacks to date stem largely from an overly aggressive and concurrent acquisition strategy with undue overlap among development, test, and production activities.

As requested, we reviewed whether individual subcontracting reports from the prime contractor for the program were accepted on eSRS. The government uses subcontracting reports on eSRS as one method of monitoring small business participation. As of December 2012, eSRS indicated that none of the subcontracting reports associated with F-35's nine contracts have been accepted. According to program officials, the program's prime contractors, Lockheed Martin and Pratt and Whitney, participate in DOD's comprehensive small business subcontracting test program. This means that their small business plans are established at the corporate level and cover all contracts that the company has been awarded throughout DOD.

Program Office Comments

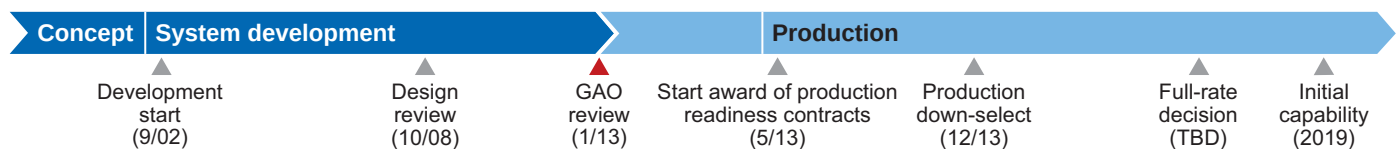
In commenting on the draft of this assessment, the program office noted that the program made great strides in the past year to further stabilize technology, design, and production maturity and continues to work on identified areas to improve program performance. The program office also provided technical comments, which were incorporated where deemed appropriate.

Family of Advanced Beyond Line-of-Sight Terminals (FAB-T)

The Air Force's FAB-T program plans to provide a family of satellite communications terminals for airborne and ground-based users that will replace many program-unique terminals. It is designed to work with current and future communications capabilities and technologies. FAB-T is expected to provide voice and data over military satellite communications for nuclear and conventional forces as well as airborne and ground command posts, including B-2, B-52, RC-135, E-6, and E-4 aircraft.



Source: FAB-T Program Office.



Program Essentials

Prime contractor: Boeing, Raytheon
 Program office: Bedford, MA
 Funding needed to complete:
 R&D: \$290.8 million
 Procurement: \$2,223.6 million
 Total funding: \$2,514.5 million
 Procurement quantity: 216

Program Performance (fiscal year 2013 dollars in millions)

	As of 12/2006	Latest 10/2012	Percent change
Research and development cost	\$1,581.8	\$2,347.4	48.4
Procurement cost	\$1,699.4	\$2,235.2	31.5
Total program cost	\$3,281.1	\$4,582.6	39.7
Program unit cost	\$15.190	\$18.629	22.6
Total quantities	216	246	13.9
Acquisition cycle time (months)	129	TBD	TBD

The latest cost data do not reflect the current cost of the program. A new acquisition program baseline has not yet been approved.

The program is currently approaching a production decision with a stable, demonstrated design but with technologies still not tested in a realistic environment. Due to continued cost and schedule growth in developing this design, the Air Force signed a development contract with Raytheon in September 2012 in an effort to establish an alternate source for a system with capabilities similar to Boeing's FAB-T effort. An acquisition baseline updated to reflect the award to a second source, and other changes to the program strategy since 2010, is expected to be approved by April 2013. Despite numerous changes to the program, an independent cost estimate has not been conducted since 2009, but is expected in May 2013.

Attainment of Product Knowledge

As of January 2013

Resources and requirements match

- Demonstrate all critical technologies in a relevant environment ●
- Demonstrate all critical technologies in a realistic environment ○
- Complete preliminary design review ●

Product design is stable

- Release at least 90 percent of design drawings ●
- Test a system-level integrated prototype ●

Manufacturing processes are mature

- Demonstrate critical processes are in control
- Demonstrate critical processes on a pilot production line
- Test a production-representative prototype

- Knowledge attained
- Knowledge not attained

- Information not available
- Not applicable

FAB-T Program

Technology, Design, and Production Maturity

According to the program office, four of the six critical technologies for the original development program are fully mature, and the other two are approaching full maturity. The FAB-T program does not currently have plans to conduct an independent technology readiness assessment for the alternate source.

According to the program office, the FAB-T design is currently on schedule for both the original and alternate source development programs.

Recent changes to the acquisition strategy initiated two production paths: one released in December 2012, providing for both command and airborne terminals, and the other planned for release in February 2013, covering only command terminals. Program officials expect both contractors to be competitive for both approaches. Based on future funding decisions for airborne terminals, the program plans to choose a path and make a down-select decision by December 2013 between the two vendors for low-rate initial production. Depending on which contractor is chosen, the low-rate decision could occur as early as the second quarter of fiscal year 2014.

Other Program Issues

In October 2010, an independent review team noted that the program was likely in breach of critical Nunn-McCurdy unit cost thresholds; however, a breach has not yet been reported by the program. In 2012, the FAB-T program made several revisions to its acquisition strategy—including modification of Boeing's development contract from cost plus award fee to firm fixed-price and the addition of the alternate source contract later awarded to Raytheon—in response to these concerns about cost growth, but a new acquisition program baseline that reflects these changes and their projected costs has not yet been approved. The program anticipates that a new independent cost estimate and revised acquisition program baseline will both be completed by June 2013. Program officials have stated that they expect this independent cost estimate may show that FAB-T is not in breach of Nunn-McCurdy thresholds.

Due to uncertainty about the development and production of FAB-T, the Air Force stopped work on contracts related to its integration with the B-2 and B-52—the two bomber platforms for which it is designed. According to officials, both programs are considering alternatives to transmit data through AEHF satellites. The two production path approach was developed in response to this uncertainty. However, if not integrated with the bombers, FAB-T may not meet its full range of planned communications capabilities as some are based on the interaction of bomber aircraft with intelligence, surveillance, and reconnaissance aircraft and command terminals.

As requested, we reviewed whether individual subcontracting reports from the prime contractor for the program were accepted in eSRS. The government uses subcontracting reports on eSRS as one method of monitoring small business participation. As of December 2012, eSRS indicated that the associated subcontracting report for FAB-T's contract has not been accepted.

Program Office Comments

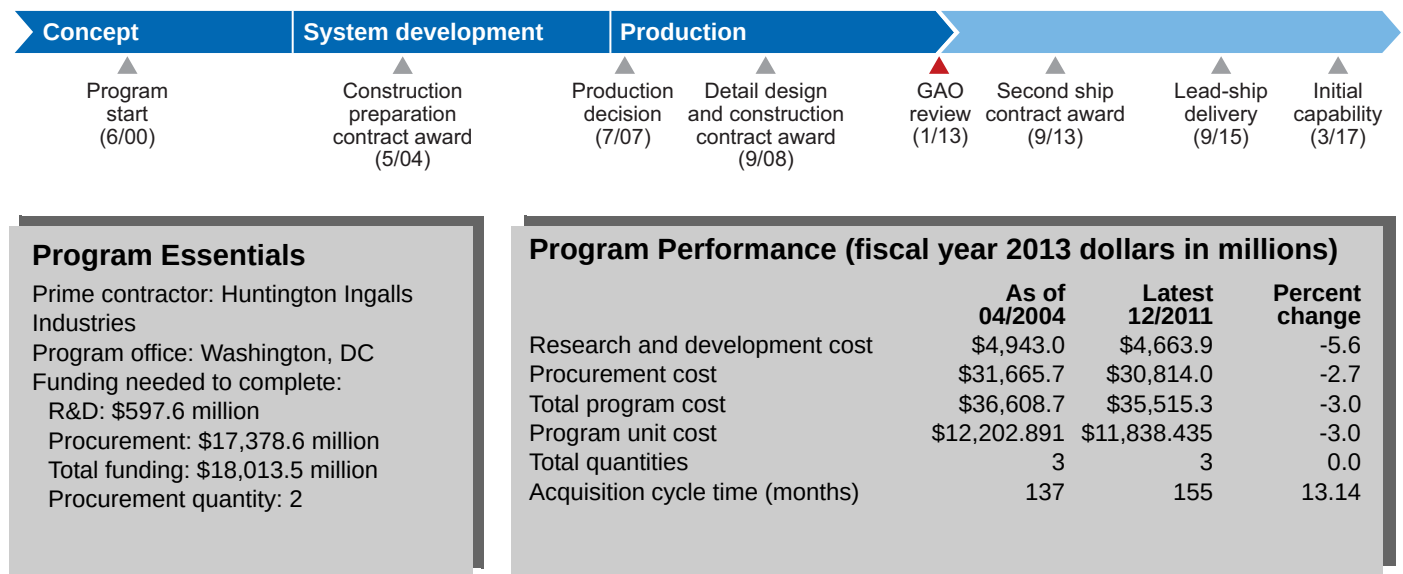
According to program officials, in 2012, the Air Force completed initiatives to control costs and introduce competition. FAB-T progressed through three acquisition decision memorandums, converting the Boeing development contract from cost plus award fee to firm-fixed price and issuing an alternate source contract, awarded to Raytheon in September 2012. Two revised acquisition strategies were approved, adding competition to development and production. Both Boeing and Raytheon are progressing through significant milestones within their relative schedules. Two production request for proposals were developed: one accounts for just the command terminal with projected release in February 2013; the other includes the airborne terminal, released in December 2012, with responses due in February 2013. The program anticipates rebaselining with an independent cost estimate and updated baseline in the spring. In addition to the above, the program office provided technical comments, which were incorporated where deemed appropriate.

Gerald R. Ford Class Nuclear Aircraft Carrier (CVN 78 Class)

The Navy's CVN 78 class of nuclear-powered aircraft carriers is designed to improve operational efficiency, enable higher sortie rates, and reduce manpower through the use of advanced propulsion, aircraft launch and recovery, and survivability technologies. The Navy awarded a contract for detail design and construction of the lead ship, CVN 78, in September 2008 and expects it to be delivered by September 2015. The Navy plans to award construction contracts for CVN 79 by September 2013 and for CVN 80 by the end of 2017.



Source: U.S. Navy.



The Navy awarded a construction contract for CVN 78 in September 2008 when 8 of the ship's 13 current critical technologies were immature and the ship's three-dimensional (3D) product model was incomplete. Since then, lead ship procurement costs have grown by over 17 percent, with ship construction now approximately 51 percent complete. At present, six of the currently planned technologies are mature, with the rest approaching maturity, and the ship's 3D product model is complete. However, maintaining design stability depends on technologies arriving at the ship in configurations consistent with the current design. Construction to date has been impeded by unforeseen welding complications, material shortages, and lagging equipment deliveries.

Attainment of Product Knowledge	
As of January 2013	
Resources and requirements match	
• Demonstrate all critical technologies in a relevant environment	●
• Demonstrate all critical technologies in a realistic environment	○
• Complete preliminary design review	●
Product design is stable	
• Complete three-dimensional product model	●
• Test a system-level integrated prototype	
Manufacturing processes are mature	
• Demonstrate critical processes are in control	
• Demonstrate critical processes on a pilot production line	
• Test a production-representative prototype	
● Knowledge attained	 Information not available
○ Knowledge not attained	Not applicable

CVN 78 Class Program

Technology Maturity

According to the Navy, 6 of CVN 78's 13 critical technologies are mature, and the remaining 7 are approaching maturity. Delays developing and producing the dual band radar (DBR) and advanced arresting gear (AAG) have driven inefficient, out of sequence construction work and caused the Navy to defer some key tests until after installation. The Navy's decision to remove DBR's volume search radar (VSR) component from the DDG 1000 destroyer shifted responsibility for maturing DBR to CVN 78, and the resulting restart of testing has been slow. Further, because a fully configured, production unit VSR is unavailable, the Navy is using a less robust, lower powered prototype to complete testing. At present, the first test of a fully configured, integrated DBR will be aboard CVN 78 after ship delivery—a strategy that introduces risks. Malfunctions in the water twisters, components used to absorb energy created when arresting aircraft, have slowed the development of AAG. To support construction, the Navy plans to produce and install AAG aboard CVN 78 prior to completing system development, which may risk retrofits late in construction. The electromagnetic aircraft launch system (EMALS) has successfully launched a wide range of aircraft during land based testing using a single launcher and four motor generators. The shipboard system will employ a more complex configuration of four launchers and 12 generators sharing a power interface. Both EMALS and AAG face reliability challenges, and neither system is expected to attain minimum required reliability until more than 10 years after CVN 78 delivery.

Design Maturity

CVN 78 completed its 3D product model in November 2009—over a year after the construction contract award. At contract award, 76 percent of the model was complete and the shipbuilder had already begun construction of at least 25 percent of structural units under a previous construction preparation contract. While the model is now considered functionally complete, maintaining design stability depends on technologies fitting within the space, weight, cooling, and power reservations allotted them. Shipboard testing may reveal a need for design changes. In addition, as construction progresses, the shipbuilder is

discovering "first-of-class" type design changes, which it will use to update the model prior to CVN 79 construction.

Production Maturity

According to program officials, CVN 78 is approximately 51 percent complete. Procurement costs for the lead ship have grown by over 17 percent since authorization of construction in fiscal year 2008, largely due to problems encountered in construction. Specifically, the new steel plating used for ship decks excessively warped and flexed during construction, which contributed to lower than desired levels of preoutfitting. In addition, the shipbuilder has experienced a shortage of the new valves critical for installing and testing different piping systems within the ship, and lagging government-furnished equipment deliveries have required deviation from the planned build sequence.

Other Program Issues

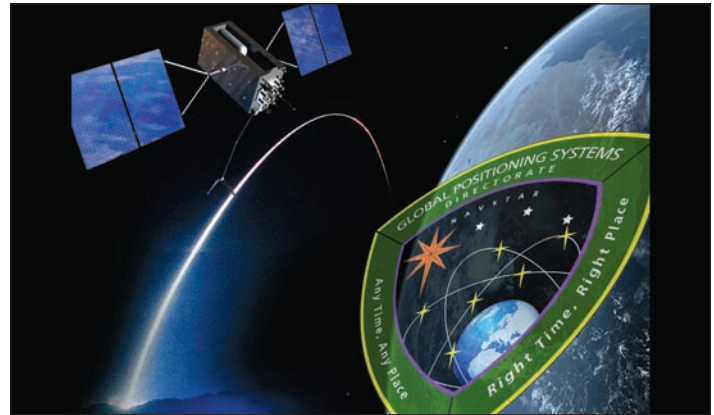
As requested, we reviewed whether individual subcontracting reports from the prime contractor for the program were accepted on eSRS. The government uses subcontracting reports on eSRS as one method of monitoring small business participation. As of December 2012, eSRS indicated that none of the associated subcontracting reports for CVN 78's two contracts have been accepted.

Program Office Comments

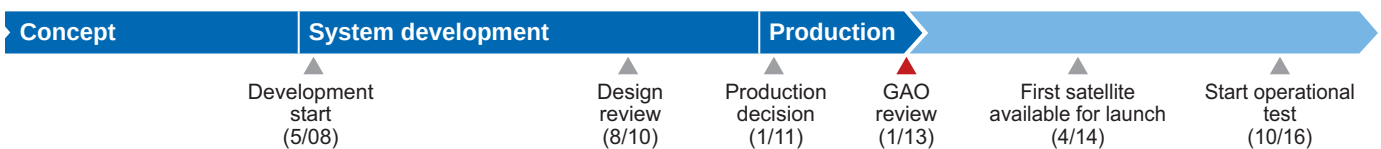
In commenting on a draft of this assessment, the program office stated that the shipbuilder is applying lessons learned from CVN 78 construction to improve production strategies and reduce labor hours needed to construct follow-on ships (CVN 79 and CVN 80). Further, the program office does not expect to repeat CVN 78's "first of class" design and production challenges on CVN 79 and CVN 80. Program officials also stated that using a nonproduction-representative VSR prototype for DBR land-based testing has mitigated much of the impact of the DDG 1000 descope of VSR and will be beneficial in exhibiting dual band functionality prior to ship delivery. In addition, program officials stated that the 12 current critical technologies in the program have met their system maturity goals, noting that an oversight team led by the Office of the Secretary of Defense disbanded in 2012 once each of these technologies was determined to be approaching maturity or mature. The program office also provided technical comments, which were incorporated where deemed appropriate.

Global Positioning System III (GPS III)

The Air Force's Global Positioning System III (GPS III) program plans to develop and field a new generation of satellites to supplement and eventually replace GPS satellites currently in use. Other programs are developing the ground system and user equipment. GPS III is to be developed incrementally. We assessed the first increment, which intends to provide capabilities such as a stronger military navigation signal to improve jamming resistance and a new civilian signal that will be interoperable with foreign satellite navigation systems.



Source: U.S. Air Force.



Program Essentials

Prime contractor: Lockheed Martin
 Program office: El Segundo, CA
 Funding needed to complete:
 R&D: \$446.7 million
 Procurement: \$936.3 million
 Total funding: \$1,383.0 million
 Procurement quantity: 4

Program Performance (fiscal year 2013 dollars in millions)

	As of 05/2008	Latest 12/2011	Percent change
Research and development cost	\$2,597.6	\$2,708.1	4.3
Procurement cost	\$1,458.4	\$1,530.5	4.9
Total program cost	\$4,056.0	\$4,238.7	4.5
Program unit cost	\$506.999	\$529.836	4.5
Total quantities	8	8	0.0
Acquisition cycle time (months)	NA	NA	NA

We could not calculate acquisition cycle times for the first increment of the GPS III program because initial operational capability will not occur until satellites from a future increment are fielded.

GPS III entered production in January 2011 with mature technologies but before testing prototypes to ensure the system would work as intended and could be manufactured efficiently. The program planned to develop a partial system prototype to demonstrate production processes and identify and solve issues prior to integrating and testing the first space vehicle; however, the navigation payload was not delivered until November 2012. Work performed to date on the development contract for the first two GPS space vehicles continues to cost more than expected. The Air Force is considering dual-launch capability for space vehicles 5 through 8 if it finds it to be technically and fiscally feasible. The Air Force postponed the first planned launch by a year in order to synchronize it with the ground system necessary to launch and control the satellites.

Attainment of Product Knowledge

As of January 2013

Resources and requirements match

- Demonstrate all critical technologies in a relevant environment ☒
- *Demonstrate all critical technologies in a realistic environment*
- Complete preliminary design review ☒

Product design is stable

- Release at least 90 percent of design drawings ☒
- Test a system-level integrated prototype ☐

Manufacturing processes are mature

- Demonstrate critical processes are in control ☒
- Demonstrate critical processes on a pilot production line ☐
- Test a production-representative prototype ☐

☒ Knowledge attained
☐ Knowledge not attained

..... Information not available
 Not applicable

GPS III Program

Technology and Design Maturity

The GPS III program reports that its critical technologies were independently assessed as mature and its design is stable. According to the program office, the critical technologies were not all previously flown on satellites, and for those that were, changes have been made for GPS III. Only one of the eight technologies completed qualification testing, which is over a year later than planned for at least two of the technologies. While the design has been mature since the 2010 design review, as measured by the number of drawings released to manufacturing, the program has yet to demonstrate that the design can meet requirements by testing a system-level integrated prototype.

Production Maturity

In January 2011, the program office reported a level of manufacturing process maturity that indicated its processes were in control and production could begin. However, a complete GPS III satellite was not tested prior to the production decision. The program is currently developing a partial system prototype to prove out production processes prior to integrating and testing the first space vehicle. It is to include almost all components, excluding redundant units. The final piece of this prototype, the navigation payload element, which includes five of the program's critical technologies, was delivered in November 2012. The Air Force is considering dual-launch capability beginning with GPS III space vehicle 9, and may dual launch earlier if they find it to be technically and fiscally feasible. Our prior work has shown that design changes during production can have significant cost and schedule consequences, including expensive retrofitting and production delays.

Other Program Issues

Given the significant cost growth and schedule delays experienced by the program's predecessor, GPS IIF, the Air Force designed GPS III to maintain stability and minimize changes with the ultimate goal of delivering capabilities in a responsible, cost-effective, and timely manner. According to the Air Force, GPS III is using a "back to basics" approach, emphasizing rigorous systems engineering, use of military specifications and standards, and an incremental approach to providing capability. The work performed to date for development of the first

two space vehicles continues to cost more than expected, which the program office attributes in part to this approach. Program officials stated that costs were shifted to earlier in the acquisition as a result of more stringent parts and materials requirements. They anticipate these requirements will result in fewer problems later in the acquisition.

Air Force officials recently stated that, although GPS III is still maintaining an April 2014 "available for launch" date for the first satellite, the planned launch date is being moved to May 2015 in order to synchronize it with the availability of the GPS Operational Control Segment (OCX) Block 0, without which the satellites cannot be launched and checked out.

As requested, we reviewed whether individual subcontracting reports from the prime contractor for the program were accepted on eSRS. The government uses subcontracting reports on eSRS as one method of monitoring small business participation. As of December 2012, eSRS indicated that the one associated subcontracting report for GPS III's contract has not been accepted.

Program Office Comments

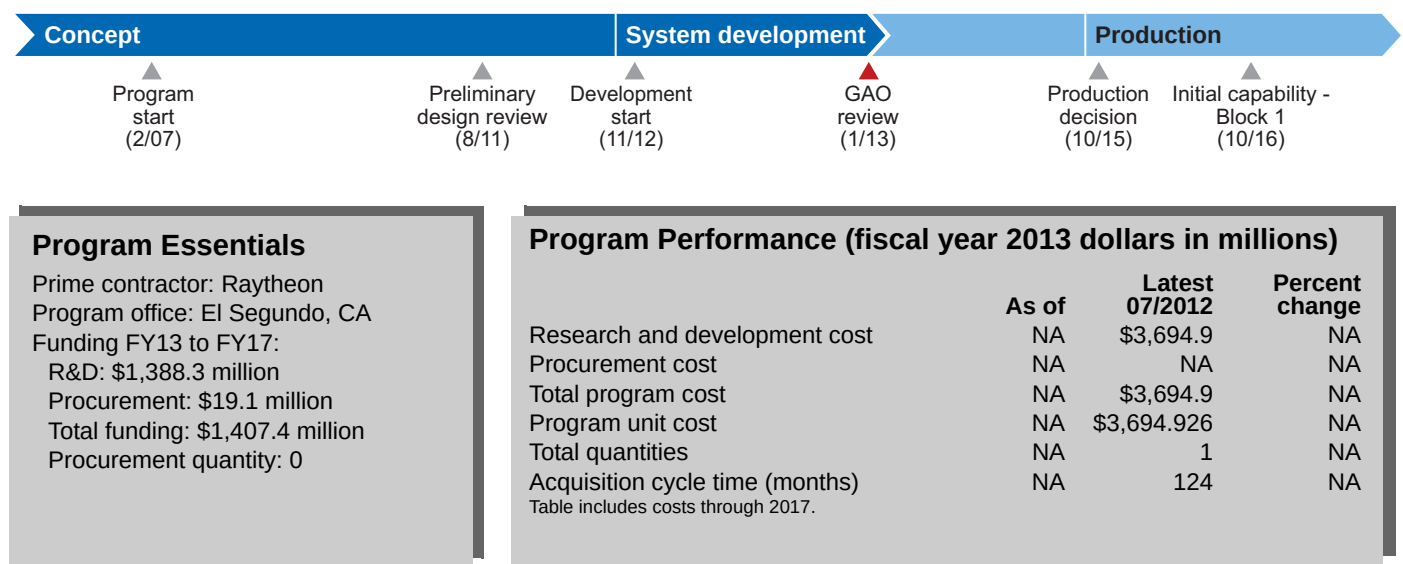
In commenting on a draft of this assessment, the Air Force noted that they used a navigation surrogate panel to reduce risks associated with the delayed integration of the GPS III navigation payload with the partial system prototype. The Air Force is pursuing dual launching GPS III for affordability and constellation replenishment purposes. The GPS and Launch Directorates plan to conduct thorough systems engineering, mission analysis, and design efforts to enable dual launch beginning with space vehicles 9 and 10. Both program offices are coordinating on final requirements that will flow to United Launch Alliance. Early studies indicate minor changes will be needed to support this capability beginning with space vehicle 9. If the dual payload adapter is available early, design and development is complete, and space vehicle changes are found to be minor with minimal to no cost impacts, GPS could dual launch earlier. The Air Force also provided technical comments, which were incorporated where deemed appropriate.

GPS III OCX Ground Control Segment (GPS OCX)

The Air Force's Global Positioning System Next Generation Operational Ground Control System (GPS OCX) will replace the current ground control system for all legacy and new GPS satellites. GPS OCX is expected to ensure reliable and secure delivery of position and timing information to military and civilian users. The Air Force plans to develop GPS OCX in blocks, with each block delivering upgrades as they become available. We assessed the initial three blocks, which support the launch, checkout and operation of GPS II and III satellites.



Source: GPS Directorate



Program Essentials

Prime contractor: Raytheon
 Program office: El Segundo, CA
 Funding FY13 to FY17:
 R&D: \$1,388.3 million
 Procurement: \$19.1 million
 Total funding: \$1,407.4 million
 Procurement quantity: 0

GPS OCX entered system development in November 2012 with its 14 technologies not yet fully mature. The program completed a preliminary design review in August 2011—4 months later than planned. The cost plus incentive-award fee contract for system development of blocks 1 and 2 was awarded in February 2010 before the program received formal approval to enter system development. According to program officials, the program later added block 0 to the contract, which accelerated the delivery of the GPS III launch and checkout system. According to program officials, 50 percent of block 1, which enables command and control of the GPS II and III satellites, is completed but the complexity of the software development effort has proven challenging. While GPS OCX block 0 will provide basic launch and checkout capabilities, block 1 will not be fielded in time to support the first GPS III satellite.

Attainment of Product Knowledge	
Projected as of January 2013	
Resources and requirements match	
• Demonstrate all critical technologies in a relevant environment	●
• Demonstrate all critical technologies in a realistic environment	○
• Complete preliminary design review	●
Product design is stable	
• Release at least 90 percent of design drawings	
• Test a system-level integrated prototype	
Manufacturing processes are mature	
• Demonstrate critical processes are in control	
• Demonstrate critical processes on a pilot production line	
• Test a production-representative prototype	
● Knowledge attained	 Information not available
○ Knowledge not attained	Not applicable

GPS OCX Program

Technology Maturity

GPS OCX is expected to provide capabilities in three increments: block 0, block 1, and block 2. block 0 provides initial capability for launch control and checkout of GPS III satellites. Block 1 is designed to operate legacy and new GPS satellites, to include new civilian signals, and block 2 is expected to deliver command and control capability for new international and modernized military signals. GPS OCX entered system development in November 2012 with its 14 critical technologies nearing maturity. Program officials said that they are testing the technologies in iterations and have completed three of the six iterations necessary to complete block 0 and block 1 testing. Information assurance and cyber defense are key components of block 1 and testing of these capabilities is scheduled to begin during fiscal year 2013. Program officials noted that these components require coordination across various parties in order to certify these capabilities and may prove challenging. Officials noted that block 0 has not completed qualification and integration testing with the GPS III space vehicle, and if this vehicle changes additional testing of block 0 and block 1 may be necessary. Software development and testing iterations for block 2 will begin in fiscal year 2014.

Other Program Issues

The program has experienced significant requirements instability and schedule delays while in technology development. According to program officials, the first three of six software packages that provide capabilities for block 0 and 1 have been completed, but the complexity and low contractor productivity for the software development effort has proven challenging. For example, the contractor initially underestimated the scope and complexity of the necessary information assurance requirements which required additional personnel with the necessary expertise and increased government management.

Aligning the schedules of GPS OCX and the GPS III satellite is a considerable risk for the program. According to Air Force officials, the first GPS III satellite launch date was rescheduled for May 2015 to align with the delivery of block 0. Any delays to block 0 would further delay the launch given that the

current ground control segment is not capable of supporting GPS III. While block 0 will support launch and check out of the GPS III satellite, block 1 must be operational to command and control GPS III satellites on orbit, control legacy GPS civil signals and satellites, and operate precise military signals. OCX block 1 is scheduled to become operational by October 2016, about 17 months after the first planned GPS III satellite launch; however, the most recent independent program assessment estimated mid- to-late fiscal year 2017 for operations to begin. Although block 0 will provide basic launch and check out capabilities for the first GPS III satellite, the GPS OCX block 1 will not be fielded in time to support the launch of the first GPS III satellite. Block 2 must be operational in order for GPS III to use international and military signals; availability is currently scheduled for 2017.

Program Office Comments

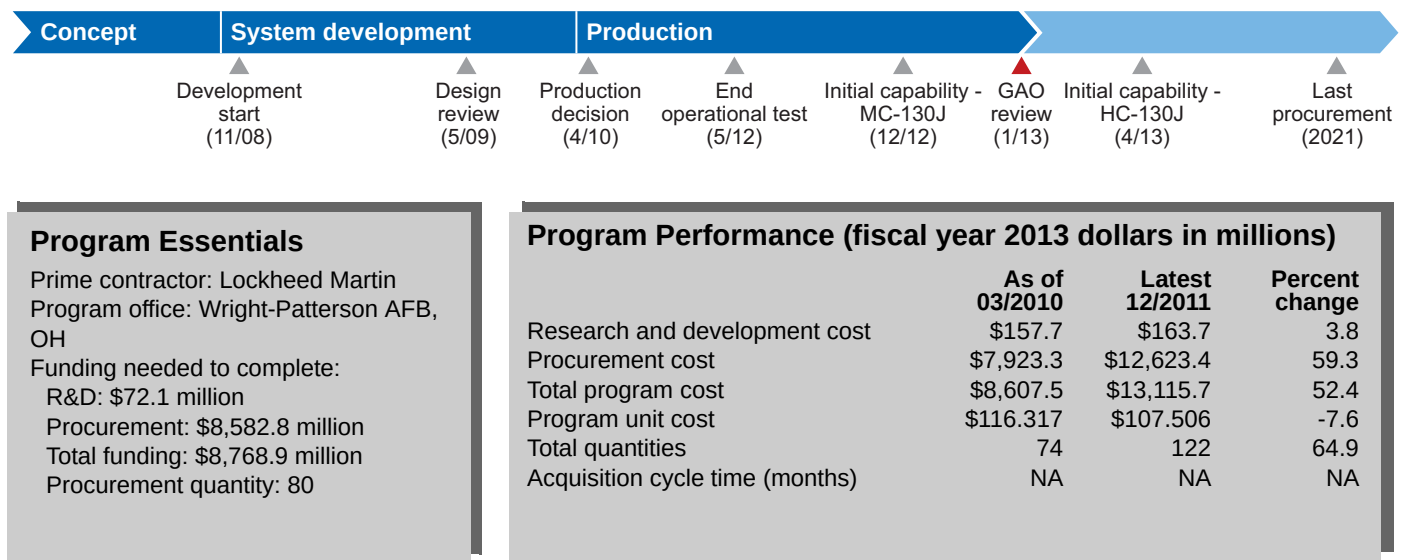
In commenting on a draft of this assessment, the program office provided technical comments, which were incorporated where deemed appropriate.

HC/MC-130 Recapitalization Program

The Air Force's HC/MC-130 Recapitalization program will replace aging Air Force HC-130P/N and Air Force Special Operations Command MC-130E/P/W/H aircraft with a multi-mission tactical aircraft based on the KC-130J platform. The primary mission of HC/MC-130J aircraft will be to provide aerial refueling, but it will also position, supply, re-supply, and recover specialized tactical ground units. The program includes a core configuration and two increments that provide additional capabilities.



Source: HC/MC-130J Program Office.



The HC/MC-130J program entered production in April 2010 with mature critical technologies, a stable design, and manufacturing processes that were in control. The HC/MC-130J design is derived from the KC-130J aerial refueling tanker, and shares many of the same technologies; the system that allows it to receive fuel in-flight and the electro-optical/infrared turret mount are unique. According to program officials, the HC/MC-130J completed initial operational testing ahead of schedule in May 2012. The MC-130J achieved initial operating capability (IOC) in December 2012 and the HC-130J is on track for IOC in April 2013. Program officials stated that the Air Force has determined that a previously planned third increment of the program will not be required and that Increment II will be the common baseline configuration for all HC/MC-130J aircraft.

Attainment of Product Knowledge	
As of January 2013	
Resources and requirements match	
• Demonstrate all critical technologies in a relevant environment	●
• Demonstrate all critical technologies in a realistic environment	●
• Complete preliminary design review	●
Product design is stable	
• Release at least 90 percent of design drawings	●
• Test a system-level integrated prototype	●
Manufacturing processes are mature	
• Demonstrate critical processes are in control	●
• Demonstrate critical processes on a pilot production line	○
• Test a production-representative prototype	●
● Knowledge attained	 Information not available
○ Knowledge not attained	Not applicable

HC/MC-130 Recapitalization Program

Technology and Design Maturity

The HC/MC-130 Recapitalization program entered system development in November 2008 with both of its critical technologies—the electro-optical/infrared turret mount and the universal aerial refueling receptacle slipway installation (UARRSI)—mature. Several of HC/MC-130J's technologies are common with KC-130J, including the rotary wing aerial refueling system.

As was reported last year, the HC/MC-130J design was stable at critical design review in May 2009. However, program officials stated that there have been changes for the Increment II design including upgraded power units and mission computers to provide additional capabilities.

Production Maturity

As previously reported, the HC/MC-130J program entered production in April 2010 with manufacturing processes that were in control. Program officials stated that all Increment 0 and Increment I aircraft have since been delivered, representing 12 of the planned 122 aircraft. Previously, the Air Force planned to procure 40 Increment II aircraft before transitioning to Increment III. According to program officials, the Air Force decided as part of the fiscal year 2014 program planning process that Increment III is not required for its mission needs. Instead, 110 Increment II aircraft will be procured and the 12 previously delivered aircraft will be modified to bring them to the Increment II configuration.

Other Program Issues

The program completed initial operational testing in May 2012, 3 months after the start of testing, and the report was issued in October 2012. Program officials stated that operational testing finished ahead of schedule because the program was able to execute tests at or near established benchmarks. In addition, the program was able to delete 75 to 100 test points through risk reduction efforts in ground, contractor, and developmental testing. This testing paid particular attention to the critical technologies.

Program officials told us that 31 deficiencies were identified during developmental tests. Among these was the ability of a countermeasures dispenser to

function during aerial refueling, which was resolved prior to the start of operational tests. Officials stated that it is up to Air Force Special Operations Command and Air Combat Command to resolve the remaining deficiencies.

A program official indicated that an undefinitized contract action was issued in October 2012 for Lot 4 aircraft production and definitization of the contract is not expected until August 2013. Definitization depends on Lockheed Martin—the prime contractor—reaching agreement on the sufficiency and auditability of their final contract proposal with DOD. This target date is well beyond the 180 days required by federal acquisition regulations. GAO has previously found that undefinitized contract actions transfer additional cost and performance risks to the government as contracting officers normally reimburse contractors for all allowable costs incurred. Further, the government also risks incurring unnecessary costs as requirements may change before the contract is definitized.

As requested, we reviewed whether individual subcontracting reports from the prime contractor for the program were accepted on eSRS. The government uses subcontracting reports on eSRS as one method of monitoring small business participation. As of December 2012, eSRS indicated that none of the subcontracting reports for HC/MC 130's two contracts have been accepted.

Program Office Comments

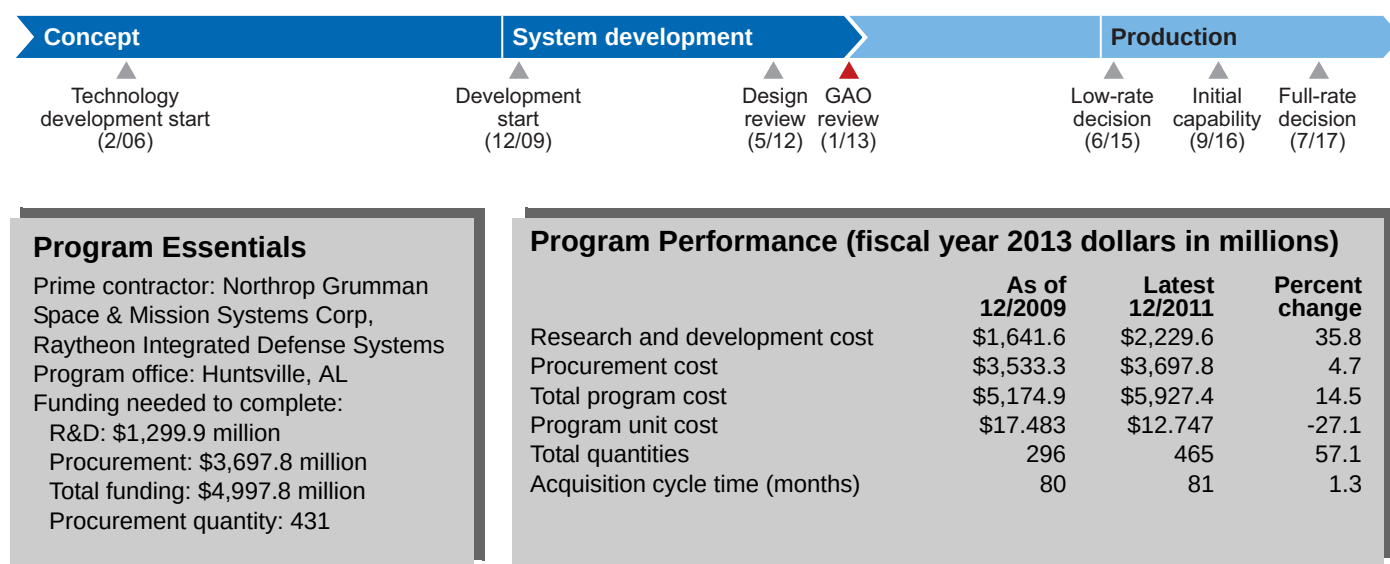
In commenting on a draft of this assessment, the program office provided technical comments, which were incorporated where deemed appropriate.

Integrated Air and Missile Defense (IAMD)

The Army's Integrated Air and Missile Defense (IAMD) program is being developed to network sensors, weapons, and a common battle command system across an integrated fire control network to support the engagement of air and missile threats. The IAMD Battle Command System (IBCS) will provide a capability to control IAMD sensors and weapons, such as the Warfighter Information Network-Tactical (WIN-T) and Patriot launcher and radar, through an interface module that supplies battle management data and enables networked operations.



Source: Northrop Grumman.



IAMD completed its critical design review in May 2012 with a stable design and technologies nearing full maturity, but does not plan to demonstrate the design can perform as expected until February 2014. IAMD's mission has not changed, but changes to its plans for integrating with other systems have significantly increased the size of its software effort, delayed its subsystem design reviews, and increased development costs by over \$551 million. These changes include adding Patriot launcher and radar functionality directly onto the integrated fire control network and increasing the number of units by 146 units to 431 total production units. WIN-T integration is also a significant risk.

Attainment of Product Knowledge	
As of January 2013	
Resources and requirements match	
• Demonstrate all critical technologies in a relevant environment	●
• Demonstrate all critical technologies in a realistic environment	○
• Complete preliminary design review	●
Product design is stable	
• Release at least 90 percent of design drawings	●
• Test a system-level integrated prototype	○
Manufacturing processes are mature	
• Demonstrate critical processes are in control	●
• Demonstrate critical processes on a pilot production line	○
• Test a production-representative prototype	○
● Knowledge attained	 Information not available
○ Knowledge not attained	Not applicable

IAMD Program

Technology Maturity

Program officials estimate that IAMD technologies will not be fully mature until its planned production decision in 2015. The IAMD program entered system development in December 2009 with its four critical technologies—battle command, integrated defense design, integrated fire control network, and distributed track management—nearing maturity, according to an Army technology readiness assessment based on a notional design. The Army updated the technology readiness assessment in March 2011 based on the winning contractor's design and reached the same conclusion about the technologies' maturity. The Office of the Assistant Secretary of Defense for Research and Engineering concurred with the assessment, but noted that integration with WIN-T is a significant risk. It also noted that the assessment was based on modeling and simulations of WIN-T and assumptions about performance. As a result, it recommended realistic, full-scale testing with WIN-T prior to a production decision.

Design Maturity

While the IAMD program has released nearly all of its total expected drawings and held a system-level design review in May 2012, DOD delayed completion of the design review approximately 6 months until several issues were resolved in November 2012. For example, the network interface for the Patriot launcher was not complete due to design changes and subsequent programmatic issues resulted in a late contract award. In addition, three risks related to network modeling, parts and materials processes, and obsolescence plans were resolved in November 2012 and, in turn, the system level review was considered complete. While these outstanding issues were resolved, tests of a fully integrated system-level prototype are not expected to begin until February 2014, over 20 months after design review. The Medium Extended Air Defense System and Surface-Launched Advanced Medium-Range Air-to-Air Missile are no longer planned to be integrated with the system because those programs have been curtailed or canceled.

Other Program Issues

IAMD's development costs have risen by about 36 percent, or over \$551 million, since beginning development and may increase further. The Army

restructured the program to incorporate the Patriot launchers and radars on the integrated fire control network and to increase the number of production units procured from 285 to 431 to account for adjustments to the battalion force structure and accelerating the fielding of capabilities. According to program officials, increasing the number of units will provide for a common command and control at all organizational levels. Program officials now estimate the size of the software development effort at over 6.6 million lines of code—a 37 percent increase over the estimate at development start. In addition, about 63 percent of this code will be newly developed code or auto-generated code which requires more effort to develop than pre-existing or modified code. The cost of the additional software has not yet been finalized, but program officials estimate that it will add 6 months to the effort.

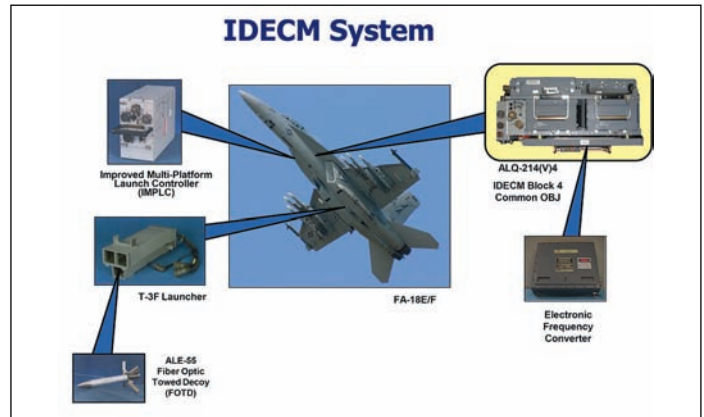
As requested, we reviewed whether individual subcontracting reports from the prime contractor for the program were accepted on eSRS. The government uses subcontracting reports on eSRS as one method of monitoring small business participation. As of December 2012, eSRS indicated that 1 of 2 associated subcontracting reports for IAMD's two contracts have been accepted.

Program Office Comments

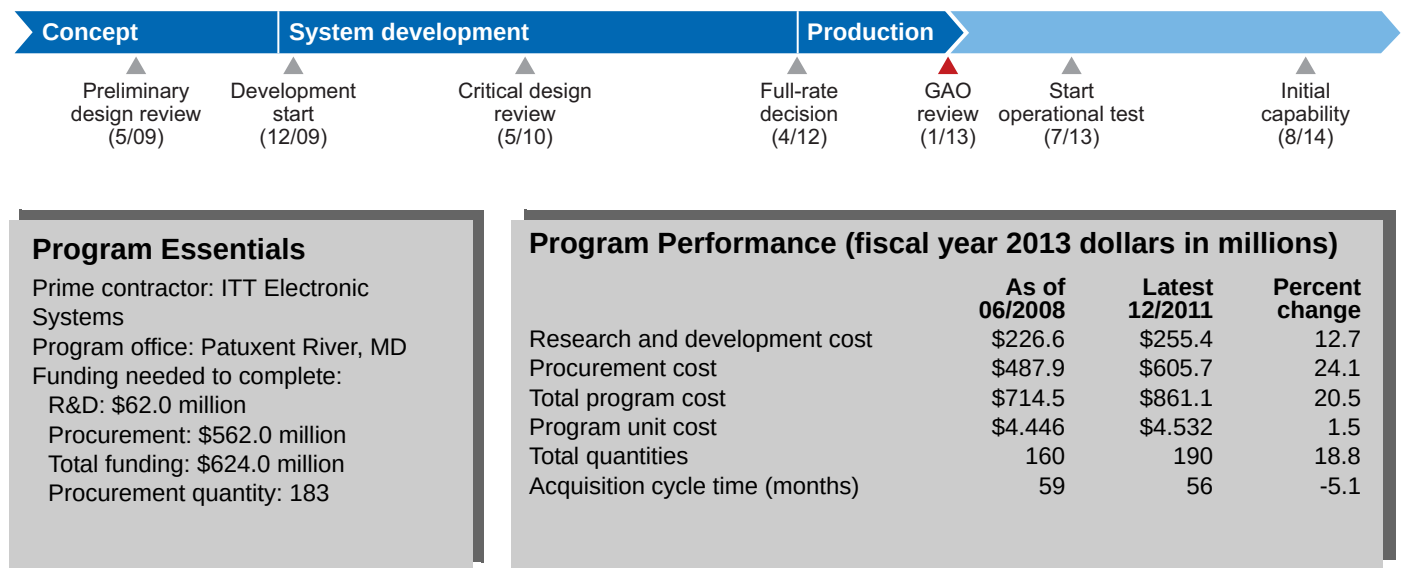
In commenting on the draft of this assessment, the IAMD program office stated that, with respect to the over \$551 million increase in the program, these funds were added as a result of the additional items brought into the program as a product improvement. The program office also stated that the 6-month delay has already been updated and approved in the baseline for low-rate production, and that the baseline program remains within its original cost and schedule projections for an initial capability in 2016. The program office also provided technical comments, which were incorporated where deemed appropriate.

Integrated Defensive Electronic Countermeasures (IDECM) Block 4

The Navy's IDECM is a radio frequency, self-protection electronic countermeasure designed to improve the survivability of F/A-18 aircraft against guided threats during air-to-ground/surface and air-to-air missions. The system consists of onboard components that receive and process radar signals and onboard and offboard jammers. IDECM is being developed incrementally; each block improves jamming or decoy capabilities. The Navy has fielded three IDECM blocks; block 4 will extend onboard jamming capabilities for F/A-18C/D aircraft.



Source: U.S. Navy.



IDECM block 4 entered full-rate production in April 2012 with mature technologies and a stable design. Block 4 primarily replaces the previous IDECM onboard jammer with a lightweight repackaged version. There is some concurrency risk on the program as the Navy has entered full-rate production before completion of ground and flight testing, which could drive costly design changes or retrofits if the redesigned jammer does not perform as intended. Program officials stated that this concurrency is necessary in order to maintain the production line from block 3 to block 4 and to meet the August 2014 initial operational capability date.

Attainment of Product Knowledge	
As of January 2013	
Resources and requirements match	
• Demonstrate all critical technologies in a relevant environment	●
• Demonstrate all critical technologies in a realistic environment	●
• Complete preliminary design review	●
Product design is stable	
• Release at least 90 percent of design drawings	●
• Test a system-level integrated prototype	●
Manufacturing processes are mature	
• Demonstrate critical processes are in control	●
• Demonstrate critical processes on a pilot production line	●
• Test a production-representative prototype	●
● Knowledge attained	 Information not available
○ Knowledge not attained	Not applicable

IDECM Block 4 Program

Technology Maturity

IDECM block 4 began system development in 2009 as an engineering change proposal to the existing block 3 onboard jammer. Block 4 will reconfigure the ALQ-214 (V)3 onboard jammer, currently only installed in the F/A-18E/F aircraft, to a common configuration—ALQ-214 (V)4—to be installed on F/A-18C/D and F/A-18E/F aircraft. In April 2009, a technology readiness assessment concluded that there were no critical technologies in the ALQ-214 (V)4 and that the system was based on mature technologies.

Design and Production Maturity

IDECM block 4's design is stable; however, there is still risk in the IDECM block 4 program, because it began full rate production of seven units in April 2012 before developmental testing was completed. The block 4 onboard jammer is a redesign of the jammer used in earlier blocks and will perform the same function as found in IDECM blocks 2 and 3, but with a different form. This redesign was driven by the need to reduce weight in order to accommodate the IDECM onboard system on F/A-18C/D aircraft. The Navy transitioned from block 3 production to block 4 production, bypassing low-rate production and proceeding directly to a full-rate production decision, before the redesigned system completed ground and flight testing. This concurrent production and testing strategy could drive costly design changes and retrofits to units in production if the redesigned jammer does not perform as intended. Officials stated that this concurrency is necessary in order to maintain the production line and to meet the August 2014 initial operational capability date for block 4. To mitigate the concurrency risk, Navy officials stated that the firm-fixed price production contract requires the contractor to deliver units that incorporate any design changes required as a result of deficiencies discovered in testing.

Other Program Issues

As requested, we reviewed whether individual subcontracting reports from the prime contractor for the program were accepted on eSRS. The government uses subcontracting reports on eSRS as one method of monitoring small business

participation. As of December 2012, eSRS indicated that the associated subcontracting report for IDECM block 4's contract has been accepted.

Program Office Comments

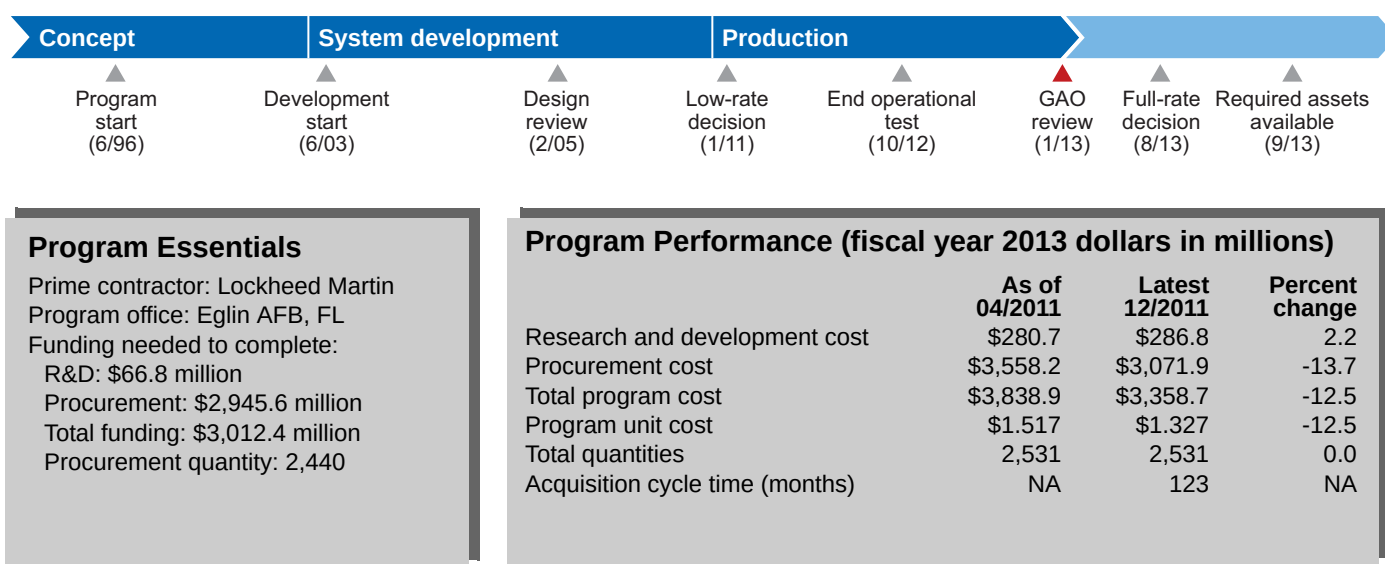
According to the program office, IDECM block 4 is an engineering change proposal to the ALQ-214(V)3 currently in full-rate production. The new hardware configuration was cut into production in April 2012. The program office believes the cost risk associated with this production decision is low. While the production line transition to the new configuration has occurred prior to the completion of flight test, all testing will be completed prior to delivery to the fleet in 2014. To date, 17 systems have been delivered that have been used to complete operational assessment and continue to be used during development testing. The firm fixed price production contract further mitigates risk by requiring the contractor to deliver assets which meet the government specifications, including incorporation of any design changes identified during the testing which is concurrent with production. For those assets already in build, the contractor would be required to retrofit the changes into those assets at no additional cost. The program also provided technical comments, which were incorporated as deemed appropriate.

Joint Air-to-Surface Standoff Missile Extended Range (JASSM-ER)

The Air Force's JASSM-ER program plans to field a next-generation cruise missile capable of destroying the enemy's war-sustaining capability from outside its air defenses. JASSM-ER missiles are low-observable, subsonic, and have a range of greater than 500 miles. They provide both fighter and bomber crews the ability to strike heavily defended targets early in a campaign. JASSM-ER is a follow-on program to the JASSM baseline program. The two missiles' hardware is 70 percent common and their software is 95 percent common.



Source: JASSM-ER Integrated Test (IT)-2- Program Office.



The JASSM-ER program office plans to begin receiving deliveries of low-rate production missiles in the first quarter of fiscal year 2013 and successfully demonstrated its technologies and design through operational testing in October 2012. Program officials stated that the production processes are in control although the data on critical manufacturing processes are not directly available to them and were not provided for our analysis. Program officials state they have overcome production issues and have not experienced any delays in production deliveries. According to the Defense Contract Management Agency (DCMA), the program continues to operate at a moderate risk because of multiple program and technical risks, such as a lack of availability of fuzes, which present the possibility of schedule delays.

Attainment of Product Knowledge	
As of January 2013	
Resources and requirements match	
• Demonstrate all critical technologies in a relevant environment	●
• Demonstrate all critical technologies in a realistic environment	●
• Complete preliminary design review	
Product design is stable	
• Release at least 90 percent of design drawings	●
• Test a system-level integrated prototype	●
Manufacturing processes are mature	
• Demonstrate critical processes are in control	
• Demonstrate critical processes on a pilot production line	●
• Test a production-representative prototype	●
● Knowledge attained	 Information not available
○ Knowledge not attained	Not applicable

JASSM-ER Program

Technology and Design Maturity

According to the program office, JASSM-ER's five critical technologies—the engine lube system, engine system, fuse, low observable features, and global positioning system—are mature and have been tested in a realistic environment using a production-representative test missile.

JASSM-ER's design is currently stable and has been successfully demonstrated in operational tests. According to the program office, the number of configuration changes has decreased over time with only one significant design change in the last 2 years. Program officials attribute much of JASSM-ER's design stability to its commonality with the JASSM baseline program currently in production.

Production Maturity

The JASSM-ER program office plans to begin receiving deliveries of low-rate production missiles in the first quarter of fiscal year 2013 with the capability in place to begin full-rate production in August 2013. In June 2012, the program awarded the contract for the second lot of 30 low-rate production missiles and plans to award the contract for a third lot of low-rate production missiles in January 2013.

Program officials stated that the production processes are in control although the data on critical manufacturing processes are not directly available to them and were not provided for our assessment. According to program officials, collection of this data is not a contractual requirement. However, program officials stated the contractor compiles and shares manufacturing data with the program office, which allows them to verify the production processes.

Program officials stated that while they have encountered production problems, the program has not experienced any delays. Last year, we reported the program discovered an engine oil leak and all engines were returned to the manufacturer to have corrective actions installed. Program officials stated that while the engines were at the manufacturer's facility, an additional problem—metal shavings in the oil—were discovered. Program officials stated they have resolved the problems and that all

engines have been retrofitted with the needed repairs with no effect on the program's production schedule.

Although the program has not encountered any delays in production deliveries, DCMA assessed the program at a moderate risk because of multiple program and technical risks which present the possibility of schedule delays. For example, the program's most significant issue is a lack of fuzes due to prior production issues. Program officials stated they plan to utilize an electronic safe and arm fuze in later production to improve reliability and enable electronic testing of each fuze as opposed to firing a sample of the fuzes—the method by which the current fuze is tested.

Other Program Issues

According to the program office, they successfully completed operational testing in October 2012 with initial results indicating the missiles achieved a direct hit on 16 out of 16 targets. Program officials stated since 2006, JASSM-ER successfully performed 26 out of 27 flight tests, including developmental, integrated, and operational testing.

As requested, we reviewed whether individual subcontracting reports from the prime contractor for the program were accepted on eSRS. The government uses subcontracting reports on eSRS as one method of monitoring small business participation. As of December 2012, eSRS indicated that none of the two subcontracting reports for JASSM-ER's two contracts have been accepted. According to program officials, JASSM-ER's contractor, Lockheed Martin, submits one subcontracting business plan for the entire corporation. The current plan covers activities until September 2013.

Program Office Comments

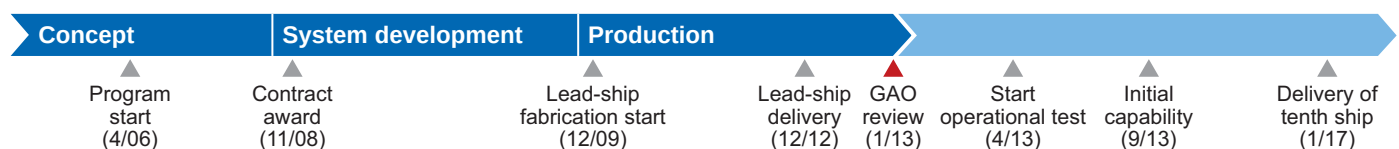
In commenting on a draft of this assessment, the Air Force provided technical comments, which were incorporated where deemed appropriate.

Joint High Speed Vessel (JHSV)

Formerly a joint program with the Army, JHSV is a Navy program to acquire high-speed, shallow-depth vessels for rapid intratheater transport. The ship, based on a commercial design, will be capable of operating without relying on shore-based infrastructure. The program received approval to build 18 ships in October 2008, but that number has since been reduced to 10. The lead ship was delivered in December 2012, 12 months later than planned, and three are currently under construction.



Source: Austal USA.



Program Essentials

Prime contractor: Austal USA
 Program office: Washington Navy Yard, DC
 Funding needed to complete:
 R&D: \$3.0 million
 Procurement: \$309.3 million
 Total funding: \$312.3 million
 Procurement quantity: 1

Program Performance (fiscal year 2013 dollars in millions)

	As of 02/2009	Latest 08/2012	Percent change
Research and development cost	\$132.2	\$128.6	-2.7
Procurement cost	\$3,609.6	\$2,012.5	-44.2
Total program cost	\$3,741.8	\$2,141.1	-42.8
Program unit cost	\$208.875	\$214.113	3.0
Total quantities	18	10	-44.4
Acquisition cycle time (months)	78	89	14.1

The JHSV program began lead-ship fabrication in December 2009 with its critical technologies mature, but without a stable design. According to program officials, the ship's three-dimensional design was completed in September 2010. The American Bureau of Shipping (ABS) approved the design in May 2012. The lead ship was launched in September 2011 and delivered in December 2012 after a 12-month delay. The second ship was launched in October 2012 with delivery expected in May 2013, and the third and fourth ships are currently under construction. The lead ship continues to experience problems with engines and corrosion in its water jet propulsion area. Program office officials also cite the availability of resources at the shipyard as a top management concern for follow-on ships.

Attainment of Product Knowledge

As of January 2013

Resources and requirements match

- Demonstrate all critical technologies in a relevant environment ●
- Demonstrate all critical technologies in a realistic environment ●
- Complete preliminary design review ●

Product design is stable

- Complete three-dimensional product model ●
- Test a system-level integrated prototype

Manufacturing processes are mature

- Demonstrate critical processes are in control
- Demonstrate critical processes on a pilot production line
- Test a production-representative prototype

- Knowledge attained
- Knowledge not attained

- Information not available
- Not applicable

JHSV Program

Technology and Design Maturity

The JHSV program began lead-ship fabrication in December 2009 with all 18 of its critical technologies mature and demonstrated in a realistic environment, but without a stable three-dimensional design. According to program officials, the ship's three-dimensional design was not completed until September 2010, 9 months after fabrication began. The shipyard did not have all drawings approved by ABS prior to the start of fabrication. This led to out-of-sequence work and additional rework to account for design changes, all of which contributed to cost overruns, schedule delays, and a significant increase in the weight of the ship that could impact ship performance. ABS did not approve the design until May 2012. With the exception of changes to correct issues identified with the lead ship, the Navy does not anticipate design changes on follow-on ships.

Production Maturity

The lead ship was delivered in December 2012 after a 12-month delay. The second ship was launched in October 2012, with about 91 percent of construction completed. Delivery is expected to occur in May 2013. The third and fourth ships are currently under construction and are on schedule to meet contracted delivery dates.

The program is examining weight reduction measures, but such measures may only realize reductions on later ships. In addition, inspection of the water jet propulsion area of the lead ship showed signs of corrosion and required drydocking. Austal USA, the shipyard that is constructing the JHSV, is also building a variant of the Littoral Combat Ship (LCS) Seaframes, which experienced similar corrosion problems. According to Austal officials, the JHSV will not receive the same corrective measures as the LCS, but rather the existing system will be modified with additional corrosion protection features. JHSV also shares the same main propulsion diesel engine that is used on Austal's version of the LCS Seaframes. During early testing of the engine, deficiencies prompted design changes that officials state are being incorporated onto the fourth and subsequent ships. Program officials indicated the Navy is working with the

shipyard and engine manufacturer to determine how to address any changes to the existing engines in the first three ships.

Other Program Issues

During production of the first JHSV, the shipyard initiated several facility upgrades and production process improvements, which the shipyard believes will enable it to build at the Navy's required rate of two JHSV and two LCS Seaframes per year. In addition, the shipyard has more than tripled the size of its workforce and partnered with the state of Alabama to establish a training facility, which along with its apprentice program accounted for almost 40 percent of Austal's new hires in 2011. Nevertheless, the program office considers competition for Austal's resources between the two shipbuilding programs to be one of its top management challenges, as the shipyard has yet to demonstrate the capability of producing the required four ships per year.

As requested, we reviewed whether individual subcontracting reports from the prime contractor for the program were accepted on eSRS. The government uses subcontracting reports on eSRS as one method of monitoring small business participation. As of December 2012, eSRS indicated that the subcontracting report for JHSV's contract has been accepted.

Program Office Comments

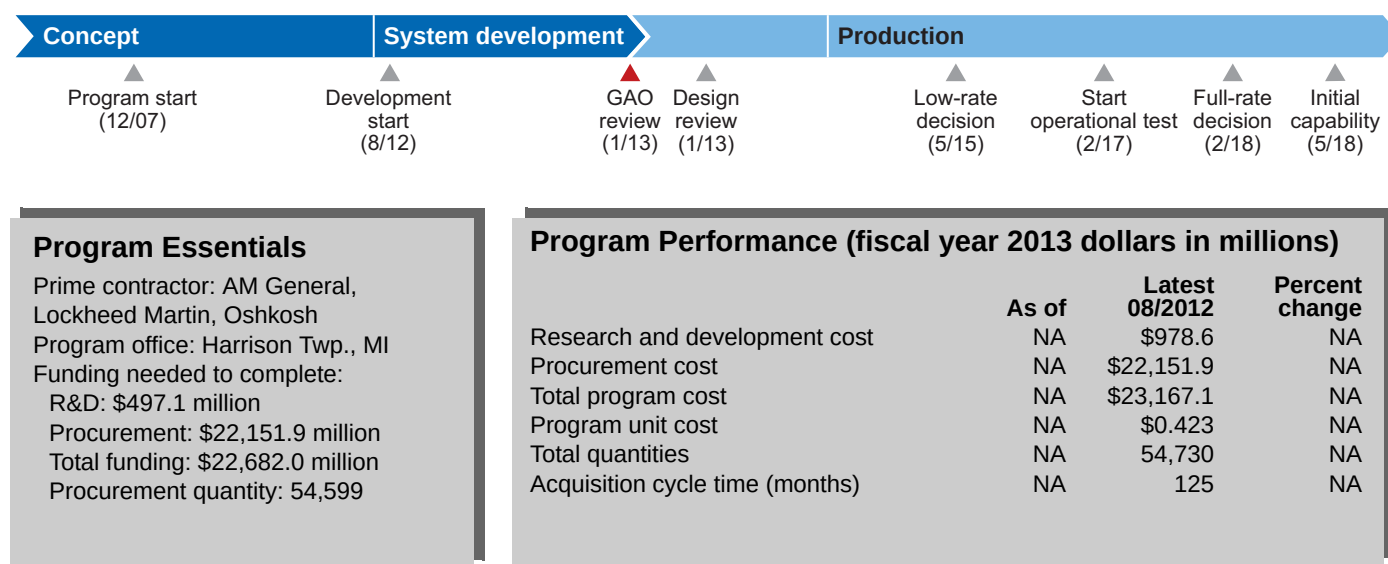
In commenting on a draft of this assessment, Navy officials noted that the Board of Inspection and Survey reported the lead ship's propulsion plant performed flawlessly during acceptance trials. Program officials said that at delivery the lead ship received interim certification from the ABS for unrestricted engine operation, and the Navy intends to hold the shipyard accountable for attaining final ABS engine certification. They noted that during pre-delivery preparations of the lead ship, the shipyard implemented modifications to the ship's cathodic protection and monitoring systems to ensure the ship met existing contractual corrosion control performance specifications. The shipyard has incorporated these modifications into the pre-launch construction scope for the remaining ships, and the Navy will monitor in-service performance of the lead ship to determine the need for other corrosion control changes. The Navy provided technical comments, which were incorporated where deemed appropriate.

Joint Light Tactical Vehicle (JLTV)

The Army and Marine Corps' JLTV is a family of vehicles being developed to replace the High Mobility Multipurpose Wheeled Vehicle (HMMWV) for some missions. The JLTV is expected to provide better protection for passengers against current and future battlefield threats, increased payload capacity, and improved automotive performance over the up-armored HMMWV; it must also be transportable. Two- and four- seat variants are planned with multiple mission configurations.



Sources: JPO JLTV EMD Industry Contractors (AM General, Oshkosh Corp. & Lockheed Martin)



The JLTV entered system development in August 2012 with its two critical technologies nearing maturity. In keeping with DOD policy calling for acquisition strategies that ensure competition throughout the program life cycle, the Army awarded three engineering and manufacturing development contracts with the goal of reducing risk and refining requirements. In lieu of a critical design review, the program will hold a design understanding review in January 2013.

Attainment of Product Knowledge	
As of January 2013	
Resources and requirements match	
• Demonstrate all critical technologies in a relevant environment	●
• Demonstrate all critical technologies in a realistic environment	○
• Complete preliminary design review	●
Product design is stable	
• Release at least 90 percent of design drawings	
• Test a system-level integrated prototype	
Manufacturing processes are mature	
• Demonstrate critical processes are in control	
• Demonstrate critical processes on a pilot production line	
• Test a production-representative prototype	
● Knowledge attained	 Information not available
○ Knowledge not attained	Not applicable

JLTV Program

Technology Maturity

As of March 2012, JLTV critical technologies—underbelly protection armor and side-kit armor—were approaching maturity and are expected to reach full maturity by the May 2015 production decision. The requirement for underbelly protection could prove especially challenging for JLTV. According to program documents, some of the components associated with the side-kit armor have already been proven in other military applications, thereby reducing risk for this technology. According to program documents, armor technologies are not expected to impede development. However, integrating the technologies to meet all system-level requirements for transportability, protection, and mobility could prove challenging.

Design Maturity

According to program documents, the Army does not plan to hold a formal critical design review during development because mature vehicle designs will be required at the time of contract award for engineering and manufacturing development. Instead, contractors will conduct a design understanding review in January 2013. According to program documents, the review will be at a level of detail similar to a critical design review and will demonstrate that the contractor's design matches the requirements. Following this review, contractors will maintain responsibility for configuration control and will inform the government of changes. The government will assume control of the design after the planned award of a single low-rate initial production contract in 2015.

Production Maturity

The Army does not intend to use process capability index data to assess production maturity, as recommended by our best practices. Instead, it intends to use other metrics, such as predicted assembly times and feasibility studies to assess production maturity by the date of the production readiness review currently scheduled for September 2014.

Other Program Issues

On the basis of the knowledge gained from the three technology development contracts which ended in May 2011, the Army and Marine Corps concluded the JLTV could not meet requirements

for both protection levels and transportability because of weight and relaxed the requirement to transport the vehicle by helicopter at high altitude and at certain temperatures. Subsequently, two variants—special purpose and command and control—were removed from the family of vehicles. The reliability, as measured by mean miles between operational mission failure, was also reduced from 3,600 to 2,400.

At the end of the development phase, a low rate initial production contract will be awarded to a single source through a full and open competition, unless a proper justification exists to limit sources. According to the Army, this strategy recognizes the possibility that multiple vendors could develop and test JLTV-compliant vehicles.

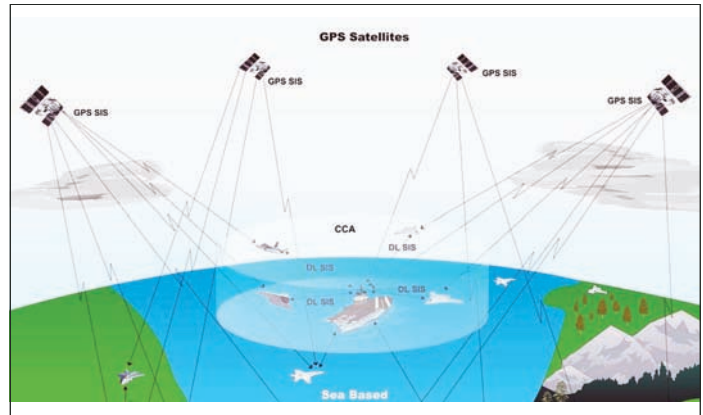
Finally, the Army plans to move ahead with the procurement of JLTV at about the same time that it plans to start the procurement of other new and costly programs like the Ground Combat Vehicle and the Armored Multi-Purpose Vehicle. The procurement of all three programs is expected to continue for a decade or more.

Program Office Comments

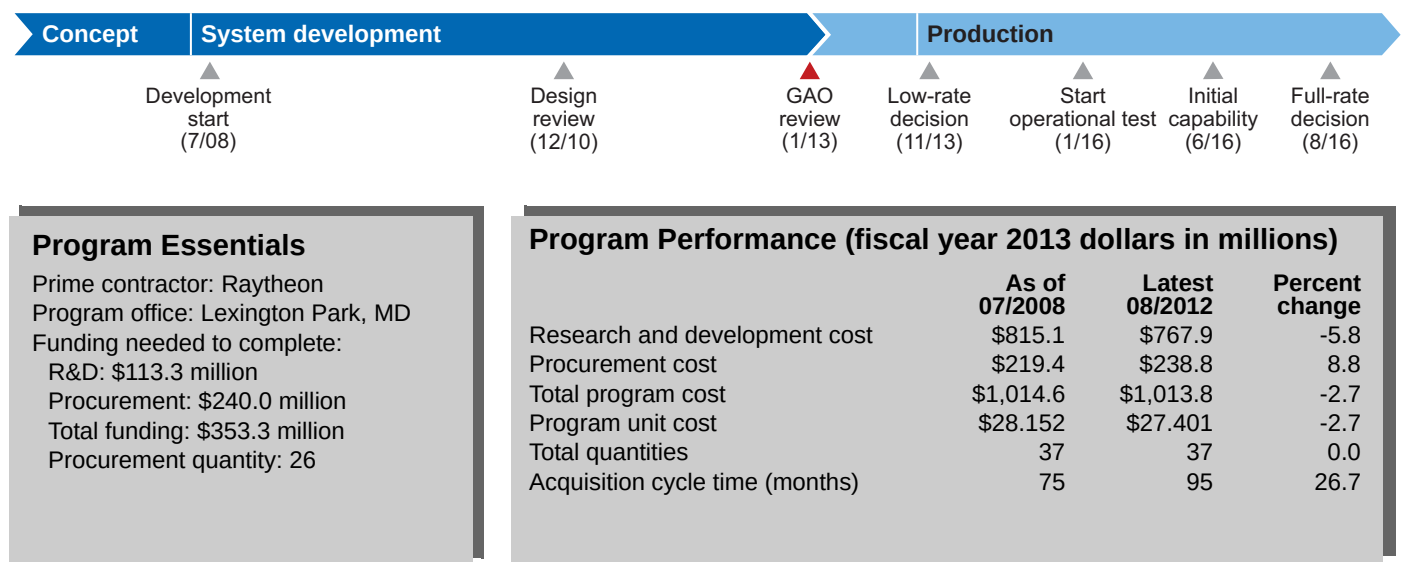
In commenting on a draft of this assessment, the program office provided technical comments, which were incorporated where deemed appropriate.

Joint Precision Approach and Landing System (JPALS) Increment 1A

JPALS Increment 1 is a Navy-led program developing a GPS-based aircraft landing system to replace current radar-based systems on its ships. It is designed to provide reliable precision approach and landing capability in adverse environmental conditions and improved interoperability. Increment 1A is the ship-based system and increment 1B will integrate JPALS with sea-based aircraft. Both are needed to provide the full capability. We assessed increment 1A and made comments on 1B.



Source: PMA-213, Navy Air Traffic Management Systems Program Office (PMA-213).



The JPALS program completed its critical design review in December 2010, without fully mature technologies and having demonstrated that the design can perform as expected. JPALS functionality is software based, and program officials report completing its baseline software development as of April 2012. The program began system-level flight testing of a prototype in July 2012 and, as of September 2012, had completed six flights with no major anomalies reported. Increment 1A's production decision moved to November 2013 due to delays for ship integrated testing, causing a schedule breach of the program's baseline. Increment 1B, which integrates JPALS into sea-based aircraft, delayed its start of system development from 2012 to 2015.

Attainment of Product Knowledge	
As of January 2013	
Resources and requirements match	
• Demonstrate all critical technologies in a relevant environment	●
• Demonstrate all critical technologies in a realistic environment	○
• Complete preliminary design review	●
Product design is stable	
• Release at least 90 percent of design drawings	●
• Test a system-level integrated prototype	●
Manufacturing processes are mature	
• Demonstrate critical processes are in control	●
• Demonstrate critical processes on a pilot production line	●
• Test a production-representative prototype	●
● Knowledge attained	 Information not available
○ Knowledge not attained	Not applicable

JPALS Increment 1A Program

Technology Maturity

JPALS Increment 1A began system development in July 2008 with its two critical technologies nearing maturity. Program officials expect to demonstrate both technologies in a realistic environment by the November 2013 production decision. JPALS functionality is primarily software based, and the program reported completing its baseline software development effort as of April 2012. Officials noted this included the integration and testing of the ship processing software, which was delayed 6 months to incorporate an updated version of an algorithm.

Design Maturity

The JPALS program held its critical design review in December 2010 and released all of its expected design drawings to manufacturing at that time; however, the program subsequently increased its released drawings total by 25 percent. The JPALS design is currently stable, and the program began system-level developmental testing of a prototype in July 2012 to show that it will perform as expected. The program has conducted six integrated flight tests as of September 2012 and officials noted that they have not identified any major anomalies.

Production Maturity

According to JPALS program officials, the program has not identified any critical manufacturing processes and the system is comprised primarily of off-the-shelf components. The program accepted delivery of its eighth and final engineering development model in June 2012. The program office stated that seven of these models are production representative and are designated for land or sea based testing.

The program reported a delay in its production decision from May 2013 to November 2013, resulting in a schedule breach against its acquisition program baseline. Program officials stated the delay was due to the availability of CVN 77 for installation and the ship-based integrated testing necessary to proceed with production. The program office reported completing JPALS installation on CVN 77 in November 2012.

Other Program Issues

According to program officials, system development for JPALS Increment 1B has been delayed from 2012 to 2015 due to adjustments in Navy priorities. They stated the delay will benefit the program by allowing increment 1B to develop as an avionics-centered approach for integration with sea-based aircraft rather than having an individual platform focus. In addition, program officials stated that if contract incentives are met in the development of increment 1A, the program may be able to incorporate capabilities intended for increments 3 and 4 at low risk with minimal additional investment. Increment 3 is designed to support auto-land capability, with increment 4 supporting unmanned aerial vehicles.

Program officials stated the increment 1A program will integrate JPALS onto 23 existing ships; incorporating JPALS on new ships is the responsibility of those respective programs.

As requested, we reviewed whether individual subcontracting reports from the prime contractor for the program were accepted on eSRS. The government uses subcontracting reports on eSRS as one method of monitoring small business participation. As of December 2012, eSRS indicated that the subcontracting report for JPALS Increment 1A's contract has not been accepted.

Program Office Comments

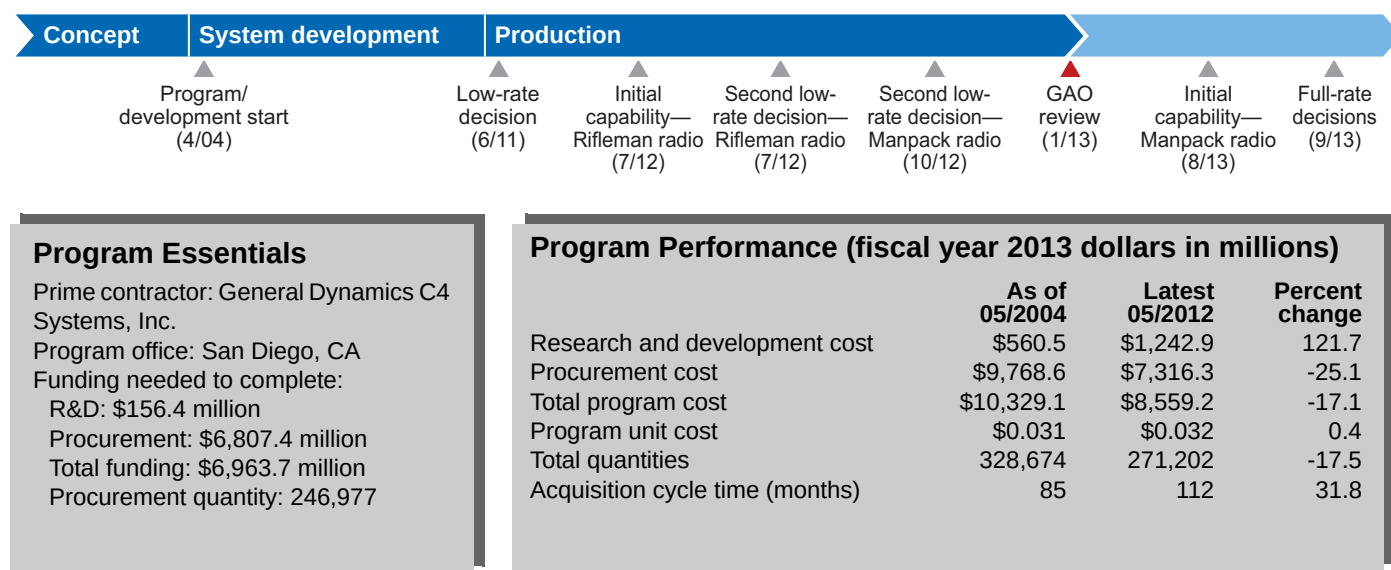
In commenting on a draft of this assessment, the JPALS program office noted that it concurred with our review. Flight testing is proceeding as planned and the system is performing as designed with no significant design or performance issues identified to date. The program is on track to execute a milestone C low-rate initial production review in November 2013 and contract award in January 2014. The program also provided technical comments, which were incorporated where deemed appropriate.

Joint Tactical Radio System (JTRS) Handheld, Manpack, and Small Form Fit (HMS) Radios

DOD's JTRS program is developing software-defined radios that will interoperate with existing radios and increase communications and networking capabilities. The JTRS HMS program is currently developing four radios: the Rifleman radio and small form fit radio D for unclassified use and the Manpack radio and small form fit radio B for use in a classified domain. A subset of the Manpack radios will be interoperable with the Mobile User Objective System (MUOS), a satellite communication system that will support radio terminals worldwide.



Source: © 2012 General Dynamics C4S.



The JTRS HMS program is conducting operational testing on both the Rifleman and Manpack variants but has not demonstrated maturity of all technologies and production processes. DOD test officials reported that the Manpack radio was not operationally effective or suitable based on the results of operational testing from April to May 2012. The radio performed better during follow-on tests, but reliability issues require additional development and demonstration. The program has been authorized to extend its low rate production to procure up to 10 percent of Rifleman radios and 5.3 percent of Manpack radios. Full-rate production decisions have been delayed for both variants and are anticipated in the third or fourth quarter of fiscal year 2013. Additionally, participation of additional contractors is complicating testing and support plans.

Attainment of Product Knowledge	
As of January 2013	
Resources and requirements match	
• Demonstrate all critical technologies in a relevant environment	●
• Demonstrate all critical technologies in a realistic environment	○
• Complete preliminary design review	●
Product design is stable	
• Release at least 90 percent of design drawings	●
• Test a system-level integrated prototype	●
Manufacturing processes are mature	
• Demonstrate critical processes are in control	○
• Demonstrate critical processes on a pilot production line	○
• Test a production-representative prototype	●
● Knowledge attained	... Information not available
○ Knowledge not attained	Not applicable

JTRS HMS Program

Technology and Design Maturity

Despite initiating operational testing on both variants, JTRS HMS has not demonstrated the maturity of all its critical technologies. JTRS HMS has yet to demonstrate one of the Rifleman radio's three critical technologies—the soldier radio waveform—or any of the Manpack radio's four critical technologies in a realistic environment. Additional testing is scheduled for both variants in fiscal year 2013.

According to program officials, the designs of both variants are stable, but reliability issues for the Manpack radio could require design modifications. The Manpack has not yet demonstrated an Army-defined reliability requirement enabling it to have an 86 percent chance of completing a 72-hour mission without an essential function failure. DOD test officials reported that the radio was not operationally effective or suitable based on the operational testing that concluded in May 2012. In October 2012, DOD testers reported that the Manpack radios only demonstrated a 64 percent chance of meeting the reliability requirement under the "benign conditions" of developmental testing, despite progress in other areas. Program officials attributed many of Manpack's reliability shortfalls to issues with the radio's peripherals and operators' lack of familiarity with the radio. They said they are updating their troubleshooting guides to help address this issue. Program officials stated additional technical risks involve connecting MUOS to Manpack, as development of the MUOS waveform software has slipped, leaving less time for integration before operational testing in February 2014.

Production Maturity

According to JTRS HMS officials, the program's manufacturing readiness is at a level consistent with DOD guidance, but not yet at a level that demonstrates that its critical manufacturing processes are in control. Program officials reported that one specific manufacturing issue identified with the first 100 low-rate Manpack radios created a breakdown of signals within the radio. However, they said a new process is in place, and the second low-rate production lot of 3,726 radios will not be affected.

Other Program Issues

Both variants of JTRS HMS have experienced schedule slips since last year's assessment. The Manpack's second low-rate decision, which authorized HMS to procure up to 5.3 percent of the variant's total quantity, slipped from March to October 2012 amid poor test results, and the program office expects the full-rate decision will slip from December 2012 to the second half of fiscal year 2013. The program office expects the Rifleman's full rate decision will also slip to the second half of fiscal year 2013, from May 2012. In July 2012, OSD authorized the program to extend the Rifleman's low-rate procurement to 10 percent of its total planned procurement quantity, and directed the program to conduct a full and open competition for full-rate contracts. OSD also required full and open competition for the Manpack, and program officials said the participation of additional contractors is complicating testing and support plans.

As requested, we reviewed whether individual subcontracting reports from the prime contractor for the program were accepted on eSRS. The government uses subcontracting reports on eSRS as one method of monitoring small business participation. As of December 2012, eSRS indicated that the subcontracting report for JTRS HMS' contract has not been accepted.

Program Office Comments

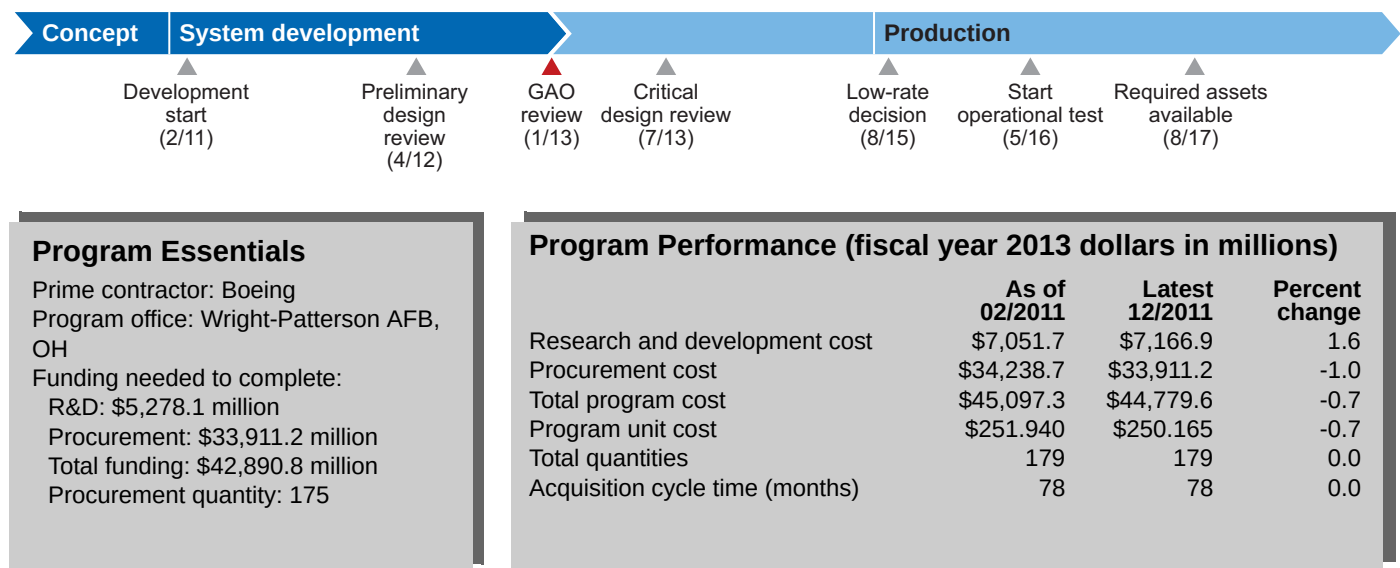
In commenting on a draft of this assessment, the program office provided technical comments, which were incorporated where deemed appropriate.

KC-46 Tanker Modernization Program

The KC-46 program is the first of three planned phases to replace the Air Force's aging fleet of KC-135 aerial refueling tankers. The planned development and production of 179 aircraft would replace about two-fifths of the KC-135 fleet. Designed with more refueling capacity, improved efficiency, and increased cargo and aeromedical evacuation capabilities than its predecessor, the KC-46 is intended to refuel Air Force, Navy, Marine Corps, and allied aircraft.



Source: © 2011 Boeing. All rights reserved.



The KC-46 program entered system development in February 2011 with all three of its critical technologies nearing maturity. The program has a plan to bring these technologies to full maturity at full-rate production in June 2017 and has established metrics to help determine the achievement of key aspects of system performance. The program completed its preliminary design review after beginning system development and, as of December 2012, had released about 60 percent of its projected engineering drawings. It plans to release 90 percent by the July 2013 critical design review. The Air Force considers the development schedule the program's highest risk, particularly the aggressive time frame planned for completion of flight testing. Other risks include concurrency between development and production, and Boeing's allocation rate of management reserve.

Attainment of Product Knowledge	
As of January 2013	
Resources and requirements match	
• Demonstrate all critical technologies in a relevant environment	●
• Demonstrate all critical technologies in a realistic environment	○
• Complete preliminary design review	●
Product design is stable	
• Release at least 90 percent of design drawings	
• Test a system-level integrated prototype	
Manufacturing processes are mature	
• Demonstrate critical processes are in control	
• Demonstrate critical processes on a pilot production line	
• Test a production-representative prototype	
● Knowledge attained	 Information not available
○ Knowledge not attained	Not applicable

KC-46 Program

Technology Maturity

The KC-46 entered system development with all three critical technologies—a three-dimensional display to monitor and enable aerial refueling activities and two software modules designed to increase situational awareness—nearing maturity, but not yet demonstrated in a realistic environment. Since last year's review, the program established a plan to fully mature these technologies by full-rate production in June 2017. In addition to these technologies, other technical risks include software development, radar warning receiver and wing aerial refueling pod integration, and aircraft weight. The program has also established metrics to help determine achievement of key aspects of system performance.

Design Maturity

In April 2012, 14 months after beginning system development, the program completed its preliminary design review. Air Force and Boeing officials agreed that the program met all established criteria regarding the KC-46 tanker aircraft design. Minor refinements in the cargo compartment to improve operational utility are being considered. As of December 2012, the contractor has released about 60 percent of engineering design drawings. The program plans to release 90 percent of design drawings by the critical design review scheduled for July 2013.

Production Maturity

According to the program schedule, Boeing expects to deliver the first developmental aircraft in April 2016 and is required to deliver 18 operationally ready aircraft by August 2017, assuming production options are exercised. Boeing has developed manufacturing and supplier management plans to modify a commercial derivative airframe with military equipment such as the refueling boom. The January 2012 decision by Boeing to close the Kansas plant expected to perform the militarization requires the relocation of skilled workers and required facilities to the state of Washington, where KC-46 development is taking place. The program does not plan to collect statistical process control data for critical manufacturing processes, but will instead use manufacturing readiness levels—a metric that supports assessments of manufacturing risk.

Other Program Issues

The Air Force, Boeing, and DOD operational and developmental testing offices have identified schedule risk as a concern, including the aggressive nature of the KC-46 flight-test program. Funding commitments and the start of low rate production are scheduled before significant development and testing activities are completed, which could mean discovering and fixing problems during production. Another risk is the rate at which Boeing has been depleting its management reserve funding. Boeing has allocated about 80 percent of its management reserve funding available to expedite risk management activities, and at this current rate will deplete it in May 2013 with about 5 years of development remaining.

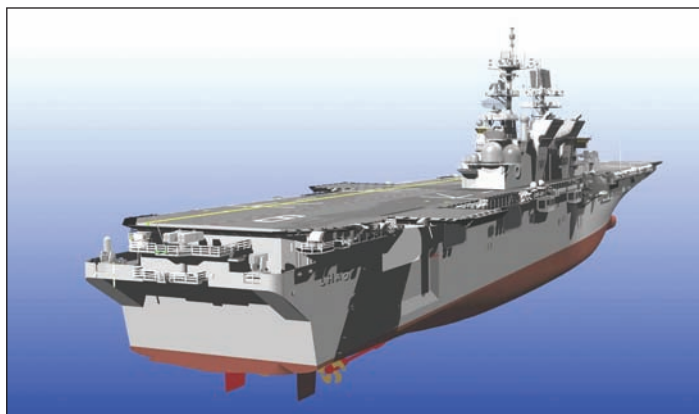
As requested, we reviewed whether individual subcontracting reports from the prime contractor for the program were accepted on eSRS. The government uses subcontracting reports on eSRS as one method of monitoring small business participation. As of December 2012, eSRS indicated that the subcontracting report associated with KC-46's contract has been accepted.

Program Office Comments

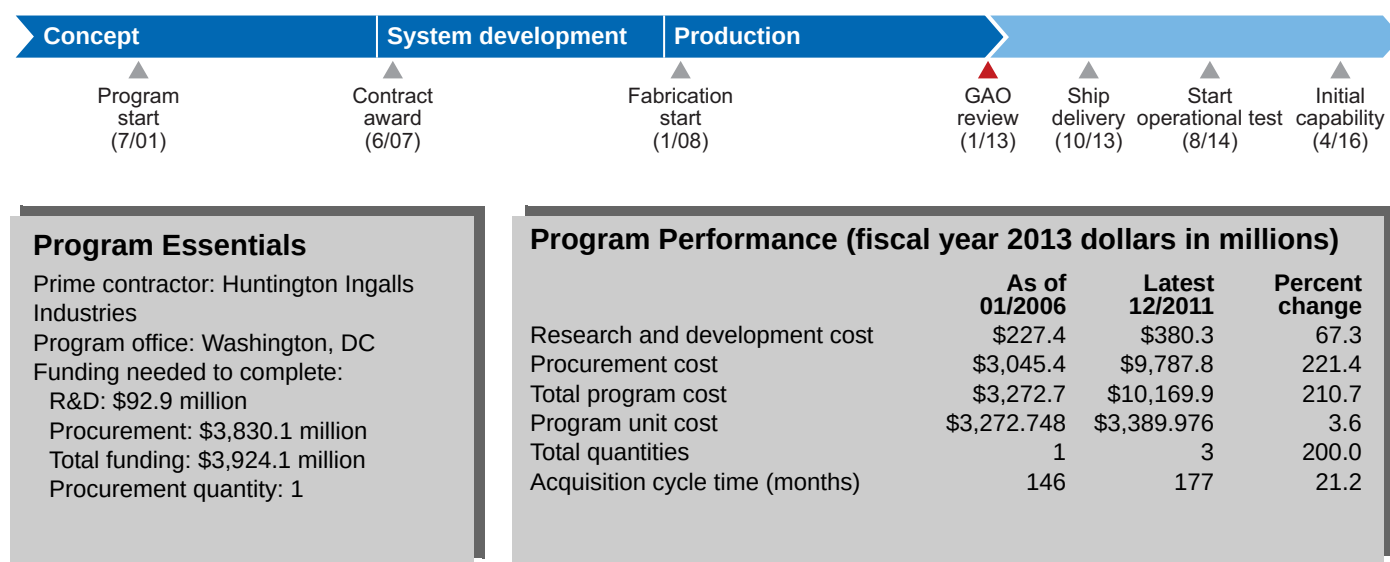
In commenting on a draft of this assessment, the program office stated they mitigated the greatest KC-46 risks to the taxpayer—cost growth and open-ended financial liability—by negotiating the competitive fixed-price incentive development contract with firm-fixed and not-to-exceed pricing for production. In addition, the program plans to continue mitigating developmental schedule risk as the program reaches critical design review and intends to maintain tight oversight of contract execution which has resulted in Boeing delivering on contractual commitments to date. The program office further stated that it plans to mitigate the risk posed by concurrency by ensuring adequate testing is completed prior to the production decision in addition to the contract provision requiring Boeing to incorporate fixes to issues found during testing into production aircraft at no additional cost. The KC-46 program office also provided technical comments, which were incorporated where deemed appropriate.

LHA 6 America Class Amphibious Assault Ship

The Navy's LHA 6 class will replace the LHA 1 *Tarawa* class amphibious assault ships. LHA 6 is a modified variant of the fielded LHD 8. It will feature enhanced aviation capabilities and is designed to support all afloat Marine Corps aviation assets in an expeditionary strike group. LHA 6 construction began in December 2008 and ship delivery is expected in October 2013. The LHA 6 class includes three ships. The Navy awarded a construction contract for LHA 7 in May 2012, with construction start planned for April 2013.



Source: U.S. Navy.



LHA 6 began construction in December 2008 with mature critical technologies, but a design that was only 65 percent complete. As of September 2012, the LHA 6 design was at least 98 percent complete and construction was 71 percent complete. The Navy expects delivery will be delayed to October 2013. Further schedule slippage could occur if the shipyard cannot maintain adequate labor resources. The LHA 6 will incur an estimated \$42.4 million in cost growth due to postdelivery rework of the ship's deck to cope with Joint Strike Fighter exhaust and downwash. A construction contract for LHA 7 was awarded in May 2012 and included incentives to improve shipyard performance. The Navy currently plans to competitively award a construction contract for the third ship, LHA 8, to include a well deck which would accommodate landing and attack craft.

Attainment of Product Knowledge	
As of January 2013	
Resources and requirements match	
• Demonstrate all critical technologies in a relevant environment	●
• Demonstrate all critical technologies in a realistic environment	●
• Complete preliminary design review	●
Product design is stable	
• Complete 100 percent of design	○
• Test a system-level integrated prototype	
Manufacturing processes are mature	
• Demonstrate critical processes are in control	
• Demonstrate critical processes on a pilot production line	
• Test a production-representative prototype	
● Knowledge attained	 Information not available
○ Knowledge not attained	Not applicable

LHA 6 America Class Program

Technology, Design, and Production Maturity

All LHA critical technologies were mature when the program awarded its construction contract in June 2007. Although not considered critical technologies, the program has identified an additional six key subsystems necessary to achieve capabilities. Five of these subsystems are mature. The sixth, the Joint Precision Approach and Landing System, is still in development, but LHA 6 can use backup aviation control systems to meet requirements. Officials reported no new critical technologies for LHA 8, but requirements are still in development.

As of September 2012, LHA 6 design was at least 98 percent complete and its construction was 71 percent complete. LHA 6 began construction in December 2008 with only 65 percent of its design complete, and subsequent design quality issues have caused a greater number of design changes than anticipated and high levels of rework during construction. The high rate of rework is due to physical interference issues, which the program office attributes to insufficient quality checks of drawings prior to construction start. While the Navy is largely reusing the LHA 6 design to construct LHA 7, officials reported that they will review selected design drawings to address known interferences. Design changes to LHA 7 include a new firefighting system and updates to the radar and the command, control, communications, computers, and intelligence systems. Design changes to LHA 8 will be more significant as the Navy will incorporate a well deck on the ship that can accommodate two landing craft, compared to three on LHD 8. Program officials report that this reduced well deck allows for better maintenance of aviation capabilities. The Navy has already involved industry in the design for LHA 8 and plans to competitively award a construction contract.

Other Program Issues

The LHA 6 will incur an estimated \$42.4 million in cost growth due to post-delivery rework of the ship's deck to cope with exhaust and downwash from the Joint Strike Fighter. In October 2011, the Navy began at-sea testing on USS Wasp to determine how LHA 6 may need to modify its flight deck and found that approximately 43 items require relocation, shielding, protection, or other modifications. According to officials, modifications

include adding below deck stiffeners, moving antennae, weapon systems and other equipment, and adding a cover to fueling stations. Officials report these modifications will occur post-delivery on LHA 6 and during construction for LHA 7.

Shortfalls in skilled-trade labor, problems implementing new business systems, and material delays contributed to a 14-month delay in LHA 6's contractual delivery date. While program officials believe issues are largely resolved, there is a risk that the schedule may slip beyond the current delivery date if the shipyard cannot provide adequate resources to maintain the construction schedule. In order to improve performance on LHA 7, the Navy included contract incentives of up to \$41 million for good shipyard performance and successful delivery by June 2018.

As requested, we reviewed whether individual subcontracting reports from the prime contractor for the program were accepted on eSRS. The government uses subcontracting reports on eSRS as one method of monitoring small business participation. As of December 2012, eSRS indicated that two of the subcontracting reports for LHA 6's two contracts have been accepted.

Program Office Comments

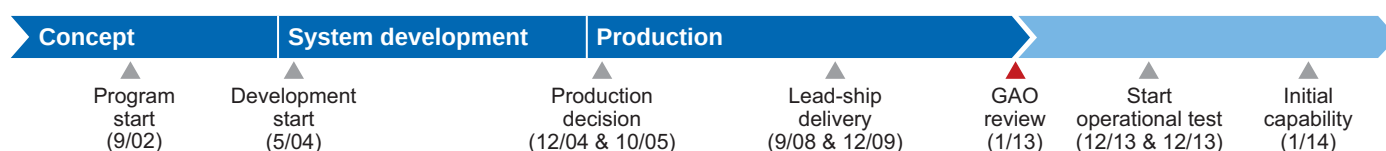
The program office stated that the shipyard has made significant progress in reducing the amount of rework being experienced in recent months. They also stated that the October 2011 at-sea testing of the USS Wasp validated Joint Strike Fighter environmental effect design solutions. Those solutions will be common with other amphibious assault ships. The program office also provided technical comments, which were incorporated where deemed appropriate.

Littoral Combat Ship (LCS)—Seaframes

The Navy's LCS is designed to perform mine countermeasures, antisubmarine warfare, and surface warfare missions. It consists of the ship itself, or seaframe, and the mission package it deploys. The Navy bought the first four seaframes in two unique designs—one based on a steel semi-planing monohull and the other based on an aluminum trimaran hull—and subsequently awarded a contract for a block buy of up to 10 ships to both contractors. We assessed both seaframe designs.



Sources: Lockheed Martin (left); General Dynamics (right).



Program Essentials

Prime contractor: Austal USA, General Dynamics, Lockheed Martin
 Program office: Washington Navy Yard, DC
 Funding needed to complete:
 R&D: \$983.1 million
 Procurement: \$22,963.3 million
 Total funding: \$24,160.7 million
 Procurement quantity: 43

Program Performance (fiscal year 2013 dollars in millions)

	As of 05/2004	Latest 08/2012	Percent change
Research and development cost	\$912.7	\$3,585.0	292.8
Procurement cost	\$485.3	\$28,487.9	5,770.2
Total program cost	\$1,398.0	\$32,286.8	2,209.5
Program unit cost	\$349.500	\$587.032	68.0
Total quantities	4	55	1,275.0
Acquisition cycle time (months)	41	116	182.9

Cost data are for the seaframe only. Research and development funding includes detail design and construction of two ships.

The LCS Seaframes program is in a period of steady production and has demonstrated the maturity of most of its critical technologies; however, it continues to make design and production process changes. The Navy started construction of LCS 1 and LCS 2 without a stable design and has had to incorporate design changes on follow-on seaframes. The Navy believes it has identified measures to address cracking on LCS 1's superstructure and hull and corrosion issues on LCS 2 that can be achieved within the program's budget. LCS 3 was delivered in June 2012 but LCS 4 delivery has been delayed and is not expected to deliver until the summer of 2013. Cost and schedule performance improvements were seen in the most recent seaframe delivery of LCS 3.

Attainment of Product Knowledge

As of January 2013

Resources and requirements match

- Demonstrate all critical technologies in a relevant environment ●
- Demonstrate all critical technologies in a realistic environment ○
- Complete preliminary design review ●

Product design is stable

- Complete three-dimensional product model ●
- Test a system-level integrated prototype

Manufacturing processes are mature

- Demonstrate critical processes are in control
- Demonstrate critical processes on a pilot production line
- Test a production-representative prototype

● Knowledge attained

○ Knowledge not attained

.... Information not available

Not applicable

LCS Program

Technology Maturity

Sixteen of the 19 critical technologies for both LCS Seaframes designs are mature and have been demonstrated in a realistic environment. The three remaining technologies—LCS 1's overhead launch and retrieval system and LCS 2's aluminum structure and trimaran hull—are nearing maturity. The overhead launch and retrieval system has not yet demonstrated its maturity by loading and offloading an actual mission module vehicle, though tests have been completed with realistic models. LCS 1 is planned to deploy to Singapore in 2013, before the system reaches full maturity. Program officials believe that LCS 2's aluminum structure and trimaran hull are mature as the ship is operational. However, an April 2010 independent assessment did not reach the same conclusion, in part because of the inability to assure a 20-year service life.

Design and Production Maturity

The Navy started construction of LCS 1 and LCS 2 without a stable design and has had to incorporate design changes on follow-on seaframes. LCS 1 and LCS 2 are still undergoing testing and any issues found will need to be incorporated into the design of follow-on ships. LCS 3 delivered in June 2012 and LCS 4 has experienced delays, but the program stated these issues are resolved and will not impact follow-on construction schedules.

After approximately 30 months of operations, the Navy discovered cracks in the superstructure and hull of LCS 1. The program office indicated that the cracks occurred either in high stress areas or were due to poor workmanship. Program officials stated that all cracks have been repaired and modifications to the design and processes have been made to mitigate cracking on follow-on ships. The Navy also reported corrosion on both variants. The corrosion on LCS 2 was due to insufficient insulation between the aluminum hull and the steel water jet and the absence of a robust corrosion protection system. The Navy will now use a corrosion protection system similar to the one found on odd numbered variants on future even-numbered seaframes to mitigate the corrosion and will backfit it on existing hulls. Corrosion was found on LCS 1 in the waterborne mission zone due in part to an

inadequate stern door seal. The Navy has made some design changes to limit corrosion on follow-on ships.

Other Program Issues

According to Navy officials, 20 berths will be added to LCS 1 to support additional manning for its deployment to Singapore in 2013. Adding crew and berthing can impact ship weight and other resources such as storage and water supplies. The requirement to conduct a Milestone C for the LCS seaframes was rescinded in October 2012. The next block-buy is scheduled for fiscal 2016, although a review supporting a full rate production decision is not planned until after fiscal 2019, when 24 of the planned 55 seaframes will already be delivered, constructed, or under contract. Due to the complexities of the LCS program, the Chief of Naval Operations established the LCS Council in August 2012 with a 3-star flag officer membership, which is responsible for ensuring that the LCS class is ready to meet its assigned capability and missions. The Council is expected to develop a plan of action with completion dates by January 2013.

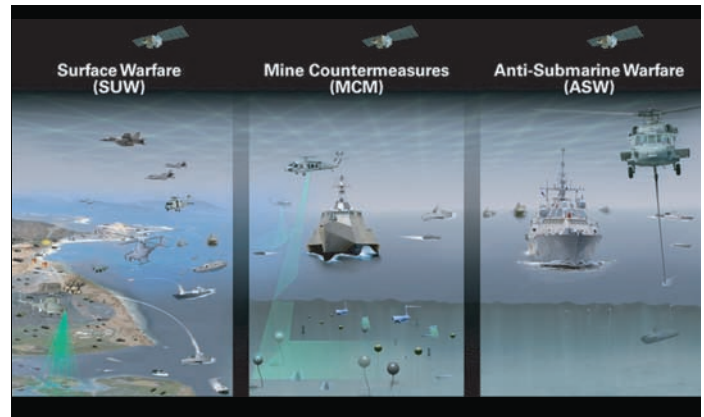
As requested, we reviewed whether individual subcontracting reports from the prime contractor for the program were accepted on eSRS. The government uses subcontracting reports on eSRS as one method of monitoring small business participation. As of December 2012, eSRS indicated that two of the associated subcontracting reports for LCS Seaframes' four contracts have been accepted.

Program Office Comments

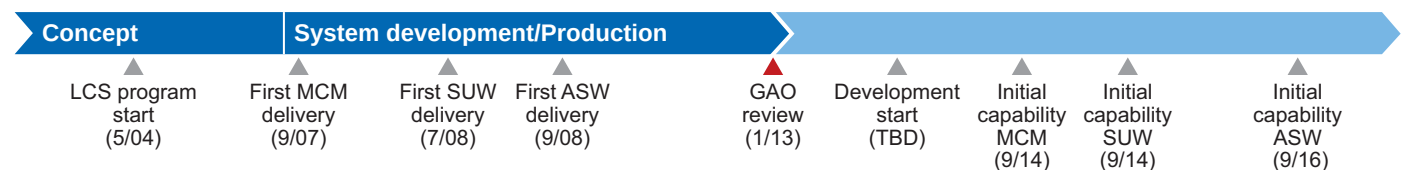
In commenting on a draft of this assessment, the program office noted that LCS 3 was delivered on target cost and ahead of schedule and LCS 5, 6, 7, and 8 have all successfully accomplished production readiness and integrated baseline reviews. LCS 5 is approximately 53 percent complete, LCS 6 is approximately 49 percent complete, LCS 7 is approximately 37 percent complete and LCS 8 is approximately 24 percent complete. The next LCS procurement is planned for fiscal year 2016 and the acquisition strategy governing the procurement has not been determined. A Defense Acquisition Board will be conducted prior to award of the next seaframe procurement. The program office also provided technical comments, which were incorporated where deemed appropriate.

Littoral Combat Ship (LCS)—Mission Modules

The Navy's Littoral Combat Ship (LCS) will perform mine countermeasures (MCM), surface warfare (SUW), and antisubmarine warfare (ASW) missions using mission modules. Modules include weapons and sensors launched and recovered from LCS seaframes and operated from MH-60 helicopters and unmanned vehicles. The LCS modules program is separate from the LCS seaframes program for management, reporting, and oversight purposes. The Navy plans to deliver increments of MCM, SUW, and ASW sequentially over time.



Source: © Northrop Grumman Corporation.



Program Essentials

Prime contractor: Northrop Grumman Corporation, Integrated Systems
 Program office: Washington Navy Yard Washington, DC
 Funding FY13 to FY17:
 R&D: \$816.6 million
 Procurement: \$1,261.3 million
 Total funding: \$2,077.9 million
 Procurement quantity: 22

Program Performance (fiscal year 2013 dollars in millions)

	As of 08/2007	Latest 08/2012	Percent change
Research and development cost	\$506.1	\$1,996.3	294.5
Procurement cost	\$3,353.9	\$1,585.9	-52.7
Total program cost	\$3,869.4	\$3,582.2	-7.4
Program unit cost	NA	NA	NA
Total quantities	64	65	1.6
Acquisition cycle time (months)	NA	NA	NA

Costs are from program start through fiscal year 2017. The Navy has yet to provide an updated cost baseline for the full cost of the program.

The Navy has taken delivery of three MCM and four SUW mission modules that are intended to provide it with an initial capability. According to the Navy, the critical technologies in these modules are mature. However, several systems continue to experience performance issues and the Navy has yet to fully integrate these technologies and test them on board an LCS in a realistic environment. The Navy is also pursuing a concurrent acquisition strategy that results in it buying and accepting delivery of additional modules while they are still in development. The Navy plans to deliver module capabilities in increments, which has a number of potential benefits. However, the first mission modules are not expected to provide full operational capability until fiscal year 2018, by which time the Navy plans to have purchased 30, and delivered 21, LCS seaframes.

Attainment of Product Knowledge

Projected as of January 2013

Resources and requirements match

- Demonstrate all critical technologies in a relevant environment ☐
- Demonstrate all critical technologies in a realistic environment ☐
- Complete preliminary design review ☒

Product design is stable

- Release at least 90 percent of design drawings
- Test a system-level integrated prototype

Manufacturing processes are mature

- Demonstrate critical processes are in control
- Demonstrate critical processes on a pilot production line
- Test a production-representative prototype

☒ Knowledge attained
☐ Knowledge not attained

..... Information not available
 Not applicable

LCS Modules Program

Mine Countermeasures (MCM)

The Navy has accepted delivery of three mission modules, and plans to accept one more in 2013, that do not yet meet requirements. According to the Navy, the critical technologies in these modules are mature, even though technologies required for the initial increment of capability have not completed developmental testing. For example, the remote minehunting system has experienced performance issues. Since the Navy concluded no better alternative exists, the system is undergoing improvements to deliver starting in 2015. Further, the Navy's airborne laser mine detection system, used to detect near-surface sea mines, had challenges identifying such objects, but the Navy expects upgrades to improve performance. The Navy's plans for future increments may also be changing. For example, DOD has concerns with the ability to tow the Organic Airborne Surface Influence Sweep, an increment three capability, leading the Navy to cancel the system. The Navy plans to establish initial operational capability in 2014, when it will have procured seven modules, and full operational capability in 2018.

Surface Warfare (SUW)

The Navy has taken delivery of four modules, which do not yet meet requirements, consisting of 30 millimeter guns, 11-meter small boats, and other capabilities. The Navy replaced the canceled Non-Line-of-Sight Launch System (NLOS-LS) with the Griffin missile. Compared to NLOS-LS's proposed range of 21 nautical miles, the Griffin, which the Navy plans to field in 2015, has an expected range of 3 nautical miles. The Navy plans to conduct a full and open competition for a "Griffin-like" replacement with increased range to provide the full capability by 2019.

Antisubmarine Warfare (ASW)

The Navy restarted development of an antisubmarine warfare module due to the failure of the initial module, which the Navy purchased but then canceled as it would not deliver enough capability over legacy assets. The Navy is currently analyzing this replacement module and plans for initial delivery in 2016 and full operational capability in 2018. The design is expected to include a variable-depth sonar—which, according to officials, performed well in initial tests—and a towed array

among other technologies. The maturity of these technologies has not yet been independently assessed.

Other Program Issues

The Navy plans to purchase 30, and deliver 21, LCS seaframes by the time the first mission modules reach full operational capability in fiscal year 2018. In October 2012, DOD delegated future decision authority to the Navy and requested an acquisition program baseline within 60 days. As of December 2012, the Navy had not provided the acquisition program baseline.

Program Office Comments

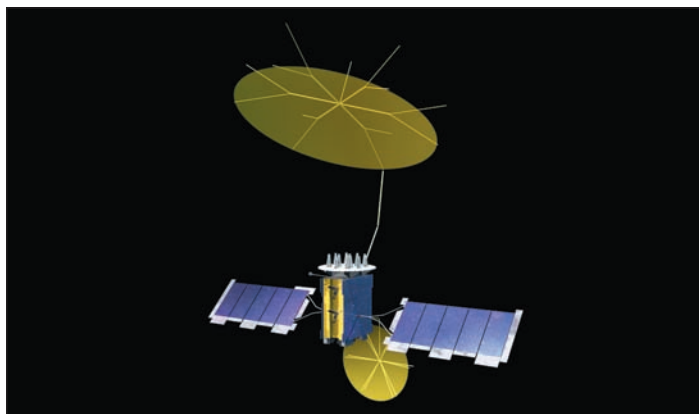
According to the program office, the Navy is employing an incremental fielding acquisition strategy that sequentially proves and incorporates technologies that will ultimately deliver full capability with the fielding of the final increments. This approach has the benefits of delivering capability early, while remaining technologies mature at a natural pace, providing unmatched flexibility to move away from systems that fail to meet cost, schedule, or performance needs. Recent testing of the initial MCM and SUW increments has been very successful. The initial MCM increment has demonstrated end-to-end capability to detect, localize, and neutralize mines. In fiscal 2012 the program completed some developmental testing of the initial MCM increment on board LCS 2. The Navy plans to complete developmental testing in fiscal 2013, in preparation for evaluation and operational testing planned for fiscal 2014. The initial SUW increment has also completed some testing on LCS 1 and will continue testing in fiscal 2013 on LCS 3. The program office also provided technical comments, which were incorporated where deemed appropriate.

GAO Response

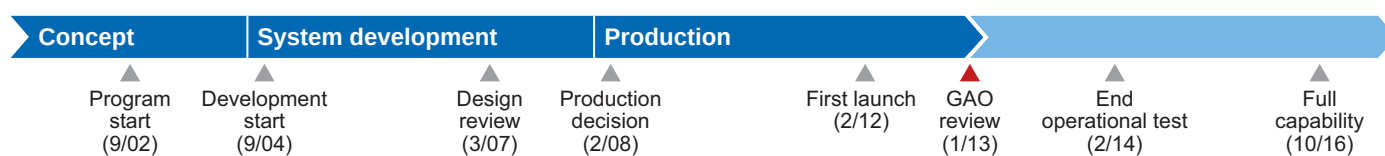
The Navy stated it is using an incremental approach to field mature systems and deliver periodic improvements in capability. However, the Navy continues to buy systems that are still in development, demonstrating significant performance issues, and not meeting all requirements—a practice that we have previously shown increases costs.

Mobile User Objective System (MUOS)

The Navy's MUOS, a satellite communication system, is expected to provide a worldwide, multiservice population of mobile and fixed-site terminal users with increased narrowband communications capacity and improved availability for small terminal users. MUOS will replace the Ultra High Frequency (UHF) Follow-On (UFO) satellite system currently in operation and provide interoperability with legacy terminals. MUOS consists of a network of satellites and an integrated ground network. We assessed both the space and ground segments.



Source: © 2007 Lockheed Martin.



Program Essentials

Prime contractor: Lockheed Martin Space Systems
 Program office: San Diego, CA
 Funding needed to complete:
 R&D: \$276.8 million
 Procurement: \$954.3 million
 Total funding: \$1,231.1 million
 Procurement quantity: 1

Program Performance (fiscal year 2013 dollars in millions)

	As of 09/2004	Latest 09/2012	Percent change
Research and development cost	\$3,753.6	\$4,440.7	18.3
Procurement cost	\$3,123.2	\$2,837.8	-9.1
Total program cost	\$6,916.6	\$7,345.9	6.2
Program unit cost	\$1,152.764	\$1,224.325	6.2
Total quantities	6	6	0.0
Acquisition cycle time (months)	90	NA	NA

Latest acquisition cycle time could not be calculated because the most recent MUOS program baseline does not estimate dates for operational capability.

The MUOS program's critical technologies are mature, its design is stable, and its manufacturing process maturity is increasing. The first satellite was launched in February 2012—26 months later than planned at development start. The launches of additional MUOS satellites remain important due to the past operational failures of two UFO satellites and predicted end-of-life of on-orbit UFO satellites. However, users will not be able to utilize many MUOS capabilities because of delays in the development and testing of a new waveform that completed formal qualification testing in November 2012 and fielding of user terminals. MUOS user terminal procurement and fielding are managed by separate programs.

Attainment of Product Knowledge

As of January 2013

Resources and requirements match

- Demonstrate all critical technologies in a relevant environment ☒
- *Demonstrate all critical technologies in a realistic environment*
- Complete preliminary design review ☒

Product design is stable

- Release at least 90 percent of design drawings ☒
- *Test a system-level integrated prototype*

Manufacturing processes are mature

- *Demonstrate critical processes are in control*
- Demonstrate critical processes on a pilot production line ☐
- *Test a production-representative prototype*

☒ Knowledge attained

☐ Knowledge not attained

.... Information not available

Not applicable

MUOS Program

Technology, Design, and Production Maturity

The MUOS program's technologies are mature, its design is stable, and its manufacturing process maturity is increasing. The first satellite has been launched and four other satellites are being built. The program has experienced quality problems in the past that resulted in cost increases and schedule delays; however, the number of manufacturing defects on the space segment has decreased over time. According to the program, a corrective action board collects and tracks all defects in manufacturing processes and the program uses this data to assess the maturity of production. We could not assess whether critical manufacturing process were in control as the program does not collect statistical process control data.

Other Program Issues

The first MUOS satellite was launched in February 2012, 26 months later than initially planned. Despite the delay and earlier, unexpected failures of two UFO satellites, the required availability level of UHF communication capabilities has been provided. The MUOS program took additional actions to increase these capabilities by activating dual digital receiver unit operations on a UFO satellite, leasing commercial services, initiating international partner agreements to share capacity, and planning to enhance digital receiver unit operations on future MUOS satellites. According to the program office, these additional satellites are needed because most on-orbit UFO satellites are past their design lives. Launch of the second MUOS satellite is scheduled for July 2013, with subsequent launches occurring in 1-year intervals.

According to the program office, a top challenge is expected future cost growth associated with future information assurance requirements. Because information assurance threats are continually evolving, accurately forecasting the scope and quantity of future requirements and estimating associated costs are problematic. The program office stated it is implementing directed solutions to satisfy known requirements to the fullest extent possible within available resources.

A remaining challenge is synchronizing deliveries of MUOS capability with compatible Joint Tactical Radio System (JTRS) Handheld, Manpack and Small Form Fit (HMS) terminals. While launching MUOS satellites is important to sustaining UHF communications capability, over 90 percent of MUOS's planned capability is dependent on the development of the MUOS waveform and the JTRS HMS program's porting of the new MUOS waveform onto the HMS terminals. In late 2011, an independent review team found several shortcomings in DOD's approach to delivering the end-to-end MUOS capability and recommended making capability trade-offs, increasing government oversight, and retaining current cost and schedule baselines. In May 2012, the Navy was assigned overall responsibility for delivering the end-to-end MUOS capability; including providing system engineering and integration support for JTRS HMS terminals. The Navy is planning for operational testing of MUOS with production-representative JTRS HMS terminals in the second quarter of fiscal 2014.

As requested, we reviewed whether individual subcontracting reports from the prime contractor for the program were accepted on eSRS. The government uses subcontracting reports on eSRS as one method of monitoring small business participation. As of December 2012, eSRS indicated that the subcontracting report for MUOS's contract has not been accepted.

Program Office Comments

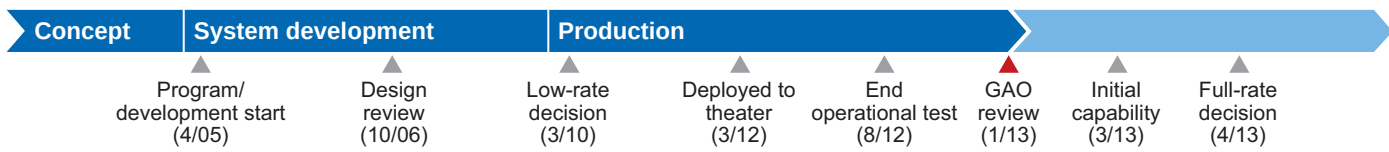
In commenting on a draft of this assessment, the program office provided technical comments, which were incorporated where deemed appropriate.

MQ-1C Unmanned Aircraft System Gray Eagle

The Army's MQ-1C Gray Eagle unmanned aircraft system (UAS) will perform reconnaissance, surveillance, target acquisition, and attack missions either alone or with other platforms such as the Longbow Apache helicopter. Each platoon-sized system includes four aircraft, payloads, data terminals, automatic take off and landing systems, ground control stations and support equipment. The program includes both block 1 systems and less-capable quick reaction capability variants. We assessed the block 1 systems.



Source: General Atomics Aeronautical Systems, Inc.



Program Essentials

Prime contractor: General Atomic Aeronautical Systems, Inc.
Program office: Redstone Arsenal, AL
Funding needed to complete:
R&D: \$126.3 million
Procurement: \$1,358.9 million
Total funding: \$1,637.1 million
Procurement quantity: 10

Program Performance (fiscal year 2013 dollars in millions)

	As of 04/2005	Latest 08/2012	Percent change
Research and development cost	\$354.9	\$982.6	176.9
Procurement cost	\$689.9	\$3,264.5	373.2
Total program cost	\$1,044.7	\$4,745.3	354.2
Program unit cost	\$208.944	\$153.076	-26.7
Total quantities	5	31	520.0
Acquisition cycle time (months)	50	95	90.0

Total quantities include 31 platoon systems consisting of four aircraft and related equipment. The program will also buy 21 aircraft to replace those lost through attrition and 7 training aircraft, for a total of 152.

The Gray Eagle program completed initial operational test and evaluation in August 2012 with mature technologies, but without a stable design or mature manufacturing processes. The planned integration of new universal ground stations, as well as the possibility of future hardware changes due to a March 2011 accident, place the program at increased cost and schedule risk if further changes are required. The program office reported that the system has been successfully demonstrated in theater as of March 2012 when the first Gray Eagle company deployed in support of combat operations in Afghanistan. However, these systems deployed with a different software package from those tested in August and will require a software upgrade. According to officials, follow-on operational testing is scheduled for 2015, after the Army's planned full-rate production start in April 2013.

Attainment of Product Knowledge

As of January 2013

Resources and requirements match	
• Demonstrate all critical technologies in a relevant environment	●
• Demonstrate all critical technologies in a realistic environment	●
• Complete preliminary design review	●
Product design is stable	
• Release at least 90 percent of design drawings	○
• Test a system-level integrated prototype	●
Manufacturing processes are mature	
• Demonstrate critical processes are in control	○
• Demonstrate critical processes on a pilot production line	●
• Test a production-representative prototype	●

● Knowledge attained

○ Knowledge not attained

.... Information not available

Not applicable

MQ-1C UAS Gray Eagle Program

Technology and Design Maturity

According to the program, all five of the Gray Eagle's critical technologies are mature. The program office stated that the design is stable; however, the program experienced a 67 percent increase in design drawings over the past year. Program officials explained that the increase is related to a new universal ground control station and ground data terminal that the Army intends to use for both Gray Eagle and Shadow unmanned aircraft systems. The program plans to integrate these new components incrementally as software upgrades to minimize changes to cost and schedule and will operationally test them in April 2015. Additional software changes have taken place as a result of issues identified in a March 2011 accident. Program officials stated that these software changes did not affect the program's cost or schedule; however, future hardware modifications to the tail are under consideration. Until all the design changes have been developed and incorporated, the program's cost and schedule remain at risk.

Production Maturity

Gray Eagle's 2009 production readiness assessment reported its manufacturing process met the maturity level requirement recommended by DOD guidance for the start of low-rate production. However, the program's manufacturing readiness level does not indicate that its production processes are stable and in control. The program expects to demonstrate the maturity of its production processes during the next independent production readiness assessment scheduled for January 2013, before the start of full-rate production. To further demonstrate production maturity the program is collecting component inspection acceptance and defect data. As of March 2012, the program met its goal of 98 percent of parts accepted, but has not achieved its goal of zero defects. Program officials explained that cost increases and degradation in performance occurred in 2011 and 2012 as a result of defects. The prime contractor, General Atomics, is currently identifying and replacing the defective parts, but has not provided a scheduled completion date.

Other Program Issues

In March 2012, three Gray Eagle systems were deployed to Afghanistan prior to the August 2012 initial operational testing. Some software on the

deployed systems differs from software used in testing, and deployed systems will receive a software upgrade in the field.

In June 2012, an independent assessment of the program's operational test readiness identified issues related to three key capabilities: sensor payloads, combat operational availability, and net readiness. The program office stated that the initial operational test and evaluation conducted in August 2012 addressed the first two issues; however, the Director, Operational Test and Evaluation has not yet issued its report on findings from that testing. Additionally, according to officials, the Gray Eagle's net readiness capabilities will not be tested until a follow-on operational test and evaluation planned for April 2015.

As requested, we reviewed whether individual subcontracting reports from the prime contractor for the program were accepted on eSRS. The government uses subcontracting reports on eSRS as one method of monitoring small business participation. As of December 2012, eSRS indicated that all of the associated subcontracting reports for Gray Eagle's six contracts have been accepted.

Program Office Comments

The Gray Eagle program stated that it has successfully established very mature design and manufacturing processes at both the prime and subcontractor levels. Additionally, it indicated that the new universal ground stations are upgrades required by obsolescence, provide commonality and interoperability with other unmanned aircraft systems such as Shadow and Hunter, and will be integrated, qualified, trained, and tested by soldiers in follow-on test and evaluation. According to the program, hardware and software changes to the tail design are complete and scheduled for integration in fiscal year 2013. The program also noted that its Risk Review Board does not treat either the universal ground control stations or the tail design changes as technical or cost risks.

GAO Response

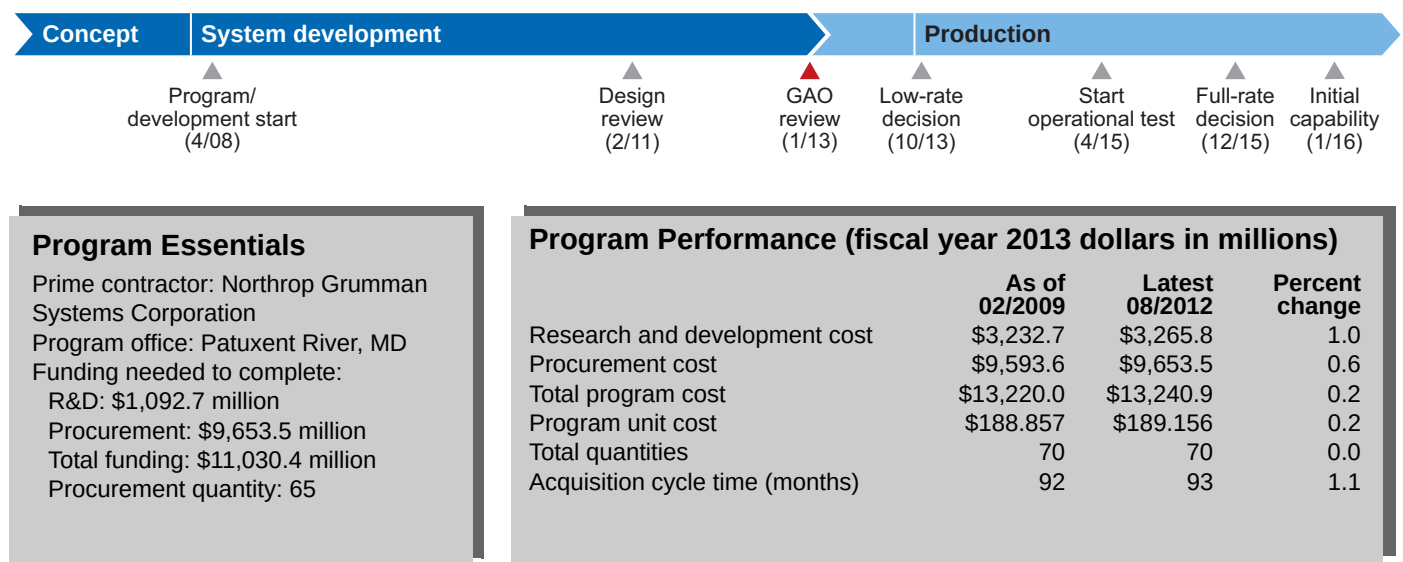
As noted, the Gray Eagle program is undergoing design changes and has yet to demonstrate the maturity of its production processes. Until hardware and software design changes have been incorporated and production processes proven stable and mature, the program's cost and schedule remain at risk.

MQ-4C Triton Unmanned Aircraft System (MQ-4C Triton)

The Navy's MQ-4C Triton, is intended to provide a persistent maritime intelligence, surveillance, and reconnaissance (ISR) capability even when no other naval forces are present. Triton will operate from five land-based sites worldwide. It will be part of a family of maritime patrol and reconnaissance systems that recapitalizes the Navy's airborne ISR assets. Planned improvements include a signals intelligence capability and an upgrade to the system's communication relay.



Source: Northrop Grumman.



The Triton program's critical technologies are mature, its design is stable, and testing began on a prototype in September 2012. The second system development aircraft, scheduled to begin testing in 2013, will be the first aircraft with a full sensor suite and the air-to-air radar subsystem. In November 2011, the program received approval to build three aircraft and ground stations, in part to demonstrate its manufacturing processes prior to its planned May 2013 production decision. However, according to program officials, manufacturing and integration challenges have delayed the production decision until October 2013. The air vehicle is based on the Air Force's RQ-4B Global Hawk with some structural changes to the airframe, but none of these require significant changes to manufacturing processes.

Attainment of Product Knowledge	
As of January 2013	
Resources and requirements match	
• Demonstrate all critical technologies in a relevant environment	●
• Demonstrate all critical technologies in a realistic environment	●
• Complete preliminary design review	●
Product design is stable	
• Release at least 90 percent of design drawings	●
• Test a system-level integrated prototype	○
Manufacturing processes are mature	
• Demonstrate critical processes are in control	●
• Demonstrate critical processes on a pilot production line	●
• Test a production-representative prototype	●
● Knowledge attained	 Information not available
○ Knowledge not attained	Not applicable

MQ-4C Triton Program

Technology Maturity

The Triton program's critical technologies are mature. DOD and the Navy certified that all technologies had been demonstrated in a relevant environment before the start of system development. Further, an April 2011 technology readiness assessment concluded that its one critical technology—a hydrocarbon sensor—was fully mature. This sensor is identical to one developed for the Navy's P-8A program. The maturity of the air-to-air radar subsystem, which enables Triton to sense and avoid other aircraft, is currently being assessed in a laboratory and is scheduled to be included on the second system development aircraft, which will begin testing in 2013.

Design Maturity

The Triton design is stable and testing of the first development aircraft began in September 2012. The second development aircraft, the first aircraft with a full sensor suite and the air-to-air radar subsystem, is nearing completion and is expected to begin testing in 2013. According to the program office, over 99 percent of the drawings are releasable to manufacturing. However, the program poses a significant software development challenge, utilizing nearly 8 million lines of code, more than 20 percent of which will be new. Much of the remaining software is derived from Global Hawk; however, officials noted that integration and testing of this code is taking longer than expected. Officials also noted that delays in the manufacturing of the aircraft wing as well as corrections to software during integration of subsystems are the primary reasons for a delay in the program's operational assessment and production decision, now scheduled for October 2013.

Production Maturity

In November 2011, the program received approval to build three air vehicles and ground stations, in part to demonstrate its manufacturing processes prior to production. According to program officials, the Navy assessed manufacturing processes to be mature based on the reported manufacturing readiness levels. The Triton aircraft is based on the Air Force's RQ-4B Global Hawk and uses sensor components and subsystems from other platforms.

There are some structural changes to the airframe, but none of these require significant changes to manufacturing processes.

Other Program Issues

The program has not reported any negative effects as a result of past challenges in the Global Hawk program. According to the program office, the performance and reliability issues experienced by the Global Hawk during operational testing have been addressed for Triton. However, cancellation of Block 30 does present a risk of cost increases to Triton due to decreased rates of production. The program office is continuing to assess the effects of the Block 30 cancellation and is evaluating these risks for future budgets. Additionally, officials noted that the recent crash of an earlier, demonstration version of the Triton aircraft was unrelated to the systems held in common with the current aircraft; however, the cause of the crash is still under review.

As requested, we reviewed whether individual subcontracting reports from the prime contractor for the program were accepted in eSRS. The government uses subcontracting reports on eSRS as one method of monitoring small business participation. As of December 2012, eSRS indicated that the associated subcontracting report for Triton's contract has been accepted.

Program Office Comments

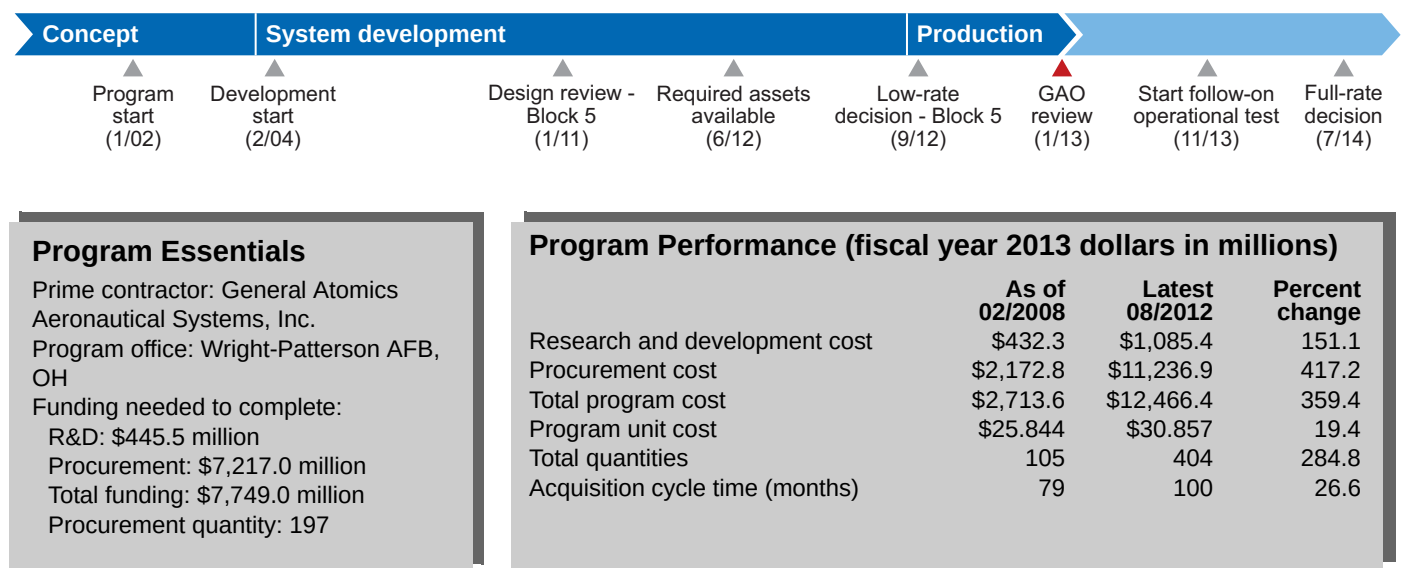
In commenting on a draft of this assessment, the Navy stated that the Triton program continues to demonstrate success during its system development phase and is poised to execute long-lead contracting efforts for low rate initial production. While manufacturing and integration challenges have delayed the advanced procurement decision, the program office stated that it will continue to aggressively manage schedule to maintain the planned initial operational capability target in fiscal year 2016. Cancellation of the Air Force's Block 30 Global Hawk procurement has been assessed for cost risk, which will be managed within the DOD budgetary process. According to officials, the program benefits from strong support within the Department of the Navy and will provide unparalleled persistent ISR capability for fleet forces at its initial operational capability. Additionally, the Navy provided technical comments, which were incorporated where deemed appropriate.

MQ-9 Unmanned Aircraft System (UAS) Reaper

The Air Force's MQ-9 Reaper is a multirole, medium-to-high-altitude endurance unmanned aircraft system capable of flying at higher speeds and 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 consists of four aircraft, a ground control station, and a satellite communications suite. We assessed the increment 1 block 5 configuration and made observations on block 1.



Source: Medium Altitude UAS Division.



After an 18-month delay, the MQ-9 program received approval in September 2012 to begin low-rate initial production of the block 5 configuration, but has not yet demonstrated that critical processes are in control. The Reaper's critical technologies are mature and all design drawings have been released, but the risk for design changes on block 5 remains until upgrades are integrated and tested. Operational testing for block 5 is scheduled for November 2013 and will also include an evaluation of block 1 capabilities not included in its initial operational testing in 2008. Prior to the low-rate decision, the Air Force conducted an operational assessment of a reduced capability block 5 configuration. The program office is working to resolve problems found during these tests, such as the overheating of the avionics bay.

Attainment of Product Knowledge	
As of January 2013	
Resources and requirements match	
• Demonstrate all critical technologies in a relevant environment	●
• Demonstrate all critical technologies in a realistic environment	●
• Complete preliminary design review	●
Product design is stable	
• Release at least 90 percent of design drawings	●
• Test a system-level integrated prototype	●
Manufacturing processes are mature	
• Demonstrate critical processes are in control	○
• Demonstrate critical processes on a pilot production line	○
• Test a production-representative prototype	●
● Knowledge attained	 Information not available
○ Knowledge not attained	Not applicable

MQ-9 UAS Reaper Program

Technology and Design Maturity

The Reaper's block 5 critical technologies are considered mature and its design is stable. In addition to the critical technologies, block 5 also includes other capability enhancements from block 1 such as upgrades to the radar, data link, sensor, landing gear, software, and ground control stations. These upgrades are in the process of being integrated and tested. Until this testing is completed, the system remains at risk of design changes.

Production Maturity

After an 18-month delay, the Air Force received approval in September 2012 for block 5 low-rate initial production. According to program officials, the block 5 manufacturing processes have reached the level of maturity recommended by DOD guidance for the start of low-rate production. However, the program's manufacturing readiness level did not indicate that its production processes were in statistical control. The Air Force is proceeding into low-rate production for block 5. It plans to procure 24 block 5 aircraft per year, the contractor's stated minimum sustaining rate, for a total of 197 block 5 aircraft. The Air Force plans to modify some block 1 aircraft to the new configuration. In 2012, aircraft production deliveries began to slip, due in part to delays in technical data and to allow correction of fuel system problems.

Other Program Issues

The program continues to face challenges responding to the warfighter's changing needs. Since inception, aircraft quantities have increased significantly—from 63 to 404 aircraft—and performance requirements continue to change. The Air Force plans to conduct follow-on operational testing of block 5 beginning in November 2013. This testing will include critical areas not assessed during initial operational testing in 2008, performed with block 1 aircraft. At that time, problems with the radar and network prevented testers from evaluating two of the system's three key requirements, the hunter and net-ready capabilities. Prior to the low-rate production decision, the Air Force conducted an operational assessment of block 5. Although flight testing was limited, block 5 aircraft demonstrated basic handling and flight controls, payload systems, the high capacity power

system, and the satellite data link. The assessment did not include radar software enhancements, high definition video modes, or flight operations with the new ground control station. During the assessment, testers found that the avionics bay was overheating, largely due to issues with the new power system and batteries. Operational testers also recommended that the program place more attention on software development. The program is working to resolve these issues.

As requested, we reviewed whether individual subcontracting reports from the prime contractor for the program were accepted on eSRS. The government uses subcontracting reports on eSRS as one method of monitoring small business participation. As of December 2012, eSRS indicated that none of the subcontracting reports for Reaper's three contracts have been accepted.

Program Office Comments

The low-rate initial production decision for the block 5 configuration was conducted in September 2012, 10 months before the projected July 2013 date. This was made possible because the first block 5 article retrofit was delivered 6 months early and software builds were de-coupled to focus software development for block 5. The manufacturing readiness levels for the contractor were assessed at the DOD target level for low rate production. Due to OSD confidence, future acquisition decisions for the program were delegated to the Air Force. Finally, the cost position depicted in the report is not an accurate reflection of MQ-9 cost growth. The 2008 numbers are for the pre-major defense acquisition program, which has different assumptions and requirements than the current program. Utilizing the acquisition program baseline signed February 2012 as the beginning position and the September 2012 baseline as the current position more accurately reflects cost growth.

GAO Response

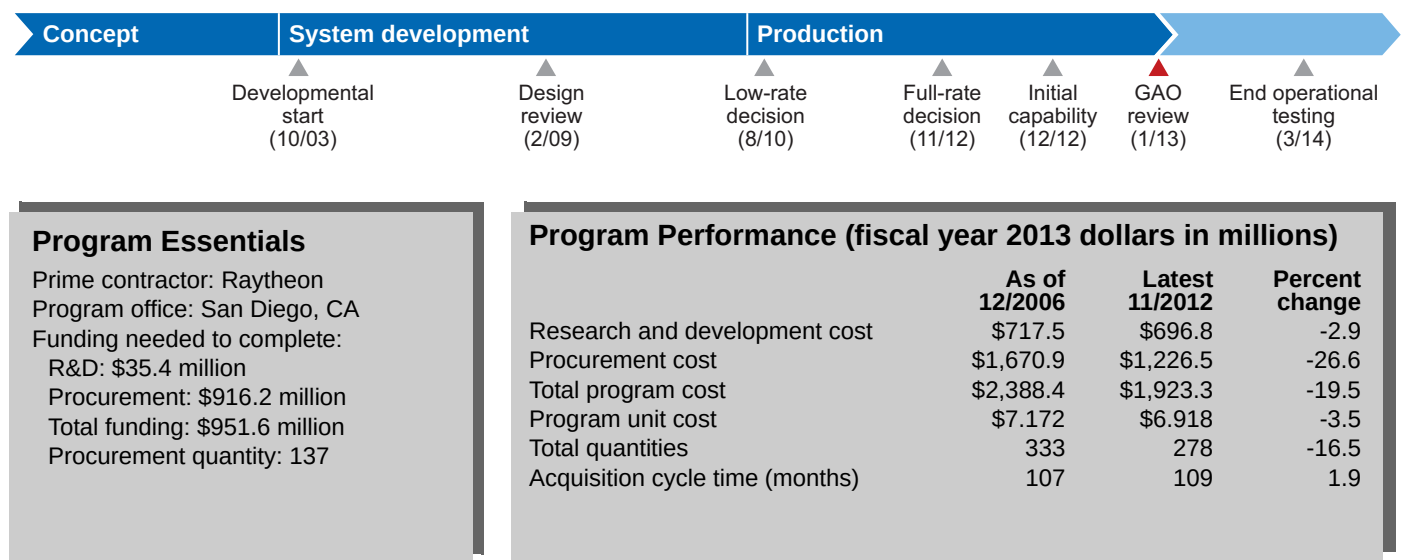
In order to give a fuller understanding of the cost and schedule performance of a program from the statement of its original business case we present a comparison of the program's first full estimate, even if the estimate precedes designation as a major acquisition, and the current cost estimate. Reaper's 2008 estimate represents the first available cost estimate we have and is consistent with past reports.

Navy Multiband Terminal (NMT)

The Navy's NMT is a next-generation maritime military satellite communications terminal for existing ships, submarines, and shore sites. NMT is designed to work with the Air Force's Advanced Extremely High Frequency and Enhanced Polar System satellite systems to provide protected and survivable satellite communications to naval forces. The NMT's multiband capabilities also allow communications with existing military satellite communication systems, such as Milstar, Wideband Global SATCOM, and the Defense Satellite Communications System.



Source: © 2008 Raytheon.



Program Essentials

Prime contractor: Raytheon
 Program office: San Diego, CA
 Funding needed to complete:
 R&D: \$35.4 million
 Procurement: \$916.2 million
 Total funding: \$951.6 million
 Procurement quantity: 137

The NMT program currently has mature technologies, a stable design, and all of its production processes in control and, in November 2012, DOD approved the NMT program for full-rate production. According to program officials, the program successfully corrected or mitigated reliability deficiencies that were found during an August 2011 initial operational test and evaluation, and in October 2012, Navy testers determined the NMT to be operationally effective and operationally suitable. NMT is also making progress on its connectivity with two satellite programs: the Air Force's Advanced Extremely High Frequency (AEHF) and Enhanced Polar System (EPS), but full compatibility is dependent upon successful launching of and testing with these satellite constellations.

Attainment of Product Knowledge	
As of January 2013	
Resources and requirements match	
• Demonstrate all critical technologies in a relevant environment	●
• Demonstrate all critical technologies in a realistic environment	●
• Complete preliminary design review	●
Product design is stable	
• Release at least 90 percent of design drawings	●
• Test a system-level integrated prototype	●
Manufacturing processes are mature	
• Demonstrate critical processes are in control	●
• Demonstrate critical processes on a pilot production line	●
• Test a production-representative prototype	●
● Knowledge attained	 Information not available
○ Knowledge not attained	Not applicable

NMT Program

Technology, Design, and Production Maturity

NMT's two critical technologies—a multiband antenna feed and monolithic microwave integrated circuit power amplifiers for Q-band and Ka-band communication frequencies—are mature and the design is stable. The NMT program office began low-rate initial production in August 2010 with processes which had been demonstrated on a pilot line, but were not in control. By the summer of 2012, the program office had demonstrated that all of NMT's production processes were in statistical control. NMT completed a production readiness review in preparation for full-rate production and, in November 2012, DOD approved the NMT program for full-rate production.

NMT's software lines of code have increased since the start of production in 2010 due to the addition of capability to support EPS. Program officials reported that 100 percent of software integration testing is complete with approximately 99 percent of the defects resolved. According to program officials, NMT is now expected to be compatible with EPS when EPS is deployed beginning in fiscal year 2015.

Other Program Issues

According to NMT program officials, during the August 2011 initial operational test and evaluation Navy testers found NMT to be operationally effective but not operationally suitable in that certain reliability requirements were not met. As a result, program officials postponed the full-rate production decision from December 2011 to November 2012. In October 2012, Navy testers verified correction of the deficiencies and determined the NMT to be operationally effective and operationally suitable. According to program officials, any design and process changes made to correct the deficiencies are being incorporated into production units.

The operational testing performed in August 2011 did not include testing of NMT's AEHF capabilities due to delays in the first AEHF satellite reaching its final orbital position. NMT program officials stated that they have taken several measures to reduce the risks associated with producing a terminal whose AEHF capabilities are not fully tested. For instance, the program tested terminals using an advanced AEHF simulator as well as a satellite on

the ground prior to its launch. In October 2011, NMT established communication with the first on-orbit AEHF satellite using the low-, medium-, and extended-data-rate capabilities. According to program officials, testing is ongoing between AEHF and NMT and the Navy expects to conduct formal testing in fiscal year 2014. In the interim, program officials stated that fielded NMT systems can provide value by accessing existing satellite communication systems such as the Defense Satellite Communications System, Milstar, Wideband Global SATCOM, Interim Polar System, and Ultra High Frequency Follow-On satellite constellations. According to program officials, the realization of the NMT's full operational capability has been delayed 2 years to 2017, to better align with the warfighter's needs.

As requested, we reviewed whether individual subcontracting reports from the prime contractor for the program were accepted on eSRS. The government uses subcontracting reports on eSRS as one method of monitoring small business participation. As of December 2012, eSRS indicated that the subcontracting report associated with NMT's contract has not been accepted. According to program officials, the contract includes a comprehensive small business subcontracting plan, the fiscal 2013 version of which was approved on September 26, 2012.

Program Office Comments

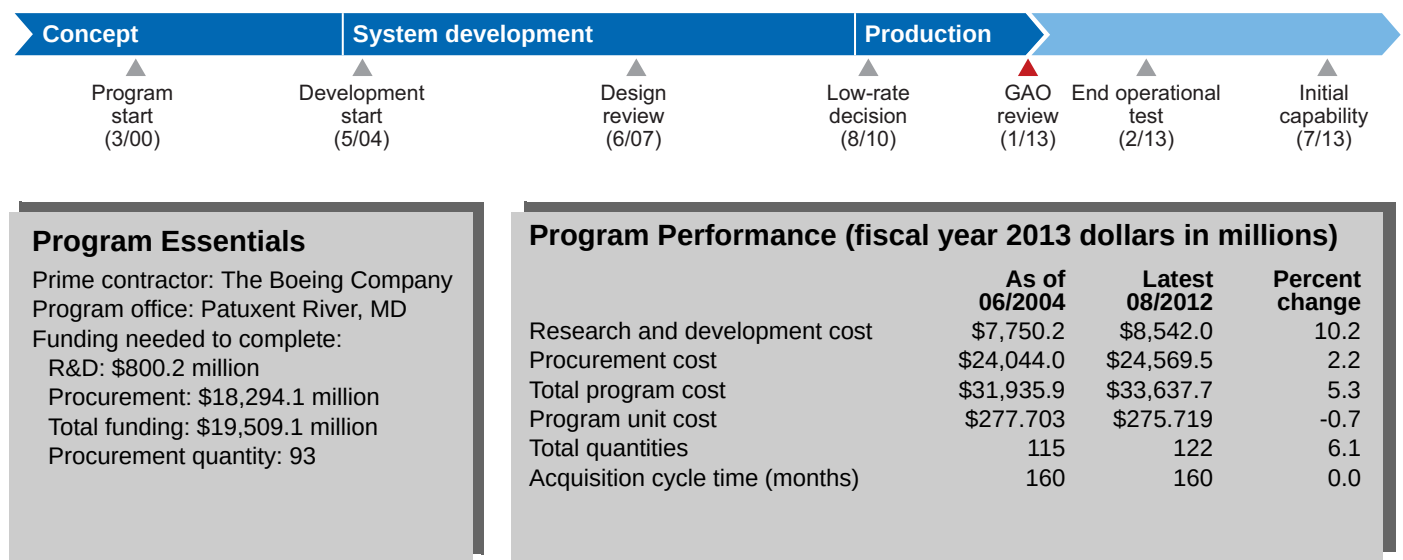
In commenting on a draft of this assessment, NMT program officials wrote that the program has entered full-rate production and achieved initial operational capability after being found operationally effective and operationally suitable by the Navy's Commander Operational Test and Evaluation Force. Officials said that, overall, NMT is committed to providing deployed naval commanders with assured access to secure, protected, command and control, communication capabilities to support the exchange of warfighter-critical information. The program also provided technical comments, which were incorporated as deemed appropriate.

P-8A Poseidon

The Navy's P-8A Poseidon is a Boeing commercial derivative aircraft that will replace the P-3C Orion. Its primary roles are antisubmarine warfare; antisurface warfare; and intelligence, surveillance, and reconnaissance. The P-8A is a part of a family of systems, including the MQ-4C Triton, that share the integrated maritime patrol mission and support the Navy's maritime warfighting capability. The program plans to field capabilities in three increments. We assessed increment one and made observations on increments two and three.



Source: P-8A Poseidon, Maritime Patrol and Reconnaissance Program Office.



The P-8A entered production in August 2010 with mature technologies, a stable design, and proven production processes; however, the program has continued to experience late design changes because it began production before completing developmental testing. The number of total design drawings has increased by 10 percent within the past year to address deficiencies discovered during testing. According to program officials, these design changes are mostly software-related, but they also include hardware changes, that must be tested and retrofitted on production aircraft before the planned first deployment in December 2013. The program expects to complete initial operational testing by February 2013, the results of which will be used, among other factors, to evaluate the program's readiness for full-rate production in July 2013.

Attainment of Product Knowledge	
As of January 2013	
Resources and requirements match	
• Demonstrate all critical technologies in a relevant environment	●
• Demonstrate all critical technologies in a realistic environment	●
• Complete preliminary design review	●
Product design is stable	
• Release at least 90 percent of design drawings	●
• Test a system-level integrated prototype	●
Manufacturing processes are mature	
• Demonstrate critical processes are in control	●
• Demonstrate critical processes on a pilot production line	●
• Test a production-representative prototype	●
● Knowledge attained	 Information not available
○ Knowledge not attained	Not applicable

P-8A Program

Technology Maturity

P-8A entered production in August 2010 with its sole critical technology, a hydro-carbon sensor, mature. The program plans to integrate additional capabilities into the P-8A. Program officials stated that work on the first of these upgrades—improvements to the Multi-static Active Coherent antisubmarine warfare system—has started. The program also awarded contracts to develop an initial architecture for increment 3.

Design Maturity

P-8A has continued to experience late design changes as it started production before completing developmental testing. The number of design drawings increased by 10 percent within 1 year as the program implemented fixes to correct deficiencies discovered during testing. According to program officials, these design changes are mostly software-related, but they also include hardware changes that must be tested and retrofitted on production aircraft before the planned first deployment in December 2013.

Production Maturity

The manufacturing processes for P-8A are considered mature, although the program encountered minor anomalies and maintenance issues with each of the first five production aircraft during the formal acceptance process. As a result, the Defense Contract Management Agency requested that Boeing conduct more pre-acceptance testing to catch and fix problems earlier. According to program officials, Boeing has agreed to perform a post-production flight prior to presenting each aircraft for formal acceptance.

Other Program Issues

P-8A entered initial operational test and evaluation in September 2012 after receiving approval from DOD's Office of Developmental Test and Evaluation. That office's assessment concluded that the program was on track to meet its performance requirements and that software maturity and reliability had steadily increased throughout developmental testing. Further, remaining issues, such as those related to weapons bay heating and torpedo performance, were not likely to present more than moderate risk during operational testing. The program plans to complete testing by February

2013. Successful completion of operational tests is one criteria necessary for the full-rate production decision in July 2013.

According to program officials, the P-8A has reduced the unit cost of the aircraft on each of its first three production contracts. To help ensure the price is fair and reasonable, DOD negotiated an agreement with Boeing to provide the Defense Contract Audit Agency (DCAA) access to data on select Boeing commercial aircraft procurements. The P-8A airframe has been designated a commercial item, so the contractor is not required to submit cost or pricing data. Officials indicated DCAA did not raise any concerns regarding the reasonableness of aircraft pricing prior to the award of the third production contract.

As requested, we reviewed whether individual subcontracting reports from the prime contractor for the program were accepted on eSRS. The government uses subcontracting reports on eSRS as one method of monitoring small business participation. As of December 2012, eSRS indicated that none of the subcontracting reports for P-8A's two contracts have been accepted. According to program officials, one of P-8A's contracts does not require individual subcontracting reports as it reports this information through a comprehensive subcontracting plan. The program's other contract does require an individual subcontracting report and the contractor is in the process of submitting it through eSRS.

Program Office Comments

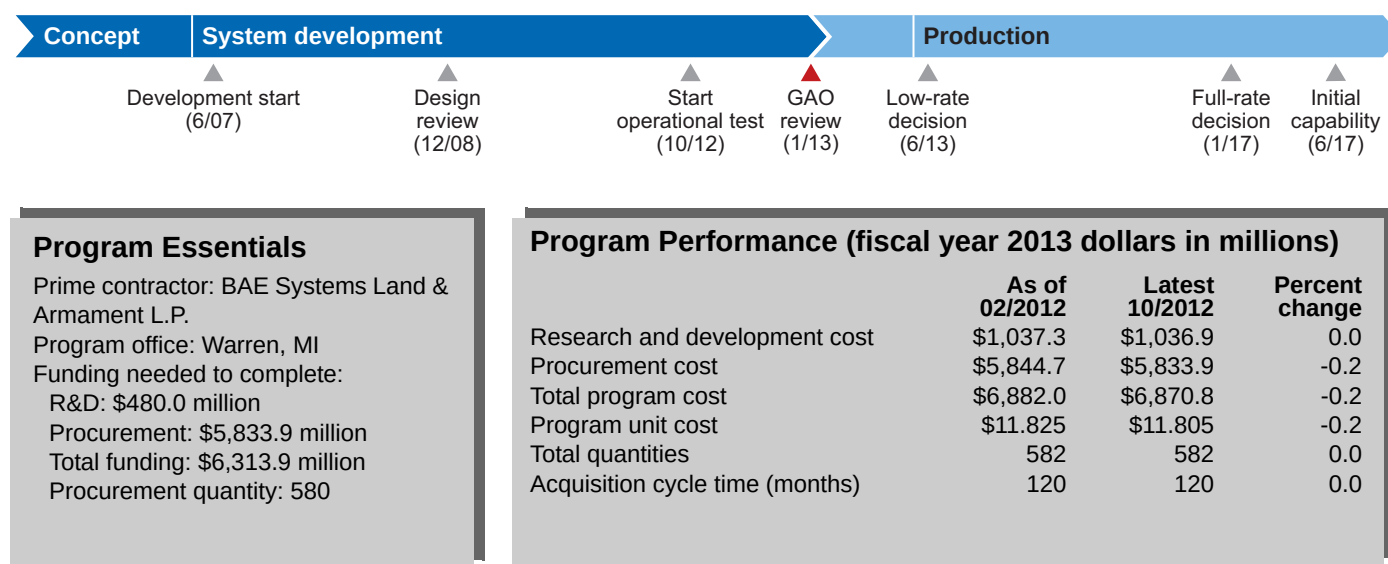
In commenting on a draft of this assessment the program office stated that the P-8A team is working to complete live fire test and evaluation in March 2013 and initial operational test and evaluation in February 2013. Both of these test events are on schedule to support the drafting of the Beyond Low-Rate Initial Production Report and the full-rate production decision review planned for July 2013. Five of six low-rate lot 1 aircraft and associated training systems have been delivered to VP-30 to support fleet transition training and readiness for the deployment of the first P-8A squadron in December 2013. The P-8A program continues to implement better buying initiatives that have reduced unit costs from low-rate lot 1 to 3 contracts.

Paladin FAASV Integrated Management (PIM)

The Army's Paladin FAASV Integrated Management (PIM) system consists of two individual platforms, a self-propelled howitzer (SPH) and a tracked ammunition carrier that provides operational support. The SPH is a tracked, aluminum armored vehicle with a 155 millimeter cannon. The PIM will provide improved sustainability over the current Paladin M109A6 howitzer fleet through the incorporation of a newly designed hull; modified M2 Bradley fighting vehicle power train, suspension system, and track; and a modernized electrical system.



Source: Product Manager Self-Propelled Howitzer Systems.



The PIM program is currently in the system development phase with its two critical technologies nearing maturity and a stable design. A production decision is scheduled for June 2013. With the cancellation of the Non-Line-of-Sight Cannon, the PIM program became an Army priority program. The program, as originally structured, was not a major defense acquisition program, but was elevated to major defense acquisition program status due to rising cost estimates. The program has also experienced schedule slippage due to delays in the start of developmental testing and changes to force protection and survivability requirements that drove the addition of new armor kits and a new ballistic hull and turret.

Attainment of Product Knowledge	
As of January 2013	
Resources and requirements match	
• Demonstrate all critical technologies in a relevant environment	●
• Demonstrate all critical technologies in a realistic environment	○
• Complete preliminary design review	●
Product design is stable	
• Release at least 90 percent of design drawings	●
• Test a system-level integrated prototype	
Manufacturing processes are mature	
• Demonstrate critical processes are in control	
• Demonstrate critical processes on a pilot production line	
• Test a production-representative prototype	
● Knowledge attained	 Information not available
○ Knowledge not attained	Not applicable

PIM Program

Technology Maturity

The program office identified two technologies, power pack integration and the ceramic bearing of the generator assembly, as critical to the PIM program and projects that they will be fully mature by production start. The program office identified these technologies as critical based on concerns about their performance at high temperatures. While neither technology is new or novel, failure of either would represent major program risk. In addition, increases in vehicle weight due to the addition of material to improve survivability, minimal power pack space, and other integration issues may degrade the ability to meet automotive performance requirements.

Design Maturity

According to the program office, the design is currently stable with all of the expected drawings released; however, the program faces a number of design challenges on major components as it moves forward. The current contractor for the engine and transmission may cease production due to lack of orders. If this occurs, production could be delayed or exceed cost thresholds. Sourcing to another vendor may result in a redesign of the engine and engine compartment resulting in a potential cost growth estimated between \$60 million and \$200 million and a schedule impact of 18 to 48 months. The program office has also identified a risk that the redesigned electronic assembly may not be robust enough to survive the shock from firing PIM's main gun. If the design fails, the estimated cost to redesign and re-test the assembly is approximately \$2 million.

Production Maturity

The low-rate initial production decision for PIM is currently scheduled for June 2013, although the program does not anticipate having production processes in control at that time. As of October 2012, the program office indicated that the contractor had self-assessed a manufacturing readiness level of 6, which is described as the capability to produce a prototype system or subsystem in a production relevant environment rather than readiness to enter into production. As we have reported in the past, beginning production

before processes are in control and demonstrated on a pilot production line presents cost and schedule risks.

Other Program Issues

The current acquisition strategy does not include a competitive procurement contract for low-rate initial production based on the government's lack of adequate technical data rights for major components, including the vehicle hull-welded structure and other components. To date the government has been unsuccessful in negotiating improved rights to this technical data.

As requested, we reviewed whether individual subcontracting reports from the prime contractor for the program were accepted on eSRS. The government uses subcontracting reports on eSRS as one method of monitoring small business participation. As of December 2012, eSRS indicated the subcontracting report for PIM's contract has been accepted.

Program Office Comments

In commenting on a draft of this assessment, the program office emphasized the program remains on track for a June 2013 production decision and provided technical comments, which were incorporated where deemed appropriate.

RQ-4A/B Global Hawk Unmanned Aircraft System

The Air Force's Global Hawk is a high-altitude, long-endurance unmanned aircraft that provides intelligence, surveillance, and reconnaissance capabilities. After a successful technology demonstration, the system entered development and limited production in March 2001. The early RQ-4A, similar to the original demonstrators, was retired in 2011, leaving a fleet of the larger and more capable RQ-4Bs, produced in three configurations—block 20, 30, and 40.



Source: Northrop Grumman.



Program Essentials

Prime contractor: Northrop Grumman
 Program office: Wright-Patterson AFB, OH
 Funding needed to complete:
 R&D: \$490.3 million
 Procurement: \$425.4 million
 Total funding: \$915.7 million
 Procurement quantity: 0

Program Performance (fiscal year 2013 dollars in millions)

	As of 03/2001	Latest 08/2012	Percent change
Research and development cost	\$1,071.9	\$3,971.8	270.5
Procurement cost	\$4,444.4	\$5,914.2	33.1
Total program cost	\$5,548.9	\$10,021.0	80.6
Program unit cost	\$88.077	\$222.690	152.8
Total quantities	63	45	-28.6
Acquisition cycle time (months)	55	125	127.3

The program essentials box does not reflect delays to the procurement of the final three aircraft due to a pending decision on block 30 termination.

The future of Global Hawk remains uncertain due to the proposed termination of the block 30 configuration. A program official noted that block 30 aircraft will continue to be operational until a final decision is made, but if termination occurs, the program will either store or divest itself of up to 21 block 30 aircraft. To date, the program has already purchased 42 of its 45 planned aircraft and will not hold a full-rate production decision, but will seek approval in summer 2013 to enter into sustainment. Developmental testing on the program's block 40 aircraft continues and the program plans to field two with an advanced radar capability in May 2013, but operational testing has been delayed more than 3 years and all of the block 40 aircraft have already been purchased. The program remains at risk for late design changes if problems are discovered during testing.

Attainment of Product Knowledge

As of January 2013

Resources and requirements match

- Demonstrate all critical technologies in a relevant environment ●
- Demonstrate all critical technologies in a realistic environment ●
- Complete preliminary design review ●

Product design is stable

- Release at least 90 percent of design drawings ●
- Test a system-level integrated prototype

Manufacturing processes are mature

- Demonstrate critical processes are in control ●
- Demonstrate critical processes on a pilot production line ●
- Test a production-representative prototype ●

● Knowledge attained

○ Knowledge not attained

.... Information not available

Not applicable

RQ-4A/B Global Hawk Program

Technology, Design, and Production Maturity

The critical technologies for the RQ-4B are mature, its basic airframe design is stable, and its manufacturing processes are mature and in statistical control. The RQ-4B aircraft consist of three configurations. Block 20 aircraft are equipped with an enhanced imagery intelligence payload, block 30 aircraft have both imagery and signals intelligence payloads, and block 40 aircraft have an advanced radar surveillance capability. The program must still successfully test one of its key capabilities for block 40 aircraft—the multiple platform radar—to ensure it performs as expected. Developmental testing for this capability is now underway and the program office intends to field two aircraft with the advanced radar capability in May 2013, but operational testing for block 40 has slipped until January 2014, more than 3 years from its current baseline. According to program officials, block 40 production is progressing well with a drop in rework rates that is expected to continue after development flight testing is complete; however, the program remains at risk for late design changes if problems with the multiple platform radar are discovered during operational testing. A program official stated that evaluations from the two block 40 aircraft that the Air Force plans to field as an early operational capability will help to inform operational testing.

Other Program Issues

As part of its fiscal year 2013 budget request, DOD terminated the block 30 system in an effort to reduce program cost. If termination of block 30 proceeds, the program will either store or divest itself of up to 21 block 30 aircraft—almost half of the total 45 aircraft that the program plans to procure. To date, the program has procured 42 aircraft. A program official noted that block 30 aircraft will continue to be manufactured and used in operations until a final decision on termination has been made. The program had planned to begin development of a restructured ground control station and communications system in fiscal year 2012 to achieve a common architecture for both the Global Hawk and the Navy's Triton unmanned aircraft systems. As a result of the block 30 termination, the program now plans to only refresh rather than restructure its ground control and communications technology efforts.

To date, all block 40 aircraft have been placed under contract and production continues for both block 30 and block 40 despite the lack of a full-rate production decision. According to program officials, the program plans to seek approval in summer 2013 to enter into sustainment.

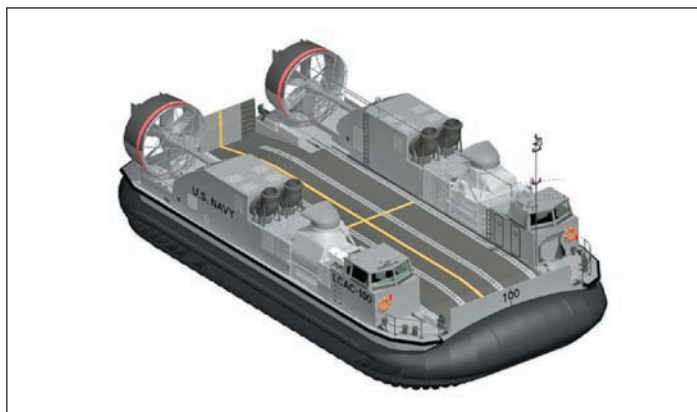
As requested, we reviewed whether individual subcontracting reports from the prime contractor for the program were accepted on eSRS. The government uses subcontracting reports on eSRS as one method of monitoring small business participation. As of December 2012, eSRS indicated that three of the subcontracting reports associated with Global Hawk's six contracts have been accepted.

Program Office Comments

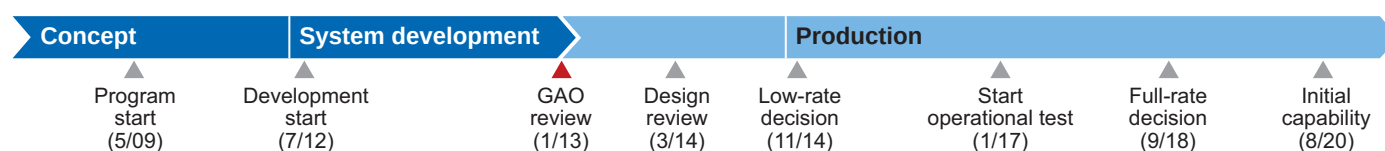
In commenting on a draft of this assessment, program officials provided technical comments, which were incorporated where deemed appropriate.

Ship to Shore Connector (SSC)

The Navy's SSC is an air-cushioned landing craft intended to transport personnel, weapon systems, equipment, and cargo from amphibious vessels to shore. SSC is the replacement for the Landing Craft, Air Cushion, which is approaching the end of its service life. The SSC will deploy in Navy well deck amphibious ships, such as the LPD 17 class, and will be used for assault and nonassault operations. The Navy awarded a detail design and construction contract in July 2012 for the lead craft, which will be used for testing and training.



Source: U.S. Navy.



Program Essentials

Prime contractor: Textron Inc.
 Program office: Washington, DC
 Funding needed to complete:
 R&D: \$297.3 million
 Procurement: \$3,476.1 million
 Total funding: \$3,792.6 million
 Procurement quantity: 71

Program Performance (fiscal year 2013 dollars in millions)

	As of 07/2012	Latest 09/2012	Percent change
Research and development cost	\$572.8	\$572.8	0.0
Procurement cost	\$3,476.1	\$3,476.1	0.0
Total program cost	\$4,068.0	\$4,068.0	0.0
Program unit cost	\$55.727	\$55.727	0.0
Total quantities	73	73	0.0
Acquisition cycle time (months)	135	135	0.0

The SSC program entered system development in July 2012 with its one critical technology—the fire suppression system—mature. Program officials stated that they anticipate the maturity of two other technologies previously identified as watch items will no longer present a concern once the program reaches its design review. Since the Navy awarded the detail design and construction contract, it has provided the contractor with 25 two-dimensional drawings to use as the basis of the design. According to the contract, the Navy plans to demonstrate the stability of the design at the program's production readiness review. In addition, milestone approval authority was delegated to the Navy as the program moves forward with system development.

Attainment of Product Knowledge

As of January 2013

Resources and requirements match

- Demonstrate all critical technologies in a relevant environment ●
- Demonstrate all critical technologies in a realistic environment ●
- Complete preliminary design review ●

Product design is stable

- Complete three-dimensional product model
- Test a system-level integrated prototype

Manufacturing processes are mature

- Demonstrate critical processes are in control
- Demonstrate critical processes on a pilot production line
- Test a production-representative prototype

● Knowledge attained ■■■ Information not available
 ○ Knowledge not attained Not applicable

SSC Program

Technology Maturity

The SSC program entered system development in July 2012 with its one critical technology—the fire suppression system—mature. Program officials stated that they anticipate two other technologies previously identified as critical technology watch list items—the gas turbine engine and the command, control, communications, computer and navigation (C4N) system—will no longer represent a technology maturity concern once the program reaches its design review. With respect to the gas turbine engine, program officials explained that the Navy identified three possible engine models that would meet the design specifications for the craft. The contractor then selected one of these engines after completing a trade-off analysis to determine which represented the best value based on performance requirements. The selected engine is currently in production for aircraft, and according to officials, the technology is mature and will only need minimal modifications to adapt it for use with SSC in maritime operations. The other technology—the C4N system—will be developed by the subcontractor responsible for developing the software for the legacy craft's service life extension program. Officials estimated that the subcontractor will have to develop over 669,000 lines of new code—and the program office has identified software development as a risk area. Officials expect that this system will provide new operational features, including a pilot/co-pilot configuration that allows each operator to bring up the same display at separate consoles.

Design Maturity

According to the contract, the Navy plans to demonstrate the stability of the SSC design at the program's production readiness review, currently planned for May 2014—an event that is scheduled to occur 2 months after the program's design review. According to program officials, since the detail design and construction contract was awarded in 2012, they have provided the contractor with 25 two-dimensional technical drawings to use as a basis for the production design. These drawings include specifications for all the major systems and contain additional details for design aspects unique to the SSC. Program officials estimated that as many as 700 total drawings will be required. Program officials noted that one of the

advantages of adopting a government-led design for the SSC was that the Navy could provide guidance to the contractor when selecting components, but ultimately leave the final selection decision to the contractor. For example, the Navy's design of the engine compartment allowed for three potential engine options that met its technical specifications but allowed the contractor the final selection of the engine based on its own assessment.

Other Program Issues

In March 2012, the Deputy Assistant Secretary of Defense for Developmental Test and Evaluation reported that it considers SSC to be of moderate to high risk because it is a complete redesign of the Landing Craft, Air Cushion, which has a legacy of reliability, corrosion, and performance issues. Since then, the milestone approval authority was delegated to the Navy as the program moves forward with system development which means the Navy will not need Office of the Secretary of Defense approval for further major acquisition decisions.

As requested, we reviewed whether individual subcontracting reports from the prime contractor for the program were accepted on eSRS. The government uses subcontracting reports on eSRS as one method of monitoring small business participation. As of December 2012, eSRS indicated that the associated subcontracting report for SSC's contract had not been accepted.

Program Office Comments

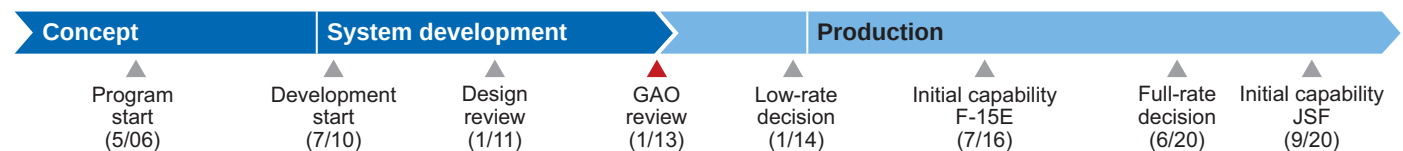
In commenting on a draft of this assessment, the Navy stated that the Ship to Shore Connector is a technically mature, low-risk program that has successfully achieved entry into system development and is proceeding towards demonstration of design maturity. A detail design and construction contract was awarded on July 6, 2012. The Navy also provided technical comments, which were incorporated where deemed appropriate.

Small Diameter Bomb Increment II

The Air Force's Small Diameter Bomb (SDB) Increment II is designed to provide attack capability against mobile targets in adverse weather and from standoff range. It combines radar, infrared, and semiactive laser sensors in a tri-mode seeker to acquire, track, and engage targets. It uses airborne and ground data links to update target locations as well as GPS and an inertial navigation system to ensure accuracy. SDB II will be integrated with F-15E, Joint Strike Fighter (JSF), F/A-18E/F, F-16C, and F-22A, as funding becomes available.



Source: © 2009 Raytheon Company.



Program Essentials

Prime contractor: Raytheon
 Program office: Eglin AFB, FL
 Funding needed to complete:
 R&D: \$773.2 million
 Procurement: \$2,221.9 million
 Total funding: \$2,995.0 million
 Procurement quantity: 17,000

Program Performance (fiscal year 2013 dollars in millions)

	As of 10/2010	Latest 08/2012	Percent change
Research and development cost	\$1,692.6	\$1,633.7	-3.5
Procurement cost	\$3,146.2	\$2,221.9	-29.4
Total program cost	\$4,838.8	\$3,855.6	-20.3
Program unit cost	\$0.282	\$0.225	-20.3
Total quantities	17,163	17,163	0.0
Acquisition cycle time (months)	72	72	0.0

The SDB II program is scheduled to enter low-rate production in January 2014. At that point the program expects to have fully matured its critical technologies as well as the design. The program's biggest risk—integration with the JSF—will not be resolved until after production begins. Program officials told us that this risk will be mitigated by the fact that any problems in integrating with the JSF should be discovered and corrected with the weapons that will integrate before SDB II. According to program officials, if delays with the program's optimistic schedule occur it could force a renegotiation of the contract for the first five production lots, potentially causing the program to lose some of the money it saved through competition. The program has successfully completed one guided flight test and failed another.

Attainment of Product Knowledge

As of January 2013

Resources and requirements match

- Demonstrate all critical technologies in a relevant environment ●
- Demonstrate all critical technologies in a realistic environment ○
- Complete preliminary design review ●

Product design is stable

- Release at least 90 percent of design drawings ●
- Test a system-level integrated prototype ●

Manufacturing processes are mature

- Demonstrate critical processes are in control
- Demonstrate critical processes on a pilot production line
- Test a production-representative prototype

● Knowledge attained ■■■■ Information not available
 ○ Knowledge not attained Not applicable

SDB II Program

Technology and Design Maturity

SDB II's critical technologies—guidance and control, multi-mode seeker, net ready data link, and payload—are currently nearing maturity despite the program entering system development in July 2010. Program officials expect the critical technologies to be mature by the low-rate production decision in January 2014.

SDB II's design is stable and it has begun flight testing, successfully completing one guided flight test and failing another. The successful test was performed in the immediate attack sub-mode, the most difficult of the program's three attack modes. The second test failed due to the dome cover not deploying, thus preventing the seeker from acquiring the target. A review board is currently investigating and program officials said this test will be rescheduled. The program plans to complete a total of 11 flight tests, including two live fire events, prior to the low-rate production decision in January 2014. The last six flight tests will utilize production representative hardware.

According to program officials, the biggest risk facing the program is integration with JSF. If JSF cannot meet its design specifications, then SDB II may not meet its requirements for weapon effectiveness or availability on that aircraft and may need design changes. The JSF is now integrating other weapons which will allow the program to determine the accuracy of its design documents. Many of these weapons have more stringent thermal and vibration requirements than SDB II. Additionally, SDB I will begin integration with JSF about 2 years prior to SDB II. By integrating with JSF after these weapons SDB II will be able to leverage data from these efforts.

Production Maturity

The SDB II program plans to take several steps to demonstrate the maturity of its manufacturing processes prior to beginning production. The program will demonstrate its critical manufacturing processes on a pilot production line and demonstrate that the system will work as intended in a reliable manner by testing a fully configured production-representative prototype. In addition, the

program plans to build over 50 guided test vehicles and live fire test assets on the production line prior to beginning actual SDB II production.

The program plans to procure about 40 percent of its quantities during low-rate production. Officials said this is due to delays with the JSF program that have postponed integration, and therefore delayed the full rate production decision. Delays with JSF have also postponed the initial capability date for SDB II on the JSF by more than 2 years.

Other Program Issues

The program currently has an optimistic test schedule prior to the low-rate production decision in January 2014. The test program has already experienced a 5-month delay resulting in a corresponding delay in the low-rate production decision and any additional delays could further postpone this decision. Further, the program only has 4 months available between the conclusion of the flight tests and milestone C for the rescheduling of any missed test events. According to program officials, if the program has to delay this decision further, it could force a renegotiation with the contractor for the first five production lots and the program could lose money that it saved through competition.

As requested, we reviewed whether individual subcontracting reports from the prime contractor for the program were accepted on eSRS. The government uses subcontracting reports on eSRS as one method of monitoring small business participation. As of December 2012, eSRS indicated that the subcontracting report associated with SDB II's contract has not been accepted.

Program Office Comments

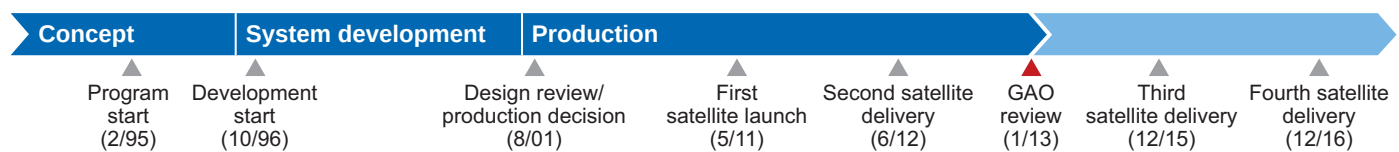
In commenting on a draft of this assessment, the program office provided technical comments, which were incorporated where deemed appropriate.

Space Based Infrared System High Component (SBIRS High)

The Air Force's SBIRS High satellite system is being developed to replace the Defense Support Program and perform a range of missile warning, missile defense, technical intelligence, and battlespace awareness missions. SBIRS High will consist of four satellites in geosynchronous earth orbit (GEO), two sensors on host satellites in highly elliptical orbit (HEO), two replenishment satellites and sensors, and fixed and mobile ground stations. We assessed the space segment and made observations about the ground segment.



Source: © 2007 Lockheed Martin.



Program Essentials

Prime contractor: Lockheed Martin Corporation
 Program office: El Segundo, CA
 Funding needed to complete:
 R&D: \$1,272.3 million
 Procurement: \$3,709.5 million
 Total funding: \$4,981.7 million
 Procurement quantity: 2

Program Performance (fiscal year 2013 dollars in millions)

	As of 10/1996	Latest 07/2012	Percent change
Research and development cost	\$4,504.0	\$11,564.3	156.8
Procurement cost	\$0.0	\$6,955.0	NA
Total program cost	\$4,730.6	\$18,777.6	296.9
Program unit cost	\$946.121	\$3,129.607	230.8
Total quantities	5	6	20.0
Acquisition cycle time (months)	86	TBD	NA

The 1996 data show no procurement cost as the Air Force planned to use research and development funds to buy all five satellites. The cost of the two HEO replenishment sensors is not included in either column.

The first SBIRS satellite launched in May 2011—roughly 9 years late—and program officials expect operational certification in early 2013. The satellite launched without a fully developed ground system or the event recovery software needed to re-establish ground control should an unforeseen failure occur. The program plans to deliver the ground system in increments, with full functionality expected in late 2018. Program officials planned to upload the completed event recovery software to the on-orbit satellite in August 2012, but recently indicated that given the first satellite's planned operational certification, testing the software on the second satellite pre-launch made more sense. Launch of the second SBIRS satellite is planned for March 2013 and the third and fourth satellites are to be available for launch in late 2015 and 2016, respectively.

Attainment of Product Knowledge

As of January 2013

Resources and requirements match

- Demonstrate all critical technologies in a relevant environment ●
- *Demonstrate all critical technologies in a realistic environment*
- Complete preliminary design review ●

Product design is stable

- Release at least 90 percent of design drawings ●
- *Test a system-level integrated prototype*

Manufacturing processes are mature

- *Demonstrate critical processes are in control*
- Demonstrate critical processes on a pilot production line ○
- *Test a production-representative prototype*

● Knowledge attained ■■■■ Information not available
 ○ Knowledge not attained Not applicable

SBIRS High Program

Technology, Design, and Production Maturity

According to the program office, the system's critical technologies are mature, its design is stable, and its manufacturing processes have been proven, as the first two satellites have been built. The first satellite underwent trial operations through November 2012 and is performing better than expected, according to program officials. Following a successful trial period, the satellite is expected to be formally certified as operational in early 2013. The second satellite is expected to launch in March 2013 and the event recovery software, not included on the first satellite, will be tested and operational on the second satellite prior to launch. Program officials say once the software is tested and approved on the second satellite, and following operational certification of the first satellite, the proven event recovery software will be uploaded to the first satellite.

According to the program, development challenges, test failures, and technical issues have resulted in significant cost growth and schedule delays for production of the third and fourth satellites. For example, the contractor underestimated the resources and time needed to develop consoles and associated software for testing component functionality, especially for the mirror assembly and electronics testing console. The Air Force is projecting a cost overrun of \$438 million for these two satellites and a satellite delivery delay of 14 months. The estimated delivery dates for the third and fourth satellites are now late 2015 and 2016, respectively.

The program plans to make slight changes to the design of its replenishment HEO sensors to address parts obsolescence and electromagnetic interference issues that affected the operation of the two on-orbit sensors. The third and fourth sensors are scheduled for delivery to the host for integration in fiscal years 2013 and 2015, respectively.

Other Program Issues

The first GEO satellite launched in May 2011 before completing development of the ground system, which processes data from the satellite's infrared sensors. The program office expects full operational functionality of the ground system in late 2018 upon delivery of the second of two capability increments. According to the program office, ground system

development proved more difficult than anticipated, and major non-ground system issues, such as flight software problems, contributed to multiple delays. The program revised its delivery schedule of ground capabilities to add increments to provide the warfighter some capabilities sooner than 2018.

The program issued its new acquisition program baseline with updated cost estimates and delivery milestones in January 2012. In August 2012, the Under Secretary of Defense for Acquisition, Technology, and Logistics authorized production of the fifth and sixth satellites. These satellites are planned to be available for launch in 2019 and 2020, respectively.

As requested, we reviewed whether individual subcontracting reports from the prime contractor for the program were accepted on eSRS. The government uses subcontracting reports on eSRS as one method of monitoring small business participation. As of December 2012, eSRS indicated that none of the subcontracting reports for SBIRS High's two contracts have been accepted.

Program Office Comments

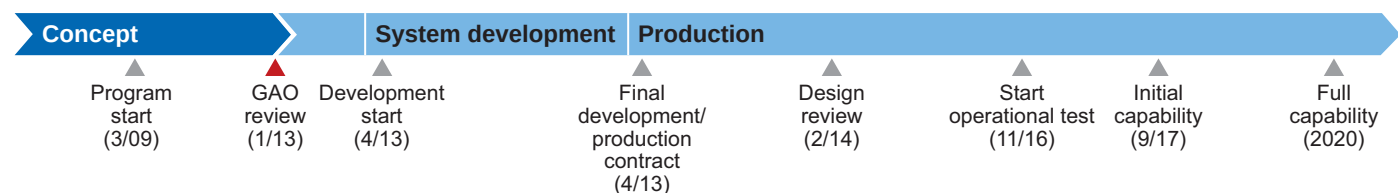
According to the program office, the SBIRS program is continuing to execute well and is on track to deliver capability to the warfighter. The first GEO satellite demonstrated outstanding overall data quality during its trial period. Despite the data quality, the satellite experienced a delay to operational certification to address a sporadic recurrence of a known spacecraft issue. The second satellite continues to prepare for its March 2013 initial launch capability. The ground system is mature and performing well. Program leadership recently approved the ground system completion baseline, which delivers all SBIRS ground capability required to meet system performance requirements. The production program's cost and schedule performance is stabilizing. The acquisition program baseline for the block buy of the fifth and sixth satellites was approved in September 2012 and the program office recently awarded the initial non-recurring engineering effort for this acquisition. The program also provided technical comments, which were incorporated where deemed appropriate.

Space Fence

The Air Force's Space Fence will be a system of large ground-based radars that will replace the Air Force's Space Surveillance System, which has been operational since 1961. Space Fence will use higher radio frequencies to detect and track smaller earth-orbiting objects. The system is expected to consist of two geographically dispersed radars, located in Kwajalein Atoll and Australia, to help ensure effective space surveillance coverage. The system's capabilities are expected to greatly increase the number of objects detected and tracked.



Source: U.S. Air Force.



Program Essentials

Prime contractor: TBD
 Program office: Hanscom AFB, MA
 Funding needed to complete:
 R&D: \$1,235.2 million
 Procurement: \$832.1 million
 Total funding: \$2,067.3 million
 Procurement quantity: 1

Program Performance (fiscal year 2013 dollars in millions)

	As of	Latest 07/2012	Percent change
Research and development cost	NA	\$1,654.0	NA
Procurement cost	NA	\$832.1	NA
Total program cost	NA	\$2,486.1	NA
Program unit cost	NA	\$1,243.052	NA
Total quantities	NA	2	NA
Acquisition cycle time (months)	NA	102	NA

The Space Fence program's first radar site includes seven critical technologies, which are nearing maturity and are expected to reach full maturity by critical design review, planned for February 2014. The program completed a successful preliminary design review in February 2012, reviewing both technology development contractors' working prototypes. The program plans to award a single system development and production contract in 2013, and plans to provide an initial operational capability by 2017 with one of the two planned radar sites completed. A new data processing system is also being developed by the Air Force under a separate program to accommodate the increased volume of data from Space Fence.

Attainment of Product Knowledge

Projected as of January 2013

Resources and requirements match

- Demonstrate all critical technologies in a relevant environment ●
- Demonstrate all critical technologies in a realistic environment ○
- Complete preliminary design review ●

Product design is stable

- Release at least 90 percent of design drawings
- Test a system-level integrated prototype

Manufacturing processes are mature

- Demonstrate critical processes are in control
- Demonstrate critical processes on a pilot production line
- Test a production-representative prototype

● Knowledge attained ■■■ Information not available
 ○ Knowledge not attained Not applicable

Space Fence Program

Technology Maturity

The Space Fence program's first radar site has seven critical technologies, all of which are nearing maturity. These critical technologies all have mature backups, the substitution of which would lead to degraded performance and increased power needs. The program office does not anticipate using the backups as all critical technologies passed preliminary design review and are expected to demonstrate full maturity by critical design review. It is possible that the configuration of the radar at the second site will not be identical to the radar at the first site; however, the basic design building blocks, such as components and subsystems, will be identical. The program's technology development phase included competitive development of two fully working prototypes by separate contractors to reduce program risk.

Other Program Issues

The Space Fence program plans to competitively award a single system development and production contract in 2013, a delay from the previously scheduled July 2012. According to the program office, the delay in contract award was caused by a new DOD requirement for a program review prior to release of the request for proposals for the system development contract. Space Fence was one of the first programs to go through this review. The program office plans to award a fixed-price incentive fee contract for system development activities for the first radar site at Kwajalein Atoll, with a contract option for the second site in western Australia. The specific configuration of the two sites will depend on which contractor is awarded the final development and production contract. Completion of the first radar is expected to provide initial operational capability, but both sites are required to achieve full operational capability, currently scheduled for fiscal 2020.

The program was able to reduce its costs as estimated at the start of the program by about \$700 million. According to program office officials, this was achieved by reducing the number of planned sites from three to two and by requiring fully functional prototypes in the technology development phase. In addition, an independent review found the program's technologies to be more mature than previously thought, further reducing assessed risk

and cost. An independent cost estimate is currently underway, and the program office expects that estimate to be close to the current estimate.

The Joint Space Operations Center (JSpOC) at Vandenberg AFB is acquiring a new data processing capability able to process the increased volume of data from the Space Fence. The JSpOC Mission System (JMS) is being developed through a separate acquisition program. According to Space Fence program office officials, their program requires deployment of JMS to achieve initial operational capability as the amount of data Space Fence is expected to generate exceeds the capabilities of the existing command and control system. Currently, the JMS program office plans to have JMS operational by the end of fiscal year 2015, enabling input and processing of data from Space Fence. However, a July 2011 test report on JMS initial capabilities found that many of its tools had limited or no operational capability and some did not match the capability provided by the legacy system because of issues including tool design, software anomalies, data inconsistencies, and the need for additional development. For the first increment of capability, JMS recently delayed its full deployment decision from September 2012 to February 2013.

Program Office Comments

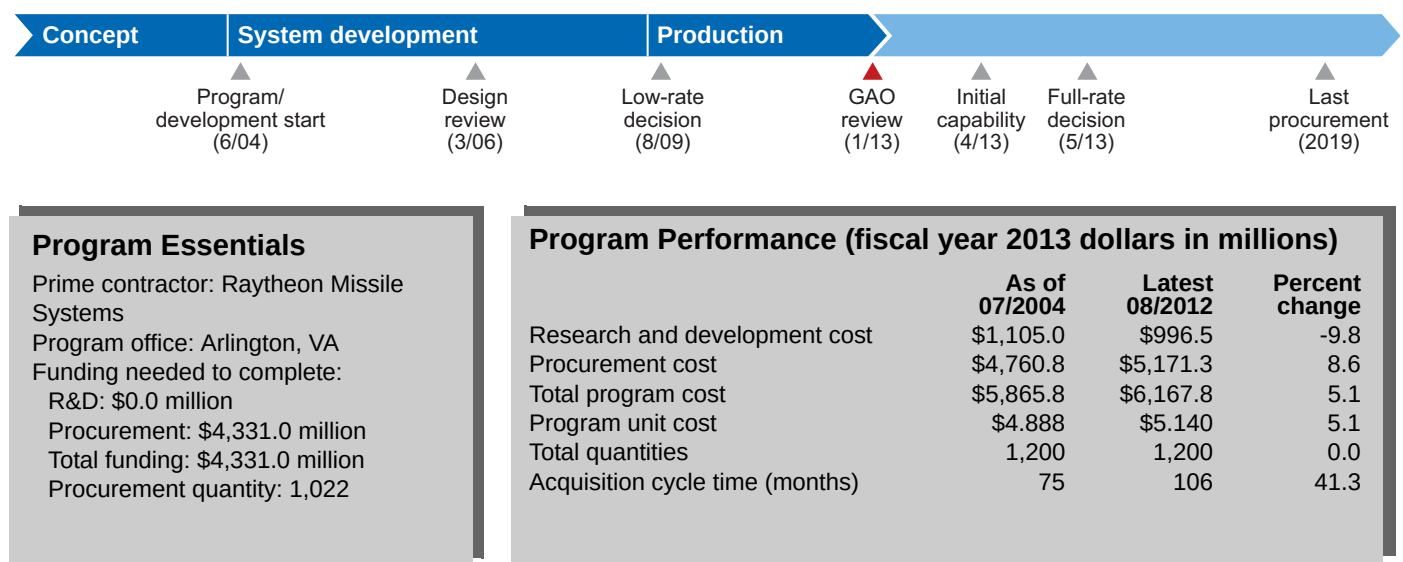
In commenting on a draft of this assessment, the program office noted that Space Fence remains on track to a 2017 initial operational capability. The Undersecretary of Defense for Acquisition, Technology, and Logistics signed the acquisition strategy in September 2012, authorizing release of the request for proposal for system development and beyond in October 2012. Award of a single contract is expected shortly after the scheduled April 2013 milestone B defense acquisition board meeting. Critical design review will occur no later than 9 months after contract award provided the program retains its programmed funding. Space Fence is working with JMS to define the interface between the systems as planned under JMS Increment 2. The program also provided technical comments, which were incorporated where deemed appropriate.

Standard Missile-6 (SM-6)

The Navy's Standard Missile-6 (SM-6) is a surface-to-air missile launched from Aegis ships. It is designed to provide ship self-defense, fleet defense, and theater air defense against aircraft, ships, and missiles at various altitudes over land and sea. It will provide an over-the-horizon engagement capability and improved capabilities at extended ranges by combining legacy Standard Missile and Advanced Medium-Range Air-to-Air Missile (AMRAAM) technology. We assessed SM-6 block 1. Follow-on blocks will be developed to meet future threats.



Source: Raytheon.



The SM-6 program's highly concurrent testing and production strategy has resulted in design changes and schedule delays due to numerous problems found in developmental and operational testing. With 178 missiles under contract, the program's full rate production decision has been delayed until fiscal year 2013 to allow for supplemental testing to verify correction of some, but not all, test failures. Despite delays, the program has not revised its near-term procurement quantities to account for the risk that the missile has not been demonstrated as suitable and reliable in its operational environment.

Attainment of Product Knowledge	
As of January 2013	
Resources and requirements match	
• Demonstrate all critical technologies in a relevant environment	●
• Demonstrate all critical technologies in a realistic environment	●
• Complete preliminary design review	●
Product design is stable	
• Release at least 90 percent of design drawings	●
• Test a system-level integrated prototype	●
Manufacturing processes are mature	
• Demonstrate critical processes are in control	○
• Demonstrate critical processes on a pilot production line	●
• Test a production-representative prototype	●
● Knowledge attained	Information not available
○ Knowledge not attained	Not applicable

SM-6 Program

Technology, Design, and Production Maturity

According to the program office, all SM-6 critical technologies are mature and its design is stable; however, the program remains at risk of further design changes pending testing to verify correction of failures. The program obtained approval at development start to conduct limited developmental testing because the risk of integrating the legacy AMRAAM missile seeker with the Standard Missile was perceived to be low. However, over half of the SM-6's at-sea developmental flight tests experienced anomalies or resulted in failure with multiple issues that have been attributed to these legacy components. The program proceeded with operational testing in June 2011 and the missile failed 5 of 12 tests. According to the program office, the Navy's operational test organization concluded that the missile is effective, but a determination of suitability and reliability is pending the completing of supplemental testing.

The SM-6 program has proven out its production processes, but has not yet demonstrated that its critical processes are in control or that the missiles produced perform reliably. According to the program, the sample size needed for measuring processes control will not be achieved until 2014.

Other Program Issues

The SM-6's highly concurrent testing and production strategy has resulted in design changes and schedule delays. In 2009, the Under Secretary of Defense for Acquisition, Technology, and Logistics approved low-rate production of up to 19 missiles before completing developmental testing and required the program to complete developmental testing prior to awarding additional contracts. The Under Secretary subsequently approved the award of two additional low-rate production contracts before this testing was complete. After numerous developmental test failures, the program proceeded into operational testing where the high failure rate continued. In February 2012, the Under Secretary of Defense approved an acquisition strategy update which extended low-rate production through fiscal year 2012 and delayed the full-rate production decision until fiscal year 2013 to allow for supplemental testing. In addition, multiple SM-6 capabilities will not be fully tested until full-rate production is well underway. According to officials,

the program plans to have 387 of 1,200 missiles under contract by the end of fiscal year 2014, prior to the fielding the Naval Integrated Fire Control-Counter Air From the Sea capability, which enables its over-the-horizon capabilities.

As requested, we reviewed whether individual subcontracting reports from the prime contractor for the program were accepted on eSRS. The government uses subcontracting reports on eSRS as one method of monitoring small business participation. As of December 2012, eSRS indicated that the subcontracting report for SM-6's contract has not been accepted.

Program Office Comments

In commenting on a draft of this assessment, the Navy disagreed with our assertion that the missile has not been demonstrated to perform reliably. According to officials, supplemental testing was successfully completed in November 2012 and the program expects the missile to be assessed as reliable. The program office also provided technical comments, which were incorporated where deemed appropriate.

GAO Response

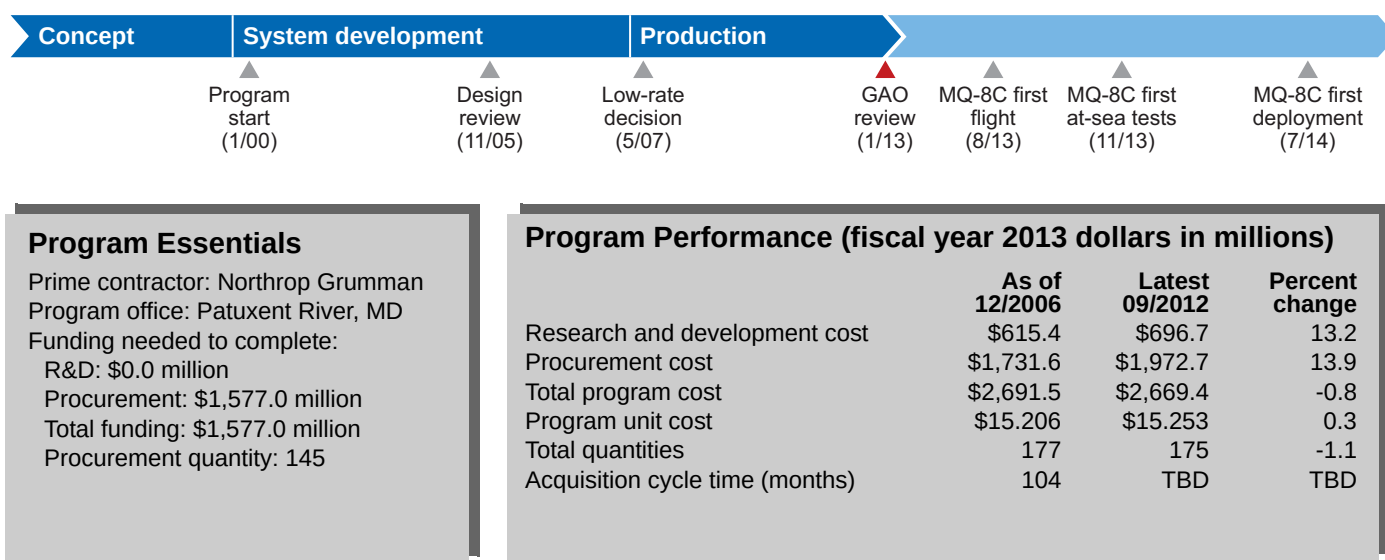
While program officials expect the SM-6 to be assessed as reliable, the Director, Operational Test and Evaluation reported in January 2013 that data from supplemental testing are insufficient to verify correction of problems found in operational testing and concluded that the missile does not meet the flight reliability criteria established by the Under Secretary of Defense. Our reviews of DOD weapons systems confirm that production costs are minimized when a fully integrated, capable prototype is demonstrated to show that the system will work as intended in a reliable manner.

Vertical Takeoff and Landing Tactical Unmanned Aerial Vehicle—MQ-8 Fire Scout (VTUAV)

The Navy's VTUAV is intended to provide real-time imagery and data in support of intelligence, surveillance, and reconnaissance missions. A VTUAV system is comprised of up to three air vehicles with sensors, two ground control stations, and one recovery system. The air vehicle launches and lands vertically, and operates from ships and land. The VTUAV is also intended for use in various operations, including surface, anti-submarine, and mine warfare. We assessed the MQ-8B and the new, larger variant of the aircraft, the MQ-8C.



Source: Northrop Grumman.



The Navy has suspended production of the MQ-8B variant of the VTUAV until 2015 and in April 2012 awarded a contract to begin development and production of a MQ-8C variant with a larger airframe to improve range, endurance, payload, and future carrying capacity. Program officials stated that delaying production of additional MQ-8B aircraft aligns with the schedule delays in the Littoral Combat Ship, its intended platform. The engineering design of the MQ-8C is still in progress and program officials stated that it is too early to tell if they will encounter any challenges. Program officials anticipate that the first flight of MQ-8C will be in August 2013 and testing of the MQ-8C at sea will begin in November 2013.

Attainment of Product Knowledge	
As of January 2013	
Resources and requirements match	
• Demonstrate all critical technologies in a relevant environment	●
• Demonstrate all critical technologies in a realistic environment	●
• Complete preliminary design review	●
Product design is stable	
• Release at least 90 percent of design drawings	●
• Test a system-level integrated prototype	●
Manufacturing processes are mature	
• Demonstrate critical processes are in control	
• Demonstrate critical processes on a pilot production line	●
• Test a production-representative prototype	●
● Knowledge attained	 Information not available
○ Knowledge not attained	Not applicable

VTUAV Program

Technology and Design Maturity

The VTUAV program did not identify any critical technologies for MQ-8B or MQ-8C. According to the program office, both rely on common, mature technologies and MQ-8C does not introduce any new technologies. Program officials noted that MQ-8B and MQ-8C share 90 percent commonality between the two systems and the differences are primarily structural modifications to accommodate the larger airframe and fuel system of MQ-8C.

The design for MQ-8B appears stable and the program has released all its expected drawings. Program officials noted that they have completed software updates and made changes to the maintenance procedures as a result of problems identified after two aircraft were lost in recent deployments. They believe that some of these issues can be attributed to the aircraft being flown longer flight hours than originally intended. Program officials stated that the engineering design of MQ-8C is still in progress and it is too early to tell if they will encounter any challenges.

Production Maturity

The VTUAV program's production processes for MQ-8B have been demonstrated, but we could not assess whether critical manufacturing processes are in control as the program does not collect data on statistical process controls or assess process capabilities using manufacturing readiness levels. The program is planning to suspend production of MQ-8B until 2015 while MQ-8C is being produced. Program officials stated that delaying production of additional MQ-8B aircraft aligns with schedule delays in Littoral Combat Ship deliveries, the platform from which MQ-8B is intended to operate. The program awarded a development and production contract for two test aircraft and six operational aircraft of the rapid deployment capability MQ-8Cs in April 2012. As the program intends to use the same production line for both variants it could experience challenges in the transition of production between the systems.

Other Program Issues

The program has shifted its focus to MQ-8C—an upgraded variant of the aircraft with improved range, endurance, payload, and future carrying capacity—due to a joint urgent operational need

from U.S. Africa Command. Officials have not determined if MQ-8C will be used on the Littoral Combat Ship and are planning to deploy it from a destroyer. Program officials anticipate that first flight of MQ-8C will be in August 2013 and testing of the MQ-8C at sea will begin in November 2013. MQ-8C may be at risk for schedule delays, due to the uncertainty of the design and the limited amount of time between contract award and first flight. MQ-8C is not required to conform to many of the acquisition practices followed by other programs as it is being developed to fill a joint urgent operational need; however, a quick reaction assessment is planned for MQ-8C 3 to 4 months prior to ship deployment. Program officials expect that a decision regarding the future of MQ-8C will occur in fiscal year 2014. In the meantime, MQ-8B will continue to pursue testing for deployment on the Littoral Combat Ship.

As requested, we reviewed whether individual subcontracting reports from the prime contractor for the program were accepted on eSRS. The government uses subcontracting reports on eSRS as one method of monitoring small business participation. As of December 2012, eSRS indicated that the subcontracting report associated with VTUAV's contract has been accepted.

Program Office Comments

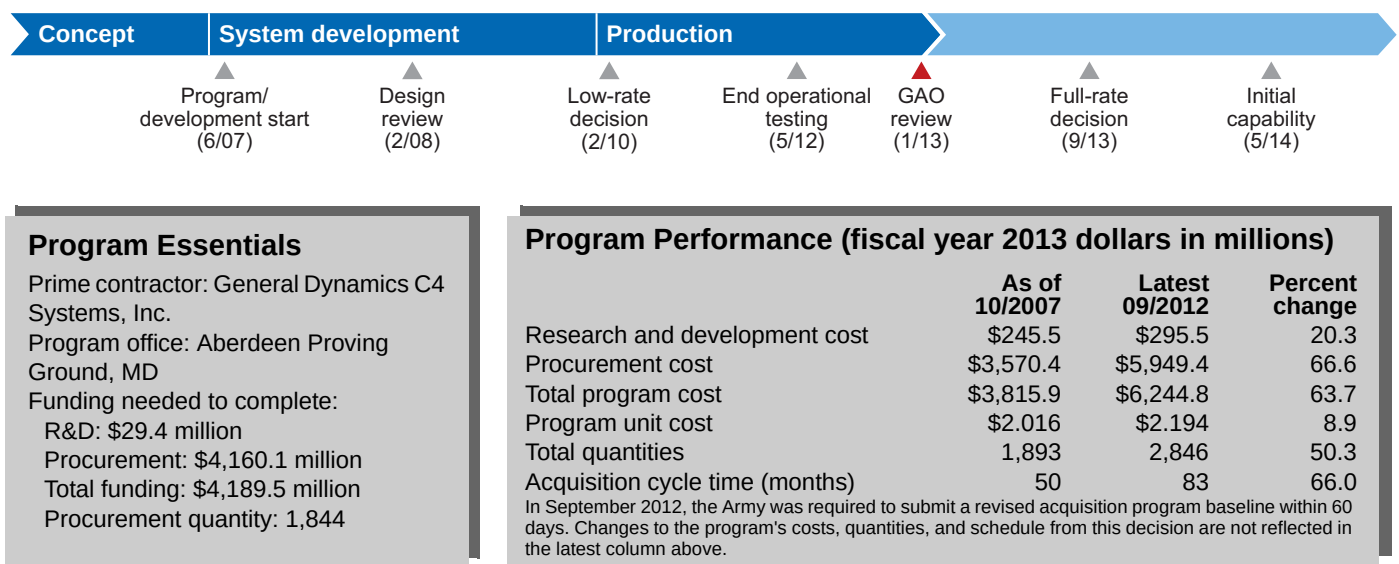
While awaiting opportunity for initial operational testing, VTUAV is deployed supporting U.S. military operations. In fiscal year 2012, MQ-8B was fielded on the USS Klakring conducting anti-piracy operations near the Horn of Africa, on the USS Simpson supporting Africa Partnership Station missions, and in Afghanistan in support of the Pentagon's Intelligence, Surveillance, and Reconnaissance Task Force. To date, the program has accumulated over 6,450 flight hours, completed a quick reaction assessment, and procured 23 aircraft, the last of which is scheduled to be delivered in fiscal year 2013. Dynamic interface testing aboard Littoral Combat Ship-3 is scheduled for August 2013. Manufacturing readiness levels are not part of the reporting metrics for the MQ-8B program as it became a requirement after the aircraft went into production. The program office also provided technical comments, which were incorporated where deemed appropriate.

Warfighter Information Network-Tactical (WIN-T) Increment 2

WIN-T is the Army's high-speed and high-capacity backbone communications network. It connects units with higher levels of command and provides the Army's tactical portion of the Global Information Grid. WIN-T was restructured following a March 2007 Nunn-McCurdy unit-cost breach of the critical threshold, and will be fielded in four increments. We assessed the second increment, which is expected to provide the Army with an initial networking on-the-move capability.



Source: PM WIN-T Increment 2.



WIN-T Increment 2 entered production in February 2010 with mature critical technologies and, according to program office metrics, a stable design. The program has tested a production-representative prototype, and has indicated that its manufacturing processes are in control. An assessment of the program's manufacturing readiness level indicates that it has demonstrated the capability recommended by DOD guidance to begin full rate production. However, during its May 2012 initial operational test, the program did not demonstrate required performance and reliability. The milestone decision authority has delayed a full rate production decision until the Army completes a follow-on operational test, and produces evidence of improved system performance and reliability.

Attainment of Product Knowledge	
As of January 2013	
Resources and requirements match	
• Demonstrate all critical technologies in a relevant environment	●
• Demonstrate all critical technologies in a realistic environment	●
• Complete preliminary design review	●
Product design is stable	
• Release at least 90 percent of design drawings	
• Test a system-level integrated prototype	●
Manufacturing processes are mature	
• Demonstrate critical processes are in control	●
• Demonstrate critical processes on a pilot production line	
• Test a production-representative prototype	●
● Knowledge attained	 Information not available
○ Knowledge not attained	Not applicable

WIN-T Increment 2 Program

Technology Maturity

All 15 WIN-T Increment 2 critical technologies were mature by its February 2010 production decision. In August 2012, an independent manufacturing readiness assessment prepared by the Army concluded that the prime contractor had achieved an acceptable level of technology maturity to continue to full rate production.

Design Maturity

According to the WIN-T program, it has integrated and tested its key technologies and subsystems, which demonstrates that the system's design is capable of working as intended. The program office does not track the metric we use to measure design maturity—the number of releasable drawings—because WIN-T is primarily an information technology integration effort. Instead, design performance is measured through a series of component, subsystem, configuration item, and network-level tests designed to demonstrate performance at increasing levels of system integration. Design stability is measured through problem-tracking report trends.

Production Maturity

The WIN-T Increment 2 program began production in February 2010 and began testing a production-representative prototype in March 2011. The program indicates that its manufacturing processes are in control. An Army manufacturing readiness assessment concluded that the program has demonstrated the capability recommended by DOD guidance to begin full rate production. However, during its May 2012 initial operational test, the program did not demonstrate required performance and reliability. As a result, the full rate production decision was delayed until the Army completes a follow-on operational test, and produces evidence of improved system performance and reliability. The program estimates that follow-on testing will take place next summer, and that a full-rate production decision will occur by September 2013.

Other Program Issues

Based on the results of the May 2012 operational test, the Director, Operational Test and Evaluation, concluded that only some of the program's configuration items and technologies were operationally effective and that the program is not

operationally suitable as six of the eight configuration items did not meet their reliability targets. The Director recommended that the Army dedicate resources to fix the program's reliability and ability to support a 72-hour mission, and demonstrate improvements through a future operational test event. The Director also recommended that the Army consider appointing an independent review panel to determine if the program is capable of meeting its original reliability targets or recommend redesign changes. The Army is to perform a life-cycle cost analysis to determine the additional costs for maintenance support due to the program's inability to meet its original reliability targets.

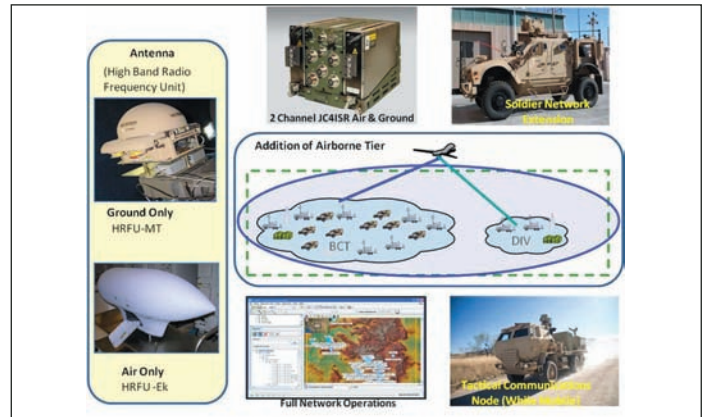
As requested, we reviewed whether individual subcontracting reports from the prime contractor for the program were accepted on eSRS. The government uses subcontracting reports on eSRS as one method of monitoring small business participation. As of December 2012, eSRS indicated that the subcontracting report for WIN-T's contract has not been accepted.

Program Office Comments

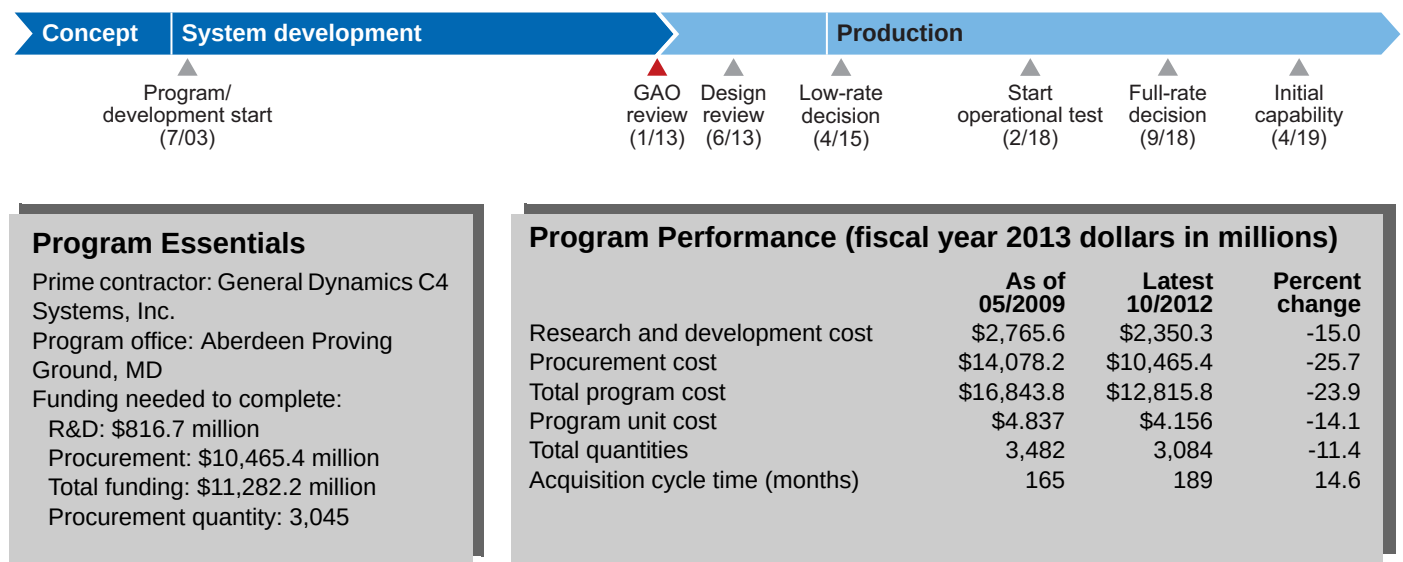
In commenting on a draft of this assessment, the program office provided technical comments, which were incorporated where deemed appropriate.

Warfighter Information Network-Tactical (WIN-T) Increment 3

WIN-T is the Army's high-speed and high-capacity backbone communications network. It connects units with higher levels of command and provides the Army's tactical portion of the Global Information Grid. WIN-T was restructured following a March 2007 Nunn-McCurdy unit-cost breach of the critical threshold, and will be fielded in four increments. We assessed the third increment, which is expected to provide the Army a full networking on-the-move capability.



Source: PM WIN-T Increment 3.



WIN-T Increment 3 will not demonstrate the maturity of all its critical technologies until its planned April 2015 production decision. Five of the program's 18 critical technologies are currently mature and 13 are nearing maturity. However, 7 additional technologies are expected to be rated as mature during the program's critical design review. The program does not use the number of design drawings released or alternative methods to assess design stability. However, the program plans to begin capturing design stability metrics once it has completed its design review and established a baseline system design. The program plans to conduct system-level developmental testing on a fully configured, production representative prototype in July 2014.

Attainment of Product Knowledge	
As of January 2013	
Resources and requirements match	
• Demonstrate all critical technologies in a relevant environment	●
• Demonstrate all critical technologies in a realistic environment	○
• Complete preliminary design review	●
Product design is stable	
• Release at least 90 percent of design drawings	
• Test a system-level integrated prototype	○
Manufacturing processes are mature	
• Demonstrate critical processes are in control	
• Demonstrate critical processes on a pilot production line	
• Test a production-representative prototype	
● Knowledge attained	 Information not available
○ Knowledge not attained	Not applicable

WIN-T Increment 3 Program

Technology Maturity

WIN-T Increment 3 will not demonstrate the maturity of all 18 of its critical technologies in a realistic environment until its planned April 2015 production decision. Five of the program's 18 critical technologies are currently mature, and 13 are nearing maturity. According to the program office, 7 of the 13 nearing maturity were demonstrated in a realistic environment during the operational test of WIN-T Increment 2 in May 2012. However, the evidence supporting a decision to rate these technologies as mature will not be fully assessed until the design review, now scheduled for June 2013, has been completed.

Two of these seven technologies—the Quality of Service Edge Device (QED), and High Assurance Internet Protocol Encryptor (HAiPE) version 3.X—were not formally rated by the Director, Defense Research and Engineering (DDR&E) during an April 2009 review of the Army's technology readiness assessment for WIN-T Increment 3—the most recent comprehensive independent assessment of the program's critical technologies. DDR&E concluded that QED had ambiguous requirements, which made it difficult to state whether it had been adequately demonstrated, and recommended that the Army clarify the requirements for this technology by the critical design review. According to the program, the Army's Training and Doctrine Command has revisited these requirements and the technology's maturity will be fully assessed during the program's critical design review. HAIPE is a device that encrypts and encapsulates Internet protocol packets so that they can be securely transported over a network of a different security classification. HAIPE version 3.X was not available for assessment at the time of DDR&E's April 2009 review, but was demonstrated during the operational test of WIN-T Increment 2 in May 2012 and the program office states that it intends to fully assess its maturity during the critical design review.

The program office stated that it has dropped two critical technologies from the original set of 20; the Joint Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance Transmission Management

Subsystem, and the Distributed Network Agent were removed due to their similarities with several of the program's other critical technologies.

Design Maturity

The program does not currently use the number of design drawings released or any alternative methods to assess design stability. According to the program office, the number of design drawings is not meaningful as WIN-T is not a manufacturing effort, but an integration effort. The program plans to begin employing alternative methods to assess design stability once it has completed its design review, now scheduled for June 2013, and has a stable baseline design, but has not made any final decisions about those methods. The program intends to conduct system-level developmental testing on a fully configured, production representative prototype in July 2014.

Other Program Issues

As requested, we reviewed whether individual subcontracting reports from the prime contractor for the program were accepted on eSRS. The government uses subcontracting reports on eSRS as one method of monitoring small business participation. As of December 2012, eSRS indicated that the subcontracting report for WIN-T Increment 3's contract has not been accepted.

Program Office Comments

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

Airborne and Maritime/Fixed Station Joint Tactical Radio System (AMF JTRS)

DOD's AMF JTRS program was developing software-defined radios and associated equipment for integration into nearly 160 different types of aircraft, ships, and fixed stations to increase communications and networking capabilities. The program was developing two radios based on a common architecture: a 2-channel small airborne radio and 4-channel maritime/fixed station radio. In 2012, DOD directed the closeout of all remaining efforts under the previous development contract and directed a new acquisition approach for the program.



Source: AMF JTRS Program Office.

Current Status

In September 2011, following an in-depth review of the program, the acting Under Secretary of Defense for Acquisition, Technology, and Logistics, directed the JTRS program executive officer to enter negotiations to restructure the existing contract to cap the government's potential liability for completion of the system development and demonstration of the 2-channel small airborne capability. Subsequent negotiations resulted in a significant gap between the government and contractor on the cost and level of capability for this radio as there remained a potential for unbounded cost increases and continued schedule and contractor performance risk. Market research determined that there were other viable non-developmental items that could be modified to meet users' revised priorities and needs. In May 2012, DOD directed the closeout of all remaining efforts under the current development contract.

In July 2012, as part of an overall JTRS reorganization, the Under Secretary directed a restructured acquisition approach to acquire a modified non-developmental item which leverages the prior investment in the AMF program to the maximum extent practical. AMF JTRS now plans to acquire a Small Airborne Link 16 Terminal and a Small Airborne Networking Radio for Army users. Approval of the program's acquisition strategy is currently scheduled for the fourth quarter of fiscal year 2013 and a production decision for both products is scheduled for the third quarter of fiscal year 2014. To meet the near-term needs for the AH-64E Apache platform, the Apache program office has independently contracted for an interim Link 16 capability. In addition, the Under Secretary transitioned responsibility for AMF JTRS program management and execution to the Army.

Estimated Program Cost and Quantity (fiscal year 2013 dollars):

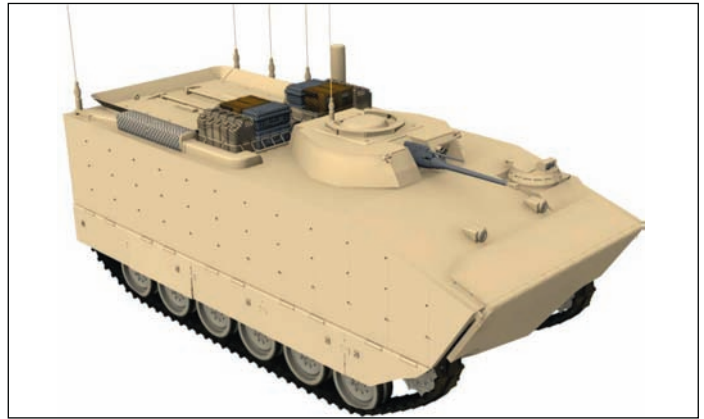
Total program: (through fiscal year 2012) \$1,718.5 million

Next Major Program Event: Milestone decision authority approval of acquisition strategy, fourth quarter, fiscal year 2013

Program Office Comments: In commenting on a draft of this assessment, the program office provided technical comments, which were incorporated where deemed appropriate.

Amphibious Combat Vehicle (ACV)

The Marine Corps' ACV is intended to transport troops from ships to shore and move them inland faster and farther than current Assault Amphibious Vehicles (AAV). Following development delays and cost increases, an initial replacement effort, the Expeditionary Fighting Vehicle (EFV) program, was found unaffordable and terminated in January 2011. The range requirements for the ACV alternatives under consideration have been eased compared to EFV and it is anticipated that a complementary land-based Marine Personnel Carrier would address some gaps.



Source: Program manager Advanced Amphibious Assault (PM AAA).

Current Status

A December 2011 materiel development decision memo directed a "highly tailored" approach to acquiring ACV that focuses on cost-effectiveness and emphasizes engineering and design analysis through establishment of affordability targets and execution of an analysis of alternatives (AOA). The Marine Corps' July 2012 AOA assessed several alternatives for comparison, including the cancelled EFV. Officials indicate that two affordable alternatives have been identified; an EFV with reduced requirements and an enhanced AAV. No matter the alternative selected for development, the desired affordability of ACV assumes use of a streamlined acquisition strategy that would limit the technology development phase, or bypass it and allow the program to begin in system development, by leveraging mature EFV technologies. Officials described an option to accelerate ACV acquisition by up to 24 months to achieve alignment of acquisition resources within the Marine Corps ground combat and tactical vehicle and the Navy acquisition portfolios. While overall portfolio investment is an important consideration, accelerating acquisition to fit into a window of available funding may not allow enough time for development. To move forward as envisioned requires demonstrating that the assumed technology maturity of potential alternatives are aligned with validated requirements for ACV and its operations. For example, reducing the launch distance from shore for ACV, as compared to EFV, has implications for Navy amphibious operations and is likely to affect requirements discussions regarding protection and water mobility and associated trade-offs as the program progresses. Unplanned technology development or design or performance trade-offs to account for changes in requirements could generate integration, cost, or schedule risk.

Estimated Program Cost and Quantity (fiscal year 2013 dollars):

Total program: TBD

Research and development (fiscal years 2013 to 2017): \$993.7 million

Acquisition related operation and maintenance (fiscal years 2013 to 2017): \$18.7 million

Quantity: TBD

Next Major Program Event: Selection of ACV alternative and technology or system development start, 2013

Program Office Comments:

In commenting on a draft of this assessment, the Navy and Marine Corps provided technical comments, which were incorporated where deemed appropriate.

Armored Multi-Purpose Vehicle (AMPV)

The Army's Armored Multi-Purpose Vehicle (AMPV) fleet is the proposed replacement to the M113 family of vehicles in the heavy brigade combat team. The AMPV will replace the M113 in five mission roles: general purpose, medical evacuation, medical treatment, mortar carrier, and mission command. The Army has determined that development of the AMPV is necessary due to mobility deficiencies identified in the M113, as well as space, weight, power, and cooling limitations that prevent the incorporation of future technologies.



Source: AMPV Product Manager.

Current Status

In March 2012, the Under Secretary of Defense for Acquisition, Technology, and Logistics approved a materiel development decision for AMPV and authorized the Army's entry into the materiel solution analysis phase. The AMPV analysis of alternatives, completed in July 2012, identified three viable solutions, each of which involves modifying an existing system. According to program officials, the materiel solution selected will most likely be a modified capital asset. Program officials anticipate approval of the AMPV acquisition strategy by DOD no later than the second quarter of fiscal year 2013. A review to approve entry into system development is scheduled for fiscal year 2014 as AMPV is expected to bypass the technology development phase.

Procurement of AMPV, with an estimated total acquisition cost of up to \$9.4 billion, will occur at about the same time as the Army's new and costly Ground Combat Vehicle and Joint Light Tactical Vehicle programs. The procurement of all three programs is expected to continue for a decade or more. Initially, the Army planned to equip the first units with AMPV in fiscal year 2017. According to program officials, the Army has delayed this 3 years, to 2020, to reduce risk in the program.

Estimated Program Cost and Quantity (fiscal year 2013 dollars):

Total program: \$8,340.0 million to \$9,440.0 million (analysis of alternatives estimate for development and procurement)

Quantity: 3,198

Next Major Program Event: Start of system development, third quarter fiscal year 2014

Program Office Comments: The program office plans to conduct a full and open competition for the system development phase.

B-2 Defensive Management System (DMS) Modernization

The Air Force's B-2 DMS modernization program, which entered technology development in 2011, is expected to upgrade the aircraft's 1980s-era analog defensive management system to a digital capability. The program intends to improve the frequency coverage and sensitivity of the electronic warfare suite, update pilot displays, and enhance in-flight replanning capabilities to avoid unanticipated air defense threats. It also expects to improve the reliability and maintainability of the DMS system and the B-2's readiness rate.



Source: U.S. Air Force.

Current Status

The program is implementing a rapid acquisition initiative to reduce its acquisition time by 2 to 3 years and lower costs by as much as \$500 million. The initiative includes: conducting early software prototyping; reducing time required for flight testing by improving test-range access and test data analysis; improving installation times by using antennas that conform to the B-2 design; and utilizing two production lot buys instead of three. The program's official cost estimate does not reflect the anticipated benefits of the initiative. The program office expects DOD to assess the progress of this initiative before the start of system development and adjust cost and schedule targets accordingly. Through this initiative, the program is investing heavily in the technology development phase, planning to invest more than half of the expected development funds during this phase for several activities that normally occur during system development, such as ordering flight test hardware and extensive software coding. While this should help expedite system development, it also increases financial risk to the government prior to a decision to fully develop the system and an assessment that the program's requirements match available resources—technologies, funding, design knowledge, and time.

As of August 2012, the contractor identified five candidate critical technologies; two related to low observable antennas; two related to nuclear hardening, and one involving the antenna electronics unit. All five were assessed as not currently mature but are projected to be nearing maturity by the start of system development in 2014. The program does not plan to prototype the full DMS, only key subsystems that present the greatest technical risk. The program expects to complete a preliminary design review prior to system development, in keeping with best practices.

Estimated Program Cost and Quantity (fiscal year 2013 dollars):

Total program: \$1,970.0 million

Research and development: \$1,354.5 million

Procurement: \$615.5 million

Quantity: 20

Next Major Program Event: System development start, April 2014

Program Office Comments: The program office provided technical comments, which were incorporated where deemed appropriate.

BMDS: Precision Tracking Space System (PTSS)

PTSS is a space-based infrared sensor system designed to provide persistent overhead tracking of ballistic missiles after boost and through the midcourse phase of flight. With a planned constellation of nine satellites, the system is expected to expand the BMDS's ability to track ballistic missiles by providing persistent coverage of approximately 70 percent of the earth's surface while handling larger missile raid sizes than current terrestrial radar sensors. The program intends to add advanced discrimination capabilities in later stages.



Source: Missile Defense Agency (MDA) Visual Information and Production Center (VIPC).

Current Status

The PTSS program conducted a technology baseline review in September 2012 and is awaiting final approval to enter into the technology development phase. The program's acquisition strategy includes the development of two initial satellites by a laboratory team while concurrently transitioning the production of the remaining satellites to industry. We have previously reported this acquisition approach entails risks and that the program has an optimistic schedule. According to the program office, they have since adjusted their acquisition strategy to minimize these concurrent activities.

The National Academies estimated that the total life-cycle cost for PTSS will range from \$18.2 billion to \$37 billion in fiscal year 2010 dollars based on configurations of either a 9-satellite or a 12-satellite constellation operating for 20 years and MDA's management of a similar system, the Space Tracking and Surveillance System, among other items. MDA disagreed with the National Academies estimate arguing they could not replicate it using their methodology and that the National Academies estimate includes more satellites than needed over the program's life cycle. MDA provided us their PTSS cost estimate but stated it is not available for publication as the agency considers it to be sensitive and protected from public disclosure. DOD's Office of Cost Assessment and Program Evaluation is conducting an independent cost estimate for PTSS as part of a larger review of the program.

The PTSS program plans to enter the technology development phase without conducting a robust analysis of alternatives. We have previously reported that without a full exploration of alternatives, programs may not achieve an optimal concept for the warfighter and tend to experience cost and schedule problems later on. While MDA programs are not required to conduct analyses of alternatives, foregoing such an analysis could prevent the establishment of a solid, executable business case before committing resources to this new acquisition. MDA and DOD are in the process of conducting a comprehensive review of PTSS that may include aspects of an analysis of alternatives, but it is unclear at this point if it will be equivalent to a robust analysis of alternatives.

Estimated Program Cost and Quantity (fiscal year 2013 dollars):

Total program: Not available for publication

Quantity: 26

Next Major Program Event: Preliminary design review, September 2013

Program Office Comments: In commenting on a draft of this assessment, MDA provided technical comments, which were incorporated where deemed appropriate.

BMDS: Terminal High Altitude Area Defense (THAAD)

The Missile Defense Agency's (MDA) THAAD is being developed as a rapidly-deployable, ground-based missile defense system with the capability to defend against short- and medium-range ballistic missiles during their late midcourse and terminal phases. A THAAD battery includes interceptors, launchers, an X-band radar, a fire control and communications system, and other support equipment. The Army certified two of six planned THAAD batteries in fiscal year 2012 for initial operational use.



Source: Missile Defense Agency.

Current Status

The Army certified that the first two THAAD batteries are safe, suitable, and supportable for Army soldiers to operate. However, the Army will not accept full materiel release of the batteries until additional criteria are completed by MDA. The Army has defined a list of the criteria, or "conditions," which must be satisfied before it will approve full materiel release, as well as the resolution plan, funding, and estimated time frames. Examples of conditions include additional flight testing, verification of safety systems, and resolution of environmental concerns. The last conditions are not expected to be resolved until the fourth quarter of fiscal year 2017.

THAAD's major components are mature and its design is stable. Reprioritization of DOD requirements in a constrained budget environment and a congressional funding reduction in fiscal years 2011 and 2012 decreased THAAD's planned interceptor production from six to three per month. The program has been meeting the reduced goal, except for a production gap in the fourth quarter of fiscal year 2012 due to a faulty memory device in the mission computers of interceptors procured in 2010 and 2011. Program officials reported that this issue has been resolved, and production rates for fiscal year 2012 averaged at least three per month.

THAAD successfully conducted its first operational test in October 2011, a major accomplishment as this was the first operational test with the Army and Department of Defense test and evaluation organizations fully engaged to ensure that test execution and results were representative of the fielded system. THAAD also demonstrated its capability to intercept a medium-range ballistic missile for the first time in October 2012 in a complex, integrated test involving multiple missile defense elements.

Estimated Program Cost (fiscal year 2013 dollars):

Total program (fiscal years 2013 to 2017): \$3,798.8 million

Research and development: \$1,450.3 million

Procurement: \$2,348.5 million

Next Major Program Event: BMDS Operational Flight Test (FTO-01), fourth quarter fiscal year 2013

Program Office Comments: In commenting on a draft of this assessment, the program office provided technical comments, which were incorporated where deemed appropriate.

Combat Rescue Helicopter (CRH)

The Air Force's Combat Rescue Helicopter (CRH) program, formerly called HH-60 Recapitalization, is an effort to replace aging HH-60G Pave Hawk helicopters. The CRH's primary mission is to recover personnel from hostile or denied territory; it will also conduct humanitarian, civil search and rescue, disaster relief, and non-combatant evacuation missions. The program is the second effort to replace the HH-60G. The first, the Combat Search and Rescue Replacement Vehicle (CSAR-X), was canceled because of cost concerns in 2009.



Source: Combat Rescue Helicopter Program Office.

Current Status

The Air Force expects that the CRH will be an existing helicopter with modifications to integrate mature technology subsystems and associated software. The CRH program received its materiel development decision in March 2012 and DOD authorized the program to bypass technology development and enter the acquisition process at the engineering and manufacturing development phase. The program successfully completed another review in September 2012, which approved its acquisition strategy and granted approval to issue a request for proposal for a full and open competition, which occurred in October 2012. The CRH program office plans to enter system development in August 2013 and award a fixed price incentive firm target development contract in the fourth quarter of 2013. The program office requested waivers for use of competitive prototypes and for holding its preliminary design review prior to system development. According to OSD officials, the preliminary design review waiver was approved in October 2012 and the competitive prototype waiver was approved in November 2012. Also, according to program officials, the program office is not planning on conducting a system functional review, because the functional baseline design is expected to be established at contract award and, as such, this review would be redundant. While DOD approved these waivers, not using competitive prototypes, conducting the preliminary design review after starting system development, and not holding a system functional review deviate from acquisition best practices. In our previous work, we have found that acquisition programs which successfully complete robust systems engineering early in the acquisition process and conduct a preliminary design review prior to starting system development typically have better outcomes. Initial operational capability for the helicopter is expected in the fourth quarter of fiscal year 2018.

Estimated Program Cost and Quantity (fiscal year 2013 dollars):

Total program (fiscal years 2013-2017): \$2,594.3 million

Research and development (fiscal years 2013-2017): \$1,265.6 million

Procurement (fiscal years 2013-2017): \$1,328.6 million

Quantity: 112

Next Major Program Event: System development start, August 2013

Program Office Comments: In commenting on a draft of this assessment, the program office provided technical comments, which were incorporated where deemed appropriate.

Common Infrared Countermeasures (CIRCM)

The Army's CIRCM, the next generation of the Advanced Threat Infrared Countermeasures (ATIRCM), will be used with the Common Missile Warning System (CMWS) and a countermeasure dispenser capable of employing expendables, such as flares and chaff, to defend aircraft from infrared-guided missiles. The CIRCM program will develop a laser-based countermeasure system for rotary-wing, tilt-rotor, and small fixed-wing aircraft across DOD. CIRCM is one of three subprograms that make up the ATIRCM/CMWS major defense acquisition program.



Sources: © 2011 BAE Systems (left); Northrop Grumman (right)

Current Status

The CIRCM program entered technology development in January 2012 after earlier prototyping efforts did not produce a system mature enough to enter system development. However, a bid protest caused a 100-day delay and caused the system development decision to slip. The CIRCM subprogram began in 2009 when the Under Secretary of Defense for Acquisition, Technology, and Logistics supported the Army's decision to restructure the ATIRCM/CMWS program. At that time, the Under Secretary determined that aircraft survivability equipment development needed better coordination of service efforts, more emphasis on competitive prototyping, and a greater focus on reducing ownership cost by increasing reliability. In June 2009, the Army received approval to award five contracts to provide prototype systems for testing. After testing these prototypes, the Army concluded that the systems were not mature enough for entry into system development. The Army subsequently decided that the program should proceed with a technology development phase that will include additional prototyping efforts to further mature CIRCM technologies and awarded two contracts in January 2012. According to the Army, there are several risks for CIRCM in technology development, including the immaturity of technologies critical to meeting a key performance requirement and the weight of the system, which may be too heavy for small aircraft. The Army plans to make a system development decision in December 2014 and plans to use an incentive fee contract focused on achievement of weight and reliability goals.

Estimated Program Cost and Quantity (fiscal year 2013 dollars):

Total program: \$3,581.6 million
 Research and development: \$784.3 million
 Procurement: \$2,797.3 million
 Quantity: 1,076

Next Major Program Event: System development start, December 2014

Program Office Comments: In commenting on a draft of this assessment, the program office provided technical comments, which were incorporated where deemed appropriate.

DDG 51 Destroyer

The DDG 51 destroyer is a multimission surface ship designed to operate against air, surface, and subsurface threats. After a nearly 4-year break in production, the Navy restarted Flight IIA production and plans to buy 10 ships between fiscal years 2012 and 2017. The Navy will begin buying a new version—Flight III—in fiscal year 2016. Flight III is expected to include the Air and Missile Defense Radar (AMDR)—a dual band radar being developed under a separate Navy program—and have an increased focus on ballistic and cruise missile defense.



Source: Bath Iron Works.

Current Status

In 2011, the Navy awarded contracts for three DDG 51 Flight IIA ships with an option for a fourth to restart production. The first three ships are under construction, with the first—DDG 113—started in July 2011. The fourth ship—DDG 116—was awarded in February 2012. According to the Navy, the design of the Flight IIA ships will be modified to include an upgraded Aegis combat system currently being developed. The Navy will also replace the existing SPS-67 radar with SPQ-9B, currently installed on several Navy ships, beginning in fiscal year 2014. The Navy has experienced several manufacturing challenges including quality issues with pipe welding and production challenges with a new reduction gear.

The National Defense Authorization Act for fiscal year 2013 authorized the Navy to award one or more multi-year procurement contracts for up to 10 ships. According to the Navy, the contract will yield an estimated \$1.5 billion in savings. The President's fiscal year 2013 budget includes plans to procure three Flight III ships, a modification of the Flight IIA design, beginning in fiscal year 2016. To date, the Navy has identified the AMDR as the only major new technology for Flight III, but more technologies are under consideration. The integration of AMDR will require changes to the power architecture.

Recently, the Under Secretary of Defense increased program oversight by elevating major acquisition decision responsibility from the Navy to the Under Secretary of Defense.

As requested, we reviewed whether individual subcontracting reports from the prime contractor for the program were accepted on eSRS. The government uses subcontracting reports on eSRS as one method of monitoring small business participation. As of December 2012, eSRS indicated that three of the associated subcontracting reports for DDG 51's four contracts have been accepted.

Estimated Program Cost and Quantity (fiscal year 2013 dollars):

Total program (fiscal years 2010 to 2017): \$20,486.1 million

Research and development (fiscal years 2010 to 2017): \$615.6 million

Procurement (fiscal years 2010 to 2017): \$19,870.4 million

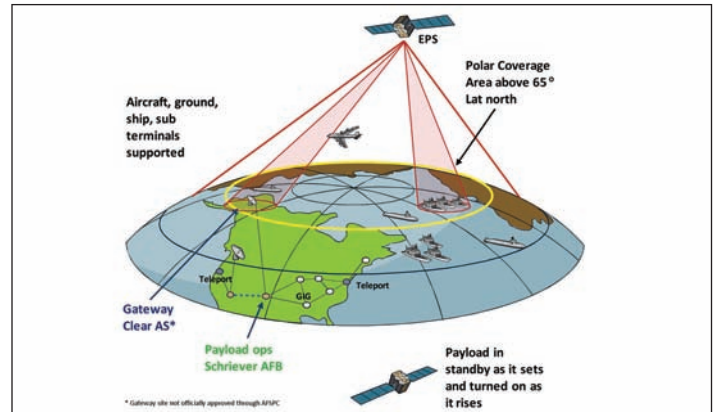
Quantity: 13

Next Major Program Event: AMDR system development start, March 2013

Program Office Comments: According to program officials, production of the first set of reduction gears is now complete and testing is underway. Production of follow on gears is on track. Huntington Ingalls Industries has taken aggressive actions to correct pipe welding quality issues.

Enhanced Polar System (EPS)

The Air Force's Enhanced Polar System is to provide next-generation protected extremely high frequency (EHF) satellite communications in the polar region. It will replace the current Interim Polar System and serve as a polar adjunct to the Advanced EHF system. EPS is to consist of two EHF payloads hosted on classified satellites, a gateway to connect modified Navy Multiband Terminals to other communication systems, and a control and planning segment.



Source: LinQuest Corporation.

Current Status

Although the EPS program's two payloads are nearly complete, funding reductions forced adjustments to the scope of the ground segments, delaying initial operational capability by 2 years. EPS was initiated in 2006 to fill the gap left by the cancellation of the Advanced Polar System. In 2007, the Under Secretary of Defense for Acquisition, Technology, and Logistics directed the EPS program to proceed to system development to synchronize the program's payload schedule with the host satellite's production timeline. The first EPS payload was delivered to the host in early 2012 for integration into the satellite and system-level testing. The second payload is expected to be delivered by the end of 2012. The two payloads are expected to be on orbit in fiscal years 2015 and 2017, respectively, but there is a risk they will be on orbit before the control and planning segment is available to operate them.

Development of the control and planning segment and gateway was delayed due to funding reductions which required a reduction in capabilities. A revised acquisition strategy was approved in January 2012 which directed a streamlined approach to system development to include waiving certain policy requirements such as competitive prototyping. The program office plans to award the development contract for the control and planning segment in late 2012, leading to a system development decision in fiscal year 2014. According to the program office, although the control and planning segment is not required for payload on-orbit testing, it is required to enable the overall functioning of the EPS system. Delays in delivery of the control and planning segment have delayed the EPS initial operational capability from fiscal year 2016 to 2018. The Navy's Space and Naval Warfare Systems Center will be responsible for the development of the gateway.

Estimated Program Cost and Quantity (fiscal year 2013 dollars):

Total program: \$1,488 million

Research and development: \$1,488 million

Quantity: 2

Next Major Program Event: System development start, second quarter fiscal year 2014

Program Office Comments: In commenting on a draft of this assessment, the program office provided technical comments, which were incorporated where deemed appropriate.

Ground Combat Vehicle (GCV)

The Ground Combat Vehicle (GCV) is an incremental program to replace segments of the Army's combat vehicle inventory. The first variant is intended to be the service's next infantry fighting vehicle, replacing a portion of the current M2 Bradley fleet. The Army wants GCV to provide a full-spectrum capability to perform offensive, defensive, stability, and support operations; carry a nine-soldier squad; emphasize force protection; and be available within 7 years of beginning technology development.



Source: Ground Combat Vehicle.

Current Status

In August 2011, the Under Secretary of Defense for Acquisition, Technology, and Logistics approved the GCV program's entry into technology development with the goals of reducing overall risk and achieving an affordable, feasible, and operationally effective preliminary GCV design. The Army awarded contracts to two contractor teams, but resolving a bid protest from a third team prevented the Army from beginning technology development until December 2011. The Army has been involved in three activities: updating the analysis of alternatives; assessing existing vehicles, such as an upgraded Bradley; and funding two contractors' efforts to build and demonstrate key subsystem prototypes.

Contractors are maturing their subsystem design concepts by making design trades to balance cost, technical, and schedule aspects of their proposed solutions. Contractors are using a combination of existing components, modified components, and new but proven technologies in their designs. The Army recently completed a ground vehicle mix analysis that will inform the analysis of alternatives update, which program officials anticipate being completed in March 2013. The Army has also assessed existing vehicles and plans to use the results to inform decisions on GCV requirements. The Army expects to have a preliminary design review in June 2013 and, at that point, according to an Army official, should be ready to determine whether GCV will be an entirely new vehicle or a modified existing vehicle. The Army plans to begin procuring GCV while also procuring other new and costly combat vehicle programs such as the Joint Light Tactical Vehicle and the Armored Multi-Purpose Vehicle.

On January 16, 2013, the Under Secretary directed a number of changes to the GCV program to enable a more affordable and executable program, including extending the technology development phase, delaying both system development and production, and selecting a single prime contractor at the start of system development. These actions provide significant reductions to the funding necessary to execute the program over the next several years, but are not reflected in the estimated costs below.

Estimated Program Cost and Quantity (fiscal year 2013 dollars):

Total program: \$37,923.5 million

Research and development: \$7,025.6 million

Procurement: \$25,365.8 million

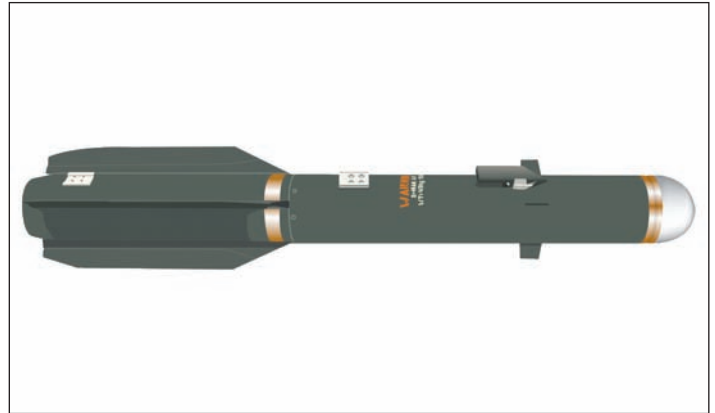
Quantity: 30 (development), 1,874 (procurement)

Next Major Program Event: System development start, TBD

Program Office Comments: In commenting on a draft of this assessment, the program office provided technical comments, which were incorporated where deemed appropriate.

Joint Air-to-Ground Missile (JAGM)

The Joint Air-to-Ground Missile is an Army-led program with joint requirements from the Navy and Marine Corps. The missile is designed to be air-launched from helicopters and unmanned aircraft systems to target tanks; light armored vehicles; missile launchers; command, control, and communications vehicles; bunkers; and buildings. It is intended to provide line-of-sight and beyond line-of-sight capabilities and deploy in a fire-and-forget mode or a precision attack mode. JAGM will replace all variants of HELLFIRE and air-launched TOW missiles.



Source: Department of Defense.

Current Status

The Army restructured JAGM in early 2012 to extend technology development by 27 months and award two fixed price contracts to contractors from the previous technology development phase. This continuation allows the Army to focus on affordability and risk reduction prior to additional investment in engineering and manufacturing development. The Under Secretary of Defense for Acquisition, Technology, and Logistics approved the revised strategy in March 2012 and delegated decision authority to the Army for the duration of technology development. The Army is planning to execute the technology development extension primarily with fiscal year 2011 and 2012 funding. While the Navy opted to terminate its investment in the program, the Under Secretary directed the Army to include the Navy when addressing affordability and requirements. According to Army program officials, discussions regarding future integration of JAGM onto the Marine Corps' AH-1Z Super Cobra platforms are ongoing.

On August 15, 2012, the Army awarded a letter contract with a not-to-exceed value of \$64.2 million that it expects to definitize into a firm fixed-price contract to Lockheed Martin for the technology development extension. In addition, on November 29, 2012, the Army awarded a letter contract with a not-to-exceed value of \$10 million to Raytheon for the first phase of extended technology development. After a successful preliminary design review, the Army may decide to exercise an option on Raytheon's contract for the remaining technology development effort. Program officials stated that these efforts will focus on the guidance section, the key technology that provides the capabilities required by the Army, Marine Corps, and Navy. Competing contractors will develop, conduct a critical design review of, and complete qualification for the guidance section. In subsequent phases, the Army will then integrate the guidance section with a legacy missile, launcher, and launch platform. This increment of JAGM is intended to satisfy the user's top priorities at a cost comparable to legacy systems. As capability improvements are approved and funded, future JAGM increments may be considered. The program office is also considering continuing competition between the two contractors throughout system development and low rate initial production.

Estimated Program Cost and Quantity (fiscal year 2013 dollars):

Total program: TBD

Research and development: \$195 million (fiscal year 2011 through fiscal year 2013)

Procurement: TBD

Quantity: TBD

Next Major Program Event: System development start; first quarter fiscal year 2015

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

Joint Land Attack Cruise Missile Defense Elevated Netted Sensor System (JLENS)

The Army's JLENS is designed to provide elevated, persistent, over-the-horizon surveillance and fire control quality data enabling protection of U.S. and coalition forces and critical assets. A JLENS orbit consists of two systems: a Fire Control Radar System and a Surveillance Radar System. Each system is comprised of a 74-meter tethered aerostat, a mobile mooring station, communication and processing stations, and ground support equipment.



Source: U.S. Army.

Current Status

The JLENS program has faced cost increases and schedule delays due to setbacks in development, including the loss of an aerostat in 2010, increased software costs, and a reduction in planned quantities from 16 production orbits to two engineering and development orbits. This reduction triggered a critical Nunn-McCurdy breach and on May 24, 2012, the program was restructured. Although JLENS is still an acquisition program, the production phase is canceled and the program will focus on developmental and operational testing and evaluations to demonstrate system capabilities. Completion of the tests is scheduled for the end of fiscal year 2013. A defense acquisition board will conduct an interim review to assess the program's status based on these test results. The restructuring also included site selection, planning, and execution of a combatant command exercise.

According to program officials, developmental testing will occur in three series and verify that design risks have been minimized, demonstrate achievement of contract technical performance requirements, assess system safety, and certify readiness for operational testing. The first series of developmental tests was completed in December 2011 and the second in September 2012. The third series of tests are scheduled for completion in late 2013. Operational testing will determine the system's operational effectiveness, suitability, and survivability and demonstrate system capabilities while being operated by trained soldiers in a simulated combat scenario. This testing is highly dependent on the availability of trained soldiers to conduct the tests. If soldiers are unavailable the program faces the risk of schedule delays. One operational test, the limited user test, planned for fiscal year 2013, has already been delayed a few months. However, according to program officials, the program office received approval to add 103 soldiers during fiscal years 2014 through 2017.

Estimated Program Cost and Quantity (fiscal year 2013 dollars):

Total program: \$2,707.2 million

Research and development: \$2,645.8 million

Military construction: \$61.4 million

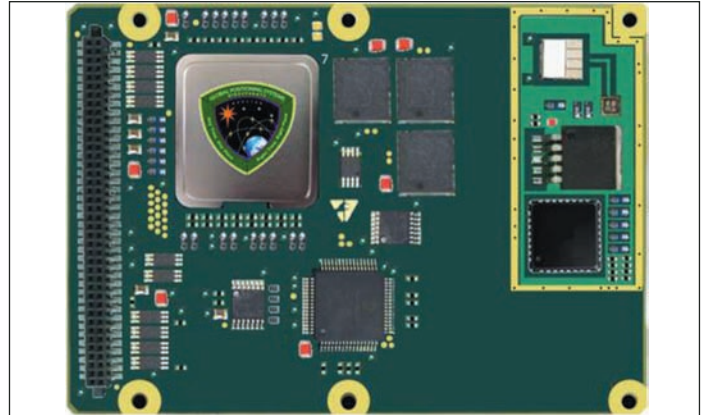
Quantity: 2

Next Major Program Event: Defense acquisition board review in third quarter of fiscal year 2013.

Program Office Comments: According to program officials, a JLENS early user test which was completed in December 2012 to determine system maturity, soldier performance, and early evaluation of key performance parameters has reduced risk for the limited user test scheduled for fiscal year 2013. Officials also provided technical comments, which were incorporated where deemed appropriate.

Military GPS User Equipment (MGUE), Increment 1

The Air Force's MGUE program will develop GPS receivers compatible with the military's next-generation GPS signal, Military-Code. The modernized receivers will provide U.S. forces with enhanced position, navigation, and time capabilities, while improving resistance to existing and emerging threats, such as jamming. The program is to be completed in two increments. Increment 1, assessed here, leverages technologies from the Modernized User Equipment (MUE) program to develop two variants and begin development of the Common GPS Module (CGM).



Source: GPS Directorate.

Current Status

In April 2012, the Air Force initiated technology development on Increment 1 of MGUE. Of the five critical technologies identified by the Air Force, four—military-code acquisition engine, military-code cryptography, selective availability/anti-spoofing module cryptography, and anti-tamper—are currently nearing maturity, and the remaining one—anti-spoofing—is projected to be near maturity when engineering and manufacturing development begins in November 2014. The Air Force originally planned to develop three variants—one each for ground, aviation, and maritime platforms. However, Navy officials believe the aviation variant can support maritime needs. As a result, the Air Force does not plan to develop a maritime-specific variant. In addition, Increment 1 will begin development of the CGM, which will equip third party developers with technologies needed to build GPS receivers that support a broad range of uses.

According to a February 2012 independent cost estimate, Increment 1 could cost \$74 million more and take a year longer to complete than estimated by the program office. The independent cost estimate cited the significant cost and schedule growth experienced by the MUE effort on which the MGUE program is based as evidence. MGUE has two main risk areas, ensuring more than one contractor meets design requirements for the application specific integrated circuit (ASIC)—a vital component leveraged from MUE—and software development. According to Air Force officials, two contractors will engineer and manufacture the ASIC. If more than one contractor cannot meet the design requirements, MGUE may experience cost and schedule growth. Developing MGUE software is a risk due to its complexity and security constraints. Air Force officials plan to track these risks by reviewing critical designs and assessing contractor performance.

Estimated Program Cost and Quantity (fiscal year 2013 dollars):

Total program: TBD

Research and development: \$1,611.9 million

Procurement: TBD

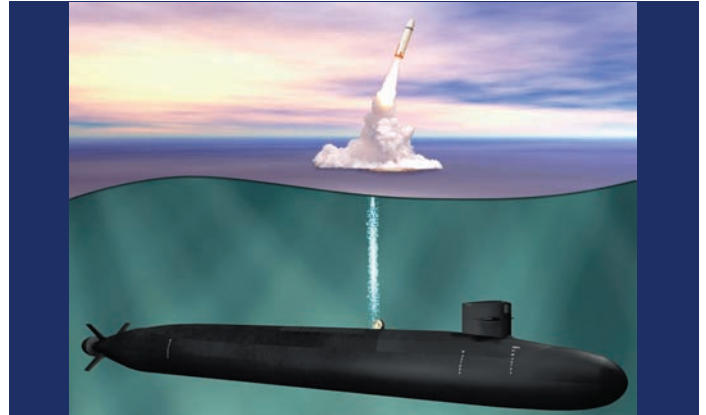
Quantity: 624 (124, Research and development; 500, Procurement)

Next Major Program Event: Preliminary design review, January 2014

Program Office Comments: In commenting on a draft of this assessment, the program office provided technical comments, which were incorporated where deemed appropriate.

Ohio-Class Replacement

The Navy's *Ohio*-Class Replacement (OR) will replace the current fleet of ballistic missile submarines (SSBN) as they begin to retire in 2027. The Navy began research and development in 2008, seeking to avoid a gap in sea-based nuclear deterrence. The Navy is working with the United Kingdom to develop a common missile compartment (CMC) for use on OR and the United Kingdom's replacement for the *Vanguard* SSBN. OR will initially carry the Trident II missile.



Source: © 2012 General Dynamics Electric Boat.

Current Status

The OR program began technology development in January 2011. The start of lead-ship construction has been delayed 2 years due to fiscal constraints and is expected to occur in 2021 with delivery in 2028. The delay results in costs above the Navy's initial estimate due to inflation. Program officials stated that while significant reviews and demonstrations will be shifted, design and technology development will continue, including work on the CMC and "quad pack" missile tube configuration with the United Kingdom; a new X-stern aft control surface configuration for steering the submarine to improve maneuverability and maintainability; an electric drive system using fewer moving parts to help meet the submarine's stealth requirement; and a new, lower maintenance propulsion shaft. Officials said they plan to have the vast majority of the three-dimensional design of the entire submarine complete prior to starting construction on the lead-ship to minimize rework, delays, and the potential for cost growth. Recently, DOD officials decided to move milestone C from fiscal year 2030 to fiscal year 2020, thereby providing an opportunity to examine program risk prior to the start of construction of the lead ship.

The program remains focused on affordability, and will emphasize efforts to reduce the average procurement unit cost for ships 2 to 12 from a currently estimated \$5.6 billion to the current target of \$4.9 billion (in fiscal year 2010 dollars). This will be done through continued investments in affordability, and leveraging as many *Virginia*-Class submarine technologies as possible. The program may also consider a joint block buy of the two classes to help reduce procurement costs.

Estimated Program Cost and Quantity (fiscal year 2013 dollars):

Total program: \$93,062.4 million
 Research and development: \$11,466.7 million
 Procurement: \$81,595.7 million
 Quantity: 12

Next Major Program Event: Systems requirement review, fiscal year 2014

Program Office Comments: According to the program office, the OR program is committed to delivering the most cost-effective SSBN possible for the U.S. Navy. The OR design is an advanced step forward from the *Ohio* and *Virginia* Class designs required to counter the threat through the 2080s. The program continues to incentivize contractors to reduce costs across design, construction, operations, and support.

Patriot/Medium Extended Air Defense System (MEADS) Combined Aggregate Program (CAP) Fire Unit

The Army's Patriot/Medium Extended Air Defense System (MEADS) Combined Aggregate Program is a ground-mobile system intended to provide low- to medium-altitude air and missile defense to counter tactical ballistic missiles, cruise missiles, or other air-breathing threats. It includes Patriot missile upgrades with a new battle management system, launchers, radars, and reloaders. MEADS is being co-developed by the United States, Germany, and Italy.



Source: MEADS International.

Current Status

In February 2011, the Office of the Secretary of Defense proposed ending U.S. involvement in the MEADS program before development had been completed due to lingering concerns about the high degree of risk in the program and its affordability. DOD still plans to provide \$781.9 million in funding for fiscal years 2012 and 2013 for design and development activities, but has determined that procurement of the system is unlikely.

Since MEADS development cannot be completed with the funding currently provided, the program office will work towards a demonstration of capabilities, including a launcher/missile characterization test and two additional intercept flight tests. The launcher/missile characterization test was completed in November 2011 and the first flight test was conducted in November 2012 against an air breathing threat. According to the preliminary report, the MEADS system acquired, tracked, and intercepted the target, and demonstrated a 360-degree cued search and track capability using the multifunctional fire control radar, battle manager, launcher and the missile. A second flight test against a non-maneuvering ballistic missile is scheduled for late 2013. The remaining development effort is focused on the multifunction fire control radar; launcher; and battle management system. According to program officials, these components, have demonstrated or exceeded predicted performance. The battle management component has developed and tested software in preparation for the second flight test. The program has stopped developing the system support vehicle, MEADS network radio, and reloader. It has also curtailed development of the surveillance radar, but plans to provide a low-cost prototype with 50 percent of the planned active transmit/receive assemblies of the full radar design for the demonstration and second flight test. Program officials stated that the surveillance radar is the most important item for the United States because it could be leveraged for other systems. Other elements, such as the near-vertical launcher and a cooling technology for rotating phased-array radars, also might prove useful on other programs.

Estimated Program Cost and Quantity (fiscal year 2013 dollars):

Total program (through fiscal year 2013): \$3,325.5 million (includes U.S., German, and Italian funding)

Next Major Program Event: Flight test, late 2013

Program Office Comments: According to program officials, the MEADS program executed within budget, met its objectives and executed two successful flight tests. The U.S. Government is in the process of concluding its participation and capturing data/technical capability to evaluate for future harvesting considerations.

Presidential Helicopter (VXX)

The Navy's VXX effort is to provide a presidential helicopter replacement fleet that will be used to transport the President, Vice President, heads of state, and others. As a successor to the terminated VH-71 program, the VXX fleet of 21 new helicopters will replace the current fleet of 19 aging VH-3D and VH-60N legacy helicopters. Until the VXX helicopters are available, the Navy is taking steps to extend the life of the legacy aircraft.



Source: U.S. Navy.

Current Status

In April 2012, an updated VXX analysis of alternatives (AOA) study, based on a Navy proposal that promises to streamline the acquisition strategy to lower the cost and risk of the program, was released. The study is based on integrating mature systems into an existing in-production commercial or military helicopter. The program plans to leverage existing avionics and mission systems and it uses less stringent requirements than those developed for VH-71. In addition, the acquisition approach includes integrating a government developed communication package and mission systems; however, integration risk of leveraging these systems was not examined. The study evaluated in-production commercially available and military platforms to determine the feasibility of both incorporating changes that do not prompt the need for an airworthiness recertification, and for incorporating more extensive upgrades that could trigger such a recertification. A May 2012 Director of Cost Assessment and Program Evaluation (CAPE) memo certifying the AOA study states that the analysis demonstrates that the proposed approach to avoid recertification is feasible for a number of options and, if adopted, offers potential for reduced cost and schedule. However, the memo cautioned that the validity of the study's results are contingent on the reduced requirements in a draft Capability Development Document (CDD) being finalized at the values used in the analysis of alternatives study and that any significant deviation would require additional analyses. The final CDD has since been approved and according to CAPE does not invalidate the results of the AOA study analysis.

As a result of termination of the VH-71 program and delay of the VXX effort, the Navy is currently funding a service life extension program for the legacy fleet that includes avionics and engine upgrades as well as the conversion of two existing fleet aircraft into training assets. Program officials state that these efforts are required to address some of the more significant legacy fleet capability gaps prior to fielding VXX. These efforts will address many but not all of the capability gaps in the legacy fleet.

Estimated Program Cost and Quantity (fiscal year 2013 dollars):

Total program: TBD

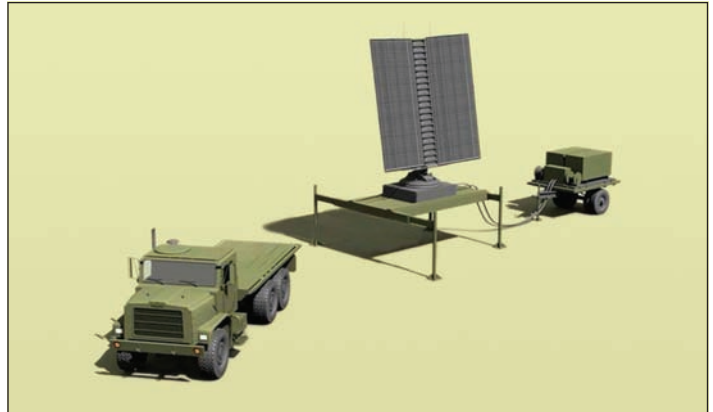
Quantity: TBD

Next Major Program Event: System development start, third quarter 2014

Program Office Comments: In commenting on a draft of this assessment, the program office provided technical comments, which were incorporated where deemed appropriate.

Three-Dimensional Expeditionary Long-Range Radar (3DELRR)

The Air Force's 3DELRR is being developed as a long-range, ground-based sensor for detecting, identifying, tracking, and reporting aircraft and missiles for the Joint Forces Air Component Commander. It is intended to provide real-time data and support a range of expeditionary operations in all types of weather and terrain. It is being acquired to replace the Air Force's AN/TPS-75 radar systems.



Source: U.S. Air Force.

Current Status

The 3DELRR program entered technology development in May 2009 and will continue these efforts through November 2013. The program is scheduled to enter system development in December 2013. The acquisition strategy for the program has changed. The Air Force completed work on two risk reduction and technology demonstration contracts, which included competing prototypes, in February 2011, and previously planned to award a single contract for additional technology development activities. Program officials reported that DOD began reviewing the acquisition strategy in June 2011 and subsequently directed the program to revise its strategy to continue competition through system development and reassess program affordability. In June 2012, DOD approved the Air Force's revised strategy, which includes at least three full and open competitions for technology and system development, unlimited rights for interface data for the government, and an open-systems approach. In August 2012, the Air Force awarded firm fixed-price contracts valued at a total of nearly \$106 million to Lockheed Martin, Northrop Grumman, and Raytheon for continued technology development, including capability demonstrations of three additional prototypes.

The 3DELRR program is currently focused on reducing technical risk and refining requirements before beginning system development. In April 2011, an independent review team reported that the program successfully demonstrated its eight critical technologies in a relevant environment during its initial prototyping effort. Program officials anticipate the technical risk will be low by the planned start of system development because the program will build and test three additional prototypes during technology development. Initial operational capability for the radar is scheduled for late 2019.

Estimated Program Cost and Quantity (fiscal year 2013 dollars):

Total program: \$2,113.1 million

Research and development: \$771.1 million

Procurement: \$1,342.1 million

Quantity: 35

Next Major Program Event: System development start, December 2013

Program Office Comments: In commenting on a draft of this assessment, the program office provided technical comments, which were incorporated where deemed appropriate.

Unmanned Carrier-Launched Airborne Surveillance and Strike (UCLASS) System

The Navy's UCLASS unmanned air vehicle is expected to provide aircraft carriers with additional intelligence, surveillance, and reconnaissance (ISR) capability, as well as targeting, strike, and bomb damage assessment. The system will address a gap in persistent sea-based ISR with precision strike capabilities. The program includes development of an unmanned aerial vehicle as well as upgrades to carrier infrastructure and systems and existing command and control systems.



Source: U.S. Navy.

Current Status

The UCLASS program received its materiel development decision in July 2011. According to officials, UCLASS requirements are being driven by a capabilities-based assessment conducted in 2009 which emphasized the need for persistent intelligence, surveillance, and reconnaissance off a large-deck aircraft carrier. The Joint Requirements Oversight Council requested that the Navy prioritize cost and schedule in the development of the platform, and that it consider arming the platform. The program plans to achieve a limited operational capability in 2020 using existing capabilities—such as precision navigation, unmanned air system command and control, sensors, and communications—that the Navy believes can be leveraged to support a UCLASS platform. In March 2012, work was completed under four broad agency announcement study contracts that the program competitively awarded to industry to identify viable system concepts for meeting program requirements. Program officials noted that each contractor took a slightly different approach, but that they were confident industry would be able to meet their needs. In June 2012, the program received service-level approval of its analysis of alternatives and submitted it to the Office of the Secretary of Defense's (OSD) Cost Assessment and Program Evaluation organization for review.

The program anticipates holding a review to enter the technology development phase in early 2013; later than the September 2012 date the program reported in our last assessment. The program is currently working to finalize its key program requirements toward approval of its acquisition strategy by the Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics. The Under Secretary will either retain decision authority for the program or delegate it to the Navy. According to program officials, OSD's Cost Assessment and Program Evaluation organization approved the UCLASS analysis of alternatives report in October 2012. The program expects approval of its technology development strategy and release of its draft request for proposal in early calendar year 2013.

Estimated Program Cost and Quantity (fiscal year 2013 dollars):

Total program: TBD

Research and development (fiscal years 2012-2017): \$2,309.1 million

Quantity: TBD

Next Major Program Event: Technology development start, 2013

Program Office Comments: In commenting on a draft of this assessment, the program office provided technical comments, which were incorporated where deemed appropriate.

Agency Comments and Our Evaluation

DOD provided written comments on a draft of this report. The comments are reprinted in appendix VII. We also received technical comments from DOD, which have been addressed in the report as appropriate.

In commenting on a draft of this report, DOD agreed with our assessment that the improvements in the performance of its major defense acquisition portfolio over the past year are largely the result of programs leaving the portfolio and reduced procurement quantities. However, DOD noted that it continues to believe that the program metrics and aggregate measures we report do not provide adequate insight into program performance or sufficiently address the questions of when, why, and how cost growth occurred.

We believe that the observations in this report do provide insight into key factors that are driving the cost changes in DOD's major defense acquisition programs and the overall portfolio. There is no single metric that can capture the performance of major weapon systems, which is why we present a multi-layered analysis. As acknowledged by DOD, we observe that nearly all of the aggregate cost reductions over the past year are the result of program restructurings and reductions in procurement quantities. Even at the aggregate level, however, we identify other key factors. For example, we note that reductions in requirements and adjustments to key cost estimating assumptions—not quantity changes—account for the bulk of the cost change in several of DOD's ship acquisition programs. In addition, we note that the use of a multi-year procurement contract and realization of other efficiencies allowed the Navy's F/A-18E/F program to realize a net cost decrease over the past year. Similarly, our observations on the knowledge attained by programs at key acquisition junctures provide insights into those factors that affect future program performance. At the individual program level we provide specific assessments on the impacts of technology, design, and manufacturing maturity on program outcomes.

DOD stated that it plans to publish a comprehensive annual report beginning in 2013 that it says will provide data and analysis on the performance of its acquisition portfolio. In addition, DOD emphasized that it plans to continue to implement recent policy and strategic initiatives aimed at controlling cost and increasing productivity. We believe that both of these efforts are positive steps in continuing to improve the management of DOD's weapon system portfolio.

We are sending copies of this report to the Secretary of Defense; the Secretaries of the Army, Navy, and Air Force; the Director of the Office of Management and Budget; and interested congressional committees. In addition, the report will be made available at no charge on the GAO Web site at <http://www.gao.gov>.

If you or your staff have any questions concerning 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. Staff members making key contributions to this report are listed in appendix VIII.

A handwritten signature in black ink, appearing to read 'Michael J. Sullivan', with a stylized, flowing script.

Michael J. Sullivan
Director, Acquisition and Sourcing Management

List of Committees

The Honorable Carl Levin
Chairman
The Honorable James M. Inhofe
Ranking Member
Committee on Armed Services
United States Senate

The Honorable Dick Durbin
Chairman
The Honorable Thad Cochran
Ranking Member
Subcommittee on Defense
Committee on Appropriations
United States Senate

The Honorable Howard P. "Buck" McKeon
Chairman
The Honorable Adam Smith
Ranking Member
Committee on Armed Services
House of Representatives

The Honorable C. W. Bill Young
Chairman
The Honorable Pete Visclosky
Ranking Member
Subcommittee on Defense
Committee on Appropriations
House of Representatives

Scope and Methodology

Analysis of the Cost Performance of DOD's Portfolio of Major Defense Acquisition Programs

To develop our observations on the overall changes in the size and cost of DOD's portfolio of major defense acquisition programs, we obtained and analyzed data from Selected Acquisition Reports (SAR) and other information in the Defense Acquisition Management Information Retrieval (DAMIR) Purview system, referred to as DAMIR.¹ In general, we refer to the 86 programs with SARs dated December 2011 as DOD's 2012 portfolio. We compared the programs that issued SARs in December 2011 with the list of programs that had issued SARs in December 2010 to identify the programs that exited and those that entered the portfolio. We then assessed the total cost changes in the portfolio that were associated with those exiting and entering programs. We converted all cost information to fiscal year 2013 dollars using conversion factors from the DOD Comptroller's National Defense Budget Estimates for Fiscal Year 2013 (table 5-9). Data for the total planned investment of major defense acquisition programs were obtained from DAMIR, which we aggregated for all programs using fiscal year 2013 dollars.

To compare the cost of MDAPs over the past year, 5 years, and from first full estimates, we collected data from December 2011, December 2010, and December 2006 SARs; program SARs reflecting first full estimates; acquisition program baselines; and program offices. For programs less than a year old, we calculated the difference between December 2011 and the first full estimate to identify the cost change over the past year. For programs less than 5 years old, we took a similar approach when calculating the cost change over the past 5 years. We retrieved data on research, development, test, and evaluation; procurement; and total acquisition cost estimates for the 86 programs in the 2012 portfolio. In some cases, we divided four programs into two distinct elements, because DOD reports performance data on them separately. As a result some of our analysis reflects a total of 90 programs and sub-elements. We analyzed the data to determine the change in research and development, procurement, and total acquisition costs from the first full estimate, generally development start, to the current estimate. For the programs that did not have a development estimate, we compared the current estimate to the production estimate. Also, for the shipbuilding programs that had a planning estimate, we compared the current estimate to the planning

¹DAMIR Purview is an executive information system operated by the Office of the Under Secretary of Defense for Acquisition, Technology and Logistics / Acquisition Resources and Analysis.

estimate. For programs that began as non-major defense acquisition programs, the first full estimate we used as a baseline may be different than the original baseline contained in DOD SARs. We obtained schedule information and calculated the cycle time from program start to initial operational capability and the delay in obtaining initial operational capability.

To calculate the amount of procurement cost growth attributable to quantity changes, we isolated the change in procurement quantities and the prior-year's acquisition procurement unit cost for programs over the past year. For those programs with a change in procurement quantities, we calculated the amount attributable to quantity changes as the change in quantity multiplied by the average procurement unit cost for the program a year ago. The resulting dollar amount is considered a change due solely to shifts in the number of units procured and may overestimate the amount of change expected when quantities increase and underestimate the expected change when quantities decrease as it does not account for other effects of quantity changes on procurement such as gain or loss of learning in production that could result in changes to unit cost over time or the use or absence of economic orders of material. However, these changes are accounted for as part of the change in cost not due to quantities.

To assess the Missile Defense Agency's Ballistic Missile Defense System (BMDS) we relied heavily on previous GAO work. BMDS is included in our analysis of the cumulative top-level changes in the composition and cost of DOD's Major Defense Acquisition Program (MDAP) portfolio over the past year. We included the program in that analysis because it represents a significant part of DOD's MDAP portfolio—currently estimated to cost at least \$133 billion through fiscal year 2017—and as such impacts the amount of funding available to support other programs. However, because BMDS was not required to establish an acquisition program baseline reflecting the total estimated cost of the program when it began, and because the program is not required to project costs beyond those years covered by DOD's budget request—currently through fiscal year 2017—no accurate assessment of program-specific cost growth or total cost can be done. Therefore, the program was excluded from nearly all of our analyses requiring program-level data—including the analyses referring to DOD's highest-cost programs.

To determine whether programs experienced an increase or decreases in buying power over the past year, we obtained data on program acquisition

unit cost to determine whether a program's buying power had increased or decreased. Not every program reported unit cost data, so when comparable data was not available those programs were excluded from our analysis. We reviewed SARs for those programs with changes in buying power over the past year to identify the primary reason(s) for those changes.

To evaluate program performance against high-risk criteria discussed by DOD, the Office of Management and Budget (OMB), and GAO, we calculated how many programs had less than a 2 percent increase in total acquisition cost over the past year, less than a 10 percent increase over the past 5 years, and less than a 15 percent increase from initial estimates using data from December 2011, December 2010, and December 2006 SARs; acquisition program baselines; and program offices. For programs that began as non-major defense acquisition programs, the first full estimate we used as a baseline may be different than the original baseline contained in DOD SARs. We also compared the performance of the 2012 portfolio in each high-risk category with the performance of the 2011 portfolio we reported last year to identify any positive or negative changes. For programs with multiple sub-programs presented in the SARs we calculated the net effect of the sub-programs to reach an aggregate program result. Through discussions with DOD officials responsible for the database and confirming selected data with program offices, we determined that the SAR data and the information retrieved from DAMIR were sufficiently reliable for our purposes.

To determine the sunk cost and cost remaining to complete the programs in the 2012 portfolio we used funding stream data obtained from DAMIR and program SARs. For each program with a baseline, we identified the funding stream closest to the program's first full estimate—in some cases the total for the funding stream matched the first full estimate, while in others the two totals were slightly different. We compiled each program's initial and current funding stream and then summed all of the program-funding streams to reach annual aggregate totals representing the initial funding profile and current funding stream for the programs in the 2012 portfolio that had a baseline. In years when the portfolio's current funding stream showed higher costs than the initial funding stream had projected, we considered that to be cost growth and in years when the current costs were lower than originally projected we considered that to be cost savings. We assessed the distribution of the portfolio's cost growth and cost savings over time and aggregated the totals to determine the amount of future funding—from fiscal year 2013 on—that had not been expected

when the programs began. This analysis excludes BMDS because it does not have an acquisition program baseline against which to measure cost growth, and the program's current cost projection only reflects funding needs through fiscal year 2017.

Analysis of Selected DOD Programs Using Knowledge-Based Criteria

Our analysis of how well programs are adhering to a knowledge-based acquisition approach focuses on 40 major defense acquisition programs that are in development or the early stages of production. To assess the knowledge attained by key decision points (system development start or detailed design contract award for shipbuilding programs, critical design review or fabrication start for shipbuilding programs, and production start), we collected data from program offices about their knowledge at each point. We did not validate the data provided by the program offices, but reviewed the data and performed various checks to determine that they were reliable enough for our purposes. Where we discovered discrepancies, we clarified the data accordingly.

Analysis of Acquisition Initiatives and Program Concurrency

To determine how DOD has begun to implement acquisition reforms, we obtained and analyzed the revised DOD 5000.02 acquisition instruction, the Weapon Systems Acquisition Reform Act of 2009, and the September 14, 2010, Under Secretary of Defense for Acquisition, Technology and Logistics memorandum on better buying power as well as subsequent memorandums clarifying and implementing that guidance, including the recently issued Better Buying Power 2.0 memorandum.

We analyzed data from surveys received from the 40 current and 17 future major defense acquisition programs in our assessment to determine the extent to which programs were implementing requirements for considering trade-offs among cost, schedule, and performance objectives before development start to establish affordability targets, and using "should cost" analyses to negotiate lower contract costs. We also collected information

on whether these programs are planning to incorporate competition, or the option of competition, into their acquisition strategies.²

To assess program concurrency we identified the programs—among those we surveyed—with knowledge point 3 dates. We used the survey responses from those programs to identify the dates for the start and end of developmental testing, compared those dates to the timing of each program's production decision and determined the number of months, if any, of developmental testing done after knowledge point 3. We then compared the number of overlapping months to the total number of months of developmental testing for each program and calculated the percentage of developmental testing done concurrent with production.

To collect data from current and future major defense acquisition programs—including cost and schedule estimates, technology maturity, and planned implementation of acquisition reforms—we distributed two electronic surveys, one survey for the current programs and a slightly different survey for the future programs. Both of the surveys were sent by e-mail in an attached Microsoft Word form that respondents could return electronically. We received responses from all of the programs we assessed from August to November 2012. To ensure the reliability of the data collected through our surveys, we took a number of steps to reduce measurement error and non-response error. These steps included conducting two pretests for the future major defense acquisition program survey and three pretests for the major defense acquisition program survey prior to distribution to ensure that our questions were clear, unbiased, and consistently interpreted; reviewing responses to identify obvious errors or inconsistencies; conducting follow-up to clarify responses when needed; and verifying the accuracy of a sample of keypunched surveys. Our pretests covered each branch of the military to

²The statute requires that the acquisition strategy for each major defense acquisition program include measures to ensure competition, or the option of competition, throughout the life cycle of the program. Weapon Systems Acquisition Reform Act of 2009, Pub. L. No. 111-23, § 202. The survey question with respect to this requirement for major defense acquisition programs read "Does the program's acquisition strategy call for competition between Milestone B and the completion of production?" For future programs the question read "Does the program's technology development strategy or acquisition strategy call for competition between Milestone B and the completion of production?" When programs answered "no" to the question, we interpreted that answer to mean that the program is not planning to incorporate competition, or the option of competition, after development start into the acquisition strategy.

better ensure that the survey questions could be understood by officials within each branch.

Individual Assessments of Weapon Programs

In total, this report presents individual assessments of 64 weapon programs. A table listing these programs is found in appendix VIII. Out of these programs, 45 are captured in a two-page format discussing technology, design, and manufacturing knowledge obtained and other program issues. Thirty-five of these 45 two-page assessments are of major defense acquisition programs, most of which are in development or early production; 2 assessments are of elements of MDA's BMDS; and 8 assessments are of programs that were projected to become major defense acquisition programs during or soon after our review. The remaining 19 programs are described in a one-page format that describes their current status. Those one-page assessments include 13 future major defense acquisition programs, 1 major defense acquisition program that is well into production, 2 elements of MDA's BMDS, and 3 major defense acquisition programs that were recently cancelled or curtailed. Over the past several years, DOD has revised policies governing weapon system acquisitions and changed the terminology used for major acquisition events. To make DOD's acquisition terminology more consistent across the 64 program assessments, we standardized the terminology for key program events. For most individual programs in our assessment, "development start" refers to the initiation of an acquisition program as well as the start of engineering and manufacturing development. This coincides with DOD's milestone B. A few programs in our assessment have a separate "program start" date, which begins a pre-system development phase for program definition and risk-reduction activities. This "program start" date generally coincides with DOD's former terminology for milestone I or DOD's current milestone A. The "production decision" generally refers to the decision to enter the production and deployment phase, typically with low-rate initial production. The "initial capability" refers to the initial operational capability—sometimes called first unit equipped or required asset availability. For shipbuilding programs, the schedule of key program events in relation to acquisition milestones varies for each program. Our work on shipbuilding best practices has identified the detailed design contract award and the start of lead ship fabrication as the points in the acquisition process roughly equivalent to development start and design review for other programs. For MDA programs that do not follow the standard DOD acquisition model but instead develop systems' capabilities incrementally, we identify the key technology development efforts that lead to an initial capability.

For each program we assessed in a two-page format, we present cost, schedule, and quantity data at the program's first full estimate and an estimate from the latest SAR or the program office reflecting 2012 data where they were available. The first full estimate is generally the cost estimate established at milestone B—development start; however, for a few programs that did not have such an estimate, we used the estimate at milestone C—production start—instead. For shipbuilding programs, we used their planning estimates if those estimates were available. For systems for which a first full estimate was not available, we only present the latest available estimate of cost and quantities. For the other programs assessed in a one-page format, we present the latest available estimate of cost and quantity from the program office.

For each program we assessed, all cost information is presented in fiscal year 2013 dollars. We converted cost information to fiscal year 2013 dollars using conversion factors from the DOD Comptroller's National Defense Budget Estimates for Fiscal Year 2013 (table 5-9). We have depicted only the program's main elements of acquisition cost—research and development and procurement. However, the total program cost also includes military construction and acquisition-related operation and maintenance costs. Because of rounding and these additional costs, in some situations, 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. In some instances, the data were not applicable, and we annotate this by using the term “not applicable (NA).” The quantities listed refer to total quantities, including both procurement and development quantities.

The schedule assessment for each program is based on acquisition cycle time, defined as the number of months between program start 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 “to be determined (TBD)” or “NA.”

The information presented on the “funding needed to complete” is from fiscal year 2013 through completion and, unless otherwise noted, draws on information from SARs or on data from the program office. In some instances, the data were not available, and we annotate this by the term “TBD” or “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.

The intent of these comparisons is to provide an aggregate, or overall, picture of a program's history. These assessments represent the sum 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.

In this year's assessment we also reviewed whether individual subcontracting reports from a program's prime contractor or contractors were accepted on the Electronic Subcontracting Reporting System (eSRS) to ascertain the availability of small business subcontracting data for major defense acquisition programs. We reviewed this information for 41 of the major defense acquisition programs, and two Ballistic Missile Defense System elements, in our assessment using the contract information reported in available SARs. See appendix VI for a list of the programs and elements we reviewed. The contract numbers for each program's, or element's, prime contracts were entered into the eSRS database to determine whether the programs individual subcontracting reports had been accepted by the government. While assessing the reliability of the eSRS database was outside of the scope of this report, we took steps to ensure that the data provided by the database were sufficiently reliable for the purpose of our analysis. The government uses individual subcontracting reports on eSRS as one method of monitoring small business participation, as the report includes goals for small business subcontracting. Not all prime contracts for major defense acquisition programs are required to submit individual subcontracting reports. For example, some contractors report small business participation at a corporate level as opposed to a program level and this data is not captured in the individual subcontracting reports on eSRS.

Product Knowledge Data on Individual Two-page Assessments

In our past work examining weapon acquisition issues and best practices for product development, we have found that leading commercial firms pursue an acquisition approach that is anchored in knowledge, whereby high levels of product knowledge are demonstrated by critical points in the acquisition process. On the basis of this work, we have identified three key knowledge points during the acquisition cycle—system development start, critical design review, and production start—at which programs need to

demonstrate critical levels of knowledge to proceed. To assess the product development knowledge of each program at these key points, we reviewed data-collection instruments and surveys submitted by programs; however, not every program had responses to each element of the data-collection instrument or survey. We also reviewed pertinent program documentation and discussed the information presented on the data-collection instrument and survey with program officials as necessary.

To assess a program's readiness to enter system development, we collected data on critical technologies and early design reviews. To assess technology maturity, we asked program officials to apply a tool, referred to as Technology Readiness Levels (TRL), for our analysis. The National Aeronautics and Space Administration originally developed TRLs, 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. TRLs are measured on a scale from 1 to 9, beginning with basic studies of a technology's feasibility and culminating with a technology fully integrated into a completed product. See appendix V for TRL definitions. Our best-practices work has shown that a TRL 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.³ For shipbuilding programs, we have recommended that this level of maturity be achieved by the contract award for detailed design.⁴ In our assessment, the technologies that have reached TRL 7, a prototype demonstrated in a realistic environment, are referred to as mature or fully mature. Those technologies that have reached TRL 6, a prototype demonstrated in a relevant environment, are referred to as approaching or nearing maturity. Satellite technologies that have achieved TRL 6 are assessed as fully mature due to the difficulty of demonstrating maturity in a realistic environment—space. In addition, we asked program officials to provide the date of the preliminary design review. We compared this date to the system development start date.

³GAO, *Best Practices: Better Matching of Needs and Resources Will Lead to Better Weapon System Outcomes*, [GAO-01-288](#) (Washington, D.C.: Mar. 8, 2001); and *Best Practices: Better Management of Technology Development Can Improve Weapon System Outcomes*, [GAO/NSIAD-99-162](#) (Washington, D.C.: July 30, 1999).

⁴GAO, *Best Practices: High Levels of Knowledge at Key Points Differentiate Commercial Shipbuilding from Navy Shipbuilding*, [GAO-09-322](#) (Washington, D.C.: May 13, 2009).

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 TRLs in those cases where information existed that raised concerns. If we were to conduct a detailed review, we might adjust the critical technologies assessed, their readiness levels 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. Where practicable, we compared technology assessments provided by the program office to assessments conducted by officials from the Office of the Assistant Secretary of Defense for Research and Engineering.

To assess design stability, we asked program officials to provide the percentage of design drawings completed or projected for completion by the design review, the production decision, and as of our current assessment.⁵ In most cases, we did not verify or validate the percentage of engineering drawings provided by the program office. We clarified the percentage of drawings completed in those cases where information that raised concerns existed. Completed drawings were defined as the number of drawings released or deemed releasable to manufacturing that can be considered the "build to" drawings. For shipbuilding programs, we asked program officials to provide the percentage of the three-dimensional product model that had been completed by the start of lead ship fabrication, and as of our current assessment.⁶ To gain greater insights into design stability, we also asked program officials to provide the date they planned to first integrate and test all key subsystems and components into a system-level integrated prototype. We compared this date to the date of the design review. We did not assess whether shipbuilding programs had completed integrated prototypes.

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.⁷ In most cases, we did not verify or validate the information provided by the program office. We clarified the number of critical manufacturing

⁵GAO, *Best Practices: Capturing Design and Manufacturing Knowledge Early Improves Acquisition Outcomes*, [GAO-02-701](#) (Washington, D.C.: July 15, 2002).

⁶[GAO-09-322](#).

⁷[GAO-02-701](#).

processes and the percentage of statistical process control where information existed that raised concerns. We used a standard called the Process Capability Index, 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 also used data provided by the program offices on their manufacturing readiness levels (MRL) for process capability and control, a subthread tracked as part of the manufacturing readiness assessment process recommended by DOD, to determine production maturity. We assessed programs as having mature manufacturing processes if they reported an MRL 9 for that subthread—meaning that manufacturing processes are stable, adequately controlled, and capable. To gain further insights into production maturity, we asked program officials whether the program planned to demonstrate critical manufacturing processes on a pilot production line before beginning low-rate production. We also asked programs on what date they planned to begin system-level development testing of a fully configured, production-representative prototype in its intended environment. We compared this date to the production start date. We did not assess production maturity for shipbuilding programs.

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 a more comprehensive assessment of risk elements.

We conducted this performance audit from July 2012 to March 2013, in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Current and First Full Estimates for DOD's 2012 Portfolio of Major Defense Acquisition Programs

Table 10 contains the current and first full total acquisition cost estimates (in fiscal year 2013 dollars) for each program or element in the Department of Defense's (DOD) 2012 major defense acquisition program portfolio. For each program we show the percent change in total acquisition cost from the first full estimate, as well as over the past year and 5 years.

Table 10: Current Cost Estimates and First Full Estimates for DOD's 2012 Portfolio of Major Defense Acquisition Programs

Fiscal year 2013 dollars in millions

Program name	Current est. total acquisition cost	First full est. total acquisition cost	Change in est. total acquisition cost from first full est. (percent)	Change in est. total acquisition cost over the past year (percent)	Change in est. total acquisition cost over the past 5 years (percent)
Advanced Extremely High Frequency (AEHF) Satellite	\$14,372	\$6,556	119.2%	-0.8%	94.6%
AGM-88E Advanced Anti-Radiation Guided Missile (AARGM)	2,025	1,647	22.9	3.4	16.4
AH-64E Apache Remanufacture	10,834	7,453	45.4	-1.9	33.8
AH-64E Apache New Build	2,015	2,439	-17.4	-11.6	-17.4
AIM-120 Advanced Medium Range Air-to-Air Missile (AMRAAM)	23,761	11,246	111.3	-2.1	25.5
AIM-9X Air-to-Air Missile Block I	1,736	3,235	-46.4	-55.0	-50.0
AIM-9X Block II Air-to-Air Missile	3,990	4,111	-3.0	-3.0	-3.0
Airborne and Maritime/Fixed Station Joint Tactical Radio System (AMF JTRS)	4,024	8,390	-52.0	-52.4	-52.0
B-2 Extremely High Frequency SATCOM Capability, Increment 1	596	731	-18.4	-7.3	-18.4
Ballistic Missile Defense System	133,324	NA	NA	2.1	NA
C-130 Avionics Modernization Program (AMP)	2,428	4,252	-42.9	-62.0	-58.9
C-130J Hercules	16,418	977	1581.1	3.6	77.6
C-5 Reliability Enhancement and Re-engining Program (RERP)	7,580	11,222	-32.5	-1.0	-31.1
CH-47F Improved Cargo Helicopter	14,628	3,313	341.5	-1.8	8.2
CH-53K Heavy Lift Replacement (CH-53K)	23,173	17,039	36.0	0.3	35.1
Chemical Demilitarization-Assembled Chemical Weapons Alternatives (Chem Demil-ACWA)	10,344	2,719	280.4	-1.2	37.5

Appendix II
Current and First Full Estimates for DOD's
2012 Portfolio of Major Defense Acquisition
Programs

(Continued From Previous Page)

Fiscal year 2013 dollars in millions

Program name	Current est. total acquisition cost	First full est. total acquisition cost	Change in est. total acquisition cost from first full est. (percent)	Change in est. total acquisition cost over the past year (percent)	Change in est. total acquisition cost over the past 5 years (percent)
Chemical Demilitarization-Chemical Materials Agency (Chem Demil-CMA)	28,814	15,993	80.8	0.9	-10.4
Cobra Judy Replacement (CJR)	1,875	1,678	11.7	-0.2	12.1
Cooperative Engagement Capability (CEC)	5,456	3,029	80.1	1.8	5.9
DDG 1000 Zumwalt Class Destroyer	21,474	35,814	-42.0	-0.6	-40.1
DDG 51 Arleigh Burke Class Guided Missile Destroyer	103,166	15,629	335.7	-1.5	27.4
E-2D Advanced Hawkeye (AHE)	19,938	15,181	31.3	9.2	20.1
EA-18G Growler	11,528	9,237	24.8	-1.8	30.9
Excalibur Precision 155mm Projectiles	1,823	4,915	-62.9	-2.3	-21.0
F/A-18E/F Super Hornet	59,379	84,115	-29.4	-0.2	7.3
F-35 Joint Strike Fighter	336,124	219,918	52.8	0.0	29.3
Family of Advanced Beyond Line-of-Sight Terminals (FAB-T)	4,583	3,281	39.7	-1.1	39.7
Family of Medium Tactical Vehicles (FMTV)	18,677	10,750	73.7	-9.5	-12.7
Gerald R. Ford Class Nuclear Aircraft Carrier (CVN 78 Class)	35,515	36,609	-3.0	1.5	10.2
Global Broadcast Service (GBS)	1,215	593	104.9	2.5	20.6
Global Positioning System (GPS) III	4,239	4,056	4.5	-4.9	4.5
Guided Multiple Launch Rocket System (GMLRS)	6,203	1,820	240.9	3.4	-2.7
H-1 Upgrades (4BW/4BN)	12,900	3,732	245.6	-0.2	44.2
HC/MC-130 Recapitalization Program	13,116	8,607	52.4	-2.6	52.4
High Mobility Artillery Rocket System (HIMARS)	2,163	4,488	-51.8	-1.3	-3.5
Integrated Air & Missile Defense (IAMD)	5,927	5,175	14.5	4.2	14.5
Integrated Defensive Electronic Countermeasures (IDECM)	2,456	2,240	9.6	0.3	9.6
Integrated Defensive Electronic Countermeasures (IDECM) Blocks	1,595	1,526	4.6	-0.5	4.6

2/3

Appendix II
Current and First Full Estimates for DOD's
2012 Portfolio of Major Defense Acquisition
Programs

(Continued From Previous Page)

Fiscal year 2013 dollars in millions

Program name	Current est. total acquisition cost	First full est. total acquisition cost	Change in est. total acquisition cost from first full est. (percent)	Change in est. total acquisition cost over the past year (percent)	Change in est. total acquisition cost over the past 5 years (percent)
Integrated Defensive Electronic Countermeasures (IDECM) Block 4	861	715	20.5	1.9	20.5
Joint Air-to-Surface Standoff Missile (JASSM and JASSM-Extended Range)	7,153	2,385	199.9	-7.4	22.1
Joint Direct Attack Munition (JDAM)	7,084	3,519	101.3	4.6	14.2
Joint High Speed Vessel (JHSV)	2,141	3,742	-42.8	-43.4	-42.8
Joint Land Attack Cruise Missile Defense Elevated Netted Sensor System (JLENS)	2,707	6,860	-60.5	-66.5	-61.1
Joint Precision Approach and Landing System (JPALS)	1,015	1,042	-2.6	0.3	-2.6
Joint Primary Aircraft Training System (JPATS)	5,919	3,833	54.4	0.5	-3.0
Joint Standoff Weapon (JSOW)	5,652	8,179	-30.9	-1.7	11.4
JSOW Baseline Variant	2,308	2,940	-21.5	-1.2	-0.2
JSOW Unitary Variant	3,344	5,239	-36.2	-2.2	21.2
Joint Tactical Radio System (JTRS) Ground Mobile Radio (GMR)	1,806	17,928	-89.9	-89.3	-89.2
Joint Tactical Radio System (JTRS) Handheld, Manpack, and (HMS) Small Form Fit Radios	8,561	10,329	-17.1	54.6	-18.6
Joint Tactical Radio System (JTRS) Network Enterprise Domain (NED)	2,129	1,009	110.9	-0.2	-6.5
KC-130J	9,851	9,761	0.9	2.0	0.9
KC-46A Tanker Modernization Program	44,780	45,097	-0.7	-0.7	-0.7
LHA 6 <i>America</i> Class Amphibious Assault Ship	10,170	3,273	210.8	-2.1	213.8
Littoral Combat Ship (LCS)—Seaframes	32,429	2,309	NA	-4.1	NA
MH-60R Multi-Mission Helicopter	14,879	5,697	161.2	-1.7	20.5
MH-60S Multi-Mission Helicopter	8,643	3,610	139.4	-0.2	1.4
Mobile User Objective System (MUOS)	7,234	6,917	4.6	0.7	11.4
MQ-1C Unmanned Aircraft System (UAS) Gray Eagle	4,745	1,045	354.2	-10.6	354.2

Appendix II
Current and First Full Estimates for DOD's
2012 Portfolio of Major Defense Acquisition
Programs

(Continued From Previous Page)

Fiscal year 2013 dollars in millions

Program name	Current est. total acquisition cost	First full est. total acquisition cost	Change in est. total acquisition cost from first full est. (percent)	Change in est. total acquisition cost over the past year (percent)	Change in est. total acquisition cost over the past 5 years (percent)
MQ-4C Triton Unmanned Aircraft System (MQ-4C Triton)	13,241	13,220	0.2	-1.4	0.2
MQ-9 Unmanned Aircraft System (UAS) Reaper	12,476	2,714	359.8	2.0	359.8
Multifunctional Information Distribution System (MIDS)	3,443	1,342	156.6	10.6	30.3
Multi-Platform Radar Technology Insertion Program (MP-RTIP)	1,478	1,849	-20.0	0.7	2.9
National Airspace System (NAS)	1,664	894	86.2	-2.5	1.6
National Polar-orbiting Operational Environmental Satellite System (NPOESS)	3,524	6,877	-48.8	-52.9	-69.6
Navstar Global Positioning System (GPS)	9,483	7,415	27.9	1.2	2.9
Navstar GPS Space & Control	7,917	6,397	23.8	1.2	3.5
Navstar GPS User Equipment	1,567	1,018	54.0	1.0	-0.1
Navy Multiband Terminal (NMT)	1,905	2,388	-20.3	-1.6	-10.7
P-8A Poseidon	33,638	31,936	5.3	-0.9	7.9
Paladin/Field Artillery Ammunition Support Vehicle (FAASV) Integrated Management (PIM)	6,871	6,882	-0.2	-0.2	-0.2
Patriot Advanced Capability - 3 (PAC-3)	12,673	5,364	136.3	6.3	21.9
Patriot/Medium Extended Air Defense System Combined Aggregate Program (MEADS CAP)	11,606	27,425	-57.7	-0.3	-55.9
Patriot/MEADS CAP Fire Unit	3,325	19,926	-83.3	-4.2	-82.6
Patriot/MEADS CAP Missile	8,281	7,499	10.4	1.4	14.4
Remote Minehunting System (RMS)	1,439	1,484	-3.0	-1.1	-2.5
RQ-4A/B Global Hawk Unmanned Aircraft System	10,021	5,549	80.6	-30.4	-3.7
San Antonio Class Amphibious Transport Dock	19,072	12,053	58.2	-0.8	28.5
Small Diameter Bomb Increment II (SDB II)	3,863	4,839	-20.2	-20.1	-20.2
Space Based Infrared System High Component (SBIRS)	18,868	4,731	298.8	0.0	66.3
SSN 774 Virginia Class Submarine	84,779	62,213	36.3	-1.6	-3.7

Appendix II
Current and First Full Estimates for DOD's
2012 Portfolio of Major Defense Acquisition
Programs

(Continued From Previous Page)

Fiscal year 2013 dollars in millions

Program name	Current est. total acquisition cost	First full est. total acquisition cost	Change in est. total acquisition cost from first full est. (percent)	Change in est. total acquisition cost over the past year (percent)	Change in est. total acquisition cost over the past 5 years (percent)
Standard Missile-6 (SM-6)	6,168	5,866	5.2	-4.8	9.8
Stryker Family of Vehicles	17,773	8,266	115.0	-5.2	22.9
Tactical Tomahawk Block IV	7,402	2,178	239.9	3.6	49.8
Thermal Weapon Sight (TWS)	3,202	3,217	-0.5	-0.5	-0.5
Trident II Missile	54,613	53,231	2.6	-0.3	3.1
UH-60M Black Hawk	26,805	13,347	100.8	3.5	24.7
UH-72A Light Utility Helicopter (LUH)	2,040	1,863	16.5	-0.9	8.9
V-22 Osprey Joint Services Advanced Vertical Lift Aircraft	58,610	41,268	42.0	-0.5	-1.2
Vertical Takeoff and Landing Tactical Unmanned Aerial Vehicle – MQ-8 Fire Scout (VTUAV)	2,669	2,692	-0.8	-0.8	26.2
Warfighter Information Network-Tactical (WIN-T) Increment 1	4,550	4,206	8.2	-1.9	8.2
Warfighter Information Network-Tactical (WIN-T) Increment 2	6,245	3,816	63.7	0.3	63.7
Warfighter Information Network-Tactical (WIN-T) Increment 3	12,816	16,844	-23.9	-10.2	-23.9
Wideband Global SATCOM (WGS)	4,116	1,229	235.0	8.9	87.0

Source: GAO analysis of DOD data.

Notes: Data were obtained from DOD's SARs, acquisition program baselines, and, in some cases, program offices. Changes in total acquisition cost for the Littoral Combat Ship—Seaframes over the past 5 years and from its first full estimate are shown as "NA" because DOD reported an incomplete baseline and cost data for the program through 2010. Likewise the BMDS total acquisition cost, cost change since first full estimate, and cost change within the past 5 years are shown as "NA" because the program did not establish a program baseline to measure against. The BMDS cost change within the past year reflects the difference between the programs total cost as reflected in the program's December 2010 and December 2011 SARs.

Changes in DOD’s 2012 Portfolio of Major Defense Acquisition Programs over 5 Years and Since First Full Estimates

Table 11 shows the change in research and development cost, procurement cost, total acquisition cost, and average delay in delivering initial operational capability for the programs in Department of Defense’s (DOD) 2012 portfolio with first full estimates. The table presents changes that have occurred in these programs over the last 5 years and since their first full cost and schedule estimates.

Table 11: Cost and Schedule Changes for Programs in DOD’s 2012 Portfolio

Fiscal year 2013 dollars in billions

	5 year comparison (2007 to 2012)	Since first full estimate (first full est. to 2012)
Change in total research and development cost	\$27 billion 12 percent	\$94 billion 49 percent
Change in total procurement cost	\$130 billion 14 percent	\$294 billion 35 percent
Change in total acquisition cost	\$158 billion 13 percent	\$403 billion 38 percent
Average change in delivering initial capabilities	12 months 17 percent	27 months 37 percent

Source: GAO analysis of DOD data.

Notes: Data were obtained from DOD’s SARs and acquisition program baselines. In a few cases data were obtained directly from program offices. Not all programs had comparable cost and schedule data and these programs were excluded from the analysis where appropriate. These cost change calculations do not reflect the cost of BMDS because no acquisition program baseline exists to measure the program against. Total acquisition cost includes research and development, procurement, acquisition operation and maintenance, and system-specific military construction costs.

Knowledge-Based Acquisition Practices

GAO’s prior work on best product-development practices found that successful programs take steps to gather knowledge that confirms that their technologies are mature, their designs stable, and their production processes are in control. Successful product developers ensure a high level of knowledge is achieved at key junctures in development. We characterize these junctures as knowledge points. The Related GAO Products section of this report includes references to the body of work that helped us identify these practices and apply them as criteria in weapon system reviews. The following table summarizes these knowledge points and associated key practices.

Table 12: Best Practices for Knowledge-based Acquisitions

Knowledge Point 1: Technologies, time, funding, and other resources match customer needs. Decision to invest in product development
Demonstrate technologies to a high readiness level—Technology Readiness Level 7—to ensure technologies will work in an operational environment
Ensure that requirements for product increment are informed by preliminary design review using systems engineering process (such as prototyping of preliminary design)
Establish cost and schedule estimates for product on the basis of knowledge from preliminary design using systems engineering tools (such as prototyping of preliminary design)
Constrain development phase (5 to 6 years or less) for incremental development
Ensure development phase fully funded (programmed in anticipation of milestone)
Align program manager tenure to complete development phase
Contract strategy that separates system integration and system demonstration activities
Conduct independent cost estimate
Conduct independent program assessment
Conduct major milestone decision review for development start
Knowledge Point 2: Design is stable and performs as expected. Decision to start building and testing production-representative prototypes
Complete system critical design review
Complete 90 percent of engineering design drawing packages
Complete subsystem and system design reviews
Demonstrate with system-level integrated prototype that design meets requirements
Complete the failure modes and effects analysis
Identify key system characteristics
Identify critical manufacturing processes
Establish reliability targets and growth plan on the basis of demonstrated reliability rates of components and subsystems

(Continued From Previous Page)

Conduct independent cost estimate

Conduct independent program assessment

Conduct major milestone decision review to enter system demonstration

Knowledge Point 3: Production meets cost, schedule, and quality targets. Decision to produce first units for customer

Demonstrate manufacturing processes

Build and test production-representative prototypes to demonstrate product in intended environment

Test production-representative prototypes to achieve reliability goal

Collect statistical process control data

Demonstrate that critical processes are capable and in statistical control

Conduct independent cost estimate

Conduct independent program assessment

Conduct major milestone decision review to begin production

Source: GAO.

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.

Appendix V
Technology Readiness Levels

(Continued From Previous Page)

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.

Major Defense Acquisition Programs' Individual Subcontracting Reports in the Electronic Subcontracting Reporting System

Table 13 shows how many individual subcontracting reports from the prime contractor for the programs we assessed were accepted on the Electronic Subcontracting Reporting System (eSRS). We reviewed this information for 41 of the major defense acquisition programs, and two Ballistic Missile Defense System elements, in our assessment using the prime contracts reported in available Selected Acquisition Reports. The government uses individual subcontracting reports on eSRS as one method of monitoring small business participation, as the report includes goals for small business subcontracting. Not all prime contracts for major defense acquisition programs are required to submit individual subcontracting reports. For example, some contractors report small business participation at a corporate level as opposed to a program level and this data is not captured in the individual subcontracting reports.

Table 13: Defense Acquisition Programs' Individual Subcontracting Reports in the Electronic Subcontracting Reporting System

Program	Number of 2012 contracts	Contracts with an accepted individual subcontracting report (as of December 2012)
AH-64E Apache Remanufacture	1	0
AIM-9X Block II Air-to-Air Missile	2	0
Airborne & Maritime/Fixed Station Joint Tactical Radio System	1	0
AN/TPS-80 Ground/Air Task Oriented Radar	1	0
BMDS: Ground-Based Midcourse Defense	2	2
BMDS: SM-3 Block IB	2	0
CH-53K Heavy Lift Replacement (CH-53K)	1	0
<i>Gerald R. Ford</i> Class Nuclear Aircraft Carrier (CVN 78 Class)	2	0
DDG 1000 <i>Zumwalt</i> Class Destroyer	6	1
DDG 51 <i>Arleigh Burke</i> Class Guided Missile Destroyer	4	3
E-2D Advanced Hawkeye (E-2D AHE)	3	1
Evolved Expendable Launch Vehicle (EELV) – Atlas V, Delta IV	10	3
Excalibur Precision 155mm Projectiles	2	0
Family of Advanced Beyond Line-of-Sight Terminals (FAB-T)	1	0
Global Positioning System (GPS) III	1	0

Appendix VI
Major Defense Acquisition Programs'
Individual Subcontracting Reports in the
Electronic Subcontracting Reporting System

(Continued From Previous Page)

Program	Number of 2012 contracts	Contracts with an accepted individual subcontracting report (as of December 2012)
HC/MC-130 Recapitalization Program	2	0
Integrated Air & Missile Defense (IAMD)	2	1
Integrated Defensive Electronic Countermeasures (IDECM)	1	1
Joint Air-to-Surface Standoff Missile (JASSM and JASSM-Extended Range)	2	0
Joint High Speed Vessel (JHSV)	1	1
Joint Land Attack Cruise Missile Defense Elevated Netted Sensor System (JLENS)	1	0
Joint Precision Approach and Landing System (JPALS) Increment 1A	1	0
F-35 Joint Strike Fighter	9	0
Joint Tactical Radio System (JTRS) Handheld, Manpack, and (HMS) Small Form Fit Radios	1	0
KC-46A Tanker Modernization Program	1	1
Littoral Combat Ship (LCS)—Seaframes	4	2
LHA 6 <i>America</i> Class Amphibious Assault Ship	2	2
MQ-1C Unmanned Aircraft System (UAS) Gray Eagle	6	6
MQ-4C Triton Unmanned Aircraft System (MQ-4C Triton)	1	1
MQ-9 Unmanned Aircraft System (UAS) Reaper	3	0
Mobile User Objective System (MUOS)	1	0
Navy Multiband Terminal (NMT)	1	0
P-8A Poseidon	2	0
Patriot/Medium Extended Air Defense System Combined Aggregate Program (MEADS CAP)	3	0
Paladin/Field Artillery Ammunition Support Vehicle (FAASV) Integrated Management (PIM)	1	1
RQ-4A/B Global Hawk Unmanned Aircraft System	6	3
Small Diameter Bomb Increment II (SDB II)	1	0
Space Based Infrared System High Component (SBIRS High)	2	0
Standard Missile-6 (SM-6)	1	0
Vertical Takeoff and Landing Tactical Unmanned Aerial Vehicle – MQ-8 Fire Scout (VTUAV)	1	1
Warfighter Information Network-Tactical (WIN-T) Increment 2	1	0

Appendix VI
Major Defense Acquisition Programs'
Individual Subcontracting Reports in the
Electronic Subcontracting Reporting System

(Continued From Previous Page)

Program	Number of 2012 contracts	Contracts with an accepted individual subcontracting report (as of December 2012)
Warfighter Information Network-Tactical (WIN-T) Increment 3	1	0
Ship to Shore Connector (SSC)	1	0
Total	98	30

Source: GAO.

Comments from the Department of Defense



ACQUISITION,
TECHNOLOGY
AND LOGISTICS

OFFICE OF THE UNDER SECRETARY OF DEFENSE

3000 DEFENSE PENTAGON
WASHINGTON, DC 20301-3000

MAR -7 2013

Mr. Michael J. Sullivan
Director, Acquisition and Sourcing Management
U.S. Government Accountability Office
441 G Street, NW
Washington, DC 20548

Dear Mr. Sullivan:

This is the Department of Defense response to the GAO Draft Report, GAO-13-294SP, "DEFENSE ACQUISITIONS: Assessments of Selected Weapon Programs," dated February 11, 2013 (GAO Code 121072).

The 2013 report shows improvement in all of the major portfolio-level metrics traditionally used by GAO to assess the DoD acquisition system. The Department recognizes, however, that programs exiting the portfolio and reductions in procurement quantities are responsible for much of the improvement in the GAO metrics. It is our opinion that the GAO metrics are still too dependent on quantity changes to offer adequate insight into program performance; the aggregate measures in the report do not sufficiently address the basic questions of when, why, and how cost growth occurred. To better understand the performance of the defense acquisition system, the USD(AT&L) will publish a new, comprehensive annual report beginning in 2013. The report will provide extensive data and analysis to improve the transparency and objectivity of performance measures, and should facilitate ongoing reviews of the Department.

The Department has implemented significant policy changes in recent years to enhance cost control. With the release of Better Buying Power 2.0, the Department extends and expands implementation of strategic initiatives to increase productivity and better control costs in the future. As a result, we expect to see continued improvement in the performance of the DoD weapon system acquisition process, over time.

The Department appreciates the opportunity to comment on the draft report. My point of contact for this effort is Mr. Joe Beauregard, 703-697-8046.

Sincerely,

A handwritten signature in cursive script that reads "Nancy L. Spruill".

Nancy L. Spruill
Director
Acquisition Resources & Analysis

GAO Contact and Acknowledgments

GAO Contact

Michael J. Sullivan, (202) 512-4841 or sullivanm@gao.gov

Acknowledgments

Principal contributors to this report were Bruce H. Thomas, Assistant Director; Matthew T. Drerup; J. Kristopher Keener; and Travis J. Masters. Other key contributors included Peter W. Anderson, David B. Best, Mary C. Coyle, Bruce D. Fairbairn, Laurier R. Fish, Arthur Gallegos, William R. Graveline, Kristine R. Hassinger, Jill N. Lacey, Deanna R. Laufer, Jean L. McSween, Diana L. Moldafsky, Jonathan Mulcare, Kenneth E. Patton, Megan L. Porter, Ronald E. Schwenn, and Roxanna T. Sun.

The following were responsible for individual programs:

System	Primary Staff
AH-64E Apache Remanufacture	Helena Brink, Erin Schoening
AIM-9X BLOCK II Air-to-Air Missile (AIM-9X Block II)	Kristin Van Wychen, Gwyneth B. Woolwine
Air and Missile Defense Radar (AMDR)	Ioan T. Ifrim, W. Kendal Roberts
Airborne & Maritime/Fixed Station Joint Tactical Radio System (AMF JTRS)	Paul G. Williams, Nathan A. Tranquilli
Amphibious Combat Vehicle (ACV)	Gwyneth B. Woolwine, Jerry W. Clark
AN/TPS-80 Ground/Air Task Oriented Radar	Bonita P. Oden, Jerry W. Clark
Armored Multi-Purpose Vehicle (AMPV)	Andrea M. Bivens, Marcus C. Ferguson
B-2 Defensive Management System (DMS) Modernization	Matthew P. Lea
BMDS: Aegis Ballistic Missile Defense Standard Missile-3 Block IB	Wiktor Niewiadomski, Ann F. Rivlin
BMDS: Ground-Based Midcourse Defense (GMD)	Steven B. Stern
BMDS: Precision Tracking Space System (PTSS)	Brian A. Tittle
BMDS: Terminal High Altitude Area Defense (THAAD)	Ivy Hubler
CH-53K Heavy Lift Replacement (CH-53K)	Robert K. Miller, Marvin E. Bonner
Combat Rescue Helicopter (CRH)	J. Andrew Walker, Robert K. Miller
Common Infrared Countermeasures (CIRCM)	Danny G. Owens
DDG 1000 Zumwalt Class Destroyer	Rebecca A. Wilson, Gwyneth B. Woolwine
DDG 51 Arleigh Burke Class Guided Missile Destroyer	W. Kendal Roberts, Ioan T. Ifrim
E-2D Advanced Hawkeye (E-2D AHE)	Teague A. Lyons, Jacob Beier
Enhanced Polar System (EPS)	Bradley L. Terry, Suzanne Sterling

Appendix VIII
GAO Contact and Acknowledgments

(Continued From Previous Page)

System	Primary Staff
Evolved Expendable Launch Vehicle (EELV) – Atlas V, Delta IV	Desiree E. Cunningham, Maria A. Durant
Excalibur Precision 155mm Projectiles	Ryan D. Stott, Carrie W. Rogers
F-22 Modernization Increment 3.2B	Sean Seales, LeAnna Parkey
F-35 Joint Strike Fighter	Marvin E. Bonner, Erin L. Stockdale
Family of Advanced Beyond Line-of-Sight Terminals (FAB-T)	Alexandra K. Dew, Justin M. Jaynes, Scott Purdy
Gerald R. Ford Class Nuclear Aircraft Carrier (CVN 78 Class)	Holly Williams, Christopher R. Durbin, Greg Campbell
Global Positioning System (GPS) III	Laura T. Holliday
Ground Combat Vehicle (GCV)	Marcus C. Ferguson, William C. Allbritton
HC/MC-130 Recapitalization Program	Brian T. Smith, Charlie Shivers
Integrated Air & Missile Defense (IAMD)	John M. Ortiz, Carol T. Mebane
Integrated Defensive Electronic Countermeasures (IDECM)-Block 4	James Kim, R. Eli DeVan
Joint Air-to-Ground Missile (JAGM)	Carrie W. Rogers, Wendy P. Smythe
Joint Air-to-Surface Standoff Missile (JASSM and JASSM-Extended Range)	Brian A. Tittle, John W. Crawford
Joint High Speed Vessel (JHSV)	Christopher E. Kunitz, Robert P. Bullock
Joint Land Attack Cruise Missile Defense Elevated Netted Sensor System (JLENS)	Maria A. Durant, John M. Ortiz
Joint Light Tactical Vehicle	Dayna L. Foster, Danny G. Owens
Joint Precision Approach and Landing System (JPALS) Increment 1A	Stephen V. Marchesani, Greg Campbell
Joint Tactical Radio System (JTRS) Handheld, Manpack, and (HMS) Small Form Fit Radios	Nathan A. Tranquilli, Paul G. Williams
KC-46 Tanker Modernization Program	Don M. Springman, Wendell K. Hudson
LHA 6 <i>America</i> Class Amphibious Assault Ship	Celina F. Davidson, Jade A. Winfree
Littoral Combat Ship (LCS)-Mission Modules	Laurier R. Fish
Littoral Combat Ship (LCS)-Seaframes	Amber N. Keyser, C. James Madar
Military GPS User Equipment (MGUE), Increment 1	Raj C. Chitikila, Jeffrey A. Fiore
Mobile User Objective System (MUOS)	Richard Y. Horiuchi, Desiree E. Cunningham
MQ-1C Unmanned Aircraft System (UAS) Gray Eagle	Tana M. Davis, Paige A. Muegenburg
MQ-4C Triton Unmanned Aircraft System (MQ-4C Triton)	Tom Twambly, Candice N. Wright
MQ-9 Unmanned Aircraft System (UAS) Reaper	Rae Ann H. Sapp, Laura Jezewski
Navy Multiband Terminal (NMT)	Lisa P. Gardner, Jeffrey M. Sanders
Next Generation Operational Control System (GPS OCX)	Erin R. Cohen, Raj C. Chitikila
Ohio Replacement (SBSD)	C. James Madar, Jessica A. Drucker
P-8A Poseidon	Heather Lynn Barker Miller, Jocelyn C. Yin
Paladin/Field Artillery Ammunition Support Vehicle (FAASV) Integrated Management (PIM)	William C. Allbritton, Andrea M. Bivens

Appendix VIII
GAO Contact and Acknowledgments

(Continued From Previous Page)

System	Primary Staff
Patriot/Medium Extended Air Defense System Combined Aggregate Program (MEADS CAP) Fire Unit	Carol T. Mebane, John M. Ortiz
Presidential Helicopter (VXX)	Jerry W. Clark, Bonita P. Oden
RQ-4A/B Global Hawk Unmanned Aircraft System	Laura Jezewski, Rae Ann H. Sapp
Ship to Shore Connector (SSC)	Molly W. Traci, Matthew M. Shaffer
Small Diameter Bomb Increment II (SDB II)	John W. Crawford, Brian A. Tittle
Space Based Infrared System High Component (SBIRS High)	Claire Buck, Maricela Cherveney
Space Fence	Laura D. Hook, Maricela Cherveney
Standard Missile-6 (SM-6)	Angie Nichols-Friedman, Elizabeth Reed Fritts
Three-Dimensional Expeditionary Long-Range Radar (3DELRR)	Claire Li, Janet McKelvey, Anne McDonough-Hughes
Unmanned Carrier-Launched Airborne Surveillance and Strike (UCLASS) System	Julie C. Hadley, Megan L. Porter, Andrew H. Redd, Kathy Hubbell
Vertical Takeoff and Landing Tactical Unmanned Aerial Vehicle – MQ-8 Fire Scout (VTUAV)	Leigh Ann Nally, Anh L. Nguyen
Warfighter Information Network-Tactical (WIN-T) Increment 2	James P. Tallon, Andrea P. Yohe
Warfighter Information Network-Tactical (WIN-T) Increment 3	James P. Tallon, Andrea P. Yohe

Source: GAO.

Related GAO Products

Weapons Acquisition Reform: Reform Act Is Helping DOD Acquisition Programs Reduce Risk, but Implementation Challenges Remain. [GAO-13-103](#). Washington, D.C.: December 14, 2012.

Joint Strike Fighter: DOD Actions Needed to Further Enhance Restructuring and Address Affordability Risks. [GAO-12-437](#). Washington, D.C.: June 14, 2012.

Missile Defense: Opportunity Exists to Strengthen Acquisitions by Reducing Concurrency. [GAO-12-486](#). Washington, D.C.: April 20, 2012.

Defense Acquisitions: Assessments of Selected Weapon Programs. [GAO-12-400SP](#). Washington, D.C.: March 29, 2012.

Weapons Acquisition Reform: Actions Needed to Address Systems Engineering and Developmental Testing Challenges. [GAO-11-806](#). Washington, D.C.: September 19, 2011.

Ballistic Missile Defense: Actions Needed to Improve Training Integration and Increase Transparency of Training Resources. [GAO-11-625](#). Washington, D.C.: July 18, 2011.

Space and Missile Defense Acquisitions: Periodic Assessment Needed to Correct Parts Quality Problems in Major Programs. [GAO-11-404](#). Washington, D.C.: June 24, 2011.

Defense Acquisitions: Assessments of Selected Weapon Programs. [GAO-11-233SP](#). Washington, D.C.: March 29, 2011.

Defense Acquisitions: Observations on Weapon Program Performance and Acquisition Reforms. [GAO-10-706T](#). Washington, D.C.: May 19, 2010.

Defense Acquisitions: Strong Leadership Is Key to Planning and Executing Stable Weapon Programs. [GAO-10-522](#). Washington, D.C.: May 6, 2010.

Best Practices: DOD Can Achieve Better Outcomes by Standardizing the Way Manufacturing Risks Are Managed. [GAO-10-439](#). Washington, D.C.: April 22, 2010.

Best Practices: High Levels of Knowledge at Key Points Differentiate Commercial Shipbuilding from Navy Shipbuilding. [GAO-09-322](#). Washington, D.C.: May 13, 2009.

Defense Acquisitions: Charting a Course for Lasting Reform. [GAO-09-663T](#). Washington, D.C.: April 30, 2009.

Defense Acquisitions: Measuring the Value of DOD's Weapon Programs Requires Starting with Realistic Baselines. [GAO-09-543T](#). Washington, D.C.: April 1, 2009.

Defense Acquisitions: DOD Must Balance Its Needs with Available Resources and Follow an Incremental Approach to Acquiring Weapon Systems. [GAO-09-431T](#). Washington, D.C.: March 3, 2009.

GAO Cost Estimating and Assessment Guide: Best Practices for Developing and Managing Capital Program Costs. [GAO-09-3SP](#). Washington, D.C.: March 2, 2009.

Defense Acquisitions: Perspectives on Potential Changes to Department of Defense Acquisition Management Framework. [GAO-09-295R](#). Washington, D.C.: February 27, 2009.

Defense Acquisitions: A Knowledge-Based Funding Approach Could Improve Major Weapon System Program Outcomes. [GAO-08-619](#). Washington, D.C.: July 2, 2008.

Best Practices: Increased Focus on Requirements and Oversight Needed to Improve DOD's Acquisition Environment and Weapon System Quality. [GAO-08-294](#). Washington, D.C.: February 1, 2008.

Best Practices: An Integrated Portfolio Management Approach to Weapon System Investments Could Improve DOD's Acquisition Outcomes. [GAO-07-388](#). Washington, D.C.: March 30, 2007.

Defense Acquisitions: Major Weapon Systems Continue to Experience Cost and Schedule Problems under DOD's Revised Policy. [GAO-06-368](#). Washington, D.C.: April 14, 2006.

Best Practices: Capturing Design and Manufacturing Knowledge Early Improves Acquisition Outcomes. [GAO-02-701](#). Washington, D.C.: July 15, 2002.

Best Practices: Better Matching of Needs and Resources Will Lead to Better Weapon System Outcomes. [GAO-01-288](#). Washington, D.C.: March 8, 2001.

Best Practices: A More Constructive Test Approach Is Key to Better Weapon System Outcomes. [GAO/NSIAD-00-199](#). Washington, D.C.: July 31, 2000.

Best Practices: Better Management of Technology Development Can Improve Weapon System Outcomes. [GAO/NSIAD-99-162](#). Washington, D.C.: July 30, 1999.

Best Practices: Successful Application to Weapon Acquisition Requires Changes in DOD's Environment. [GAO/NSIAD-98-56](#). Washington, D.C.: February 24, 1998.

GAO's Mission

The Government Accountability Office, the audit, evaluation, and investigative arm of Congress, exists to support Congress in meeting its constitutional responsibilities and to help improve the performance and accountability of the federal government for the American people. GAO examines the use of public funds; evaluates federal programs and policies; and provides analyses, recommendations, and other assistance to help Congress make informed oversight, policy, and funding decisions. GAO's commitment to good government is reflected in its core values of accountability, integrity, and reliability.

Obtaining Copies of GAO Reports and Testimony

The fastest and easiest way to obtain copies of GAO documents at no cost is through GAO's Web site (www.gao.gov). Each weekday afternoon, GAO posts on its Web site newly released reports, testimony, and correspondence. To have GAO e mail you a list of newly posted products, go to www.gao.gov and select "E-mail Updates."

Order by Phone

The price of each GAO publication reflects GAO's actual cost of production and distribution and depends on the number of pages in the publication and whether the publication is printed in color or black and white. Pricing and ordering information is posted on GAO's Web site, <http://www.gao.gov/ordering.htm>.

Place orders by calling (202) 512-6000, toll free (866) 801-7077, or TDD (202) 512-2537.

Orders may be paid for using American Express, Discover Card, MasterCard, Visa, check, or money order. Call for additional information.

Connect with GAO

Connect with GAO on [Facebook](#), [Flickr](#), [Twitter](#), and [YouTube](#). Subscribe to our [RSS Feeds](#) or [E-mail Updates](#). Listen to our [Podcasts](#). Visit GAO on the web at www.gao.gov.

To Report Fraud, Waste, and Abuse in Federal Programs

Contact:

Web site: www.gao.gov/fraudnet/fraudnet.htm

E-mail: fraudnet@gao.gov

Automated answering system: (800) 424-5454 or (202) 512-7470

Congressional Relations

Katherine Siggerud, Managing Director, siggerudk@gao.gov, (202) 512-4400 U.S. Government Accountability Office, 441 G Street NW, Room 7125 Washington, DC 20548

Public Affairs

Chuck Young, Managing Director, youngc1@gao.gov, (202) 512-4800 U.S. Government Accountability Office, 441 G Street NW, Room 7149 Washington, DC 20548