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Report to Congressional Committees
May 2019
GAO-19-336SP

WEAPON SYSTEMS ANNUAL ASSESSMENT

Limited Use of Knowledge-Based Practices Continues to Undercut DOD's Investments

Part 2 - Army Programs

Accessible Version

.

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Abbreviations

AEHF	Advanced Extremely High Frequency Satellite
CDR	Critical Design Review
CPAF	cost-plus-award-fee
CPFF	cost-plus-fixed-fee
CPIF	cost-plus-incentive fee
CVN 78	Gerald R. Ford Class Nuclear Aircraft Carrier
DAMIR	Defense Acquisition Management Information Retrieval
DDG 51	DDG 51 Arleigh Burke Class Guided Missile Destroyer
DOD	Department of Defense
eSRS	Electronic Subcontracting Reporting System

F-35	F-35 Lightning II Joint Strike Fighter
FFP	firm-fixed-price
FPDS-NG	Federal Procurement Data System-Next Generation
FPI	fixed-price incentive
IDIQ	indefinite-delivery/indefinite-quantity
MDAP	Major Defense Acquisition Program
MH-60R	MH-60R Multi-Mission Helicopter
MRL	manufacturing readiness level
NA	not applicable
NDAA	National Defense Authorization Act
OMB	Office of Management and Budget
P-8A Increment 3	P-8A Poseidon, Increment 3
SAR	Selected Acquisition Report
SBIRS High	Space Based Infrared System High
SSN 774	SSN 774 Virginia Class Submarine
TBD	to be determined
TRL	technology readiness level
USAF	United States Air Force
USMC	United States Marine Corps
USN	United States Navy
WIN-T Inc. 2	Warfighter Information Network-Tactical Increment 2
WIN-T Inc. 3	Warfighter Information Network-Tactical Increment 3
WSARA	Weapon Systems Acquisition Reform Act

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Assessments of Individual Programs

This section contains (1) 51 assessments of individual weapon programs and (2) four summary analyses—each segmented by military department. Each assessment presents data on the extent to which programs are following a knowledge-based acquisition approach to product development.[1] Each military department's summary analysis page presents aggregated information about selected programs' acquisition phases, current estimated funding needs, knowledge attained, cost and schedule performance, oversight authorities, software characteristics, and competition in contracting. To develop the individual program assessments, we collected program information using a web-based questionnaire, obtained and reviewed agency documents, and interviewed program officials.

For 39 programs, all of which were in development or early production, 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 couple of programs that did not have such an estimate, we used the estimate at production start. For shipbuilding programs, we used their planning estimates if those estimates were available. For programs that began as non-MDAPs, we used the first full estimate available. See figure 21 for an illustration of the layout of each two-page assessment.

[1]The assessments also contain basic information about the program, including the prime contractor(s) and contract type(s). We abbreviated the following contract types in the individual assessments: cost-plus-award-fee (CPAF), cost-plus-fixed-fee (CPFF), cost-plus-incentive-fee (CPIF), firm-fixed-price (FFP), fixed-price incentive (FPI), and indefinite-delivery / indefinite-quantity (IDIQ).

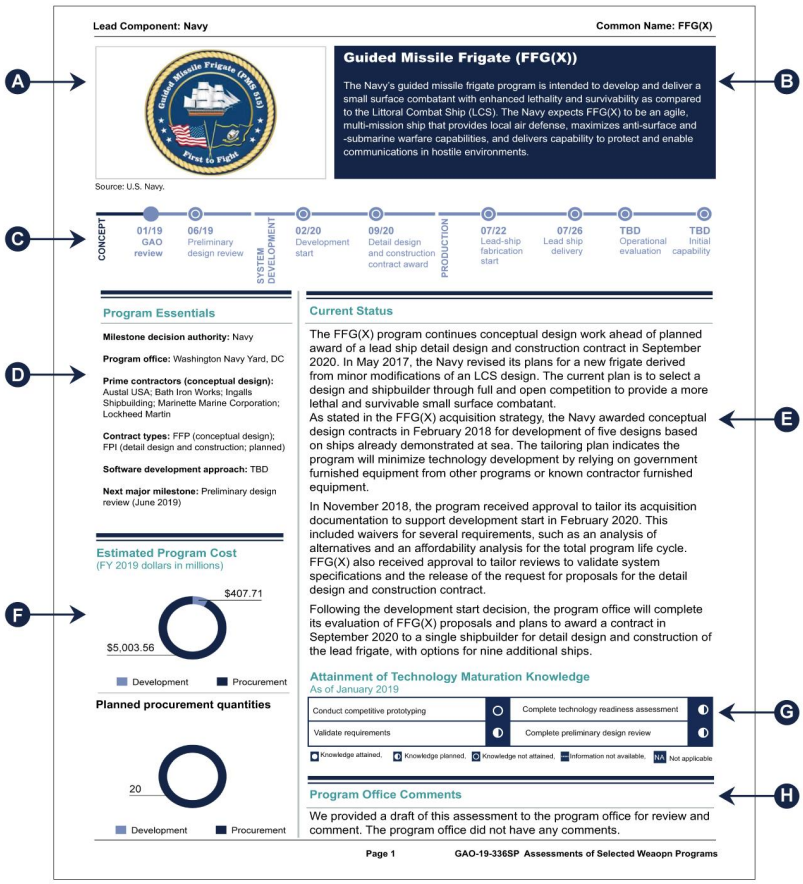
Figure 21: Illustration of Program Two-Page Assessment

Source: GAO. | GAO-19-336SP

In addition, we produced one-page assessments on the current status of 12 programs, which include (1) six future MDAPs; (2) one MDAP that was in development, but released its cost baseline very late in our review, and

(3) five MDAPs that were well into production, but planned to introduce new increments of capability. See figure 22 for an illustration of the layout of each one-page assessment.

Figure 22: Illustration of Program One-Page Assessment



- **A** Illustration or photo of system
- **B** Program description
- **C** Schedule timeline identifying key dates for the program, including the start of development, major decision reviews, production decisions, and planned operational capability
- **D** **Program Essentials** Programmatic information, including milestone decision authority, program office location, prime contractor, contract type, software development approach, software development approach, and next major milestone
- **E** **Current Status** Updated status of program
- **F** **Estimated Program Cost** Current estimated funding needs and quantity requirements
- **G** **Attainment of Technology Maturation Knowledge** Depiction of key knowledge programs should attain prior to entering system development and the program's progress in attaining that knowledge
- **H** **Program Office Comments** General comments provided by the cognizant program office

Source: GAO. | GAO-19-336SP

For 45 of our one- and two-page assessments, we used scorecards to depict the extent of knowledge that a program has gained.[2] These scorecards display key knowledge-based acquisition practices that should be implemented by certain points in the acquisition process. In our prior and current work, we found that the more knowledge a program has attained by each of these key points, the more likely the weapon system will be delivered within its estimated cost and schedule. In a current MDAP, knowledge deficits signal that the program is proceeding without sufficient knowledge about its technologies, design, or manufacturing processes, and faces unresolved risks that could lead to cost growth and schedule delays.

For each scorecard, we used a closed circle to denote a knowledge-based practice the program implemented. We used an open circle to denote a knowledge-based practice the program did not, or has not yet, implemented. For future MDAPs only, we used a partially closed circle to denote a knowledge-based practice that the program reported it plans to implement. If the program did not provide us with enough information to make a determination, we showed this with a dashed line. We also marked as “NA” any scorecard field that corresponded with a knowledge-based practice that was not applicable to the program. A knowledge-based practice may not be applicable to a particular program if it has not yet reached the point in the acquisition cycle when the practice should be implemented, or if the particular practice is not relevant to the program. For shipbuilding programs, we assessed different key points in the acquisition cycle and applicable knowledge-based practices, which were informed by our prior work.[3] Appendix II provides additional detail on our scorecard methodology. Figures 23 and 24 provide examples of the knowledge scorecards we used in our assessments.

[2]We did not use scorecards in five of our one-page assessments of MDAPs that were well into production, but planned to introduce new increments of capability, because our metrics on knowledge attainment were incongruent with the acquisition strategies these programs employed. We did not use a scorecard in a sixth one-page assessment—for VC-25B Presidential Aircraft Recapitalization—which released a baseline late in our review.

[3]GAO-09-322.

Figure 23: Examples of Knowledge Scorecards on Two-Page Assessments

Program in production

Attainment of Product Knowledge

As of January 2019

	Status at	Current status
Resources and requirements match	Development start	
• Demonstrate all critical technologies are very close to final form, fit, and function within a relevant environment	●	●
• Demonstrate all critical technologies in form, fit and function within a realistic environment	○	●
• Complete a system-level preliminary design review	●	●
Product design is stable	Design review	
• Release at least 90 percent of design drawings	●	●
• Test a system-level integrated prototype	○	○
Manufacturing processes are mature	Production start	
• Demonstrate Manufacturing Readiness Level of at least 9 or critical processes are in statistical control	NA	NA
• Demonstrate critical processes on a pilot production line	NA	NA
• Test a production-representative prototype in its intended environment	NA	NA

● Knowledge attained ··· Information not available
○ Knowledge not attained NA Not applicable

Shipbuilding program

Attainment of Product Knowledge

As of January 2019

	Status at	Current status
Resources and requirements match	Detail design contract award	
• Demonstrate all critical technologies are very close to final form, fit, and function within a relevant environment	○	●
• Demonstrate all critical technologies in form, fit and function within a realistic environment	○	○
• Complete a system-level preliminary design review	○	●
Product design is stable	Fabrication start	
• Complete basic and functional design to include 100 percent of 3D product modeling	○	●

● Knowledge attained ··· Information not available
○ Knowledge not attained NA Not applicable

Source: GAO analysis of Department of Defense data. | GAO-19-336SP

Figure 24: Example of Knowledge Scorecard on One-Page Assessments

Attainment of Technology Development Knowledge

As of January 2019

Conduct competitive prototyping	○	Complete technology readiness assessment	◐
Validate requirements	●	Complete preliminary design review	◐

● Knowledge attained, ◐ Knowledge planned, ○ Knowledge not attained, ····· Information not available, NA Not applicable

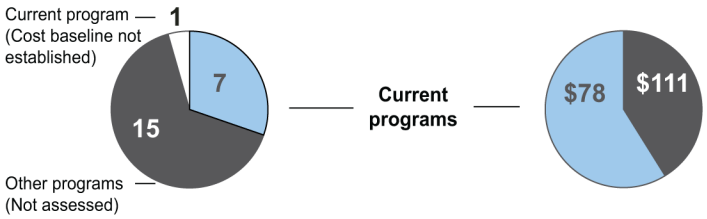
Source: GAO analysis of Department of Defense data. | GAO-19-336SP

ARMY PROGRAM ASSESSMENTS

GAO Assessed 7 of the Army's 23 Current Major Defense Acquisition Programs

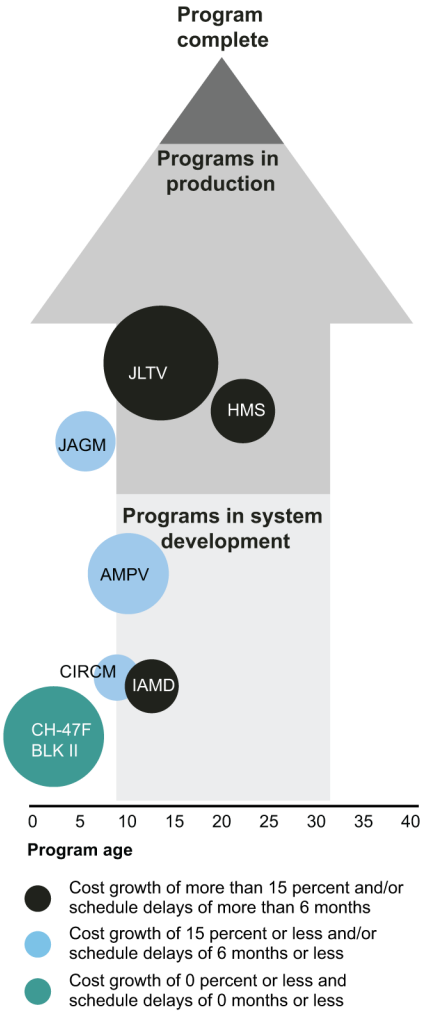
The 7 Current Programs GAO Assessed Represent 41 Percent of the Army's $189 Billion Estimated Total Acquisition Costs

(Fiscal Year 2019 dollars in billions)



We also assessed two future major defense acquisition programs. We did not assess programs that had yet to enter technology development or had already progressed into full-rate production.

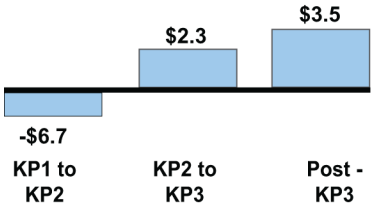
Most Current Programs GAO Assessed Have Either Cost Growth, Schedule Delays, or Both



Note: Bubble size is based on each program's currently estimated future acquisition funding needed.

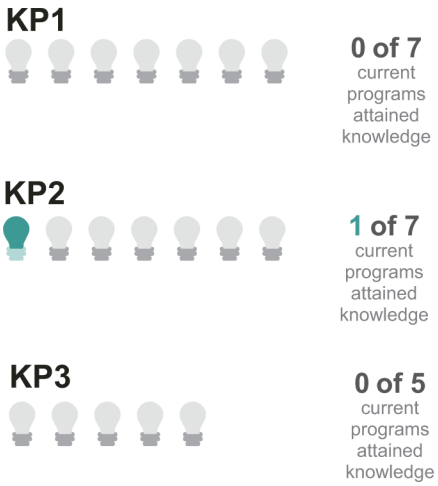
Total Acquisition Cost Performance in Current Programs Varied Among Knowledge Points (KP)

(Fiscal Year 2019 dollars in billions)



A cost decrease due to a significant quantity decrease in one current program—HMS—accounted for most of the cost decrease between KP1 and KP2.

Most Current Programs Did Not Attain Knowledge at Key Points



Average Acquisition Cycle Time of Current Programs Increased by 16 Months from First Full Estimate (FFE) to Current Estimate

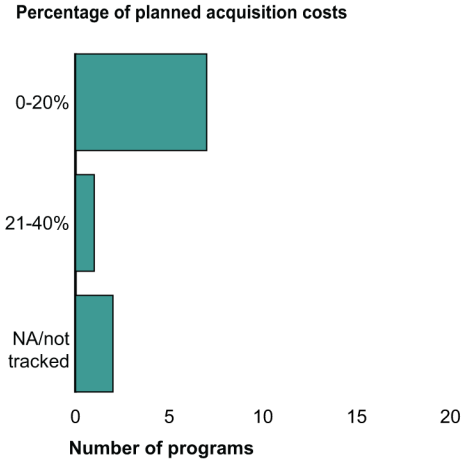
One current program—ITEP—entered system development after December 2017 and therefore is excluded from our cost, schedule, knowledge attainment, and contract analysis.

Cost and schedule analysis is primarily based on estimates from December 2017 selected acquisition reports. This information may differ from the amounts reported in the individual assessments, which are based on more recent program estimates in some cases. Please see appendix II for details.

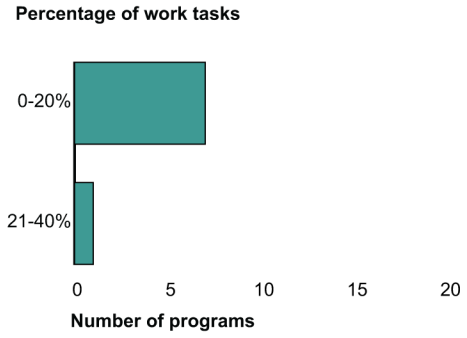
Source: GAO analysis of Department of Defense data. | GAO-19-336SP

ARMY PROGRAM ASSESSMENTS

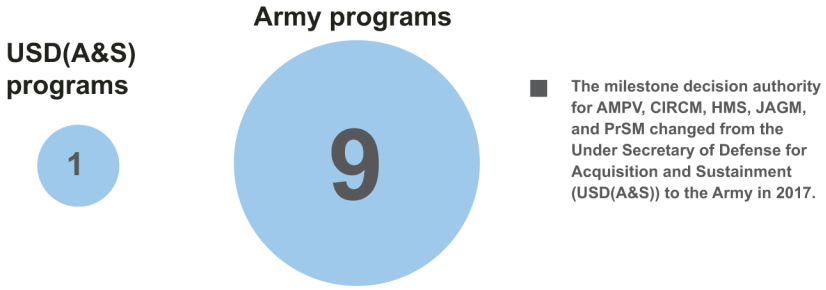
Most Current and Future Army Programs Report that Less than 20 Percent of Planned Acquisition Costs are Specifically for Software



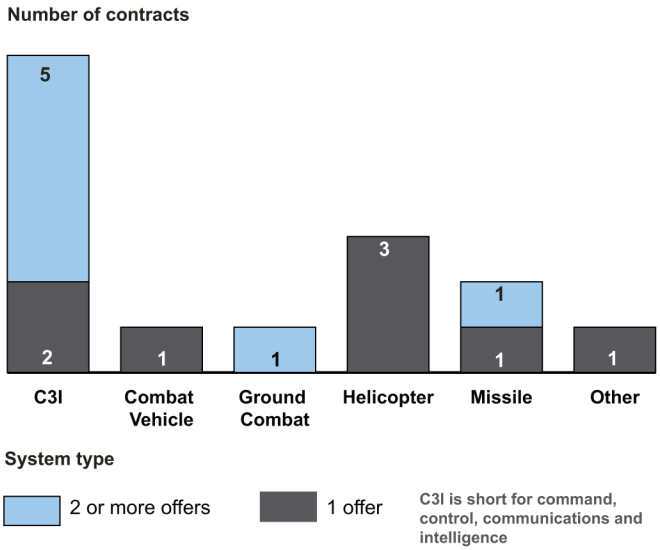
Most Current Army Programs Report that Less than 20 Percent of Work Tasks are Software-Related



The Army was the Milestone Decision Authority in 2017 for 9 of its Current and Future Programs in GAO's Review



The Army Received One Offer on Solicitations for Just Over Half of its Currently Reported Major Contracts for Development and Procurement



Source: GAO analysis of Department of Defense data. | GAO-19-336SP

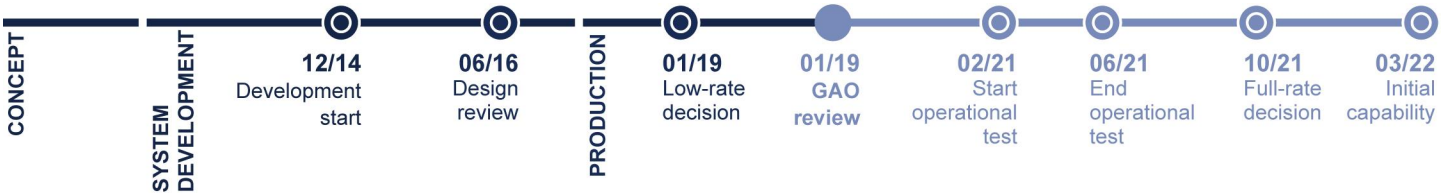
Army Program Assessments[a]
2-page assessments
Armored Multi-Purpose Vehicle (AMPV)
CH-47F Modernized Cargo Helicopter (CH-47F Block II)
Common Infrared Countermeasure (CIRCM)
Handheld, Manpack, and Small Form Fit Radios (HMS)
Integrated Air and Missile Defense (IAMD)
Improved Turbine Engine Program (ITEP)
Joint Air-to-Ground Missile (JAGM)
Joint Light Tactical Vehicle (JLTV)
1-page assessments
Indirect Fire Protection Capability Increment 2 – Intercept Block 1 (IFPC Inc 2-I Block 1)
Precision Strike Missile (PrSM)

[a]We abbreviate the following contract types in the individual assessments: cost-plus-award-fee (CPAF), cost-plus-fixed-fee (CPFF), cost-plus-incentive-fee (CPIF), firm-fixed-price (FFP), fixed-price incentive (FPI), and indefinite-delivery / indefinite-quantity (IDIQ).

Source: BAE.

Armored Multi-Purpose Vehicle (AMPV)

The Army's AMPV is the replacement to the M113 family of vehicles at the brigade level and below. The AMPV will replace the M113 in five mission roles: general purpose, medical evacuation, medical treatment, mortar carrier, and mission command. The Army determined that development of the AMPV is necessary due to mobility, survivability, and force protection deficiencies identified with the M113, as well as space, weight, power, and cooling limitations that prevent the incorporation of future technologies.



Program Essentials

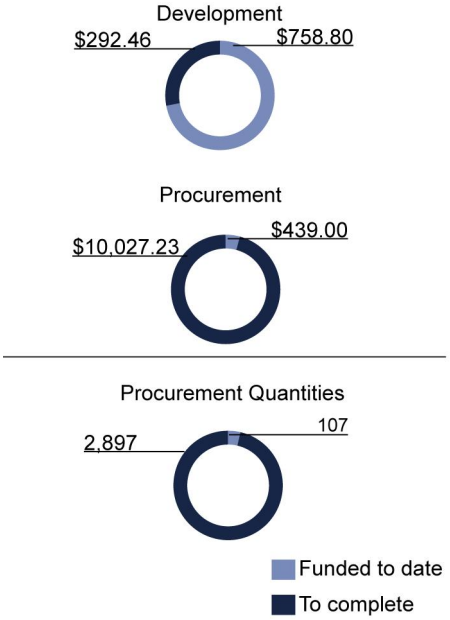
Milestone decision authority: Army
Program office: Warren, MI
Prime contractor: BAE Systems
Contract type: CPIF (development)
Software development approach: Incremental
Next major milestone: Start operational testing (February 2021)

Program Performance (fiscal year 2019 dollars in millions)

	First full estimate (05/2015)	Latest (06/2018)	Percentage change
Development	$1,050.90	$1,051.30	0.0%
Procurement	10,354.8	$10,466.20	+1.1%
Unit cost	$3.89	$3.95	+1.8%
Acquisition cycle time (months)	87	87	0.0%
Total quantities	2,936	2,936	0.0%

Total quantities comprise 39 development quantities and 2,897 procurement quantities.

Funding and Quantities
(fiscal year 2019 dollars in millions)



Attainment of Product Knowledge
As of January 2019

	Status at	Current Status
Resources and requirements match	**Development Start**	
• Demonstrate all critical technologies are very close to final form, fit and function within a relevant environment	●	●
• Demonstrate all critical technologies in form, fit and function within a realistic environment	●	●
• Complete a system-level preliminary design review	○	●
Product design is stable	**Design Review**	
• Release at least 90 percent of design drawings	●	●
• Test a system-level integrated prototype	○	●
Manufacturing processes are mature	**Production Start**	
• Demonstrate Manufacturing Readiness Level of at least 9, or critical processes are in statistical control	○	○
• Demonstrate critical processes on a pilot production line	○	○
• Test a production-representative prototype in its intended environment	●	●

● Knowledge attained, ○ Knowledge not attained, … Information not available, NA Not applicable

AMPV Program

Technology Maturity and Design Stability

The AMPV program has matured its critical technologies and stabilized its design. The program entered system development in December 2014 with its critical technologies deemed fully mature by an independent review team. Program officials noted that although the AMPV uses a new hull design, a majority of subsystems are derived from existing vehicles. For example, the AMPV uses a common powertrain with the Bradley infantry fighting vehicle.

While the program has released over 90 percent of expected design drawings to manufacturing, the overall number has fluctuated due to vehicle configuration changes. Following its critical design review (CDR) in June 2016, the program's number of expected drawings increased by nearly 19 percent. In our 2018 assessment, we reported that this increase was due to the contractor underestimating the number and complexity of design drawings needed. For our current assessment, however, we found that the program has now lowered its total number of design drawings by 19 percent. According to program officials, this decrease reflected a changed design due to testing results. This lowered number re-establishes that the program released over 90 percent of its design drawings to manufacturing by CDR. We have updated our assessment of product knowledge table to reflect this latest calculation.

To maintain schedule, the program office delayed some of its developmental testing, which it now expects to complete in July 2019—over 5 months after it entered low-rate initial production and contrary to best practices. Remaining technical risk areas include the automatic fire extinguishing system and hard transmission shifts, both of which may require redesigns if testing reveals further deficiencies.

Production Readiness

The AMPV program entered low-rate initial production in January 2019. The program's manufacturing readiness level did not indicate that its production processes were in statistical control, as recommended by best practices. Further, the program office did not demonstrate its critical manufacturing processes on a pilot production line prior to production start. The program attributed this to the contractor's need to address manufacturing process deficiencies discovered during production of prototype AMPV units.

The contractor, BAE Systems, delivered all 29 prototype vehicles by March 2018—5 months later than earlier program plans, which called for delivery of all vehicles by October 2017. As a result, the contractor had less time than initially planned between the prototype deliveries and the start of low rate initial production to resolve production issues. Problems with parts shortages and changes to engineering drawings, among other things, caused the late deliveries. In light of these challenges, BAE Systems is modifying its overall manufacturing plan to include changes to assembly and facility processes. For example, it is implementing robotic welding to improve quality and manufacturing throughput. In a program assessment report, the Defense Contract Management Agency (DCMA) noted that although these manufacturing modifications should improve the overall process, some changes will, in fact, introduce new risks.

Our review of program documentation shows that the program's ability to meet increased production quantities remains a key risk area. In September 2017, the Army increased the program's low-rate initial production quantity from 289 to 551 vehicles spread over 4 years to support the European Deterrence Initiative (EDI)—an effort intended to reassure allies and partners of U.S. commitment to their security. According to program officials, this quantity has been lowered to 469 vehicles spread over 3 years with the final EDI vehicles being procured as part of full rate production. Persisting AMPV technical challenges, coupled with contractor plans to produce AMPV in the same facility as two other major platforms—the M109A7 Family of Vehicles, and M88A2 HERCULES recovery vehicles—will together constrain AMPV deliveries.

Other Program Issues

Based on recent results from ongoing reliability tests, the program reported that it is slightly below its reliability goal for the start of low-rate initial production. Program officials stated the contractor has addressed AMPV-unique issues, but legacy powertrain problems remain.

Program Office Comments

We provided a draft of this assessment to the program office for review and comment. The program office provided technical comments, which we incorporated where appropriate. Program officials stated that AMPV began production ahead of schedule in January 2019 and is executing activities to show manufacturing processes are nearing maturity. According to the program, production processes will reach full maturity to support full-rate production in fiscal year 2022. To date, the program reports that it has implemented production process changes that improve vehicle quality and provide capacity for increased production quantities. In addition, program officials stated that BAE Systems produced vehicle hulls ahead of the first low-rate production vehicle to validate these process changes. At the same time, program officials stated that they continue to improve the AMPV design based on recent test results. They also stated that vehicle developmental tests will finish in July 2019, and they assess the risk of additional re-design of the vehicle to be low. Further, program officials said that AMPV is meeting its overall availability requirement, but reliability is a watch item.

Source: Copyright © 2017 Boeing. All rights reserved.

CH-47F Modernized Cargo Helicopter (CH-47F Block II)

The Army's CH-47F Block II program upgrades existing CH-47F aircraft intended to provide additional capability, greater reach, and increased payload capacity. Improvements include a strengthened airframe and drive train, improved flight controls, upgraded fuel and electrical systems, and advanced rotor blades that the Army expects will increase lift in hot weather conditions. The Army also expects the improved fuel and rotor components to reduce operating and support costs. CH-47F helicopters provide the Army's only heavy lift capability and are scheduled to remain in service through 2060.

Program Essentials

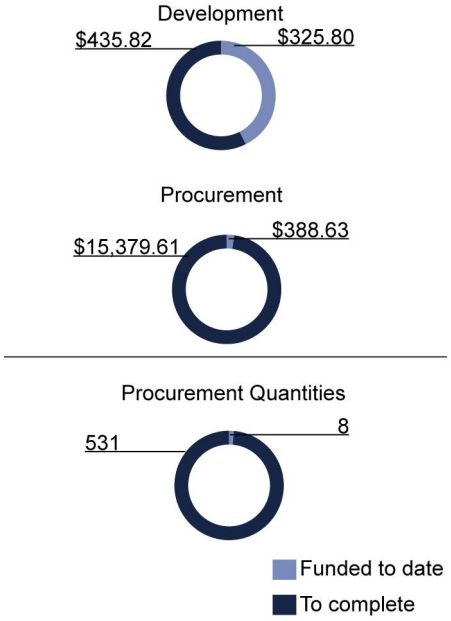
Milestone decision authority: Army
Program office: Redstone Arsenal, AL
Prime contractor: Boeing
Contract type: CPIF (development)
Software development approach: Mixed
Next major milestone: Production start (August 2021)

Program Performance (fiscal year 2019 dollars in millions)

	First full estimate (02/2018)	Latest (06/2018)	Percentage change
Development	$791.70	$761.60	-3.8%
Procurement	$15,714.80	$15,768.20	+0.3%
Unit cost	$30.92	$30.97	+0.2%
Acquisition cycle time (months)	88	88	0.00%
Total quantities	542	542	0.00%

Total quantities comprise 3 development quantities and 539 procurement quantities.

Funding and Quantities
(fiscal year 2019 dollars in millions)



Attainment of Product Knowledge
As of January 2019

	Status at	Current Status
Resources and requirements match	**Development Start**	
• Demonstrate all critical technologies are very close to final form, fit and function within a relevant environment	●	●
• Demonstrate all critical technologies in form, fit and function within a realistic environment	○	○
• Complete a system-level preliminary design review	●	●
Product design is stable	**Design Review**	
• Release at least 90 percent of design drawings	●	●
• Test a system-level integrated prototype	○	○
Manufacturing processes are mature	**Production Start**	
• Demonstrate Manufacturing Readiness Level of at least 9, or critical processes are in statistical control	NA	NA
• Demonstrate critical processes on a pilot production line	NA	NA
• Test a production-representative prototype in its intended environment	NA	NA

● Knowledge attained, ○ Knowledge not attained, … Information not available, NA Not applicable

CH-47F Block II Program

Technology Maturity

CH-47F Block II critical technologies continue to approach maturity at the same time that the program reports that it has released 99 percent of planned drawings, which constitutes a stable design. As the program continues to mature each technology into a final form, fit, and function, the program may need to revise its system drawings to accommodate necessary changes, which could compromise the program's design stability.

The program office has identified two critical technologies—Ferrium C61 steel and the advanced Chinook rotor blade (ACRB)—that it assesses as approaching maturity. Ferrium C61 is a new, high strength steel designed to create an improved drive train (shafts) that can operate under increased horsepower, without needing to redesign the CH-47F transmission. According to the program office, the CH-47F Block II will be the first to use this material in this type of application. Other applications include power transmission shafts and gears in the aerospace and energy industries, as well as off-road vehicles. Program officials expect the production cost of Ferrium C61 shafts to be higher than the steel used in existing CH-47F aircraft, but they stated that they will not be able to estimate the cost until production processes are established.

The ACRB is a carbon fiber blade intended to improve the aircraft's lift performance while also minimizing effects on forward flight. The Block II program is tracking technical risks with ACRB. Program officials stated they have demonstrated the ACRB in an operational environment near or at planned operational configuration. Nonetheless, the program characterizes the ACRB design as more complex than legacy blades due to a new tip design, which has introduced manufacturing risk. According to officials, prototypes and process changes will help limit that risk.

Design Stability

CH-47F Block II released 90 percent of its design drawings by critical design review (CDR) in December 2017. Prior to the CDR, however, the program did not elect to developmentally test a fully configured, production representative prototype in its intended environment. Instead, the program plans to initiate this prototype testing in August 2019 (20 months after CDR)—an approach inconsistent with best practices. Until the program completes this testing, it cannot know whether its design is actually stable.

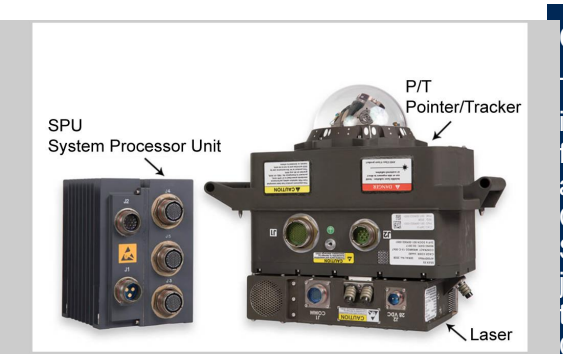
Production Readiness

The program plans to enter production in August 2021 following delivery of three aircraft that officials report were procured as part of system development. The prime contractor, Boeing, is producing the three system development aircraft in the same final assembly facility as the current Block I aircraft using many of the same processes, tools, and management procedures. The program plans to demonstrate statistical control of critical manufacturing processes as part of a production readiness assessment before starting production, which aligns with GAO best practices. Program officials noted that Boeing—as the original designer and prime manufacturer of the CH-47 series aircraft since 1962—has demonstrated statistical control of manufacturing processes in previous models.

The program office further stated that Boeing is the only capable source for Block II production. According to the program office, Boeing's significant cargo helicopter experience, possession of CH-47F-unique tooling and test equipment, and existing Block I production line preclude use of full and open competition for Block II production.

Program Office Comments

We provided a draft of this assessment to the program office for review and comment. The program office provided technical comments, which we incorporated where appropriate. The program office stated that the CH-47F Block II program is ahead of schedule and within expected cost. Specifically, the program office stated that following the development contract award, it has consistently reported favorable cost and schedule performance and met program milestones ahead of schedule, which the program office considers indicative of overall positive program health. The program office also stated that testing of the first system-level integrated prototype could begin in July 2020. It also said that it conducted two test flights that confirmed ACRB design for the development phase of the CH-47F program. Further, the program office stated that the similarities between the legacy CH-47F and the new Block II design allows for demonstration of critical technologies before prototype testing. According to the program office, this constituted a low-risk approach to reduce program cost and schedule.



Source: Northrop Grumman Systems Corporation.

Common Infrared Countermeasure (CIRCM)

The Army's CIRCM is the next generation lightweight, laser-based infrared countermeasure system for rotary-wing, tilt-rotor, and small fixed-wing aircraft across DOD. CIRCM consists of three major items—a system processor unit, a pointer tracker, and an infrared laser. CIRCM receives input from the Army's Common Missile Warning System and employs the pointer tracker to track incoming missiles. It jams the missile by using laser energy, thus causing the missile to miss the aircraft. CIRCM is to replace the Advanced Threat Infrared Countermeasures system and enable integration of laser-based infrared countermeasures onto smaller aircraft.

Program Essentials

Milestone decision authority: Army

Program office: Huntsville, AL

Prime contractor: Northrop Grumman

Contract type: CPFF/FPI/FFP (development and low-rate initial production)

Software development approach: Incremental

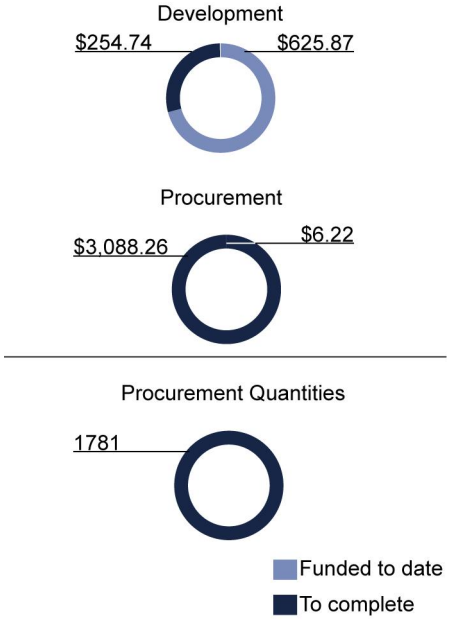
Next major milestone: Start operational testing (June 2019)

Program Performance (fiscal year 2019 dollars in millions)

	First full estimate (07/2016)	Latest (11/2018)	Percentage change
Development	$802.50	$880.60	+9.7%
Procurement	$1,895.70	$3,094.50	+63.2%
Unit cost	$2.40	$2.18	-9.2%
Acquisition cycle time (months)	115	117	+1.7%
Total quantities	1,124	1,829	+62.7%

Quantities comprise 48 development quantities and 1,781 procurement quantities.

Funding and Quantities
(fiscal year 2019 dollars in millions)



Attainment of Product Knowledge
As of January 2019

	Status at	Current Status
Resources and requirements match	**Development Start**	
• Demonstrate all critical technologies are very close to final form, fit and function within a relevant environment	●	●
• Demonstrate all critical technologies in form, fit and function within a realistic environment	○	●
• Complete a system-level preliminary design review	●	●
Product design is stable	**Design Review**	
• Release at least 90 percent of design drawings	●	●
• Test a system-level integrated prototype	●	●
Manufacturing processes are mature	**Production Start**	
• Demonstrate Manufacturing Readiness Level of at least 9, or critical processes are in statistical control	○	○
• Demonstrate critical processes on a pilot production line	●	●
• Test a production-representative prototype in its intended environment	●	●

● Knowledge attained, ○ Knowledge not attained, … Information not available, NA Not applicable

CIRCM Program

Technology Maturity, Design Stability, and Production Readiness

The CIRCM program has fully matured its six critical technologies and stabilized its design. However, 4 months into production, the program had yet to demonstrate that its critical manufacturing processes were in statistical control—an approach inconsistent with best practices.

Following development start, the program demonstrated its six critical technologies by integrating a prototype CIRCM system on an Army aircraft and testing it in a realistic environment. The program has also released 100 percent of design drawings, which indicates a stable design. Nonetheless, persistent reliability shortfalls with CIRCM units—and the design changes potentially required to remedy these shortfalls—pose risk to CIRCM's design stability.

In April 2017, the DOD Inspector General found deficiencies with the CIRCM program office's plan for demonstrating minimum reliability requirements. The Inspector General recommended that the Army revisit CIRCM performance requirements and test plans prior to production start. In response, the Army took actions that included updating system reliability requirements in the CIRCM's master test plan. This update set a new goal for the end of the system's initial operational test and evaluation phase in November 2019—achieving150 hours "mean time between operational mission failure" with an 80 percent likelihood of operating for 150 hours without a failure. Program officials stated that meeting this goal will position the CIRCM to demonstrate 214 hours mean time between operational mission failure as required for the program's June 2020 full-rate production decision.

At the time of its low-rate initial production start in September 2018, the CIRCM demonstrated 148.5 hours reliability at a 50 percent likelihood of performing reliably for 148.5 hours without failure. More recently, the program reported that it has increased CIRCM's reliability performance to 151 hours within the same 50 percent likelihood. In a September 2018 briefing it prepared for the CIRCM production decision, the Army's Aircraft Survivability Equipment project management office that oversees the CIRCM program office stated that, should CIRCM ultimately fall short of the 214-hour requirement, the consequences will likely be delayed entry into full-rate production and postponement in equipping the first Army unit with CIRCM.

The program office reported that, at the time of CIRCM's entry into low-rate initial production, the contractor, Northrop Grumman, had achieved manufacturing readiness at the level recommended by DOD guidance. That guidance calls for programs to demonstrate critical manufacturing processes on a pilot production line, but does not require statistical control of those processes until the full-rate production decision. Our prior work has found that this DOD standard falls short of the industry best practice.

Further, a June 2018 production readiness review identified concerns with (1) Northrop Grumman's ability to oversee subcontractors and (2) the pointer tracker subcontactor's ability to deliver reliable components on schedule. The Office of the Secretary of Defense expressed similar concerns and found that the pointer tracker subcontractor may be challenged to increase production from 6 units per month to the 26 per month needed to support low-rate production and testing. The Army also is tracking risks that Northrop Grumman cannot provide timely delivery of CIRCM assets for testing and that production facilities for the pointer tracker component do not have the capacity to meet demand for full-rate production. The program has mitigation efforts for both risks under way, which include, among other things, increasing repair capability at Northrop Grumman and adding to the workforce at the pointer tracker production facility. It expects to retire the testing assets risk in May 2019 and the pointer tracker production risk in October 2019.

Program Office Comments

We provided a draft of this assessment to the program office for review and comment. The program office stated that CIRCM completed all engineering and manufacturing development activities and entered production in September 2018. According to the program office, CIRCM exceeded all key performance requirements as demonstrated through rigorous laboratory, aircraft flight, and live fire missile testing. The program office also stated that the Army Test and Evaluation Command Director assessed CIRCM to be an effective system and on track to be suitable and survivable. Further, the office stated that the program has awarded a low-rate initial production contract and identified plans to begin initial operational test and evaluation in June 2019. According to the program office, it continues to aggressively manage contractor performance to facilitate a successful transition to full-rate production. Additionally, the Army stated that the CIRCM program is on track to achieve the 214-hour requirement necessary for full-rate production, and that it will reassess program strategy going forward if CIRCM does not achieve this goal.

Source: U.S. Army.

Handheld, Manpack, and Small Form Fit Radios (HMS)

Through its HMS program, the Army is procuring software-defined radios that will connect with existing radios and increase the service's communications and networking capabilities. The program continues efforts begun under the former Joint Tactical Radio System program to procure multiple radios, including the Handheld (Leader and Rifleman) and the Manpack. A subset of Manpack radios will operate with the Mobile User Objective System (MUOS)—a worldwide, multiservice Navy satellite communication system. In 2017, the Army deferred its acquisition of one-channel Rifleman radios in favor of two-channel Leader radios.

Program Essentials

Milestone decision authority: Army

Program office: Aberdeen Proving Ground, MD

Prime contractors: General Dynamics C4 Systems, Inc.; Harris Corporation; Collins Aerospace; Thales Defense and Security

Contract types: CPAF (development); FFP/IDIQ (low-rate initial and full-rate production)

Software development approach: Other (modifications to existing systems)

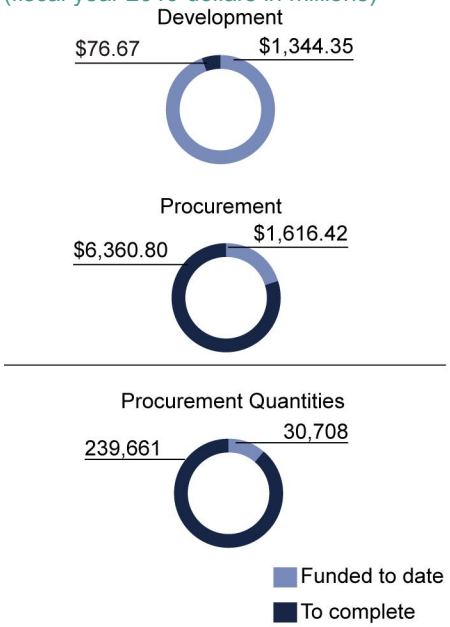
Next major milestone: Full-rate production (February 2021)

Program Performance (fiscal year 2019 dollars in millions)

	First full estimate (05/2004)	Latest (06/2018)	Percentage change
Development	$609.90	$1,421.00	+133.0%
Procurement	$10,629.60	$7,977.20	-25.0%
Unit cost	$0.03	$0.04	+2.4%
Acquisition cycle time (months)	85	124	+45.88%
Total quantities	328,674	271,202	-17.5%

Acquisition cycle time reflects development start to initial operational capability for the Manpack radio (August 2014). Total quantities comprise 833 development quantities and 270,369 procurement quantities.

Funding and Quantities
(fiscal year 2019 dollars in millions)



Attainment of Product Knowledge
As of January 2019

	Status at	Current Status
Resources and requirements match	**Development Start**	
• Demonstrate all critical technologies are very close to final form, fit and function within a relevant environment	○	NA
• Demonstrate all critical technologies in form, fit and function within a realistic environment	○	NA
• Complete a system-level preliminary design review	○	NA
Product design is stable	**Design Review**	
• Release at least 90 percent of design drawings	○	NA
• Test a system-level integrated prototype	●	NA
Manufacturing processes are mature	**Production Start**	
• Demonstrate Manufacturing Readiness Level of at least 9, or critical processes are in statistical control	○	NA
• Demonstrate critical processes on a pilot production line	○	NA
• Test a production-representative prototype in its intended environment	●	NA

● Knowledge attained, ○ Knowledge not attained, … Information not available, NA Not applicable

HMS Program

Technology Maturity, Design Stability, and Production Readiness

The HMS program office is now acquiring the Leader and Manpack radios as non-developmental items, which has precluded the program's use or tracking of any critical technologies. When the HMS program started development in 2004, it did not assess the maturity of the technologies it then deemed critical—an approach inconsistent with best practices. The program had also not fully matured its critical technologies by its 2011 production start. Instead, the program completed development of individual critical technologies in May 2015. This divergence from best practices likely contributed to the over 130 percent increase in development costs since the first full estimate.

At its 2008 critical design review, the program office had completed fewer than half of its planned design drawings, which did not meet best practices criteria for design stability. Most importantly, the program's persistent technology immaturity between 2004 and 2011, including at the critical design review, contributed to radio designs that did not fully accommodate the final form, fit, and function of critical technologies as they matured. These design shortfalls became evident as HMS radios entered testing, with testers identifying significant reliability and suitability problems with radios at that time.

With the move to a non-developmental acquisition—including their decision to shift to a two-channel radio and introduce an additional waveform—the program has developed a new test plan. The Army has started working with the contractors to perform customer and qualification testing to ensure their radios meet Army specifications. These tests will support preparations for operational testing, which is scheduled to begin in June 2020.

The HMS program has not yet finalized its assessments of contractor manufacturing readiness levels under the restructured program. To date, the HMS program office completed preliminary assessments of the Harris Corporation's and Collins Aerospace's readiness to begin production for the Manpack radio and found them to be on track to support production decisions. Further, program officials stated that they already held a follow-up assessment of Harris Corporation and plan to hold one with Collins Aerospace in June 2019. Officials reported that the program added Leader radios to the existing program in summer 2018 and that they plan to assess production readiness of Leader in late fiscal year 2019.

Other Program Issues

At present, warfighters are not able to use the MUOS waveform—which some Manpack radios will rely on—because the MUOS program is still addressing deficiencies found in initial operational testing in November 2015. Over the past several years, problems with MUOS testing have repeatedly delayed availability of the waveform. Although the program office has not identified MUOS as a critical technology, without this waveform, affected Manpack radios will be able to communicate only through legacy communications, which limit the capacity of the network. The Navy currently plans additional MUOS testing for mid-2019, but further delays to the waveform could lead to delays in fielding affected Manpack radios by March 2020, which is already delayed from initial plans by nearly 2 years. Program officials told us Manpack radio low-rate initial production will move forward regardless of the MUOS waveform performance during the Navy's testing scheduled in 2019.

Program Office Comments

We provided a draft of this assessment to the program office for review and comment. The program office provided technical comments, which we incorporated where appropriate. According to the program office, in September 2018, it added the two-channel Leader Radio capabilities to the existing Handheld indefinite-delivery/indefinite-quantity contracts with two vendors, Harris Corporation and Thales Defense & Security. The program office also said that, based on the Army Network Review, it amended the Leader Radio capability production document to address threshold radio waveforms, weight, and size. Additionally, it stated that it is also amending the Manpack capability production document to address waveform clarifications, and that this documentation is currently pending approval from Army leadership. According to the program office, these amended documents will validate and stabilize requirements consistent with current non-developmental item capabilities and the HMS acquisition strategy. The program also said that it awarded low-rate initial production delivery orders to procure 3,800 Leader radios and an additional low-rate delivery order to procure 2,258 Generation 2 Manpack radios.

Source: Northrop Grumman.

Integrated Air and Missile Defense (IAMD)

The Army's IAMD program plans to network sensors, weapons, and a common battle command system across an integrated fire control network. Its purpose is to support the engagement of air and missile threats. The IAMD battle command system will provide a capability for the Army to control and manage IAMD sensors and weapons, such as the Sentinel radar and Patriot launcher and radar, through an interface module that supplies battle management data and enables networked operations.

Program Essentials

Milestone decision authority: Under Secretary of Defense for Acquisition and Sustainment

Program office: Redstone Arsenal, AL

Prime contractor: Northrop Grumman Space & Mission Systems Corporation and Raytheon

Contract type: CPIF/CPFF/FPI (development)

Software development approach: Mixed

Next major milestone: Low-rate initial production (September 2020)

Program Performance (fiscal year 2019 dollars in millions)

	First full estimate (12/2009)	Latest (06/2018)	Percentage change
Development	$1,786.00	$3,314.20	+85.6%
Procurement	$3,844.20	$3,872.70	+0.7%
Unit cost	$19.02	$15.14	-20.4%
Acquisition cycle time (months)	80	148	+85.0%
Total quantities	296	479	61.8%

Total quantities comprise 25 development quantities and 454 procurement quantities.

Funding and Quantities
(fiscal year 2019 dollars in millions)

Attainment of Product Knowledge
As of January 2019

	Status at	Current Status
Resources and requirements match	**Development Start**	
• Demonstrate all critical technologies are very close to final form, fit and function within a relevant environment	●	●
• Demonstrate all critical technologies in form, fit and function within a realistic environment	○	●
• Complete a system-level preliminary design review	●	●
Product design is stable	**Design Review**	
• Release at least 90 percent of design drawings	○	●
• Test a system-level integrated prototype	○	●
Manufacturing processes are mature	**Production Start**	
• Demonstrate Manufacturing Readiness Level of at least 9, or critical processes are in statistical control	NA	NA
• Demonstrate critical processes on a pilot production line	NA	NA
• Test a production-representative prototype in its intended environment	NA	NA

● Knowledge attained, ○ Knowledge not attained, … Information not available, NA Not applicable

IAMD Program

Technology Maturity and Design Stability

The IAMD program has demonstrated that its four critical technologies are mature and that its system design is stable. Since our 2018 assessment, the program changed two IAMD command and control components that program officials said were reaching end-of-life and becoming unreliable. This change contributed to a 29 percent reduction in the program's total number of expected design drawings. To date, the program has completed 96 percent of its revised total number of expected design drawings, which constitutes a stable design.

IAMD battle command system (IBCS) software performance indicated the need for several improvements including more soldier training. Program officials stated that the first exercises to address this and involve warfighters in August 2017 and October 2017 were successful and that the results of 2018 tests also demonstrated progress over previous tests. At the same time, program officials acknowledged that upcoming tests will require additional refinements. Despite these mixed results, the program office is confident that software reliability is on track in part because the number of software failures the program has experienced has decreased and software deliveries are on schedule. However, our review of analysis of the test results indicated that the software continues to need several improvements, including to display and tracking capabilities.These and additional developmental tests are in preparation for a second limited user test (referred to as limited testing) in early 2020. The program is conducting a second test because it demonstrated an unsatisfactory performance of the IBCS software in 2016 during the initial limited testing.

The program office plans to begin IBCS qualification testing in mid-2019, followed by the start of the next major software build. To help further reduce the risk of IBCS deficiencies during the 2020 test, program officials stated the contractor is testing IBCS software with tactical network and weapon/sensor interfaces prior to government acceptance so that issues can be addressed before acceptance.

Production Readiness

The program plans to conduct a manufacturing readiness assessment in fiscal year 2020, in preparation for the September 2020 low-rate initial production decision. However, the program has allotted only a few months between the planned completion of the limited test in mid-2020 and the September 2020 production decision. Officials stated that the program recently began piloting an Agile software development approach, which provides opportunities for the program office to correct software deficiencies that may arise during the limited test in a shorter timeframe. This strategy does not fully account, however, for any hardware deficiencies, or for more severe software deficiencies, that may be discovered during the test. Should either of those occur, the program will likely face a choice: postpone its low-rate initial production decision to afford time to resolve deficiencies or enter low-rate initial production with system performance that, at present, it would deem unsatisfactory.

Other Program Issues

After experiencing cost growth in excess of the limits authorized in its acquisition program baseline, in December 2017 the Army received approval from the Under Secretary of Acquisition, Technology, and Logistics to restructure the program. The Army is now executing the program within revised cost and schedule parameters and, in accordance with the Under Secretary's direction, plans to update its acquisition program baseline at the time of the low-rate initial production decision in September 2020. At that point, program officials said, a new independent cost estimate will also be available.

The program also noted that hardware delays for the government software integration lab may threaten the schedule leading up to its low-rate initial production decision. According to program officials, the program has mitigated hardware shortages by implementing incremental deliveries of hardware.

Program Office Comments

We provided a draft of this assessment to the program office for review and comment. The program office provided technical comments, which we incorporated where appropriate. Program officials stated that the program has received hardware and software on schedule to support training and testing, and is continuing to develop key performance capabilities needed to support the low-rate production decision.

Source: U.S. Army.

Improved Turbine Engine Program (ITEP)

The Army's ITEP is developing a replacement engine for the Black Hawk and Apache helicopter fleets. The new engine is being designed to provide increased power, performance, and fuel efficiency; enhanced reliability; increased service life; and a lower maintenance burden. The Army plans to field the new engine in fiscal year 2027.

Program Essentials

Milestone decision authority: Army

Program office: Redstone Arsenal, AL

Prime contractor: Advanced Turbine Engine Company; General Electric Company

Contract type: FPI (design)

Software development approach: Agile development

Next major milestone: Design review (March 2020)

Program Performance (fiscal year 2019 dollars in millions)

	First full estimate (N/A)	Latest (10/2018)	Percentage change
Development	N/A	$1,913.30	N/A
Procurement	N/A	$8.322.50	N/A
Unit cost	N/A	$1.73	N/A
Acquisition cycle time (months)	N/A	103	N/A
Total quantities	N/A	5,994	N/A

ITEP received approval to enter development in January 2019, but has yet to approve a program baseline, which would identify a first full estimate. Total quantities comprise 69 development and 5,925 procurement quantities.

Funding and Quantities
(fiscal year 2019 dollars in millions)

Attainment of Product Knowledge
As of January 2019

	Status at	Current Status
Resources and requirements match	**Development Start**	
• Demonstrate all critical technologies are very close to final form, fit and function within a relevant environment	NA	●
• Demonstrate all critical technologies in form, fit and function within a realistic environment	NA	○
• Complete a system-level preliminary design review	NA	●
Product design is stable	**Design Review**	
• Release at least 90 percent of design drawings	NA	NA
• Test a system-level integrated prototype	NA	NA
Manufacturing processes are mature	**Production Start**	
• Demonstrate Manufacturing Readiness Level of at least 9, or critical processes are in statistical control	NA	NA
• Demonstrate critical processes on a pilot production line	NA	NA
• Test a production-representative prototype in its intended environment	NA	NA

● Knowledge attained, ○ Knowledge not attained, … Information not available, NA Not applicable

ITEP Program

Technology Maturity

The ITEP program office received approval to enter system development in January 2019 with five critical technologies approaching full maturity. Because ITEP had not established a baseline as of the end of January 2019, the program's attainment of product knowledge could not be assessed at development start. ITEP entered technology development in August 2016 with the award of two contracts to General Electric and the Advanced Turbine Engine Company. During this phase, the program office identified three critical technologies: the advanced inlet particle separator, compressor advanced aerodynamics, and hybrid bearings. Both contractors incorporated these technologies into their prototypes for full-engine testing. A technology readiness assessment by the Office of the Assistant Secretary of the Army (Acquistion, Logistics, and Technology) (ASA (ALT)) in June 2018 concluded that these three technologies were nearing full maturity.

After completing an independent review of preliminary designs, the Office of the Chief Systems Engineer within ASA (ALT) identified two additional engine components as critical technologies, based on the contractors' use of additive manufacturing. Additive manufacturing relies on 3D printing, and is often used in rapid prototyping and direct digital manufacturing. Because both contractors are using additive manufacturing in other programs, the review team concluded that these two technologies are also approaching full maturity. The Army plans to further mature all five critical technologies through engine testing beginning in fiscal year 2021, 2 years after the start of system development.

Design Stability

In spring 2018, the ITEP program office conducted individual preliminary design reviews with both contractors to assess each design. In August 2018, an independent review team from the Office of the Chief Systems Engineer, ASA (ALT), also assessed each design. The independent review concluded that preliminary design reviews lacked objective and quantifiable entrance criteria. In addition, it found that the design reviews of lower level elements could not fully inform the system-level review because the schedule was compressed. Despite these findings, the independent review team concluded that the program office's efforts to close deficiencies identified in the preliminary design reviews were sufficient and concluded the program was ready to proceed into system development. Following the start of system development, the program office plans to select one vendor and hold a critical design review in March 2020.

Production Readiness

An independent technical review conducted by the Under Secretary of Defense for Research and Engineering in October 2018 assessed manufacturing risk as low. This review concluded that the program demonstrated all manufacturing processes—to include additive manufacturing—in a production-relevant environment, on the basis that each contractor has used these processes in conventional manufacturing. The program currently plans to begin production in July 2024.

Other Program Issues

ITEP is highly dependent on concurrent development efforts by the engine vendors and the aircraft manufacturers, and this dependency has limited early design analysis. During technology development, both engine vendors conducted trade studies with the aircraft manufacturers to develop a proposed interface control document for their respective designs. However, the vendors could not fully assess how their designs conformed with the structural and environmental constraints of the aircraft.The program plans to have the proposed interface control document finalized during system development when the selected engine vendor and the aircraft manufacturer conducts a detailed structural and environmental analysis to support integration.

Program Office Comments

We provided a draft of this assessment to the program office for review and comment. The program office stated that it awarded the engineering and manufacturing development contract to General Electric on February 1, 2019. According the program office, it is providing incentives to the contractor to accelerate ITEP's schedule and thus allow integration into the Black Hawk and Apache helicopters and other aircraft.

Source: U.S. Army.

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, bunkers, and buildings. It is intended to provide precision attack capabilities no matter the time of day or weather conditions. JAGM will replace all Hellfire missile variants.

Program Essentials

Milestone decision authority: Army

Program office: Redstone Arsenal, AL

Prime contractor: Lockheed Martin

Contract type: FPI (development and low-rate initial production)

Software development approach: Incremental

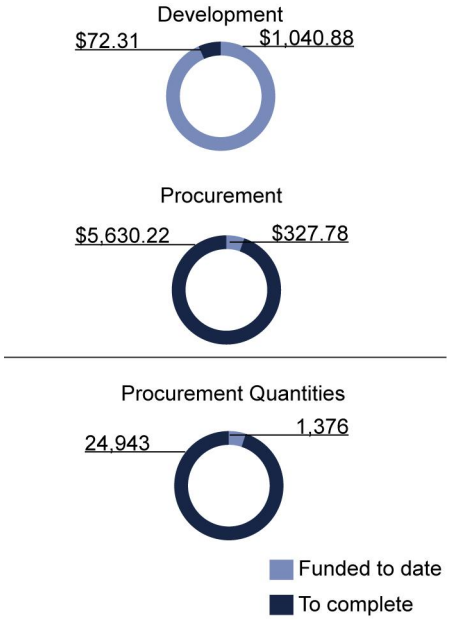
Next major milestone: Start operational test (March 2019)

Program Performance (fiscal year 2019 dollars in millions)

	First full estimate (09/2015)	Latest (12/2018)	Percentage change
Development	$1,040.60	$1,113.20	+7.0%
Procurement	$4,989.30	$5,958.00	+19.4%
Unit cost	$0.23	$0.27	+18.0%
Acquisition cycle time (months)	38	44	+15.8%
Total quantities	26,437	26,437	0.00%

Total quantities comprise 118 development quantities and 26,319 procurement quantities.

Funding and Quantities
(fiscal year 2019 dollars in millions)



Attainment of Product Knowledge
As of January 2019

	Status at	Current Status
Resources and requirements match	**Development Start**	
• Demonstrate all critical technologies are very close to final form, fit and function within a relevant environment	●	●
• Demonstrate all critical technologies in form, fit and function within a realistic environment	○	●
• Complete a system-level preliminary design review	○	○
Product design is stable	**Design Review**	
• Release at least 90 percent of design drawings	○	●
• Test a system-level integrated prototype	●	●
Manufacturing processes are mature	**Production Start**	
• Demonstrate Manufacturing Readiness Level of at least 9, or critical processes are in statistical control	○	○
• Demonstrate critical processes on a pilot production line	●	●
• Test a production-representative prototype in its intended environment	○	●

● Knowledge attained, ○ Knowledge not attained, … Information not available, NA Not applicable

JAGM Program

Technology Maturity and Design Stability

The JAGM program has matured its three critical technologies and stabilized its system design. The program office assessed all technologies—guidance seeker assembly/sensor platform, sensor software, and mission software—as mature in 2016 following a series of successful ground tests and one flight test from a MQ-1C Gray Eagle. JAGM components—including the motor, warhead, and electronics—have already been fully matured for the existing Hellfire missile, thus decreasing development and manufacturing risks.

The program reported that JAGM had a stable design at its January 2016 critical design review. Since our 2018 assessment, however, the program changed the total number of JAGM drawings, including adding 10 drawings related to updated parts, operations, and calibration procedures. This is the third year in a row in which the program has reported an increase in total design drawings. As a result of this drawing growth, we found that the program office had released 89 percent of JAGM drawings at the critical design review—an amount that falls just short of the 90 percent level recommended by best practices. We have updated our Attainment of Product Knowledge table to reflect this change in design stability from our previous assessment. The program reported that it has now released all planned drawings for JAGM.

Production Readiness

The JAGM program entered low-rate initial production in June 2018, at which time it had achieved manufacturing readiness at the level recommended by DOD guidance. That guidance calls for programs to demonstrate critical manufacturing processes on a pilot production line, but does not require statistical control of those processes until the full rate production decision. Our prior work has found that this DOD standard falls short of the industry best practice.

The program exercised contract options at the end of fiscal year 2018 and beginning of fiscal year 2019 for low-rate production totaling 1,423 missiles. A program official told us that the contractor began delivering the first lot of 373 low-rate production missiles in December 2018. The program expects 1,050 missiles from the second and third lots to be delivered by November 2021. The program plans to exercise another contract option for 796 low-rate production missiles in the fourth quarter of fiscal year 2019. Program officials told us that due to limited funding, they will purchase fewer missiles in the fourth lot than originally planned.

Since our 2018 assessment, the program office delayed its full-rate production decision by 7.5 months to allow for the collection and review of additional cost and software data. This additional information was needed to inform the full-rate production decision.

Other Program Issues

In April 2016, the Army delayed initial operational testing and evaluation for JAGM by 2 years as the AH-64 Apache helicopter's software—used to launch Hellfire missiles—required more pilot input than expected. The Apache program office has since developed and tested new platform software that will enable pilots to more easily select the full range of options. The program began integrated testing of the missile in January 2019.

The program completed 49 developmental test firings in March 2018—including 10 firings during a limited test under operational conditions—to support its June 2018 low-rate production decision. The program also identified several JAGM deficiencies during the test. According to program officials, all of the deficiencies identified have been addressed and successfully resolved, including a missile failure. They also stated that the program was able to successfully demonstrate firing two missiles consecutively in January 2019, and that they had determined that a previous missile failure was due to the incorrect sequencing of actions in the cockpit.

In December 2018, the program office reported a significant cost increase from its prior estimate, which it stated was because of changes in program requirements, changes in cost estimating methodologies, and an extended procurement schedule.

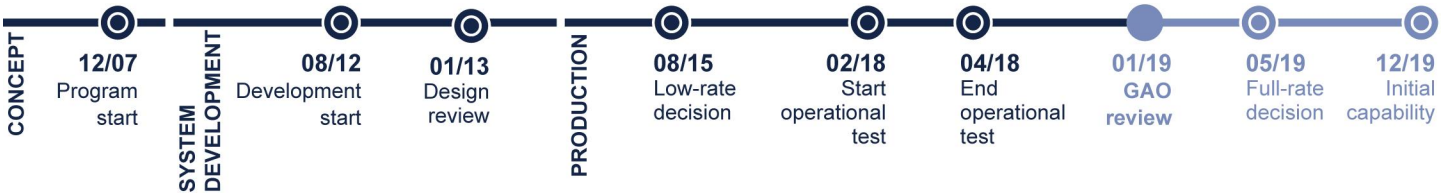
Program Office Comments

We provided a draft of this assessment to the program office for review and comment. The program provided technical comments, which we incorporated where appropriate. The program office stated that the 7.5-month delay in the full-rate production decision has not negatively affected the program in any way. The program office also said that it will use the additional cost and software information it is now gathering to better inform that full-rate production decision. At the same time, the program office reported that it remains on track to award a full-rate production contract in September 2020, as previously planned.

Source: U.S. Army.

Joint Light Tactical Vehicle (JLTV)

The Army and Marine Corps' JLTV is a family of vehicles developed to replace the High Mobility Multipurpose Wheeled Vehicle (HMMWV) for some missions. The JLTV is expected to provide protection for passengers against current and future battlefield threats, increased payload capacity, and improved automotive performance over the up-armored HMMWV variant, which includes an armor package. It is designed to be transported by air or ship. Two- and four-seat variants are planned with multiple mission configurations.



Program Essentials

Milestone decision authority: Army

Program office: Harrison Township, MI

Prime contractor: Oshkosh Defense, LLC

Contract type: FFP (production)

Software development approach: Waterfall

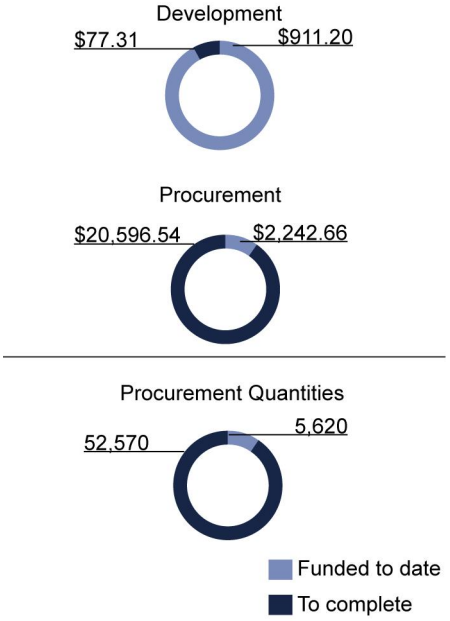
Next major milestone: Full-rate production (May 2019)

Program Performance (fiscal year 2019 dollars in millions)

	First full estimate (10/2012)	Latest (06/2018)	Percentage change
Development	$1,065.90	$988.50	-7.3%
Procurement	$24,127.20	$22,839.20	-5.3%
Unit cost	$0.46	$0.41	-10.5%
Acquisition cycle time (months)	125	144	+15.2%
Total quantities	54,730	58,306	+6.5%

Total quantities comprise 116 development quantities and 58,190 procurement quantities.

Funding and Quantities
(fiscal year 2019 dollars in millions)



Attainment of Product Knowledge
As of January 2019

	Status at	Current Status
Resources and requirements match	**Development Start**	
• Demonstrate all critical technologies are very close to final form, fit and function within a relevant environment	●	●
• Demonstrate all critical technologies in form, fit and function within a realistic environment	○	●
• Complete a system-level preliminary design review	●	●
Product design is stable	**Design Review**	
• Release at least 90 percent of design drawings	○	●
• Test a system-level integrated prototype	○	●
Manufacturing processes are mature	**Production Start**	
• Demonstrate Manufacturing Readiness Level of at least 9, or critical processes are in statistical control	○	●
• Demonstrate critical processes on a pilot production line	●	●
• Test a production-representative prototype in its intended environment	●	●

● Knowledge attained, ○ Knowledge not attained, … Information not available, NA Not applicable

JLTV Program

Technology Maturity and Design Stability

The JLTV program has matured its two critical technologies and stabilized the system design. However, the program's discovery of significant deficiencies during operational testing—and the corrections that those now require—pose risk to maintaining that design stability.

Following our 2018 assessment, the program's total number of drawings increased to accommodate needed retrofits, capability changes, and delayed release of vehicle parts that support JLTV fielding. These drawing increases caused the program to fall just short of the best practice of 90 percent design drawings released at critical design review. We have updated our Attainment of Product Knowledge table to reflect this change.

Production Readiness

Program officials conducted a manufacturing readiness assessment in September 2018 that found that the prime contractor, Oshkosh Defense, had matured production processes and demonstrated high manufacturing readiness levels. Program officials stated that, during low-rate initial production, Oshkosh significantly reduced the number of defects per manufactured vehicle, from 14.6 in September 2016 to 1.3 in September 2018. Program officials also stated that Oshkosh has provided on-time deliveries for 6 consecutive months and is now producing vehicles 2 months ahead of schedule at a rate of about 11 per day. The program is also utilizing statistical process controls to demonstrate ongoing JLTV production readiness.

In October 2018 program officials had yet to accept 39 vehicles because of deficiencies related to their Warfighter Information Network-Tactical (WIN-T) kit configuration, which provides satellite communication capabilties to the user. Program officials stated they will not accept these vehicles until Oshkosh and the WIN-T program resolve the deficiencies.

Other Program Issues

The Army and Marine Corps recently concluded operational testing for JLTV and found the vehicles to be survivable for the crew and effective for small combat and transport missions, but not operationally suitable because of their high maintenance needs, low reliability, training and manual deficiencies, and safety shortcomings. The Director, Operational Test and Evaluation, made the same findings as the Army and Marine Corps. Army operational testers recommended a conditional release to full-rate production for most of the vehicle variants, pending resolution of all suitability-related deficiencies. Marine Corps operational testers, however, found the JLTV could support their mission and advocated for the program's unconditional transition into full-rate production. However, the Army delayed the full-rate decision from December 2018 to May 2019 to review new potential requirements. According to officials, the review will not affect fielding and existing vehicles will be retrofitted if the requirements are incorporated. Officials also said they addressed some of the deficiencies discovered during testing by extending training, adjusting vehicle maintenance tasks, authenticating manuals, and correcting door and latch safety issues.

Program officials previously reported to us that the JLTV engineering drawings were inadequate to facilitate open competition for production in fiscal year 2021 and beyond. Following our 2018 assessment, program officials stated they were concerned about the quality of the engineering drawings and therefore changed management and engineering processes in order to give Oshkosh improved feedback for fixing the drawings. As a result, program officials stated that they have seen significant improvements to the drawings. Program officials stated they have validated 90 percent of the drawing modifications and anticipate completing validation by March 2019. Program officials stated the drawings are now primarily government-validated and can be used in future competitions for contracts to build or support vehicles to government specifications.

Program Office Comments

We provided a draft of this assessment to the program office for review and comment. The program office provided technical comments, which we incorporated where appropriate.

Source: U.S. Army.

Indirect Fire Protection Capability Increment 2-Intercept Block 1 (IFPC Inc 2-I Block 1)

The Army's IFPC Inc 2-I is a follow-on effort to enhance and extend the range of the first IFPC increment, which provided a short-range capability to counter threats from rockets, artillery, and mortars. IFPC Inc 2-I consists of four separate subsystems—an existing sensor, interceptor (missile), and fire control system, and a new multi-mission launcher the Army plans to develop—in three blocks. We assessed Block 1, which the Army expects will counter cruise missiles and unmanned aircraft.

CONCEPT

- **03/14** Program start
- **06/17** Design review
- **01/19** GAO review
- **05/19** Interim system - procurement contract award
- **05 - 06/19** Interim system - interoperability testing
- **07 - 9/20** Interim system - delivery

Program Essentials

Milestone decision authority: Army

Program office: Huntsville, AL

Prime contractor: Rafael Advanced Defense Systems

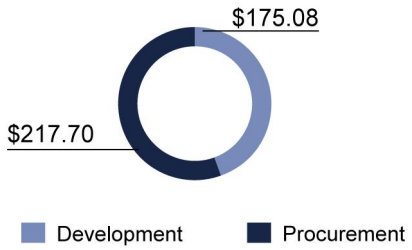
Contract type (planned): FFP (procurement of interim system)

Software development approach: NA

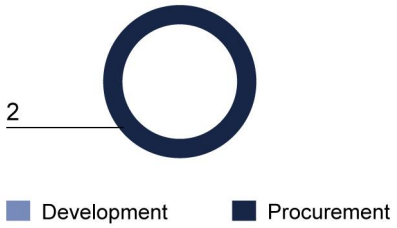
Next major milestone: Procurement contract award for interim system (May 2019)

Estimated Program Cost

(FY 2019 dollars in millions)



Planned Quantities



Note: Estimated program costs reflect fiscal year 2019 and 2020 amounts only. Planned quantities reflect Iron Dome quantities only.

Current Status

The Army is pursuing a two-phased approach to acquiring IFPC Inc 2-I Block 1 capabilities. According to program officials, the Army identified two critical problems in February 2018 as the program prepared to enter system development. Specifically, Raytheon—the developer of the original planned interceptor—determined that the interceptor would shut down during operations to avoid overheating, resulting in a failure to launch. In addition, Army warfighters expressed concerns regarding the difficult procedures needed to reload the interceptor into the launcher. As a result of these discoveries, the Army's Air and Missile Defense cross-functional team reviewed the program and recommended alternative approaches.

In addition, in response to legislation the Army certified that there is a need for an interim missile defense capability and plans to deploy two batteries capable of fixed-site cruise missile defense—the required capability of IFPC Inc 2-I—by September 30, 2020. In the short term, to meet this schedule and provide interim capabilities, the Army plans to acquire two Israeli Iron Dome batteries from Rafael. Program officials stated that they are planning interoperability experimentation for these batteries in fiscal year 2019 with the Sentinel radar and Integrated Battle Command System. Depending on the outcome of these experiments, the Army may elect to develop a new, interoperable launcher for the long term, which it would plan to field by 2023.

Attainment of Technology Maturation Knowledge

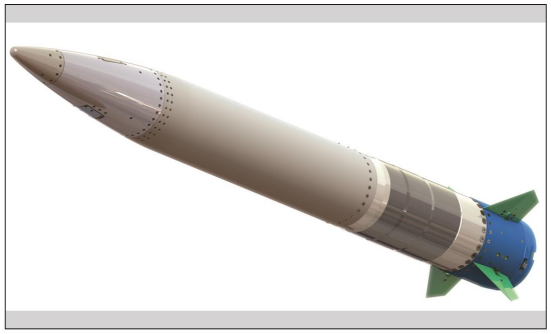
As of January 2019

Conduct competitive prototyping	○	Complete technology readiness assessment	○
Validate requirements	○	Complete preliminary design review	○

● Knowledge attained, ◐ Knowledge planned, ○ Knowledge not attained, … Information not available, NA Not applicable

Program Office Comments

We provided a draft of this assessment to the program office for review and comment. The program office provided technical comments, which we incorporated where appropriate.



Source: U. S. Army.

Precision Strike Missile (PrSM)

The Army's Precision Strike Missile (PrSM) (formerly known as Long Range Precision Fires) will be a ballistic missile designed to attack area and point targets at planned ranges of 400 kilometers or more. The Army anticipates that each PrSM missile container will hold two missiles for launch. The Army plans to design PrSM, as one of a family of munitions, to be compatible with existing M142 and M270A2 rocket launcher systems and to comply with statutory requirements for insensitive munitions and DOD policy on cluster munitions.

Program Essentials

Milestone decision authority: Army

Program office: Redstone Arsenal, AL

Prime contractors: Lockheed Martin; Raytheon

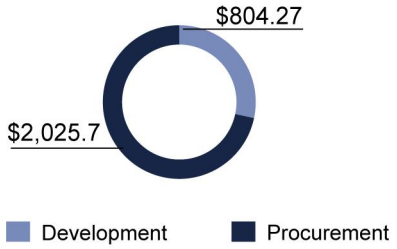
Contract type: Other transaction agreement (technology maturation and risk reduction)

Software development approach: Agile development

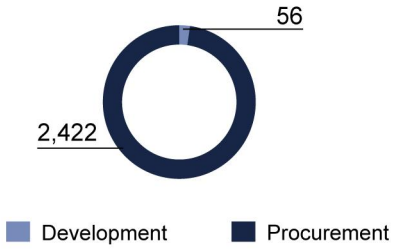
Next major milestone: Development start (June 2021)

Estimated Program Cost

(FY 2019 dollars in millions



Planned Quantities



Current Status

The Army worked to maintain PrSM competitive prototyping amidst funding constraints. The Army plans to down-select from two prime contractor teams and prototypes to one in 2021 prior to development start. According to the program office, it requested and the Army provided funding to facilitate these competitive prototyping plans.

The Army identified PrSM as a priority and has accelerated the missile's acquisition schedule to provide an early capability in fiscal year 2023. However, the missile will be usable only from the M142 launcher by then. A program official stated that legacy systems on the M270 launcher need to be updated before PrSM software can be integrated.

The Army continues to refine PrSM performance requirements. In December 2018, the Army increased the range requirement from 300 to 400 kilometers and launcher quantities from one to two.

Attainment of Technology Maturation Knowledge

As of January 2019

Conduct competitive prototyping	●	Complete technology readiness assessment	◐
Validate requirements	◐	Complete preliminary design review	●

● Knowledge attained, ◐ Knowledge planned, ○ Knowledge not attained, … Information not available, NA Not applicable

Program Office Comments

We provided a draft of this assessment to the program office for review and comment. The program office provided technical comments, which we incorporated where appropriate. Program officials stated that the Army continues to maintain competition and accelerate the program. According to the program office, the current timeline reflects acceleration of the approved schedule, in accordance with Army leadership's desire to field a capability in fiscal year 2023, complete testing in fiscal year 2024, and begin full rate production. The program office said that it continues efforts to accelerate PrSM's integration with the M270 launcher.