



February 2022

MISSILE DEFENSE

Addressing Cost Estimating and Reporting Shortfalls Could Improve Insight into Full Costs of Programs and Flight Tests

GAO Highlights

Highlights of [GAO-22-104344](#), a report to congressional committees

Why GAO Did This Study

Since 2002, MDA received over \$174 billion to develop a system-of-systems known as the Missile Defense System to detect, track, and defeat enemy missiles. GAO has long reported on MDA's progress in working to improve the system's costs, schedules, and performance.

Congress included provisions in legislation for GAO to assess MDA's progress toward meeting its acquisition goals. This report assesses the extent to which MDA's program and flight test cost (1) estimates align with GAO's leading practices for cost estimating and (2) information is transparent and traceable when reported to Congress. GAO reviewed MDA's cost estimates and baseline reporting for the seven most recently established programs, seven flight test cost estimates prepared under the newly established cost model, and flight test information in mandated reports to Congress. GAO also interviewed officials within DOD, MDA, and the military services.

What GAO Recommends

Congress should consider reviving MDA's semiannual requirement to report on flight test costs, and consider requiring clarification on MDA's flight test reporting methodology. GAO is making six new recommendations to DOD to help improve the completeness and accuracy of MDA's program and flight test cost estimates and reporting. DOD concurred with four recommendations but did not concur with two recommendations. GAO continues to believe the recommendations are valid, as discussed in the report.

View [GAO-22-104344](#). For more information, contact John D. Sawyer at (202) 512-4841 or SawyerJ@gao.gov.

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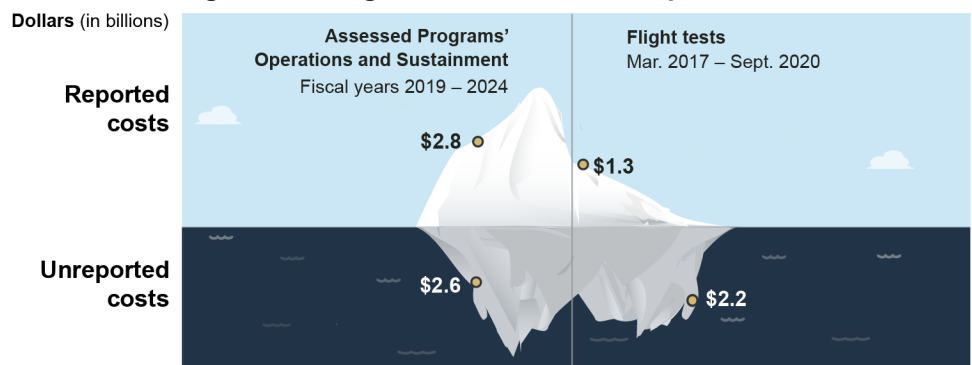
What GAO Found

The Department of Defense's (DOD) Missile Defense Agency (MDA) is continuing efforts to deliver systems to the warfighter that will protect against enemy missiles. However, shortfalls persist with MDA's program and flight test cost estimates and reporting.

Program cost estimates. MDA continues to omit the military services' operations and sustainment costs from the program life-cycle cost estimates, as depicted below. By omitting these costs, MDA limits decision-makers' insight into the full financial commitments needed for affordability and funding determinations. In the report, GAO outlines actions MDA can take to account for these costs consistent with a 2013 recommendation with which DOD partially concurred.

Flight test cost estimates. Accuracy issues linger with MDA's flight test cost estimates that could skew the agency's annual \$1.3 billion funding request, such as not being regularly updated with actual costs. However, MDA is taking steps to improve these cost estimates by using a new cost model, among other things.

Some MDA Program and Flight Test Costs Are Unreported



Source: GAO analysis of Missile Defense Agency (MDA) data. | GAO-22-104344

Program cost reporting. MDA continues to adjust program baselines without clear traceability over time. MDA also forgoes recurrent comparisons to the original baseline. Such adjustments and omissions impede decision-makers' awareness of each program's cost performance and total system cost. In the report, GAO notes actions MDA can take to address the traceability of program baselines consistent with a 2013 recommendation with which DOD concurred.

Flight test cost reporting. Congress required MDA to report on flight test costs, but we found the information lacking due to the agency's reporting methodology. MDA only accounted for about \$1.3 billion of at least \$3.5 billion in funding the agency requested for flight testing between March 2017 and September 2020. Moreover, the reporting requirement ended in December 2021. Without further reporting on complete flight test costs, Congress does not have information needed to facilitate holding the agency accountable for its spending.

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Abbreviations

Aegis BMD	Aegis Ballistic Missile Defense
AN/TPY-2	Army Navy/Transportable Radar Surveillance and Control Model-2
AWS	Aegis Weapon System
BAR	Ballistic Missile Defense Accountability Report
C2BMC	Command, Control, Battle Management, and Communications
CAPE	Cost Assessment and Program Evaluation
DOD	Department of Defense
FEX	Flight Test Experiment Other
FTM	Flight Test Aegis Weapon System
FTT	Flight Test THAAD Weapon System
FTX	Flight Test Other
GM BVT	Ground-based Midcourse Defense Weapon System Booster Vehicle Test
GMD	Ground-based Midcourse Defense
IMTP	Integrated Master Test Plan
JCE	joint cost estimate
LRDR	Long Range Discrimination Radar
MDA	Missile Defense Agency
MDS	Missile Defense System
NDAA	National Defense Authorization Act
SBX	Sea Based X-Band
SM-3	Standard Missile-3
THAAD	Terminal High Altitude Area Defense
WBS	work breakdown structure

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February 2, 2022

Congressional Committees

From 2002 through 2021, the Department of Defense’s (DOD) Missile Defense Agency (MDA) has received over \$174 billion to develop a system-of-systems known as the Missile Defense System (MDS) for the purpose of detecting, tracking, and defeating enemy ballistic missiles.¹ MDA plans to spend an additional \$38 billion through fiscal year 2025—about \$10 billion annually—to continue its efforts.² MDA’s flight testing is critical for these efforts, but it has continued to be volatile with a decade-long trend of not being completed as planned.

Over the years, we have reported on MDA’s progress developing and testing the MDS; however, we have faced challenges assessing the associated costs due to a number of shortcomings in the agency’s cost information, such as its comprehensiveness, accuracy, transparency, and traceability.³ Accordingly, we have made a variety of recommendations and Congress has passed several laws aimed at improving MDA’s cost estimates and reporting. While MDA has taken some actions, several recommendations remain unimplemented, and the challenges we identified persist. The comprehensiveness, accuracy, transparency, and traceability of MDA’s cost information are necessary to ensure that such investments provide the best value to the taxpayer in light of increasingly limited resources. Moreover, MDA’s cost information serves as the foundation for identifying the necessary investment in each system that comprises the MDS to ensure its long-term viability and transferability of ownership to the military services.

¹MDA has renamed its system-of-systems from the Ballistic Missile Defense System (BMDS) to the MDS to reflect the recent broadening of the system’s focus to include non-ballistic missile threats, such as hypersonic and cruise missiles.

²We used the planned amounts for fiscal year 2022 through 2025 from MDA’s budget submission for fiscal year 2021 since the amounts for these years were not included in MDA’s budget submission for fiscal year 2022.

³For the purposes of this report, we use several terms that we define as follows: cost information is *comprehensive* if it includes all possible costs, *accurate* if sound cost estimating practices are used, *transparent* if fully disclosed, and *traceable* if consistent or reconcilable over time.

Since 2002, Congress has included provisions in various National Defense Authorization Acts (NDAA) for GAO to prepare annual assessments of MDA's progress toward meeting its acquisition goals, including any findings and recommendations on missile defense acquisition programs and accountability that the Comptroller General considers appropriate.⁴ To date, we have issued 18 reports, with our most recent report issued in April 2021.⁵ This report, for which we conducted work under the same authority, focuses on the extent to which MDA's program and flight test cost: (1) estimates align with GAO's leading practices for cost estimating and (2) information is transparent and traceable over time when reported to Congress.

To assess the extent to which MDA's program and flight test cost estimates align with selected leading practices within GAO's *Cost Estimating and Assessment Guide*, we chose a non-generalizable sample of estimates, collected relevant documentation, prepared records of analysis with our determinations, and provided our records of analysis to MDA for review and comment.⁶ For program cost estimates, we selected seven of MDA's most recently established baselines from its 2019 baseline reporting—known as the Ballistic Missile Defense System Accountability Report (BAR)—and assessed them against the leading practices of a comprehensive cost estimate.⁷ For flight test cost estimates, we chose a total of seven flight tests from MDA's fiscal year 2021 test plan—known as the Integrated Master Test Plan (IMTP)—with a planned execution date between fiscal years 2020 and 2022 and

⁴National Defense Authorization Act for Fiscal Year 2002, Pub. L. No. 107-107, § 232(g) (2001). The National Defense Authorization Act for Fiscal Year 2012, Pub. L. No. 112-81, § 232(a) (2011), as amended by the National Defense Authorization Act for Fiscal Year 2016, Pub. L. No. 114-92, § 1688 (2015), extended GAO's reviews through fiscal year 2020. The William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021, Pub. L. No. 116-283, § 1644 (2021), further extended GAO's reviews through fiscal year 2025 and added *emerging issues* among the items to review, as warranted.

⁵GAO, *Missile Defense: Fiscal Year 2020 Delivery and Testing Progressed, but Annual Goals Unmet*, [GAO-21-314](#), (Washington, D.C.: Apr. 28, 2021).

⁶GAO, *Cost Estimating and Assessment Guide: Best Practices for Developing and Managing Program Costs*, [GAO-20-195G](#) (Washington, D.C.: Mar. 12, 2020). For more detailed information on our scope and methodology, see Appendix I.

⁷We omitted the Targets and Countermeasures program from our sample selection because it is unlike MDA's other programs, in that it solely supports testing. In 2021, MDA renamed its baseline reporting from the BAR to the Missile Defense Accountability Report (MDAR) to align with the broadened focus noted above.

assessed them against the leading practices for an accurate cost estimate.⁸

In addition, we reviewed relevant legislation, policies, and guidance for cost estimating, and held meetings with MDA officials from the Cost and Test Directorates, as well as with program officials, to discuss pertinent cost estimating practices. We also corresponded with DOD officials, including the Office of the Under Secretary of Defense for Research and Engineering and Acquisition and Sustainment, Office of Cost Assessment and Program Evaluation (CAPE), and the military services (Air Force, Army, and Navy) to discuss operation and sustainment costs.

To assess the extent to which the program cost information that MDA reports to Congress is traceable over time, we examined the program life-cycle cost estimates in each annual baseline report for the seven selected programs to determine the traceability from year-to-year. We also reviewed whether MDA included a comparison to the original baseline in each baseline report, as set forth in law.⁹ For reported flight test costs, we reviewed the seven reports MDA provided to Congress between March 2017 and September 2020 in response to the semi-annual reporting requirement outlined in the NDAA for fiscal year 2017.¹⁰ To assess the transparency of the flight test costs included in these reports to Congress, we reviewed the test plans and cost estimates MDA used to support its budget requests over the same time frame. In addition, we reviewed relevant legislation, policies, and guidance and corresponded with MDA officials to clarify information, where needed.

We conducted this performance audit from May 2020 to February 2022 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.

⁸GAO-20-195G. The flight test cost estimates from this test plan (IMTP 21.1) represent the first full implementation of MDA's new cost model.

⁹10 U.S.C. § 225(c)(2)(B)(ii). All legal citations are applicable to the audit timeframe.

¹⁰National Defense Authorization Act for Fiscal Year 2017, Pub. L. No. 114-328, § 1695 (2016).

Background

MDA is developing a system-of-systems comprised of land-, sea-, and space-based systems located across the globe to function as a single system known as the MDS. The MDS is designed to defend against enemy missiles of various ranges, speeds, and performance characteristics. To remain responsive to rapidly evolving threats, MDA incrementally improves each system via multiple subparts—blocks, configurations, increments, or spirals—that are acquisition programs (see table 1).¹¹ Hereinafter, we use the terms system and program to refer to an MDS system and system subpart, respectively (e.g., the C2BMC system versus the C2BMC Spiral 8.2-5 program).

Table 1: Overview of the Missile Defense Agency’s (MDA) Systems and Programs

System	Description	Number of programs
Aegis Ashore	Land-based system that uses a radar, command and control, and Standard Missile-3 (SM-3) interceptors.	3
Aegis Ballistic Missile Defense SM-3 Interceptors	Interceptors capable of identifying, tracking, and defeating enemy missiles.	3
Aegis Weapon System	Land- and ship-based capabilities with a radar, command and control, and SM-3 interceptors.	3
Army Navy/Transportable Radar Surveillance and Control Model-2	Land-based, transportable, high-resolution, X-band radar.	4
Command, Control, Battle Management, and Communications	Globally deployed software and hardware—workstations, servers, and network equipment—that integrates missile defense systems for a coordinated response.	5
Ground-based Midcourse Defense (GMD)	Land-based, stationary system that uses launch, communications, fire control, and interceptors with a booster and kill vehicle.	3
Long Range Discrimination Radar	Land-based, stationary, S-band radar.	1
Sea-based X-Band Radar	Sea-based, mobile radar.	2
Terminal High Altitude Area Defense	Land-based, mobile system that uses interceptors, launchers, a radar, and fire control and communications.	3
Upgraded Early Warning Radar	Land-based, stationary, phased-array radar.	3

Source: GAO analysis of MDA data. | GAO-22-104344

Note: The systems and number of programs listed in this table are based on MDA’s baseline reporting for fiscal years 2010 through 2021. This table does not include all of the systems and associated programs for the Missile Defense System.

¹¹The BMDS, now known as the MDS, is an overarching “system of systems” that is a major defense acquisition program (MDAP), which is defined in 10 U.S.C. § 2430 and implemented by DOD in instruction and guidance commonly referred to as its 5000 series. In this report, we distinguish the overarching system/MDAP from the underlying systems (also called “elements” by MDA, e.g., Terminal High Altitude Area Defense) and the programs that comprise those systems, as noted in table 1.

MDA is required by law to transfer ownership (i.e., the acquisition and total obligation authority) of certain systems to the designated military service (e.g., Air Force, Army, Navy) when there has been a decision to enter into production and deployment pursuant to DOD guidance.¹² Once transferred, the designated military service becomes responsible for the ownership costs, and operating and sustaining the system over the duration of its life cycle.¹³ We previously reported that such transfers have not occurred due to various challenges and unresolved military services' concerns regarding affordability.¹⁴ Despite the military services' affordability concerns and MDA's request to retain its current responsibilities for these systems in perpetuity, Congress has further directed that such transfers occur no later than the President's Budget Submission for Fiscal Year 2023 (between Jan. 3 and Feb. 7, 2022).¹⁵

Cost Estimating

MDA uses life cycle cost estimates (hereinafter referred to as program cost estimates) to identify the necessary investment in each program and support funding needs outlined in its annual budget request.¹⁶ Generally, a program cost estimate is the projected sum total of expected costs for development, production, operations and sustainment, and disposal. To prepare program cost estimates, MDA uses program-specific cost models and its *Cost Estimating and Analysis Handbook*, which in 2014 we found

¹²National Defense Authorization Act for Fiscal Year 2018, Pub. L. No. 115-91, § 1676(b) (2017), as amended by John S. McCain National Defense Authorization Act for Fiscal Year 2019, Pub. L. No. 115-232, § 1679 (2018), and William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021, Pub. L. No. 116-283, § 1643 (2020). See also 10 U.S.C. § 2366(e)(8). DOD direction also states that MDA transfers the responsibility for production and operations and sustainment to a military service.

¹³Operation and sustainment include supplies, maintenance, transportation, personnel, training, safety, and other supportability considerations. DOD's *Funding Responsibilities for Ballistic Missile Defense System Elements* memorandum, dated June 10, 2011, states that MDA must bear the operation and sustainment costs for the first two years after a system is initially fielded, and thereafter, it is the military service's responsibility, unless otherwise specified in a transfer agreement between MDA and the military service. MDA retains responsibility for the MDS-specific equipment for the life of the system.

¹⁴GAO, *Missile Defense: Assessment of Testing Approach Needed as Delays and Changes Persist*, [GAO-20-432](#) (Washington, D.C.: July 23, 2020).

¹⁵Pub. L. No. 115-91, § 1676(b), as amended by Pub. L. No. 115-232, § 1679 and Pub. L. No. 116-283, § 1643.

¹⁶The budget request is a formal government process to provide funding for federal agencies each fiscal year—October 1 through September 30.

generally aligns with GAO's *Cost Estimating and Assessment Guide*.¹⁷ MDA also prepares cost estimates for flight tests each fiscal year to support its budget request.¹⁸ In 2017, we found issues with MDA's process for preparing flight test cost estimates, as well as a lack of policy and guidance.¹⁹ However, MDA has since revised its process for preparing flight test cost estimates and issued guidance, which we explain in more detail later in this report.

Flight Testing

MDA uses flight tests as part of its efforts to: (1) determine whether a system is properly designed, built, and integrated; (2) understand a system's performance, to include capabilities and limitations; and (3) support next steps and decisions. MDA's flight tests are developmental, operational, or a combination of both, the former verifying a system's design is built correctly and the latter demonstrating the system can successfully accomplish its mission in the hands of the warfighter under realistic conditions. There are intercept and non-intercept flight tests. An intercept flight test involves a system actively engaging one or more threat-representative targets. A non-intercept flight test is used to assess certain aspects of a system's performance, with or without a target. An example of a non-intercept flight test is flying a modified interceptor to evaluate engineering changes or design upgrades. In December 2016, Congress mandated that MDA provide reports on flight test costs every 180 days; this reporting requirement ended in December 2021.²⁰

¹⁷MDA, *Cost Estimating and Analysis Handbook* (Jun. 19, 2012) and *Missile Defense: Cost Estimating Practices Have Improved, and Continued Evaluation Will Determine Effectiveness*, [GAO-15-210R](#) (Washington, D.C.: Dec. 12, 2014). MDA updated its *Cost Estimating and Analysis Handbook* in July 2021.

¹⁸MDA officials told us that they use the same cost estimating methodologies outlined in the agency's *Cost Estimating and Analysis Handbook* for flight tests.

¹⁹GAO, *Missile Defense: Some Progress Delivering Capabilities, but Challenges with Testing Transparency and Requirements Development Need to Be Addressed*, [GAO-17-381](#) (Washington, D.C.: May 30, 2017).

²⁰Pub. L. No. 114-328, § 1695 and the National Defense Authorization Act for Fiscal Year 2020, Publ. L. No. 116-92, § 1702(b)(9) (2019). This legislation required MDA to report from March 2017 through December 2021 on the outcome and costs for all flight tests planned to occur during each 180-day notification period, and to identify funds expended on an attempted flight test and a cost estimate for a retest.

Baseline Reporting

MDA has six different baselines—starting point and parameters against which to measure progress—one of which is resource (or cost) and another is test (see table 2).²¹

Table 2: Six Baselines in MDA’s Annual Baseline Reporting

Baseline	Description
Contract	Timeline for MDA contracts and the steps in the contracting process from the request for proposal through proposal receipt, completion of negotiations, contract award, and contract execution.
Operational capacity	List of Missile Defense System (MDS)-level hardware and software available to the warfighter for operational use.
Resource (cost)	Expected investment for the delivery of an MDS product and presented as follows: <ul style="list-style-type: none">• A program cost estimate, including research and development, procurement, military construction, operations and sustainment, and disposal.• Unit costs for the delivery of each item (e.g., interceptors, launchers, etc.).• A time-phased estimate of the program’s life cycle cost estimate showing the total budget for prior years and annual budget for future years.
Schedule	Timeline for key product development milestones and tasks, such as important acquisition decisions and product deliveries.
Technical	Configuration-controlled repository of specifications and interface requirements, along with guidance and documentation used to build and assess the MDS. Also, a list of current, enduring, and future capability needs, as prioritized by the warfighter, and knowledge points.
Test	Schedule of major flight and ground tests, key modeling and simulation events, and the primary goals associated with each.

Source: GAO analysis of Missile Defense Agency (MDA) documentation. | GAO-22-104344

As required by law, MDA reports these baselines to Congress annually in the Ballistic Missile Defense System Accountability Report (BAR) and integrated master test plan (IMTP) (hereinafter referred to as the baseline reporting and test plan, respectively).²² Statute also sets forth that every iteration of MDA’s baseline reporting include a cost estimate for each program, as well as comparisons to the cost estimate reported in the last baseline reporting and the initial baseline.²³ In 2013, we made two priority

²¹MDA Directive 5013.01, *Acquisition Management* (Sept. 30, 2019).

²²Pub. L. No. 112-81, § 231, as amended, codified at 10 U.S.C. § 225, requires the MDA Director to establish and maintain an acquisition baseline for each program entering engineering and manufacturing development, and production and deployment. This law details the specific content MDA must include in the acquisition baseline.

²³10 U.S.C. § 225(c). MDA has interpreted this statute’s reference to “initial baseline” as either the first baseline set—which we call the original baseline for the purposes of this report—or a revised baseline—which MDA refers to as a revised initial baseline.

recommendations related to the transparency of MDA's program baselines, one specific to accounting for all program life-cycle costs, including the military services' operation and sustainment, and the other on ensuring their traceability to enable meaningful comparisons over time.²⁴ We outline our assessment of MDA's progress in meeting the intent of these priority recommendations later in this report.

MDA's test plan supports the agency's funding request for testing each fiscal year and outlines upcoming testing, including the test name, test type, any targets, and the fiscal year quarter the test is scheduled for execution. The test plan is finalized and signed annually and midway through the year MDA updates the test plan with vetted and approved changes. We have made a variety of recommendations since 2011 to improve MDA's test plan, but we do not address MDA's progress in meeting these recommendations in this report.²⁵

Program and Flight Test Cost Estimates Are Improving but Continue to Lack Comprehensiveness and Accuracy, Respectively

While MDA's program and flight test cost estimates are improving, we found that comprehensiveness remains an issue with the former and accuracy issues persist with the latter. Specifically, MDA has two prominent issues related to the comprehensiveness of its program estimates: (1) omission of military services' operations and sustainment costs and (2) work breakdown structure (WBS) inconsistencies. MDA's flight test cost estimates are not accurate and can misrepresent the amount of funding the agency needs for flight tests each year. Whether for a program or flight test, decision makers need comprehensive and accurate cost estimates to render informed determinations on affordability, prioritization, and funding.

²⁴GAO, *Missile Defense: Opportunity to Refocus on Strengthening Acquisition Management*, [GAO-13-432](#) (Washington, D.C.: Apr. 26, 2013). GAO identifies recommendations as "priority" because they are important to helping save the federal government money, aiding in congressional decision-making, and improving government programs, among other things. The Comptroller General of the United States provides an annual report on priority recommendations to encourage action. The most recent annual report was released in August 2021. See *Priority Open Recommendations: Department of Defense*, [GAO-21-522PR](#) (Washington, D.C.: Aug. 2, 2021).

²⁵GAO, *Missile Defense: Actions Needed to Improve Transparency and Accountability*, [GAO-11-372](#) (Washington, D.C.: Mar. 24, 2011); [GAO-13-432](#); *Missile Defense: Some Progress Delivering Capabilities, but Challenges with Testing Transparency and Requirements Development Need to Be Addressed*, [GAO-17-381](#) (Washington, D.C.: May 30, 2017); *Missile Defense: The Warfighter and Decision Makers Would Benefit from Better Communication about the System's Capabilities and Limitations*, [GAO-18-324](#) (Washington, D.C.: May 30, 2018); and [GAO-20-432](#).

Additional Work Remains to Ensure Program Cost Estimates Are Comprehensive

MDA has taken steps to improve its program cost estimates since our 2011 and 2013 assessments, but its estimates are still not comprehensive.²⁶ In 2014, we reported that MDA had issued a *Cost Estimating and Analysis Handbook* that generally comports with the tenets of GAO's *Cost Estimating and Assessment Guide*.²⁷ According to GAO's *Cost Estimating and Assessment Guide*, for a cost estimate to be comprehensive, it must (1) include all life-cycle costs regardless of funding source, (2) be based on an up-to-date and reasonable technical baseline, (3) be based on a WBS and have an associated dictionary to ensure costs are neither omitted nor double-counted, and (4) document all cost-influencing ground rules and assumptions.²⁸ For this report, we assessed seven MDA program cost estimates against the leading practices for a comprehensive estimate and found a marked improvement.²⁹ All programs in this assessment attained an overall rating of substantially met as compared to the programs in our prior assessment that were rated as partially met. However, many of the current program cost estimates also fell short—partially or minimally met—in the leading practices specific to including all life-cycle costs and using a WBS and associated dictionary (see fig. 1).

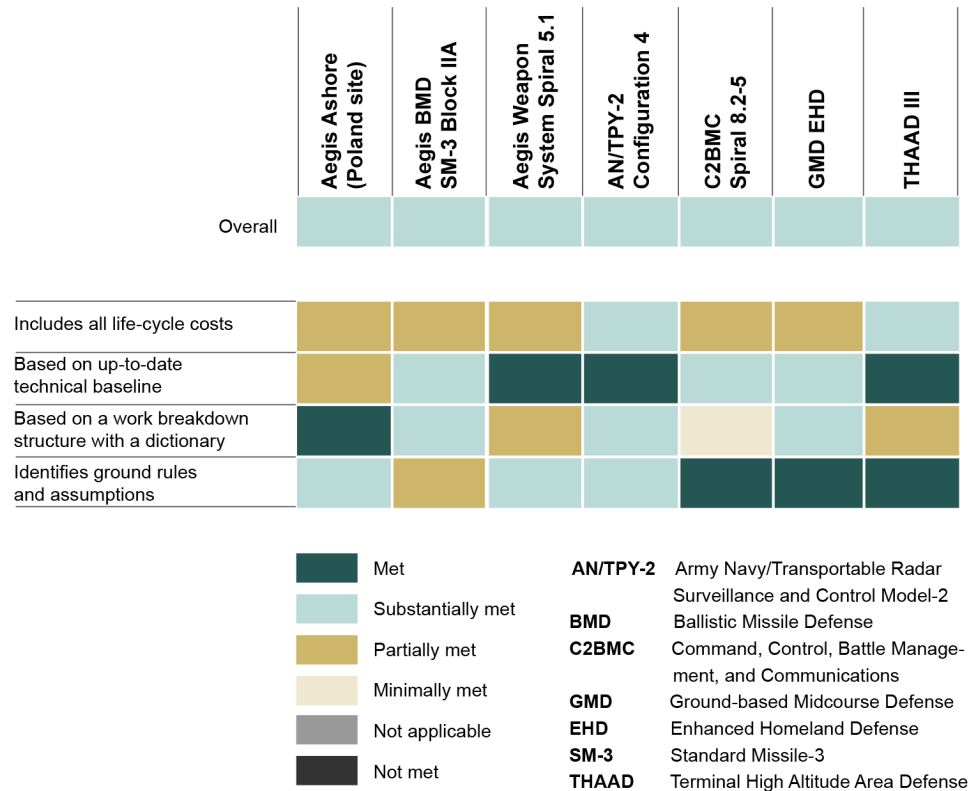
²⁶[GAO-11-372](#) and [GAO-13-432](#).

²⁷[GAO-15-210R](#).

²⁸[GAO-20-195G](#).

²⁹The seven programs we assessed for this report are not the same programs we assessed in our 2011 report ([GAO-11-372](#)).

Figure 1: Selected MDA Program Cost Estimates Assessed against GAO’s Leading Practices for Comprehensiveness



Source: GAO analysis of Missile Defense Agency (MDA) data. | GAO-22-104344

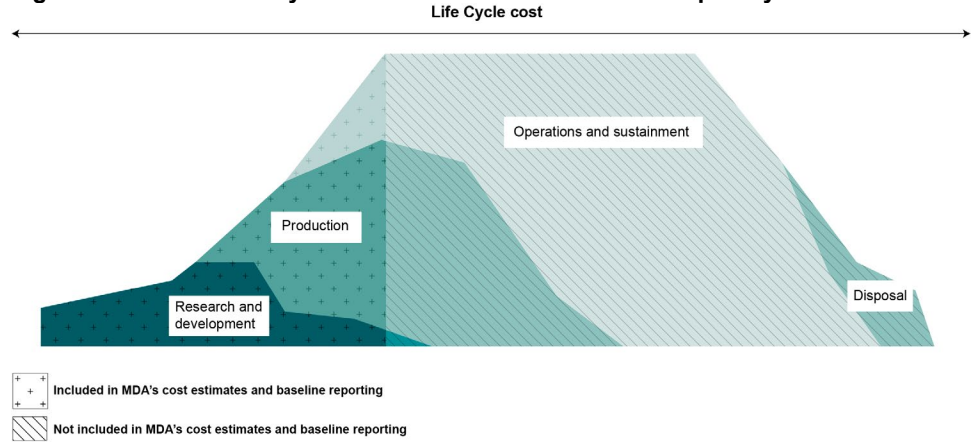
Note: The leading practices for a comprehensive cost estimate are set forth in GAO’s *Cost Estimating and Assessment Guide* (GAO-20-195G). We used the following scale for the ratings we assigned to each leading practice: not met = 1; minimally met = 2; partially met = 3; substantially met = 4; and met = 5. We took the average of the ratings for the leading practices to determine the overall rating for comprehensiveness as follows: not met = 1.0 to 1.4; minimally met = 1.5 to 2.4; partially met = 2.5 to 3.4; substantially met = 3.5 to 4.4; and met = 4.5 to 5.0. Our ratings for the *includes all life-cycle costs* leading practice for the AN/TPY-2 Configuration 4 and THAAD III programs are based on joint cost estimates for operations and sustainment costs with the Army.

Operations and Sustainment Costs Omitted

MDA continues to omit the operations and sustainment costs borne by the military services from the agency’s program cost estimates and baseline reporting. However, the agency’s *Cost Estimating and Analysis Handbook* states that a fully comprehensive cost estimate captures the complete technical and programmatic scope of the work to be performed

and addresses all applicable life-cycle phases and costs.³⁰ As noted earlier, each program is a subpart of an MDS system, and both MDA and the military services have operations and sustainment costs for most of the systems, the former as the developer and overarching manager of the MDS and the latter as the user.³¹ Accounting for all operations and sustainment costs is critical because, as we previously reported, these costs can represent up to 70 percent of a system's cost over its entire life cycle, as notionally depicted in figure 2.³²

Figure 2: Notional Life Cycle Cost Profile for an MDA-Developed System



Source: GAO analysis of Department of Defense and Missile Defense Agency (MDA) data. | GAO-22-104344

Note: This notional depiction is based on a typical funding profile from GAO's *Cost Estimating and Assessment Guide* (GAO-20-195G) and DOD's 2011 *Funding Responsibilities for Ballistic Missile Defense Systems Elements* memorandum. MDA is required to fund certain items for the first two years of operations and sustainment and thereafter, it is the responsibility of the respective military service unless otherwise specified in a transfer agreement between MDA and the military service.

³⁰MDA, *Cost Estimating and Analysis Handbook*, (Jun. 19, 2012). MDA revised this handbook in July 2021. While contrary to what we found during this review, the handbook now specifies that all life-cycle costs be included in a cost estimate and reported to decision makers regardless of the funding source.

³¹See National Defense Authorization Act for Fiscal Year 2014, Pub. L. No. 113-66, § 231 (2013), codified at 10 U.S.C. § 225(e). An MDA program with a designated lead military service can transfer ownership from MDA to the military service at the start of production—Milestone C or equivalent decision. DOD's June 10, 2011, memorandum entitled *Funding Responsibilities for Ballistic Missile Defense System Elements* describes transfer agreements between MDA and the military services and sets forth each entity's respective funding responsibilities.

³²GAO, *Missile Defense: Actions Needed to Improve Planning and Cost Estimates for Long-Term Support of Ballistic Missile Defense*, GAO-08-1068 (Washington, D.C.: Sept. 25, 2008).

Without a full accounting of the operations and sustainment costs, decision makers and others lack a complete understanding of each program's—and ultimately system's—costs. For instance, Congress and DOD need a complete understanding of the life-cycle costs to adjust priorities and funding as needed, to cancel a program in the event costs become untenable, and to understand the financial commitments levied on the military services when transfers of ownership occur. An official from DOD's Office of Cost Assessment and Program Evaluation (CAPE) said that this information could also assist in the preparation of independent cost estimates for the programs that comprise the MDS systems, as now required by DOD policy.³³

Despite the importance of accounting for all life-cycle costs, we found that neither MDA's cost estimates nor baseline reporting capture the military services' operations and sustainment costs. In our 2013 assessment we noted this same finding, and at that time made a priority recommendation that MDA account for these costs.³⁴ In fiscal year 2014, Congress mandated that MDA include “a description of the military services' operations and sustainment functions and costs” in its baseline reporting.³⁵ MDA officials told us they meet this requirement by including a statement in the baseline reporting that the military services' costs are omitted. Thus, MDA does not identify the military services' operations and sustainment costs.³⁶ Consequently, MDA continues to account only for the MDA-borne costs, leading to understated life-cycle costs in MDA's cost estimates and baseline reporting.

When we attempted to identify the military services' operations and sustainment costs, we found that there were multiple and disparate sources not connected in any centralized way, which made quantifying

³³DOD, Directive-type Memorandum (DTM)-20-002, *Missile Defense System Policies and Governance* (Mar. 13, 2020). An independent cost estimate, per GAO's *Cost Estimating and Assessment Guide*, is considered the best and most reliable method for validating a program's cost estimate because it is less burdened with organizational bias, tends to incorporate adequate risk, and helps ensure that all requirements are captured. Thus, it tends to be more conservative and often forecasts higher costs.

³⁴[GAO-13-432](#).















³⁵Pub. L. No. 113-66, § 231, codified at 10 U.S.C. § 225(e).

³⁶In the 2020 BAR, MDA does list the dollar value for some operations and sustainment costs shifted to the Air Force for the Long Range Discrimination Radar Configuration 1 program. However, this is the only instance wherein MDA identifies any specific dollar values for these costs in its baseline reporting.

these costs difficult or, in some instances, impossible. For example, one source was a joint cost estimate (JCE), which according to MDA policy, is a cost estimate for operations and sustainment jointly prepared by MDA and a military service.³⁷ MDA policy indicates that a JCE is required for any system or program with a designated lead military service, but it does not specify whether a JCE is required for both a system *and* its underlying programs or whether one may be used in lieu of the other. Congress, DOD, or other oversight entities may be unaware of the JCEs as a source for some costs, as we initially were, because MDA does not include citations to the JCEs in its program cost estimates or baseline reporting. Rather, MDA provided the JCEs prepared to date to us when we requested more specific information on the military services' operations and sustainment costs. Nonetheless, as shown in figure 3, we found that MDA has not prepared a program-specific JCE or updated a system JCE for most of the programs we assessed that should have a JCE.

³⁷MDA Directive 5010.19, *Ballistic Missile Defense System Capability Transition and Transfer Policy* (May 2014).

Figure 3: Status of Joint Cost Estimates (JCE) to Capture the Military Services' Operations and Sustainment Costs for Missile Defense Systems and Programs

System	Program	JCE prepared ^a	JCE date (if applicable)	Changes since JCE prepared	
	Aegis Ashore	Romania site	Yes ^b	 Jan. 2016	In 2019, MDA extended its responsibilities for operations and sustainment to address some latent site requirements.
		Poland site	No ^c		
	Aegis Ballistic Missile Defense Standard Missile-3	Block IB	No ^c		
		Block IIA	No ^c		
	Aegis Weapon System ^b	Spiral 4.1	No ^c		
		Spiral 5.1	No ^c		
	Army Navy/Transportable Radar Surveillance and Control Model-2 (AN/TPY-2)	Configuration 3	Yes	 July 2021	
		Configuration 4	Yes		
	Ground-based Midcourse Defense	Enhanced Homeland Defense	No ^c		
	Long Range Discrimination Radar	Configuration 1	Yes ^d	 Apr. 2019	In October 2019, MDA began efforts to establish the next program—LRDR configuration 2.
	Sea Based X-Band (Radar)	Upgrades	Yes ^d	 Sept. 2012	In October 2014, the Navy returned the SBX to MDA to serve as a test and operational asset.
	Terminal High Altitude Area Defense	I	Yes	 July 2021	
		II	Yes		
		III	Yes		
	Upgraded Early Warning Radar	Increment 3	No ^c		

GAO assessed programs

Source: GAO analysis of Missile Defense Agency (MDA) data. | GAO-22-104344

^aThis figure lists all of the systems or associated programs that should have a JCE, which means that MDA can transfer ownership to the lead military service once in production—at the Milestone C or equivalent decision.

^bAccording to MDA, the JCE for the Aegis Ashore Romania site will not be updated despite recent scope and duration changes to the operations and sustainment costs because ownership of this site has been transferred to the Navy.

^cAccording to MDA, a JCE is not required for these programs although we have identified that both MDA and the military service bear responsibilities for operations and sustainment costs. MDA has since modified its naming conventions for the Aegis Weapon System software spirals.

^dAccording to MDA, the JCEs for these programs are being updated.

MDA officials provided various explanations for why they have not prepared JCEs with the military services for certain programs or systems, as required by MDA policy, and said they are working to update some existing JCEs within the next year or so. Since each new program can expand the breadth and duration of a system's operations and sustainment, it is important that a JCE exist for each program or if for a system, be properly updated when a new program is added or other changes occur. Otherwise, the JCE will not contain the most up-to-date operation and sustainment costs and a considerable amount of operations and sustainment costs could be excluded.

We also found that none of the JCEs have been independently verified by DOD's CAPE, as advised by MDA policy.³⁸ Specifically, MDA policy states that "MDA and the lead [military] service will pursue independent verification of joint cost estimates" by DOD's CAPE, but does not specify that independent verification must be obtained. Independent verification is important because some military service officials told us (1) they had affordability concerns due to understated costs in the JCEs and (2) there are significant divides between MDA-calculated costs for operations and sustainment and their own. One example provided by a military service official indicated that the MDA-calculated operations and sustainment costs for a certain program were about \$15 million, but using the military service's standards, the calculation would be closer to \$70 million. Thus, without a clear requirement for MDA to obtain independent verification of each JCE, the operations and sustainment costs could continue to be understated and the military services' concerns about affordability may persist.

For programs without a JCE, we sought out other potential sources for the military services' operations and sustainment costs, such as military service's budget submissions. Representatives from DOD's CAPE and a military service told us that one would need to "dig deep" into the military services' budget submissions to identify the operations and sustainment costs for MDA programs or systems. When we searched each of the military service's operations and sustainment budget submissions for fiscal year 2019, we found it difficult to locate the relevant operations and sustainment costs because costs were dispersed throughout, often with no clear connection to an MDA program or system. For instance, within the Army's fiscal year 2019 operations and sustainment budget

³⁸MDA Directive 5010.19, *Ballistic Missile Defense System Capability Transition and Transfer Policy* (May 2014).

submission there were no connections to the AN/TPY-2, THAAD, or GMD programs or systems. Ultimately, without a JCE and relying solely on information in the military services' budget submissions, we could not fully quantify the military services' operations and sustainment costs associated with MDA programs or systems.

Upon request, however, MDA was able to quantify the military services' operations and sustainment costs. Specifically, MDA officials provided a document detailing the military services' operation and sustainment costs totaling \$3 billion for fiscal years 2019 through 2024, with an amount for each fiscal year. For example, MDA's document shows the Army's \$1.3 billion in operations and sustainment costs over this time frame for THAAD and AN/TPY-2, which includes support by soldiers, base operations, repair parts, fuel, communications, and security forces. When we asked MDA why the military services' costs were not cited in its cost estimates or baseline reporting, MDA officials told us that they are not responsible for the operations and sustainment costs the military services fund. While we recognize that the military services fund these costs, these costs are part of the program's—and ultimately the system's—life-cycle costs. Our *Cost Estimating and Assessment Guide* states that all life-cycle costs should be accounted for regardless of funding source.³⁹

As noted above, MDA has insight into all of the life-cycle costs but continues not to account for some costs, contrary to our 2013 priority recommendation.⁴⁰ DOD agreed in its response to our 2013 priority recommendation that decision makers should have insight into all life-cycle costs, but disagreed that MDA should be the one to account for the military services' operations and sustainment costs. Since then, DOD has reiterated its position and indicated that the five JCEs prepared to-date represent sufficient action on MDA's part to account for all operations and sustainment costs.⁴¹ We disagree and maintain that MDA's baseline reporting is the most appropriate way to account for all of the life-cycle costs, including the military services' operations and sustainment;

³⁹[GAO-20-195G](#). As noted earlier in this report, MDA revised its *Cost Estimating and Analysis Handbook* in July 2021 and it now specifies that all program life-cycle costs be included in a cost estimate and reported to decision makers regardless of the funding source.

⁴⁰[GAO-13-432](#).

⁴¹The five JCEs are listed in Figure 3 and include: Aegis Ashore-Romania (Jan. 2016), AN/TPY-2 (Jul. 2021), LRDR (Apr. 2019), SBX (Sept. 2012), and THAAD (Jul. 2021).

otherwise, these costs are not captured in a centralized way. It is important that Congress and others within DOD understand the total investment in order to make funding decisions, prepare independent cost estimates, and inform the next steps as MDA is on the verge of transferring ownership of some systems to the military services as required by law.⁴² One practical way MDA could account for all life-cycle costs is to include a citation to the JCE or other source for the military services' operations and sustainment costs in its cost estimates and baseline reporting. This approach should satisfy our 2013 priority recommendation that MDA account for all life-cycle costs, including the military services' operations and sustainment.⁴³

WBS Inconsistencies

Most of the program cost estimates we assessed contained WBS inconsistencies, such as a missing program or contractor WBS, misalignment between the program and contractor WBSs, and missing WBS dictionaries.⁴⁴ For example, MDA officials said the contractor WBS for C2BMC was inadvertently "taken off contract" in 2011 and was not added back until 2019—nearly 8 years later—but noted that they continued to track the contractor's costs during this time frame via formal reports from the contractor. MDA's *Cost Estimating and Analysis Handbook* and other policies require program cost estimates to have a WBS and dictionary, and designate the responsibility for ensuring alignment between the program and contractor WBSs to MDA's Cost Estimating and Analysis Directorate and the applicable program director or manager. MDA's Director for Cost Estimating and Analysis could not pinpoint the cause for the WBS inconsistencies we identified, but acknowledged them. Figure 4 shows that two programs among the seven we assessed did not have any WBS inconsistencies, while the remaining programs had one or more.

⁴²Pub. L. No. 115-91, § 1676(b), as amended by Pub. L. No. 115-232, § 1679 and Pub. L. No. 116-283, § 1643.

⁴³[GAO-13-432](#).

⁴⁴The program WBS represents the entire program over its life cycle and the contractor WBS is for a portion of the program under the responsibility of a specific contractor.

Figure 4: Inconsistencies in Assessed MDA Program Cost Estimates' Work Breakdown Structures (WBS)

Program	Program and contractor have a WBS?	Program and contractor WBS aligned?	Program and contractor WBS have a dictionary?
Aegis Ashore (Poland site)	✓	✓	✓
Aegis Ballistic Missile Defense Standard Missile-3 Block IIA	X	X	X
Aegis Weapon System Spiral 5.1	✓	✓	X
Army Navy/Transportable Radar Surveillance and Control Model-2 Configuration 4	✓	✓	✓
Command, Control, Battle Management, and Communications Spiral 8.2-5	X	X	X
Ground-based Midcourse Defense Enhanced Homeland Defense	✓	X	✓
Terminal High Altitude Area Defense III	X	X	X

✓ Yes

X No

Source: GAO analysis of Missile Defense Agency (MDA) data. | GAO-22-104344

Note: Aligned means that the program WBS matches up with the contractor WBS.

Beyond diverging from MDA's policies cited above, these WBS inconsistencies are also contrary to leading practices outlined in GAO's *Cost Estimating and Assessment Guide*.⁴⁵ First, both the program and contractor should be in agreement regarding the WBS because a WBS is essential for developing a cost estimate and serves as the framework for identifying, developing, and tracking all relevant program costs.

⁴⁵[GAO-20-195G](#).

Specifically, a WBS diagrams all of the deliverables—hardware, software, and data—into small, discrete parts to show how each part relates to other parts, the program as a whole, and enables the determination of the corresponding cost. When a WBS is missing or there is misalignment between the program and contractor WBSs, an agency cannot ensure that all relevant costs are accounted for. Last, each WBS should have a WBS dictionary that provides a narrative description of the work to be performed in each discrete part. Without exploring and determining the causes for the WBS inconsistencies, MDA may encounter cost increases, schedule delays, and other issues as unaccounted-for costs emerge.

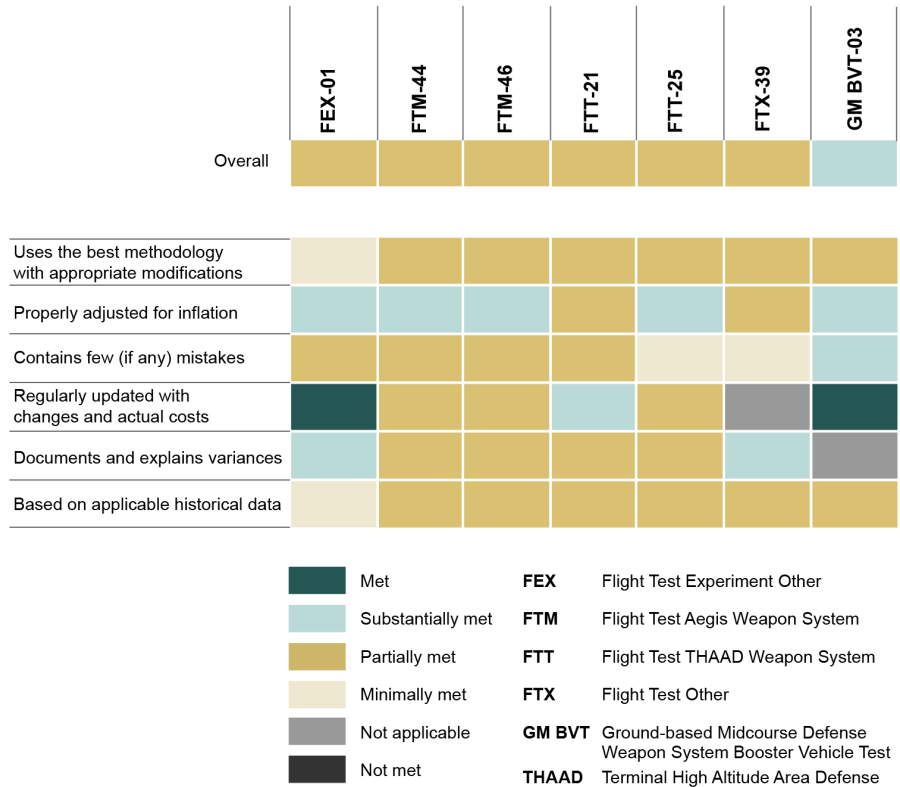
Accuracy Issues Linger with Flight Test Cost Estimates While Improvements Are Underway

MDA's flight test cost estimates lack accuracy, but they are evolving as the agency takes a variety of steps to improve them. Per GAO's *Cost Estimating and Assessment Guide*, for a cost estimate to be accurate, it must (1) use the best estimating methodology appropriately, (2) be properly adjusted for inflation, (3) contain few mistakes, (4) be regularly updated with changes and actual costs, (5) document and explain variances between planned and actual costs, and (6) be based on applicable historical data.⁴⁶ In 2017, we found significant deficiencies with MDA's flight tests cost estimates, but since then, MDA has made revisions to its cost estimating process.⁴⁷ For this report, we assessed seven flight test cost estimates prepared under MDA's revised cost estimating process to ascertain MDA's progress. We found that six of these seven flight test cost estimates had an overall rating for accuracy of partially met, which is an improvement over our previous assessment of minimally met. Although improved, the current flight test cost estimates fell short in the use of estimating methodology and historical data, mistakes, and regular updates, as shown in figure 5. Therefore, MDA's average annual funding request of \$1.3 billion for flight tests continues to be based on inaccurate cost estimates.

⁴⁶[GAO-20-195G](#).

⁴⁷[GAO-17-381](#).

Figure 5: Selected MDA Flight Test Cost Estimates Assessed against GAO's Leading Practices for Accuracy



Source: GAO analysis of Missile Defense Agency (MDA) data. | GAO-22-104344

Note: The leading practices for an accurate cost estimate are set forth in GAO's *Cost Estimating and Assessment Guide* (GAO-20-195G). We used the following scale for the ratings we assigned to each leading practice: not met = 1; minimally met = 2; partially met = 3; substantially met = 4; and met = 5. We took the average of the ratings for the leading practices to determine the overall rating for accuracy as follows: not met = 1.0 to 1.4; minimally met = 1.5 to 2.4; partially met = 2.5 to 3.4; substantially met = 3.5 to 4.4; and met = 4.5 to 5.0. We rated the *regularly updated with changes and actual costs* leading practice as met for two flight tests—FEX-01 and GM BVT-03—because both were updated to reflect changes; however, based on when MDA prepared these cost estimates, the actual costs were not applicable and therefore not factored into the rating.

Use of Estimating Methodologies and Historical Data

MDA’s cost estimating methodology for some flight tests was an analogy, but MDA generally did not make adjustments to account for differences that can misrepresent the costs for these flight tests. An analogy involves estimating costs for a new flight test by using the cost estimate from a prior similar flight test as the basis, then making adjustments to account for any differences between the flight tests. Ultimately, the accuracy of the new flight test’s cost estimate is dependent on the initial similarity to the prior flight test and the adjustments made to account for the differences. Otherwise, the new flight test’s cost estimate could be under-stated or over-inflated. However, we found that, when MDA used an analogy, there were considerable differences, such as the location of the test range, and no adjustments were made. For example, MDA did not make adjustments to two new THAAD flight tests at test ranges in New Mexico and Alaska although the prior flight tests used as their basis were executed at a test range near Hawaii, as shown in table 3.

Table 3: Comparison of Technical Differences between New Flight Tests for the Terminal High Altitude Area Defense (THAAD) Program and Those Used as Analogous for Cost Estimates

Flight test	Prior THAAD flight tests used as analogous		New THAAD flight tests	
	Prior test #1	Prior test #2	New test #1	New test #2
Test type ^a	Intercept	Intercept	Non-intercept	Intercept
Target type (range) ^b	Medium	Medium	Short	Intermediate
Target launch method	Air	Air	Ground	Air
Test range location	Reagan Test Site (Near Hawaii, Western Pacific Ocean)	Reagan Test Site (Near Hawaii, Western Pacific Ocean)	White Sands Missile Range (New Mexico)	Pacific Spaceport Complex-Alaska

Source: GAO analysis of Missile Defense Agency data. | GAO-22-104344

^aAn intercept flight test involves a system actively engaging one or more threat-representative targets and a non-intercept flight test is used to assess certain aspects of a system’s performance, with or without a target.

^bThe target ranges in kilometers are as follows: short (less than 1,000), medium (1,000-3,000), intermediate (3,000-5,500), and intercontinental (greater than 5,500).

Moreover, contrary to GAO’s leading practices for cost estimating, MDA did not document the rationale for using these prior flight tests as analogous, the similarities or differences, or cite a subject matter expert’s inputs and validation of the comparability between the flight tests.⁴⁸ MDA recently created a dedicated form to capture the subject matter expert’s inputs and validation as part of its ongoing efforts to improve flight test

⁴⁸[GAO-20-195G](#).

help ensure appropriate adjustments are made when MDA uses an analogy for estimating costs.

MDA's estimating methodology for some other flight test costs was an engineering build-up and adjustments were not made to account for varying requirements, which can also misrepresent costs. An engineering build-up involves starting at the lowest level of costs to build one piece of the estimate at a time; the pieces are then summed up to create the cost estimate. MDA used this method to develop costs for frequently used assets that support flight testing, like the Pacific Tracker Vessel—a ship with a telemetry system and radar.⁴⁹ MDA officials told us that costs for the Pacific Tracker Vessel are reusable and can be applied to multiple flight tests. We found that MDA used the same costs for the Pacific Tracker Vessel for five of the flight tests we assessed, although these flight tests had varying requirements, such as the location of the test range.

For example, one of these was a THAAD flight test at a test range in Alaska, but the cost MDA cited for the Pacific Tracker Vessel is at a test range in Hawaii, which is more expensive. Although costs for the Pacific Tracker Vessel are tailorable based on the location of the test range, MDA officials told us that the costs are instead dependent on the Pacific Tracker Vessel's positioning to support a flight test. Further, MDA officials said that the necessary positioning was Hawaii for all five flight tests. However, this dependency was not evident within MDA's flight test cost estimates or supporting documentation. GAO's *Cost Estimating and Assessment Guide* indicates that any such dependencies, or ground rules and assumptions, should be clearly documented. Otherwise, when the engineering build-up method is used, an estimate must account for unique variables—in this case, the location of the test range.⁵⁰ Without the necessary tailoring of these costs, there is potential for a flight test's cost estimate to under- or over-state costs, but MDA's creation of a dedicated form to capture the subject matter expert's inputs and validation should help with tailoring these costs or provide documentation when costs are not tailored.

⁴⁹The cost for the Pacific Tracker Vessel is an engineering build-up of labor, fuel, and travel based on costs per day and days in port and at sea.

⁵⁰[GAO-20-195G](#).

MDA also leveraged historical data for its flight test cost estimates, a leading practice identified in GAO's *Cost Estimating and Assessment Guide*.⁵¹ However, we could not identify how and where MDA made adjustments to account for certain differences in flight tests. For example, the mission execution and logistics costs for a THAAD flight test at a test range in New Mexico were based on two prior Aegis BMD flight tests out of a test range in Hawaii. MDA did not provide an explanation or documentation on how it scaled the actual costs from these prior flight tests to account for the technical differences between the systems and location of the test ranges; without such explanation, we cannot ascertain their applicability. This is another area that should be improved by MDA's creation of a dedicated form to capture the subject matter expert's inputs and validation.

Cost Estimating Mistakes

We found mistakes in MDA's flight test cost estimates, as some costs were not traceable to the source data or assumptions. As an example of not being traceable to the source data, the cost estimate for one THAAD flight test cites \$2 million for contractor mission engineering, but the source data for this cost is from two prior flight tests that cited more than \$20 million for this activity. An example of a flight test cost estimate diverging from the set-forth assumptions is a GMD flight test that included the cost for a lethality assessment—specific to an intercept test—although it is a non-intercept test.⁵² MDA officials acknowledged the mistake and said they have since corrected it and taken steps to exclude the cost of a lethality assessment from future cost estimates for non-intercept flight tests. GAO's *Cost Estimating and Assessment Guide* specifies that, in order to preclude mistakes, source data for a cost estimate should exist and be traceable, and documentation should identify the assumptions, methods, and calculations used to generate each cost.⁵³ Traceability to the source data ensures that a cost estimate is accurate, without which, an agency's budget request each year could have shortages or overages. MDA officials told us that documentation for cost estimates can lag the agency's review process, but they are working to improve this moving forward.

⁵¹[GAO-20-195G](#).

⁵²A lethality assessment involves data collection and analysis to determine the damage to a target (missile representing an enemy threat) caused by the impact from an interceptor.

⁵³[GAO-20-195G](#).

Regularly Updating Cost Estimates with Actual Costs

MDA does not regularly update its flight test cost estimates with actual costs—the amount of funds the agency expends on the activities that make up a flight test, as those activities occur. In 2016, we highlighted that MDA was unable to track and report the actual costs for flight tests and in 2017 further detailed that it was because of (1) inconsistencies from not using a common WBS and (2) the way expended funds were coded in the payment (accounting) system.⁵⁴ Since then, MDA has taken steps to rectify the inconsistencies—the former with its new flight test cost model with a common WBS and the latter with policies requiring the agency’s personnel to use specific naming conventions when coding expended funds.⁵⁵ In taking these steps, MDA officials told us they now have a daily logbook that reflects the amount of funding that has been expended on a given flight test. However, MDA is still working to ensure that the naming conventions are fully implemented across the agency, to include its contractors, to ensure that all costs for each flight test are in the logbook.

While MDA now has the ability to identify actual costs, the flight test cost estimates we assessed had not been updated with the actual costs. MDA guidance does not specify the point in time that actual costs must be incorporated into a flight test cost estimate, which should be as soon as they become available according to GAO’s *Cost Estimating and Assessment Guide*.⁵⁶ MDA officials told us that until a flight test has been executed, they consider it premature to update the cost estimate with actual costs, although years could have elapsed by that point. However, we found that even an executed flight test’s cost estimate had not been updated with actual costs. For example, one THAAD flight test was executed in October 2019 and when MDA provided us the cost estimate in July 2020—9 months later—it had not been updated with the actual costs.⁵⁷

⁵⁴GAO, *Missile Defense: Ballistic Missile Defense System Testing Delays Affect Delivery of Capabilities*, [GAO-16-339R](#) (Washington, D.C.: Apr. 28, 2016) and [GAO-17-381](#).

⁵⁵MDA, *Individual Flight Test Costs Standard Operating Procedures* (Sept. 27, 2016), and MDA, *Memorandum for Capturing Budget and Execution Reporting of Individual Flight Test Costs* (Sept. 28, 2016).

⁵⁶[GAO-20-195G](#).

⁵⁷MDA officials noted that although the actual costs for this THAAD flight test were not reflected in the cost estimate, they did include the actual costs for this test in a mandated report to Congress dated April 9, 2020.

Regularly updating a cost estimate with actual costs as they become available achieves multiple ends. First, it ensures that the cost estimate is accurate (relevant and current), thereby strengthening its credibility for budgeting purposes. Second, it archives and helps ensure the reliability of cost data used as the basis for future cost estimates. Third, it enables variance analysis to identify when, how much, and why actual costs were more or less than planned, which helps cost estimators reconsider and correct assumptions, improve estimating methods, and avoid repeating mistakes on future estimates. Last, it facilitates internal and external oversight and accountability. Without updating its guidance to require flight test cost estimates to be regularly updated with actual costs as they become available, MDA will continue to rely on and reuse flight test cost estimates that under- or over-inflate costs.

Steps to Improve Flight Test Cost Estimates

MDA officials highlighted a number of steps they are taking to improve flight test cost estimates, some of which are driven by the findings and recommendations from our 2017 missile defense report.⁵⁸ The most prominent action is MDA's new, integrated, and more automated flight test cost model with a common WBS. A cost model serves as the framework for creating cost estimates and a common WBS ensures consistency across the cost estimates. MDA's new flight test cost model replaced multiple program-unique, manually compiled flight test cost models. MDA began developing this new flight test cost model in January 2017, and made iterative progress to release the first cost estimates in 2019. MDA also issued guidance for this new flight test cost model. While the flight test cost estimates we assessed for this report had some lingering accuracy issues, as noted above, there is potential for them to improve as MDA's new flight test cost model and associated processes evolve over time.

MDA has made multiple revisions to its cost estimating process to streamline and improve its flight test cost estimates. For example, rather than continuing to use program-unique costs, MDA compiled over 600 commonly used costs, such as engineering, contractor support, and flight test range, for programs to select among when preparing and updating their flight test cost estimates. According to MDA officials, these commonly used costs can help ensure consistency across programs for certain flight test costs. MDA also developed rules that stipulate when and how each cost should be selected for a flight test. To ensure that these costs stay up-to-date, MDA officials told us that they are developing a

⁵⁸[GAO-17-381](#).

stop-light flagging mechanism—green, yellow, red—based on each cost’s last verification date, with green for less than a year, yellow for one to two years, and red for more than 2 years. To reduce and better track revisions to flight test cost estimates, MDA instituted open and locked periods for when the programs can select and make adjustments to the costs. MDA also created a dedicated form to capture the subject matter expert’s inputs and validation of the costs included in a cost estimate, as noted earlier in this report.⁵⁹ In addition, MDA established reviews during the preparation of the annual flight test cost estimates to identify and correct mistakes and initiated bi-annual working groups to discuss and resolve issues as they arise.

Inadequacies in Reported Program and Flight Test Costs Impede Oversight

MDA reports to Congress on program and flight test costs, but the reported information has inadequacies with transparency, traceability over time, and completeness that impede oversight. For program costs, MDA makes untraceable adjustments to the baselines and omits recurring comparisons against the original baseline, both of which hinder insight into the cost performance of each program and ability to determine the total system costs. For flight test costs, MDA provided mandated reports to Congress semiannually from March 2017 through September 2020, but these reports omitted information due to the agency’s methodological approach for reporting.⁶⁰

Baseline Reporting Continues to Lack Transparency and Traceability Needed to Gauge Program Progress and Total System Costs

MDA has made improvements to its baseline reporting over the years; however, MDA continues to make untraced baseline adjustments and inconsistently reports against the original baseline, both of which obscure insight into the cost performance of each program and the total system costs. In 2010, as required by law, MDA established and began reporting program baselines annually.⁶¹ To improve this baseline reporting, Congress has enacted legislation, and we have made a variety of recommendations that MDA has taken action on, such as identifying the dates for the original and any revised baselines and explaining significant

⁵⁹MDA revised its *Cost Estimating and Analysis Handbook* in July 2021 and it includes a template to capture the subject matter expert’s inputs and validation.

⁶⁰Pub. L. No. 114-328, § 1695. The legislation required MDA to report on the outcomes and costs for all flight tests planned to occur during each 180-day notification period, and to identify funds expended on an attempted flight test and a cost estimate for a retest.

⁶¹National Defense Authorization Act for Fiscal Year 2008, Pub. L. No. 110-181, § 223 (2008). Pub. L. No. 112-81, § 231, as amended, codified at 10 U.S.C. § 225, struck Pub. L. No. 110-181, § 223(g).

Some Program Baseline
Adjustments Not Traceable
over Time

changes to program baselines.⁶² GAO's *Cost Estimating and Assessment Guide* notes the importance of baselines for providing decision makers, like Congress and DOD, with insight into the total cost of a system and the cost performance of the programs that comprise it—in terms of how much an agency initially planned to spend as compared to the current cost estimate in order to measure and monitor progress.⁶³ Such insight informs decision makers' affordability determinations, investment decisions, and oversight of an agency's stewardship of public funds.

MDA continues to make adjustments to program baselines in such a way that the program's cost performance is no longer traceable when comparing over time, which undermines the utility of program baselines as an oversight tool for Congress. While baseline adjustments are, at times, necessary, we have previously reported that when baseline adjustments are made they should be clearly traceable.⁶⁴ In 2013, we found that MDA's program baseline adjustments lacked traceability and we made a priority recommendation for MDA to correct such traceability issues to enable meaningful comparisons over time.⁶⁵ DOD agreed that program baselines should enable meaningful comparisons. In 2015, MDA began adding a list of significant program baseline changes to its baseline reporting, and said that a program's cost performance can be discerned simply by collating the list of significant changes from each fiscal year. In July 2020, DOD requested that we close our 2013 priority recommendation as implemented.⁶⁶

However, when we collated the list of significant changes to costs for the seven program baselines we assessed, we identified untraced adjustments. For example, one program we assessed—Aegis Weapon System Spiral 5.1—moved from a consolidated baseline with two other software spirals in the 2019 baseline reporting to its own dedicated

⁶²See, e.g., Pub. L. No. 112-81, § 231, as amended, codified at 10 U.S.C. § 225. [GAO-11-372](#) and [GAO-13-432](#).

⁶³[GAO-20-195G](#).

⁶⁴[GAO-13-432](#). MDA officials noted that 10 U.S.C. § 225 gives the MDA Director the authority to make adjustments to program baselines, as appropriate.

⁶⁵[GAO-13-432](#). In August 2021, we communicated to DOD that this priority recommendation remained open and additional action was needed ([GAO-21-522PR](#)).

⁶⁶[GAO-13-432](#).

baseline in the 2020 baseline reporting.⁶⁷ MDA's baseline reporting did not trace how the once-consolidated costs were distributed across the three now-separate baselines. Specifically, some development costs were: (1) removed, (2) not specific to a software spiral, or (3) different due to naming conventions between the former and new baselines. The lack of traceability in MDA's baseline reporting necessitated the preparation of crosswalks and analysis of all three now-separate baselines to understand the cost performance of a single program. With these additional steps, we found a \$1.5 billion increase in development costs for the Aegis Weapon System Spiral 5.1 program between the 2019 and 2020 baseline reporting, but MDA only reported a \$664 million increase—a difference of \$851 million.

As shown by the example above, despite MDA's addition of a list of significant program baseline changes to its baseline reporting, untraced adjustments persist. Without clear traceability of these adjustments, as we previously recommended, the program baselines will continue to be of limited use for decision makers to track program cost performance. As such, further action is necessary to implement our priority recommendation and ensure that adjustments to the program baselines are traceable, thereby enabling meaningful comparisons over time. Since we focused in this report on the information MDA includes in its baseline reporting, we did not delve into the potential underlying causes for continued traceability issues, which can span the gamut of data systems used to create the baseline reporting, processes and the associated timing, policies and user guides, personnel and training, or other areas. In line with our prior recommendation, we advise that MDA explore potential causes for the traceability issues in the baseline reporting and implement the appropriate corrective actions.⁶⁸ Taking corrective actions to rectify the traceability issues and enable meaningful comparisons over time would meet the intent of our recommendation and support the closure of the recommendation as implemented.

⁶⁷MDA refers to this Aegis Weapon System software spiral as Ballistic Missile Defense 5.x, which includes several software upgrades.

⁶⁸[GAO-13-432](#).

Program Baseline Reporting
Does Not Include Recurrent
Comparisons to Original
Baseline

MDA does not include comparisons to each program's original baseline in every iteration of its baseline reporting, which limits decision makers' and oversight entities' insight into programs' actual cost performance.⁶⁹ GAO's *Cost Estimating and Assessment Guide* stresses the importance of maintaining insight into the original baseline to fully understand a program's cost performance, but MDA policy permits the omission of recurrent comparisons to the original program baselines.⁷⁰ Thus, MDA includes a comparison to the original program baseline until it is revised, and thereafter the cost is compared to the most recently revised baseline.⁷¹ We found that MDA revised the baseline one or more times for about half of the programs we assessed—three of seven—and did not consistently report changes against the original baseline, as shown in table 4.

⁶⁹Legislation, codified at 10 U.S.C. § 225(c), specifies the inclusion of a comparison to the initial baseline in each iteration of MDA's annual baseline reporting. MDA has interpreted this to mean either the first baseline established or a revised baseline which it refers to as the "revised initial baseline." We refer to the unrevised initial baseline as the original baseline.

⁷⁰[GAO-20-195G](#) and MDA Instruction 5013.02-INS, *Acquisition Management* (Aug. 24, 2013).

⁷¹MDA Handbook Version 3: *MDA Resource Baseline Development for BMDS Accountability Report* (Oct. 9, 2015).

Table 4: Baseline Status and Reporting for Assessed MDA Programs

Program	Original baseline	Revised baseline	Recurring comparisons to original baseline in the baseline reporting	Comparison to original baseline each time baseline revised
Aegis Ashore (Poland site)	July 2012	Apr. 2015 Oct. 2018	No	No
Aegis Ballistic Missile Defense Standard Missile-3 IIA	Apr. 2014	Jan. 2017	No	No
Aegis Weapon System 5.1 ^a	Apr. 2014	Apr. 2015 Mar. 2016 May 2019	No	No
Army Navy/Transportable Radar Surveillance and Control Model-2 Configuration 4	July 2018	No	Yes	N/A
Command, Control, Battle Management, and Communications 8.2-5	Oct. 2018	No	Yes	N/A
Ground-based Midcourse Defense Enhanced Homeland Defense	Dec. 2014	No	Yes	N/A
Terminal High Altitude Area Defense III	Aug. 2018	No	Yes	N/A

Source: GAO analysis of Missile Defense Agency (MDA) data. | GAO-22-104344

^aMDA refers to this Aegis Weapon System software spiral as Ballistic Missile Defense 5.x, which includes other software upgrades.

Since a revised baseline is a new starting point from which to gauge progress—the schedule is extended and cost growth is zeroed out—MDA’s comparisons to revised rather than original baselines conceal program cost performance information needed by decision makers. For example, decision makers may be unaware that Aegis Ashore Poland’s costs have increased by \$121 million rather than the \$90 million reported by MDA—a \$31 million difference. In such cases, a comparison to the original baseline provides decision makers a better means for determining whether to continue a program or cancel it to pursue a more affordable option. Thus, without updating its policy to require recurrent comparisons to the programs’ original baseline in every iteration of the baseline reporting, MDA is not providing decision makers with information necessary to fully understand each program’s cost performance.

Total System Costs Obscured by Shifts Across and Outside of Program Baselines

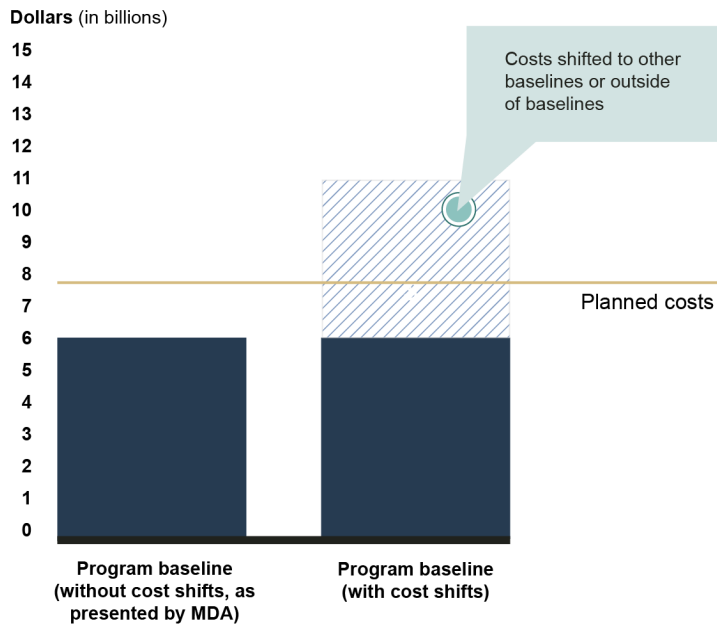
We attempted to aggregate the multiple program baselines that comprise a system to identify the total system costs but found it challenging because MDA shifts costs across and outside of program baselines.⁷² GAO's *Cost Estimating and Assessment Guide* says that a program's costs should track to a specific baseline—that is, represent a discrete effort—to enable decision makers to understand the total investment and clearly track when, how much, and why the costs are more or less than planned.⁷³ Contrary to this, we found that when one program's baseline closes, MDA policy allows remaining costs to be shifted to the next program's baseline.⁷⁴ MDA also shifts some costs outside of the program baselines to the military services or to other efforts that have not been baselined, which creates often-inaccessible offshoots of costs. Ultimately, we found that MDA's shifting of costs across and outside of program baselines misrepresented the cost performance of a program, as notionally depicted in figure 6, and made discerning the total system cost—summing up the multiple program baselines that comprise it—difficult.

⁷²Each system consists of multiple subparts—blocks, configurations, increments, or spirals—that we refer to as programs in this report.

⁷³[GAO-20-195G](#).

⁷⁴MDA Instruction 5013.02-INS, *Acquisition Management* (Aug. 24, 2013).

Figure 6: Notional Depiction of an MDA Program Baseline with and without Accounted-for Cost Shifts



Source: GAO analysis of Missile Defense Agency (MDA) data. | GAO-22-104344

The following examples demonstrate some of the challenges notionally depicted above:

- AN/TPY-2.** Three of the four program baselines that comprise AN/TPY-2, as presented by MDA in its baseline reporting, appeared to come in under planned cost with an overall total decrease of about \$11.5 billion. After we accounted for costs shifted across the program baselines, we found that the total system cost decreased by \$750 million. However, after we included the operations and sustainment costs shifted outside of the program baselines to the military service, we found that the total system cost increased by about \$4.8 billion.⁷⁵
- GMD.** The two program baselines that comprise GMD, as presented by MDA in its baseline reporting, appeared to come in under planned cost with an overall total decrease of nearly \$11 billion. After we accounted for costs shifted across the program baselines, we found that one program baseline exceeded planned costs and the total

⁷⁵ The amount of operations and sustainment costs for the AN/TPY-2 system shifted outside of the program baselines to the military service—the Army—is based on a JCE dated July 2021.

system cost increased by \$201 million. However, after we included costs shifted elsewhere, such as to the military service or efforts without a baseline, we found that the total system cost increased by at least \$2.3 billion.⁷⁶

- **THAAD.** The three program baselines that comprise THAAD, as presented by MDA in its baseline reporting, appeared to come in under planned costs with an overall decrease of \$8.5 billion. After we accounted for costs shifted across the program baselines, we found that two programs exceeded planned costs and the total system cost increased by \$1.2 billion. However, after we included operations and sustainment costs shifted outside of the program baselines to the military service, we found that the total system cost increased by about \$3.2 billion.⁷⁷

The level of effort that must be undertaken reconciling costs shifted across and outside of each program baseline to understand a program's cost performance or to identify a total system cost is incongruent with the purpose of a baseline. Congress and other decision makers need to understand both a program's cost performance and the total system cost for affordability determinations, investment decisions, and oversight of an agency's stewardship of public funds. However, the program baselines are frequently changing due to shifting costs and there is no existing policy requirement for MDA to report the total cost for each system. Other entities within DOD, like the military services, are required to identify and regularly report total system costs, irrespective of increments (or programs) that comprise it, to ensure Congress has insight into the entire investment necessary for a system.⁷⁸ Without MDA reporting total system costs, Congress and other decision makers will continue to lack a full understanding of the financial commitments for each system and the cost performance of the individual programs needed for oversight. Furthermore, both DOD's CAPE and the military services will not have the total system cost to leverage when preparing independent cost estimates

⁷⁶ This total system cost does not include some GMD efforts that have not been baselined, such as over \$2 billion in costs incurred for the Redesignated Kill Vehicle canceled in August 2019 or between \$11 billion and \$13 billion for the Next Generation Interceptor currently in development.

⁷⁷ The amount of operations and sustainment costs for the THAAD system shifted outside of the program baselines to the military service—the Army—is based on a JCE dated July 2021.

⁷⁸ 10 U.S.C. § 2432.

and planning for future transfers of system ownership, respectively, as outlined earlier in this report.

Methodological Approach Has Led to Incomplete Information Reported to Congress on Flight Test Costs

Since 2017, MDA was mandated to provide Congress regular reports on flight test costs and between March 2017 and September 2020 MDA provided seven reports.⁷⁹ Among these reports, we found that MDA generally only cited costs for flight tests that were executed (i.e., costs for delayed and canceled tests were omitted). Overall, MDA only accounted for about \$1.3 billion of at least \$3.5 billion in funding the agency requested for flight testing over this period (see table 5).

Table 5: MDA's Flight Test Cost Information Reported to Congress, March 2017 to September 2020

Information	Reported by MDA	Not reported by MDA	Total
Number of flight tests	50	20	70
Number of flight tests with costs cited	32	38	70
Amount of funding for flight tests	1.3 billion ^a	2.2 billion ^b	3.5 billion^b

Source: GAO analysis of Missile Defense Agency (MDA) data. | GAO-22-104344

^aAmount of flight test costs MDA cited in the reports to Congress less approximately \$500 million in interceptor costs, because although interceptors costs are a part of the overall cost of a flight test, the interceptor costs are not included in MDA's flight test cost estimates or associated funding requests.

^bFor context, we compare the flight test costs MDA cited in the reports to Congress to its total funding request for flight testing between fiscal years 2017 and 2020.

While MDA maintained that the information it included in the reports to Congress met the requirements outlined in legislation, we found the information to be incomplete due to issues with its methodological approach for reporting, as outlined below:

- **Interpretation of flight test costs.** MDA determined what type of costs to include in the reports to Congress based on its interpretation of the legislative requirement to identify costs for all planned flight tests.⁸⁰ The different types of costs that MDA could include are planned costs (the flight test cost estimate), actual costs to-date, estimated remaining costs, or some combination of these. We found

⁷⁹Pub. L. No. 114-328, § 1695. The legislation requires MDA to report on the outcome and costs for all flight tests planned to occur during each 180-day notification period, and to identify funds expended on an attempted flight test and a cost estimate for a retest.

⁸⁰Pub. L. No. 114-328, § 1695.

that MDA reported either planned costs or a combination of actuals to-date and the estimated remaining costs, but not both. For example, for flight tests during fiscal year 2017, MDA reported planned costs until it implemented corrective measures to report actual costs. By only reporting planned costs, MDA under-reported the costs for at least two flight tests—FET-01 and FTT-18—by nearly \$80 million. In the reports to Congress after 2017, MDA officials told us that they provided the actuals to-date and estimated remaining expenses, but not the planned cost.⁸¹ Without both planned and actual costs, as outlined in GAO's *Cost Estimating and Assessment Guide*, Congress cannot know how much MDA expected to spend on each flight test as compared to how much it actually spent, and how that aligns with the funds Congress provided for the flight tests.⁸²

- **Application of methodologies.** MDA told us that it used two methodologies when not including flight test costs in a report to Congress: (1) tests outside of the reporting period or (2) non-MDA tests with no MDA asset participation.⁸³ However, we found issues related to the application of these methodologies.

For the first methodology, MDA told us that it did not include costs for flight tests that were outside of the 180-day reporting period of a specific report to Congress. MDA determined which flight tests to include in the 180-day reporting period based on a specific test plan. However, instead of the test plan corresponding with its budget request, we found that MDA primarily used more recent test plans wherein some flight tests were delayed or canceled. For example, for the report to Congress on flight tests planned during the latter portion of fiscal year 2020 MDA did not use its fiscal year 2020 test plan, but instead used its fiscal year 2021 test

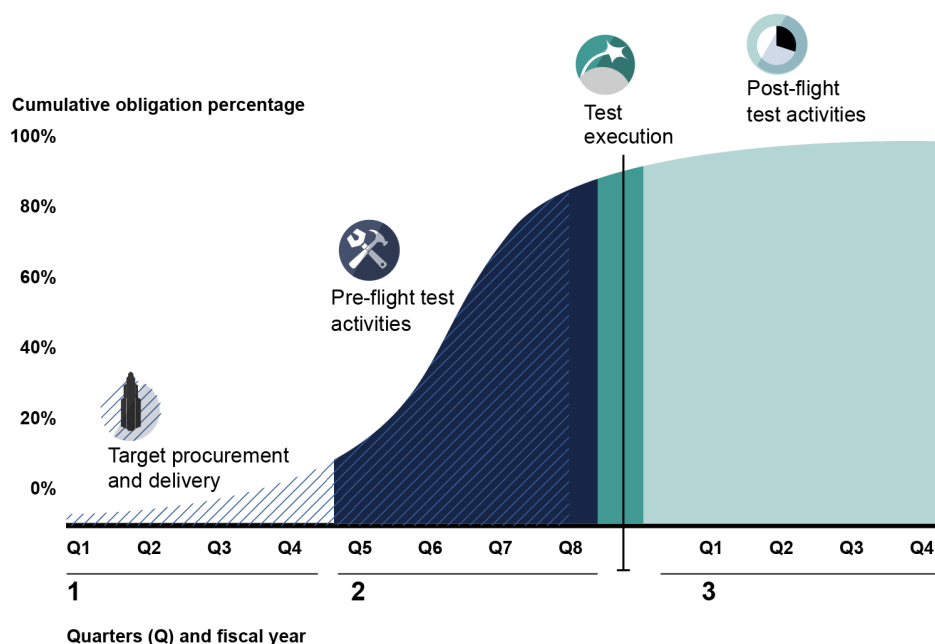
⁸¹MDA officials said that to address a congressionally identified information need, in the September 2020 report to Congress MDA began including the funding requested for executed flight tests. Such information provides insight into how much funding MDA has received in relation to how much it has spent. For example, for one flight test—FEX-01—MDA received \$25 million in funding and spent \$19 million.

⁸²[GAO-20-195G](#). *Planned costs* are just that, a plan, as shown in cost estimates used to support budget requests, and *actual costs* show the reality of what has been spent.

⁸³MDA officials later told us that there were two additional circumstances when flight test costs were not cited in a report to Congress. Specifically, they did not cite costs for a flight test (1) funded by other entities, such as the Israel Missile Defense Organization; or (2) special access programs.

plan.⁸⁴ Thus, MDA did not consider its third and largest major operational flight test within this 180-day reporting period. Similarly, FTM-24 was in MDA’s test plan (and budget request) for multiple fiscal years and later canceled, but was not considered within a 180-day reporting period due to the test plan MDA used. Although, MDA considered these flight tests outside of a 180-day reporting period, MDA begins spending funds up to 2 years in advance of a test’s planned execution (see fig. 7). Thus, MDA omitted any funding it had received and spent for these flight tests to date—nearly \$160 million—from the reports to Congress.

Figure 7: Typical Spending Profile for an MDA Flight Test



Source: GAO depiction of Missile Defense Agency (MDA) graphic. | GAO-22-104344

Note: MDA officials told us that target procurement can be initiated 5 years or more before a flight test’s planned execution. We did not include this additional span of time in this graphic for two reasons: (1) the span of time in this graphic is identical to the MDA-provided graphic for a typical spending profile for a flight test, and (2) MDA officials told us that they do not consider a target as part of a flight test cost estimate until they confirm that target’s assignment to a specific flight test.

⁸⁴Our conclusion is based on the scope and methodological approach used for our mandated annual assessment of MDA’s acquisition progress. As disclosed to MDA, we use the documentation that MDA cites in support of its budget request to determine the agency’s plans, in terms of flight tests, asset deliveries, and other efforts. Thus, for planned flight tests for fiscal year 2020, the 2020 test plan (IMTP 20.1) would be the appropriate test plan, and MDA has a mid-year update to this test plan (IMTP 21.0) that reflects budget and fact-of-life changes.

For the second methodology, MDA officials told us that they did not include costs for non-MDA flight tests with no MDA asset participation. MDA cited this methodology often for flight tests related to the Army's Patriot weapon system. However, MDA did have cost estimates for some, but not all, of these flight tests, which suggests some level of involvement by MDA that necessitated funding. MDA officials did not tell us why the costs for the flight tests with a cost estimate were not included in a report to Congress.

MDA continued reporting to Congress on flight tests until the mandate ended in December 2021, but the methodological issues outlined above resulted in an incomplete accounting of flight test costs.⁸⁵ There is no other established requirement for MDA to report on flight test costs.⁸⁶ MDA receives an average of approximately \$1.3 billion each fiscal year but has consistently fallen short of its annual test plan—delaying, canceling, or merging flight tests—without identifying the corresponding effects on its costs and funding needs; though, we have previously recommended that it do so.⁸⁷ Thus, the limited traceability we have previously reported on—how much funding MDA has requested, received, and spent on a flight test within a fiscal year and over time—persists.⁸⁸ Without congressional language reviving MDA's flight test reporting requirement, a lack of insight into the costs associated with MDA's flight tests will continue. Moreover, if the reporting requirement is revived without corrections to address the methodological issues—reporting the planned and actual costs, resolving issues in the application of methodologies such as using the appropriate test plan—the reports will continue to lack the information necessary to provide Congress complete insight into flight test costs.

⁸⁵Pub. L. No. 116-92, § 1702(b)(9).

⁸⁶MDA officials told us that they have processes in place to respond to congressional and other external inquiries and that they provide required information, such as flight test costs, upon request.

⁸⁷[GAO-11-372](#) and [GAO-17-381](#). The volatility of MDA's test plan is attributable to factors external and internal to MDA's control. For example, external factors include inclement weather, test range availability, and the ongoing pandemic, while internal factors include the use of highly concurrent acquisition strategies (overlap between development and production), an aggressive test plan (more tests planned than can likely be achieved in a given time frame), and little to no schedule margin between tests to ensure executability.

⁸⁸[GAO-11-372](#), [GAO-16-339R](#), and [GAO-17-381](#).

Conclusions

MDA has made and continues to make strides to improve its program and flight test cost estimates. For programs, MDA has updated guidance for cost estimating, and for flight tests, it has created a new cost model and devised a way to capture actual costs, among other improvements. However, the continued lack of comprehensiveness and accuracy of these cost estimates creates several challenges as Congress and other decision makers seek insight into the cost associated with programs and flight tests. First, Congress and other decision makers continue to lack insight into the comprehensive life-cycle costs and long-term affordability of programs—and ultimately systems—although there is action MDA can take to provide the necessary insight. Such insight is vital as MDA is on the verge of transferring ownership of some systems to the military services as required by law. Next, the program WBSs contain inconsistencies that may prevent all costs from being captured. Lastly, MDA relies on problematic flight test cost estimates that are not updated with actual costs to support its budget submission. Thus, the flight test cost estimates do not provide Congress reasonable assurance that MDA requests the right amount of funding—enough or too much—in its budget submission each year.

In addition, reporting remains an issue for both program and flight test costs—without which Congress, DOD, and oversight entities cannot accurately gauge progress. For programs, MDA has made refinements to its baseline reporting to better track changes, but continues to make untraced adjustments that affect meaningful comparisons of the program's cost performance over time. The cause of the traceability issues is unclear but is something MDA can explore to determine the appropriate corrective measures. Otherwise, traceability issues with program baselines will persist and impede the information available to Congress to facilitate holding MDA accountable and to consider the prudence of the continued existence of certain programs or systems. For flight tests, MDA continued reporting through December 2021 when the reporting mandate ended. Without congressional direction to revive the reporting requirement and correct the methodological issues with MDA's reporting, Congress will continue to lack complete insight into flight test costs.

Matters for Congressional Consideration

We are making the following two matters for congressional consideration:

Congress should consider reviving the Director of MDA's semiannual requirement to report on flight test costs. (Matter for Consideration 1)

Congress should consider requiring the Director of MDA to clarify the appropriate flight test plan to be used in the agency's methodology for semiannually reporting on flight test costs, and that both up-to-date planned and actual costs are to be cited regardless of a flight test's execution status. (Matter for Consideration 2)

Recommendations for Executive Action

We are making the following six recommendations to DOD:

The Director of MDA should enforce existing policy to ensure all programs with a designated lead military service are covered by a dedicated Joint Cost Estimate (JCE) or a system-level JCE that is promptly updated with any new program's costs. (Recommendation 1)

The Director of MDA should update existing policy to specify that independent verification by DOD's office of Cost Assessment and Program Evaluation is required to be obtained for each Joint Cost Estimate. (Recommendation 2)

The Director of MDA should explore potential causes for work breakdown structure (WBS) inconsistencies and implement corrective actions to ensure each program has a WBS that is aligned with the contractor WBS, and includes a WBS dictionary. (Recommendation 3)

The Director of MDA should update its *Cost Estimating and Analysis Handbook* and other relevant policies and guidance to specify that actual costs for flight tests be regularly incorporated, as they become available, into the agency's flight test cost estimates. (Recommendation 4)

The Director of MDA should update relevant policies and processes to require the inclusion of a comparison against the original program cost baseline in each iteration of the agency's baseline reporting. (Recommendation 5)

The Director of MDA should update relevant policies and processes to track each system's costs—the combined total of all programs that comprise the system—in its annual baseline reporting. (Recommendation 6)

Agency Comments and Our Evaluation

DOD provided a response to a draft of this report, which is reprinted in appendix II and summarized below. MDA also provided technical comments, which we incorporated as appropriate.

DOD concurred with our first four recommendations. For the first and second recommendations, DOD stated that MDA intends to revise and enforce its policy for Joint Cost Estimates (JCE) to ensure applicable programs have a JCE that is properly updated and independently verified by DOD's office for Cost Assessment and Program Evaluation (CAPE). However, MDA has not yet revised this policy, updated or prepared new JCEs, or had any JCEs independently verified by DOD CAPE. For the third and fourth recommendations, DOD noted MDA's recent revisions to its *Cost Estimating and Analysis Handbook* to resolve Work Breakdown Structure (WBS) issues and ensure cost estimates are regularly updated with actual costs. We will assess the revisions to the handbook and continue to monitor any additional actions that either DOD or MDA take in response to our third and fourth recommendations.

DOD did not concur with our fifth recommendation for MDA to include recurrent comparisons against each program's original baseline, with a two-fold rationale. First, DOD said MDA's baseline reporting meets statutory requirements even when reporting against a revised rather than original baseline. The statute specifies that MDA include recurrent comparisons against the "initial" baseline, and MDA's interpretation of "initial" as meaning either "original" or "revised" makes its baseline comparisons less meaningful.⁸⁹ Recurrent comparisons to the original baseline are also consistent with GAO's leading practices for cost estimating. Next, DOD said that such comparisons are of little value because the scope of each MDA program is constantly evolving to address emergent warfighter needs. We disagree and maintain that, regardless of what drives changes to a program, insight into the original baseline is essential for oversight and informed decision-making. For instance, a comparison to the original cost baseline shows how the expected investment in a program has evolved, which decision makers can use to adjust priorities and funding, or to cancel a program in the event costs become untenable. We maintain that our recommendation is valid.

DOD did not concur with our sixth recommendation for MDA to track total system costs, with a two-fold rationale. First, DOD said that the total cost

⁸⁹10 U.S.C. § 225.

for each MDA system can be discerned by simply compiling the active and closed program baselines. However, we found this methodology to be insufficient because, as discussed in this report, MDA shifts costs across and outside of program baselines and also makes untraced adjustments to the program baselines. Second, DOD said that MDA's baseline reporting is in accordance with statute. While statute does not require MDA to report total system costs, it does not preclude such reporting. As we note in this report, other DOD entities are required to report total system costs to ensure decision makers have insight into the investment necessary for a system. Therefore, we believe there is a need for MDA to provide comparable insight into the total cost for each MDA system to assist (1) decision makers with investment and funding determinations, (2) DOD's CAPE with preparing independent cost estimates, and (3) the military services with planning for future transfers of system ownership. We maintain that our recommendation is valid.

We are sending copies of this report to the appropriate congressional committees, the Secretary of Defense, and the Director of MDA. In addition, the report is available at no charge on the GAO website at <http://www.gao.gov>.

If you or your staff have any questions about this report, please contact me at (202) 512-4841 or SawyerJ@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made key contributions to this report are listed in appendix III.



John D. Sawyer
Acting Director, Contracting and National Security Acquisitions

List of Committees

The Honorable Jack Reed
Chairman
The Honorable James M. Inhofe
Ranking Member
Committee on Armed Services
United States Senate

The Honorable Jon Tester
Chairman
The Honorable Richard Shelby
Ranking Member
Subcommittee on Defense
Committee on Appropriations
United States Senate

The Honorable Adam Smith
Chairman
The Honorable Mike Rogers
Ranking Member
Committee on Armed Services
House of Representatives

The Honorable Betty McCollum
Chair
The Honorable Ken Calvert
Ranking Member
Subcommittee on Defense
Committee on Appropriations
House of Representatives

Appendix I: Objectives, Scope, and Methodology

This report assesses the extent to which the Missile Defense Agency's (MDA) program and flight test cost: (1) estimates align with GAO's leading practices for cost estimating and (2) information is transparent and traceable over time when reported to Congress.

As outlined in GAO's *Cost Estimating and Assessment Guide*, we have found that a reliable cost estimate has four characteristics—comprehensive, well-documented, accurate, and credible.¹ A cost estimate is considered reliable if the overall assessment ratings for each of the four characteristics are substantially or fully met. If any of the characteristics are not met, minimally met, or partially met, then the cost estimate does not fully reflect a high-quality estimate and cannot be considered reliable. We selected the comprehensive characteristic for our assessment of program cost estimates and the accurate characteristic for the flight test cost estimates, as explained below.

We assessed program cost estimates against the comprehensive characteristic, which has the following four leading practices: (1) includes all life-cycle costs regardless of funding source, (2) based on an up-to-date and reasonable technical baseline, (3) based on a work breakdown structure (WBS) and has an associated dictionary to ensure costs are neither omitted nor double-counted, and (4) documents all cost-influencing ground rules and assumptions. We selected this characteristic to assess whether the actions MDA has taken over the years to improve its program cost estimates address our 2013 priority recommendation for MDA to account for all program life-cycle costs; specifically the military service's operations and sustainment, as we have previously found that these costs can represent over 70 percent of a system's cost over its entire life.²

For example, MDA and the military services have prepared five joint cost estimates to-date to capture the military service's operations and sustainment costs. We evaluated whether a joint cost estimate exists for each program or system and the independent verification status by the Department of Defense's (DOD) Office of Cost Assessment and Program Evaluation (CAPE). We also reviewed MDA's program cost estimates and

¹GAO, *Cost Estimating and Assessment Guide: Best Practices for Developing and Managing Program Costs*, [GAO-20-195G](#) (Washington, D.C.: Mar. 12, 2020).

²GAO, *Missile Defense: Opportunity to Refocus on Strengthening Acquisition Management*, [GAO-13-432](#) (Washington, D.C.: Apr. 26, 2013) and *Missile Defense: Actions Needed to Improve Planning and Cost Estimates for Long-Term Support of Ballistic Missile Defense*, [GAO-08-1068](#) (Washington, D.C.: Sept. 25, 2008).

baseline reporting to determine if and how the joint cost estimates were included.

We selected seven of the 20 programs outlined in MDA’s 2019 baseline reporting, dated April 16, 2019, with the most recently established baselines (i.e., the newest block, configuration, increment, or spiral). We selected one of the four sensor (or radar) programs and excluded the Targets and Countermeasures program from the possibility of selection because it solely supports MDA testing. We selected programs with the most recently established baselines as most likely to fully reflect MDA’s more recent actions to improve its program cost estimates and enable us to assess whether such actions meet the intent of our 2013 priority recommendation.³ Our selection of programs is a non-generalizable sample, which means that any findings cannot be used to make inferences about other programs. However, we determined that our selection of programs was appropriate for our design and objectives and that the selection would generate valid and reliable evidence to support our work. The seven programs we selected are listed in table 6.

Table 6: MDA Programs Selected for Assessment against GAO’s Leading Practices for a Comprehensive Cost Estimate

Program	Original baseline	Revised baseline
Aegis Ashore (Poland site)	July 2012	Apr. 2015 Oct. 2018
Aegis Ballistic Missile Defense (BMD) Standard Missile-3 (SM-3) IIA	Apr. 2014	Jan. 2017
Aegis Weapon System (AWS) 5.1 ^a	Apr. 2014	Apr. 2015 Mar. 2016 May 2019
Army Navy/Transportable Radar Surveillance and Control Model-2 (AN/TPY-2) Configuration 4	July 2018	No
Command, Control, Battle Management, and Communications (C2BMC) Spiral 8.2-5	Oct. 2018	No
Ground-based Midcourse Defense (GMD) Enhanced Homeland Defense (EHD)	Dec. 2014	No
Terminal High Altitude Area Defense (THAAD) III	Aug. 2018	No

Source: GAO presentation of Missile Defense Agency (MDA) data. | GAO-22-104344

^aMDA refers to this Aegis Weapon System software spiral as Ballistic Missile Defense 5.x, which includes other software upgrades.

³[GAO-13-432](#).

We assessed flight test cost estimates against the accurate characteristic which has the following six leading practices: (1) uses the best methodology appropriately, (2) properly adjusted for inflation, (3) contains few, if any, minor mistakes, (4) is regularly updated with changes and actual costs, (5) documents and explains variances between the estimated and actual costs, and (6) is based on applicable historical data. We used this characteristic to assess MDA's progress addressing our 2017 recommendations to rectify deficiencies with flight test cost estimates, such as a lack of guidance and a common WBS.⁴ Further, the accurate characteristic was the most pertinent given our prior reporting on MDA's inability to meet its annual test plan for which it requests an average of approximately \$1.3 billion each fiscal year and the continued lack of insight into how much funding MDA has requested, received, and spent on a flight test within a fiscal year and over time.⁵

We selected seven of 21 flight tests planned for execution between fiscal years 2020 and 2022—four intercept and three non-intercept—outlined in MDA's 2021 test plan, dated February 10, 2020.⁶ MDA prepared all of the flight test costs estimates in this test plan using its new flight test cost model; thus, we could assess any potential progress MDA has made in addressing our 2017 recommendations.⁷ Since our selection of flight tests is a non-generalizable sample, our findings cannot be used to make inferences about other flight tests. We determined that the selection of flight tests was appropriate for our design and objectives and that the selection would generate valid and reliable evidence to support our work. The seven flight tests we selected are listed in table 7.

⁴GAO, *Missile Defense: Some Progress Delivering Capabilities, but Challenges with Testing Transparency and Requirements Development Need to Be Addressed*, [GAO-17-381](#) (Washington, D.C.: May 30, 2017).

⁵GAO, *Missile Defense: Actions Needed to Improve Transparency and Accountability*, [GAO-11-372](#) (Washington, D.C.: Mar. 24, 2011); *Missile Defense: Ballistic Missile Defense System Testing Delays Affect Delivery of Capabilities*, [GAO-16-339R](#) (Washington, D.C.: Apr. 28, 2016); and [GAO-17-381](#).

⁶An intercept flight test involves a system actively engaging one or more threat representative targets; whereas, a non-intercept test is used to assess certain aspects of system performance, with or without a target.

⁷[GAO-17-381](#).

Table 7: MDA Flight Tests Selected for Assessment against GAO’s Leading Practices for an Accurate Cost Estimate

Flight test name	Intercept or non-intercept	Planned execution date
FEX-01	Non-intercept	2QFY2020
FTM-44	Intercept	3QFY2020
FTM-46	Intercept	1QFY2022
FTT-21	Intercept	2QFY2021
FTT-25	Intercept	3QFY2022
FTX-39	Non-intercept	1QFY2020
GM BVT-03	Non-intercept	1QFY2021

Abbreviations:

- FEX Flight Test Experiment Other
- FTM Flight Test Aegis Weapon System
- FTT Flight Test Terminal High Altitude Area Defense (THAAD) Weapon System
- FTX Flight Test Other
- FY Fiscal year
- GM BVT Ground-based Midcourse Defense Weapon System Booster Vehicle Test

Source: GAO presentation of Missile Defense Agency (MDA) data. | GAO-22-104344

For both the program and flight test cost estimates, we prepared documented assessments wherein we assigned numerical ratings to each leading practice and an overall rating for the characteristic.⁸ We provided our assessments to MDA for review and incorporated any comments, additional evidence, and updates to ratings, as appropriate. We also met with MDA officials from the Cost and Test Directorates, as well as program officials, to discuss the pertinent cost estimating practices. In addition, we corresponded with DOD officials, including the Office of the Under Secretary of Defense for Research and Engineering and Acquisition and Sustainment, CAPE, and the military services (Air Force, Army, and Navy) to discuss accounting for and reporting on the operation and sustainment costs for MDA programs.

To assess the transparency and traceability of reported program costs, we used the same selection of programs as outlined above and reviewed the life cycle cost estimates MDA included in every iteration of its baseline reporting going back to each program’s original baseline, which varied

⁸We used the following scale for the ratings we assigned to each leading practice: not met = 1; minimally met = 2; partially met = 3; substantially met = 4; and met = 5. We took the average of the ratings for the leading practices to determine the overall rating for a characteristic (comprehensive or accurate) as follows: not met = 1.0 to 1.4; minimally met = 1.5 to 2.4; partially met = 2.5 to 3.4; substantially met = 3.5 to 4.4; and met = 4.5 to 5.0.

between fiscal years 2012 and 2019 (see table 6 above). We assessed whether MDA included a comparison against the initial program cost baseline in every iteration of the baseline reporting, as set forth in law.⁹ We also analyzed the program cost estimates from year-to-year to determine their reconcilability and identify any discrepancies, with the aim of assessing the extent to which MDA has addressed our 2013 priority recommendation regarding the traceability of its baseline adjustments and ability to make meaningful comparisons over time.¹⁰ In addition, we performed analysis to determine total system costs—the combined total of programs that comprise a system.

To assess the transparency and traceability of reported flight test costs, we reviewed the seven legally required reports MDA provided to Congress between March 2017 and September 2020.¹¹ Using the test plan that supported the agency’s budget request each fiscal year, we identified the flight tests MDA did and did not include in each report to Congress. We identified the amount of funding MDA requested for flight testing for fiscal years 2017 through 2020 and the flight test cost estimates MDA used to support the funding requests for those fiscal years. We compared the total amount MDA cited in the reports to Congress for flight tests against the funding MDA requested for flight testing as well as the supporting flight test cost estimates to determine the alignment. We provided a documented assessment to MDA for review and incorporated any comments, additional evidence, and updates to ratings, as appropriate. In addition, we corresponded with MDA officials from the Cost Directorate to clarify information, where needed.

We conducted this performance audit from May 2020 to February 2022 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.

⁹10 U.S.C. § 225. MDA has interpreted this statute’s reference to “initial baseline” as either the first baseline set—which we call the original baseline for the purposes of this report—or a revised baseline—which MDA refers to as a revised initial baseline.

¹⁰[GAO-13-432](#).

¹¹National Defense Authorization Act for Fiscal Year 2017, Pub. L. No. 114-328, § 1695 (2016).

Appendix II: Comments from the Department of Defense



RESEARCH
AND ENGINEERING

UNDER SECRETARY OF DEFENSE
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WASHINGTON, DC 20301-3030

20 JAN 2022

Mr. John Sawyer
Acting Director, Contracting and National Security Acquisitions
U.S. Government Accountability Office
441 G Street, NW
Washington, DC 20548

Dear Mr. Sawyer:

This is the Department of Defense response to the Government Accountability Office (GAO) Draft Report GAO-22-104344, "MISSILE DEFENSE: Addressing Cost Estimating and Reporting Shortfalls Could Improve Insight into Full Costs of Programs and Flight Tests," dated November 2021 (GAO Code 104344). The Department is providing the enclosed official written comments for inclusion in the report. My point of contact for this action is Mr. Kimo Hollingsworth, Director of Congressional Affairs, Missile Defense Agency, at 571-231-8105 or kimo.hollingsworth@mda.mil.

Sincerely,

A handwritten signature in black ink, appearing to read "Heidi Shyu".

Heidi Shyu

Enclosure:
As stated

DEPARTMENT OF DEFENSE
RESPONSE TO
GOVERNMENT ACCOUNTABILITY OFFICE
REQUEST FOR INFORMATION
“MISSILE DEFENSE AGENCY COST ESTIMATES” #104344
RESPONSES TO RECOMMENDATIONS
GAO DRAFT REPORT GAO-22-104344

REQUEST: Provide responses to the following Matters for Congressional Consideration 1 and 2 and Recommendations 1 - 6 from GAO Draft Report GAO-22-104344:

Matters for Consideration 1: *Congress should consider reviving the Director of MDA’s semiannual requirement to report on flight test costs.*

RESPONSE: No objection.

Matters for Consideration 2: *Congress should consider requiring the Director of MDA to clarify the appropriate flight test plan to be used in the agency’s methodology for semiannually reporting on flight test costs, and that both up-to-date planned and actual costs are to be cited regardless of a flight test’s execution status.*

RESPONSE: No objection.

Recommendation 1: *The Director of MDA should enforce existing policy to ensure all programs with a designated lead military service are covered by a dedicated Joint Cost Estimate (JCE) or a system-level JCE that is promptly updated with any new program’s costs.*

RESPONSE: Concur. MDA will continue to enforce existing policy for Joint Cost Estimates.

Recommendation 2: *The Director of MDA should update existing policy to specify that independent verification by DOD’s office of Cost Assessment and Program Evaluation is required to be obtained for each Joint Cost Estimate.*

RESPONSE: Concur. MDA will update MDA policy to require an independent verification from the DOD’s office of Cost Assessment and Program Evaluation of MDA-Military Service approved joint cost estimates.

**Appendix II: Comments from the Department
of Defense**

Recommendation 3: *The Director of MDA should explore potential causes for work breakdown structure (WBS) inconsistencies and implement corrective actions to ensure each program has a WBS that is aligned with the contractor WBS, and includes a WBS dictionary.*

RESPONSE: Concur. MDA recognized the WBS disconnects and updated and published the MDA Cost Estimating Handbook in July, 2021. The updated MDA Cost Estimating Handbook is provided at Attachment 22. Pages 155 through 158 outline this update.

Recommendation 4: *The Director of MDA should update its Cost Estimating Handbook and other relevant policies and guidance to specify that actual costs for flight tests be regularly incorporated, as they become available, into the agency's flight test cost estimates.*

RESPONSE: Concur. MDA updated and published the MDA Cost Estimating Handbook reflecting this update in July, 2021. The updated MDA Cost Estimating Handbook is provided at Attachment 22. Page 213 outlines this update.

Recommendation 5: *The Director of MDA should update relevant policies and processes to require the inclusion of a comparison against the original program cost baseline in each iteration of the agency's baseline reporting.*

RESPONSE: Non-concur. MDA policy already exists to account for appropriate cost reporting to initial program baselines. In accordance with 10 USC §225, the MDA Director must report against any new program baselines and may adjust or revise the existing programs' baselines. The component programs make up the single Missile Defense System (MDS). Both the January 2002 SecDef Memorandum, "Missile Defense Program Direction" and the "MDA Charter" (DoDD 5134.09) direct MDA to develop a single integrated program (i.e., MDS), apply a capability-based warfighter requirements process, and develop and deploy incremental capability to the warfighter as soon as possible.

MDA establishes new component programs and/or revises component program baselines to incorporate component program changes, to include added scope and content increases for emergent warfighter-required capability. Program scope changes are inherent in capability-based acquisition that incrementally develops and deploys capability. Existing MDA reporting policy is in accordance with 10 USC §225 and requires reporting in the annual Missile Defense Accountability Report (MDAR), formerly the Ballistic Missile Defense System Accountability Report or BAR, of comparisons to the previous MDAR and to the initial or last revised initial baselines. If the baselines are revised, comparisons are required against the previous report, the last revised initial baselines, and, in the interest of transparency, an additional comparison is required in the next MDAR against the former initial or revised baselines. While a cost comparison to the original or initial baseline can be done, it provides little value, due to the incremental addition of scope, to satisfy iterative warfighter needs.

**Appendix II: Comments from the Department
of Defense**

Recommendation 6: *The Director of MDA should update relevant policies and processes to track each system's costs—the combined total of all programs that comprise the system—in its annual baseline reporting.*

RESPONSE: Non-concur. MDA reporting policy is in accordance with 10 USC §225 and requires reporting in the annual Missile Defense Accountability Report (MDAR), formerly the Ballistic Missile Defense System Accountability Report or BAR. In the spirit of transparency, existing MDA policy directs a final report on closed component program baselines in the MDAR following the year in which the Director approves revised initial baselines that include new scope required by the warfighter. The compilation of closed and active baselines as reported in the MDAR for individual MDS component programs represent the total cost of each MDS component program and meets statutory requirements.

Appendix III: GAO Contact and Staff Acknowledgements

GAO Contact

John D. Sawyer (202) 512-4841 or SawyerJ@gao.gov

Staff Acknowledgments

In addition to the contact named above, LaTonya Miller, Assistant Director; Rose Brister; Juaná Collymore, Jennifer Echard; Emile Ettegui; Helena Johnson; Jennifer Leotta; Miranda Riemer; Kevin O'Neill; Mary Weiland; Alyssa Weir; and Robin Wilson made key contributions to this report.

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