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MISSILE DEFENSE

Opportunities Exist to Strengthen Acquisitions by Reducing Concurrency and Improving Parts Quality

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GAO-12-600T

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Highlights

Highlights of GAO-12-600T, a testimony before the Subcommittee on Strategic Forces, Committee on Armed Services, U.S. Senate

Why GAO Did This Study

In order to meet its mission, MDA is developing a highly complex system of systems—ground-, sea-, and space-based sensors, interceptors, and battle management. Since its initiation in 2002, MDA has been given a significant amount of flexibility in executing the development and fielding of the ballistic missile defense system. This statement addresses progress MDA made in the past year, the challenges it still faces with concurrent acquisitions and how it is addressing parts quality issues. It is based on GAO's April 2012 report on missile defense and its June 2011 report on space and missile defense parts quality problems.

What GAO Recommends

GAO makes no new recommendations in this statement. In the April 2012 report, GAO made recommendations to strengthen MDA's longer-term acquisition prospects including a review of MDA's acquisitions for concurrency to determine whether the proper balance has been struck between planned deployment dates and concurrency risks to achieve those dates. The report includes additional recommendations on how individual program elements can reduce concurrency. DOD agreed with six of the seven recommendations and partially agreed with one.

DOD generally concurred with the recommendations in the June 2011 report for greater coordination between government organizations responsible for major space and missile defense programs on parts quality issues and periodic reporting to Congress.

View GAO-12-600T. For more information, contact Cristina Chaplain at (202) 512-4841 or chaplainc@gao.gov.

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MISSILE DEFENSE

Opportunities Exist to Strengthen Acquisitions by Reducing Concurrency and Improving Parts Quality

What GAO Found

In fiscal year 2011, the Missile Defense Agency (MDA) experienced mixed results in executing its fiscal year 2011 development goals and tests. For the first time in 5 years, GAO was able to report that the agency delivered all of the targets used in fiscal year 2011 test events with the targets performing as expected. In addition, the Aegis Ballistic Missile Defense program's Standard Missile-3 Block IA missile was able to intercept an intermediate-range target for the first time and the Terminal High Altitude Area Defense program successfully conducted its first operational flight test. However, none of the programs GAO assessed were able to fully accomplish their asset delivery and capability goals for the year. Flight test failures, a test anomaly, and delays disrupted MDA's flight test plan and the acquisition strategies of several components. Flight test failures forced MDA to suspend or slow production of three out of four interceptors currently being manufactured. Some of the difficulties in MDA's testing and production of assets can be attributed to its highly concurrent acquisition approach.

Concurrency is broadly defined as the overlap between technology development and product development or between product development and production. High levels of concurrency were present in MDA's initial efforts and are present in current efforts. For example, MDA's flight test failures of a new variant of the Ground-based Midcourse Defense program's interceptors while production was underway delayed delivery to the warfighter, increased costs, and will require retrofit of fielded equipment. Flight test costs to confirm its capability has increased from $236 million to about $1 billion. MDA has taken positive steps to incorporate some acquisition best practices, such as increasing competition and partnering with laboratories to build prototypes. For example, MDA took actions in fiscal year 2011 to reduce acquisition risks and prevent future cost growth in its Aegis SM-3 Block IIA program. Nevertheless, as long as newer programs adopt acquisition approaches with elevated levels of concurrency, there is still considerable risk of future performance shortfalls that will require retrofits, cost overruns, and schedule delays.

MDA is also taking the initiative to address parts quality issues through various means, including internal policies, collaborative initiatives with other agencies, and contracting strategies to hold its contractors more accountable. Quality issues have seriously impeded to the development of the missile defenses in recent years. For example, during a fiscal year 2010 Terminal High Altitude Area Defense flight test, the air-launched target failed to initiate after it was dropped from the aircraft and fell into the ocean. A failure review board identified shortcomings in internal processes at the contractor to be the cause of the failure. This failure led to a delay of the planned test, restructuring of other planned tests, and hundreds of millions of dollars being spent to develop and acquire new medium-range air-launched targets. Parts quality issues will require sustained attention from both the executive and legislative branches. MDA is exhibiting some leadership, but there are significant barriers to addressing quality problems, such as the increase in counterfeit electronic parts, a declining government share of the overall electronic parts market, and workforce gaps within the aerospace sector.

Chairman Nelson, Ranking Member Sessions, and Members of the Subcommittee:

I am pleased to be here today to discuss the progress made by the Department of Defense's (DOD) Missile Defense Agency (MDA). In 2002, MDA was charged with developing and fielding the Ballistic Missile Defense System (BMDS), expected to be capable of defending the United States, deployed troops, friends, and allies against ballistic missiles of all ranges in all phases of flight. To enable MDA to field and enhance a missile defense system quickly, the Secretary of Defense in 2002 delayed entry of the BMDS program into DOD's traditional acquisition process until a mature capability was ready to be handed over to a military service for production and operation. To meet a presidential directive to deliver an initial capability by 2004 and to meet a presidential announcement in 2009 to deploy missile defenses to Europe, the program concurrently developed and fielded assets and continues to utilize this approach. Since its inception, MDA has spent more than $80 billion and plans to spend an additional $44 billion through 2016 to develop a highly complex system of systems.

Since 2002, National Defense Authorization Acts have mandated that we prepare annual assessments of MDA's ongoing cost, schedule, testing, and performance progress.[1] We recently issued our report covering MDA's progress during fiscal year 2011 as well as challenges related to MDA's use of highly concurrent acquisition strategies.[2] My statement today will focus on the issues covered in that report as well our June 2011 report on parts quality issues affecting space and missile defense

[1] National Defense Authorization Act for Fiscal Year 2002, Pub. L. No. 107-107, § 232(g) (2001); Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005, Pub. L. No. 108-375, § 233 (2004); National Defense Authorization Act for Fiscal Year 2006, Pub. L. No. 109-163, § 232; John Warner National Defense Authorization Act for Fiscal Year 2007, Pub. L. No. 109-364, § 224 (2006); and National Defense Authorization Act for Fiscal Year 2008, Pub. L. No. 110-181, § 225. See also National Defense Authorization Act for Fiscal Year 2012, Pub. L. No. 112-81, § 232 (2011).

[2] GAO, *Missile Defense: Opportunity Exists to Strengthen Acquisitions by Reducing Concurrency*, GAO-12-486 (Washington, D.C.: Apr. 20, 2012).

systems.[3] Our work highlighted a number of causal factors behind the parts quality problems being experienced at MDA and space agencies.

We conducted the work underlying this testimony according to 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. Additional information on our scope and methodology is available in each of the issued reports.

Background

MDA's BMDS is being designed to counter ballistic missiles of all ranges—short, medium, intermediate, and intercontinental.[4] Since ballistic missiles have different ranges, speeds, sizes, and performance characteristics, MDA is developing multiple systems that when integrated provide multiple opportunities to destroy ballistic missiles before they can reach their targets. The BMDS architecture includes space-based and airborne sensors as well as ground- and sea-based radars; ground- and sea-based interceptor missiles; and a command and control, battle management, and communications system to provide the warfighter with the necessary communication links to the sensors and interceptor missiles.

Table 1 provides a brief description of 10 BMDS elements and supporting efforts currently under development by MDA.

[3] GAO, Space and Missile Defense Acquisitions: Periodic Assessment Needed to Correct Parts Quality Problems in Major Programs, GAO-11-404 (Washington, D.C.: June 24, 2011).

[4] Ballistic missiles are classified by range: short-range ballistic missiles have a range of less than1,000 kilometers (621 miles), medium-range ballistic missiles have a range of from 1,000 to 3,000 kilometers (621-1,864 miles), intermediate-range ballistic missiles have a range of from 3,000 to 5,500 kilometers (1,864-3,418 miles), and intercontinental ballistic missiles have a range of greater than 5,500 kilometers (3,418 miles).

Table 1: Description of MDA's BMDS Elements and Supporting Efforts

BMDS element/supporting effort	Description
Aegis Ballistic Missile Defense (Aegis BMD) with Standard Missile-3 (SM-3) Block IA and Block IB	Aegis BMD is a sea-based missile defense system being developed in capability-based increments to defend against ballistic missiles of all ranges. Key components include the shipboard SPY-1 radar, SM-3 missiles, and command and control systems. It also is used as a forward-deployed sensor for surveillance and tracking of ballistic missiles. The SM-3 missile has multiple versions in development or production. The first two variants are referred to as the SM-3 Block IA and SM-3 Block IB.[a]
Aegis Ashore	Aegis Ashore is a future land-based variant of the ship-based Aegis BMD. It is expected to track and intercept ballistic missiles in their midcourse phase of flight using SM-3 interceptor variants as they become available. Key components include a vertical launch system and a reconstitutable enclosure that houses the SPY-1 radar and command and control system known as the deckhouse. DOD plans to deploy the first Aegis Ashore with SM-3 Block IB in the 2015 time frame as part of the missile defense of Europe called the European Phased Adaptive Approach (PAA).
Aegis BMD SM-3 Block IIA	The SM-3 Block IIA is the third SM-3 variant to be developed for use with the sea-based and future land-based Aegis Ballistic BMD. This program began in 2006 as a joint development with Japan, and it was added to the European PAA when that approach was announced in 2009. As part of European PAA Phase III, the SM-3 Block IIA is planned to be fielded with Aegis Weapons System version 5.1 by the 2018 time frame.
Aegis BMD SM-3 Block IIB	The SM-3 IIB is the fourth SM-3 variant planned. It is intended to defend against medium- and intermediate-range ballistic missiles and provide early intercept capabilities against some intercontinental ballistic missiles. The SM-3 Block IIB program began in June 2010 and is planned to be fielded by the 2020 time frame as part of the European PAA Phase IV. Given its early stage of development, program management officials stated that the SM-3 Block IIB is not managed within the Aegis BMD Program Office and has not been baselined.
BMDS Sensors	MDA is developing various sensors for fielding. These include forward-based sensors; mobile, sea-based, space-based, and airborne sensors; as well as upgrades to existing early warning radars. The BMDS uses these sensors to identify and continuously track ballistic missiles in all phases of flight.
Command, Control, Battle Management, and Communications (C2BMC)	C2BMC is the integrating element of the BMDS. Its role is to provide deliberate planning, situational awareness, sensor management, and battle management for the integrated BMDS.
Ground-based Midcourse Defense (GMD)	GMD is a ground-based missile defense system designed to destroy intermediate and intercontinental ballistic missiles during the midcourse phase of their flight. Its mission is to protect the U.S. homeland against ballistic missile attacks from North Korea and the Middle East. GMD has two ground-based interceptor variants—the Capability Enhancement I (CE-I) and the Capability Enhancement II (CE-II). MDA has emplaced its total planned inventory of 30 interceptors at two missile field sites—Fort Greely, Alaska, and Vandenberg, California.
Precision Tracking and Space System (PTSS)	PTSS is being developed as an operational component of the BMDS designed to support intercept of regional medium- and intermediate-range ballistic missile threats to U.S. forces and allies and long-range threats to the United States. PTSS will track large missile raid sizes after booster burnout, which could enable earlier intercepts.
Targets and Countermeasures	MDA develops and manufactures highly complex targets for short, medium, intermediate, and eventually intercontinental ranges used in BMDS flight tests to present realistic threat scenarios. The targets are designed to encompass the full spectrum of threat missile ranges and capabilities.

BMDS element/supporting effort	Description
Terminal High Altitude Area Defense (THAAD)	THAAD is a ground-based missile defense system designed to destroy short- and medium-range ballistic missiles during the late-midcourse and terminal phases of flight. Its mission is to defend deployed U.S. forces and friendly foreign population centers.

Source: MDA data.

Note: The European PAA is a policy announced by the President in 2009 that articulates a schedule for delivering four phases of capability to defend Europe and augment current protection of the U.S. homeland in the following timeframes: Phase 1 in 2011, Phase 2 in 2015, Phase 3 in 2018, and Phase 4 in 2020.

[a]MDA is currently developing or producing four versions of the SM-3 interceptor—IA, IB, IIA, and IIB. The SM-3 Block IA and SM-3 Block IB are the earlier variants of the missile. The SM-3 Block IIA and SM-3 Block IIB are planned to provide successively greater range and velocity to intercept medium to long-range ballistic missiles.

MDA Experienced Mixed Progress in Development and Delivery Efforts

MDA experienced mixed results in executing its fiscal year 2011 development goals and BMDS tests. For the first time in 5 years, we are able to report that all of the targets used in fiscal year 2011 test events were delivered as planned and performed as expected. In addition, the Aegis BMD program's SM-3 Block IA missile was able to intercept an intermediate-range target for the first time. Also, the THAAD program successfully conducted its first operational flight test in October 2011. However, none of the programs we assessed were able to fully accomplish their asset delivery and capability goals for the year.

See table 2 for how each of these programs met some of its goals during the fiscal year. Our report provides further detail on these selected accomplishments.[5]

[5] GAO-12-486.

Table 2: BMDS Fiscal Year 2011 Selected Accomplishments

Element	Fully accomplished goals	Partially or not accomplished goals
Aegis BMD SM-3 Block IA	An April 2011 flight test demonstrated capability required for European Phased Adaptive Approach (PAA) Phase I. Deployed first ship in support of European PAA Phase I.	Delivered 6 out of 19 planned missiles by the end of fiscal year 2011; delivery of 12 missiles is on hold pending the results of the failure investigation of the anomaly that occurred during an April 2011 flight test. Depending on the results, delivered missiles may have to be retrofitted.
Aegis BMD SM-3 Block IB	Delivered first SM-3 Block IB developmental interceptor and fired it in the first flight test in September 2011.	The SM-3 Block IB failed to intercept the target during its first flight test, resulting in a failure review board investigation of the cause of the failure. The flight test is scheduled to be reconducted in 2012, delaying the certification of the Aegis BMD 4.0.1 weapon system.
Aegis BMD SM-3 Block IIA	None	Subsystem preliminary design review failures led to a program replan that adjusted the preliminary design review date to fiscal year 2012 and included new subsystem reviews for the failed components. The new subsystem reviews were completed in fiscal year 2011 and early fiscal year 2012.
Aegis BMD SM-3 Block IIB	Awarded three concept definition and program planning contracts in April 2011 and approved to begin technology development in July 2011.	Demonstration of low-cost divert and attitude control system components was delayed until the first quarter of fiscal year 2012.
Aegis Ashore	Completed preliminary design review in August 2011.	A new deckhouse fabrication plan delayed the award of the deckhouse fabrication contract, procurement of deckhouse fabrication materials, and the start of construction.
GMD	Completed three of the five limited interceptor upgrades, partially to resolve component issues identified in developmental testing and manufacturing.	Flight test failure in the first quarter of fiscal year 2011 resulted in interceptor production suspension pending the completion of an investigation and a successful non-intercept flight test.
PTSS	Completed system requirements and system design reviews in the second quarter of fiscal year 2011.	Approval to begin technology development was delayed to the fourth quarter of fiscal year 2012.
Targets	Launched all 11 targets as planned.	Delivered 11 out of 14 targets it had planned.
THAAD	Successfully conducted first operational flight test in October 2011. Delivered 11 missiles.	Materiel release to Army delayed to the second quarter of fiscal year 2012. THAAD delayed plans to deliver first battery to fiscal year 2012 because of production issues with the interceptor.

Source: GAO analysis of MDA data.

Note: BMDS fiscal year 2011 asset and capability deliveries for Airborne Infrared; C2BMC; joint U.S.-Israel BMDS; Sea-based X-band radar; and Space Tracking and Surveillance System elements were not reviewed.

Although some programs completed significant accomplishments during the fiscal year, there were also several critical test failures. These as well as a test anomaly and delays disrupted MDA's flight test plan and the acquisition strategies of several components. Overall, flight test failures and an anomaly forced MDA to suspend or slow production of three out of four interceptors currently being manufactured.

- The Aegis BMD SM-3 Block IA program conducted a successful intercept in April 2011, but there was an anomaly in a critical component of the interceptor during the test. This component is common with the Block IB missile. Program management officials stated that the SM-3 Block IA deliveries have been suspended while the failure reviews are being conducted.

- The Aegis BMD SM-3 Block IB program failed in its first intercept attempt in September 2011. The Aegis program has had to add an additional flight test and delay multiple other flight tests. Program management officials stated that the SM-3 Block IB production has been slowed while the failure reviews are being conducted.

- The GMD program has been disrupted by two recent test failures. As a result of a failed flight test in January 2010, MDA added a retest designated as Flight Test GMD-06a (FTG-06a).[6] However, this retest also failed in December 2010 because of a failure in a key component of the kill vehicle. As a result of these failures, MDA has decided to halt flight testing and restructure its multiyear flight test program, halt production of the interceptors, and redirect resources to return-to-flight activities.

Production issues forced MDA to slow production of the THAAD interceptors, the fourth missile being manufactured.

Highly Concurrent Acquisition Strategies Often Lead to Performance, Cost, and Schedule Consequences

To meet the 2002 presidential direction to initially rapidly field and update missile defense capabilities as well as a 2009 presidential announcement to deploy missile defenses in Europe, MDA has undertaken and continues to undertake highly concurrent acquisitions. While this approach enabled MDA to rapidly deploy an initial capability in 2005 by concurrently developing, manufacturing, and fielding BMDS assets, it also led to the initiation of large-scale acquisition efforts before critical technologies were fully understood and allowed programs to move forward into production without having tests completed to verify performance. After delivering its initial capability in 2005, MDA continued these high-risk practices that have resulted in problems requiring extensive retrofits, redesigns, delays, and cost increases. While MDA has incorporated some acquisition best practices in its newer programs, its

[6] The failed January 2010 flight test—FTG-06—was planned as the first test of GMD's enhanced version of the kill vehicle—the CE-II.

acquisition strategies still include high or elevated levels of concurrency that result in increased acquisition risk—including performance shortfalls, cost growth, and schedule delays—for these newer programs.

Concurrency is broadly defined as overlap between technology development and product development or between product development and production of a system. This overlap is intended to introduce systems rapidly, to fulfill an urgent need, to avoid technology obsolescence, and to maintain an efficient industrial development and production workforce. However, while some concurrency is understandable, committing to product development before requirements are understood and technologies mature as well as committing to production and fielding before development is complete is a high-risk strategy that often results in performance shortfalls, unexpected cost increases, schedule delays, and test problems.[7] At the very least, a highly concurrent strategy forces decision makers to make key decisions without adequate information about the weapon's demonstrated operational effectiveness, reliability, logistic supportability, and readiness for production. Also, starting production before critical tests have been successfully completed has resulted in the purchase of systems that do not perform as intended. These premature commitments mean that a substantial commitment to production has been made before the results of testing are available to decision makers. Accordingly, they create pressure to avoid production breaks even when problems are discovered in testing. These premature purchases have affected the operational readiness of our forces and quite often have led to expensive modifications.

In contrast, our work has found that successful programs that deliver promised capabilities for the estimated cost and schedule follow a systematic and disciplined knowledge-based approach, in which high levels of product knowledge are demonstrated at critical points in development.[8] This approach recognizes that development programs require an appropriate balance between schedule and risk and, in practice, programs can be executed successfully with some level of

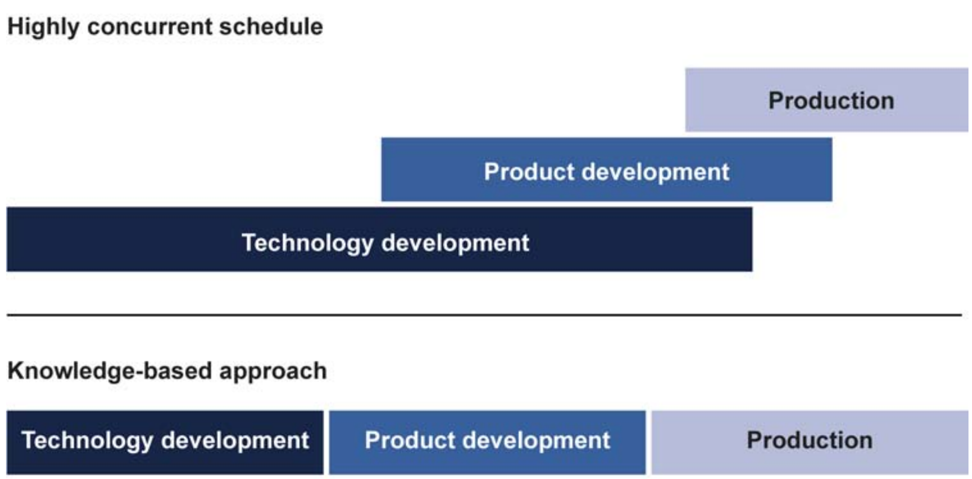
[7] GAO, *Best Practices: Capturing Design and Manufacturing Knowledge Early Improves Acquisition Outcomes*, GAO-02-701 (Washington, D.C.: July 15, 2002), and *Defense Acquisitions: Production and Fielding of Missile Defense Components Continue with Less Testing and Validation Than Planned*, GAO-09-338 (Washington, D.C.: Mar. 13, 2009).

[8] GAO, *Defense Acquisitions: Assessments of Selected Major Weapon Programs*, GAO-06-391 (Washington, D.C.: Mar. 31, 2006).

concurrency. For example, it is appropriate to order long-lead production material in advance of the production decision, with the pre-requisite that developmental testing is substantially accomplished and the design confirmed to work as intended. This knowledge-based approach is not unduly concurrent. Rather, programs gather knowledge that demonstrates that their technologies are mature, designs are stable, and production processes are in control before transitioning between acquisition phases, which helps programs identify and resolve risks early. It is a process in which technology development and product development are treated differently and managed separately. Technology development must allow room for unexpected results and delays. Developing a product culminates in delivery and therefore gives great weight to design and production. If a program falls short in technology maturity, it is harder to achieve design stability and almost impossible to achieve production maturity. It is therefore key to separate technology from product development and product development from production—and thus avoid concurrency. A knowledge-based approach delivers a product on time, within budget, and with the promised capabilities.

See figure 1 for depictions of a concurrent schedule and a schedule that uses a knowledge-based approach.

Figure 1: Concurrency Compared to the Knowledge-Based Approach



Source: GAO analysis.

MDA's Concurrent Acquisition Strategies Allowed It to Deliver Assets Quickly but Also Led to Performance Issues with Cost and Schedule Consequences

To meet the 2002 presidential direction to initially rapidly field and update missile defense capabilities as well as the 2009 presidential announcement to deploy missile defenses in Europe, MDA has undertaken and continues to undertake highly concurrent acquisitions. Such practices enabled MDA to quickly ramp up efforts in order to meet tight presidential deadlines, but they were high risk and resulted in problems that required extensive retrofits, redesigns, delays, and cost increases.

Table 3 illustrates concurrency in past efforts and its associated effects. Among earlier MDA programs, concurrency was most pronounced in the GMD program, where the agency was pressed to deliver initial capabilities within a few years to meet the 2002 presidential directive. The consequences here have been significant, in terms of production delays and performance shortfalls, and are still affecting the agency.

Table 3: Examples of Concurrency in MDA Programs' Acquisition Strategies and Associated Effects

MDA program	Acquisition concurrency	Associated effects
GMD's initial capability including CE-I interceptors in 2004[a]	To meet the presidential directive to deploy an initial set of missile defense capabilities by 2004, the program concurrently matured technology, designed the system, tested the design, and produced and deployed an initial set of missile defense capabilities.	CE-I interceptors were rapidly delivered to the warfighter requiring an extensive and expensive retrofit and refurbishment program that is still ongoing.
GMD's enhanced interceptor production[a]	Prior to fully completing development and demonstrating the capability of the CE-I interceptor, MDA committed in 2004 to development of an enhanced version of the interceptor called the CE-II. MDA proceeded to concurrently develop, manufacture, and deliver 12 of these interceptors The first and second flight tests of the enhanced interceptor failed.	CE-II interceptors were delivered prematurely to the warfighter and will require an extensive and expensive retrofit. It will take several additional years to demonstrate full CE-II capabilities. Production has been halted and the flight test plan has been altered, increasing the cost to initially confirm the CE-II capability from $236 million to about $1 billion.
Aegis BMD SM-3 Block IB	MDA approved production of the SM-3 Block IB missile before completing developmental testing to confirm that the technologies were fully mature and the design worked as intended. In addition, MDA decided to manufacture SM-3 Block IB missiles beyond those needed for developmental testing before some criteria were met, including a successful first flight test demonstrating that the system functioned as intended.	Production has been delayed, delivery of capability has been delayed, and development costs have grown. The program has had to add an additional flight test and delay multiple additional flight tests due to the failure of the program's first attempted intercept in September 2011. Because of the failure, MDA was unable to validate initial SM-3 Block IB capability. In addition, an anomaly occurred in an April 2011 flight test of the SM-3 Block IA in a booster component that is common with the Block IB missile. Block IB production is being slowed while failure reviews are being conducted.

MDA program	Acquisition concurrency	Associated effects
THAAD	The agency awarded a contract for the production of THAAD's first two operational batteries before its design was stable and developmental testing of all critical components was complete.	Problems encountered while THAAD was concurrently designing and producing assets delayed fielding of the first two THAAD batteries by more than 2 years and increased costs by $40 million.

Source: GAO analysis of MDA data.

[a]High levels of concurrency will continue for the GMD program with developmental flight testing extending until at least 2022, well after production of the interceptor is scheduled to be completed. MDA is accepting the risk that these developmental flight tests may discover issues that require costly design changes and retrofit programs to resolve.

In recent years, MDA has taken positive steps to incorporate some acquisition best practices, such as increasing competition and partnering with laboratories to build prototypes. For example, MDA took actions in fiscal year 2011 to reduce acquisition risks and prevent future cost growth in its Aegis BMD SM-3 Block IIA program. The agency recognized that the program's schedule included elevated acquisition risks, so it appropriately added more time to the program by revising the schedule to relieve schedule compression between its subsystem and system-level design reviews. In addition, it incorporated lessons learned from other SM-3 variants into its development to further mitigate production unit costs. Moreover, for its PTSS program, MDA has simplified the design and requirements.

However, table 4 shows that the agency's current acquisition strategies still include high or elevated levels of concurrency that set many of its newer programs up for increased acquisition risk, including performance shortfalls, cost growth, and schedule delays.

Table 4: MDA's Acquisition Concurrency and Associated Risks in Its Newer Programs

MDA program	Acquisition concurrency	Risks
Aegis BMD SM-3 Block IIB	Based on a tentative schedule, the program plans to commit to product development more than a year prior to holding a preliminary design review. By contrast, major defense acquisition programs outside MDA are generally required to complete this review before committing to product development.	Without holding key system engineering events culminating in a preliminary design review, programs cannot ensure that requirements are defined and feasible and that the proposed design can meet those requirements within cost, schedule, and other system constraints.
Aegis Ashore	The program began product development for two Aegis Ashore systems—one designated for testing and the other operational— and set the acquisition baseline before completing the preliminary design review. High levels of concurrency can be seen in its construction and procurement plan, and the program has not aligned its flight testing schedule with construction and component procurement decisions.	There are increased technical risks and increased risk of cost growth because the agency committed to product development for the two systems with less technical knowledge than recommended by acquisition best practices and without ensuring that requirements were defined, feasible, and achievable within cost and schedule constraints.
Precision Tracking and Space System	An industry team will develop and produce two engineering and manufacturing development satellites while a laboratory-led contractor team is still in the development phase of building two lab development satellites.	This strategy may not enable decision makers to fully benefit from the knowledge gained through on-orbit testing of the lab-built satellites and its design before making major commitments on the industry-built development satellites since those will be under contract and under construction before the on-orbit testing can take place.

Source: GAO analysis of MDA data.

In our April 2012 report, we made two recommendations to strengthen MDA's longer-term acquisition prospects.[9] We recommended that the Secretary of Defense direct the Office of Acquisition Technology and Logistics to (1) review all of MDA's acquisitions for concurrency and determine whether the proper balance has been struck between the planned deployment dates and the concurrency risks taken to achieve those dates and (2) review and report to the Secretary of Defense the extent to which the directed capability delivery dates announced by the President in 2009 are contributing to concurrency in missile defense acquisitions and recommend schedule adjustments where significant benefits can be obtained by reducing concurrency. DOD concurred with both of these recommendations.

[9] GAO-12-486.

In addition, we recommended specific steps to reduce concurrency in several of MDA's programs. DOD agreed with four of the five missile defense element-specific recommendations and partially agreed with our recommendation to report to the Office of the Secretary of Defense and to Congress the root cause of the SM-3 Block IB developmental flight test failure, path forward for future development, and the plans to bridge production from the SM-3 Block IA to the SM-3 Block IB before committing to additional purchases of the SM-3 Block IB. DOD commented that MDA will report this information to the Office of the Secretary of Defense and to Congress upon completion of the failure review in the third quarter of fiscal year 2012. However, DOD makes no reference to delaying additional purchases until the recommended actions are completed. We maintain our position that MDA should take the recommended actions before committing to additional purchases of the SM-3 Block IB.

Parts Quality Issues Have Also Had a Significant Effect on Performance, Cost, and Schedule

MDA parts quality issues have seriously impeded the development of the BMDS in recent years. For example, during a THAAD flight test in fiscal year 2010, the air-launched target failed to initiate after it was dropped from the aircraft and fell into the ocean. The test was aborted and a subsequent failure review board investigation identified as the immediate cause of the failure the rigging of cables to the missile in the aircraft and shortcomings in internal processes at the contractor as the underlying cause. This failure led to a delay of the planned test, restructuring of other planned tests, and hundreds of millions of dollars being spent to develop and acquire new medium-range air-launched targets. In another widely-reported example, the GMD element's first intercept test of its CE-II Ground-Based Interceptor failed and the ensuing investigation determined the root cause of the failure to be a quality control event. This failure also caused multiple flight tests to be rescheduled, delayed program milestones, and cost hundreds of millions of dollars for a retest.

In view of the cost and importance of space and missile defense acquisitions, we were asked to examine parts quality problems affecting satellites and missile defense systems across DOD and the National Aeronautical and Space Administration. In June 2011, we reported that parts problems discovered after assembly or integration of the instrument or spacecraft had more significant consequences as they required lengthy failure analysis, disassembly, rework, and reassembly—sometimes resulting in a launch delay. For example, the Space Tracking and Surveillance System program, a space-based infrared sensor program with two demonstration satellites that launched in September 2009, discovered problems with defective electronic parts in the Space-Ground

Link Subsystem during system-level testing and integration of the satellite. By the time the problem was discovered, the manufacturer no longer produced the part and an alternate contractor had to be found to manufacture and test replacement parts. According to officials, the problem cost about $7 million and was one of the factors that contributed to a 17-month launch delay of two demonstration satellites and delayed participation in the BMDS testing we reported on in March 2009.[10]

Our work highlighted a number of causal factors behind the parts quality problems being experienced at MDA and space agencies.[11] While we present examples of the parts quality issues we found at MDA below, the June 2011 report also describes the parts quality issues we found with other space agencies.

- *Poor workmanship*. For example, poor soldering workmanship caused a power distribution unit to experience problems during vehicle-level testing on MDA's Targets and Countermeasures program. According to MDA officials, all units of the same design by the same manufacturer had to be X-ray inspected and reworked, involving extensive hardware disassembly. As a corrective action, soldering technicians were provided with training to improve their soldering operations and ability to perform better visual inspections after soldering.

- *The use of undocumented and untested manufacturing processes*. For example, MDA's Aegis BMD program reported that the brackets used to accommodate communications and power cabling were improperly bonded to SM-3 Block IA rocket motors, potentially leading to mission failure. A failure review board determined that the subcontractor had changed the bonding process to reduce high scrap rates and that the new process was not tested and verified before it was implemented.

- *Poor control of manufacturing materials and the failure to prevent contamination*. The GMD program reported a problem with defective titanium tubing. The defective tubing was rejected in 2004 and was to be returned to the supplier; however, because of poor control of

[10] GAO, *Defense Acquisitions: Assessments of Selected Weapon Programs*, GAO-09-326SP (Washington, D.C.: Mar. 30, 2009).

[11] GAO-11-404.

manufacturing materials, a portion of the material was not returned and was inadvertently used to fabricate manifolds for two complete CE-II Ground-Based Interceptors. The vehicles had already been processed and delivered to the prime contractor for integration when the problem was discovered.

- *Prime contractor's failure to ensure that its subcontractors and suppliers met program requirements*. The GMD program experienced a failure with an electronics part purchased from an unauthorized supplier. According to program officials, the prime contractor required subcontractors to only purchase parts from authorized suppliers; however, the subcontractor failed to execute the requirement and the prime contractor did not verify compliance.

At the time of our June 2011 report, MDA had instituted policies to prevent and detect parts quality problems. The programs reviewed in the report—GMD, Aegis BMD, Space Tracking and Surveillance System, and Targets and Countermeasures—were initiated before these recent policies aimed at preventing and detecting parts quality problems took full effect. In addition to new policies focused on quality, MDA has developed a supplier road map database in an effort to gain greater visibility into the supply chain to more effectively manage supply chain risks. In addition, according to MDA officials, MDA has recently been auditing parts distributors in order to rank them for risk in terms of counterfeit parts.

MDA also participates in a variety of collaborative initiatives to address quality, in particular, parts quality. These range from informal groups focused on identifying and sharing news about emerging problems as quickly as possible, to partnerships that conduct supplier assessments, to formal groups focused on identifying ways industry and the government can work together to prevent and mitigate problems.

Moreover, since our report, MDA has added a new clause in one of its GMD contracts to provide contractor accountability for quality. We have not yet fully assessed the clause but it may allow the contracting officer to make an equitable reduction of performance incentive fee on two contract line items for certain types of quality problems. This new clause shows some leadership by MDA to hold contractors accountable for parts quality. But, we do not yet know what the impact of this clause will be on improving MDA's problems with parts quality.

Our June 2011 report recommended greater coordination between government organizations responsible for major space and missile defense programs on parts quality issues and periodic reporting to Congress. DOD partially concurred with our recommendation for greater coordination but responded that it would work with the National Aeronautics and Space Administration to determine the optimal government-wide assessment and reporting implementation to include all quality issues, of which parts, materials, and processes would be one of the major focus areas. In addition, DOD proposed an annual reporting period to ensure planned, deliberate, and consistent assessments. We support DOD’s willingness to address all quality issues and to include parts, materials, and processes as an important focus area in an annual report. DOD further stated that it had no objection to providing a report to Congress, if Congress wanted one. We believe that DOD should proactively provide its proposed annual reports to Congress on a routine basis, rather than waiting for any requests from Congress, which could be inconsistent from year to year.

The parts quality issues will require sustained attention from both the executive and legislative branches to improve the quality of the systems in development, particularly because there are significant barriers to addressing quality problems, such as an increase in counterfeit electronic parts, a declining government share of the overall electronic parts market, and workforce gaps within the aerospace sector.

Concluding Observations

In conclusion, as the MDA completes a decade of its work, it continues to make progress in delivering assets, completing intercept tests, and addressing some of the quality issues that have plagued it in the past. This year, there were significant accomplishments, such as the successful operational test for THAAD, but also setbacks, including failed tests and their aftermath. Such setbacks reflect inherent risks associated with the challenging nature of missile defense development, but they are also exacerbated by strategies that adopt high levels of concurrency that leave decision makers with less knowledge than needed to move programs forward. Given that initial capabilities are now in place and broader fiscal pressures require sound and more efficient management approaches, it is now time for DOD to reassess MDA's strategy of accelerating development and production to determine whether this approach needs to be rethought for current and future BMDS programs.

Chairman Nelson, Ranking Member Sessions, and Members of the Subcommittee, this concludes my statement. I am happy to answer any questions you have.

GAO Contact and Staff Acknowledgments

For future questions about this statement, please contact me at (202) 512-4841 or chaplainc@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this statement. Individuals making key contributions to this statement include David B. Best, Assistant Director; Meredith Allen Kimmett; Ivy Hubler; Steven Stern; Ann Rivlin; Kenneth E. Patton; Robert S. Swierczek; and Alyssa B. Weir.

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