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Using Metrics to Understand the Performance of the Adaptive Acquisition Framework

One of the more significant changes to the Defense Acquisition System since 2015 is the revision to the U.S. Department of Defense (DoD) 5000 acquisition policy that created a set of distinct acquisition pathways, known as the Adaptive Acquisition Framework (AAF). Congress initiated these changes by providing statutory relief to DoD through the introduction of the Middle Tier of Acquisition and Software Acquisition pathways, which were instantiated in law. DoD then completed the AAF by designing additional pathways to accommodate the diversity of systems and services that DoD acquires. The AAF is intended to create a more tailored process that reflects that diversity. The underlying assumption is that improved, and more specific, tailoring of program management and execution will enable DoD to acquire the capabilities it needs more effectively and efficiently. Currently, the AAF has six pathways, all of which are further tailorable

KEY FINDINGS

- Adaptive Acquisition Framework metrics should be regularly reviewed and are expected to change in response to changes in strategic goals, leadership priorities, and the results of analysis.

- Regular and well-defined data governance and management procedures need to be in place for all pathways.

- A high level of subject-matter expertise is required to gather, process, and analyze data and interpret results.

- Pathway-specific data challenges are exacerbated by programs interconnected through multiple pathways.

- The output of this initial set of metrics should be used to refine policy and process and to improve pathway performance and outcomes.

to the characteristics of the program. The objective of this study was to assist the Office of the Under Secretary of Defense for Acquisition and Sustainment (OUSD[A&S]) with developing metrics to measure AAF performance and assess whether the pathways are achieving their goals.

The six pathways are shown in Figure 1.

The pathways are defined in their respective policy documents as follows:

- Urgent Capability Acquisition (UCA): This policy establishes acquisition pathways for use in acquiring capabilities to fulfill urgent operational needs and quick reaction capabilities.[1]
- Middle Tier of Acquisition (MTA): This policy establishes procedures for rapid prototyping

and rapid fielding of capabilities. It is intended to enable accelerated development and demonstration of capabilities.[2]

- Major Capability Acquisition (MCA): This policy establishes a pathway for Major Defense Acquisition Programs (MDAPs), other programs categorized as Acquisition Category (ACAT) I, major systems, usually categorized as ACAT II, and Automated Information Systems (not managed by other acquisition pathways).[3]
- Software Acquisition: This policy establishes an acquisition pathway for the development and procurement of custom software.[4]
- Defense Business Systems (DBS): This policy guides acquisition of business capabilities and

FIGURE 1

The Adaptive Acquisition Framework
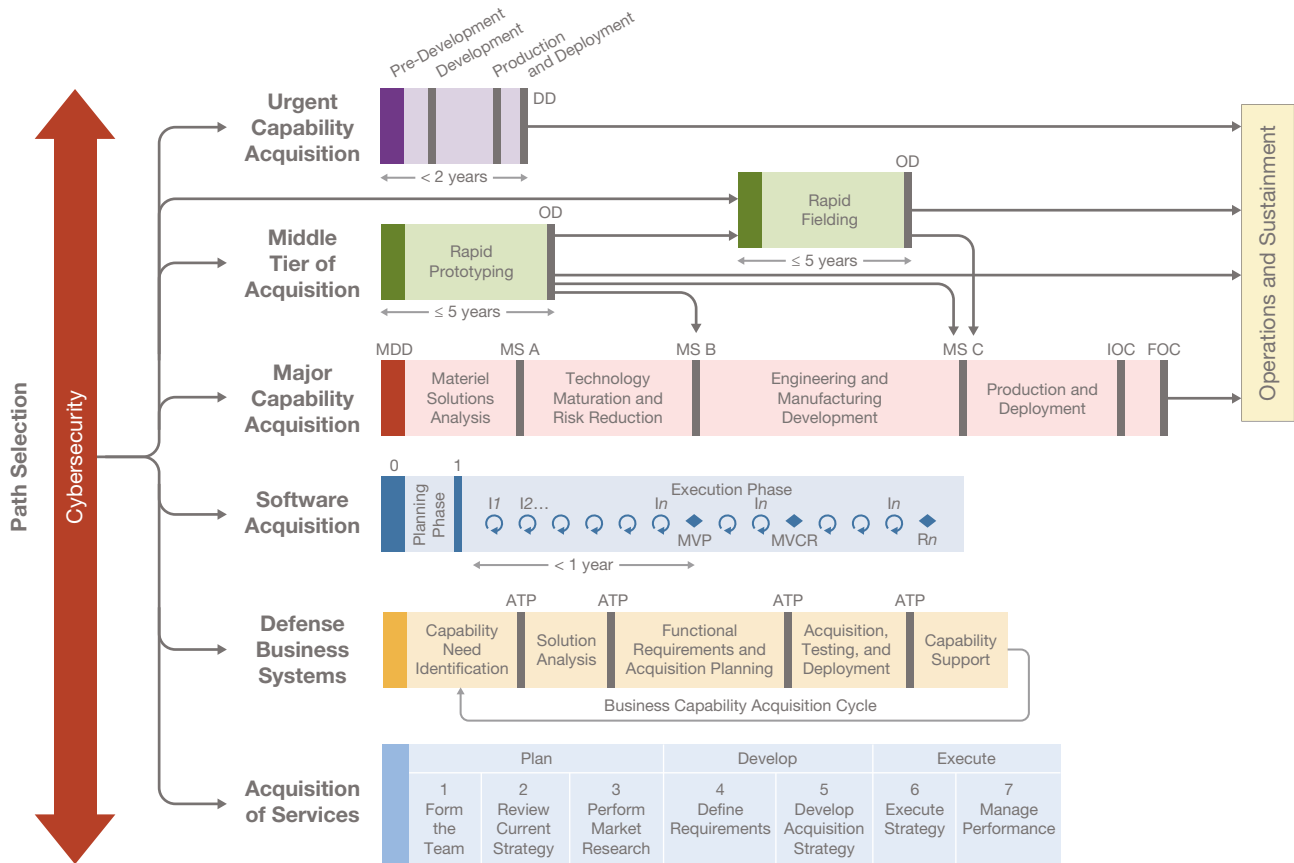
SOURCE: DoDI 5000.02, 2020, p. 10.
NOTES: DD = deposition decision; OD = outcome determination; MDD = material development decision; MS = milestone; IOC = initial operational capability; FOC = full operational capability; I = iteration; R = release; MVP = minimum viable product; MVCR = minimum viable capability release; ATP = authority to proceed.

their supporting business (information technology [IT]) systems across DoD components. It includes business system capability procured "as a service."[5]

- Acquisition of Services (AoS): This pathway is for acquisition of services rather than products. Services can range from landscaping installations to information technology (IT) support.[6]

These policies implement applicable statutes, assign responsibilities, provide guidance and direction, and establish management structures for each pathway. Congress also provided some statutory relief for MTA and Software Acquisition that helped make these pathways viable, including how requirements and reporting are handled.

The AAF has existed since 2020 and needs to be examined to assess its effectiveness.[7] The U.S. Government Accountability Office (GAO) agrees and requested metrics to evaluate pathway performance.[8] At the same time, DoD leadership is also interested in metrics and is pushing data to inform metrics;[9] however, this means that effective data governance is required for each pathway and for the AAF as a whole. Metrics that provide insight into pathway performance and health are part of this governance.[10] Therefore, DoD is promulgating policy to that effect and establishing standards.[11]

Study Objectives and Approach

This research builds on prior RAND research from fiscal years (FYs) 2019–2021 that identified acquisition metrics to assess the health of the overall acquisition system. The objective of the prior analysis was to systematically identify strategic questions, metrics, and analytics within OUSD(A&S) offices that would assist DoD in understanding how well it is meeting its short-term and longer-term strategic goals with respect to acquisition.[12]

The prior research adapted a process, described by Savitz, Matthews, and Weilant,[13] that provides an overview of how to identify measures and metrics that can be used to inform decisionmaking, assessment, planning, and communication. Central to this

Abbreviations

AAF	Adaptive Acquisition Framework
ACAT	Acquisition Category
AoS	Acquisition of Services
ATP	authority to proceed
AVDF	Acquisition Visibility Data Framework
BCAC	Business Capability Acquisition Cycle
BCAT	Business System Category
CAPE	Cost Assessment and Program Evaluation
CVE	common vulnerability or exposure
DAMIR	Defense Acquisition Management Information Retrieval
DAU	Defense Acquisition University
DAVE	Defense Acquisition Visibility Environment
DBS	defense business system
DevSecOps	Development, Security, and Operations
DoD	U.S. Department of Defense
DODI	Department of Defense Instruction
DOT&E	Director, Operational Test & Evaluation
FPDS	Federal Procurement Data System
FPDS-NG	Federal Procurement Data System–Next Generation
FY	fiscal year
GAO	U.S. Government Accountability Office
IOC	initial operational capability
IT	information technology
JCIDS	Joint Capabilities Integration and Development System
JEON	joint emergent operational need
JUON	joint urgent operational need
KPP	key performance parameter
MAIS	Major Acquisition Information System
MCA	Major Capability Acquisition
MDAP	Major Defense Acquisition Program
MTA	Middle Tier of Acquisition
NDAA	National Defense Authorization Act
OUSD(A&S)	Office of the Undersecretary of Defense for Acquisition and Sustainment
PALT	Procurement Administrative Lead Time
TRL	technology readiness level
UCA	Urgent Capability Acquisition

metrics identification and evaluation approach is generating a logic model that describes the linkages among inputs, activities, outputs, outcomes, and strategic goals. The prior research tailored the traditional logic model approach to measure the health of the acquisition system.

The objective of the research reported here was to identify metrics for each AAF pathway that can provide insight into whether a given pathway is performing as intended. We derived a simplified logic model (Figure 2) from the more detailed logic model in the previous work by Arena et al. We then applied this logic model to individual pathways with an additional step that compares proposed metrics with current required data.

The logic model constructed for each AAF pathway provided the analytical framework to identify metrics for that pathway. The analysis was supported by a rigorous review of AAF policy, a broader literature review focused on metrics, and a series of stakeholder interviews on topics that included pathway-specific goals, current metrics, and data governance, management, and analytical issues.
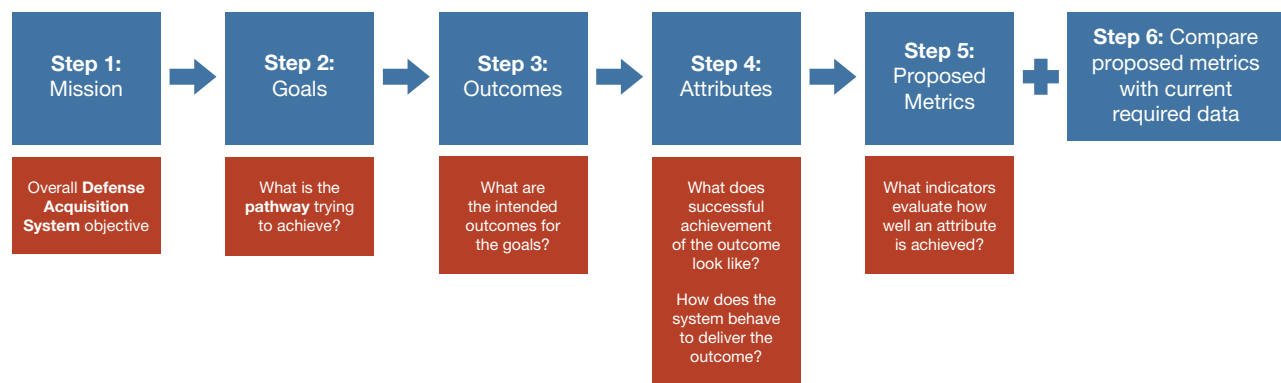
The next section addresses AAF challenges, both common and unique. We then identify an initial set of metrics for measuring the health of each pathway. Additional information on each AAF pathway, including the current state of the policy and data environment, is contained in the appendixes.

Challenges Identifying Metrics for AAF Pathways

Identifying metrics to measure the health or performance of each AAF pathway is associated with various challenges. Through our analysis of subject-matter expert interviews conducted during this study and drawing on prior work, we were able to identify challenges for implementing metrics for the AAF.[14] Although these challenges tend to fall into common categories of issues, the way or the degree to which they apply may be unique to each pathway.

Challenges common across AAF pathways include determining what programs are using a pathway and why, identifying the strategic goals related to pathway (not program) performance, defining metrics that provide insight into the extent to which those goals are being achieved, identifying authoritative sources of data, defining data standards that apply across the AAF pathways, and collecting and processing the data to support analysis. One challenge in particular exists across most of the pathways when conducting analyses of the AAF. The amount of and the specific data elements collected are intentionally different within and across the pathways, although that is not necessarily problematic. For example, the data are still governed for each pathway within OUSD(A&S)'s Acquisition Visibility Data Framework (AVDF); however, the differences in data collected on smaller and larger programs may con-

FIGURE 2

Simplified Logic Model Used to Identify AAF Metrics and Data Gaps

Step 1: Mission → **Step 2:** Goals → **Step 3:** Outcomes → **Step 4:** Attributes → **Step 5:** Proposed Metrics + **Step 6:** Compare proposed metrics with current required data

Overall **Defense Acquisition System** objective

What is the **pathway** trying to achieve?

What are the intended outcomes for the goals?

What does successful achievement of the outcome look like?

How does the system behave to deliver the outcome?

What indicators evaluate how well an attribute is achieved?

SOURCE: Adapted from Savitz, Matthews, and Weilant, 2017.

strain the metrics that can be derived for each pathway and affect standardization.

The UCA, Software, and MTA pathways share a common challenge of trying to balance the schedule imperative of the pathway with information requirements for monitoring and oversight. Based on our review of the policies for each of these pathways, UCA, Software Acquisition, and MTA pathways are designed to facilitate acceleration of capability delivery, and they downplay reporting for purposes of monitoring and oversight of the pathway.

Within both the MTA and MCA pathways, there is less data availability for non-major MTA programs and lower ACAT-level programs than for major capabilities. This means that some metrics will reflect only larger programs, which poses a potential challenge when conducting analysis of these pathways. However, OUSD(A&S) made the determination that less data are required for non-major MTA and lower ACAT-level programs than for major capabilities. Much of the data for major capabilities are driven by specific statutory guidance that may not be fully applicable for the non-major MTA and lower ACAT-level programs.

An AAF metrics framework also has pathway-unique challenges that need to be addressed. Figure 3 summarizes two key challenges for each pathway.

For example, we found that in the UCA Pathway, DoD leadership does not require a significant amount of data on these efforts in order to allow staff to focus on building the capability as quickly as possible. While this meets the main priority of the pathway (quickly fielding a capability), a lack of data makes analysis difficult. In addition, existing data are difficult to acquire due to disaggregated governance across the Joint Staff and the components. The Office of the Secretary of Defense (OSD) is responsible for joint urgent capabilities only. The components have additional urgent capability processes, but the existing data are mostly decentralized in the components and are almost entirely classified. OSD has little formal leverage with component-level UCA Pathway owners to unify and standardize data collection.

We identified multiple MTA Pathway–unique challenges. First, a majority of MTA programs are lower-dollar value programs with a minimal set of information that is collected. The data may need to be supplemented on an ad hoc basis from component-level program offices. Secondly, the pathway contains a mix of programs (prototypes and items for rapid fielding/major or non-major), which means not every capability can be treated the same way in this pathway from a data perspective. Finally, there is tension between the schedule imperative and information requirements (i.e., leadership does not want to levy unnecessary information requirements on MTA programs that will lengthen schedule).

For the MCA Pathway, less data are available on ACAT II–IV programs than ACAT I programs at the OSD level. The components are not required to share all their smaller program data with OSD. OSD and the components are still working through what smaller program data need to be shared for the Department's pivot to capability portfolio analysis in the Integrated Acquisition Portfolio Review, which requires data from acquisition programs of all levels. Additionally, available ACAT II–IV data may differ among the components. For instance, the Navy and the Air Force use different software and collect slightly different sets of data elements for their smaller programs, though both are derived from the long history of MDAP reporting.[15]

Significant challenges also exist in transitions between the MCA Pathway and other pathways. DoDI 5000.02 recommends that program managers "may leverage a combination of acquisition pathways to provide value not otherwise available through use of a single pathway."[16] These transitions need to be planned early with prototypes and software, and synchronization is needed for requirements, budgets, schedules, contracting, testing, intellectual property, and sustainment, between pathways and potentially programs that will merge into other programs.

It is also not clear whether there is or should be an agreement on the strategic questions and goals of the MCA Pathway between OSD and the components. Because strategic questions and goals drive which metrics are of interest, and therefore what data are collected, differences between OSD and components could lead to somewhat different sets of metrics. While that is not necessarily a problem—metrics should be consistent with senior leader preferences and interests, and they will change over time in response to both internal and external factors—this

inconsistency could lead to confusion among outside organizations like GAO or Congress.

Use of the Software Acquisition Pathway is still ramping up (14 programs are in planning and 21 are in the execution phase), so data collection is in the early stages. Also, programs have only recently started sending data to OSD, which means no full set of information exists yet for analysis.[17] As experience is gained with reporting, both metrics and analysis can be refined. Additionally, software acquisition metrics are different from typical cost, schedule, and performance metrics (e.g., software supports continuing evolution across the lifecycle of the system and does not have discreet "acquisition" and "sustainment" phases; deliveries are continuous; and no Acquisition Program Baseline [APB] exists). These differences also mean that there is likely going to be a learning curve for the DoD acquisition workforce for understanding what these metrics mean and how they are measured. For example, the time it takes to recover from a cyber attack is a measure of software resilience. While no defined schedule end-point may exist, the frequency with which new capabilities are added is a relevant schedule metric of interest to users.

For the DBS Pathway, the full list of DBSs and their associated data need to be aggregated from information systems outside of the acquisition community; those systems were not designed to capture the kind of information needed to assess program or pathway health. Additionally, while some data are defined in the AVDF[18] common data standard (i.e., program number, program name, required funding—total acquisition-related operation and maintenance quantity), many AVDF data elements are not readily available for most DBS programs.[19]

The AoS Pathway does not have entry documentation (i.e., a formal declaration that a program or effort is going to use the pathway, which may consist of an Acquisition Decision Memorandum), so analysis relies solely on labor-intensive data collection to assess what programs are using the pathway. There is also limited post-award performance information to assess requirements and Procurement Administrative Lead Time (PALT) to assess timeliness (except for major contracts). Other features unique to the AoS Pathway include the unit of analysis being a contract or contract action, not necessarily a program, and tremendous variation in the size of programs. In addition, no formal program office may exist, especially for smaller activities; program management and contract monitoring are often "other duty as assigned," rather than a full-time position.

FIGURE 3
Key Pathway-Specific Challenges

Urgent Capability Acquisition	Middle Tier of Acquisition	Major Capability Acquisition
1. No centralized data source exists for urgent needs due to disaggregated governance across Joint Staff/Components 2. Tension exists between schedule imperative and information requirements; decreases available data for analysis	1. There is less data available for analysis on non-major MTA programs than major MTA programs 2. Tension exists between schedule imperative and information requirements; decreases available data for analysis	1. There is less data available for analysis on ACAT II–IV programs than ACAT I programs 2. Programs integrating into MCA from other pathways creates data governance and management challenges

Software Acquisition	Defense Business Systems	Acquisition of Services
1. While different from typical hardware metrics, software performance still needs to be measured to ensure capability delivery at the predicted cost 2. Data collection is in the early stages; no automation exists yet between OSD and component-level information systems	1. Full list of DBS and associated data needs to be aggregated from information systems outside acquisition community 2. Some data is defined in the AVDF data standard, but is not readily available for most DBS programs	1. No entry documentation, so analysis relies solely on labor-intensive data collection to assess who is using pathway 2. Limited post-award performance information to assess requirements and PALT to assess timeliness

Finally, integration of programs into the Major Capability Pathway from other pathways creates data governance and management challenges such as understanding the applicable set of approved/governed data elements when combining the information from the different pathways and adjusting to the new pathway data reporting requirements.

Primary Set of AAF Pathway Metrics

Our focus is on identifying metrics to assess the performance of each AAF pathway—whether the pathway is achieving its intended outcomes and strategic goals. It is useful to think of the set of programs using a given pathway as a portfolio and the metrics of interest as those that provide insight into the status of the portfolio. Some potential metrics inherently

measure status at the portfolio level. Other metrics are program-centric but can be aggregated to provide a measure of portfolio performance. For example, the cost growth of programs using a given pathway can be aggregated to produce an average portfolio cost growth value.

Figure 4 lists the five initial metrics recommended for each pathway. These metrics link back to the strategic goals of each pathway, as is best practice in identifying metrics. Among each of the five metrics per pathway, some measure more critical aspects of an individual pathway's health than others, but all will help provide DoD leadership and the GAO with better insight into the health of the AAF as a whole. Traditional cost, schedule, and performance metrics are included in this initial set of recommended metrics but are tailored to the way these metrics make sense for each pathway. We also include two addi-

FIGURE 4

Primary Set of Pathway-Specific Metrics

Pathway	Metrics
Urgent Capability Acquisition	1. Program cost estimate (total) 2. Time elapsed from requirement validation date to solution sponsor assignment 3. Total number of capabilities terminated, sustained, or transitioned at disposition decision 4. Time elapsed from requirement validation date to capability delivery or revalidation of requirement 5. Total number of joint urgent operational needs/joint emergent operational needs/Warfighter Senior Integration Group special interest items
Middle Tier of Acquisition	1. Average percentage cost growth (quantity adjusted, if applicable) 2. Difference between MTA start date and expected operational demonstration date 3. Beginning Technology Readiness Level 5 or greater 4. Percentage change in initial and current budget (year-over-year) 5. Number of rapid prototypes fielded, transitioned, or terminated
Major Capability Acquisition	1. Average percentage cost growth (quantity adjusted, if applicable) 2. Average schedule slippage between planned and actual initial operational capability (or equivalent) 3. Average percentage of objective/threshold key performance parameters (KPPs) met (or equivalent) 4. Fraction of programs failing initial testing 5. Fraction of programs either entirely from or partly from other pathways

Pathway	Metrics
Software Acquisition	1. Program cost estimate (total) 2. Average lead time 3. Change fail rate 4. Average mean time to resolve experienced cyber incident or common vulnerability or exposure (CVE) 5. Average deployment frequency
Defense Business Systems	1. Average percentage cost growth 2. Limited deployment authority to proceed date slippage (initial operational capability slippage equivalent)–percent delta of planned versus actual schedule 3. Percentage established performance parameters met for each release before development or delivery 4. Compliance with cyber policy is being monitored/tracked 5. Fraction of contracts competitively awarded
Acquisition of Services	1. Average percentage cost growth 2. Average schedule slippage between need date and service requirement received 3. Percentage of warfighter objectives met (or equivalent) 4. Average procurement acquisition lead time 5. Number of effective bid protests (per the GAO definition)

A high level of subject-matter expertise is required to gather and process the necessary data, conduct the analysis, and interpret results.

tional unique metrics per pathway that provide more direct measures of pathway health. We have selected metrics for which data are available or data gaps can be readily resolved. More information on these metrics can be found in the corresponding appendix for each pathway.

The selected metrics are not intended to be comprehensive in providing insight to pathway performance. Rather, we found that it is important to start performance measurement in a way that is feasible—data are or could be made available—in order to demonstrate the utility of the metrics in terms of providing insight into pathway health and building confidence among stakeholder organizations. As confidence and experience in performance measurement are gained, the specific set of metrics for each pathway can and should be modified to address other aspects of pathway health. While different subject-matter experts might select a different set of metrics to initiate a performance measurement system, the most important thing is to begin, and to learn and improve data collection and analysis to support improved policy design and pathway outcomes.

We recommend that DoD pilot this system of metrics. A pilot will help to better understand and address the challenges that we identified, generate lessons learned to modify or improve data governance and management for pathway metrics, and, of course, provide insight into the health and performance of each AAF pathway.

Conclusions and Observations

As is good practice in enterprise-level metrics, we chose a limited set of metrics per pathway to start.[20] Five were chosen for each AAF pathway from a list of over 75 possible metrics per pathway identified in each logic model. There is no right or wrong answer

for the exact number, but it is counterproductive for an organization to start by implementing a large number of metrics. The chosen metrics also need to show some consistency across pathways for comparison (if appropriate) in order to understand the entire framework. Importantly, the goals (and derived metrics) should align with leadership interests and policy preferences. It is also useful to focus on one or more specific attributes of pathway health as they relate to strategic goals using available data and collection tools. This is a manageable set of metrics to gain initial pathway health insights with the understanding that, given DoD's complexities, implementation will require an iterative process (i.e., the metrics chosen will change over time as DoD's goals and leadership change).

The DoD acquisition community should also consider several additional observations regarding implementation:

- Strategic goals are critical—they define the use cases for each pathway and therefore associated metrics and data needs.
- A high level of subject-matter expertise is required to gather and process the necessary data, conduct the analysis, and interpret results. This finding cannot be understated. Facts, assumptions, and limitations of the source data must be clearly and deeply understood—and explicitly documented, approved, and promulgated—to allow for accurate "processing" (consistent calculations, data curation, etc.) and subsequent analysis. Each pathway collects unique data and therefore has its own challenges and nuances that need to be understood when collecting and preparing the data for analysis. Interpretation of the results is likewise difficult and nuanced,

given that the data may have outliers at the lower levels that are driving the metrics.

- The recommended metrics should be regularly reviewed for relevance and should be expected to change in response to changes in strategic goals, leadership priorities, and the results of analysis. This may be a challenge in that it requires discussions leading to agreement on metrics and the data needed. This first set of metrics focuses on those that will provide near-term insights with data that do not appear to have significant gaps. Additional metrics can be identified through changes in leadership's focus and the Department's strategic vision, along with data governance, management, and analysis as each pathway matures.

- Regular and well-defined data governance and management procedures should be established and maintained for all pathways. Within the OUSD(A&S), the Office of Acquisition Enablers has been working with the pathway owner and the data owners in the components to establish the governance and data standards. While this is a voluntary system of data reporting, the offices responsible for acquisition data in OUSD(A&S) and the components have worked together for years to maintain and update standards for acquisition data to the benefit of all. In addition, senior leadership has recognized data as an enterprise resource that should be transparent and shared.[21]

- Pathway-specific data challenges are exacerbated by programs interconnected through multiple pathways. Some programs will use multiple pathways for different elements of the system; if those pathways handle data differently, then values for the "merged" program may be misleading. This problem occurs at the juncture of program and portfolio (pathway) perspectives and is a significant analytic challenge that should be addressed.

- The output of this initial set of metrics should be used to inform decisions to refine policy and process and improve pathway performance and outcomes.

It is also important to acknowledge that the data needed for pathway performance metrics are not the only data needed for the operation of the Defense Acquisition System.

Appendix A. Urgent Capability Acquisition Pathway

The use of urgent capabilities in DoD acquisition has a high-profile history. There was frequent use during the Operation Iraqi Freedom/Operation Enduring Freedom era. One highly visible example of an urgent capability is the Mine Resistant Ambush Protected Vehicle program (MRAP), which was the first major military acquisition since World War II to go from a decision to buy to production in less than one year.[22] Urgent capabilities have also received significant congressional attention—for example, in the FY 2003 National Defense Authorization Act (NDAA):

> SecDef [Secretary of Defense] shall prescribe procedures for the **rapid acquisition** and deployment of items that are—(1) currently under development by the DoD or available from the commercial sector; and (2) **urgently needed** to react to an enemy threat or to respond to significant and urgent safety situations. (Public Law 107-314; emphasis added)

The Urgent Capability Acquisition (UCA) Pathway is used to "field capabilities to fulfill urgent existing and/or emerging operational needs or quick reactions in less than 2 years."[23] Figure A.1 depicts the UCA Pathway.

Policy

The UCA Pathway is focused on quickly filling some of DoD's most important, near-term capability gaps identified by operational users:

a. It is DoD's highest priority to provide warfighters involved in conflict or preparing for imminent contingency operations with the capabilities needed to overcome unforeseen threats, achieve mission success, and reduce risk of casualties, as described in DoDD [Department of Defense Directive] 5000.71.

b. The estimated cost for acquisition programs that provide capabilities to fulfill urgent operational needs and other quick reaction capabilities that can be fielded in less than 2 years must not exceed $525 million in research, development, and test and evaluation, or $3.065 billion for procurements in Fiscal Year 2020 constant dollars.[24]

UCAs may be fulfilled at the component or joint level. Performance and cost goals are subordinated to schedule imperatives. No funding is readily available for urgent needs, so funding sources must be identified from year-of-execution appropriations. Users can provide immediate feedback, which means that refinement of the capability is possible because of this proximity to end users. Life-cycle issues are minimally considered upfront because of the urgent timeline.[25]

UCA guidance provides goals, advantages, approaches, and potential uses of the pathway that can be linked to pathway metrics. In order to centralize and improve workforce knowledge of the UCA Pathway goals and instruction, the Defense Acquisition University (DAU) provides clarification, training, frequently asked questions, and some lessons learned to date through *DAU Powerful Examples*.[26]

FIGURE A.1

Urgent Capability Acquisition Pathway

SOURCE: Defense Acquisition University, "Urgent Capability Acquisition," webpage, undated.
NOTE: DD = disposition decision.

DAU also centralizes relevant OSD and component guidance that is available. Finally, basic data requirements have been written into guidance.

Data Governance, Management, and Analytics

UCA data governance and management is largely decentralized. The Joint Staff is the proponent for joint urgent operational needs (JUONs) and joint emergent operational needs (JEONs); these processes are managed by the Joint Rapid Acquisition Cell (JRAC). The JRAC Director assigns responsibility to DoD components for the funding and resolution of validated JUONs and JEONs. The components fund, manage, and fulfill both JUONs/JEONs and component-specific urgent operational needs.

Data governance is limited for UCA. The UCA Pathway owner is the JRAC, but the JRAC does not have visibility over component-level UCAs that (may) form the majority of activity in this pathway. Data requirements are also in flux as organizations attempt to define what data are required, what should be measured, and how.

For data management, the JRAC has promulgated guidance but has limited ability to compel uniform data collection and management at the component level. Most data related to UCAs are classified for operations security reasons. The JRAC is cognizant that schedule is critical and does not want to create additional data requirements. Given the above conditions, existing analytics for the UCA Pathway are limited, and any analysis is typically ad hoc.

UCA Strategic Questions and Metrics

We identified relevant strategic questions for the UCA Pathway through examining policy and discussions with subject-matter experts. The JRAC emphasizes that two main strategic questions are most important for the UCA Pathway:

- Does the solution address the capability gap?
- Is the solution delivered to the operational user as soon as practicable?

Secondary goals are suggested by the GAO, but of lesser importance:

- Given the primary measures of success, are UCAs being acquired cost effectively?
- Is the UCA process accessible and transparent?[27]

We then used the simplified logic model to map these questions to metrics. Table A.1 provides an initial list of five metrics that help to determine pathway health along with the intent of the metric, whether a related AVDF data element is available, and whether there is a gap in data availability. The first two metrics are related to schedule, given that providing capability to the warfighter on schedule is the highest priority of the UCA Pathway. The third metric is a proxy for measuring performance and user satisfaction. The fourth metric measures volume or frequency of use of the pathway, and the final metric measures the cost of urgent capabilities using the UCA Pathway.

Challenges to Implementing Metrics for UCA Pathway

We identified multiple challenges that should be addressed when implementing metrics for the UCA Pathway, using our analysis of subject-matter expert interviews conducted during this study and drawing on prior work.[28] First, DoD leadership does not require a significant amount of data on these efforts in order to allow staff to focus on building the capability as quickly as possible. Although this meets the main priority of the pathway, a lack of data makes analysis difficult. In addition, existing data are difficult to acquire because of the disaggregated governance across Joint Staff and components. OSD is responsible for joint urgent capabilities only. The components have additional urgent capability processes, but the existing data are mostly decentralized in the components. OSD has little formal leverage with component-level UCA Pathway owners to unify data collection. Data do not exist in any centralized information systems across the Department. The data are almost completely stored on classified networks, which impedes access and reduces widespread sharing.[29] Data cannot be easily manipulated for

TABLE A.1

Suggested UCA Metrics: Indicators for Pathway Health

Metric	Intent of Metric	AVDF Element Available	Data Gap Notes
Time elapsed from requirement validation date to solution sponsor assignment	Measures process time within the JRAC	Not in AVDF	It is possible to collect for urgent capabilities that the JRAC oversees
Time elapsed from requirement validation date to capability delivery or revalidation of requirement	Measures total UCA process time	Not in AVDF	It is possible to collect for urgent capabilities that the JRAC oversees
Total number of capabilities terminated, sustained, or transitioned at disposition decision	Proxy for measuring performance and user satisfaction	Not in AVDF[a]	It is possible to collect for urgent capabilities that the JRAC oversees
Total number of JUONs/ JEONs/ Warfighter Senior Integration Group special interest items	Measures volume or frequency of use of the process	AVDF has "UCA Urgent Need ID" (AV0835)	No gap
Program cost estimate (total)	Measures cost of urgent capabilities using UCA Pathway	Not in AVDF[b]	It is possible to collect for urgent capabilities that the JRAC oversees

[a] AVDF does contain "AV0124.2, Budget Estimate—Total Procurement Quantity," defined as "The total number of fully-configured end items produced using procurement appropriations to execute a program's or subprogram's acquisition strategy, including prior production, planned production presuming a particular budget position for a Future Years Defense Program (FYDP), and future production required." However, the JRAC does not currently collect a quantity data field. Moreover, AV0124.2 reflects the total buy and does not account for combat attrition, etc., although OUSD(A&S)/Acquisition Enablers is currently working with the Office of the Deputy Assistant Secretary of Defense for Materiel Readiness to add an AVDF data element that does account for total production end items currently in service, i.e., at time of disposition.

[b] Potentially, this metric could be mapped to AV0834, *FYXX Unfunded Request*, which should be based on the approved cost estimate (and is in the JRAC's data). The JRAC-approved definition (and note) convey that this should cover the entire cost (unless the program will transition to an MCA).

analysis, because it largely exists in different spreadsheet formats, PDFs, and narrative storyboards. Finally, data need to be centralized, structured, and processed to yield meaningful pathway health insights.

Recommendations for the UCA Pathway

We offer some recommendations for DoD to consider regarding UCA Pathway metrics:

- A limited set of pathway health metrics are potentially attainable through existing data sources for the JRAC's joint urgent capabilities. Given that DoD does not have a clear view of all urgent capabilities, we suggest starting use of metrics with JRAC data only (i.e., a measurable subset, even if it is a small subset of the total).

- The JRAC (as the UCA Pathway owner) should discuss potential options with the components for obtaining a limited set of structured information on component-level urgent capabilities.
- Efforts to engage components in improving data collection and maintenance should be ongoing; the components are currently planning for how to address the AAF as a whole, making this an ideal time for engagement.
- DoD should carefully consider data structure and storage location for any future data collection, given that UCA program data are largely classified.
- Finally, DoD may want to use "edge cases" to assess how well recommended metrics reflect current understanding of pathway health.

Appendix B. Middle Tier of Acquisition Pathway

Congress created the Middle Tier of Acquisition (MTA) Pathway in Section 804 of the FY16 NDAA with additional revisions through the FY18 NDAA. MTA's objective is to use rapid prototyping and fielding to accelerate delivering capabilities to the warfighter. MTA was the first AAF pathway implemented, and components are using this pathway to embrace schedule benefits and other authorities granted by Congress. This pathway has been used most often by the Department of the Air Force, but the other components are also using this pathway. Figure B.1 depicts the MTA Pathway.

Policy

MTA guidance provides goals, advantages, approaches, and potential uses of the pathway that can be linked to pathway metrics. The MTA policy has gone through an OSD-level revision based on feedback from the acquisition workforce. In order to centralize and improve workforce knowledge of the MTA Pathway goals and instruction, the DAU provides clarification, training, frequently asked questions, and some lessons learned to date through *DAU Powerful Examples*. DAU also centralizes available relevant OSD and component guidance. Finally, basic data requirements have been written into guidance.[30]

The MTA Pathway enables "rapid" risk reduction and cost savings to DoD, creates new business opportunities, and accelerates capability development. The MTA Pathway also provides program managers with a streamlined approach to accelerate capability matu-ration before transitioning to a separate, longer-term acquisition pathway. Program managers also have the option of minimally developing a capability before moving it into rapid fielding, while assessing feasibility in applying available or emerging technology to meet a military need. Guidance provides several additional advantages, including that MTA programs are exempt from MDAP designation and from the formal Joint Capabilities Integration and Development System (JCIDS) requirements process. A program in the MTA Pathway also sends a signal to the operational and acquisition communities that the program is streamlined and focused on accelerating delivery to the field or conducting a risk reduction activity to accelerate technology maturation. Finally, program managers may also want to use the MTA Pathway to break vendor lock, employ rapid technology insertion, or deploy a minimum capability.[31]

Data Governance, Management, and Analytics

MTA data governance, management, and analytics are more mature than those of the other pathways (except MCA). Components are providing required data, but quality may not be adequately verified, and data are not always complete when they are entered in the Defense Acquisition Visibility Environment (DAVE) (e.g., blank cells, potential errors).[32]

MTA stakeholders are following good practices in data governance and management:

- DoD is using the Acquisition Visibility Steering Group/Acquisition Visibility Working Group to make decisions on governance and management.

FIGURE B.1

Middle Tier of Acquisition Pathway
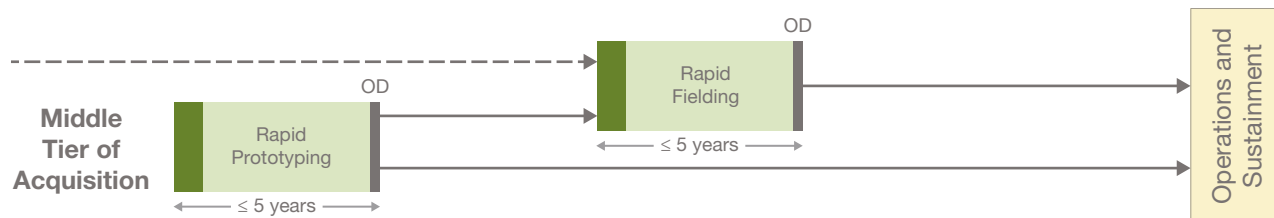
SOURCE: Defense Acquisition University, "Middle Tier of Acquisition (MTA)," webpage, undated.
NOTE: OD = outcome determination.

- A list of all MTA programs is available in DAVE's Authoritative Program List.
- MTA core program identification data are maintained in DAVE via structured format.
- MTA data standards are defined in the AVDF.
- MTA program data are being integrated into component-level programmatic information systems.
- Planning is being done for electronic transmission to OSD.

Analysis of the MTA data collected to date is being done by multiple stakeholders. There are some analytics in Advana for the Deputy Secretary of Defense/Deputy's Management Action Group (DMAG) and for other leadership purposes. The GAO also publishes analysis on MTA programs in its annual report.[33]

MTA Strategic Questions and Metrics

We identified relevant strategic questions for the MTA Pathway through policy and discussions with subject-matter experts:

- Is the MTA Pathway providing the necessary capabilities?
- Is the MTA Pathway providing the capabilities on time and at cost?
- What is the minimum set of technical requirements for the capability that can be rapidly developed, integrated, and fielded?
- Is the MTA Pathway promoting the use of innovative technologies to rapidly develop fieldable prototypes to demonstrate new capabilities and meet emerging military needs?
- Are MTA rapid prototypes reducing future cost and risk to DoD?

We then used the simplified logic model to map these questions to metrics. Through this process, we found that these questions are not easily measurable. As a result, we identified metrics that are proxies for getting close to answering these questions. Table B.1 provides an initial list of five metrics that help to determine pathway health along with the intent of the metric, whether a related AVDF data element is available, and whether there is a gap in data availability. The first three metrics are related to cost,

schedule, and performance, and the final two metrics reflect two important metrics to understand stable resources and potential outcomes of the pathway.

Challenges to Implementing Metrics for MTA Pathway

We identified multiple challenges that should be addressed when implementing metrics for the MTA Pathway, using our analysis of subject-matter expert interviews conducted during this study and drawing on prior work.[34] First, MTA programs face data challenges similar to those faced by ACAT II–IV programs before the AAF. A majority of MTA programs are lower-dollar value programs with a minimal set of information that is collected. The data may need to be supplemented on an ad hoc basis from component-level program offices. The GAO has also noted the inconsistent reporting of MTA cost data to OSD, Congress, and the GAO, which means that the data need additional governance and management to improve their quality.[35] Second, because the pathway contains a mix of programs (prototypes and items for rapid fielding/major or non-major), not every capability can be treated the same in this pathway. Finally, tension exists between schedule imperative and information requirements (i.e., leadership does not want to levy unnecessary information requirements on MTA programs that will lengthen schedule).

Recommendations for the MTA Pathway

We offer some recommendations for DoD to consider regarding MTA Pathway metrics:

- Data have been collected for several years on this pathway, so the data set should support pathway and longitudinal analyses/capacity to do more advanced analyses. DoD should begin to conduct longitudinal and more advanced analyses to determine the utility of the MTA Pathway thus far.
- DoD should address pathway transition in existing policy, data standards, quality compliance, business rules, and metrics.

TABLE B.1

Suggested MTA Metrics: Indicators for Pathway Health

Metric	Intent of Metric	AVDF Element Available	Data Gap Notes
Average percentage cost growth (quantity adjusted, if applicable)	Indicates whether the capability in this pathway experiences a particular amount of cost growth	Cost estimates are captured in the AVDF via AV0539, Acquisition Document Type, in the Acquisition Information Repository (AIR). The specific document type is Data Element number 1696 (DEn1696), Cost Estimate[a]	Cost estimates are not captured directly in the MTA data in DAVE
Difference between MTA start date and expected operational demonstration date	Indicates schedule slippage of efforts in this pathway	Schedule information is captured in AVDF through MTA Program Start Date (AV0072) and MTA–Operational Demonstration Date (AV0760)	Schedule information is also captured in the MTA data in DAVE
Beginning Technology Readiness Level 5 or greater	Notes TRL level when entering MTA Execution Phase (i.e., appropriateness of pathway)	Technology Readiness is captured in AVDF as Demonstrated Technology Readiness Level (AV0061)	TRL is also captured in the MTA data in DAVE
Percentage change in initial and current budget (year-over-year)	Ensures resources are stable, so budget changes do not negatively affect schedule	Budget information is captured in AVDF using Budget Estimate—Account Annual Amount (AV0731)	Budget information is also captured in the MTA data in DAVE
Number of rapid prototypes fielded, transitioned, or terminated	Tracks pathway outcomes	Outcome type is in the AVDF using MTA—Outcome Type (AV0784)	Outcome type is also captured in the MTA data in DAVE

[a] These data are available on the unstructured data side (in the Acquisition Information Repository, or AIR) and are reflected in the AVDF as an enumerated value for AV0539, Acquisition Document Type (which currently has 111 active document types). The specific document type is DEn1696, Cost Estimate, and is required by DODI 5000.80 to be loaded into DAVE interfaces (AIR). DEn1696 definition: An approved/signed cost estimate for an MTA program similar to a DoD Component Cost Estimate, Independent Cost Estimate (ICE), or other approved/signed cost estimate developed by component per DoDI 5000.80.

- DoD should conduct case studies in order to identify good practices and challenges within the MTA Pathway. Additional information, such as MTA-approved acquisition documentation (e.g., Acquisition Strategies), can supplement these analyses.
- DoD should track outcome data, including user satisfaction metrics, over the next couple of years to improve pathway use.

Appendix C. Major Capability Acquisition Pathway

The Major Capability Acquisition (MCA) Pathway represents the baseline acquisition process for DoD programs. The pathway is used to "acquire and modernize military unique programs that provide enduring capability."[36] MCA capabilities typically follow a structured "analyze, design, develop, integrate, test, evaluate, produce, and support" approach. This pathway is designed to support MDAPs, major systems, and other complex acquisitions across all ACAT levels. It also integrates the capabilities acquired through other pathways. Figure C.1 depicts the MCA Pathway.

Policy

The MCA policy environment is mature, due largely in part to significant congressional interest in the development of large investments, such as MDAPs. Current MCA policy largely resembles prior instantiations of the DoDI 5000.02 policy environment. Compared with other pathways, MCA contains the longest list of statutory and regulatory information requirements, including Nunn-McCurdy and Clinger-Cohen requirements.[37] However, MCA policy emphasizes that program managers tailor regulatory information that is relevant to the acquisition program, while the statutory requirements identified in the program information tables may not be waived unless permitted by the relevant statute. The pathway also supports complex programs that may involve international partners and foreign military sales. However, the major difference for the MCA Pathway is how it interacts with the capabilities

developed from the other pathways. Programs in the MCA Pathway may integrate technology and capabilities acquired using other acquisition pathways.

Data Governance, Management, and Analytics

MCA data are highly visible, and major systems within this pathway typically receive the most oversight scrutiny from congressional and DoD leadership. There are significant congressional information requirements and DoD leadership analytic efforts in place across the OUSD(A&S), Office of the Under Secretary of Defense for Research and Engineering, and Office of Cost Assessment and Program Evaluation (CAPE). The data have widespread production and use: Program offices, functional offices, contractors, and many others throughout DoD produce the information, and this information is then used by analysts, decisionmakers, and other stakeholders inside and outside DoD.

Because the process structure reflects the traditional acquisition process for MDAPs, MDAP (or ACAT I) program data collection and standards are mature, reflecting the historical need for Selected Acquisition Report (SAR) and Defense Acquisition Executive Summary (DAES) reporting. This pathway has metrics collection practices that have been standardized over time; as a result, OSD and component policy and data environments for ACAT II–IV programs are very similar and based largely on ACAT I program statutory, regulatory, and policy information requirements. The components and OSD have converged on a common data framework over the past 15 years. Thus, agreement exists on a long list of

FIGURE C.1

Major Capability Acquisition Pathway
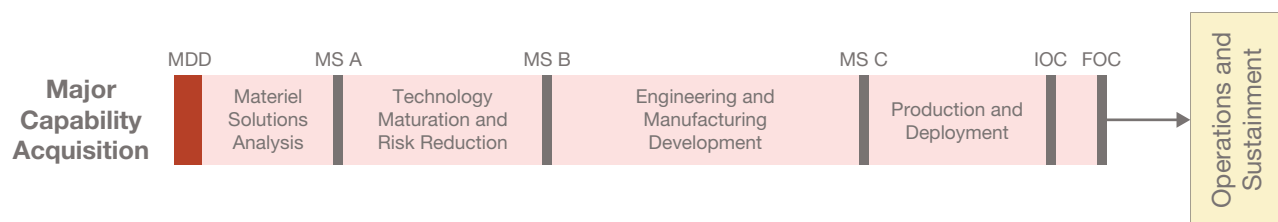
SOURCE: Defense Acquisition University, "Major Capability Acquisition," webpage, undated.

data elements and definitions through the AVDF, and there is a shared understanding of the definitions of those program data even as the specific metrics used, and preferred, by leadership in OSD and the components differ slightly.

MCA Pathway data governance, management, and collection status are also mature. The Acquisition Visibility Steering Group/Acquisition Visibility Working Group and AVDF provide a baseline data standard and data element definitions for use by other pathways. This includes the engagement and participation of the components. This pathway leverages historic MDAP data collection (previously Defense Acquisition Management Information Retrieval [DAMIR]) that is now implemented through DAVE. OSD and the components created a formal Acquisition Program List (APL) that consolidates service-level lists of ACAT programs in one location in OSD's DAVE. Components also have created procedures that, in effect, align the collection and transmission of data with OSD information requirements: Components are electronically centralizing, storing, and sending information to OSD. The Army and the Air Force use Project Management Resource Tools (PMRT), whereas the Navy uses the Research, Development, and Acquisition Information System (RDAIS) 3.0 and Jupiter. U.S. Special Operations Command uses an information system similar to the Comprehensive Cost and Requirement (CCaR) System. Components provide data on MDAPs to DAVE but only metadata on smaller programs. The components are starting to share program data for ACAT IIs and below with Advana.

MCA Strategic Questions and Metrics

We identified relevant strategic questions for the MCA Pathway through policy and discussions with subject-matter experts:

- Does the MCA Pathway deliver the needed capabilities to the warfighter?
- Does the MCA Pathway provide capabilities at cost?
- Does the MCA Pathway deliver solutions to the end user within an expected schedule?

- Is the MCA Pathway developing technologically advanced and world-leading capabilities?
- Does the MCA Pathway leverage and integrate capabilities matured in other pathways?

We then used the simplified logic model to map these questions to metrics. Table D.1 provides an initial list of five metrics that help to determine pathway health along with the intent of the metric, whether a related AVDF data element is available, and whether there is a gap in data availability. The data elements required to calculate most of these metrics are governed and defined in the AVDF. However, data may not exist for all programs using the MCA Pathway, especially for ACAT II–IV programs. The first metric provides an understanding of the average percentage of objective and key performance parameters (KPPs) that are met, while the second metric (average percentage cost growth) indicates the extent to which programs experience cost growth. The third metric (average schedule slippage) signifies delays in schedule. The fourth metric is the fraction of programs that fail initial testing, indicating whether pathway programs are acquiring technologies that are sufficiently mature to be used in the field (i.e., technology readiness). While this metric is only one possible indicator of whether technologies are being used effectively, even failures due to human error are indicative of a problem in the pathway (i.e., not enough opportunities to build experience in design and test engineers and in manufacturers). The last metric to consider is the fraction of programs that utilize capabilities matured in other pathways.

Challenges to Implementing Metrics for MCA Pathway

We identified multiple challenges that should be addressed when implementing metrics for the MCA Pathway, using our analysis of subject-matter expert interviews conducted during this study and drawing on prior work.[38] The first challenge is that there are less data available on ACAT II–IV programs than ACAT I programs at the OSD level. The components are not required to share all their smaller program data with OSD. OSD and the components are still working through what smaller program data need

TABLE C.1
Suggested MCA Metrics: Indicators for Pathway Health

Metric	Intent of Metric	AVDF Element Available	Data Gap Notes
Average percentage of objective/threshold KPPs met (or equivalent)	Indicates whether delivery capability meets end user needs	AVDF captures Performance Attribute Name (AV0292)[a]	Some KPPs are classified, and the data will only be available in a classified annex
Average percentage cost growth (quantity adjusted, if applicable)	Indicates whether capabilities in this pathway experience a particular amount of cost growth	AVDF captures Cost Baseline—Total Acquisition Current Estimate Amount (AV0810) and Total Acquisition—Related O&M Quantity (AV0840) or Total Development Quantity (AV0123) or Total Procurement Quantity (AV0124)	Data are available but will require some data curation to prepare the data for analysis
Average schedule slippage between planned and actual IOC (or equivalent)	Indicates whether programs in this pathway experience a particular amount of schedule slippage	AVDF captures Event Estimate Date (AV0282) and Event Actual Date (AV0713)	Data are available but will require some data curation to prepare the data for analysis
Fraction of programs failing initial testing	Indicates whether the programs are acquiring technologies that are sufficiently mature to be used in the field (i.e., technology readiness)	No	May be collected by DOT&E and disseminated to program offices
Fraction of programs either entirely from or partly from other pathways	Indicates whether programs in this pathway leverage capabilities matured in other pathways	No	Could be tracked in pathway entrance memorandum among other sources

NOTES: IOC = initial operational capability; DOT&E = Director, Operational Test & Evaluation; O&M = operations and maintenance.

[a] Available data from the objective, threshold, current estimate, and demonstrated KPP, key system attribute (KSA), or additional performance attribute (APA) (if initially entered in the Acquisition Program Baseline) should fully support calculation of this metric.

to be shared for the Department's pivot to capability portfolio analysis in the Integrated Acquisition Portfolio Review, which requires data from acquisition programs of all levels. Additionally, available ACAT II–IV data may differ among the components. For instance, the Navy and the Air Force use different software and collect slightly different sets of data elements for their smaller programs, though both are derived from the long history of MDAP reporting.[39]

Significant challenges also exist in transitions between the MCA Pathway and other pathways. DoDI 5000.02 recommends that program managers "may leverage a combination of acquisition pathways to provide value not otherwise available through use of a single pathway."[40] These transitions need to be planned early with prototypes and software, and requirements, budgets, schedules, contracting, testing, intellectual property, and sustainment need to

be synchronized between pathways and, potentially, programs that will merge into other programs.

It is also not clear whether there is or should be an agreement on the strategic questions and goals of the MCA Pathway between OSD and the components. Because strategic questions and goals drive which metrics are of interest, and therefore what data are collected, differences between OSD and components could lead to somewhat different sets of metrics. While that is not necessarily a problem—metrics should be consistent with senior leader preferences and interests and should change over time in response to both internal and external factors—the differences could lead to confusion among outside organizations such as GAO or Congress.

Recommendations for the MCA Pathway

We offer some recommendations for DoD to consider regarding the MCA Pathway metrics:

- DoD should continue to build on achievements in policy standardization and governance and management over the past ten years.
- Despite the standardization to ACAT I–level definitions, there are still less data available for the ACAT II–IV levels. DoD should determine how to integrate ACAT II–IV data into portfolio metrics. This likely includes identifying a minimum set of data elements to report for ACAT II–IV (e.g., program description information, specific cost and schedule data).

- DoD should address data gaps that prevent measurement of more insightful pathway and mission portfolio metrics in support of the Integrated Acquisition Portfolio Review.
- DoD should address pathway transition issues in existing policy, data standards, business rules, quality compliance, and metrics.
- DoD should conduct case studies specifically on the integration of capabilities into the MCA Pathway and identify metrics that will help establish good practices and monitor and address pathway challenges.

Appendix D. Software Acquisition Pathway

The Software Acquisition Pathway's objective is to facilitate rapid, iterative delivery of software capability and is designed for software-intensive systems. This pathway integrates modern software development practices, such as Agile Software Development, DevSecOps (Development, Security, and Operations), and Lean Practices. The pathway has two phases—planning and execution—and also has two path options—applications and embedded software.[41] The "Decision Authority" for a particular software effort documents the decision and rationale for a program to use this pathway in an Acquisition Decision Memorandum. Finally, active user engagement is a key tenet of this pathway.[42] Figure D.1 depicts the Software Acquisition Pathway.

Policy

DoD's software modernization is subject to significant congressional interest and oversight. Since around 2000, congressional involvement has defined and redefined statutes related to software modernization. At the same time, many changes have occurred in industry best practices and lessons learned in software development. Figure D.2 provides a snapshot of software modernization over the past five NDAAs.

DoDI 5000.87 is the latest instantiation of DoD's software acquisition policy.[43] Some key tenets of DoDI 5000.87 that apply to Software Acquisition Pathway programs include that they

- are not subject to JCIDS
- are not treated as MDAPs
- must demonstrate the viability and effectiveness of capabilities for operational use not later than one year after the date on which funds are first obligated
- must use modern iterative software development methodologies (e.g., agile or lean), modern tools and techniques (e.g., DevSecOps), and human-centered design processes to iteratively deliver software
- must employ active collaboration with end users
- must do value assessments at least annually
- must leverage existing enterprise services
- must address cybersecurity, program protection, and intellectual property from program inception
- must integrate, streamline, and automate software development testing, government developmental testing, system safety assessment, security certification, and operational test and evaluation.[44]

The Software Acquisition Pathway guidance provides goals, advantages, approaches, and potential uses of the pathway that can be linked to pathway metrics. In order to centralize and improve workforce knowledge of the Software Acquisition Pathway goals and instruction, the DAU provides clarification, training, frequently asked questions, and some lessons learned to date. DAU also centralizes relevant OSD and component guidance. Finally, basic data requirements have been written into guidance. In addition to the training available, OUSD(A&S) also has a mentor program to assist program offices that are beginning to navigate this new pathway.

FIGURE D.1

Software Acquisition Pathway

SOURCE: Defense Acquisition University, "Software Acquisition," webpage, undated.

Snapshot of Software Pathway–Related Legislation Since FY18

- FY18, Sec. 872 (Defense Innovation Board software analysis)
- FY18, Sec. 891 (Agile or iterative development training)
- FY18, Sec. 873/874 (Agile Pilots)
- FY19, Sec. 868 (Defense Science Board recommendations implementation)
- FY19, Sec. 869 (Agile or iterative development methods implemented in pilot program)
- FY20, Sec. 230 (Digital Careers)
- FY20, Sec. 231 (Digital Engineering and T&E)
- FY20, Sec. 255 (DoD-wide software science and technology strategy)

- **FY20, Sec. 800 (Established Software Acquisition Pathway)**

- FY20, Sec. 862 (Software Training)
- FY21, Sec. 812 (Inclusion of software in government performance of acquisition functions)
- FY21, Sec. 835 (DBS use in software pathway)
- FY21, Sec. 834 (Consumption-based solutions to address software-intensive warfighting capability pilot program)
- FY21, Sec. 838 (Comptroller General report on software acquisition reforms)
- FY22, Sec. 835 (Independent study on technical debt in software-intensive systems)*
- FY22, Sec. 836 (Cadre of software development and acquisition experts)*
- FY22, Sec. 1522 (Legacy information technologies and systems accountability)*
- FY22, Sec. 1531 (Digital development infrastructure plan and working group)*

SOURCES: Brady, 2021; National Defense Authorization Act for Fiscal Year 2022.
* Potentially relevant to software acquisition.

Data Governance, Management, and Analytics

The Software Acquisition Pathway is establishing a new data environment for software-intensive capabilities, because the Software Acquisition Pathway is collecting new data for software-intensive programs. In addition, these data have not been collected in the past within the DoD Office of the Chief Information Officer, OUSD(A&S), or component-level information systems, other than through the Director of CAPE (e.g., via Software Resources Data Report). Because no mechanism currently exists to collect this information automatically, Software Acquisition Pathway programs are sending data via spreadsheet. Plans are being made to collect this information through DAVE, Advana, and component-level information systems. As of March 2022, only one biannual data collection had occurred, so analysis is limited.

Software Acquisition Strategic Questions and Metrics

Conceptual thinking on Software Pathway metrics is mature.[45] A metrics framework exists that is supported by prior required analysis by Congress (e.g., the GAO and the Section 874 pilot program). The Software Pathway owner has also defined strategic questions and metrics and is in the process of building data governance via the Acquisition Visibility Steering Group/Acquisition Visibility Working Group and AVDF.

When defining metrics for software, an important distinction needs to be made between legacy hardware-centric systems and modern software practices. Software acquisition metrics do not follow traditional cost, schedule, and performance metrics, and there is no acquisition program baseline. While different from typical hardware metrics, software performance still needs to be measured to ensure delivery of a required capability at the predicted cost. Figure D.3 provides the distinctions between legacy hardware and modern software.

Comparison of Legacy and Modern Software

Legacy Hardware-Centric Systems	Modern Software Practices
• Define requirements upfront • Detailed cost estimates • Baseline cost, schedule, and performance in APB • Measure performance versus APB • Track contractor via earned value management (EVM) data • Focus on compliance	• Iterative requirements • Active user engagements • Iterative and incremental cost and performance estimates • Annual value assessments • Continuous improvement • Responsive to changes • Focus on users/mission impact • Deploy capabilities in frequent blocks

There is no baseline associated with modern software practices (i.e., no Acquisition Program Baseline)

SOURCE: Brady, 2021, p. 33.

We identified relevant strategic questions for the Software Acquisition Pathway through policy and discussions with subject-matter experts:

- Does the Software Acquisition Pathway deliver capabilities quickly and continuously to the warfighter to meet the changing threats?
- Does the Software Acquisition Pathway deliver stable and reliable capabilities?
- Does the Software Acquisition Pathway provide value (i.e., return on investment) to DoD at the predicted cost?
- Does the Software Acquisition Pathway provide cyber resilient capabilities?[46]

We then used the simplified logic model to map these questions to metrics. Table D.1 provides an initial list of five metrics that help to determine pathway health along with the intent of the metric, whether a related AVDF data element is available, and whether there is a gap in data availability. The first metric provides an understanding of total cost of software efforts in the pathway, and the second metric (average lead time) provides an understanding of the average duration to deliver a capability or feature into operation, measured from the time the code is committed (development activity finished) to the time it is available for release to operations (production). The third metric (change fail rate) provides an understanding

of the percentage of releases to the production/operational environment that require subsequent remediation. The fourth metric provides an understanding of the mean response time for a program to resolve a cyber incident or common vulnerability or exposure (CVE) from the time of identification through resolution. Finally, average deployment frequency provides an understanding of the average frequency of releases into an operational environment.

Challenges to Implementing Metrics for Software Acquisition Pathway

We identified multiple challenges that should be addressed when implementing metrics for the Software Acquisition Pathway, using our analysis of subject-matter expert interviews conducted during this study and drawing on prior work.[47] First, use of the Software Acquisition Pathway is ramping up (14 programs are in planning and 21 are in the execution phase),[48] so there is still a learning curve for programs in this pathway. Also, OUSD(A&S) has identified Software Acquisition Pathway metrics, but programs have only recently started sending data to OSD. Thus, no full set of information exists yet. Second, software acquisition metrics are different from the typical cost, schedule, and performance (e.g., software supports continuing evolution across the life cycle of the system and does not have discreet

TABLE D.1

Suggested Software Acquisition Metrics: Indicators for Pathway Health

Metric	Intent of Metric	AVDF Element Available	Data Gap Notes
Program cost estimate (total)	Provides an understanding of total cost of software efforts in the pathway	AVDF captures Cost Baseline—Total Acquisition Current Estimate Amount (AV0810)	No gap as long as data is submitted by all programs
Average lead time	Provides an understanding of the average duration to deliver a capability or feature into operation, measured from the time the code is committed (development activity finished) to the time it is available for release to operations (production)	AVDF captures Average Lead Time (AV0848)	No gap as long as data is submitted by all programs
Change fail rate	Provides an understanding of the percentage of releases to the production/operational environment that require subsequent remediation	AVDF captures Change Fail Rate Percentage (AV0851)	No gap as long as data is submitted by all programs
Average mean time to resolve experienced cyber incident or CVE	Provides an understanding of the mean response time a program was able to resolve a cyber incident or CVE from the time of identification through resolution	AVDF captures Mean Time to Resolve Experienced Cyber Incident or Common Vulnerability or Exposure (AV0867)	No gap as long as data is submitted by all programs
Average deployment frequency	Provides and understanding of the average frequency of releases into an operational environment	AVDF captures Average Deployment Frequency (AV0845)	No gap as long as data is submitted by all programs

"acquisition" and "sustainment" phases; deliveries are continuous; and no APB exists), which also means that a learning curve is likely for the DoD acquisition workforce to understand what these metrics mean, what they measure, and how. Software data also are not yet collected in a central information system, and the data are being sent manually via spreadsheet to OSD from the program offices. The components and OSD are still working through governance and management of centralizing and automating data feeds. In addition, Congress added another sub-pathway within the Software Acquisition Pathway for software-intensive DBSs in Section 835 of FY21

NDAA. This new sub-pathway creates additional churn in the Software Acquisition and DBS pathways, as the workforce needs to figure out what pathway is applicable to specific situations. Finally, interactions with other pathways need to be evaluated. Some programs are already transferring to the Software Acquisition Pathway from the MTA Pathway, and it is not clear what data will be fully available for these programs, given that MTA data elements are different. The reverse is true for programs that are moving from the Software Acquisition Pathway to other pathways as a technology insertion (i.e., when moving into the MCA Pathway).

Recommendations for the Software Acquisition Pathway

We offer some recommendations for DoD to consider regarding Software Acquisition Pathway metrics:

- The Software Acquisition Pathway is creating a full set of metrics that are different from traditional acquisition metrics, with some that may also be applicable to DBSs utilizing the Software Acquisition Pathway. DoD should consider aligning Software Acquisition Pathway and DBS Pathway metrics and data to create a common data and measurement standard for software-intensive programs.
- OSD pathway owners should work with the components now to identify a plan for collecting software acquisition information centrally going forward.
- DoD should include data standards, business rules, and metrics in existing policies that will address programs transitioning between pathways (e.g., MTA Pathway to Software Acquisition Pathway).
- Finally, DoD should continue analyzing case studies or pilot programs as a way to identify and establish good practices and address challenges using the Software Acquisition Pathway (e.g., test implementation challenges of new metrics before fully implementing).

Appendix E. Defense Business Systems Pathway

DoD created the Defense Business Systems (DBS) Pathway under the Adaptive Acquisition Framework in January 2020. Under the updated policy, the objective of DBS is to facilitate business changes to improve organizational performance and to ensure system efficiency, effectiveness, cyber resilience, and audit compliance.[49] The DBS Pathway aims to align system acquisition with commercial or government best practices and to minimize the need for customization of commercial products to fit government needs. This pathway is intended for all defense business capabilities and their supporting business systems and "as-a-service" solutions. It can also be used for other non-developmental, software-intensive programs, including national security systems.

Figure E.1 depicts the DBS Pathway.

The DBS Pathway is distinctly different from other pathways, given the uniqueness of DBSs. DBSs differ from weapon system programs in several ways:

- IT requirements govern DBS and IT programs.
- DBSs do not follow the JCIDS process to define acquisition requirements and follow the Capability Requirements process through the Chief Information Officer (DoD or component, depending on the Business System Category [BCAT] or any delegation of authority) instead.
- DBSs are organized by BCAT versus ACAT for major systems acquisition.
- DBSs follow the Business Capability Acquisition Cycle (BCAC) with authority to proceed (ATP) rather than the traditional acquisition life cycle with milestones.[50]

Policy

The DBS policy environment is complex and has changed a lot over the past two decades. Significant congressional involvement and changes in best practices and lessons learned in software practices have contributed to the complex DBS policy environment. DBS acquisition also has a long legislative history: Since the early 2000s, Congress has passed legislation that defined DBS roles and responsibilities, stakeholder organizations, and processes associated with acquiring DBSs.[51] Figure E.2 depicts the legislative history of DBSs.

Currently, U.S. Code Title 10, Section 2222 defines DBS as follows:

(1)(A) Defense business system. - The term "defense business system" means an information system that is operated by, for, or on behalf of the Department of Defense, including any of the following:

- A financial system
- A financial data feeder system
- A contracting system
- A logistics system
- A planning and budgeting system
- An installations management system
- A human resources management system
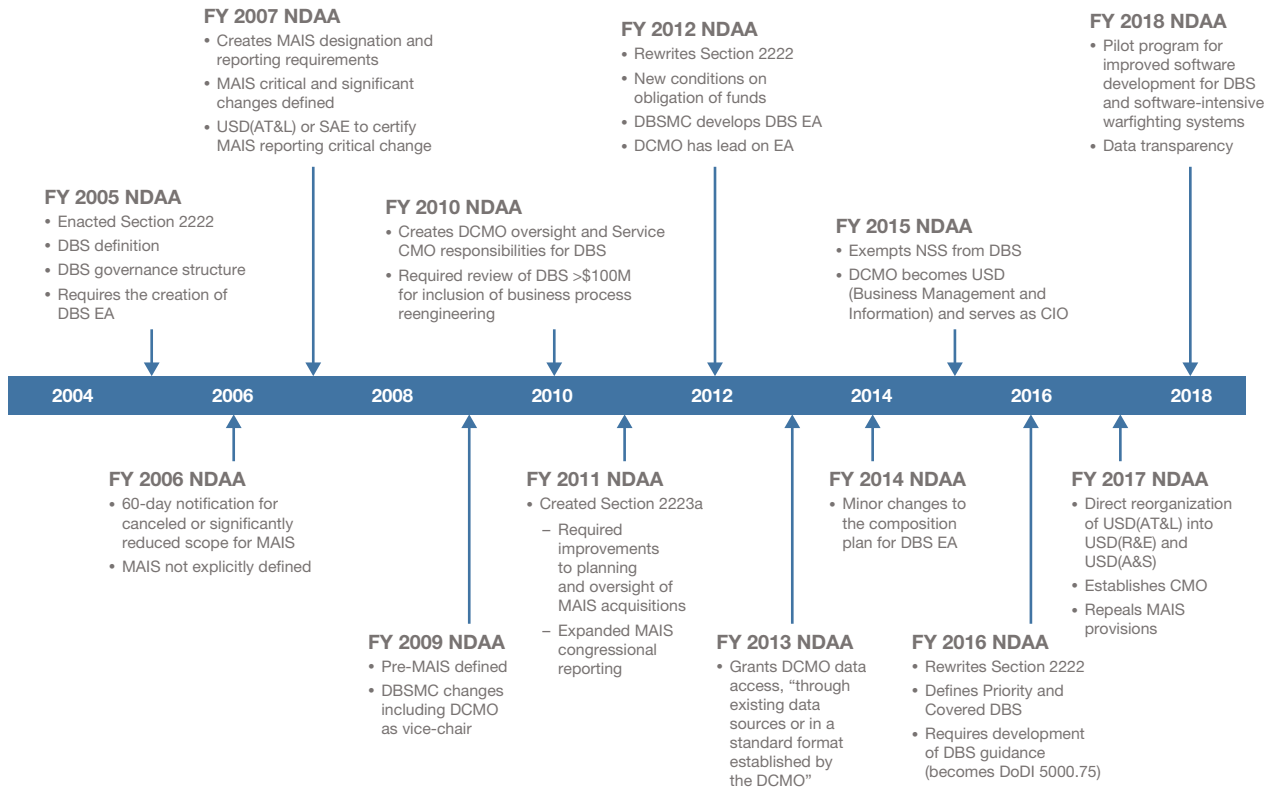- A training and readiness system.[52]

Additionally, DBS policy emphasizes using commercial off-the-shelf technology, but Congress also wants DoD to apply innovation to software in DBS. The latter practice requires stitching together attributes of Software Acquisition and DBS pathways, where the spirit of the DBS Pathway helps improve user communities' processes through commercial off-the-shelf software, and the Software Acquisition Pathway helps field a customized, innovative soft-

FIGURE E.1

Defense Business Systems Pathway

SOURCE: Defense Acquisition University, "Defense Business Systems (DBS)," webpage, undated.

FIGURE E.2
Legislative History of Defense Business Systems

FY 2007 NDAA
- Creates MAIS designation and reporting requirements
- MAIS critical and significant changes defined
- USD(AT&L) or SAE to certify MAIS reporting critical change

FY 2012 NDAA
- Rewrites Section 2222
- New conditions on obligation of funds
- DBSMC develops DBS EA
- DCMO has lead on EA

FY 2018 NDAA
- Pilot program for improved software development for DBS and software-intensive warfighting systems
- Data transparency

FY 2005 NDAA
- Enacted Section 2222
- DBS definition
- DBS governance structure
- Requires the creation of DBS EA

FY 2010 NDAA
- Creates DCMO oversight and Service CMO responsibilities for DBS
- Required review of DBS >$100M for inclusion of business process reengineering

FY 2015 NDAA
- Exempts NSS from DBS
- DCMO becomes USD (Business Management and Information) and serves as CIO

| 2004 | 2006 | 2008 | 2010 | 2012 | 2014 | 2016 | 2018 |

FY 2006 NDAA
- 60-day notification for canceled or significantly reduced scope for MAIS
- MAIS not explicitly defined

FY 2011 NDAA
- Created Section 2223a
  - Required improvements to planning and oversight of MAIS acquisitions
  - Expanded MAIS congressional reporting

FY 2014 NDAA
- Minor changes to the composition plan for DBS EA

FY 2017 NDAA
- Direct reorganization of USD(AT&L) into USD(R&E) and USD(A&S)
- Establishes CMO
- Repeals MAIS provisions

FY 2009 NDAA
- Pre-MAIS defined
- DBSMC changes including DCMO as vice-chair

FY 2013 NDAA
- Grants DCMO data access, "through existing data sources or in a standard format established by the DCMO"

FY 2016 NDAA
- Rewrites Section 2222
- Defines Priority and Covered DBS
- Requires development of DBS guidance (becomes DoDI 5000.75)

SOURCES: Previous RAND analysis of FY2005–2018 NDAA legislation: Public Law 108-375, Public Law 109-163, Public Law 109-364, Public Law 110-417, Public Law 111-84, Public Law 111-383, Public Law 112-239, Public Law 113-66, Public Law 113-291, Public Law 114-92, Public Law 114-328, and Public Law 115-291.

NOTES: MAIS = Major Acquisition Information System; USD(AT&L) = Under Secretary of Defense for Acquisition, Technology, and Logistics; CIO = Chief Information Officer; USD(A&S) = Under Secretary of Defense for Acquisition and Sustainment; USD(R&E) = Under Secretary of Defense for Research and Engineering; DBMSC = Defense Business Systems Management Committee; DCMO = Deputy Chief Management Office; EA = enterprise architecture.

ware rapidly. DoD is in the process of establishing this hybrid pathway option. However, a program that meets the definition of DBS will still have to follow DBS statutes regardless of the pathway.[53] That said, while DBSs are subject to the overall statutes and policies governing all DoD IT investments, additional acquisition requirements are in separate law and policy (e.g., DoDI 5000.02 and DoDI 5000.75). Furthermore, the DBS policy requires several stakeholders' agreement and approval: OUSD(A&S), Chief Information Officer, Comptroller, and Director of Administration and Management. The DBS Pathway is also governed by the Defense Business Council, Configuration Steering Board, and Defense Acquisition Board.[54]

Overall, DBS guidance provides goals, approaches, and potential uses of the pathway that can be linked to pathway metrics. The DBS Pathway emphasizes tailoring, minimal customization, and functional sponsor involvement, as well as an iterative acquisition approach. The flexibility to tailor a DBS acquisition program throughout its lifecycle, minimizing the need for customization of commercial products to the maximum extent practicable, and actively seeking to involve functional and acquisition communities encourages rapid decisionmaking on requirements, cost, schedule, performance, and risk. Using the iterative approach also helps facilitate functional sponsor involvement throughout the BCAC with the program manager and releases of capability or smaller iterations throughout the life cycle. The

DBS Pathway also aims to leverage commercial successes with demonstrated software. This practice is intended to increase return on investment and minimize the need for customization of commercial products as much as possible, as well as align with commercial and government best practices. Finally, program managers can also use the DBS Pathway to focus on cost and performance by reducing cost of acquisition, deploying some functionality to select number of users, and achieving organization change through innovative business process changes.[55]

Data Governance, Management, and Analytics

Similar to the complex policy environment, the DBS data environment is also complicated, with many stakeholders and decentralization of data across DoD. The DoD Chief Information Officer, OUSD(A&S), and components collect data for different purposes. Historically, the Chief Information Officer has collected DBS data for IT statutory and regulatory reasons. The OUSD(A&S) has also previously collected information on major automated information systems (MAISs) only and does not have authority over data systems that have been tracking IT systems. Components collect acquisition information on DBS at all BCAT levels.

Furthermore, DBS data management systems are generally outside the acquisition community, except for DAVE and DAMIR,[56] and are not designed to collect acquisition program data. Table E.1 shows various DBS data management systems and summarizes the types of data these systems collect.

The data environment also causes wide variation across the components because of decentralized data governance and management authorities.[57]

DBS Strategic Questions and Metrics

We identified strategic questions relevant to the DBS Pathway based on policy and statute reviews and discussions with subject-matter experts:[58]

- Does the DBS Pathway help field systems that increase efficiency of DoD's business functions?
- Is the DBS Pathway providing the needed capabilities cost effectively?
- Are individual programs able to tailor the BCAC approach to acquire DBS as needed?
- Is the DBS Pathway maximizing the benefits of successfully demonstrated commercial software and business practices?
- Does the DBS Pathway field systems that help reduce future cost and risk to DoD?

TABLE E.1

DBS Data Management Systems and Data Types

Data System	Data Type
Defense Information Technology Investment Portal (DITIP)	Certification requests and investment creation
DoD IT Portfolio Repository (DITPR)	Specific DBS data, Clinger-Cohen Act (CCA) Compliance, Federal Information Security Modernization Act (FISMA) compliance, e-authority, system and portfolio reports
Select and Native Programming–IT (SNaP-IT)	Budget data, Annual IT Report, Section 322 Report
DAVE/DAMIR	DBS program list (27 only) and DAMIR [archive of Major Acquisition Information System (MAIS) data]
Advana—DoD's big data platform for advanced analytics	Will add data in the future

SOURCE: RAND interviews with subject-matter experts, December 2021.

We then used the simplified logic model to map these questions to potential pathway metrics. Table E.2 provides an initial list of five metrics that help to determine pathway health along with the intent of the metric, whether a related AVDF data element is available, and whether there is a gap in data availability. The first three metrics are related to cost, schedule, and performance, while the final two metrics reflect two important metrics to understand the cyber resilience and health of the commercial industry as potential outcomes of the pathway.

TABLE E.2

Suggested DBS Metrics: Indicators for Pathway Health

Metric	Intent of Metric	AVDF Element Available	Data Gap Notes
Average percentage cost growth	Indicates whether capabilities in this pathway experience cost growth (cost growth may indicate poor investment management or risk reduction practice)	AVDF captures Life-Cycle Cost Category (AV0207)	The AVDF data element for cost estimates is approved and governed; however data availability is an issue. There may be additional data in Chief Information Officer information systems related to cost
Limited deployment ATP date slippage (IOC slippage equivalent)—percent delta of planned versus actual schedule	Indicates whether programs in this pathway experience a particular amount of schedule slippage	AVDF captures Event Estimate Date (AV0282) and Event Actual Date (AV0713)	A standard schedule event is captured only for larger systems in AVDF, and data is likely not collected across other programs
Percentage established performance parameters met for each release before development or delivery	Indicates whether delivered capability meets performance targets and end user needs	AVDF captures Performance Attribute Name (AV0292), Performance Attribute Objective Value (AV0294), Performance Attribute Threshold Value (AV0293)[a]	Lowest acceptable level of performance for a system attribute, below which the system is not operationally effective or suitable or may not provide an improvement over current capabilities captured in DAVE (DAMIR) for subset of DBS
Compliance with cyber policy is being monitored/tracked	Indicates whether fielded business systems will continue to function despite adverse cyber events	No	Not defined in AVDF but may be reported in non-acquisition systems
Fraction of contracts competitively awarded	Indicates whether acquisition approach is leveraging competition to acquire the needed capability at reduced cost and risk	No	Not defined in AVDF but maybe collected through another source, like FPDS-NG

NOTES: ATP = authority to proceed; IOC = initial operational capability; FPDS-NG = Federal Procurement Data System–Next Generation.

[a] Available data from the objective, threshold, current estimate, and demonstrated KPP, key system attribute (KSA), or additional performance attribute (APA) (if initially entered in the Acquisition Program Baseline) should fully support calculation of this metric.

Challenges to Implementing Metrics for DBS Pathway

We identified multiple challenges that should be addressed when implementing metrics for the DBS Pathway, using our analysis of subject-matter expert interviews conducted during this study and drawing on prior work.[59] First, the DBS data currently being collected focus primarily on basic program information and traditional acquisition metrics, such as cost, schedule, and performance, and not on software-applicable metrics. As a result, available data do not fully capture software-intensive commercial off-the-shelf or government off-the-shelf products. Second, the DBS and Software Acquisition pathways can potentially overlap and be contradictory. Congress has created a sub-pathway in the Software Acquisition Pathway related to DBS, but this initiative may create confusion for the acquisition workforce trying to implement the DBS Pathway. Third, it is unclear how data requirements will be addressed if program managers are acquiring a software-intensive national security system (an exception allowed for DBS). For example, a program may transition from DBS to the MCA Pathway, or another pathway, without clear acquisition data collection requirements. Fourth, current data collection for DBS is minimal, and component-level program offices will need to provide additional data. Finally, as Table E.1 shows, DBS acquisition data reside in multiple information systems in the IT community. These systems are not aligned with information systems within the acquisition community. While acquisition data are probably being captured for some DBS, such as the former MAIS, or in systems such as the Federal Procurement Data System–Next Generation (FPDS-NG), extracting those data and aligning them with budget or Chief Information Officer datasets will be difficult.

Recommendations for the DBS Pathway

Finally, we offer some recommendations for DoD to consider regarding DBS Pathway metrics:

- DoD should compile and maintain a full list of DBS programs in order to gain insights for more than just major information systems.
- DoD should focus data collection efforts on larger programs such as BCAT I. Analytic rigor should also be applied to BCAT II programs, while rolling up the remaining programs.[60]
- DoD should consider including in DBS metrics those Software Pathway metrics (the metrics that the Software Pathway owners are currently creating) that may be applicable to DBS (e.g., program cost estimate [total], average mean time to resolve experienced cyber incident or CVE).
- DoD should address any pathway transition issues in existing policy, data standards, business rules, quality compliance, and metrics.
- DoD should conduct case studies to identify good practices and challenges using the DBS Pathway. For example, identify metrics that will help establish good practices and monitor and address challenges.

Appendix F. Acquisition of Services Pathway

The Acquisition of Services (AoS) Pathway differs from the other pathways in that it supports acquisition of services rather than specific products. Managing services requirements as a process is more analogous to procurement or contracting, which is a subset of the different acquisition activities, than it is to product acquisition; for that reason, the processes captured in this pathway have historically been separated from other acquisition activities. Figure F.1 depicts the AoS Pathway.

Policy

Unlike other pathways, there is no formal "pathway use" declaration in the form of either a memorandum or a decision to place a services program in the AoS Pathway. This makes it challenging to identify the programs in the pathway, something that is required in order to calculate many pathway health metrics.

The AoS Pathway is in the early stages of identifying metrics. Policy mentions or implies a range of "appropriate, efficient, and effective" measures. Some of these metrics are associated with individual program or contract activity, while other metrics are inherently at the portfolio level. There is no data standard in place for the metrics, and the pathway has yet to be implemented within the AVDF. However, initial work by OUSD(A&S)'s Office of Acquisition Enablers has begun to identify metrics and tie

them to the AVDF. Although there is no agreed-upon data framework, the FPDS-NG data dictionary forces some level of standardization.

Data Governance, Management, and Analytics

Historically, AoS policy and data have been treated separately from other acquisition policy and usually within a procurement or contracting directorate. Some policies and processes apply throughout the government; for example, data collected through FPDS-NG also includes other federal government services information. For that reason, it is also unclear who has the responsibility for AoS Pathway analytics. That function moved from Defense Procurement and Acquisition Policy (DPAP) to Chief Management Officer (CMO) but was essentially lost when the CMO was disestablished. Furthermore, the in-house DoD subject-matter experts for these datasets are limited, although components are more mature with the contract decision and execution data than is OSD.

OUSD(A&S)'s Office of Acquisition Enablers is currently coordinating a list of 62 proposed data elements for governance approval; these metadata are expected to be published in the July 2022 AVDF release, to be followed by an AoS data standards promulgation memorandum.

FIGURE F.1
Acquisition of Services Pathway

Acquisition of Services	Plan			Develop		Execute	
	1 Form the Team	2 Review Current Strategy	3 Perform Market Research	4 Define Requirements	5 Develop Acquisition Strategy	6 Execute Strategy	7 Manage Performance

SOURCE: Defense Acquisition University, "Acquisition of Services," webpage, undated.

AoS Strategic Questions and Metrics

We identified relevant strategic questions for the AoS Pathway through examination of policy and discussions with subject-matter experts:

- Is the AoS Pathway appropriate, efficient, and effective at delivering services requirements to the warfighter?
- Does the AoS Pathway support acquisition of services equally across different categories?
- Do AoS Pathway processes lead to services that adhere to cost, schedule, and performance targets?
- Does the AoS Pathway leverage small businesses and non-traditional sources and contracting approaches (e.g., Other Transaction Authority [OTA])?
- Does the AoS Pathway leverage competition in source selection?

We then used the simplified logic model to map these questions to metrics. Table F.1 provides an initial list of five metrics that help to determine pathway health along with the intent of the metric, whether a related AVDF data element is available, and whether there is a gap in data availability. The first metric to consider is the average percentage cost growth of services procured via this pathway. The second metric on average schedule slippage indicates the extent of slippage in acquiring these services. Procurement Acquisition Lead Time (PALT) measures the contract planning and development time, while knowing the

TABLE F.1

Suggested AoS Metrics: Indicators for Pathway Health

Metric	Intent of Metric	AVDF Element Available	Data Gap Notes
Average percentage cost growth (quantity adjusted, if applicable)	Indicates whether services in this pathway experience a particular amount of cost growth	AVDF captures Life-Cycle Cost Category (AV0207) (pending July 2022 AVDF release)	There is a data challenge in linking the programs (which deliver end items, not services) to the supporting AoS contracts extant in FPDS-NG or component contract writing systems
Average schedule slippage between need date and service requirement received	Indicates whether services in this pathway experience a particular amount of slippage	AVDF captures Event Estimate Date (AV0282) and Event Actual Date (AV0713) (pending July 2022 AVDF release)	The events captured in the schedule are not the same for each program (due to tailoring and flexible implementation)
Average procurement acquisition lead time	Measures the contract planning and development time	AVDF captures "input" data elements to calculate this metric; AVDF captures Event Estimate Date (AV0282) and Event Actual Date (AV0713) (pending July 2022 AVDF release)	There is a data challenge in linking the programs (which deliver end items, not services) to the supporting AoS contracts extant in FPDS-NG or component contract writing systems
Percentage of warfighter objectives met (or equivalent)	Indicates whether the pathway has produced services that meet the warfighter's needs	AVDF captures Performance Attribute Name (AV0292), Performance Attribute Objective Value (AV0294), Performance Attribute Threshold Value (AV0293) (pending July 2022 AVDF release)	Data for some services may be on CPARS for some, but may require new data collection (e.g., user survey)
Number of effective bid protests (per the GAO definition)	Captures the amount of source selection processes within the pathway that were inappropriately or incorrectly carried out	No	Data are available from the GAO

NOTE: CPARS = Contractor Performance Assessment Reporting System.

percentage of warfighter objectives met indicates whether the pathway has produced services that meet the requestor's needs. The last metric to consider is the number of effective bid protests upheld by the GAO; this indicates the extent of inappropriate or incorrect source selection processes carried out through the pathway.

Challenges to Implementing Metrics for AoS Pathway

We identified multiple challenges that should be addressed when implementing metrics for the AoS Pathway, using our analysis of subject-matter expert interviews conducted during this study and drawing on prior work.[61] The AoS Pathway does not have entry documentation (i.e., a formal declaration that a program or effort is going to use the pathway, which may consist of an Acquisition Decision Memorandum), so analysis relies solely on labor-intensive data collection to assess what programs are using the pathway. There is also limited post-award performance information to assess requirements and PALT to assess timeliness (except for major contracts). The current approach for data collection makes AoS data processing and analytics challenging. FPDS-NG only provides information post-award. The use of contracts as the primary unit of analysis rather than using the "program" leads to a focus solely on contracting data. With many small transactions occurring without a formal program office and no centralized system for services acquisition, it is challenging to pull data and make analyses comparable to the other pathways. This is further exacerbated by unique attributes of different categories of services that may have potentially distinct metric analytics that need to be calculated separately. The result of these differences leads to a very decentralized decisionmaking and execution of the contracts in the pathway.

Recommendations for the AoS Pathway

We offer some recommendations for DoD to consider regarding AoS Pathway metrics:

- DoD should continue ongoing activities to implement AoS data elements in AVDF and promulgate data standards for those elements. This should include not just descriptive metadata to identify AoS programs, but also substantive cost, schedule, and performance data needed to assess pathway health.

- DoD should conduct a pilot test in which specific data are pulled from the relevant data sources to construct metrics (identified in the table above) intended to provide insight into AoS Pathway health. The results of this pilot test should be used to refine an initial set of pathway health metrics and required data elements.

- DoD should address current data gaps that prevent the measurement of more insightful AoS Pathway metrics, including total number of bridge contracts and number of contracts with deficiencies.

- DoD should consider developing in-house subject-matter experts for processing and analyzing service-specific data.

- DoD should explore other available databases besides FPDS-NG in order to understand what other already collected data might be relevant for evaluating pathway health.

Notes

1 DoDI 5000.81, *Urgent Capability Acquisition*, Washington, D.C.: U.S. Department of Defense, December 31, 2019.

2 DoDI 5000.80, *Operation of the Middle Tier of Acquisition (MTA)*, Washington, D.C.: U.S. Department of Defense, December 30, 2019.

3 DoDI 5000.85, *Major Capability Acquisition*, Washington, D.C.: U.S. Department of Defense, November 4, 2021.

4 DoDI 5000.87, *Operation of the Software Acquisition Pathway*, Washington, D.C.: U.S. Department of Defense, October 2, 2020.

5 DoDI 5000.75, *Business Systems Requirements and Acquisition*, Washington, D.C.: U.S. Department of Defense, January 24, 2020.

6 DoDI 5000.7, *Defense Acquisition of Services*, Washington, D.C.: U.S. Department of Defense, January 10, 2020.

7 We used 2020 as the approximate date for the release of the AAF because DoDI 5000.02 was effective as January 23, 2020.

8 U.S. Government Accountability Office, *DoD Acquisition Reform Leadership Attention Needed to Effectively Implement Changes to Acquisition Oversight*, Washington, D.C., GAO-19-439, June 2019.

9 For example, DoD senior leadership is also increasingly asking for information on the status of different mission-oriented portfolios of programs. This is in the Integrated Acquisition Portfolio Review and the Deputy's Management Action Group executive analytics efforts. See Deputy Secretary of Defense, "Principles and Standards for Analysis Supporting Strategic Decisions," memorandum, February 2, 2022.

10 Deputy Secretary of Defense, "Creating Data Advantage," memorandum, May 5, 2021. See also OUSD(A&S), *Data Transparency to Enable Acquisition Pathways*, Washington, D.C., June 15, 2020.

11 OUSD(A&S), Office of Acquisition Enablers, *Acquisition and Sustainment Data and Analysis Strategic Implementation Plan*, December 2020b; OUSD(A&S), "Promulgation of the Acquisition Visibility Data Framework as the Common Data Framework for Acquisition and Sustainment," memorandum, October 13, 2020.

12 Mark V. Arena, Megan McKernan, Julia A. Thompson, and Sydne Newberry, unpublished RAND Corporation research, 2021.

13 Scott Savitz, Miriam Matthews, and Sarah Weilant, *Assessing Impact to Inform Decisions: A Toolkit on Measures for Policymakers*, Santa Monica, Calif.: RAND Corporation, TL-263-OSD, 2017.

14 Elizabeth M. Bartels, Jeffrey A. Drezner, and Joel B. Predd, *Building a Broader Evidence Base for Defense Acquisition Policymaking*, Santa Monica, Calif.: RAND Corporation, RR-A202-1, 2020.

15 Jeffrey A. Drezner, Megan McKernan, Austin Lewis, Ken Munson, Devon Hill, Jaime Hastings, Geoffrey McGovern, Marek Posard, and Jerry M. Sollinger, *Issues with Access to Acquisition Data and Information in the Department of Defense: Identification and Characterization of Data for Acquisition Category (ACAT) II–IV, Pre-MDAPs, and Defense Business Systems*, Santa Monica, Calif.: RAND Corporation, 2019, Not available to the general public.

16 DoDI 5000.02, 2020, p. 9.

17 As of March 2022, there was only one biannual data collection.

18 According to the Office of the Assistant Secretary of Defense for Acquisition, Office of Acquisition Data and Analytics/Enterprise Information: "The AVDF provides the Acquisition community an authoritative, governed set of data elements, definitions, rules, and other metadata for the Adaptive Acquisition Framework (AAF). The AVDF establishes a common enterprise data standard for DoD that will enable the six AAF pathways through data" (OUSD[A&S], Acquisition Data and Analytics/Enterprise Information, homepage, undated).

19 According to the FY22Q1 Acquisition Visibility Data Framework, 85 data elements are available for DBS out of 624 total.

20 See PricewaterhouseCoopers LLC, "Guide to Key Performance Indicators: Communicating the Measures That Matter," 2007, p. 5; Aron Pinker, Charles G. Smith, and Jack W. Booher, "Selecting Effective Acquisition Process Metrics," *Acquisition Review Quarterly*, Spring 1997; Performance-Based Management Special Interest Group, T*he Performance-Based Management Handbook*, Volume 2, *Establishing an Integrated Performance Measurement System*, September 2001; Robert D. Behn, "Why Measure Performance? Different Purposes Require Different Measures," *Public Administration Review*, Vol. 63, No. 5, September/October 2003.

21 Deputy Secretary of Defense, 2021. See also OUSD(A&S), 2020.

22 Public Law 107–314, Bob Stump National Defense Authorization Act for Fiscal Year 2003, December 2, 2002, Section 806; Jen Judson, "30 Years: MRAP—Rapid Acquisition Success," DefenseNews, October 25, 2016.

23 Defense Acquisition University, "Urgent Capability Acquisition," webpage, undated.

24 DoDI 5000.81, 2019, p. 3.

25 DoDI 5000.81, 2019.

26 Defense Acquisition University, "Powerful Example: JRAC Helps Warfighters Overcome Urgent Threat from Enemy Drones," blog post, August 6, 2019.

27 U.S. Government Accountability Office, *Warfighter Support: Improvements to DoD's Urgent Needs Processes Would Enhance Oversight and Expedite Efforts to Meet Critical Warfighter Needs*, Washington, D.C., GAO 10-460, April 2010; U.S. Government Accountability Office, *Urgent Warfighter Needs: Opportunities Exist to Expedite Development and Fielding of Joint Capabilities*, Washington, D.C., GAO 12-385, April 2012.

28 Mark V. Arena, Megan McKernan, Julia A. Thompson, and Sydne Newberry, unpublished RAND Corporation research, 2021; Bartels et al., 2020.

29 It may be possible to leverage Joint Chiefs of Staff/J-8's (Force Structure, Resources, and Assessment Directorate) Knowledge Management/Decision Support (KM/DS) informa-

tion system, which is maintained on Secret Internet Protocol Router Network (SIPRNet), to obtain data that informs the metrics noted in Table A.1. KM/DS contains structured and unstructured data. Although KM/DS is also used primarily for programs with joint interest, it may have a broader swath than data collected within the JRAC. Historically, availability of structured KM/DS data exports has been a challenge, but it still represents an opportunity given sufficient senior leadership attention. However, KM/DS would need to be evaluated to ensure it contains relevant information that is updated regularly.

30 DoDI 5000.80, 2019, p. 11.

31 DoDI 5000.80, 2019; Chris Davis, OUSD(A&S), "Middle Tier of Acquisition (MTA) Training Brief," June 2020.

32 According to DoDI 5000.80, p. 11:

In addition to the documentation listed in Table 1, CAEs [Component Acquisition Executives] will ensure availability of the program identification data (PID) via DAVE interfaces. . . . PID requirements are tiered between major and non-major systems. CAEs will submit updated PID via DAVE interfaces with the President's Budget and Program Objective Memorandum submissions to OSD. CAEs must comply with the online PID requirements, consistent with the policy specified in this issuance.

33 U.S. Government Accountability Office, *Weapon Systems Annual Assessment: Updated Program Oversight Approach Needed*, Washington, D.C., GAO-21-222, June 8, 2021.

34 Mark V. Arena, Megan McKernan, Julia A. Thompson, and Sydne Newberry, unpublished RAND Corporation research, 2021; Bartels et al., 2020.

35 U.S. Government Accountability Office, 2021, p. 22.

36 Defense Acquisition University, "Major Capability Acquisition," webpage, undated.

37 The 1982 Nunn-McCurdy act was intended to limit cost overruns for weapon system acquisition; the 1996 Clinger Cohen Act defined the way the federal government designs, uses, and disposes of IT.

38 Mark V. Arena, Megan McKernan, Julia A. Thompson, and Sydne Newberry, unpublished RAND Corporation research, 2021; Bartels et al., 2020.

39 Drezner et al., 2019.

40 DoDI 5000.02, 2020, p. 9.

41 There is a defense business system–specific option to be added per Section 835, FY21 NDAA.

42 Sean Brady, DoD Senior Lead for Software Acquisition, USD(A&S)/Acquisition Enablers, "DoD's Software Acquisition Pathway, Digital Delivery at the Speed of Relevance, DAU West—Let's Talk Agile," January 6, 2020; Sean Brady, DoD Senior Lead for Software Acquisition, USD(A&S)/Acquisition Enablers, "DoD's Software Acquisition Pathway, Digital Delivery at the Speed of Relevance, First Annual State of the SWP," October 6, 2021; Defense Acquisition University, "Software Acquisition," webpage, undated.

43 DoDI 5000.87, 2020.

44 Defense Acquisition University, "Software Acquisition," webpage, undated.

45 Brady, 2020; Brady, 2021; OUSD(A&S), Office of Acquisition Enablers, "Baseline Software Acquisition Pathway Reporting and Feedback," November 19, 2020a.

46 Derived from Brady, 2020; Brady, 2021, p. 41; OUSD(A&S), Office of Acquisition Enablers, 2020a.

47 Mark V. Arena, Megan McKernan, Julia A. Thompson, and Sydne Newberry, unpublished RAND Corporation research, 2021; Bartels et al., 2020.

48 As of the writing of this report, there were 35 total software acquisition programs in the pathway.

49 DoDI 5000.75, 2020.

50 Derived from DoDI 5000.75, 2020.

51 Drezner et al., 2019.

52 10 U.S. Code Section 2222.: Defense Business Systems: Business Process Reengineering; Enterprise Architecture; Management.

53 Drezner et al., 2019.

54 Defense Acquisition University, "Defense Business Systems (DBS)," webpage, undated; Drezner et al., 2019.

55 DoDI 5000.75, 2020.

56 DAMIR was recently decommissioned and is no longer available; however DAMIR previously was the location for MAIS information.

57 Drezner et al., 2019.

58 10 U.S.C. Section 2222; DoDI 5000.75, 2020; and Defense Acquisition University, "Defense Business Systems (DBS)," webpage, undated.

59 Mark V. Arena, Megan McKernan, Julia A. Thompson, and Sydne Newberry, unpublished RAND Corporation research, 2021; Bartels et al., 2020.

60 According to the GAO, as of FY 2008, DoD had 2,097 business system investments. U.S. Government Accountability Office, *Defense Business Systems: DOD Needs to Continue Improving Guidance and Plans for Effectively Managing Investments*, Washington, D.C., GAO-18-130, April 2018, p. 6.

61 Mark V. Arena, Megan McKernan, Julia A. Thompson, and Sydne Newberry, unpublished RAND Corporation research, 2021; Bartels et al., 2020.

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Defense Acquisition University, "Adaptive Acquisition Framework," webpage, undated. As of March 31, 2022: https://aaf.dau.edu/

Defense Acquisition University, "Defense Business Systems (DBS)," webpage, undated. As of December 13, 2021: https://aaf.dau.edu/aaf/dbs/

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About This Report

One of the more significant changes to the Defense Acquisition System since 2015 is the creation of the Adaptive Acquisition Framework (AAF). Congress initiated these changes through the introduction of the Middle Tier of Acquisition (MTA) and Software Acquisition pathways, which were instantiated in law. DoD then completed the AAF by designing additional pathways to accommodate the diversity of systems and services that DoD acquires. The AAF is intended to create a more tailored process that reflects that diversity. Currently, the AAF has six pathways, all of which are further tailorable to the characteristics of the program.

In light of the above changes, the Office of the Under Secretary of Defense for Acquisition and Sustainment, Office of Acquisition Enablers, asked the RAND Corporation's National Defense Research Institute to identify and assess metrics that could provide insight into the health of the AAF.

The research employs a logic model approach to define metrics that are linked to strategic objectives. This report assumes that the reader is familiar with the DoD AAF and program and portfolio data. This research is a follow-on from prior efforts on issues with access to acquisition data and information in the Department of Defense (Riposo et al., 2015; McKernan et al., 2016; McKernan et al., 2017; McKernan et al., 2018; Drezner et al., 2018; Drezner et al., 2019; Drezner, McKernan, et al., 2020; Drezner, Schmid, et al., 2020; Mark V. Arena, Megan McKernan, Julia A. Thompson, and Sydne Newberry, unpublished RAND Corporation research, 2021).

This report should be of interest to those concerned with defense acquisition performance. The audience is limited mostly to those in government, and we assume that the reader has a basic understanding of defense acquisition and it associated processes.

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