Assessment of Analysis of Alternative Studies in the Department of Defense as Compared to Best Practices

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The estimated cost of this report or study for the Department of Defense is approximately $78,000 for the 2021 Fiscal Year. This includes $0.00 in expenses and $78,000 in DoD labor.

Table of Contents

Preface

Section 832(c)(2) of the National Defense Authorization Act (NDAA) for Fiscal Year (FY) 2020 (Public Law 116-92) requires the Under Secretary of Defense for Acquisition and Sustainment (USD(A&S)) to engage with an independent entity, including under the Program for Acquisition Innovation Research, to assess the conduct analyses of alternatives (AoA). Section 832(c)(2) requires the USD(A&S) to submit a report which includes this assessment, along with a review and assessment of the findings of the assessment. This report satisfies this requirement. Section 832(c)(2) provided that the report should be submitted; no later than one year after the enactment date of the FY2020 NDAA, enacted 23 December 2019. Due to business disruptions associated with the COVID-19 pandemic, the Department required additional time to complete its initial report. An interim response was provided to the congressional armed services committees on January 4, 2021, indicating that the initial report would be submitted at the end of June 2021.

The research presented was conducted from January 2020 to June 2021. This research should be of interest not only to the Office of the Secretary of Defense, but also to stakeholders interested in the Department's efforts on improving the conduct of AoAs.

Executive Summary

Purpose Statement

The purpose of this report is to address requirement subsection c) of section 832 of the FY2020 NDAA: (1) assess the time required to complete AoAs completed during the last five fiscal years, as compared with best practices; (2) provide recommendations and policy options to improve analyses of alternatives; and (3) discuss any other matters as identified by the Under Secretary.

Methodology

This report is informed by literature reviews, collection of AoA report artifacts, an AoA survey questionnaire, and input from Federally Funded Research and Development Centers (FFRDCs). The collection of AoA artifacts provide the time required to complete AoAs. The literature review, survey questionnaire, and FFRDC input inform the comparison of DoD AoAs with industry best practices and improvement recommendations.

Scope and Limitations

The scope of this report is AoAs conducted within the DoD over the past five years. Some limitations of this report are: (1) the limited AoA sample size, particularly when stratified by component; (2) the nine notable best industry practices chosen to review; and, (3) the low response rate to the AoA survey questionnaire.

Significant Findings

Analysis of AoA Collection Tool

- The median time to complete AoAs in DoD over the previous five years is 13 months.
- The Air Force completes AoAs in 10 months, the shortest median time of the Services.
- The Navy takes 14.5 months, the longest median time, to complete AoAs of the Services.

Analysis of AoA Survey Questionnaire

- 43 percent of respondents responsible for conducting AoAs believe they were not provided enough time to complete their AoA.
- 43 percent of respondents responsible for conducting AoAs believe they did not fully understand the baseline capability.
- 71.4 percent of respondents felt that some biasing was a factor when selecting a particular AoA solution.

Recommendations

- Congress and CAPE should provide serious consideration of providing additional time as warranted for individual situations given the median AoA completion time was 13 months and the interquartile range was 10 months for this study period. The Department should use statistical process control methods such as Exponentially Weighted Moving Average (EWMA) control charts to understand the baseline timeframe as well as periodicity to update said baseline.
- The Department should ensure that the baseline capability is understood and introduced prior to conducting an AoA.
- The Department should remove biasing from the AoA process by establishing trade-space boundaries based on mission needs/requirements that are clearly documented prior to choosing an alternative solution.

Introduction

According to Defense Acquisition University (DAU):

> The Analysis of Alternative (AoA) is a documented evaluation of the performance, operational effectiveness, operational suitability, and estimated costs of alternative systems to meet a capability need that has been identified through the Joint Capabilities Integration and Development Systems (JCIDS) process. The AoA assesses the advantages and disadvantages of various materiel alternatives being considered to satisfy the capability need. The AoA also considers the sensitivity of each alternative to possible changes to key assumptions or variables. The AoA is a key input to the process of defining the system capabilities set forth and further refined in the Capability Development Document (CDD). (2011)

Section 832 of the FY20 NDAA, titled "Analysis of Alternatives Pursuant to Material Development Decisions," requires (a) The Secretary of Defense to update AoA guidance, (b) establish reporting requirements for AoAs that could not be completed in the Congressional mandated nine-month period, and (c) for the USD(A&S) to charter an independent entity to provide a report on AoAs that assesses how they are conducted as compared to best practices over the past five years. The Director, Cost Assessment and Program Evaluation (DCAPE) has addressed requirements (a) and (b) of section 832. In this report, the Office of the Under Secretary of Defense (Acquisition and Sustainment) will address requirement (c), assessing AoAs. The Office partnered with the Institute for Defense Analysis (IDA) and RAND to complete the assessment and provide a comprehensive evaluation.

CAPE updated the AoA policy document, DoDI 5000.84, governing AoAs on August 4, 2020. This updated policy was written to codify the changes to the AoA procedures directed by

Congress in section 832 of the FY20 NDAA. The updated DoDI includes the nine month timeline for AoAs as directed by section 832. While not a change from previous AoA policy, the responsibilities of the DCAPE are also stated within the DoDI and are reproduced below.

1) Develops and issues study guidance and approves study plans for the AoAs for MDAPs.
2) Evaluates the adequacy of each AoA for MDAPs.

CAPE does not conduct the AoA analysis nor does CAPE endorse any of the alternatives considered. The thresholds for Major Defense Acquisition Programs (MDAPs) are defined in title 10, U.S. Code § 2430. Any program that does meet these thresholds does not require CAPE oversight.

Research Questions

The following questions provided the baseline for evaluation for the report:

1. What is the median time to complete AoAs in DoD over the past five years (2015-2020)?
2. Is DoD adhering to AoA best practices when conducting AoAs?
3. What recommendations and policies can improve the conduct of AoAs?

Approach and Methodology

Scope

- The scope of this analysis is limited to AoAs conducted over a five-year period, from 2015-2020.
- The core best practices were examined to evaluate the conduct of AoAs in the same five-year period and, after evaluation, deemed most important to inform the scope of this analysis.

Literature Review of AoAs and Best Practices

A literature review of AoA policy and best practices was conducted to inform the final report. The review was used to inform an AoA best practices questionnaire that was disseminated to entities that completed AoAs over the most recent five years, by focusing on the use of the most significant best practices obtained from the literature review. The literature review examined both past and current Department of Defense policies; AoA best practices from the GAO, Air Force, and MITRE's Systems Engineering Guide; and, the Department of Energy's AoA Guide.

AoA Best Practices Survey Questionnaire

Nine survey questions pertaining to AoA best practices deemed most pertinent were compiled based on the literature review of industry best practices, and delivered to individual AoA POCs to complete. The tenth survey question was designed to solicit insight for Congress on recommendations for improving the process of conducting AoAs. The best practices deemed most applicable were:

1. Providing the AoA team with adequate resources, including funding, time, and personnel (GAO, 2016; MITRE, 2014)
2. Ensuring the team understood what the baseline capability was to compare to other alternatives (GAO,2016)
3. Ensuring that biasing toward a particular AoA solution was eliminated (Department of Energy 2018; MITRE, 2014; GAO, 2016; USAF Office of Aerospace Studies, 2016)
4. Ensuring the proper experienced staff were assigned to the AoA team (GAO, 2016)
5. Ensuring that staff levels assigned for each AoA are adequate. (MITRE, 2014)
6. Ensuring a Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel, Facilities and Policy (DOTMLPF) analysis was conducted prior to conducting the AoA (MITRE, 2014)

7. Ensuring that a risk analysis was completed (GAO, 2016)
8. Ensuring that a sensitivity analysis was completed (GAO, 2016)
9. Ensuring that the highest level of AoA was conducted (DOE, 2018; Ullman, 2011)

AoA Report Data Collection

An AoA data collection tool was developed to collect information on which entities conducted AoAs over the past five years, the dates the AoA began and ended, completion times (in months), costs associated with conducting the AoA, what program was attributed to the AoA, the service component associated with the program and AoA, and the AoA points of contact information for each program. The DoD Acquisition Information Repository (AIR) database was queried and the data collection tool was delivered to CAPE to gather the requisite AoA information.

Analysis

An analysis of the inputs from both CAPE and the AIR database to the data collection tool was conducted to inform results that answer the first research question from this report: What is the median time to complete AoAs in the Department of Defense over the most recent five years, dating from 2015-2020? The analysis is descriptive in nature and produces summary statistics tables on the amount of time it takes to complete AoAs. An examination and analysis of the survey results, along with input from FFRDC, informs the second and third research questions.

Limitations

- The Services conduct AoAs without CAPE involvement for non-Major Defense Acquisition Programs (MDAP). This assessment does not include data for non-MDAP AoAs conducted by the Services.

- Twenty five MDAP AoAs were conducted during the period of interest and, although some generalizations can be made from parametric statistical results, not many can be made regarding the stratification by service type using parametric methods.
- CAPE provided 11 points of contact (POC) that conducted the AoAs. A survey on AoA best practices was sent to the 11 POCs. Four responses were received. One respondent provided responses for three unique AoAs under their purview, bringing the total to seven AoAs accounted for in survey responses.
- Additional survey responses were provided by RAND and IDA, a proportionally small sample of responses to inform the overall survey analysis.
- CAPE guidance on AoA policy was updated as of August 4, 2020. Applicable results addressed by the updated policy are further highlighted in the report, as applicable.

Assessment Findings

AoA Completion Time Assessment and Descriptive Statistics (2015-2020)

Table 1 *(Time to Complete Analysis of Alternatives (in Months) (For Most Recent 5 Years))* documents descriptive statistics for 25 AoAs conducted by the Department from 2015-2020. Overall, the median completion times for AoAs conducted by DoD during the timeframe under investigation, as required by Congress, is thirteen months. Both Table 1 and Figure 1 *(Boxplot of Time to Complete AoAs by Service Components)* illustrate that the Air Force, as a stand-alone service, completed AoAs in the shortest duration with a median completion time of ten months. Conversely, the Navy reflects the longest completion time as a stand-alone service with a median completion time of 14.5 months. Figure 2, *Histogram of Time to Complete AoAs*, illustrates the distribution of AoA completion times. While a generally small sample size, it reflects the initial evaluation of Services current time to complete and can serve as a meaningful representation of the

variation in programs being evaluated within each Service, number of programs completing AoAs, and the disparity over time.

Table 1. Time to Complete Analysis of Alternatives (in Months) (For Most Recent 5 Years)

Component	N	Min	Q1	Median	Mean	Standard Deviation	Q3	Max
Air Force	7	6.0	9.5	10.0	14.6	7.9	19.5	28.0
Air Force, Navy	1	16.0	16.0	16.0	16.0	NA	16.0	16.0
Army	9	4.0	11.0	13.0	17.0	11.5	25.0	36.0
Army, USMC, SOCOM	1	21.0	21.0	21.0	21.0	NA	21.0	21.0
Navy	4	3.0	10.5	14.5	17.2	14.3	21.2	37.0
Space Force	1	12.0	12.0	12.0	12.0	NA	12.0	12.0
USAF, USN	1	9.0	9.0	9.0	9.0	NA	9.0	9.0
USMC	1	11.0	11.0	11.0	11.0	NA	11.0	11.0
All DoD	**25**	**3.0**	**10.0**	**13.0**	**15.7**	**9.6**	**20.0**	**37.0**

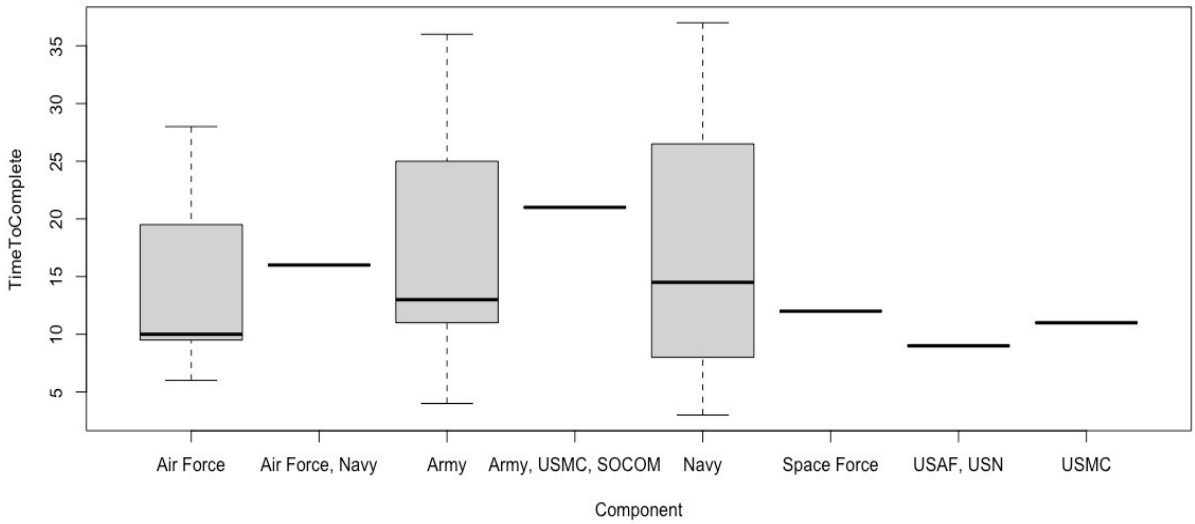

Figure 1. Boxplot of Time to Complete AoAs by Service Component

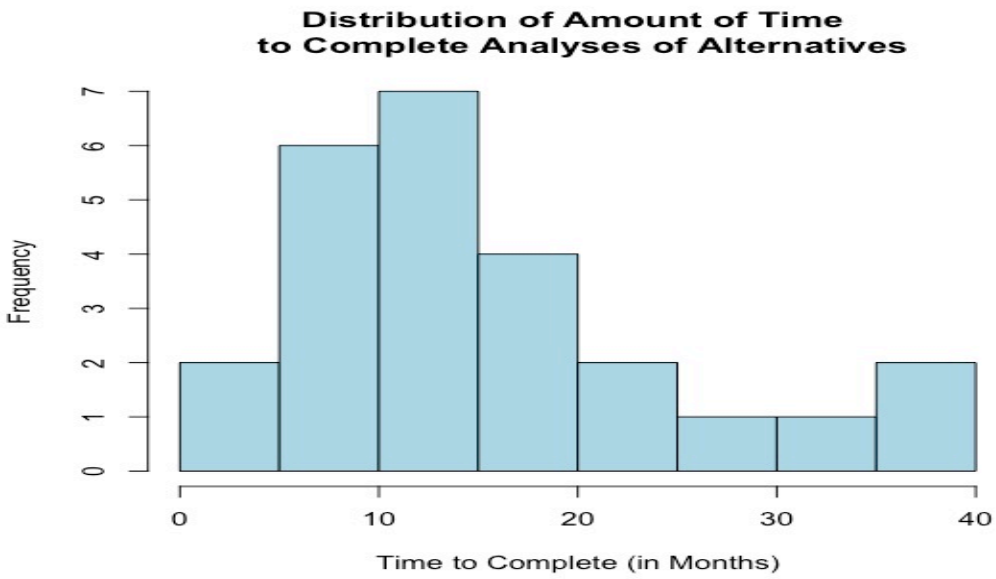

Figure 2. Histogram of Time to Complete AoAs

Cost to Conduct AoAs

Data was available for two programs regarding the total cost to conduct an AoA study. Based on information reviewed, the range of costs is between $300,000 and $1,900,000. The AoA completion time of six months is attributed to the lower cost and the AoA completion time of 25 months is attributed to higher cost. CAPE noted that each Service conducts AoAs differently. The Army and Marine Corps tends to do their analysis in-house, the Air Force typically outsources the analysis, the Navy does both in-house and outsource analysis. This preference can significantly impact the cost of the analysis.

Analysis of Results from the AoA Survey Questionnaire (Appendix A)

Question one addressed the availability of resources to complete an AoA. As pertains to funding, 85 percent of respondents indicated they felt they received adequate funding, though some indicated it was necessary to lobby for additional funding in order to successfully complete. The same percentage indicated that they felt they were appropriately staffed with personnel, with several respondents indicating that the correct amount of personnel was granted during execution of the

AoA though not found prior to beginning execution. While there were promising results as related to funding and personnel, just over half responded favorably that they were provided sufficient time to conduct and complete the AoA. Of the fifty-seven percent of favorable responses, some stated that the scope, depth, and breadth of the studies involved greater complexity than originally expected. This can be attributed to the lack of accurate foundational work being done prior to the initiation of the AoA, directly resulting in an impact on funding and personnel challenges.

Question two reflects that just over half of respondents, 57 percent, felt that they fully understood the baseline capability before conducting the AoA.

Nearly three-quarters of respondents felt as though bias played a role in selection of a particular AoA solution, with 71.4 percent responding to question three that they believe this was the case. Nearly half of respondents, 42.8 percent, felt as though they were biased toward an alternative solution by stakeholders, while an equal number of respondents, 28.6 felt as though they were not biased toward a particular alternative solution or were partially biased toward a particular solution, respectively.

In an effort to gain a better understanding of the team's level of experience conducting the AoA, the following was reflected in the survey results for question 4: The average minimum experience for the AoA team was eight years; the average team had 17.8 years of experience among team members; the median years of experience on an AoA team is 19.3 years; and, the average maximum years of experience on AoA teams surveyed was 20.5 years. Results from question five indicate that, on average, 20 personnel were assigned to the AoA team, though there was a case where there were 200 personnel assigned. Some of those 200 individuals may have been part time staff.

Every respondent indicated that the elements of the DOTMLPF analysis was conducted at some point during the AoA (Question six); however, 42.9 percent of respondents stated that this

analysis occurs during the AoA, and not prior to the execution of the AoA. Every participant also responded that a risk analysis was conducted as part of the AoA (Question seven), along with a sensitivity analysis (Question eight).

Nearly three quarters of respondents, 71.4 percent, responded to question 9 that they were not aware of the level of AoA that was produced; however, 28.6 percent stated that they conducted AoAs at level three or above.

Survey question 10 was designed to specifically address Congress' requirement to collect recommendations and policy options to improve the AoA process. Respondents provided responses to the possibilities for improving AoAs (Table 2: *Survey Response Feedback on How to Improve AoAs).*

Table 2. Survey Response Feedback on How to Improve AoAs

1. Create AoA templates.
2. Create a Security Classification Guide. Security Classification Guides for the proposed environment as a requirement of the AoA process, especially in light of the SECDEF Memo for the NC3 Umbrella Classification Guidance, will ensure protection of information at the highest levels from inception of the program.
3. Intellectual capital investment at the beginning and throughout the requirements generation process is the primary area that could use additional attention.
4. The JCIDS process works; however, it is often disregarded because it is difficult and the incentive structure does not elicit required behavior.
5. The CBA/ICD/AoA process should be conducted by someone who is present throughout the entire process to ensure continuity.
6. Do not fund a program before an AoA is started. Doing so incentivizes poor behavior.
7. Ensure complete understanding of the question being asked is.
8. Ensure complete understanding of what the actual decision is to be made.
9. Ensure complete understanding of what information the decision-maker needs in order to make said decision.
10. Ensure complete understanding of the decision-makers value stream and relative relational values.
11. Establish a stakeholder group (to include the frozen middle) that understands and desires insight into value, opportunity costs, investment costs, returns on investment, opportunity costs, operational risks, programmatic risks and how that relates to balancing the decision to be made with data available.
12. Provide authority to execute without consistent appeals for permission in order to gather relevant data in a world where almost all are very reluctant to "share"/provide.

13. Create a Counter Space Protection Policy.
14. In some cases, interaction with sponsors has been limited to formal SAGs. Recommend opportunities for informal feedback throughout study to address concerns earlier and more fully.
15. In cases where the AoA provider is directly engaging with industry, industry should have clear guidance from the government on what they are allowed to provide and what is covered by NDAs.
16. There are always changes throughout the study and there will inevitably be changes in assumptions/approaches from what is outlined in the study plan. There should be clear guidance on capturing/documenting changes (Does the study plan need to be updated and/or re-approved based on any changes in the analysis? What level of change constitutes an update?).

Significant Findings on AoAs

In response to the request by OUSD(A&S) for information on AoAs and policies to improve them, IDA provided observations from their experience and knowledge on the topic, as well as a recent study, *Improving the Quality and Use of Analysts and Analytics in the Department of Defense*, by Levine et al. (2020):

- A reasonable set of alternatives was pursued in only half of the analyses. In the other half, the alternatives analyzed were declared a priority to be the best candidates without the more rigorous comparisons that the AoA itself should provide.
- Study scoping matters. An overly broad scope can lead to an analysis that produces nothing useful.
- Requirements should inform an AoA but not unduly constrain it. Sometimes the best result is found by slightly relaxing a requirement.
- Unreasonable assumptions and constraints were not uncommon and were sometimes used to confine the outcomes to a set of pre-determined solutions.
- Large group analyses (including joint analyses) can be problematic. Conclusions can be diluted when trying to accommodate all competing stakeholder interests.

- Inappropriate analytical methodologies were used in numerous analyses, such as an over-reliance on optimization models.
- Results and recommendations were supported by analysis in only about half of the studies. Some studies presented unsubstantiated conclusions that were only loosely connected to the analyses or even at odds with them.
- Shortcomings of AoAs include:
    - Failure to include the "do nothing" option/baseline in the set of alternatives evaluated.
    - Failure to include the full range of materiel and non-materiel alternatives, such as:
        - Improperly screening out unpopular feasible alternatives prior to analysis
        - Including infeasible (e.g., unaffordable or technically immature) alternatives
    - Failure to explicitly include all relevant stakeholder values in the selection criteria.
    - Failure to adequately characterize the risks and uncertainty associated with each alternative to help decision makers differentiate between alternatives, including:
        - Cost risk
        - Schedule risk
        - Technology maturity risk
        - Acquisition risk (e.g. funding priority, advocacy, organizational skills, etc.).
    - Failure to quantify the tradeoffs associated with choosing one alternative over another.
    - Using selection criteria that overlap significantly, leading to double-counting.
    - Failure to consider resource constraints (e.g. infrastructure, facilities, skilled labor, materials).
    - Treating separable decisions as a single AoA.
    - Failure to consider resource constraints (e.g. infrastructure, facilities, skilled labor, materials).

IDA contends that both the AoA timeline and access to the appropriate data within this timeline are critical elements to a successful AoA. Specifically, some AoAs suffered from unrealistic time constraints. Time is needed for conceptualization, data collection and difference resolutions, model creation and testing, reflection and debate on results, as well as time to conduct "what if ...?" excursions. AoAs should be started and completed as early as possible within a program's acquisition timeline in order to inform requirements rather than being informed by them. OSD should provide guidance for AoA content as early as possible, such as before advocates have the opportunity to obtain leadership commitments to a particular approach absent rigorous analysis. IDA's experience is at least 12 months should be anticipated for AoA completion. Contentious acquisitions require even longer.

Second, access to sound data is critical, and time should be allowed to gain such access. Data that is either withheld or cannot be found can lead to informed guesses rather than objective analysis, ultimately potentially undermining the AoA's conclusions. Thus, the Services and DoD agencies must be required to comply with requests for data. Directive language pertaining to this should require a response within one month. If the timeframe cannot be met, an explanation from the DoD source office justifying why more time is required or why the data cannot be provided should be submitted. Both recommended responses will allow the analysts to quickly pivot to a new approach if the data is not forthcoming.

Finally, time is needed to obtain special access clearances for AoAs involving SCI material. The Services and OSD must be directed to accelerate clearances for AoAs in order to both provide adequate time to read in selected analysts and provide for acquisition and certification of special computers required for the task.

IDA further stated that objectivity is critical for AoAs to satisfy three criteria: they (1) used reasonable alternatives, (2) made appropriate assumptions and constraints, and (3) supported their recommendations by analyses. According to the Levine et. al. (2020) IDA sponsored study on AoAs:

> The IDA team assessed that conducting objective, unbiased AoAs remains a challenge for the Department. The team saw cases in which an AoA appeared to be constrained to endorse the extant service position rather than objectively assessing a reasonable range of realistic alternatives. Some AoAs eliminated feasible alternatives that did not satisfy 100% of extant requirements, while others recommended a solution despite the fact that it did not satisfy all approved requirements, which created at least the appearance that the analysis was distorted in an effort to advance a preferred alternative

Conclusions and Recommendations

Based on results of analysis of AoA best practices from this report, AoAs conducted in DoD over the previous five years, from 2015 to 2020, were found to be adhering to 66 percent of the most crucial best practices outlined by the GAO's "Best Practices for the Analysis of Alternatives Process," MITRE's "System Engineering Guide," and the Air Force's "Analysis of Alternatives Handbook."

There are three key problems areas that it is recommended the Department of Defense focus attention: (1) the amount of time allotted to conducting AoAs to successful completion; (2) ensuring that the baseline capability is fully understood prior to conducting the AoA; and, (3) ensuring that AoA alternative biases in the solution process are eliminated.

Best Practice Problem Area 1: Allotted to Complete AoAs

The median time to complete AoAs in the Department over the previous five years currently under review for this study is thirteen months. Recently, Congress implemented guidance that AoAs be completed within nine months (FY2020 NDAA section 832). In their updated AoA policy, CAPE complied with Congress and set the requirement for AoA completion time at nine months, implemented in Department of Defense Instruction (DoDI) 5000.84, "Analysis of Alternatives," published August 4, 2020. Experience recommends that AoAs be afforded at least 12 months for completion and additional time for more contentious acquisition situations. Additionally, based on survey responses 43 percent of respondents believe that they were not offered appropriate amounts of time to complete AoAs, as well as some being too complex to be completed within a nine-month time frame. A strict nine-month completion requirement may limit the success of the program.

Problem Area 1 Recommendation

OUSD(A&S) recommends Congress and CAPE provide serious consideration of providing additional time as warranted for individual situations given the median AoA completion time of 13 months and interquartile range of 10 months in this study. Additionally, AoA completion times should be reassessed in five year increments, or at an alternative periodicity deemed sufficient by CAPE, in consultation with Congress, as well as alignment with the AoA process as per lean six sigma best practices of process improvement. Specifically, since conducting AoAs is an intensive process, statistical process control methods should be implemented to establish a baseline and identify cases that are out of upper limit process intervals and determine the reasoning. Montgomery (2008) states that an Exponentially Weighted Moving Average (EWMA) statistical process control chart may be a method to monitor AoA completion times. An EWMA weighs recent AoA completion times more heavily than older ones. The EWMA control chart can inform

Department of Defense leadership if the process of conducting AoAs is getting improving or worsening, and inform policy changes for updating AoA completion times.

Best Practice Problem Area 2: Baseline Capability

DOE (2018) states that if the baseline capability is not understood and examined, possible implications include no benchmark for comparison, thus allowing arbitrary comparisons between alternatives and hindering the credibility of the study. From the Levine et al. (2020) study in AoAs, IDA found that DoD often lacks including the baseline/"do nothing" capability as an alternative solution. This is represented by the 42 percent of survey respondents who believe that lack of baseline capability understanding was an issue when conducting their specific AoA.

Problem Area 2 Recommendation

The Department of Defense must ensure that the baseline capability is included and fully understood prior to conducting future AoAs. CAPE also recommends that Services follow updated AoA guidance in DoDI 5000.84 dated August 4, 2020 to ensure that the baseline capability is included and fully understood as an alternative solution. The DoDI states, "At minimum, the study guidance will require: One alternative that represents the status quo and sufficient additional alternatives to enable a robust exploration of the trade-space."

Best Practice Problem Area 3: Biasing in AoA Solution Selection Process

Biasing toward a particular AoA solution is frequently problematic, as reported by 71 percent of survey respondents when conducting their specific AoA. IDA researchers found similar results, which reflected that 50 percent of AoAs under review contained biasing toward a predisposed solution. Biasing may result in the most applicable and viable solution is not chosen and an inferior solution is chosen due to influential biased voices having significant input.

Problem Area 3 Recommendation

It is strongly recommended that the Department of Defense implements a process where biasing in the alternative solution is removed from the process as much as possible. DOE (2018) states that this can be accomplished using selection criteria based on mission needs/requirements which are clearly documented prior to choosing an alternative solution. As stated in their report, "an unbiased AoA process ensures that the AoA is not conducted with a predisposition toward one alternative over others; it is performed independent of the contractor responsible for executing the project, and based on traceable and verified information."

Survey Responses to Further Improve AoAs

Entities conducting AoAs have great insight into what worked, what did not, and how the AoA process can be improved. Creating an AoA after action report/suggestion box where participants of AoAs can provide feedback may be prudent. For example, based on the responses to the AoA survey conducted, potential opportunities for improving AoAs may be to:

1. Create a security classification guide;
2. Ensure that there are dedicated personnel throughout the process;
3. Do not fund a program until the AoA begins;
4. Give the AoA team the authority necessary to gather data from various entities that house the data to foster information sharing that ultimately results in a better AoA;
5. Allow for informal interaction vice strictly formal interaction between those conducting the AoAs and the sponsors to allow discussion and address concerns earlier in the AoA process; and,
6. Ensure clear guidance is provided on capturing/documenting changes to the AoA.

Appendices

A. AoA Survey Questionnaire Document

Analysis of Alternatives Questionnaire

Organization_____ POC_____ Telephone_____

E-Mail_____ Name of Program_____

1. Were you provided adequate resources to successfully complete the Analysis of Alternatives?
    a. Funding?
    b. Personnel?
    c. Time?
2. Did you fully understand the baseline capability before conducting the AoA?
3. Do you feel that you were biased toward a particular AoA alternative solution?
4. What was the level of experience of the SME staff conducting the AoA?
    a. Minimum years of experience?
    b. Mean years of experience?
    c. Median years of experience?
    d. Maximum years of experience?
5. What was the total number of staff assigned to the AoA team?
6. Was a DOTMLPF analysis conducted prior to/as part of the AoA?
7. Was risk analysis incorporated in the AoA?
8. Was sensitivity analysis conducted as part of the AoA?
9. What level of AoA was produced (level 3 or 4)
10. What additional guidance in policy do you feel would be helpful in successfully completing AoAs?

B. AoAs Reviewed for this Report

Table 3. List of AoAs Reviewed in Levine Study

AoA	Organization
C-17	IDA
AC-130 Weapons	IDA
Mark VI	IDA
Next Gen Gunship	RAND
GCV[1]	Army
OASuW	Navy
T-AO(X)	CAN
JWARN	Army
SBEM	Air Force
DCGS (Navy-2)	RAND
Next Gen Chem Detector	Army
JCREW	IDA
Wideband Comms	OSD/A&S & USAF
AEA	USAF
F-15 EPAWSS	USAF

Table 4. AoAs Reviewed in the Scope of this Study

Program	Component	Study Lead	Study Performer
Next Generation Air Dominance (NGAD)	Navy	Navy	Navy
Lower Tier Air and Missile Defense - Sensor	Army	Army	TRAC
Unified Platform	Air Force	AFSPC/A5C	AFSPC/A5C
Future Vertical Lift CS3	Army, USMC, SOCOM	TRAC	Army
Wideband Communications Services	Air Force	OUSD(AT&L) & PDSA	Air Force
Next Generation Air Dominance (NGAD)	Air Force	Air Force	Air Force
Offensive Anti-Surface Weapon (OASuW) AoA Update	Navy	Navy (NAVAIR)	Navy / JHU-APL
Next Gen Strike Weapon (NGSW)	Air Force, Navy	Air Force	Air Force (ACC)
Dominating Mobility Through Terrain Shaping and Engagement Inc. 1	Army	TRAC	Army
Long Range Precision Fires	Army	TRAC	Army
SOF UCI	Navy	USSOCOM	RAND
Enhanced Heavy Equipment Transporter System (EHETS)	Army	TRAC	Army
SBIRS Follow-on AoA	Space Force	AFSPC/A5F	Air Force
B-52 Radar Modernization Program	Air Force	AFGSC	Air Force
Advanced Reconnaissance Vehicle	USMC	CD&I	USMC
AF Advanced Battle Management System	Air Force	Air Force	ACC
ISPAN MPAS Inc. 5	Air Force	USSSTRATCOM/JFCC GS	USSSTRATCOM/JFCC GS
Joint TACAIR Synthetic Training	USAF, USN	USAF	AFAMS
F-22 Sensor Enhancements AoA	Air Force	Air Force	Air Force
Mobile Protected Firepower	Army	TRAC	Army
Future Surface Combatant Forces	Navy	N96	SPA
Army Training Information System (ATIS)	Army	Army Training Support Center	Army
Biometrics Enabling Capability (BEC)	Army	Army Material Systems Analysis Activity	Army
Next Generation Biometrics Collection Capability (NXGBCC)	Army	Army Material Systems Analysis Activity	Army
Mobile Protected Firepower (MPF)	Army	TRADOC Analysis Center	Army

[1] Ground Combat Vehicle (GCV) is only program from the Levine et al. (2020) study that is part of the scope of this report. The IDA team found that there was biasing toward the service position rather than an objective assessment of the other alternative solutions.

C. List of Illustrations

Figures

Tables

D. List of Acronyms

ADA	Acquisition Data Analytics
AEA	Airborne Electronic Attack
AIR	Acquisition Information Repository
AoA	Analysis of Alternatives
CAPE	Cost Assessment and Program Evaluation
CBA	Cost Benefit Analysis
CDD	Capability Development Document
DCAPE	Director, Cost Assessment and Program Evaluation
DCGS	Distributed Common Ground System
DoD	Department of Defense
DOE	Department of Energy
DOTMLPF	Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel, Facilities and Policy
EWMA	Exponentially Weighted Moving Average
EPAWSS	Eagle passive/Active Warning and Survivability
FFRDC	Federally Funded Research and Development Center
GAO	Government Accountability Office
GCV	Ground Combat Vehicle
ICD	Initial Capabilities Document
IDA	Institute for Defense Analysis
ISPAN	Integrated Strategic Planning and Analysis Network
JCIDS	Joint Capabilities Integration and Development Systems
JCREW	Joint Counter Radio Controlled Improvised Explosive
JWARN	Joint Warning and Reporting Network
NC3	Nuclear Command Control and Communications
NDA	Non-Disclosure Agreement
NDAA	National Defense Authorization Act

OASuW	Offensive Anti-Surface Warfare
OSD	Office of the Secretary of Defense
OUSD(A&S)	Office of the Under Secretary of Defense for Acquisition and Sustainment
POC	Point of Contact
SAG	Study Advisory Group
SBEM	Space Based Environmental Monitoring
SBIRS	Space Based Infrared System
SECDEF	Secretary of Defense
SOF UCI	Special Operations Force Undersea Clandestine Insertion
TACAIR	Tactical Air Command
USAF	United State Air Force
USD(A&S)	Under Secretary of Defense for Acquisition and Sustainment

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