T-7A Red Hawk

Source: Boeing Corporation. | GAO-22-105230

# OVERVIEW

## DOD Weapon Portfolio for 2022

### Insight into cost performance is hampered by limited data and schedule challenges remain.

The portfolio of DOD's costliest weapon programs tracked by the Office of the Secretary of Defense (OSD) consists of MDAPs, future MDAPs, and MTA programs with costs exceeding the cost threshold for MDAP designation. Table 5 shows the programs that DOD tracked in these categories as of the third quarter of fiscal year 2021. While not reflected in the portfolio, the military departments also track other costly programs, such as classified programs, and programs that have yet to formally designate an AAF pathway but expect to exceed the cost threshold for MDAP designation.

**Table 5:** Portfolio of Costliest Weapon Programs Tracked by DOD (as of third quarter fiscal year 2021)

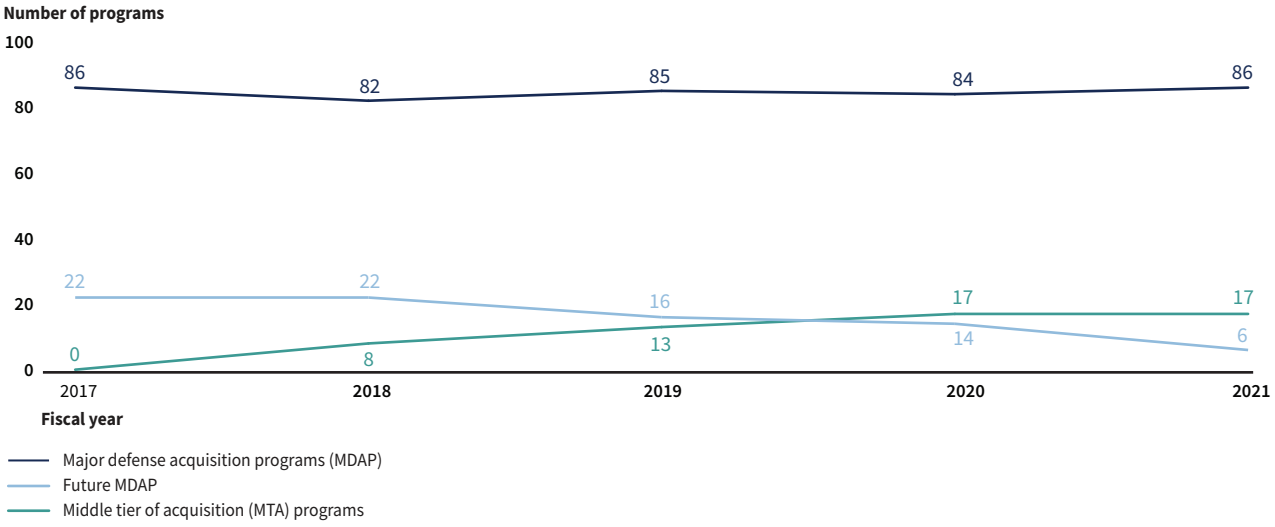
| Type of program | Number of programs | Air Force | Navy | Army | DOD |
|---|---|---|---|---|---|
| Major defense acquisition program (MDAP) | 86 | 30 | 39 | 15 | 2 |
| Future MDAP | 6 | 3 | 1 | 2 | 0 |
| Middle tier of acquisition program exceeding the cost thresholds for MDAP designation | 17 | 10 | 1 | 6 | 0 |

Source: GAO analysis of Department of Defense (DOD) information. | GAO-22-105230

**Note:** The table reflects the count of programs DOD tracks in its Defense Acquisition Visibility Environment and Defense Acquisition Management Information Retrieval systems. Program counts do not match the number of individual programs we assessed in this report due to our criteria for selecting programs.

The composition of DOD's weapon portfolio has evolved over the last 5 fiscal years with the introduction of the MTA pathway in April 2018 and the implementation of the AAF in January 2020. The number of MDAPs that DOD tracks has remained relatively consistent. However, the number of future MDAPs decreased while the use of the MTA pathway generally increased in the last 5 years (see figure 4).

**Figure 4:** DOD's Use of Future MDAPs Decreased While MTA Programs Increased over the Last 5 Years




Source: GAO analysis of Department of Defense (DOD) information. | GAO-22-105230

**Note:** This figure reflects programs identified by DOD in each fiscal year. Data for 2021 reflects information obtained from DOD in the third quarter of fiscal year 2021.

# SUMMARY OF WEAPON PROGRAMS GAO ASSESSED

**Incomplete data in fiscal year 2022 budget request limits analysis of entire portfolio.**

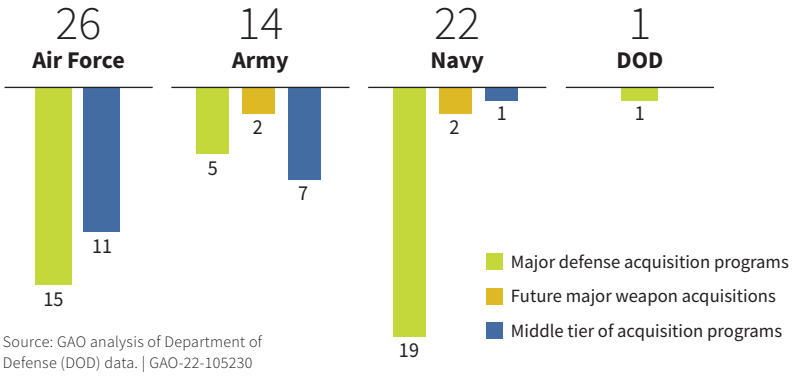
**Figure 5:** GAO Assessed 63 Selected DOD Weapon Acquisition Efforts in 2022

Source: GAO analysis of Department of Defense (DOD) data. | GAO-22-105230

In prior years, we assessed the cost and schedule performance of DOD's portfolio of over 80 MDAPs. Due to the lack of comprehensive Selected Acquisition Reports produced for the fiscal year 2021 reporting period, this year we could not assess the full portfolio of MDAPs. DOD determined it could not develop these reports due to incomplete data in the budget request for fiscal year 2022. As such, this year our analysis is limited to a subset of MDAPs that we individually assessed. Figure 6 shows the type of programs that we reviewed by military department.

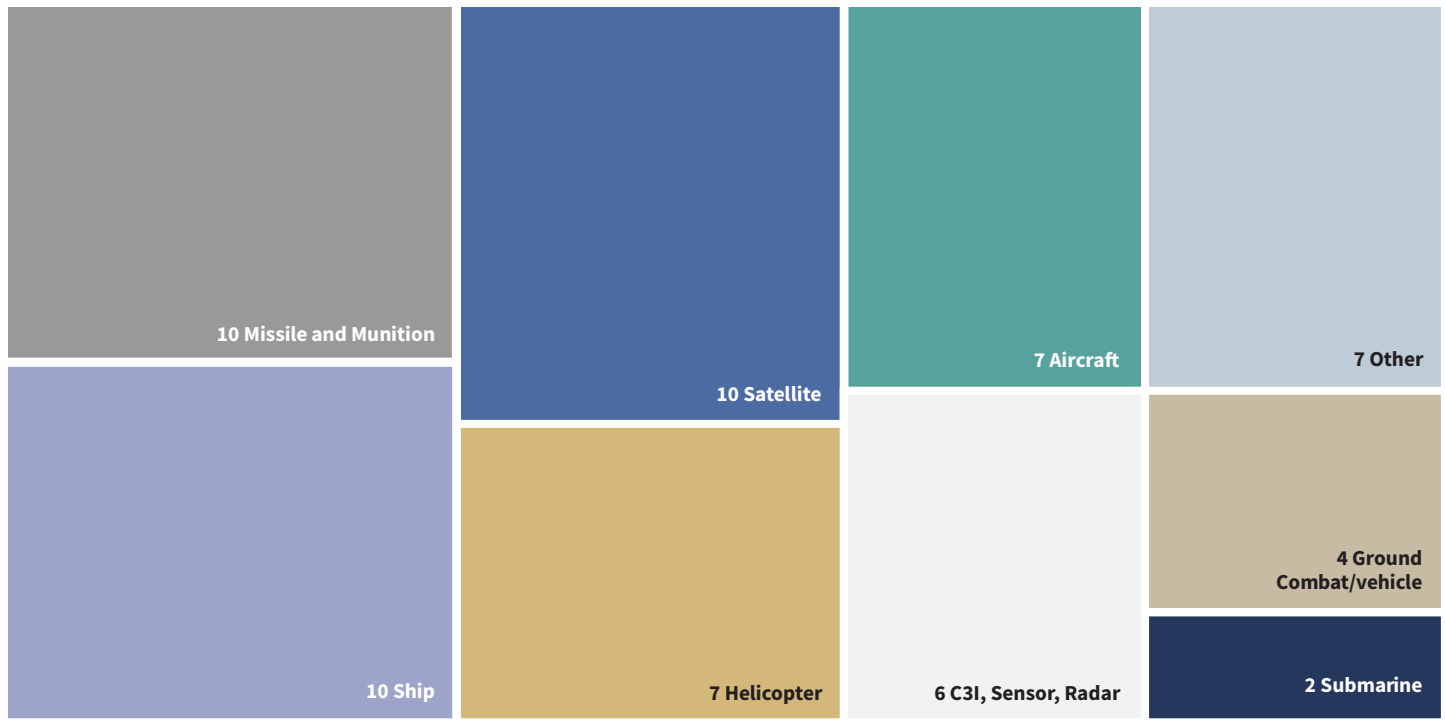
Source: © 2021 Dynetics, Inc. | GAO-22-105230

**Figure 6:** Type of Programs GAO Reviewed by Military Department




Source: GAO analysis of Department of Defense (DOD) data. | GAO-22-105230

**Figure 7:** Number of Programs GAO Reviewed by Commodity




C3I = Command, Control, Communications and Intelligence
Source: GAO analysis of Department of Defense data. | GAO-22-105230

**Note:** "Other" includes programs that did not list a program type in their Selected Acquisition Report, mission systems, and software systems and components, among other things.

## FUTURE MAJOR WEAPON ACQUISITIONS

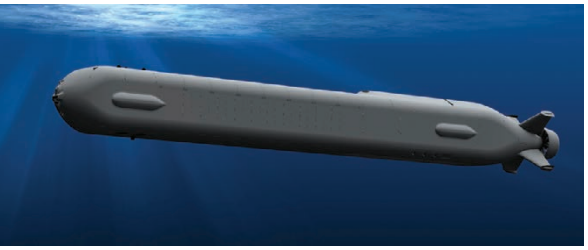
**Costly research and development efforts exist that have yet to designate an AAF pathway.**

We have previously reported on future MDAPs to highlight large planned investments and assess the extent to which these programs planned to acquire sufficient knowledge by the time they were formally initiated as MDAPs. However, with the introduction of the AAF, many of DOD's costliest future acquisition efforts no longer begin development as a future MDAP.

For example, research and development efforts may begin development before deciding on an AAF pathway. These efforts are not tracked by OSD until they are formally initiated using an AAF pathway.

For the first time, this year we gathered available information about those efforts, which, collectively with future MDAPs, we refer to as "Future Major Weapon Acquisitions." Figure 8 highlights examples of future major weapon acquisitions likely to reach the cost threshold for MDAP designation that have yet to formally initiate an AAF pathway.

**Figure 8:** Examples of Future Major Weapon Acquisitions Identified by GAO That Have Yet to Designate an Acquisition Pathway



Source: U.S. Navy. | GAO-22-105230

### Orca Extra Large Unmanned Undersea Vehicle (XLUUV)

**Military department:** Navy

**Description:** The XLUUV is an uncrewed undersea vehicle that is expected to meet various undersea missions by leveraging a modular payload bay that can carry and deploy various payload types.

**Approach:** Currently being developed as a research and development project in response to an emergent operational need. Design contracts were awarded in September 2017 to develop initial designs and the Navy exercised options in 2019 to acquire five systems. The program reported in June 2021 that delivery of the first system was delayed from December 2020 to September 2022.

**Estimated funding:** Fiscal year 2022 budget request includes $328 million (excludes costs beyond fiscal year 2022 needed to complete the system).

**Quantity for current effort:** Five under construction; up to four more under contract.

**Planned acquisition pathway:** As of March 2022, the Navy plans to transition XLUUV to the major capability acquisition pathway at some point in the future.

Source: U.S. Navy. | GAO-22-105230

### Large Unmanned Surface Vehicle (LUSV)

**Military department:** Navy

**Description:** The LUSV is a planned long-endurance, uncrewed ship capable of conducting warfare operations with varying levels of autonomy. It is expected to integrate anti-ship and land-attack capabilities.

**Approach:** Currently being developed as a research and development project. The Navy plans to incrementally deliver capability as technologies mature and qualify representative machinery plants prior to proceeding to production.

**Estimated funding:** Fiscal year 2022 budget request includes $473.1 million (excludes costs beyond fiscal year 2022 needed to complete the system).

**Quantity for current effort:** To be determined.

**Planned acquisition pathway:** As of March 2022, the Navy plans to transition LUSV to the major capability acquisition pathway at some point in the future.

Source: U.S. Army. | GAO-22-105230

### Long Range Hypersonic Weapon (LRHW)

**Military department:** Army

**Description:** The LRHW effort seeks to develop and field a ground-launched, hypersonic missile as part of the Army's strategic, long-range, precision fires portfolio. LRHW is a joint effort with the Navy's Conventional Prompt Strike program, which is developing the same system to be fired from ships.

**Approach:** LRHW is using research and development funds to deliver an initial capability.

**Estimated funding:** $2+ billion in research development, testing, and evaluation costs through fiscal year 2025.

**Quantity for current effort:** 8 (developmental quantity through fiscal year 2025).

**Planned acquisition pathway:** To be determined.

As of January 2022, DOD has yet to update its approach to tracking future major weapon acquisitions to reflect the AAF. However, these efforts reflect significant investments to address capability gaps and warfighter needs that are occurring before programs are formally initiated in an AAF pathway. The resulting lack of insight has the potential to undermine DOD's understanding of its full portfolio of weapon programs and ability to allocate resources to programs that best accomplish the department's goals. We will continue our efforts in our future assessments to identify and report on these programs.

DOD MDAP Portfolio

# COSTS

**Insight into MDAP cost performance is limited by lack of data.**

Due to the lack of available data, we could not assess the 1-year cost performance of MDAPs. DOD officials told us they have collected cost data, but those data are inconsistent across the military departments. The inconsistency results from military departments not consistently accounting for future year funding since it was not included in the fiscal year 2022 budget request. Since January 2021, some programs reported new baselines due to updated program costs or milestones. Specifically, we found that seven MDAPs issued new baselines since January 2021, and of those, six show increased costs since our last assessment.

Source: General Dynamics Electric Boat. | GAO-22-105230

## Examples of MDAPs that reported cost growth since our last assessment

### SSBN 826 *Columbia* Class Ballistic Missile Submarine

The program reported over a $3.4 billion total cost increase since our last assessment. This increase reflects the August 2020 independent cost estimate for the whole class, expenditures on the supplier base and missile tubes that required costly rework, and poor contractor performance during design, among other things.

### Integrated Air and Missile Defense (IAMD)

The program reported over a $1 billion total cost increase since our last assessment. A new baseline cost estimate was validated in support of the January 2021 production decision. According to the program office, the updated cost estimate increased funding through fiscal year 2031 in order to provide additional warfighter capability to respond to emerging threats, such as enabling integration with additional weapons and sensors, as well as continuous software development and testing.

Source: Dynetics | GAO-22-105230

### Ship to Shore Connector Amphibious Craft (SSC)

The program reported a nearly $510 million cost increase since our last assessment. It breached its cost baseline thresholds in March 2021 due to technical challenges, along with labor and material cost growth. The next 14 craft on the follow-on contract are also expected to have increased unit costs, according to program officials.

Source: Textron Systems. | GAO-22-105230

DOD MDAP Portfolio

# SCHEDULE PERFORMANCE

## More than half of MDAPs reported schedule delays since last year.

**Next Generation Jammer Mid-Band**
(shown on an EA-18G Growler aircraft)

Source: U.S. Navy. | GAO-22-105230

Despite DOD's efforts over the last several years to accelerate capability delivery, over half of the MDAPs we reviewed reported a delay achieving initial operational capability (IOC) since our last assessment. None of the 29 programs for which we reviewed their schedule reported accelerating a cycle time. Moreover, nine programs that reported schedule delays in our last assessment also reported further delays as of January 2022.

**Table 6:** More Than Half of Major Defense Acquisition Programs GAO Reviewed Reported a Cycle Time Delay since January 2021

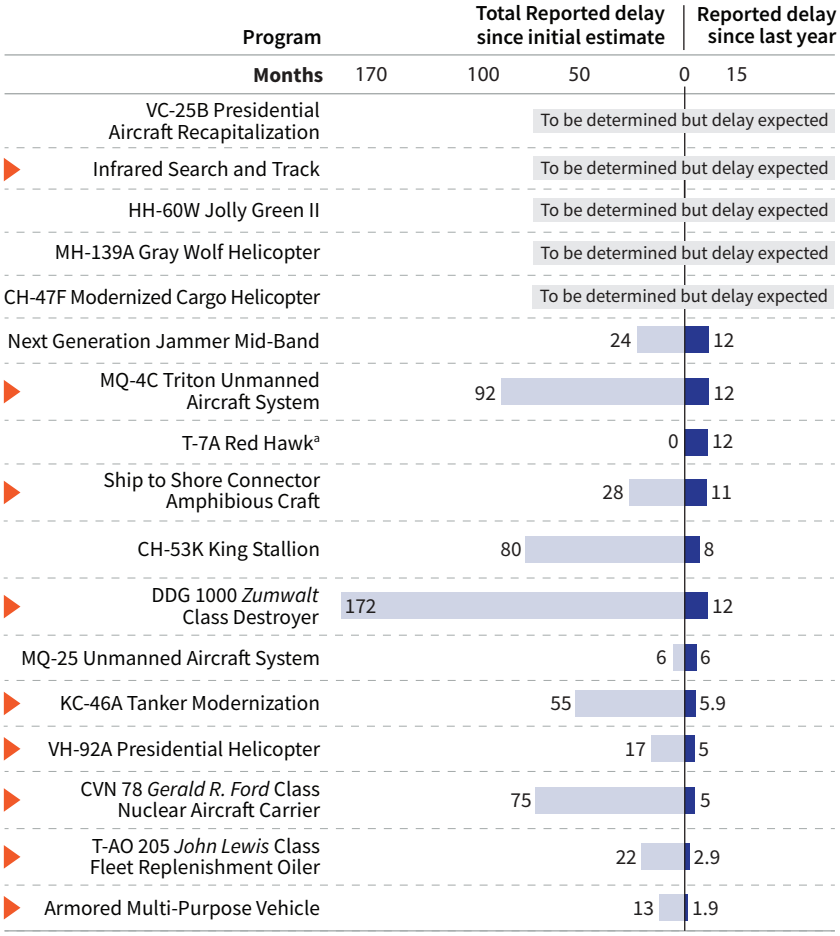
| Type of program | Number of MDAPs | Percentage of MDAPs | Range of known delay (in months) reported in the past year |
|---|---|---|---|
| Reported a cycle time delay | 17 | 59 | 2-12[a] |
| Did not report a cycle time delay | 12 | 41 | — |
| **Total** | **29** | | |

Source: GAO analysis of Department of Defense data. | GAO-22-105230

**Note:** We analyzed 29 major defense acquisition programs (MDAP) that had yet to declare IOC as of April 2021. We measure IOC change as a cycle time change.

[a]Five programs reported initial operational capability (IOC) delays but the total delay was unknown at the time of our review.

**Figure 9:** Major Defense Acquisition Programs GAO Reviewed That Reported a Cycle Time Delay since January 2021




Source: GAO analysis of Department of Defense data. | GAO-22-105230

**Note:** Initial operational capability (IOC) is generally a point in time when a system can meet the minimum operational capabilities for a user's stated need. Five programs that were included in our portfolio analysis and individual program assessments were excluded from this analysis either because they do not track IOC or because they already achieved IOC as of April 2021.

[a]T-7A Red Hawk reported a 12-month delay since last year, but the program is currently ahead of its IOC objective date.

### Examples of programs that reported IOC delays since our last assessment

**VC-25B Presidential Aircraft Recapitalization**
The program projects a delay due to the contractor transitioning to a new supplier and other issues, which requires the program to develop a new baseline, according to program officials. However, the extent of the delay has yet to be determined.

**Next Generation Jammer Mid-Band**
The program reported a delay due to a design issue with a test pod, which required a redesign to support flight testing. The issue was first discovered in 2019, but the program did not anticipate at the time that it would affect testing.

**CVN 78 *Gerald R. Ford* Class Nuclear Aircraft Carrier**
The program reported a 21-month delay in its December 2019 Selected Acquisition Report. In September 2021, the program reported an additional delay due to issues with the ship's Advanced Weapons Elevators.

**MQ-4C Triton Unmanned Aircraft System**
The program reported a 16-month delay in its December 2019 Selected Acquisition Report. Program officials reported an additional delay due to technical problems.

**Ship to Shore Connector Amphibious Craft**
The program reported a 5-month delay in its December 2019 Selected Acquisition Report. The program has since reported an additional delay due to technical challenges with its propeller and gearbox.

## DOD MTA Portfolio

**MTA programs face schedule challenges and persistent data quality issues.**

Since our last assessment, we expanded our coverage of MTA programs to include 19 programs—17 rapid prototyping and two rapid fielding—15 of which have estimated costs greater than the threshold for MDAP designation.[37] These programs provide critical capabilities that vary from aircraft hardware to satellite communication capabilities. We reviewed four new MTA efforts this year—two of which were previously tracked as pre-MDAPs by DOD—while two other programs from our last assessment exited our portfolio (see figure 10).

Source: JHU/APL. | GAO-22-105230

**Figure 10:** Overview of 19 MTA Programs Reviewed by GAO

**Middle tier of acquisition (MTA) pathway**

Rapid Prototyping — ≤ 5 years → Rapid Fielding — ≤ 5 years

**We reviewed 17 rapid prototyping efforts:**

**Air Force**
- Air-launched Rapid Response Weapon (ARRW)
- B-52 Commercial Engine Replacement Program (CERP) Rapid Virtual Prototype (RVP)
- ★ **Deep Space Advanced Radar Capability (DARC)**
- Evolved Strategic SATCOM (ESS)
- F-22 Rapid Prototyping
- Future Operationally Resilient Ground Evolution (FORGE)
- Military Global Positioning System (GPS) User Equipment Increment 2 (MGUE Inc. 2)
- Next Generation Overhead Persistent Infrared Block 0-Geosynchronous Satellites (Next Gen OPIR Block 0 GEO)
- Protected Tactical Enterprise Service (PTES)
- Protected Tactical SATCOM (PTS)

**Army**
- Extended Range Cannon Artillery (ERCA)
- ★ **Future Long-Range Assault Aircraft (FLRAA)**
- ★ **Indirect Fire Protection Capability Increment 2 (IFPC Inc. 2)**
- Lower Tier Air and Missile Defense Sensor (LTAMDS)
- Mobile Protected Firepower (MPF)
- Optionally Manned Fighting Vehicle (OMFV)

**Navy**
- Conventional Prompt Strike (CPS)

**We reviewed two rapid fielding efforts:**

**Air Force**
- F-15EX

**Army**
- ★ **Integrated Visual Augmentation System (IVAS)**

**Two efforts from our prior report are no longer included:**
- The Air Force's Air Operations Center Weapon System Modifications program transitioned to the software acquisition pathway.
- The Army's Integrated Visual Augmentation System (IVAS) rapid prototyping effort is ongoing through fiscal year 2023 but has been funded to over 96 percent of its total estimated cost and transitioned to a rapid fielding effort.

★ **New MTA effort reviewed by GAO this year**

Source: GAO analysis of Department of Defense data. | GAO-22-105230

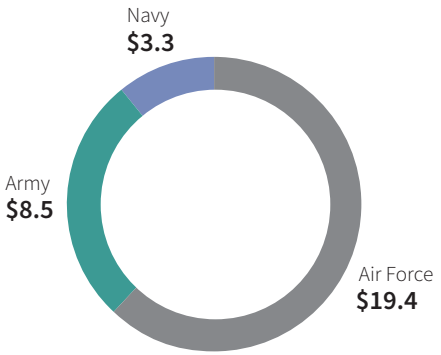
[37]We also assessed four MTA programs that did not meet the cost threshold for MDAP designation. See appendix II for additional details on our selection methodology for these programs.

# COST

**DOD plans to invest about $31 billion in current MTA programs, but cost reporting continues to be inconsistent.**

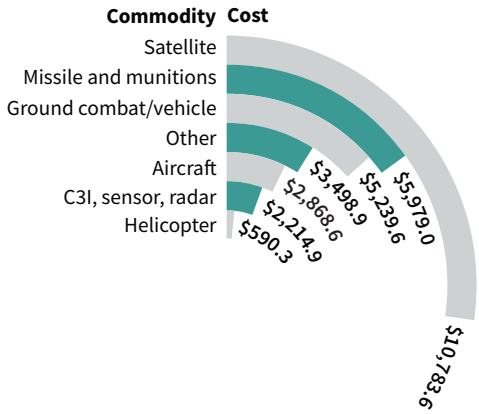
As in past years, we found that MTA programs reported inconsistent cost information to us. We also identified other reliability concerns with MTA program data submitted to OSD and Congress. Combined cost estimates totaled $31.2 billion for the 19 MTA programs we reviewed (see figures 11 and 12).

**Figure 11:** Planned Cost of Current Middle Tier of Acquisition Efforts (fiscal year 2022 dollars in billions)




Source: GAO analysis of Department of Defense data. | GAO-22-105230

**Figure 12:** Estimated Costs of Current Middle Tier of Acquisition Efforts by Commodity (fiscal year 2022 dollars in millions)




**C3I** = Command, Control, Communications and Intelligence

Source: GAO analysis of Department of Defense data. | GAO-22-105230

For the third consecutive year, we found that MTA cost information reported to us was inconsistent across programs. In some cases, reported costs reflected a different scope than the current MTA effort or included funding beyond the current effort. This required follow up with program officials to clarify data and resolve discrepancies.

We also identified other reliability concerns with MTA program data submitted by program offices to OSD. For example, we found discrepancies in MTA planned completion dates and critical technology information reported to OSD compared to what was reported to us. Unreliable data hinders effective DOD and congressional oversight of these programs. We have ongoing work that is further examining these data reliability issues. We expect to issue a report on the results of that review later in 2022.

### Examples of MTA programs that reported inconsistent costs as compared with our last assessment

#### Lower Tier Air and Missile Defense Sensor (LTAMDS)

Source: Copyright 2020 Raytheon Company. | GAO-22-105230

- The Army's LTAMDS program reported a cost estimate this year that was approximately $800 million higher than what the program reported in our prior assessment.
- According to the program, the funding it reported to us in our prior assessment considered only the costs related to developing and fielding urgent material release prototypes and did not include development costs for the entire time frame of the current MTA effort.

#### Next Generation Overhead Persistent Infrared Block 0-Geosynchronous Earth Orbit Satellites (Next Gen OPIR Block 0 GEO)

- The Air Force's Next Gen OPIR program reported a cost estimate approximately $3.1 billion lower than what the program reported in our prior assessment.
- Program office officials told us the prior costs included both the Next Gen OPIR GEO and Next Gen OPIR Polar satellite portions of the program; however, the latter is no longer part of this MTA effort and, thus, not included in our assessment.

#### Conventional Prompt Strike (CPS)

- The Navy's CPS program reported a cost estimate approximately $700 million lower than what the program reported in our prior assessment.
- According to officials, the program received approximately 24 percent less funding than requested for fiscal year 2021 and underwent a program restructuring as a result.

**DOD MTA Portfolio**

# SCHEDULE

**Delayed interim milestones put planned completion dates and outcomes at risk.**

Some MTA programs have experienced challenges that have delayed interim milestones and depleted schedule margin towards planned completion dates, suggesting that initial plans may have been overly optimistic.

We will continue to monitor the effects of these schedule changes, including the potential that programs may need to consider tradeoffs such as reduced residual capability at the completion of the MTA effort.

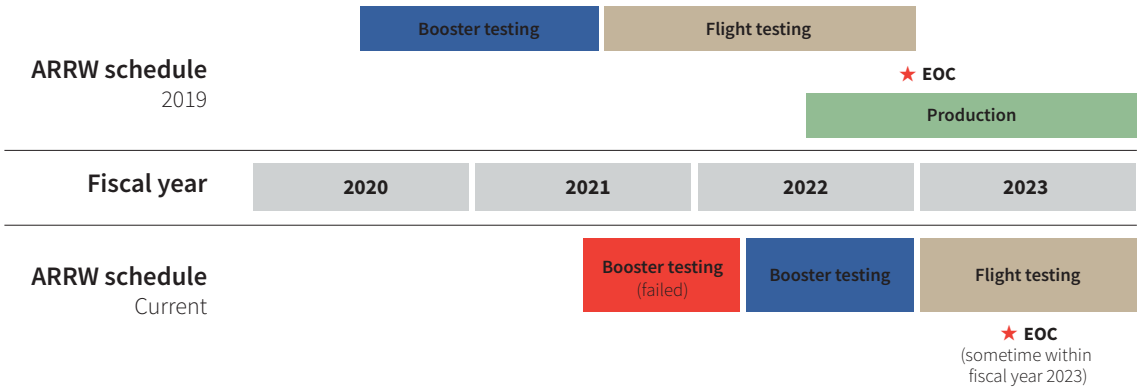
Source: U.S. Air Force. | GAO-22-105230

## Examples of MTA Programs with Reported Delays

**The Air Force's Air-launched Rapid Response Weapon (ARRW)** rapid prototyping effort had an aggressive, time-compressed flight test schedule. The plan included three booster tests in fiscal year 2021. However, after two failed attempts to execute the first test, initial testing was paused to find the cause of these failures. The program subsequently experienced another booster test failure during the first quarter of fiscal year 2022. As a result, the remaining test schedule was compressed and MTA completion was delayed by 11 months, exhausting the remaining schedule margin within the original 5-year schedule.

The program requested procurement funding for 12 missiles and was planning to move forward with initiation of a new rapid fielding effort in fiscal year 2022. However, the Joint Explanatory Statement accompanying the Consolidated Appropriations Act, 2022 stated that no procurement funds were being provided for ARRW, and instead provided additional research, development, test and evaluation funds to support an extension of the testing program and mitigate a projected funding shortfall for the prototyping effort.

**Figure 13:** Optimistic Development Schedule for Air-launched Rapid Response Weapon (ARRW) Program Compressed Following Early Testing Challenges




EOC = Early Operational Capability

Source: GAO analysis of program office documentation. | GAO-22-105230

We reported last year that critical technologies for the **Army's Extended Range Cannon Artillery (ERCA)** program were generally less mature than officials were expecting. However, the program planned to make significant progress on maturing these technologies before the end of the effort. This year, we found that the program's technology readiness assessment, completed in July 2021, revealed issues that testing officials said would require additional effort for maturing technologies. Programs officials also cited delays related to COVID-19, prototype manufacturing, and the availability of ammunition for testing. As a result, the program is pursuing a request for a waiver to extend the effort an additional year beyond the 5-year MTA time frame in DOD policy.

The **Army's Lower Tier Air and Missile Defense Sensor (LTAMDS)** program delayed planned operational testing from November 2021 to the third quarter of fiscal year 2023 due to integration challenges. The program also delayed its expected MTA completion date by one year to the fourth quarter of fiscal year 2023—2 months before the 5-year point since initiation. Officials acknowledged hardware delivery delays increase risk to the program, but told us they still expect to complete testing and program activities during fiscal year 2023.

DOD MTA Portfolio

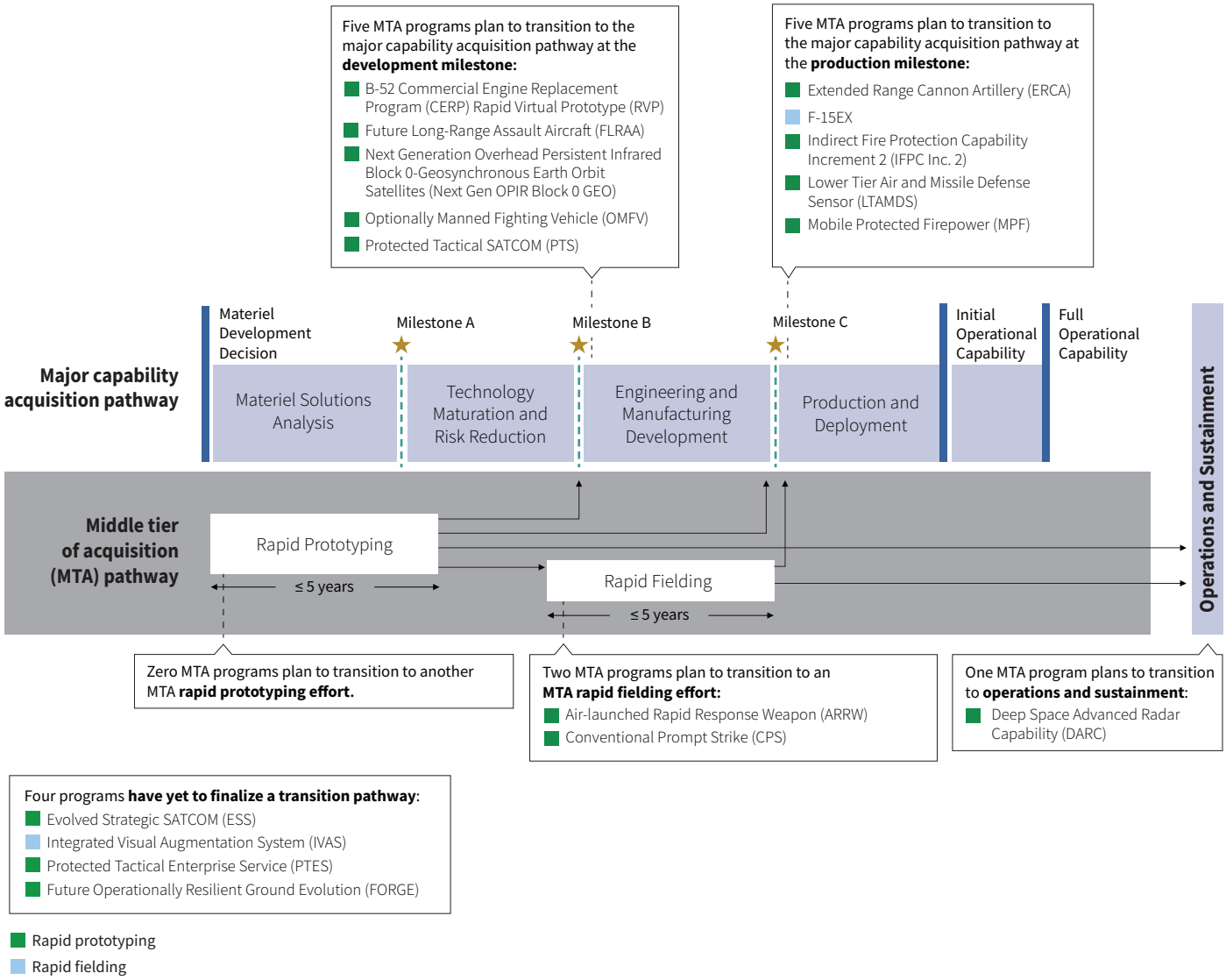
# TRANSITION PLANS

**Most MTA programs now plan to transition to the major capability acquisition pathway.**

Of the 13 MTA programs that identified a specific transition plan, 10 expect to transition to the major capability acquisition pathway—up from six of 13 last year. This includes two programs—the Air Force's B-52 CERP RVP and the Army's LTAMDS—that previously planned to transition to another MTA effort. An additional program, the Space Force's ESS, is also considering a similar shift.

It is too soon to tell what effect the progress made during current MTA efforts will have on overall time frames for capability delivery. We will continue to monitor these programs as they transition to follow-on pathways. Figure 14 shows transition plans for MTA programs we reviewed.

**Figure 14:** Planned Transition Pathway of Current MTA Programs GAO Reviewed




Source: GAO analysis of Department of Defense data. | GAO-22-105230

**Notes:** MGUE Inc. 2 is developing receiver cards that the individual military services will produce and field. Thus, it does not have a transition path aligned with the AAF. F-22 Rapid Prototyping plans to transition most selected capabilities as individual programs to different pathways. F-15EX will transition during production, which is already ongoing for the program's first two lots.

DOD MTA Portfolio

# TRANSITION PLANS

**Examples of programs' changes to transition plans since our prior assessment**

**Conventional Prompt Strike (CPS)** changed its transition plan from executing another rapid prototyping effort to transitioning to rapid fielding following funding cuts, the impending retirement of a submarine, and new Navy mission requirements, according to program officials.

**B-52 Commercial Engine Replacement Program (CERP) Rapid Virtual Prototype (RVP)** planned to transition to another rapid prototyping effort. However, officials now say the program will transition to the major capability acquisition pathway at system development due to a high level of interest in the B-52 program and to facilitate more oversight from OSD.

**Lower Tier Air and Missile Defense Sensor (LTAMDS)** planned to transition to a rapid fielding MTA effort, but officials said they would be unable to produce all radars within the 5-year timeline established by DOD policy. The program now plans to transition to the major capability acquisition pathway at production.

**Evolved Strategic SATCOM (ESS)** planned to transition to a rapid fielding effort, but is now considering instead a transition to the major capability acquisition pathway at system development. Program officials are unsure whether they could meet the 5-year MTA timeline established by DOD policy for the follow-on effort.

Source: U.S. Air Force. | GAO-22-105230

Source: LinQuest. | GAO-22-105230

**Protected Tactical Enterprise Service (PTES)** planned to transition to a rapid fielding MTA effort, but officials said the software acquisition pathway is a potential option now that the pathway has matured and has been more clearly defined since it was rolled out in 2020.

DOD MDAP Portfolio

DOD MTA Portfolio

# COVID-19

## Programs continue to report challenges related to COVID-19.

Source: U.S. Navy photo courtesy of Huntington Ingalls Industries. I GAO-22-105230

### Examples of COVID-19-related challenges reported by programs

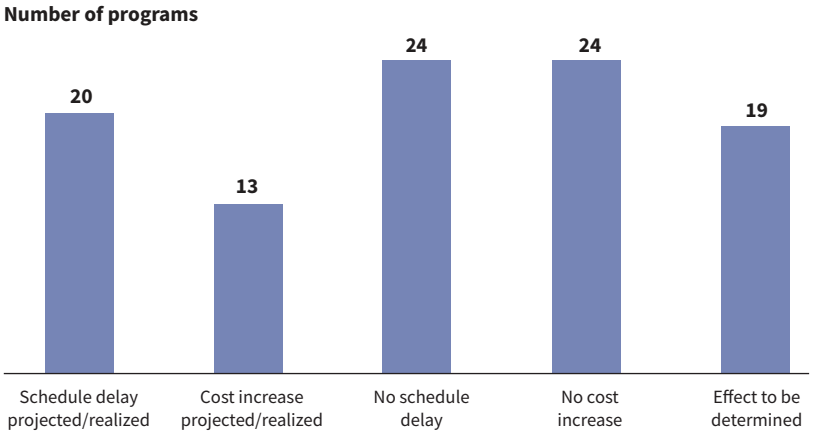
**SSN 774 *Virginia* Class Submarine**
The program reported that COVID-19 challenges exacerbated existing issues from its missile tube and casting vendors. Additionally, experience levels, inefficiencies, staffing shortfalls, and a temporary shutdown of hiring and training pipelines as a result of COVID-19 resulted in delays to Block IV construction. The program reported that COVID-19 effects added schedule risk in the form of material delivery delays and production inefficiencies related to workforce attendance, growth, and training.

**Improved Turbine Engine Program**
The program reported nearly a 16-week delay due to material or supplier delays as a result of COVID-19 challenges. In addition, the program reported that the contractor is experiencing higher than anticipated costs due to COVID-19 and is currently negotiating an equitable adjustment. Program officials stated they did not know the total effect on costs as of August 2021.

**Next Generation Jammer Mid-Band**
The program reported that COVID-19 challenges delayed the delivery of system components by 10 weeks and led to a cost increase of over $4 million due to supplier challenges caused by COVID-19.

For the second consecutive year, we surveyed MDAPs and MTA programs on challenges associated with COVID-19. This year, 35 of the 40 MDAPs and 10 of the 19 MTAs we surveyed reported challenges associated with COVID-19. In particular, more than half of the programs reported that they expect to experience or experienced cost or schedule challenges associated with COVID-19. Figure 15 shows the count of MDAPs and MTA programs that reported cost and schedule challenges associated with COVID-19.

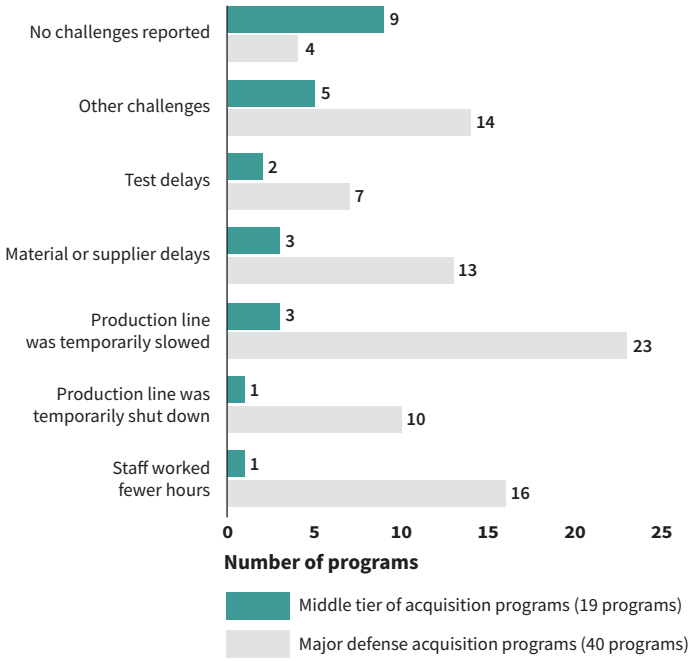
**Figure 15:** Extent to which Programs Reported Cost or Schedule Effects Associated with COVID-19 as of July 2021




Source: GAO analysis of questionnaire responses. | GAO-22-105230

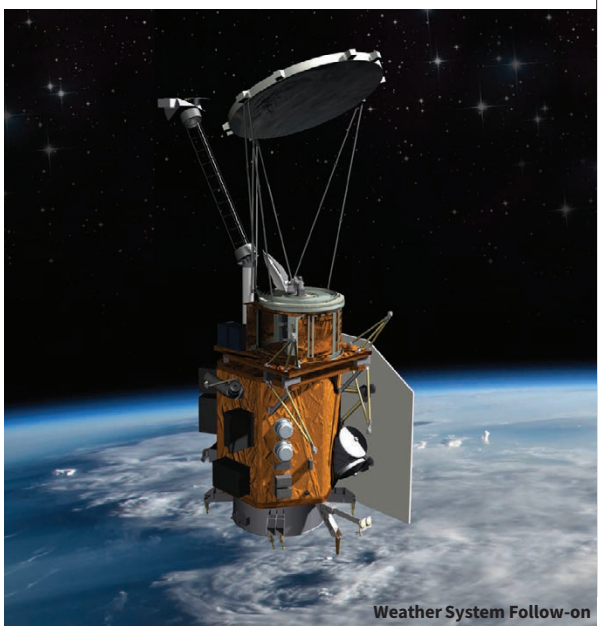
**Note:** We asked 59 programs if they experienced cost or schedule challenges. The counts above do not sum to 59 because programs could select more than one option.

**Figure 16:** Reported Challenges due to COVID-19 as of July 2021




Source: GAO analysis of questionnaire responses. | GAO-22-105230

**Note:** In some cases programs reported multiple challenges. As such, the totals in figure 16 above do not sum to 59 programs.




Source: © 2020 by Ball Aerospace & Technologies Corp. All rights reserved. | GAO-22-105230

# OVERVIEW

## GAO Knowledge-Based Practices

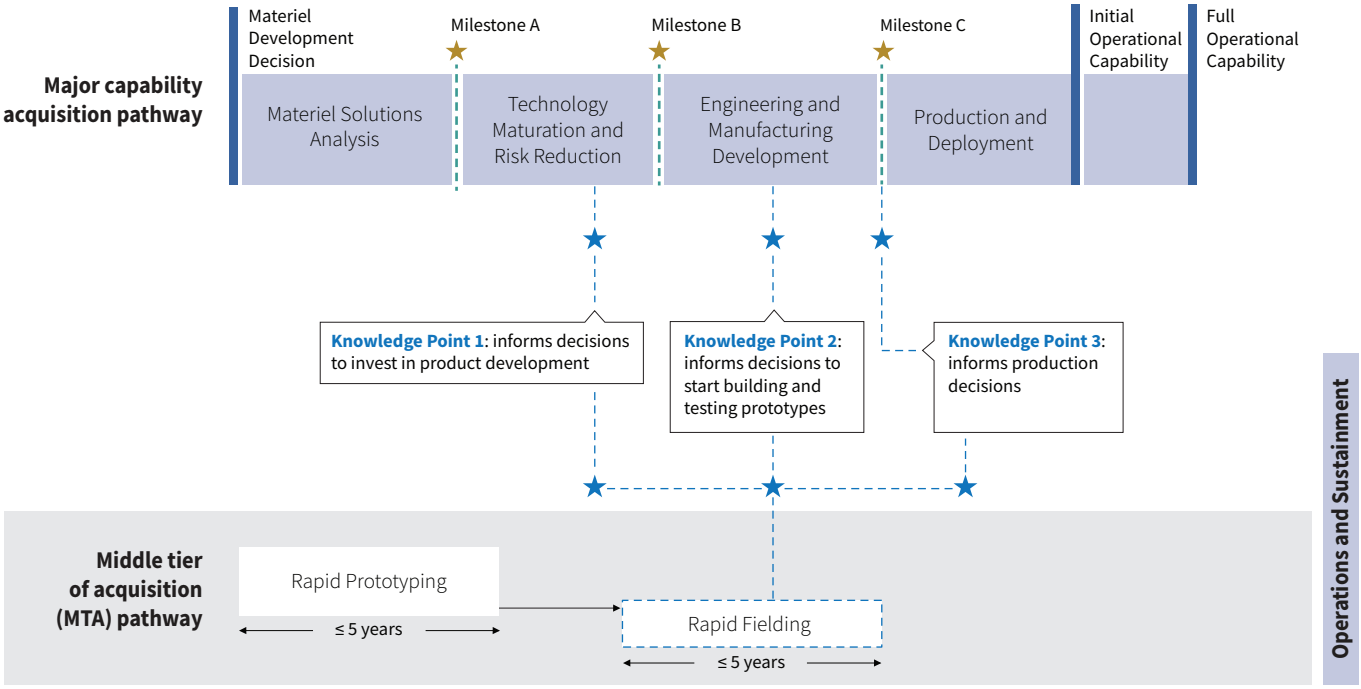
**Programs' attainment of knowledge is limited, potentially increasing weapon system costs and slowing delivery.**

Our body of work on MDAPs shows that attaining high levels of knowledge before programs make significant commitments during product development drives positive acquisition outcomes. A knowledge deficit early in a program can cascade through design and production.

For the second consecutive year, we assessed the extent to which MTA programs plan to obtain acquisition knowledge in preparation for planned follow-on efforts.[38] Our past work shows that gaining appropriate knowledge during the MTA effort will help ensure the program is well-positioned to field its eventual planned capabilities in a timely manner. For MTA programs, a knowledge deficit at the end of the current MTA effort poses cost and schedule risks after the program transitions to a follow-on effort.

Figure 17 depicts our knowledge-based acquisition practices.

**Figure 17:** GAO-Identified Knowledge Points Depicted on the Major Capability Acquisition and Middle Tier of Acquisition Pathways




Source: GAO analysis of Department of Defense Instruction 5000.80, 5000.85, and leading acquisition practices. | GAO-22-105230

[38]We applied our knowledge-based acquisition practices to MTA programs based on a program's specific transition plan. For example, if an MTA program planned to transition to the major capability acquisition pathway at system development, we assessed the extent to which the program planned to demonstrate knowledge that informs the decision to invest in product development by the end of the current MTA effort.

## Knowledge-Based Practices

# MDAPs

**MDAPs continue to proceed with limited knowledge, but some have opportunities to improve knowledge to inform future investments.**

CH-47F Modernized Cargo Helicopter Block II

Source: U.S. Army. I GAO-22-105230

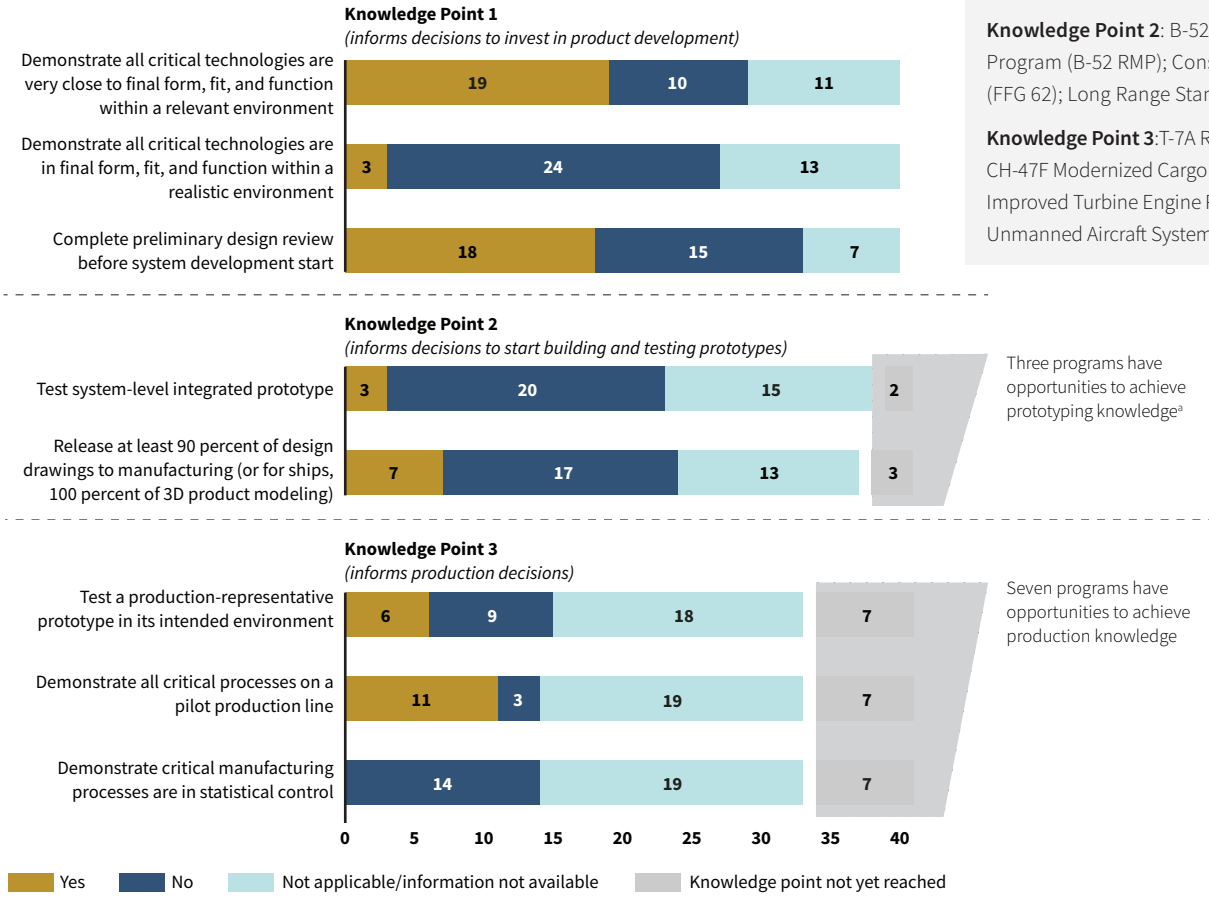
We continue to find that many MDAPs missed opportunities at key acquisition milestones to make knowledge-based decisions that can lead to improved cost and schedule outcomes. However, a limited number of MDAPs that have yet to reach key milestones still have opportunities to achieve knowledge to inform investment decisions for testing and production.

### Observations

- Over half of the MDAPs we reviewed did not demonstrate critical technologies in a realistic environment before beginning system development—a practice that informs decisions to invest in product development.
- Additionally, 20 programs did not test a system-level integrated prototype, which informs decisions to build and test prototypes.
- Opportunities remain for three programs that have yet to reach their critical design review (knowledge point 2) to gain sufficient knowledge to inform decisions to build and test prototypes.
- Similarly, seven programs that have yet to reach their production milestone (knowledge point 3) still have the opportunity to gain sufficient knowledge to inform decisions to invest in production.

Figure 18 identifies the number of programs that have implemented key knowledge practices by the expected milestone.

**Figure 18:** Over Half of 40 Major Defense Acquisition Programs Did Not Implement Key Knowledge Practices




**Programs that have opportunities to attain knowledge before key milestones**

**Knowledge Point 2**: B-52 Radar Modernization Program (B-52 RMP); Constellation Class Frigate (FFG 62); Long Range Stand Off Weapon (LRSO)

**Knowledge Point 3**:T-7A Red Hawk; B-52 RMP; CH-47F Modernized Cargo Helicopter Block II; Improved Turbine Engine Program; LRSO; MQ-25 Unmanned Aircraft System; Precision Strike Missile

Source: GAO analysis of questionnaire data. I GAO-22-105230

**Notes:** DOD guidance calls for programs to demonstrate critical manufacturing processes on a pilot production line, but does not call for statistical control of those processes until the full-rate production decision. Leading acquisition practices, in contrast, call for this knowledge to be in hand at production start in order to ensure manufacturing processes are repeatable, sustainable, and capable of consistently producing parts within quality standards. We scored a knowledge-based practice as "not applicable" for a program if the particular practice was not relevant to the program, such as test of a production-representative satellite prototype in its intended environment of space. We also scored our six MDAP increments as "not applicable ."

[a]Testing a system-level integrated prototype does not apply to shipbuilding programs, thus FFG 62 is counted as "not applicable" for that knowledge point.

## Knowledge-Based Practices

# MDAPs

**Certain knowledge-based practices are linked to better program outcomes.**

For the fifth consecutive year, we found that, in general, MDAPs that completed certain knowledge-based practices had better cost and schedule outcomes. We conducted a statistical correlation analysis to determine whether a statistically significant link exists between non-shipbuilding MDAPs' unit costs and schedule performance and their implementation of leading acquisition practices.[39]

**Observations**

» We observed three knowledge-based practices with a statistically significant correlation to improved program cost and schedule performance, as shown in table 7.

**Table 7:** Statistically Significant Knowledge-Based Acquisition Practices and Corresponding Performance Outcomes among 27 Selected MDAPs

| Knowledge practice | Net performance difference from programs that implemented the practice |
|---|---|
| Complete a preliminary design review before system development start | **36.4%** less unit cost growth<br>**31.7%** less schedule growth |
| Release at least 90 percent of design drawings by critical design review | **49%** less unit cost growth<br>**46.1%** less schedule growth |
| Test a system-level integrated prototype by critical design review | **26.4%** less unit cost growth<br>**31.4%** less schedule growth |

Source: GAO analysis of Department of Defense data and acquisition programs' responses to GAO questionnaire. | GAO-22-105230

**Notes:** We analyzed 27 major defense acquisition programs (MDAP) initiated between fiscal year 2011 and fiscal year 2021 that were completed programs or had passed all three knowledge points.

» This year, for the first time, we observed that demonstrating critical processes on a pilot production line prior to low-rate production correlated with larger schedule growth compared to programs that did not implement this practice. We do not have insight into the reason for this correlation, but we will continue to assess the effects of this practice in future reports.

» Consistent with prior years, we did not have sufficient data to calculate statistically significant results for some practices because of the insufficient number of programs implementing those practices. As the number of programs completing all three knowledge points increases, it is possible our analysis in future years will identify additional practices that have a statistically significant correlation to program outcomes.

[39]We analyzed 27 MDAPs—an increase of three programs from our 2021 analysis—that have completed system development, held a critical design review, and started production (i.e., completed knowledge points 1 through 3). These 27 programs are a separate subset from the 59 programs included in our questionnaire analysis. For example, shipbuilding projects use different metrics and are, therefore, excluded from the statistical analysis.

**Knowledge-Based Practices**

# MTA PROGRAMS

**Current knowledge attainment plans for MTA programs signal risk for some follow-on efforts.**

We continued to find that MTA programs' plans to attain product knowledge before starting follow-on development or production efforts fall short of our leading acquisition practices. With DOD's increasing use of the MTA pathway, these programs now account for most of DOD's costliest new weapon acquisitions. Insufficient attainment of knowledge prior to beginning follow-on efforts may increase the risk that these critical capabilities encounter cost, schedule, or technical challenges during development or production.

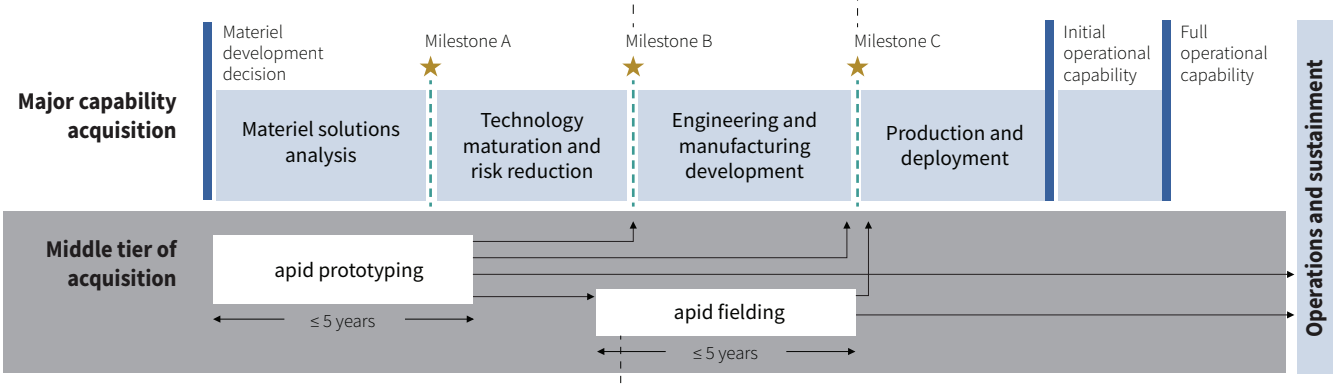
## Observations

- This year, we continued to find that most MTA programs that have identified a transition plan do not plan to attain levels of knowledge recommended by leading acquisition practices before transitioning to their follow-on effort (see figure 19).
  - For example, all seven programs planning to transition into production (five at the production milestone of the major capability acquisition pathway and two MTA rapid fielding efforts) have knowledge attainment plans that fall short of leading acquisition practices for manufacturing maturity. This approach helps ensure the system can be produced within the program's cost, schedule, and quality targets.
- Four MTA programs were unsure of their transition plan, inhibiting our ability to assess planned knowledge attainment against our knowledge-based practices.

**Figure 19:** Overview of Knowledge Attainment Plans for Middle Tier of Acquisition (MTA) Programs GAO Reviewed

| MTA programs that plan to transition to the major capability acquisition pathway at the **development milestone**: | **Planned attainment of knowledge** |
|---|---|
| | Point 1 |
| B-52 Commercial Engine Replacement Program (CERP) Rapid Virtual Prototype (RVP) | 💡 |
| Future Long-Range Assault Aircraft (FLRAA) | ◎ |
| Next Generation Overhead Persistent Infrared Block 0-Geosynchronous Earth Orbit Satellites (Next Gen OPIR Block 0 GEO) | 💡 |
| Optionally Manned Fighting Vehicle (OMFV) | N/A |
| Pro ected Tactical SATCOM (PTS) | ◎ |

| MTA programs that plan to transition to the major capability acquisition pathway at the **production milestone**: | **Planned attainment of knowledge** | | |
|---|---|---|---|
| | Point 1 | Point 2 | Point 3 |
| Ex ended Range Cannon Artillery (ERCA) | 💡 | 💡 | ◎ |
| F-15EX | 💡 | 💡 | ◎ |
| Indirect Fire Protection Capability Increment 2 (IFPC Inc. 2) | N/A | 💡 | ◎ |
| Lower Tier Air and Missile Defense Sensor (LTAMDS) | 💡 | 💡 | ◎ |
| Mobile Protected Firepower (MPF) | 💡 | 💡 | ◎ |




Programs that have **yet to determine its transition pathway** and for which knowledge attainment plans could not be assessed:

- Evolved Stra egic SATCOM (ESS)
- Future Operationally Resilient Ground Evolution (FORGE)
- Integrated Visual Augmentation Sys em (IVAS) Rapid Fielding
- Protected Tactical Enterprise Service (PTES)

| Programs that plan to transition to a MTA **rapid fielding effort**: | **Planned attainment of knowledge** | | |
|---|---|---|---|
| | Point 1 | Point 2 | Point 3 |
| Air-launched Rapid Response Weapon (ARRW) | 💡 | 💡 | ◎ |
| Conventional Prompt Strike (CPS) | 💡 | ◎ | ◎ |

💡 = Knowledge attained or planned ◎ = Knowledge not planned **N/A** = Not applicable/information not available

Source: GAO analysis of program questionnaire responses. | GAO-22-105230

**Notes:** Knowledge point 1 informs decisions on whether to invest in development, whereas knowledge points 2 and 3 relate to design stability and production readiness, respectively. We did not assess Optionally Manned Fighting Vehicle or Indirect Fire Protection Capability Increment 2 against knowledge point 1—which includes demonstrating critical technologies in relevant and realistic environments—because the programs have yet to identify critical technologies. Evolved Strategic SATCOM has yet to determine whether it will transition to the major capability acquisition pathway with entry at system development or to a rapid fielding effort. However, the program does not plan to attain knowledge point 1, which applies to both transition pathways under consideration.

Knowledge-Based Practices

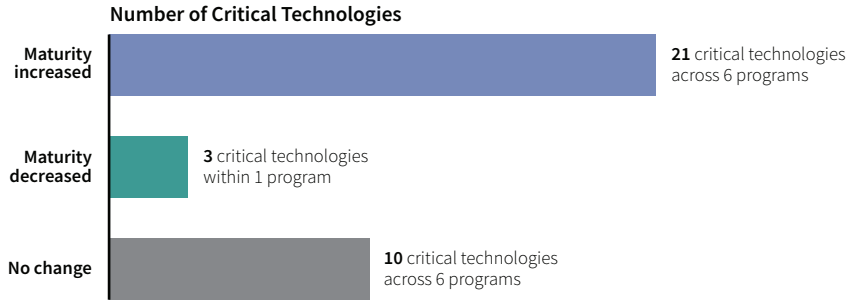
# MTA PROGRAMS

**Programs reported increasing the maturity of some critical technologies over the past year.**

This year, 13 of the 19 MTA programs reported critical technologies, with most having at least one technology that has yet to reach maturity. Programs made progress over the past year towards maturation for some of the technologies that were immature as of our report last year.[40] But the amount of work remaining to reach maturity for all critical technologies varies significantly between programs.[41]

We reviewed the maturation progress over the past year of 34 immature critical technologies across eight MTA efforts. We found that the programs reported making measurable progress in maturing approximately two-thirds of these technologies (see figure 20).

**Figure 20:** Maturation Progress of Immature Critical Technologies for MTA Programs Since GAO's Prior Report




Source: GAO analysis of Department of Defense data. | GAO-22-105230

**Notes:** Three additional critical technologies across three programs were reported as mature last year but are at lower technology readiness levels this year and are no longer considered mature. These technologies are not reflected in this figure. Programs with multiple critical technologies could be included in more than one category.

The Army's **Lower Tier Air and Missile Defense Sensor (LTAMDS)** program reported that four of its critical technologies achieved maturity since our last assessment. Officials expect the program's final critical technology to reach maturity in fiscal year 2023.

The Navy's **Conventional Prompt Strike (CPS)** program office said it discovered inconsistencies in prior reporting on critical technologies and conducted a review to ensure a more consistent approach, resulting in lower technology readiness levels than reported last year. The program still expects to reach maturity for all critical technologies before the end of the current MTA effort, planned for March 2024.

[40]GAO, *Weapon Systems Annual Assessment: Updated Program Oversight Approach Needed*, GAO-21-222 (Washington, D.C.: June 8, 2021).

[41]We consider critical technologies as mature when they have reached a technology readiness level of 7. However, satellite technologies that have achieved a technology readiness level of 6 are assessed as fully mature due to the difficulty of demonstrating maturity in a realistic environment (space).

Knowledge-Based Practices

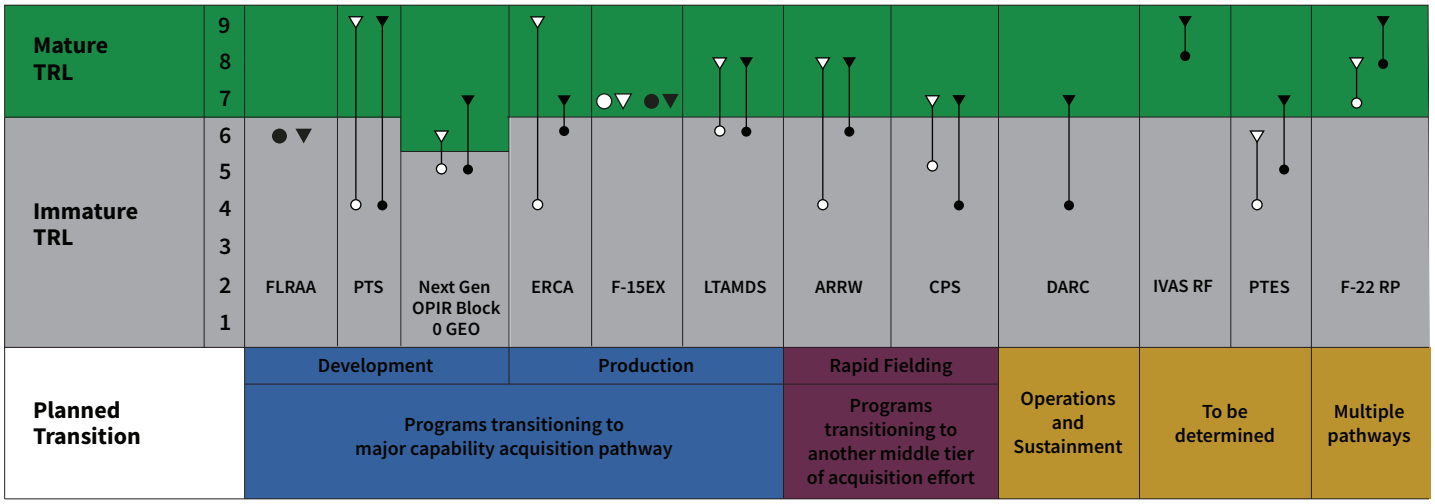
# MTA PROGRAMS

**Substantial work remains for some programs to fully mature critical technologies.**

Nearly all MTA programs that reported having critical technologies plan for them to reach maturity before the end of the current MTA effort. For example, four programs reported that all of their technologies were at least approaching maturity, representing a major step-up in readiness that could include prototype demonstrations in a relevant environment. However, significant work remains for other programs. For example, three programs reported a current technology readiness level (TRL) as low as 4—corresponding with component validation in a laboratory environment.

We reported last year that technology maturation plans for some MTA programs were aggressive. Our analysis included multiple programs that planned to increase more than one TRL by the end of the current effort to achieve maturity. However, our prior work shows increasing even one TRL can take multiple years and becomes more challenging as the technology approaches maturity.[42] Figure 21 summarizes MTA programs' current and planned technology readiness levels as compared with our assessment in our 2021 report.

**Figure 21:** Current and Planned Technology Readiness Levels for Middle Tier of Acquisition Programs That Identified Critical Technologies, as Compared with GAO's Prior Report




○ Technology Readiness Level (TRL), as of report last year
△ Projected TRL at MTA Completion, as of report last year
● Current TRL
▲ Projected TRL at MTA Completion

**ARRW** Air-launched Rapid Response Weapon
**CPS** Conventional Prompt Strike
**DARC** Deep Space Advanced Radar Capability
**ERCA** Extended Range Cannon Artillery
**F-22 RP** F-22 Rapid Prototyping
**FLRAA** Future Long-Range Assault Aircraft
**IVAS RF** Integrated Visual Augmentation System (Rapid Fielding)
**LTAMDS** Lower Tier Air and Missile Defense Sensor
**PTES** Protected Tactical Enterprise Service
**PTS** Protected Tactical SATCOM
**Next Gen OPIR Block 0 GEO** Next Generation Overhead Persistent Infrared Block 0-Geosynchronous Earth Orbit Satellites

Source: GAO analysis of Department of Defense documentation. I GAO-22-105230

**Notes:** For programs with multiple critical technologies, the figure represents the lowest current TRL and the lowest planned TRL at program completion. Evolved Strategic SATCOM also has critical technologies, but the program reported that the three contractors developing prototypes have technologies at different maturity levels. See GAO-21-222 for the report noted in the figure.

[42]GAO-21-222.

Knowledge-Based Practices

# MTA PROGRAMS

**New MTA programs continue to start without key documentation to support well-informed initiation decisions.**

We continue to find that DOD is initiating MTA programs with incomplete business cases. Our prior work shows that this information is important to help leaders make well-informed decisions about MTA program initiation.

Figure 22 summarizes the status of five key business case documents for the four new MTA programs we reviewed in this assessment.

**Figure 22:** Completion of Key Business Case Documents for Four New Middle Tier of Acquisition Programs Reviewed in GAO's Assessment, as of January 2022

| Program name | Approved requirements document | | Approved middle tier of acquisition strategy | | Formal technology risk assessment | | Cost estimate based on independent assessment | | Formal schedule risk assessment | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Initiation | Jan. 2022 | Initiation | Jan. 2022 | Initiation | Jan. 2022 | Initiation | Jan. 2022 | Initiation | Jan. 2022 |
| Deep Space Advanced Radar Capability (Rapid Prototyping) | ✓ | ✓ | ✓ | ✓ | ✗ | ✗ | ✗ | ✓ | ✗ | ✗ |
| Future Long-Range Assault Aircraft (Rapid Prototyping) | ✓ | ✓ | ✓ | ✓ | ✗ | ✗ | ✓ | ✓ | ✗ | ✗ |
| Indirect Fire Protection Capability Increment 2 (Rapid Prototyping) | ✓ | ✓ | ✓ | ✓ | ✗ | ✗ | ✓ | ✓ | ✗ | ✗ |
| Integrated Visual Augmentation System (Rapid Fielding) | ✓ | ✓ | ✓ | ✓ | ✗ | ✗ | ✗ | ✓ | ✗ | ✓ |

✓ Program had business case element ✗ Program did not have business case element

Source: GAO analysis of Department of Defense documentation. | GAO-22-105230

**Notes:** DOD Instruction 5000.80 requires MTA programs above certain cost thresholds to submit the following elements of a business case to the Under Secretary of Defense for Acquisition and Sustainment (USD A&S) at program initiation: approved requirements; a cost estimate; and an acquisition strategy that includes security, schedule, and technical or production risks, and also includes a test strategy or assessment of test results, and a transition plan. Moreover, DOD Instruction 5000.73 requires the Office of Cost Assessment and Program Evaluation to conduct an estimate of life-cycle costs for programs likely to exceed the acquisition category (ACAT) I threshold using the rapid prototyping path, or the ACAT I or II thresholds using the rapid fielding path.

None of the four new MTA programs included in this year's report completed formal assessments of schedule or technology risk at initiation. These elements help decision makers identify whether MTA programs using the rapid prototyping path are well-positioned to deliver a residual operational capability within 5 years, and MTA programs using the rapid fielding path are well-positioned to complete fielding within 5 years—objectives outlined in statute and DOD policy.

The importance of business case information is underscored by the challenges some programs are now facing. As mentioned above, the **Army's ERCA** and **LTAMDS programs** and the **Air Force's ARRW program** have experienced developmental challenges and schedule delays that now threaten the 5-year timelines.[43] These programs lacked key business case elements at initiation—including approved acquisition strategies and formal technology and schedule risk assessments—that could have helped decision makers assess the programs' likelihood of meeting MTA schedule objectives.

The **Army's MPF program**, in contrast, had all elements of its business case at initiation. The program reports that MPF's Soldier Vehicle Assessment and limited user test were completed in 2021 and MTA completion is planned for the third quarter of fiscal year 2022—a date that has remained steady during each of the 3 years we have included the program in our report.

Source: U.S. Army. | GAO-22-105230

[43]According to DOD Instruction 5000.80, MTA efforts may not exceed 5 years after the start date without a waiver from the Defense Acquisition Executive.