United States Government Accountability Office

Report to Congressional Committees

June 2024

# MISSILE DEFENSE

# Next Generation Interceptor Program Should Take Steps to Reduce Risk and Improve Efficiency

GAO-24-106315

GAO Highlights

Highlights of GAO-24-106315, a report to congressional committees

June 2024

# MISSILE DEFENSE

## Next Generation Interceptor Program Should Take Steps to Reduce Risk and Improve Efficiency

## Why GAO Did This Study

According to DOD, potential adversaries are expanding and enhancing their missile capabilities to attack the U.S., while current U.S. interceptors approach the end of their planned service life. To address this challenge, DOD has stated that it needs to begin fielding the NGI by 2028. To assist in this effort, MDA plans to use virtual tools and software to increase the program's efficiency.

Congress included a provision in statute for MDA to annually report on the status of NGI's development goals, cost, and stakeholder reviews and for GAO to assess NGI's acquisition progress. This report addresses the extent to which MDA (1) made progress in developing NGI, (2) addressed significant NGI technical risks, and (3) implemented a virtual environment to facilitate NGI development.

GAO reviewed DOD documents and independent risk, cost, and test assessments and interviewed DOD officials. GAO conducted site visits to observe construction of NGI's launch facility and key supporting radars.

## What GAO Recommends

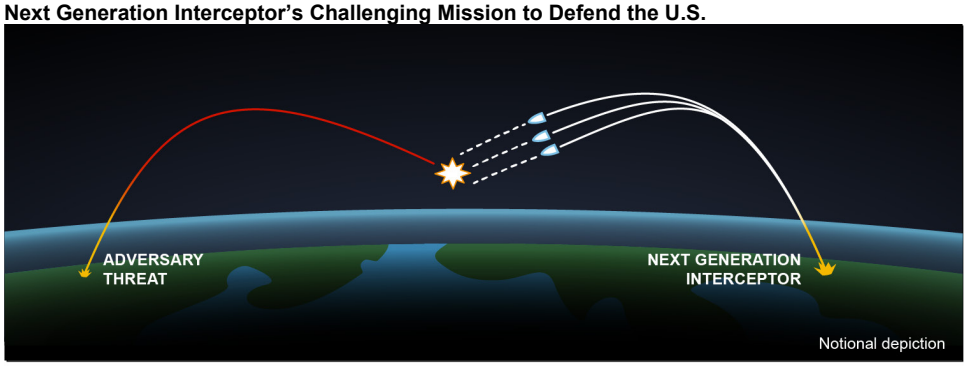
GAO is making five recommendations to DOD, including to regularly coordinate with stakeholders regarding MDA's threat requirements, ensure performance simulations fully represent the environment NGI is expected to operate in, and periodically assess efforts to implement a virtual environment. DOD agreed with one recommendation but did not agree with the other four. GAO maintains that all of the recommendations are valid, as discussed in this report.

View GAO-24-106315. For more information, contact Jon Ludwigson at (202) 512-4841 or LudwigsonJ@gao.gov.

## What GAO Found

The Missile Defense Agency (MDA) is developing a new system—the Next Generation Interceptor (NGI)—to defend the U.S. against complex missile attacks (see figure). The Department of Defense (DOD) tasked MDA with expediting the system's development and fielding interceptors starting in 2028.

**Next Generation Interceptor's Challenging Mission to Defend the U.S.**




Source: GAO analysis of Missile Defense Agency information. | GAO-24-106315

The NGI program is on track to start product development in 2024 but the program is planning to overlap design and production activities to accelerate flight testing. Any major design issues could disrupt this strategy. Further, the schedule for NGI is already optimistic when compared to development timeframes of similar weapon systems and MDA's history of unmet testing goals, as GAO reported in May 2023 (GAO-23-106011). NGI's costs have also increased by hundreds of millions of dollars, but the program is still within planned funding levels. MDA officials expect further increases due to supply chain issues and rising material costs.

In 2022, DOD's independent review identified multiple high-risk items and actions MDA could take to reduce technical risk. MDA disagreed with key aspects of the risk assessment and, to date, has taken limited steps to mitigate these risks. For example:

- MDA has not fully addressed directions from DOD officials regarding updating NGI's threat-related performance requirements, monitoring and reporting threat changes, and collaborating with stakeholders.
- MDA intends to make key acquisition decisions based on NGI performance simulations that do not fully represent how the warfighter intends to use the system—a necessary step to verify NGI designs are sufficiently mature and will meet performance requirements.

By not addressing these risks in a timely manner, MDA is increasing the potential for later discovering performance shortfalls that could delay the program.

MDA made some initial progress establishing a virtual environment to enable collaboration on NGI development. However, MDA encountered challenges and is not periodically assessing implementation progress, as it had planned. Doing so could help MDA identify potential efficiencies to achieve its fielding deadline.

# Contents

## Abbreviations

| | |
|---|---|
| A&S | Acquisition and Sustainment |
| CAPE | Cost Assessment and Program Evaluation |
| DOD | Department of Defense |
| DOT&E | Director, Operational Test and Evaluation |
| GMD | Ground-Based Midcourse Defense |
| IT | information technology |
| MDA | Missile Defense Agency |
| MDS | Missile Defense System |
| NGI | Next Generation Interceptor |
| OUSD | Office of the Under Secretary of Defense |
| R&E | Research and Engineering |
| USD | Under Secretary of Defense |

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Congressional Committees

Since 2002, the Missile Defense Agency (MDA) has been developing the Ground-Based Midcourse Defense (GMD) system to defend the U.S. homeland against a limited ballistic missile attack from potential adversaries such as North Korea and Iran. Over the past two decades, MDA developed and fielded a fleet of over 40 Ground-Based Interceptors at Fort Greely, Alaska and Vandenberg Space Force Base, California to defend against these missile threats.[1] However, according to the Department of Defense (DOD), North Korea has continued to expand its nuclear and missile capabilities and Iran has continued to pursue a space program, which could lead to a long-range missile capability. Meanwhile, the Ground-Based Interceptors continue to age and approach the end of their planned 20-year service life.[2]

MDA is developing a new, more capable GMD interceptor, called the Next Generation Interceptor (NGI), to respond to evolving threats and augment and eventually replace the aging Ground-Based Interceptors. According to U.S. Northern Command, NGI is a priority for homeland missile defense, with initial fielding needed starting in fiscal year 2028 or sooner.[3] Congress has also noted the need for DOD to ensure NGI receives rigorous technical and acquisition oversight and mitigate risks early in the program.[4] DOD responded, in part, by conducting independent technical risk and cost assessments of the program. For example, DOD's Director for Cost Assessment and Program Evaluation (CAPE) estimates the total cost to design, develop, produce, operate, and sustain an initial capability of 20 production unit NGIs and additional test articles will exceed $17 billion. NGI is also the first program MDA is developing and managing in a

[1]The Ground-Based Interceptor is a three-stage missile equipped with a kill vehicle payload that destroys ballistic missiles using the force of a direct collision.

[2]MDA is performing service life extensions and maintenance on the existing fleet to ensure it remains viable until replacement interceptors are fielded. For more information, see GAO, *Missile Defense: Annual Goals Unmet for Deliveries and Testing*, GAO-23-106011 (Washington, D.C.: May 18, 2023).

[3]GMD is operated by U.S. Northern Command, which is one of 11 combatant commands within DOD and is responsible for deterring, detecting, and defeating threats to the U.S.

[4]See the National Defense Authorization Act for Fiscal Year 2020, Pub. L. No. 116-92, § 1687(a)(2) (2019).

digital engineering environment that relies on digital tools for collaboration and design to, among other things, improve program efficiency.

In our prior reporting on missile defense, we have highlighted the importance of MDA incorporating lessons learned into the NGI program.[5] Lessons we have reported include: (1) utilizing knowledge-based practices; (2) involving stakeholders early and often; (3) performing robust testing; (4) promoting competition; and (5) providing effective oversight. Although MDA is planning to use event-driven, performance-based knowledge points to assess NGI progress, we have also previously found that MDA has often fallen back to some high risk practices (e.g., overlapping development with production, reducing testing) when faced with developmental delays or schedule pressures.[6] Instead, our prior work has shown that adhering to a knowledge-based acquisition approach that couples rigorous engineering with well-informed requirements should provide MDA with a faster, more reliable pathway for delivering capability to the warfighter.[7]

The National Defense Authorization Act for Fiscal Year 2022 directed MDA to annually submit "accountability matrices" to Congress and GAO describing the status of NGI's development goals, cost, and stakeholder reviews.[8] The Act also contained a provision for GAO to assess NGI's acquisition progress. This report addresses the extent to which MDA has (1) made progress in developing NGI, (2) addressed significant NGI technical risks, and (3) implemented a digital engineering environment to facilitate NGI development.

To assess the extent to which MDA has made progress developing NGI, we compared the current status of key NGI development activities and program cost described in MDA's May 2023 NGI accountability matrices report and program execution materials to MDA's original plans, such as the program's 2020 acquisition strategy. We met with officials from MDA

[5]See GAO, *Missile Defense: Observations on Ground-based Midcourse Defense Acquisition Challenges and Potential Contract Strategy Changes*, GAO-21-135R (Washington, D.C.: Oct. 21, 2020).

[6]See GAO, *Missile Defense: Lessons Learned From Acquisition Efforts*, GAO-20-490T (Washington, D.C.: Mar. 12, 2020).

[7]GAO, *Defense Acquisitions: Joint Action Needed by DOD and Congress to Improve Outcomes*, GAO-16-187T (Washington, D.C.: Oct. 27, 2015).

[8]Pub. L. No. 117-81, § 1668 (2021) (as amended by the National Defense Authorization Act for Fiscal Year 2024, Pub. L. No. 118-31, § 1662 (2023)).

and the NGI contractors, Lockheed Martin and Northrop Grumman, to discuss the progress of key activities. In addition, we interviewed officials from the Office of the Under Secretary of Defense (OUSD) for Research and Engineering (R&E), OUSD for Acquisition and Sustainment (A&S), and Director for Operational Test and Evaluation (DOT&E). MDA has fielded GMD and supporting missile capabilities at various locations in the U.S. and throughout the world that will integrate with NGI once it is fielded. We visited Fort Greely, Alaska to view the deployed GMD system and the construction progress at the GMD missile field where future NGIs will be installed. In addition, we visited Clear Space Force Base, Alaska to observe radars that will support NGI in defending against future threat advancements. We also met with GMD operators from the U.S. Army's 100th Missile Defense Brigade at Fort Greely and Schriever Space Force Base, Colorado and observed these crews conducting simulated GMD engagements to gain insights into how warfighter operations will evolve once NGI is fielded.

To assess the extent to which MDA addressed significant NGI technical risks, we reviewed an independent technical risk assessment report of the NGI program completed by OUSD(R&E) in July 2022. We tailored the scope of our assessment based on the ratings assigned in OUSD(R&E)'s assessment, focusing on the most significant risks that OUSD(R&E) assessed as having a high likelihood of occurrence and high consequence. We reviewed responses MDA provided to OUSD(R&E) for each significant risk item and any actions the GMD program planned to take to mitigate the risks. We compared OUSD(R&E)'s assessment and MDA's responses and planned actions to program requirements and DOD guidance and policy. These included a January 2021 technology development decision memorandum from the Under Secretary of Defense (USD) for A&S and DOD's September 2020 policy for use of intelligence in defense acquisitions.[9] We also compared MDA's planned actions to some of the key acquisition best practices we have emphasized in our reporting on missile defense acquisition.[10] We met

[9]See Under Secretary of Defense for Acquisition and Sustainment, *Ballistic Missile Defense System – Next Generation Interceptor Technology Development Decision Memorandum* (Jan. 13, 2021); and DOD Instruction 5000.86, *Acquisition Intelligence* (Sept. 11, 2020).

[10]See GAO, *Missile Defense: Recent Acquisition Policy Changes Balance Risk and Flexibility, but Actions Needed to Refine Requirements Process*, GAO-22-563 (Washington, D.C.: Nov. 10, 2021); and *Missile Defense: Further Collaboration with the Intelligence Community Would Help MDA Keep Pace with Emerging Threats*, GAO-20-177 (Washington, D.C.: Dec. 11, 2019).

with the NGI contractors and the following DOD components to obtain their perspectives on NGI's technical risks: MDA, OUSD(R&E), OUSD(A&S), DOT&E, joint staff, U.S. Northern Command, U.S. Space Command, and the National Air and Space Intelligence Center. We also obtained relevant information from the Defense Intelligence Agency and the U.S. Army's Missile Defense System Operational Test Agency.[11]

To assess the extent to which MDA implemented a digital engineering environment to facilitate NGI development, we reviewed program planning and execution documents to identify current implementation status and any significant cost or schedule variances attributed to digital engineering implementation. We compared MDA's implementation plans to DOD guidance for transitioning to a digital engineering environment and GAO's leading practices for iterative product development, Agile implementation, and knowledge-based missile defense acquisition practices.[12] We met with MDA, the NGI prime contractors, and OUSD(R&E) to discuss risks and issues the GMD program has faced while implementing DOD's Digital Engineering Strategy and the extent to which the program office has implemented its digital engineering infrastructure.

For the purposes of this report, we generally discuss the NGI program as a collective, government-managed effort and, except where noted, do not describe the plans, actions, or perspectives of any one contractor. MDA established policies, procedures, and standards to protect information associated with NGI's competitive development approach. According to MDA, the agency is protecting business information (e.g., proprietary, budgetary, acquisition planning information), technical data, and other information that, if improperly released, could create the appearance of or an actual unfair competitive advantage or jeopardize the integrity of the competition. In some instances, we provide general amounts and percentages to avoid disclosing information MDA has identified as sensitive to the competition. We also identify in this report instances in

[11]The Missile Defense System Operational Test Agency conducts independent operational assessments of Missile Defense System capability and provides recommendations to the Commanding General, Army Test and Evaluation Command.

[12]See GAO, *Leading Practices: Iterative Cycles Enable Rapid Delivery of Complex, Innovative Products*, GAO-23-106222 (Washington, D.C. July 27, 2023); GAO-22-563; and *Agile Assessment Guide: Best Practices for Agile Adoption and Implementation*, GAO-20-590G (Washington, D.C.: Sept. 28, 2020). For DOD's digital engineering strategy, see Office of the Deputy Assistant Secretary of Defense for Systems Engineering, *Department of Defense: Digital Engineering Strategy* (Washington, D.C.: June 2018).

which we removed information that DOD determined was sensitive. These information restrictions did not substantively impair our ability to present the findings and supporting evidence of our audit in this report.

We conducted this performance audit from December 2022 to June 2024 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 the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

## Background

MDA's mission is to develop and deploy a layered Missile Defense System (MDS) to defend the U.S., its deployed forces, allies, and friends from missile attacks in all phases of flight.[13] The MDS is comprised of multiple elements necessary to identify missile launches, track missile threats, and provide this information to individual interceptors designed to destroy incoming missiles. GMD is an element of the MDS designed to defend against intermediate-range and intercontinental ballistic missiles fired by potential adversaries.

GMD currently consists of Ground-Based Interceptors and a ground system that manages communications and battle operations. GMD launches interceptors from missile fields based in Fort Greely, Alaska and Vandenberg Space Force Base, California in conjunction with a network of ground-, sea-, and space-based MDS sensors and command and control systems. Interceptors use rocket motors to fly into space toward the predicted location of an incoming missile and release kill vehicles equipped with thrusters and sensors to find and destroy the warhead through "hit-to-kill" collisions.

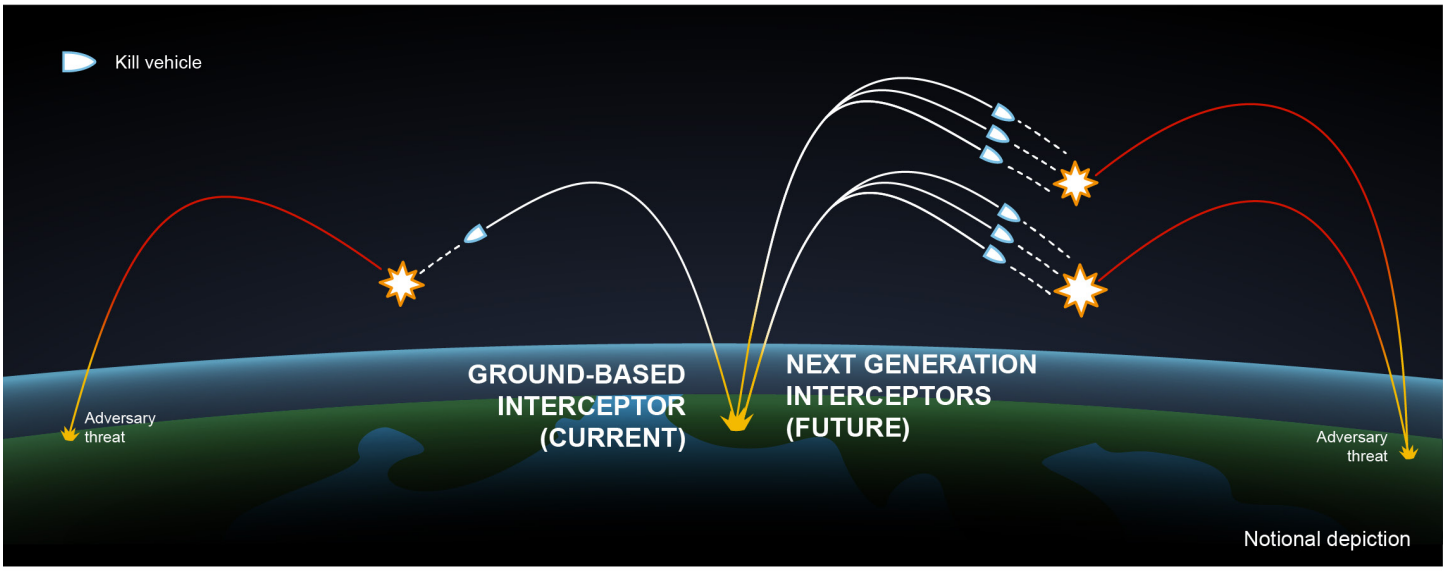
According to the National Air and Space Intelligence Center, adversary ballistic missile systems are becoming more mobile, survivable, reliable, and accurate while also achieving longer ranges. The threats posed by these missiles are likely to continue to increase and grow more complex. To counter these threats, MDA is developing a new GMD interceptor

[13]A traditional ballistic missile has three phases of flight: boost, midcourse, and terminal. The boost phase lasts about 1 to 5 minutes as the missile is powered by rocket motors through Earth's atmosphere. The missile then coasts unpowered along a ballistic trajectory for up to 20 minutes—referred to as the midcourse phase. The missile then descends and reaches its intended target in less than 5 minutes—referred to as the terminal phase.

called NGI. MDA plans to integrate NGI with the existing GMD infrastructure and the other elements of the MDS.

According to MDA officials, the NGI design includes both new booster designs and multiple kill vehicles. Having multiple kill vehicles per interceptor, as opposed to a single kill vehicle—as the Ground-Based Interceptor uses—potentially enables one interceptor to defend against a greater volume of increasingly complex adversary missile threats. Figure 1 provides an overview of how both adversary missile and missile defense capabilities are evolving, resulting in a more complex mission.

**Figure 1: Next Generation Interceptor's Role in Increasingly Complex U.S. Homeland Missile Defense Mission**




Source: GAO analysis of Missile Defense Agency information. | GAO-24-106315

Note: The number of Next Generation Interceptor kill vehicles depicted in the figure is notional and not representative of either NGI contractor's design.

The NGI development effort included a period with two different contractors, Lockheed Martin and Northrop Grumman, each pursuing unique interceptor designs to meet MDA's requirements and competing to be selected to continue the effort. DOD tasked MDA with expediting NGI development. MDA previously planned for the two contractors to execute the development of their respective designs through the critical design review—currently planned for fiscal year 2025—at which point MDA intended to select one of the contractors to continue with testing and

production.[14] However, in its fiscal year 2025 budget request (submitted March 2024), MDA described plans to down select to one contractor in fiscal year 2024 based on data from the preliminary design reviews and NGI's first knowledge point milestone. MDA stated that completion of these activities provided significant risk reduction and confidence to select a single NGI design to proceed to the critical design review and beyond. On April 15, 2024, MDA announced it had selected Lockheed Martin to continue development of NGI through critical design review, qualification, integration into the GMD weapon system, and flight testing.

## MDA's Threat Requirements Process

MDA has a tailored process for determining what types of missile threats to design the MDS elements to defend against. When MDA was established in 2002, it was exempted from DOD's traditional requirements-setting process. The Secretary of Defense provided MDA the flexibility to address emerging threats and allowed MDA to adopt a non-standard approach to acquisition and requirements-setting in recognition that the full details and parameters of potential threats were not yet fully known.

MDA uses threat assessments to select a set of threat models in which it incrementally designs MDS capabilities to defend against. MDA combines the capabilities from the selected threat models into parameters, forming what the agency refers to as the parametric threat space. MDA assigns subsets of the threat space to each of the MDS elements to inform the design of their respective systems. MDA also assigns specific threat models to each of the elements for use in simulations as they are undergoing development. MDA uses the assigned threat models to verify that each element's system design has the capability necessary to defend against its assigned threat space.

## Models and Simulations

The MDS is a complex system of systems that cannot be completely assessed through flight testing alone because of safety and funding constraints. Therefore, MDA creates digital representations, or "models," of MDS elements, threat missiles, and operational environments and conditions to simulate attack scenarios. MDA relies heavily on these models and simulations for designing MDS elements and evaluating their

[14]A critical design review is a multi-disciplined technical review that ensures the initial product baseline is established. According to the Defense Acquisition University, a successful completion of a critical design review provides a sound technical basis for proceeding into fabrication, integration, and developmental test and evaluation.

performance both in early development design reviews and later in formal ground testing.

In ground testing, each MDS element is represented by a digital model or actual system hardware and software and is connected to a network of simulators. During ground test execution, digital models of threat missiles and operational environments and conditions are applied throughout the network of simulators. Representations of MDS elements interact with these models to simulate a potential real-world MDS operation (i.e., "engagement"). Using models allows MDA to run many different types of engagements repeatedly and alter different aspects of the simulation (e.g., different threat attack scenarios) to assess performance of the MDS.

## Digital Engineering

In 2018, DOD developed a strategy to guide the planning, development, and implementation of the digital engineering transformation across the department. DOD tasked components, such as MDA, with developing their own implementation plans during 2018.[15] According to DOD, traditional engineering practices are often document-based, time-consuming, and stove-piped, with limited access and flow of data across organizational boundaries. As reflected in the Digital Engineering Strategy, DOD intends to shift from traditional engineering practices to a digital engineering approach. This approach models increasingly complex systems in a virtual environment with the goal of reducing acquisition costs, reducing development timelines, and increasing confidence in performance before production.

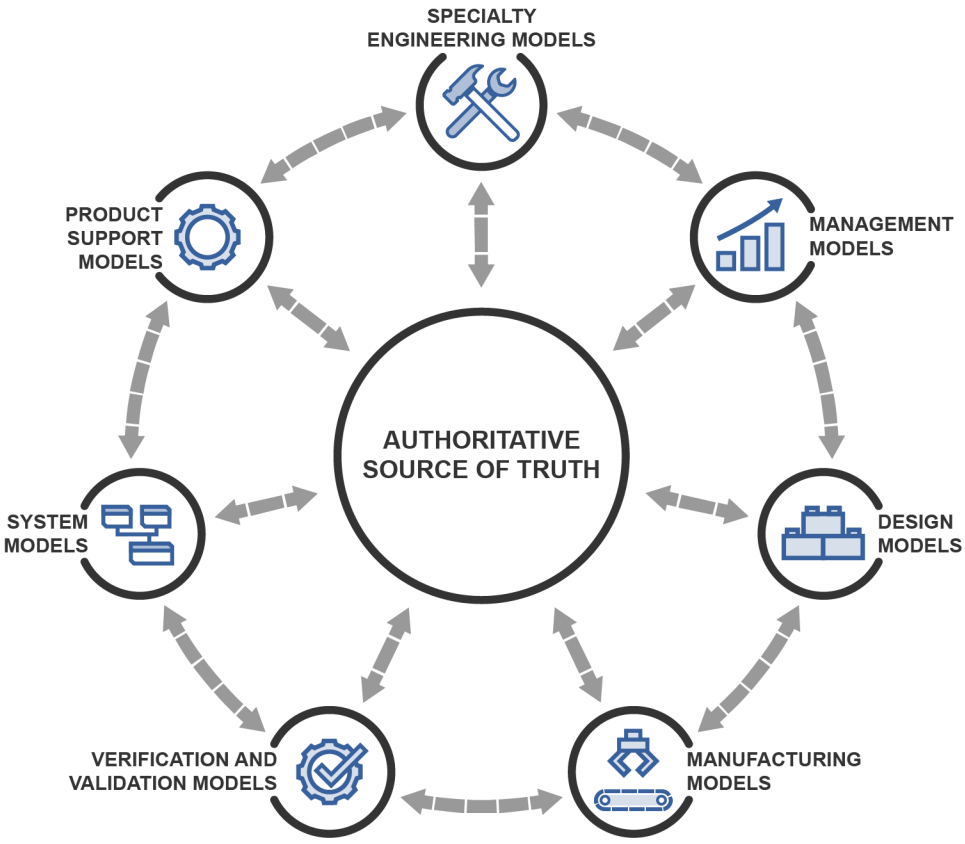
DOD previously used physical and digital documents and manual version control practices to accomplish systems engineering activities. According to DOD's strategy, moving forward, engineering activities will be achieved in a secure digital environment. DOD also plans to use digital engineering to automate workflows and increase collaboration by making data more accessible to users and reducing timelines for reviews and approvals, thereby increasing efficiency in program management.

A key component of digital engineering is model-based systems engineering. According to the International Council on Systems Engineering, model-based system engineering is the formalized application of modeling to support system requirements, design, analysis, verification, and validation activities beginning in the conceptual design

[15]DOD Digital Engineering Strategy (2018).

phase and continuing throughout development and later life cycle phases.[16] Figure 2 depicts the relationship between various models and an authoritative source of truth within digital engineering.[17]

**Figure 2: Digital and Models-Based Systems Engineering in Department of Defense Weapon System Acquisitions**




Source: The Office of the Under Secretary of Defense for Research and Engineering, GAO (icons). | GAO-24-106315

Note: An authoritative source of truth in digital engineering refers to an entity, such as a person, governing body, or system, that applies expert judgment and rules to proclaim a digital artifact is valid and originates from a legitimate source.

[16]The International Council on Systems Engineering is a not-for-profit organization founded to develop and disseminate the transdisciplinary principles and practices that enable the realization of successful systems.

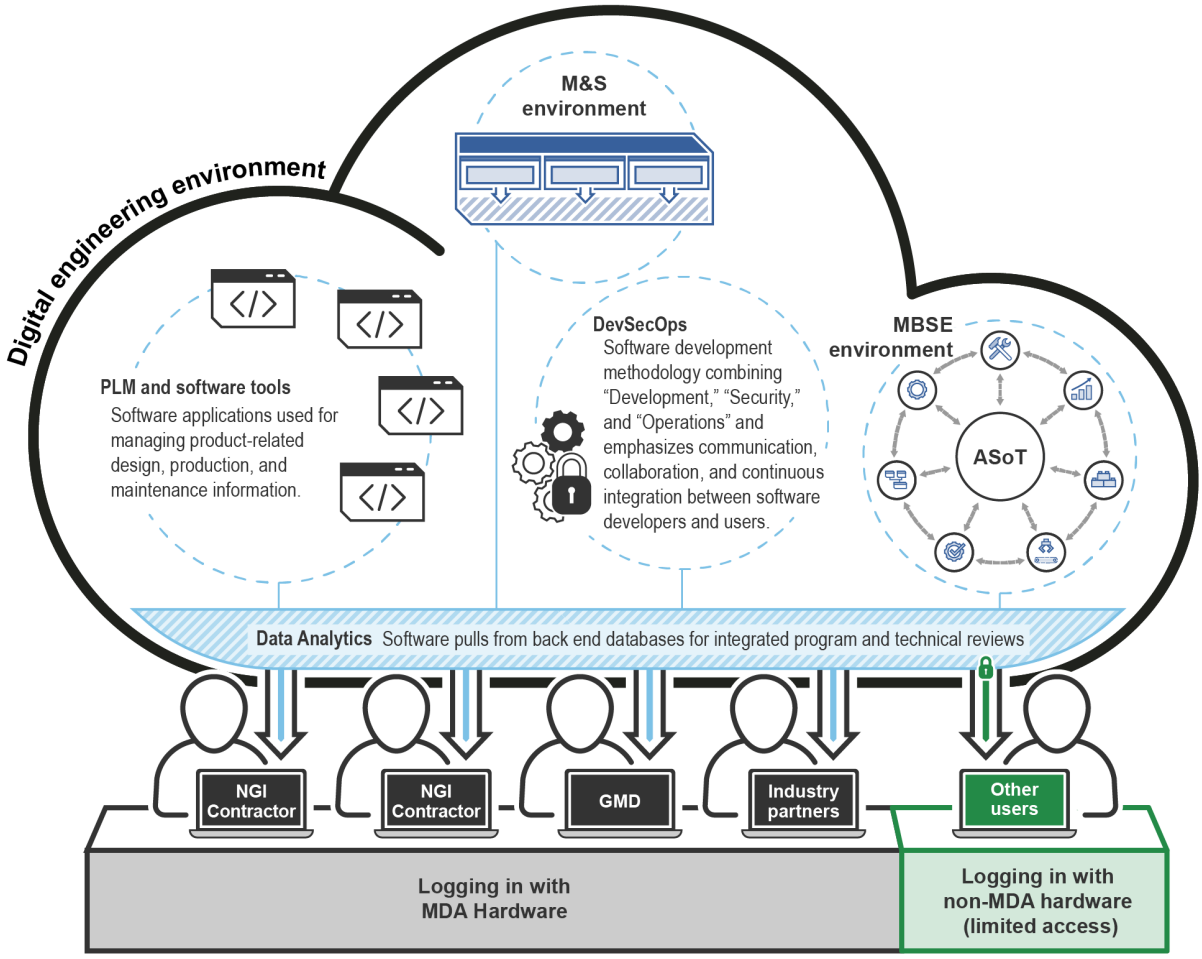
[17]An authoritative source of truth in digital engineering refers to an entity, such as a person, governing body, or system that applies expert judgment and rules to proclaim a digital artifact is valid and originates from a legitimate source.

By employing digital engineering practices, DOD intends to prototype and test designs virtually, before any physical hardware is produced, with the goal of improving system cost, schedule, and performance. For example, developers can reduce overall program risk by identifying flaws in the design sooner in the systems engineering process before costly production activities begin. DOD also envisions system modifications and upgrades that occur over the acquisition lifecycle to flow through the digital engineering environment, updating the system model in near real-time.

To enable digital engineering, MDA must establish a digital engineering environment. This includes the hardware, software, tools, and networks required to develop and analyze the NGI design in a virtual environment. MDA also requires a high degree of cybersecurity to ensure the data stored within the environment is sufficiently protected. An authorizing official has final approval on hardware, software applications, and tools selected for implementation based on cybersecurity policy and interoperability, among other factors.

A digital engineering environment is intended to provide an ecosystem for the generation of program data. Within this ecosystem, both the government and contractors can automate technical processes like parts management, programmatic reviews, and software development. Decision-makers can visualize and analyze data using dashboards and metrics that are updated in near real time. The digital engineering environment is also intended to provide a collaborative environment to share data and data products with industry partners and other government agencies. Figure 3 provides an overview of a notional digital engineering environment.

**Figure 3: Overview of a Notional Digital Engineering Environment**




ASoT = Authoritative Source of Truth
DevSecOps = Development, Security, and Operations
GMD = Ground-Based Midcourse Defense
MBSE = Model-Based System Engineering
MDA = Missile Defense Agency
M&S = Modeling and Simulation
NGI = Next Generation Interceptor
PLM = Product Lifecycle Management

Source: GAO analysis of Missile Defense Agency information, GAO (icons). | GAO-24-106315

## MDA Is Meeting Initial NGI Development Goals, but Maintaining Schedule and Cost Will Be Difficult

MDA is making progress developing NGI and the program is currently estimating initial interceptor deliveries will occur by the fourth quarter of fiscal year 2027, 1 year ahead of schedule. However, we found that NGI's schedule is optimistic when compared to DOD's historical performance developing and testing systems similar to NGI. MDA also plans to continue to purchase long lead materials for initial interceptors intended for use in upcoming flight tests. But NGI designs are not yet mature, and any changes could necessitate rework on interceptors currently in early production. Furthermore, according to program officials, the program's prime contract development costs have increased by hundreds of millions of dollars in the last year (specific details are sensitive) but remain within the program's current budget.

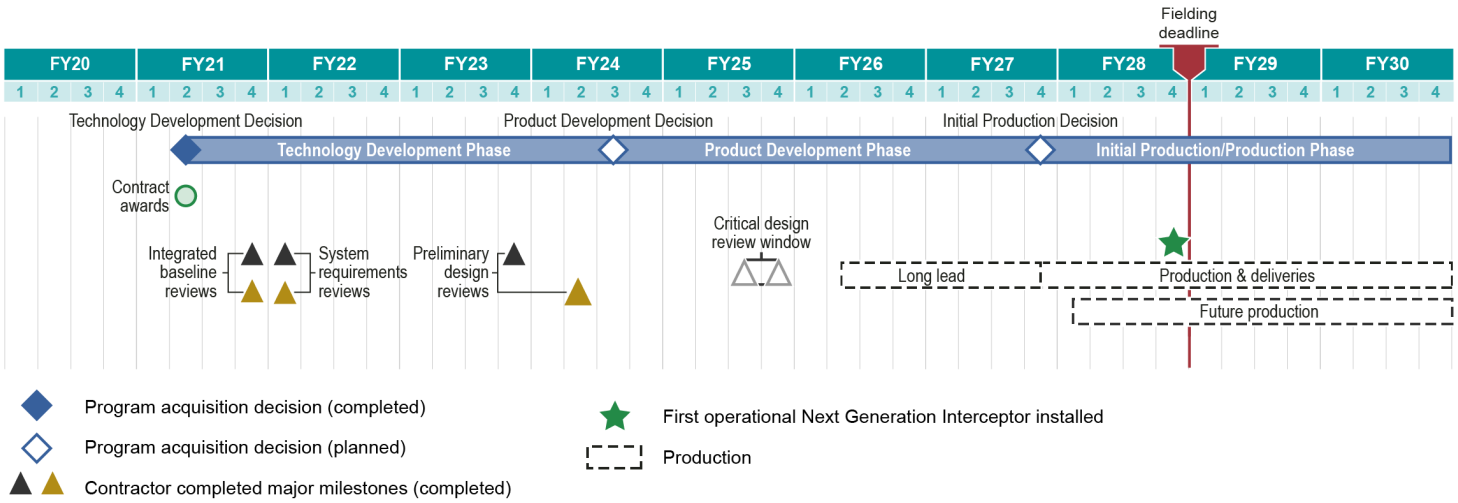
### NGI Is Progressing through Early Milestones, but Staying on Schedule Will Be Challenging

MDA's strategy to award two contractors with development contracts was intended to reduce technical risk, incentivize contractors to compete to deliver capability on time or ahead of schedule, and promote competitive pricing.[18] On April 15, 2024, MDA announced it had selected Lockheed Martin to continue development of NGI through critical design review and beyond. Prior to the down select decision, both NGI contractors were projecting that, if selected, they would deliver interceptors to U.S. Northern Command starting in the fourth quarter of fiscal year 2027, which is one year ahead of MDA's overarching schedule for the program.[19] Figure 4 provides an overview of NGI's schedule.

[18]MDA competitively awarded two cost-reimbursement-type contracts for NGI development, which both included cost-plus-incentive-fee line items. The use of incentive fees is intended to control cost and reward technical and schedule performance, according to the NGI incentive fee plans.

[19]Our review of NGI development progress primarily occurred during the competitive development effort, which we later refer to as the "dual source period." As such, our report includes information from the two NGI contractors.

**Figure 4: Next Generation Interceptor Schedule, as of March 2024**




FY = Fiscal Year

Source: GAO analysis of Missile Defense Agency information. | GAO-24-106315

Note: DOD identified the schedule for planned flight and ground tests for the Next Generation Interceptor as sensitive. Therefore, the timing of those events is omitted from this report.

The NGI contractors achieved their early program milestones and, prior to the down select decision, were preparing to begin product development starting in mid-fiscal year 2024. For example, one NGI contractor held its preliminary design review in September 2023 and the other contractor held its preliminary design review in January 2024. Program officials stated that both contractors remained fully staffed from the start of development, which MDA officials told us is often a challenge for other defense acquisition programs. Both NGI contractors also made progress developing critical technologies. According to DOD's technology readiness assessment guide, a technology is critical if the technology is new or novel and the system being acquired depends on the technology to meet operational requirements.[20] OUSD(R&E) officials told us they will assess NGI's critical technology maturation status prior to a USD(A&S) product development decision for NGI, currently scheduled for the third quarter of fiscal year 2024.

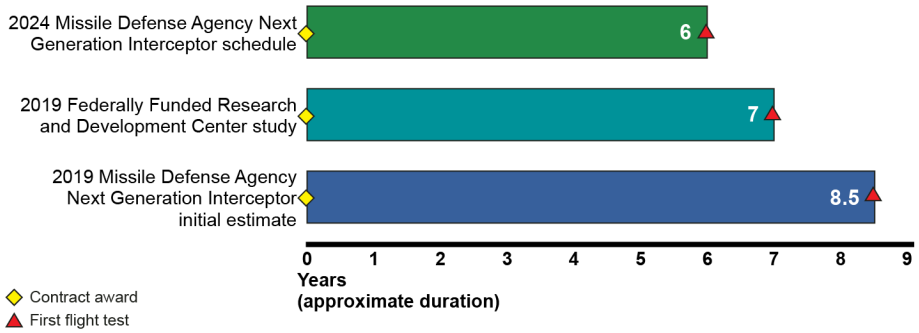
[20]DOD, *Technology Readiness Assessment (TRA) Deskbook* (July 2009). While the Deskbook has been replaced by OUSD(R&E), *Technology Readiness Assessment Guidebook* (June 2023), the Deskbook is referenced in NGI contract documents.

Although the NGI program is progressing through early schedule goals, we found that MDA's ability to maintain NGI's current schedule will be challenging. For example, NGI's schedule is optimistic when compared to DOD's historical performance developing and testing systems similar to NGI. NGI's schedule is also optimistic when compared to research MDA gathered to understand current technologies and potential application to the NGI goals—a process MDA refers to as market research.

More specifically, MDA's current NGI schedule includes flight testing starting within approximately 6 years after MDA awarded the current development contracts. However, a 2019 study conducted by a Federally Funded Research and Development Center found that kill vehicles, satellites, and strategic systems—weapon systems similar to NGI—take approximately 7 years from contract award to reach first flight test or are ready to launch.[21] Further, MDA estimated in 2019 that it would take about 8 1/2 years from contract award for NGI to conduct its first flight test (see figure 5 for a comparison of the analyses). To this point, CAPE stated in its 2021 independent cost estimate that NGI's schedule was too short in duration given historical experience, and that the schedule could be at risk if the program faces delays. GMD officials told us that when DOD established the NGI acquisition strategy in 2020, it planned to incentivize contractors to improve upon the 8 1/2 years that MDA previously estimated it would take to reach flight testing and resulted in NGI's current accelerated schedule.

[21]Institute for Defense Analyses (sponsored by OUSD(R&E)), *Cost and Schedule Assessments for Redesigned Kill Vehicle (RKV) Alternative Courses of Action (COA)*, (Aug. 9, 2019). The study assessed 7 strategic system programs, 24 DOD satellite programs, and 7 tactical kill vehicle programs. The study identified an approximate 7-year mean amongst the programs from authorization to proceed to first intercept or ready for first launch, with a standard deviation around the mean of plus or minus 1 year.

**Figure 5: Comparison of Planned Next Generation Interceptor Development Duration to Prior Estimates**




Source: GAO analysis of Missile Defense Agency and Institute for Defense Analyses information. | GAO-24-106315

Note: The Missile Defense Agency's 2019 initial estimate for the Next Generation Interceptor's schedule was developed before the program's acquisition strategy was approved in 2020, which program officials stated included plans for incentives for contractors that enabled the schedule to subsequently be accelerated.

MDA has yet to demonstrate that it can conduct flight testing for the GMD system at the pace needed to support NGI's 2028 fielding deadline. In our prior reporting on missile defense, we have found that MDA has struggled to achieve its annual testing goals.[22] NGI production and fielding is contingent on the program successfully executing three intercept flight tests within a span of 2 years. However, the GMD program has never successfully executed more than two intercept flight tests within a span of 2 years since the program started testing operationally configured GMD interceptors in 2006. A provision in the National Defense Authorization Act for Fiscal Year 2017 generally requires MDA to conduct annual GMD flight testing, subject to exceptions, but the program has historically averaged one intercept flight test per every 1.73 years.[23] NGI might face similar challenges, in part, because DOD plans for NGI flight testing to increase in difficulty with each successive test.

MDA's ability to accelerate GMD's testing pace to support NGI's fielding deadline will be challenging. In 2013, DOD performed an assessment of the feasibility to accelerate GMD's testing pace and found that, with additional funding, it should be possible to conduct three flight tests within

[22]For our most recent report assessing MDA's progress in achieving its annual acquisition goals, see GAO-23-106011.

[23]Pub. L. No. 114-328, § 1689 (2016), as amended by Pub. L. No. 116-92, § 902(97) (2019) and Pub. L. No. 117-81, § 1668(d) (2021).

two years. However, in our previous review of DOD's assessment, we found that it was not likely that MDA could accelerate GMD's testing pace, because the program: (1) had not previously demonstrated such testing pace; (2) continually experienced testing delays; and (3) planned for future testing to be increasingly challenging.[24]

MDA is also overlapping some development and production activities to accelerate NGI flight testing, which adds risk. CAPE stated in its 2021 independent cost estimate that NGI's schedule-driven strategy resulted in concurrent design and build efforts. Our prior work on missile defense acquisitions has shown such concurrency can carry significant programmatic risk.[25] USD(A&S) authorized MDA in 2023, subject to the availability of funds, to order additional long lead test materials for 8 test articles, per contractor, after conducting preliminary design reviews. While procuring long lead items would have provided the contractors time to build up initial units to support planned flight testing, this strategy could pose other challenges. In particular, because MDA does not expect for the NGI design to be finalized until the program completes the critical design review, the current interceptor design may not be stable. Any significant discoveries made during development may, in turn, disrupt the program.

## NGI's Cost Has Increased, but Remains within the Program's Budget

According to program officials, NGI's prime contract development cost increased by hundreds of millions of dollars in the program's early stages.[26] Officials reported that some of the program's cost growth is attributable to actions its contractors took to mitigate schedule risk and increasing material costs, both of which directly relate to supply chain issues and were further exacerbated by the COVID-19 pandemic.

MDA officials acknowledge that the decision for contractors to buy multiple parts resulted in cost growth and that, up to this point, the program has prioritized schedule. NGI development is primarily executed through cost-reimbursement contract line items, where the government

[24]GAO, *Missile Defense: DOD's Report Provides Limited Insight on Testing Options for the Ground-based Midcourse Defense System*, GAO-14-350R (Washington, D.C.: Apr. 30, 2014).

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

[26]Our review of NGI cost performance primarily occurred during the dual source period. As such, our report includes information from the two NGI contractors. We provide generalized numbers and percentages to avoid disclosing information MDA has identified as sensitive.

pays contractors for the total allowable incurred cost, to the extent prescribed in the contract. However, program officials indicated that they do not believe trading cost for schedule is sustainable going forward.

DOD is currently budgeting funding for the NGI program at the level proposed in CAPE's independent cost assessment, which was a few billion dollars higher than MDA's initial NGI estimate. The William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021 tasked CAPE with preparing a cost estimate for the NGI program.[27] CAPE performed the estimate in February 2021 and identified a total for NGI's research, development, test, and evaluation costs. This estimate assumed NGI's cost would grow beyond the amount MDA initially estimated. USD(A&S) directed MDA in a January 2021 memorandum to fund the NGI program to CAPE's cost estimate to ensure there would be adequate funding in DOD's budget to cover potential cost growth.[28] As we have previously reported, utilizing independent cost estimates aligns with key knowledge-based acquisition leading practices for missile defense, in part, because they provide an unbiased test of whether MDA's estimates are reasonable.[29]

NGI's costs remain within the program's current funding level, but the cost growth accumulated in the first 3 years of the program has reduced the government's funding margin as a result of accelerated schedules. Although the program is currently retaining significant funding margin, our prior work assessing DOD's portfolio of major weapon programs has shown that the overwhelming majority of cost growth occurs later in the development and production phases.[30] Additionally, program officials expect costs to increase further but, at this point, they do not anticipate exceeding the CAPE estimate.

[27]Pub. L. No. 116-283, § 1647(c) (2021).

[28]In the January 2021 NGI technology development decision memorandum, USD(A&S) directed MDA to fund the NGI program based on preliminary results of CAPE's cost estimate. CAPE subsequently finalized the cost estimate in February 2021, which indicated the same cost totals as stated in the preliminary results cited in the January 2021 memorandum.

[29]See GAO-22-563.

[30]For example, see GAO, *Weapon Systems Annual Assessment: Knowledge Gaps Pose Risks to Sustaining Recent Positive Trends*, GAO-18-360SP (Washington, D.C.: Apr. 25, 2018).

## MDA Is Taking Steps to Address Some, but Not All, Significant NGI Technical Risks

MDA is addressing some, but not all, significant risks that OUSD(R&E) identified in a 2022 independent technical risk assessment of the NGI program. MDA disagreed with much of OUSD(R&E)'s assessment and has taken limited steps to address the identified risks. For example, MDA addressed risks associated with completing all required survivability testing on component-level parts prior to conducting preliminary design reviews. However, MDA is not fully addressing risks associated with NGI's threat requirements. Furthermore, MDA is not fully developing the models and simulations necessary to evaluate NGI performance and technology maturity.

### Independent Assessment Identified Key Risks, but MDA Disagreed with Assessment

In 2020, DOD established plans for USD(R&E) to conduct independent technical risk assessments of NGI. These are to be done as part of an effort to ensure the program receives rigorous technical and acquisition oversight in accordance with a provision in the National Defense Authorization Act for Fiscal Year 2020.[31] OUSD(R&E) conducted its first assessment of the NGI program in December 2020 to support a technology development decision and assessed the program's overall risk as high. MDA disagreed with OUSD(R&E)'s assessment in a report the agency submitted to Congress in December 2020. MDA stated that it assessed NGI's risk as low-to-moderate due to contributing factors, such as prior technology maturation efforts, employing a knowledge point strategy that requires early prototyping, and the completeness of contractor proposed design and development plans. USD(A&S) subsequently directed MDA in its January 2021 memorandum to support USD(R&E) in conducting risk assessments and develop mitigation plans for any identified risks.[32]

In 2022, OUSD(R&E) conducted its second risk assessment of NGI and determined that the program's overall technical risk remained high. OUSD(R&E) described its findings in a July 2022 report, which included recommendations intended to help MDA mitigate the risks. Three of the most significant risks OUSD(R&E) identified included

1. completing all required survivability testing on component-level parts in the NGI design prior to conducting preliminary design reviews;

[31]See Pub. L. No. 116-92, § 1687(a)(2) (2019).

[32]According to NGI's acquisition plan, USD(A&S) is the milestone decision authority for the program.

2. challenges associated with NGI's threat requirements (details are omitted due to sensitivity); and
3. developing the models and simulations needed to evaluate interceptor performance and mature certain critical technologies.

MDA provided a response to OUSD(R&E) in September 2022 describing actions it was taking to address risks to completing survivability testing. However, MDA officials generally disagreed with much of OUSD(R&E)'s assessment regarding threat requirements and models and simulations affecting near-term assessments. We found that OUSD(R&E)'s findings and recommendations regarding threat requirements and models and simulations were consistent with DOD policy, guidance, and capability requirements established for NGI. We also found that MDA was not taking steps to fully address these risks.

## MDA Addressed Parts Survivability Testing Risks for Preliminary Design Reviews

In its 2022 independent technical risk assessment, OUSD(R&E) found that MDA was at high risk of not being able to complete parts survivability testing prior to conducting preliminary design reviews. MDA required its contractors to conduct survivability testing on certain NGI component-level parts (details omitted due to sensitivity) prior to conducting a preliminary design review. This requirement is, in part, to address a lesson learned from a previously failed effort to redesign the Ground-Based Interceptor's kill vehicle.[33] Our prior work has also shown that parts issues are sometimes more easily addressed without major disruptions to the program if they are discovered earlier in the development process.[34]

We found that MDA reduced the risk to completing NGI parts testing by reserving time at testing facilities, minimizing the number of parts requiring testing, and using existing test data, where available. The program did experience some challenges completing a backlog of test reports, but these challenges did not affect the timely completion of testing.

[33]Parts testing conducted prior to a critical design review for the GMD Redesigned Kill Vehicle revealed significant performance risks stemming from the use of commercial off-the-shelf parts and re-use of Aegis Standard Missile-3 Block IIA components. These challenges led to significant cost growth and schedule delays, which later prompted DOD to cancel the effort. For more information, see GAO-21-135R and *Missile Defense: Assessment of Testing Approach Needed as Delays and Changes Persist*, GAO-20-432 (Washington, D.C.: July 23, 2020).

[34]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).

## MDA Is Not Fully Addressing Risks with NGI's Threat Requirements

DOD established initial threat requirements for NGI in March 2020 to support NGI's development, design reviews, and acquisition decisions. MDA coordinated with the intelligence community and joint staff on NGI's threat requirements in early 2020, prior to requesting proposals from industry for NGI development. However, OUSD(R&E) raised concerns in its 2022 NGI risk assessment about challenges associated with NGI's threat requirements (details are omitted due to sensitivity). OUSD(R&E) recommended that MDA

- coordinate with U.S. Northern Command to review NGI's threats; and
- ensure NGI's threats are aligned with findings from intelligence community assessments that could affect NGI requirements, design, development, evaluation, and employment.

We found that OUSD(R&E)'s recommendations are consistent with the January 2021 NGI technology development decision memorandum signed by USD(A&S) and a memorandum signed by the Vice Chairman of the Joint Chiefs of Staff in March 2020 approving NGI's capability requirements. In addition, DOD policy states, among other things, that intelligence must be integrated into the acquisition lifecycle to ensure agile and effective warfighting capability, and that defense acquisition programs must use relevant information produced by the intelligence community in all phases of the acquisition lifecycle.[35] The policy also emphasizes the need for collaboration between the requirements, acquisition, and research and development communities to ensure awareness of adversary capabilities and intentions.

The recommendations from OUSD(R&E)'s risk assessment generally align with three types of activities we identified from USD(A&S)'s January 2021 memorandum and the Vice Chairman's March 2020 memorandum:

(1) **Updating threat requirements:** The USD(A&S) directed MDA to ensure NGI's threat scenarios are operationally realistic. MDA was to do so, in part, by using the results of intelligence community assessments to update NGI's performance specification, as needed, to support development and evaluation.

[35]DOD Instruction 5000.86. While MDA is not subject to all of the requirements of this instruction, the document includes statements of policy that provide insights into DOD's policy decisions in this area.

(2) **Monitoring and reporting threat changes:** The Vice Chairman requested that MDA brief the Missile Defense Executive Board—the agency's executive oversight board that is co-chaired by USD(A&S) and USD(R&E)—whenever changes to intelligence community assessments occur. The Vice Chairman also directed MDA to brief the Joint Requirements Oversight Council if such a discovery necessitates a change to NGI's requirements.[36]

(3) **Collaborating with stakeholders:** The USD(A&S) directed MDA to include representation from specific DOD stakeholders, including the intelligence community, at all formal engineering technical reviews. MDA's acquisition instruction identifies system requirements reviews, preliminary design reviews, and critical design reviews as technical reviews.[37]

DOT&E officials also found recent intelligence community assessments to be useful for evaluating NGI performance. DOT&E officials stated they intend to leverage these assessments to evaluate the adequacy of NGI's planned flight tests.[38] DOT&E officials also stated they intend to leverage the results of the assessments to inform their recommendations for the design of flight test targets that will be used in future NGI flight tests.

However, MDA has not fully addressed OUSD(R&E)'s concerns regarding NGI's threat requirements, or the previously mentioned NGI activities directed by the USD(A&S) and Vice Chairman for (1) updating threat requirements, (2) monitoring and reporting threat changes, and (3) collaborating with stakeholders. Specifically, MDA officials generally disagreed with OUSD(R&E)'s risk assessment regarding NGI's threat requirements. According to MDA, the agency assessed available intelligence community assessments and determined no changes to NGI's threat requirements have been needed. Nonetheless, MDA stated in its response to OUSD(R&E) that it was developing a prioritized list of threat models to provide to contractors to support performance assessments to be conducted in advance of preliminary design reviews in

[36]The Joint Requirements Oversight Council is comprised of the Vice Chiefs of Staff from each of the military services and advises the Chairman of the Joint Chiefs of Staff on capability requirements.

[37]MDA Instruction 5013.02-INS, *Acquisition Management* (Aug. 24, 2013).

[38]For programs under its oversight, DOT&E may provide acquisition decision makers with a report summarizing the assessment of the test adequacy and operational performance findings in support of milestone decisions. For more information, see USD(R&E) and DOT&E, *Test and Evaluation Enterprise Guidebook* (Aug.19, 2022).

late 2023. Although MDA said it would share the agency's recommendations with stakeholders, MDA did not do so when it subsequently revised NGI's assigned threats in 2023.

We also reviewed agency documentation and found that MDA did not fully address the Vice Chairman's 2020 memorandum for monitoring and promptly reporting threat changes.[39] Due to the acquisition and requirement flexibilities granted to MDA, the MDS and NGI do not follow DOD acquisition policy and guidance that requires most acquisition programs to utilize critical intelligence parameters to ensure capabilities remain competitive against threats. Critical intelligence parameters are threat capabilities or thresholds established collaboratively by the requirements sponsor and capability developer, changes to which would critically reduce the effectiveness and survivability of the proposed system. According to DOD guidance, critical intelligence parameters receive focused analysis and reporting that can inform revisions to requirements.[40] In the event a critical intelligence parameter may have been exceeded, DOD policy describes actions that must be taken, including a review by the Chairman of the Joint Chiefs of Staff.[41]

MDA officials told us they monitor intelligence community assessments but do not utilize critical intelligence parameters. MDA officials stated that, due to the complexity of the MDS, the agency uses a different process to monitor and respond to changes in the threat, in accordance with the agency's unique acquisition authorities. Similarly, OUSD(A&S) officials told us that critical intelligence parameters are a component of DOD's traditional requirements-setting process from which MDA has been exempted. OUSD(A&S) officials stated MDA's unique threat monitoring process is analogous to critical intelligence parameter monitoring. MDA's unique process does not include analogous steps for reporting significant changes in the threat to key DOD stakeholders, as would be required from programs that utilize critical intelligence parameters. However, as previously mentioned, the Vice Chairman's March 2020 memorandum requested MDA to brief the Missile Defense Executive Board whenever changes to intelligence community assessments occur, and directed MDA

[39]Details regarding our review of agency documentation were included in the draft version of this report that was provided to DOD for comment. DOD determined the information was sensitive and was therefore omitted.

[40]OUSD(A&S), *Intelligence Support to the Adaptive Acquisition Framework (ISTAAF) Guidebook*, (Washington, D.C.: Sept. 2021).

[41]DOD Instruction 5000.86.

to brief the Joint Requirements Oversight Council if such a discovery necessitates a change to NGI's requirements.

By not fully addressing the Vice Chairman's memorandum, MDA risks under-utilizing the department's available resources and pre-empting senior leader decision-making on whether and how to address any changes in the threat potentially affecting NGI. Our prior work on missile defense acquisitions has shown that by working closely with stakeholders (e.g., intelligence community, joint staff, combatant commanders) throughout the development of its programs, MDA would increase the likelihood that the capabilities it pursues are needed, affordable, effective, and delivered to the warfighter as quickly as feasible.[42] Our prior missile defense work has also shown that establishing buy-in from decision makers (e.g., Missile Defense Executive Board, Joint Requirements Oversight Council) is a key enabler for achieving better acquisition outcomes because DOD components provide varying perspectives due to their unique areas of expertise and experience. Moreover, according to our standards for internal control, management should communicate information to oversight bodies on a timely basis.[43]

MDA also did not include representation from the intelligence community at all NGI formal engineering technical reviews, as directed by USD(A&S) in its January 2021 memorandum. The Defense Intelligence Agency told us in July 2023 that it was unaware of anyone receiving invitations or attending NGI system requirements reviews that occurred in 2021. Officials from the National Air and Space Intelligence Center—the intelligence community component responsible for assessing the missile threats relevant to NGI—similarly told us they had not received invitations to attend the NGI reviews. Although their attendance was not required in USD(A&S)'s memorandum, we previously found that intelligence community components like the National Air and Space Intelligence Center are uniquely positioned to assist MDA on issues pertaining to threat missiles due to its mission, experience, expertise, and data sources.[44] OUSD(A&S) officials stated that MDA has not met the intent of the direction in USD(A&S)'s January 2021 memorandum.

[42]See GAO-22-563 and GAO-20-177.

[43]GAO, *Standards for Internal Control in the Federal Government*, GAO-14-704G (Washington, D.C.: Sept. 10, 2014).

[44]GAO-20-177.

Despite this disagreement, MDA has improved its coordination with the intelligence community since our December 2019 report made recommendations in this area.[45] MDA implemented processes for collective threat prioritization and stood up a permanent joint threat modeling program with the intelligence community, addressing two of our three recommendations. However, MDA could do more to address our outstanding December 2019 recommendation to fully engage the intelligence community on key threat-related acquisition processes and decisions. We continue to view this recommendation as partially addressed, in part, because MDA is not taking steps to mitigate risks to NGI's threat requirements or follow USD(A&S) directions for consistently engaging the intelligence community and utilizing their assessments. By not taking these steps, MDA runs the risk of delivering a capability that either does not fully meet the warfighter's needs or requires costly, time-consuming redesign efforts to address threats.

## MDA Is Not Fully Addressing Modeling and Simulation Risks

OUSD(R&E) also raised significant concerns in its 2022 NGI risk assessment with MDA's ability to develop the models and simulations necessary to fully evaluate NGI performance and technology maturity. According to OUSD(R&E)'s risk assessment, the models and simulations necessary to support NGI development and assessment require further development or upgrades.[46]

Other DOD components have also expressed concern about MDA's modeling and simulation capabilities. In May 2023, GMD's Technical Direction Agent identified "watch items" with NGI modeling and simulation, performance assessments, and software maturation.[47] In addition, U.S. Northern Command officials told us in June 2023 they were concerned about the lack of models and simulations available to support NGI development efforts. MDS Operational Test Agency and DOT&E officials similarly told us they are concerned that MDA will not have the

[45]In December 2019, we recommended MDA coordinate with the intelligence community on: (1) collectively prioritizing its threat assessment needs; (2) obtaining input on key threat-related acquisition processes and decisions; and (3) validating its threat models. See GAO-20-177.

[46]Specific details regarding modeling and simulation limitations were omitted due to DOD sensitivity concerns.

[47]According to MDA, the GMD Technical Direction Agent is an advisory body comprised of Federally Funded Research and Development Centers and University Affiliated Research Centers. Its mission is to provide independent and objective analysis and recommendations on technical issues and product development challenges.

necessary models and simulations developed in time to support planned ground testing.

Program officials generally did not agree that near-term performance and technology maturation assessments were at risk due to modeling and simulation limitations. However, we found that the specific intercept conditions referenced in OUSD(R&E)'s assessment (details omitted due to sensitivity) are consistent with how the warfighter intends to use the system, as described to us by U.S. Northern Command officials and indicated in NGI capability requirements documents. Moreover, according to DOD guidance, demonstrating technology maturity includes testing in a relevant environment that simulates both the most important and most stressing aspects of the operational environment.[48] CAPE officials told us in February 2024 that foregoing adequate simulation capabilities directly amplifies risks to the program because MDA will be relying on these same models and simulations for verification activities in lieu of more extensive flight testing. CAPE officials added that insufficient modeling and simulation would potentially leave some of the most critical questions regarding NGI's performance unanswered.

Due to its current approach, MDA will not be able to fully verify whether NGI's design will achieve the required performance for upcoming design reviews due to existing modeling and simulation limitations. MDA also risks not being able to fully assess whether contractor software is sufficiently mature. Our prior work on defense acquisition has shown that allowing a program to begin product development with immature critical technologies creates significant risk for later having to perform major redesigns, which can negatively affect a program's budget and schedule.

## MDA Has Not Prioritized Some Modeling and Simulation Improvements

MDA, in its response to OUSD(R&E)'s risk assessment, generally agreed that modeling and simulation limitations were a risk to MDA ground testing that is currently scheduled to start in 2026. To address the risk, MDA stated that the GMD program would, among other actions, ensure NGI-specific requirements for the MDS-level modeling and simulation framework are identified, planned for, and implemented. MDA also told us in June 2023 that it plans to align development of an all-digital MDS-level simulator with the NGI program. DOT&E officials told us this new digital

[48]See DOD, *Technology Readiness Assessment (TRA) Deskbook,* OUSD(R&E), *Technology Readiness Assessment Guidebook*. MDA officials told us they required both contractors to demonstrate all critical technologies at a technology readiness level 6 or higher by preliminary design review, which, according to the Deskbook and OUSD(R&E)'s June 2023 Guidebook, includes demonstration in a relevant environment.

simulator will be essential for conducting NGI operational assessments because it will provide significantly greater simulation capabilities, once developed.

MDA has taken steps to improve its modeling and simulations, but over the past decade has not consistently pursued or funded improvement efforts. For example, we found in May 2018 that MDA was not fully funding efforts to improve its models and simulations in DOD's budget.[49] DOT&E, OUSD(R&E), and the MDS Operational Test Agency have all observed continued funding shortfalls since that time. According to MDA budget documents, requested funding for models and simulations decreased in fiscal year 2024, in part, because MDA realigned funding in the budget to higher agency priorities. In addition, MDS Operational Test Agency officials told us in February 2024 that they received notice from MDA that it has suspended its efforts to develop the new digital simulator for the next several years.

DOT&E recommended in its recent MDS annual assessment that funding MDS model development should be a top priority for MDA, DOD, and Congress.[50] MDS Operational Test Agency officials also stated that adding NGI's unique simulation architecture to existing ground testing capabilities will significantly increase complexity and require investments beyond the NGI program in order to be successful.

Prioritizing the development and funding of models and simulations that more fully represent real-world scenarios and conditions would benefit the NGI development effort. For example, it would provide opportunities for the program to identify any performance limitations early and address them before flight testing. Conversely, not determining the funding needs for developing the models and simulations needed to assess the full range of expected uses and operational conditions could prevent MDA from verifying NGI's performance until well after the system is fielded.

[49]GAO, *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).

[50]DOT&E, *2022 Assessment of the Missile Defense System (MDS)* (Feb. 2023). DOT&E submits independent operational test and evaluation reports to senior DOD leadership.

## MDA Has Taken Initial Steps to Implement a Digital Engineering Environment but Is Not Assessing Progress after Facing Challenges

MDA established an initial digital engineering environment to support NGI development but has not followed through on its implementation plans. More specifically, MDA established: (1) a digital engineering plan that supports DOD-wide goals for the digital engineering transformation; (2) an initial digital engineering environment to collaborate with industry partners and other government agencies on NGI development; and (3) a federated IT framework to focus on IT services and infrastructure across the agency. In implementing this digital environment, MDA encountered challenges with software approvals, hardware delays, security requirements, and unrealized efficiencies, which increased program costs. However, the program is not following through on some of its plans to periodically re-assess its progress implementing a digital engineering environment.

### MDA Established an Implementation Plan, Initial Digital Engineering Environment, and IT Framework

MDA has made progress establishing an initial digital engineering environment to support NGI development. GMD's digital engineering plan, signed in the first quarter of fiscal year 2022, outlines a phased approach to increase its digital engineering maturity, capability, and integration among GMD components, including NGI, over time.[51] This plan is intended to align with DOD's overarching digital engineering strategy and address the need to collaborate across the GMD program. According to DOD, information is traditionally stove-piped, limiting data sharing between organizations to briefing charts and static documents. According to the GMD program, implementing a digital engineering environment will facilitate the shift from a document-centric environment to a model-centric environment where data is readily available digitally and in near-real time. This environment is expected to improve development timelines and help identify program risks that may otherwise be hidden or difficult to assess.

Key components of GMD's plan include overviews of how the program plans to implement digital engineering by functional area. For example, MDA plans to use digital dashboards to support program control activities, like monitoring contractor performance and schedule status. MDA also plans to use digital reviews to highlight linkages from architecture to performance. Both of these efforts are intended to provide more depth and context for the reviewer, such as program officials.

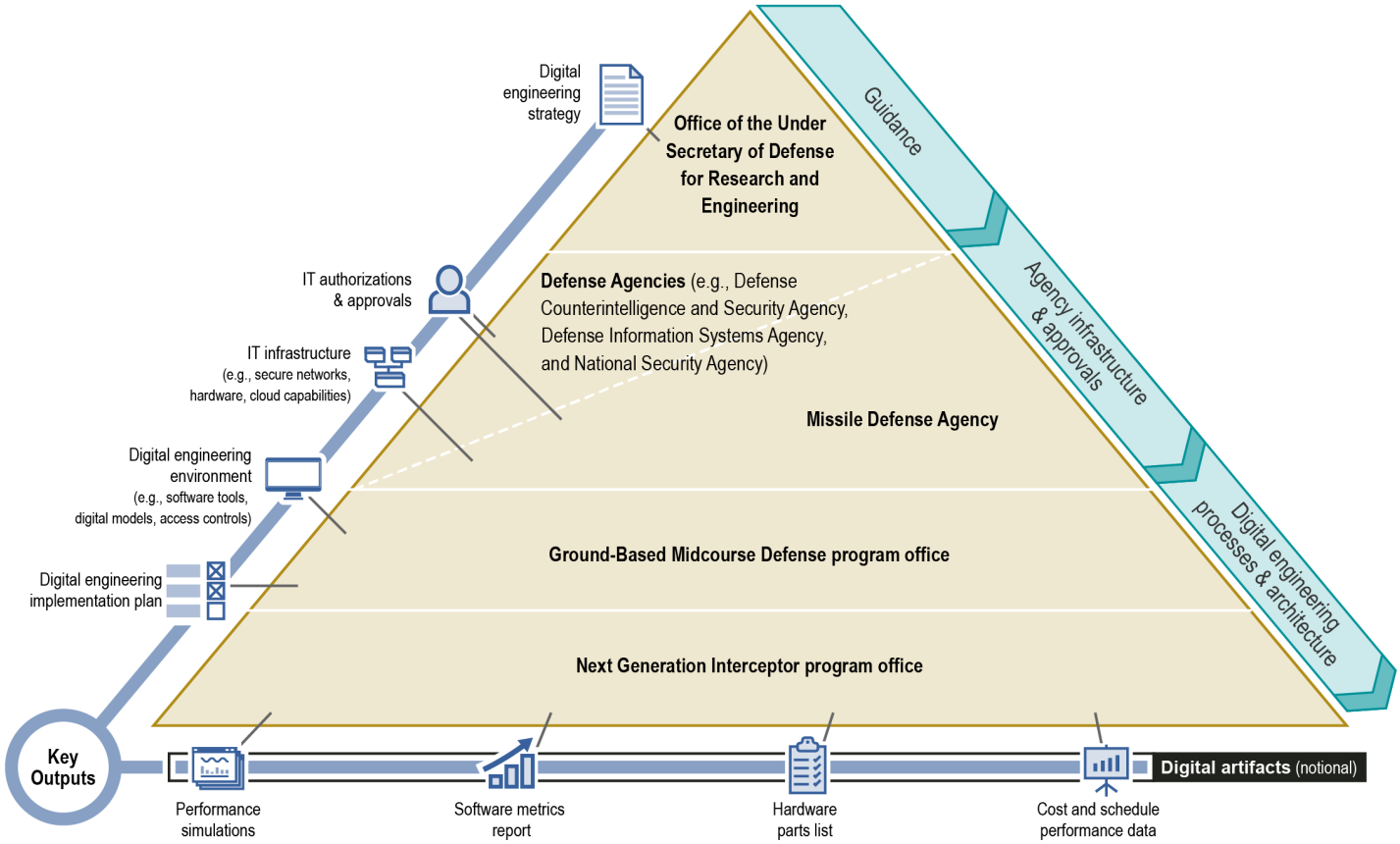
[51]The GMD program is responsible for implementing the digital engineering environment that will be used for NGI.

The GMD plan outlines a multi-phased approach and defines processes and functions for successfully executing digital engineering at all levels of the program, including NGI. In addition, the plan identifies organizational roles and responsibilities and defines the integrated digital engineering environment. According to the GMD program, it has accomplished the stated goals for establishing digital engineering, growing digital engineering capability, and sustaining digital engineering capability. We did not specifically evaluate whether MDA achieved all of the goals stated in its digital engineering plan. However, we identified some items from the plan that MDA did not accomplish, which we discuss further below.

Consistent with this plan, the GMD program established an initial iteration of its digital engineering environment, in part, to support NGI development. The digital engineering environment consists of software applications and tools. These include a models-based system engineering application intended to allow engineers to perform analyses for requirements verification and track design progress with metrics. The digital engineering environment also includes the physical infrastructure where the data reside.

MDA also established a federated IT framework to consolidate various, disparate IT services and infrastructure into a common, agency-wide IT infrastructure. According to MDA, this new IT framework is intended to provide the infrastructure for digital data environments across the agency, allowing program offices to focus on acquisition activities and alleviating some of the burden of establishing digital engineering infrastructure and processes for each program. By establishing an agency-wide IT framework, MDA expects to maximize IT investments and facilitate cost sharing across its programs. Figure 6 provides an overview of the various organizations involved in implementing digital engineering to support NGI development.

**Figure 6: DOD Organizations Involved in Next Generation Interceptor Digital Engineering Implementation**




Source: GAO analysis of Department of Defense information, GAO (icons). | GAO-24-106315

Note: Digital artifacts are produced within, or generated from, the digital engineering ecosystem. These artifacts provide data for alternative views to visualize, communicate, and deliver data, information, and knowledge to stakeholders.

According to MDA officials, GMD is the agency's pathfinder for digital engineering transformation. NGI contractors used the term "born digital" to characterize the focus on digital engineering since the program's inception.

## MDA Encountered Challenges Implementing Its Digital Engineering Environment

The GMD program has faced challenges with adding software and hardware to its digital engineering environment in a timely manner.[52] Additionally, establishing digital engineering infrastructure that meets standards set forth in cybersecurity policy and implementing digital engineering practices have proven more difficult than the GMD program initially anticipated. According to the NGI contractors, they planned to realize efficiencies from implementing digital engineering early in the program. However, due to government implementation delays, these efficiencies have not fully materialized, and NGI contractors asserted costs have grown by tens of millions of dollars (specific details are sensitive). These shortcomings are consistent with concerns previously raised by CAPE in its 2021 NGI independent cost estimate, which credited MDA for pursuing digital engineering but questioned when efficiencies and their resulting cost savings would be realized.

### Software Approval and Supply Chain Challenges Have Led to Cost Growth

MDA's internal process for approving software for use in the digital engineering environment took several months longer than the GMD program expected. MDA has also experienced supply chain challenges with obtaining hardware needed, in part, to support the digital engineering environment, which further contributed to NGI's cost growth. One of the elements of DOD's digital engineering strategy is to streamline the technology approval process so that digital engineering activities intended to improve productivity and acquisition efficiency can be adopted in a timely manner. In 2022, NGI program documentation indicated that MDA software approvals were not keeping pace with software submissions. According to an NGI contractor, delays in approving software negatively affected program office review timelines and delayed acceptance of contract deliverables. According to both contractors, the approval delays also caused costs to rise because their work took longer than planned. As of April 2023, MDA officials told us they had caught up with software approvals. However, contractors stated MDA continued to remain behind on approvals relative to application submissions.

### Challenging Security Requirements Have Resulted in Inefficient Technical Solutions

MDA has not investigated more efficient ways to move data between classified and unclassified environments as planned, resulting in inefficient processes to move data between digital environments. MDA's digital engineering environments currently exist at distinct classification levels with no automated way to move data between unclassified and

[52]Our review of the GMD program's implementation of a digital engineering environment primarily occurred during the NGI dual source period. As such, our report includes information and perspectives from the two NGI contractors.

classified environments, referred to as a cross-domain solution.[53] This increases labor and the potential for data inadvertently being moved to an incorrect level of security due to human error.

The NGI program had to create new, unplanned networks because of unexpected security challenges, resulting in increased cost. The Defense Counterintelligence and Security Agency did not approve some network extensions, according to NGI contractors. Establishing and maintaining a classified network requires a significant initial investment in hardware and software along with IT and cybersecurity resources. As a result, the program incurred unplanned, additional costs to support new networks.

## Assumed Efficiencies from Digital Engineering Did Not Fully Materialize

According to MDA, contractors did not realize all possible efficiencies from implementing digital engineering early in the program. As a result, contractors reported expending more effort than expected to complete systems engineering requirements and architecture work. Contractor representatives attributed the cost growth they experienced, in part, to MDA's digital engineering environment in place at the time that did not fully support contractor specified timelines.

DOD's digital engineering strategy emphasizes the need for reliable, available, secure, and connected information networks across all classification levels to securely facilitate the flow of information. According to the contractors, their plans assumed MDA's digital engineering processes and environment would be more mature and more fully implemented earlier in the program. As this did not materialize, the contractors pursued workarounds. For example, according to contractors:

- Contract deliverables that were expected to be submitted digitally had to be converted to paper copies and then submitted to the government. This resulted in the contractors expending more effort than expected to deliver documentation. Government review was also not conducted in the digital environment as expected. Program officials told us in November 2023 that deliverables submitted digitally were now being reviewed in their native format without resorting to paper printouts.
- Contractor plans assumed that early engineering reviews, traditionally conducted via briefing charts, would be performed in an all-digital format. However, the contractors opted to use both approaches for

[53]A cross-domain solution provides an automated and auditable method for transferring data of one level of security classification to another to increase program security and efficiency.

system requirements reviews performed in 2021 because the digital engineering infrastructure was not capable of supporting a fully digital review, as planned. This resulted in more work than anticipated to prepare for and conduct the reviews. Nevertheless, MDA officials and contractors described the reviews as successes, noting that some action items were closed during the meetings due to digital information being readily available. However, the contractors had to use unplanned program management resources to prepare for the reviews (e.g., preparing briefing documents).

Contractor representatives told us that efficiencies will eventually be realized as MDA's digital engineering environment becomes more capable, and they included this assumption in their cost and schedule forecasts. If these efficiencies are not realized, the program risks increased costs and schedule overruns.

## MDA Has Not Followed Through on Plans for Conducting Periodic Organizational Assessments

MDA conducted an initial assessment of its efforts implementing a digital engineering environment, but it has not conducted any follow-up organizational assessments. GMD's digital engineering plan outlined a multi-phased approach to increasing digital engineering maturity and capability, with assessments planned along the way to measure the program's progress in achieving its digital engineering goals. The GMD Technical Direction Agent conducted an organizational assessment in 2020. The assessment focused on the GMD program's readiness to implement digital engineering according to the goals established in DOD's digital transformation plan. The assessment identified focus areas to develop additional digital engineering capability and made recommendations for improvements (details are omitted due to sensitivity).

Although GMD's digital engineering plan called for conducting additional organizational assessments to re-assess the program's progress, MDA has yet to perform a follow-up assessment. The plan also called for quarterly reviews of the digital engineering plan to ensure lessons learned from NGI pathfinder efforts are implemented. MDA officials told us they have been conducting quarterly reviews of the plan and, to date, there have been no updates to documentation as a result of the reviews. MDA officials told us that they do not intend to conduct any future digital engineering organizational assessments because they have implemented a continuous improvement process and are utilizing Agile methodologies

to incrementally increase capability.[54] Additionally, MDA officials told us in October 2023 that they were conducting an agency-wide digital maturity self-assessment. These new efforts, however, have not been documented in the program's implementation plan, although MDA officials told us they would consider implementing findings from the self-assessment once they are published. We requested documentation from MDA regarding the new efforts. MDA provided us information and examples of lessons learned for digital engineering. However, MDA informed us it did not have any documentation regarding the agency-wide assessment available at the time of our assessment.

While MDA plans to take some steps to improve capabilities, our leading practices and prior work on missile defense acquisition indicate that performing periodic independent reviews and assessments can help position programs for success. These actions can assist decision makers by tempering over-optimism in program planning and identifying significant risks up front so decision makers can provide additional resources or pursue other options.

- Per GAO's Agile guide, management should perform health assessments to ensure that adequate resources—including people, funding, and tools—are provided so performance management and evaluation activities can be implemented appropriately at various levels.[55] Management must also be committed to balancing periodic program-wide health assessments with monitoring progress made to deploy capabilities.
- In November 2021, we found that independent reviews entail up front work but, when acted upon by decision makers, can result in lower life-cycle cost, more schedule reliability, and greater capability delivered.[56] Additionally, when reviewers are not responsible for activities being evaluated, greater objectivity is achieved, and the overall program being evaluated can benefit from the experience and expertise of the independent review team.

As previously discussed, MDA has fallen short on some of its NGI digital engineering efforts, which has contributed to the program's cost growth

[54]Agile is a development methodology that emphasizes early and continuous delivery, fast feedback cycles, rhythmic delivery pace, the use of collaborative teams, and measuring progress in terms of working software.

[55]See GAO-20-590G.

[56]See GAO-22-563.

and resulted in inefficient workarounds for both the government and NGI contractors. Digital engineering requires new methods, processes, and tools, which will change how the engineering and acquisition community operate. This cultural shift presents many challenges, and it is to be expected that issues will arise as the capability and workforce develops. However, conducting periodic independent assessments to monitor progress could help NGI maintain its accelerated schedule and reduce additional cost growth.

Updated independent assessments could also help MDA identify and prioritize the most critical capabilities that users of the digital engineering environment need. For example, opportunities to increase the technical performance of the digital engineering environment may be overlooked by not periodically evaluating both progress to date and future capability needs to ensure priorities are aligned with available resources and schedule. By not following through on conducting periodic independent assessments of MDA's digital engineering efforts, the NGI program risks missing opportunities to maximize the full benefits of utilizing the digital engineering environment.

## Conclusions

MDA has little margin for error developing NGI, given (1) the system's critical mission for defending the U.S. against a nuclear missile attack, (2) ongoing threat advancements, and (3) the warfighter's urgent need to begin fielding the system as soon as possible. DOD and Congress have taken steps to reduce the risk of NGI not meeting its intended mission by pursuing the development of two separate NGI designs and requiring enhanced technical and acquisition oversight of the program.

MDA could further reduce risk to the program by better working with key stakeholders, including the intelligence community and joint staff, to address high risk items identified by OUSD(R&E) with NGI's threat requirements. By not fully meeting requirements for regularly coordinating with key stakeholders and monitoring and promptly reporting threat activity that may have implications for NGI's threat requirements, MDA risks delivering capability to the warfighter that has been outpaced by the threat. Also, by not using models and simulations that fully represent how the warfighter intends to use NGI, MDA risks discovering performance shortfalls later on in the program, such as during production and testing. MDA could also potentially realize increased efficiency by following through on its plans to conduct periodic independent organizational assessments as the program stands up a digital engineering environment.

## Recommendations for Executive Action

We are making the following five recommendations to DOD:

The Secretary of Defense should task the Under Secretary of Defense for Acquisition and Sustainment with ensuring the Director, MDA regularly coordinates with the intelligence community, joint staff, and combatant commands throughout NGI development to prioritize and, if necessary, update NGI's threat requirements. (Recommendation 1)

The Secretary of Defense should task the Under Secretary of Defense for Acquisition and Sustainment with ensuring the Director, MDA promptly reports any changes in the threat that may have implications for NGI's threat requirements to appropriate senior DOD leaders, including those on the Missile Defense Executive Board and the Joint Requirements Oversight Council. (Recommendation 2)

The Secretary of Defense should task the Under Secretary of Defense for Acquisition and Sustainment with ensuring the Director, MDA uses models and simulations that fully represent stressing intercept conditions for NGI performance and technology maturation assessments supporting the program's critical design review and key acquisition decisions. (Recommendation 3)

The Director, MDA should develop a plan for budgeting for and expediting the development of all models—including models that represent stressing intercept conditions NGI is expected to encounter—and simulations necessary to support the NGI critical design review and ground testing. (Recommendation 4)

The Director, MDA should conduct periodic independent organizational assessments of its efforts for implementing a digital engineering environment for the GMD program to support NGI development and incorporate lessons learned into its implementation plans, as needed. (Recommendation 5)

## Agency Comments and Our Evaluation

DOD provided written comments on a draft of this report. These comments are reprinted in appendix I and summarized below. DOD also provided technical comments, which we incorporated as appropriate. DOD did not concur with our first four recommendations, for updating and monitoring NGI's threat requirements and addressing modeling and simulation limitations. DOD concurred with our fifth recommendation that MDA should conduct independent organizational assessments of GMD's efforts to establish a digital engineering environment. As we discuss below, we continue to believe all five of our recommendations are valid

and that implementing them would help DOD mitigate NGI's most significant technical risks and improve program efficiency.

DOD did not concur with our first recommendation, that MDA should regularly coordinate with departmental stakeholders on prioritizing and, if necessary, updating NGI's threat requirements. DOD stated that its concurrence could be interpreted to mean that MDA does not already regularly coordinate with stakeholders. DOD stated that MDA continuously coordinates with the intelligence community and regularly coordinates with the joint staff and combatant commands. DOD cited recommendations from our December 2019 report, which it has previously implemented, to improve MDA's coordination with the intelligence community.[57] DOD also stated that MDA provides updated threat requirements to all MDS elements and ensures those requirements are met through the agency's robust design, development, and delivery process. In addition, DOD stated that NGI's existing threat requirements are robust and cover the anticipated threat.

We believe our recommendation remains valid. We agree with DOD that MDA has general, agency-wide processes for coordinating with stakeholders and monitoring and updating threat requirements. We also agree that DOD established some of these processes based on our prior recommendations. However, as stated in this report, our review of MDA actions directly pertaining to NGI found that MDA has not addressed concerns identified by OUSD(R&E) in its 2022 risk assessment regarding NGI's threat requirements. As discussed in this report, we also found that MDA did not fully address directions from USD(A&S) to: (1) develop mitigation plans for risks identified by OUSD(R&E); (2) use intelligence community threat assessments to update NGI's threat requirements, as needed; and (3) include the intelligence community at all formal NGI technical reviews. DOD did not provide any new information in its response that substantively changed our findings. We continue to believe that our recommendation would help DOD mitigate the risk of discovering performance shortfalls later that could delay the program. We intend to

[57]See GAO-20-177. DOD also raised concerns in its response with our description of the status of an open recommendation from this report. DOD referenced our online recommendation database (available at https://www.gao.gov/reports-testimonies/recommendations-database), which described the status of the recommendation as "partially addressed." DOD stated we incorrectly described the status of the recommendation as "unaddressed" in our report and noted that we acknowledge in our report an example that demonstrates MDA has taken action to implement the recommendation. For consistency, we revised our description of the recommendation status in this report as partially addressed.

review the results of the upcoming NGI product development decision in 2024 to determine whether USD(A&S) takes any actions to implement our recommendation.

DOD did not concur with our second recommendation, that MDA should promptly report to appropriate senior DOD leaders any changes in the threat that may have implications for NGI's threat requirements. DOD stated that its concurrence could be interpreted to mean that MDA does not promptly report such changes to senior DOD leaders. DOD described venues through which MDA can report these changes, such as the Missile Defense Executive Board and its standing committees. DOD also stated that, when threat changes are determined by MDA and the intelligence community to be relevant to NGI and exceed the current parametric threat space, such changes already require prompt escalation to DOD senior leadership.[58] In addition, DOD stated there have been no changes to NGI's top-level performance requirements since they were approved in 2020 and described a statutory requirement for notifying the congressional defense committees of any such changes.[59]

We believe our recommendation remains valid. We agree with DOD that MDA can and should promptly report significant changes in the threat and that the agency has venues available to do so. However, as we discussed in this report, we reviewed agency documentation and found that MDA did not fully address the requirement DOD cited in its response for monitoring and promptly reporting threat changes to senior DOD leadership. DOD also did not provide any new information in its response that demonstrated MDA fully addressed this requirement. We believe it is incumbent on MDA to promptly report to senior DOD leaders any significant changes in the threat potentially affecting NGI, even if MDA does not believe a change to NGI's requirements is warranted. Our recommendation would help ensure that senior DOD leaders are involved in decisions on whether changes to NGI's requirements are needed. We intend to review the results of the upcoming NGI product development

[58]According to MDA officials, the requirement DOD cited in its response to our second recommendation refers to the activities directed in the Vice Chairman's March 2020 NGI memorandum for monitoring and reporting threat changes.

[59]Section 1647 of the William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021 requires MDA to notify the congressional defense committees of any changes made to NGI's requirements established in the equivalent to capability development documentation. Pub. L. No. 116-283, § 1647(a) (2021).

decision in 2024 to determine whether USD(A&S) takes any actions to implement our recommendation.

DOD did not concur with our third recommendation, that MDA should use models and simulations that fully represent stressing intercept conditions for NGI performance and technology maturation assessments. DOD stated that the recommendation could be interpreted to mean that MDA is not currently increasing model and simulation fidelity over the acquisition lifecycle, as appropriate. DOD also stated that MDA plans to use high-fidelity models that fully represent stressing intercept conditions to support NGI's critical design review and is currently working toward increasing the fidelity of these models and simulations.

We believe our recommendation remains valid. We are encouraged that MDA is committed to improving its models and simulations. However, DOD did not provide any new evidence or explain in its response how it will mature these models before it makes critical program decisions. Our recommendation would help ensure MDA receives appropriate direction and oversight from USD(A&S) to improve its modeling and simulation. We intend to review the results of the upcoming NGI product development decision in 2024 to determine whether USD(A&S) takes any actions to implement our recommendation.

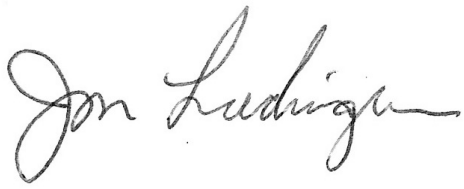
DOD did not concur with our fourth recommendation, that MDA should develop a plan for expediting development of the models and simulations needed to support NGI development, as well as a plan for budgeting funding for those efforts. DOD stated that the President's budget appropriately supports MDA model development and that the department's budgeting process allocates limited resources across many high priority capabilities. DOD stated that MDA will continue to prioritize initiatives in its budget requests in a manner that best positions the agency to carry out its mission.

We believe our recommendation remains valid. We recognize that budget constraints have and will likely continue to require MDA make difficult budgetary decisions. However, as discussed in this report, DOT&E recommended that funding MDS model development should be a top priority for MDA, DOD, and Congress. We also discussed in our report that MDA is suspending its efforts to develop the new, all-digital MDS simulator—a capability that DOT&E officials told us will be essential for conducting NGI operational assessments. Our recommendation would help ensure MDA sufficiently prioritizes these and other modeling and simulation improvement efforts and that any risks related to planning and

funding choices are recognized by DOD and Congress. We intend to review MDA's fiscal year 2025 and future year budget requests to determine whether the agency has taken sufficient action to address our recommendation.

We are sending copies of this report to the appropriate congressional committees, the Secretary of Defense, Under Secretary of Defense for Acquisition and Sustainment, Under Secretary of Defense for Research and Engineering, and the Director, 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 LudwigsonJ@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 II.



Jon Ludwigson
Director, Contracting and National Security Acquisitions

*List of Committees*

The Honorable Jack Reed
Chairman
The Honorable Roger Wicker
Ranking Member
Committee on Armed Services
United States Senate

The Honorable Jon Tester
Chair
The Honorable Susan Collins
Ranking Member
Subcommittee on Defense
Committee on Appropriations
United States Senate

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

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

# Appendix I: Comments from the Department of Defense

CUI

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WASHINGTON, DC 20301-3030

RESEARCH
AND ENGINEERING

February 12, 2024

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

Dear Mr. Ludwigson:

This is the Department of Defense response (Enclosure 1) to the Government Accountability Office (GAO) Draft Report GAO-24-106315, "MISSILE DEFENSE: Next Generation Interceptor Program Should Take Steps to Reduce Risk and Improve Efficiency," dated February 2024 (GAO Code 106315). The Department is providing the enclosed official written comments for inclusion in the report (Enclosure 2).

Sincerely,

[redacted]

David A. Honey, PhD

Enclosures:
As stated

This document is not CUI when separated from enclosure
CUI

**RESPONSE TO DRAFT REPORT GAO-24-106315 RECOMMENDATIONS**

**RECOMMENDATION 1:** The Secretary of Defense should task the Under Secretary of Defense for Acquisition and Sustainment with ensuring the Director, MDA regularly coordinates with the intelligence community, joint staff, and combatant commands throughout NGI development to prioritize and, if necessary, update NGI's threat requirements.

**RESPONSE 1:** DoD non-concurs.

The recommendation could be interpreted to convey that the Missile Defense Agency (MDA) does not already regularly coordinate with the intelligence community, joint staff, and combatant commands. MDA will continue its constant coordination with the Defense Intelligence Enterprise, the joint staff, and the combatant commands in both formal venues and through informal discussions. Given MDA's construct as a single Major Defense Acquisition Program, MDA's Directorate for Engineering Technical Intelligence continuously coordinates with the intelligence community, provides updated threat requirements to all of the Elements of the Missile Defense System including Ground-Based Midcourse Defense which has the Next Generation Interceptor as a Product, and ensures those threat requirements are met through MDA's robust design, development and delivery process. Additionally, MDA leadership coordinates habitually with the joint staff and combatant commands through the Missile Defense Executive Board and its multiple standing committees, as well as other requested and scheduled meetings.

As mentioned in the report, over the past year alone, GAO has closed as implemented, two separate recommendations related to MDA's regular coordination with the intelligence community from a December 2019 GAO report on DoD's use of intelligence community threat assessments for missile defense acquisitions (GAO 20-177). A third recommendation from the same report, incorrectly stated in this report to be considered "unaddressed", is considered by GAO to be partially addressed because, according to GAO's recommendation database at gao.gov as of 9 January 2024, DoD has taken "significant steps to implement [the] recommendation. Specifically, MDA coordinated with the intelligence community on developing and establishing the threat space and threat-related requirements for the Next Generation Interceptor (NGI)."

The Next Generation Interceptor program has threat requirements allocated to it to cover the anticipated threat and requirements in place for modularity and upgradeability to support potential design upgrades, if necessary, to counter advances in the threat beyond the existing allocation. Existing threat requirements are robust and are driving a capable hardware and software Next Generation Interceptor design.

**RECOMMENDATION 2:** The Secretary of Defense should task the Under Secretary of Defense for Acquisition and Sustainment with ensuring the Director, MDA promptly reports any changes in the threat that may have implications for NGI's threat requirements to

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ENCLOSURE 1

appropriate senior DOD leaders, including those on the Missile Defense Executive Board and the Joint Requirements Oversight Council.

**RESPONSE 2:** DoD Non-concurs.

The recommendation could be interpreted to convey that MDA does not promptly report any changes in the threat that have implications for NGI's threat requirements to appropriate senior DOD leaders. Though there have been no changes to NGI's top level requirements from the baseline established at the March 2020 Missile Defense Executive Board, MDA has several formal venues and a multitude of existing informal channels for reporting changes in NGI threat requirements to DoD leaders. These include, but are not limited to, the Missile Defense Executive Board and its multiple standing committee meetings, design reviews, In Progress Reviews, weekly reports, and weekly meetings. Further, the Capabilities Utility Assessment delivered by the USSPACECOM to support each milestone decision during the design, development and production process includes the collective independent assessment from the appropriate Warfighting Combatant Commands regarding the capability's ability to meet requirements and any gaps in the capability.

Threat changes that have been assessed by MDA and the intelligence community to be (1) relevant to Next Generation Interceptor and (2) exceed the current parametric threat space already require prompt escalation to DoD senior leadership. Further, if the threat, or any other need, drives a change to Next Generation Interceptor requirements, MDA is required by Section 1647 of the Fiscal Year 2021 National Defense Authorization Act (Public Law 116-283) to report those changes in requirements to Congress. Any such report would be coordinated with the OUSD(A&S), OUSD(R&E), and other Department of Defense stakeholders.

**RECOMMENDATION 3:** The Secretary of Defense should task the Under Secretary of Defense for Acquisition and Sustainment with ensuring the Director, MDA uses models and simulations that fully represent stressing intercept conditions for NGI performance and technology maturation assessments supporting the program's critical design reviews and key acquisition decisions.

**RESPONSE 3:** DoD non-concurs.

The recommendation could be interpreted to convey that MDA is not currently increasing model and simulation fidelity over the acquisition lifecycle as appropriate. MDA's NGI Acquisition Plan dated March 30, 2020 already includes the use of high fidelity models and simulations that fully represent stressing intercept conditions to support NGI's critical design reviews. MDA uses medium fidelity models to support the preliminary design review due to the level of design maturity and is currently working toward increasing the fidelity of current models and simulations consistent with design maturity to fully represent the stressing intercept conditions to support the NGI critical design review. It is important to note that the high fidelity models and simulations require actual flight software inclusive of algorithms and actual flight hardware in the loop for accredited results and analysis. Those are not known and available until designed, developed, tested, qualified and delivered to support the critical design review.

MDA will continue to use models and simulations that are of appropriate fidelity relative to the acquisition phase throughout the life of the NGI program.

**RECOMMENDATION 4:** The Director, MDA should develop a plan for budgeting for and expediting the development of all models—including models that represent stressing intercept conditions NGI is expected to encounter—and simulations necessary to support NGI critical design reviews and ground testing.

**RESPONSE 4:** DoD non-concurs.

MDA's budget process already includes identifying and budgeting for the engineering activities required to develop, test, integrate and field capability improvements, including Next Generation Interceptor. This includes developing and accrediting the models and simulations needed for assessing component, element and MDA level performance. The President's Budget currently appropriately supports Missile Defense Agency model development. Throughout the Planning, Programming, Budgeting, and Execution (PPBE) Process, the Department of Defense allocates the Department's limited resources across many high priority capabilities as is deemed necessary to best accomplish the Department's mission. MDA will continue to align its budget requests with identified resource requirements from across the Missile Defense System, prioritizing the initiatives in a way that best positions the Agency to carry out its mission to develop and deploy a layered Missile Defense System to defend the United States, its deployed forces, allies, and friends from missile attacks in all phases of flight.

**RECOMMENDATION 5:** The Director, MDA should conduct periodic independent organizational assessments of its efforts for implementing a digital engineering environment for the GMD program to support NGI development and incorporate lessons learned into its implementation plans, as needed.

**RESPONSE 5:** DoD Concurs.

# Appendix II: GAO Contact and Staff Acknowledgments

## GAO Contact

Jon Ludwigson, (202) 512-4841 or LudwigsonJ@gao.gov

## Staff Acknowledgments

In addition to the contact named above, Pete Anderson, Breanne Cave, Daniel Chandler, Min-Hei (Michelle) Kim, Patty Lentini, James Madar (Assistant Director), Kevin O'Neill, John Ortiz, Lexie Schutz, Brian Tittle (Analyst in Charge), Eric Trout, Wes Wilhelm, and Adam Wolfe made key contributions to this report.

# Related GAO Products

*Missile Defense: Annual Goals Unmet for Deliveries and Testing*. GAO-23-106011. Washington, D.C.: May 18, 2023.

*Missile Defense: Better Oversight and Coordination Needed for Counter-Hypersonic Development*. GAO-22-105075. Washington D.C.: June 16, 2022.

*Missile Defense: Addressing Cost Estimating and Reporting Shortfalls Could Improve Insight into Full Costs of Programs and Flight Tests*. GAO-22-104344. Washington D.C.: February 2, 2022.

*Missile Defense: Recent Acquisition Policy Changes Balance Risk and Flexibility, but Actions Needed to Refine Requirements Process*. GAO-22-563. Washington D.C.: November 10, 2021.

*Missile Defense: Observations on Ground-based Midcourse Defense Acquisition Challenges and Potential Contract Strategy Changes*. GAO-21-135R. Washington D.C.: October 21, 2020.

*Missile Defense: Further Collaboration with the Intelligence Community Would Help MDA Keep Pace with Emerging Threats*. GAO-20-177. Washington D.C.: December 11, 2019.

*Missile Defense: Delivery Delays Provide Opportunity for Increased Testing to Better Understand Capability*. GAO-19-387. Washington D.C.: June 6, 2019.

*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.

*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: Ballistic Missile Defense System Testing Delays Affect Delivery of Capabilities*. GAO-16-339R. Washington D.C.: April 28, 2016.

*Missile Defense: Assessment of DOD's Reports on Status of Efforts and Options for Improving Homeland Missile Defense*. GAO-16-254R. Washington D.C.: February 17, 2016.

*Missile Defense: Opportunities Exist to Reduce Acquisition Risk and Improve Reporting on System Capabilities*. GAO-15-345. Washington D.C.: May 6, 2015.

*Missile Defense: Cost Estimating Practices Have Improved, and Continued Evaluation Will Determine Effectiveness*. GAO-15-210R. Washington D.C.: December 12, 2014.

*Regional Missile Defense: DOD's 2014 Report Generally Addressed Required Reporting Elements, but Excluded Additional Key Details*. GAO-15-32. Washington D.C.: December 1, 2014.

*Missile Defense: Mixed Progress in Achieving Acquisition Goals and Improving Accountability*. GAO-14-481T. Washington D.C.: April 2, 2014.

*Missile Defense: Opportunity to Refocus on Strengthening Acquisition Management*. GAO-13-432. Washington D.C.: April 26, 2013.