

**NOT  
MEASUREMENT  
SENSITIVE**

**DOE G 413.3-22  
6-6-2018**

## **Analysis of Alternatives Guide**

*[This Guide describes suggested nonmandatory approaches for meeting requirements. Guides are not requirements documents and are not to be construed as requirements in any audit or appraisal for compliance with the parent Policy, Order, Notice, or Manual.]*

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**U.S. Department of Energy**  
**Washington, D.C. 20585**

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**INITIATED BY:**  
**Office of Project Management**



## FOREWORD

This Department of Energy (DOE) Guide is for use by all DOE elements. This Guide assists individuals and teams in conducting Analysis of Alternatives (AoA) for capital asset projects and programs consistent with published Government Accountability Office (GAO) best practices (see GAO report GAO-16-22, *Amphibious Combat Vehicle, Some Acquisition Activities Demonstrate Best Practices; Attainment of Amphibious Capability to be Determined, Appendix I*, dated October 2015).<sup>1</sup> The suggested DOE tailored process uses a systems engineering methodology that integrates requirements analysis based on mission need, identification and analysis of alternatives, risk identification and analysis, and concept exploration in order to evolve a cost effective, preferred alternative to meet a mission need.

DOE Guides are part of the DOE Directives Program and are issued to provide supplemental information and additional guidance regarding the Department's expectations of its requirements as contained in rules, Orders, Notices, and regulatory standards. Guides may also provide acceptable methods for implementing these requirements, but are not prescriptive by nature. Guides are neither substitutes for requirements, nor do they replace technical standards that are used to describe established practices and procedures for implementing requirements. Send citations of errors, omissions, ambiguities, and contradictions found in this guide to [PMpolicy@hq.doe.gov](mailto:PMpolicy@hq.doe.gov).

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<sup>1</sup> This GAO-16-22 publication updates and supersedes the AoA best practices previously listed in GAO-15-37, *DOE and NNSA Project Management; Analysis of Alternatives Could be Improved by Incorporating Best Practices*, dated December 2014. This guide will follow the best practices recommended by GAO-16-22.



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## 1.0 INTRODUCTION

### 1.1 Purpose

An Analysis of Alternatives (AoA) is an important element of the Department of Energy's (DOE) requirements and acquisition process. The overall goal is to improve project management by ensuring the identification and analysis of feasible solutions to mission needs, or capability gaps, prior to making costly investment decisions. As such, DOE O 413.3B requires that an independent AoA be conducted<sup>2</sup> prior to Critical Decision (CD)-1 and recommends that it be consistent with best practices identified by the GAO, which is outlined in their latest report GAO-16-22.<sup>3</sup> This guide describes how GAO's recommended AoA best practices are implemented into DOE O 413.3B. It should be noted that GAO recognizes that "these practices can provide a framework to help ensure that entities consistently and reliably select the best alternative that best meets mission needs." The guidance below is meant as an overview of the key principles that lead to a successful AoA process and not as a "how to" guide with detailed instructions for each best practice identified.<sup>4</sup>

The AoA is an analytical comparison of the operational effectiveness, suitability, risk, and life cycle cost (or total ownership cost, if applicable) of alternatives that satisfy validated capability needs.<sup>5</sup> AoAs are not decisional documents, but are inputs that may be used by Program Secretarial Offices to recommend a preferred alternative. AoAs also help Federal Project Directors (FPDs) and Project Management Executives (PMEs) determine the most effective approach for achieving the technical and functional requirements associated with a specific mission need within the constraints provided. The AoA process is a critical step in the project planning and approval process and is not a substitute for an Acquisition Plan as required by the Federal Acquisition Regulation once an alternative has been selected. AoAs are conducted as part of the DOE systems engineering methodology that integrates requirement analysis, alternative analysis, risk identification and analysis (including application-specific technical maturity, safety, security, health, and environmental considerations), acquisition strategies, and concept exploration in order to determine a preferred solution to meet a mission need.<sup>6</sup>

DOE O 413.3B requires that the responsible program office shall conduct an AoA that is **independent of the contractor organization responsible for managing the construction or constructing the capital asset project**. The AoA will be conducted for projects with an estimated Total Project Cost (TPC) greater than \$50M prior to approval of CD-1, *Approve Alternative Selection and Cost Range*, and may also be conducted when a performance baseline deviation occurs or if new technologies or solutions become available. This determination will be made by the PME. The AoA should be consistent with published GAO best practices, as delineated in GAO-16-22.

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<sup>2</sup> DOE O 413.3B, *Program and Project Management for the Acquisition of Capital Assets*, Appendix A, Table 2.1; and DOE G 413.3-13, *DOE Acquisition Strategy Guide for Capital Asset Projects*.

<sup>3</sup> DOE O 413.3B refers to AoA best practices in GAO-15-37, dated December 2014; since then, the GAO best practices for AoA have been superseded by GAO-16-22, dated October 2015.

<sup>4</sup> GAO-16-22, *Amphibious Combat Vehicle, Some Acquisitions Activities Demonstrate Best Practices; Attainment of Amphibious Capability to be Determined*, Appendix 1, dated October 2015.

<sup>5</sup> DoD Air Force Aerospace Studies, *Analysis of Alternative (AoA) Handbook*, June 2013.

<sup>6</sup> DOE O 413.3B, Appendix A, Section 4.b.

There are many similarities between AoAs and the Feasibility Studies or other reviews that are conducted as appropriate, in accordance with Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Resource Conservation and Recovery Act (RCRA), and National Environmental Policy Act (NEPA) before a decision is made (e.g., selection of a remedial action). The AoA best practices outlined in this guide are relevant and should be incorporated into the CERCLA, RCRA, and NEPA processes as applicable. AoAs performed in order to meet the requirements of CERCLA and RCRA will be accepted as satisfying the requirements for an independent AoA.

DOE programs may use this guide directly or to assist in the development of their own AoA Process Guides, Manuals, or Handbooks tailored to their particular technologies and processes. A program-specific AoA Guide, Manual, or Handbook should take precedence over this Guide when conducting a review of an AoA for projects under that specific program. While Programs developing their own guides, manuals and handbooks is a reasonable practice, the ultimate authority for the conduct of an AoA should be the PME or the Program Secretarial Officer (PSO) approved in the Preliminary Project Execution Plan (PPEP).

## **1.2 Applicability**

This guide is for use by all DOE elements. This guide should assist individuals and teams involved in conducting AoAs. For DOE capital asset projects subject to DOE O 413.3B, this guide is especially useful to DOE program and project managers.

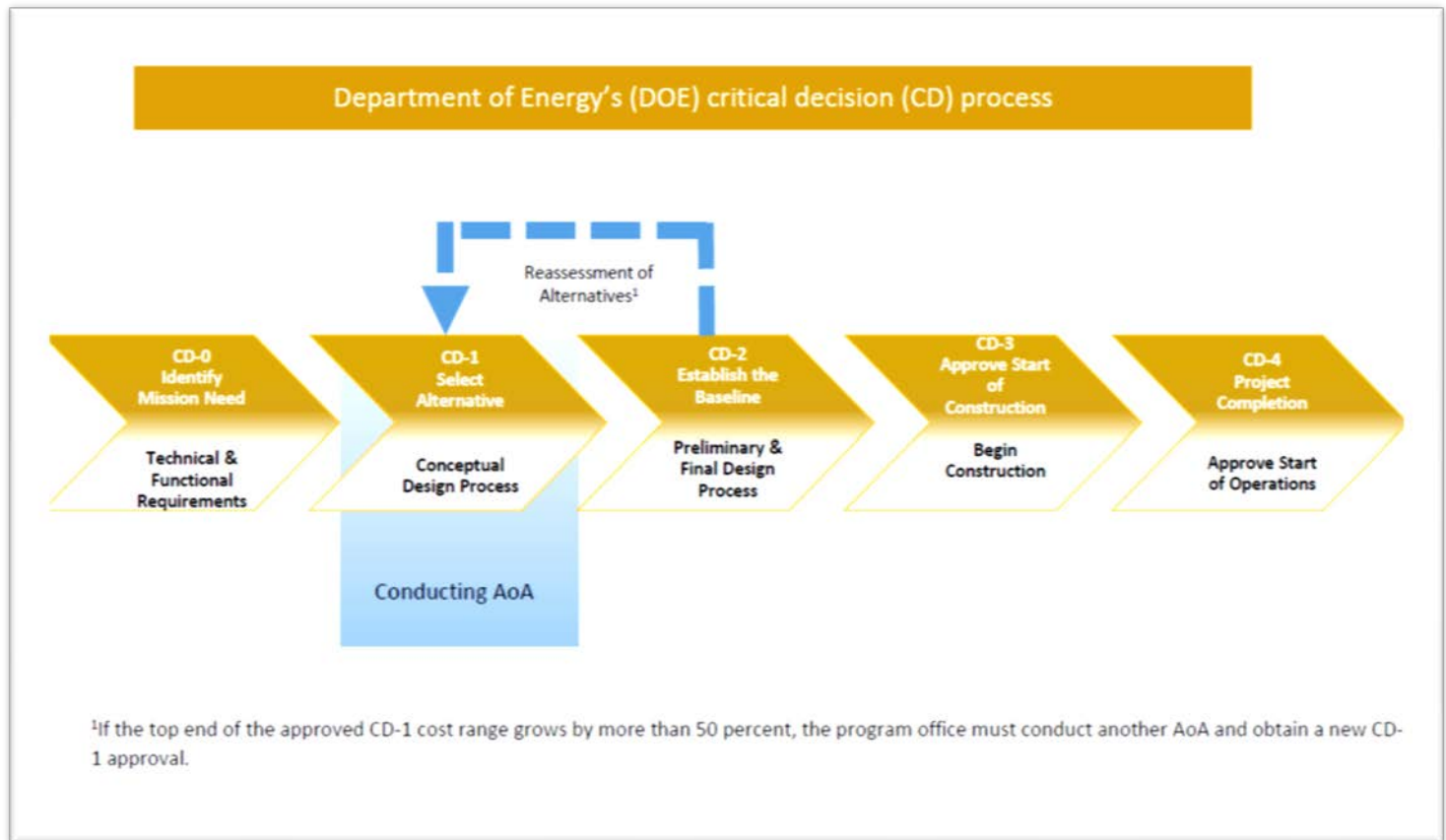
## **1.3 AoA and the DOE Acquisition Management Process**

An AoA is part of the DOE Acquisition Management Process for capital asset projects. See Figure 1 for an illustration of how the AoA plays an important role in the DOE critical decision process, specifically for implementing the requirement for the responsible program office to conduct an AoA that is independent of the contractor organization responsible for managing the construction or constructing the capital asset project prior to CD-1; and as applicable, when a performance baseline deviation occurs, or when new technologies or solutions become available as determined by the PME.

This guide advocates a uniform and documented process consistent with the 22 criteria of best practices identified in the GAO-16-22 report. Emphasis is made on frequent and open communication in the AoA process both to understand what the senior decision makers need and to convey what the analysis uncovers. This guide advocates a sound analytical process rather than specific tools. Detailed analytical tools are often necessary for key parts of the AoA, but it is often more practical to adhere to simpler approaches such as parametric analysis and requirements gathering. The complexity of the AoA depends on the project cost, risks, geographical location, and technological complexity (nuclear vs. non-nuclear, or hazardous vs. non-hazardous). The key is to lay down early the key requirements and assumptions for selection of the best alternative and following a process that avoids the pitfalls of biased analysis.



The recommended DOE AoA process, which is based on and adapted from the GAO best practices, is discussed in detail in Section 2.0 of this guide<sup>7</sup>. However, it should be emphasized that the AoA process does not stand alone but is an important step of the overall DOE Systems Engineering Process<sup>8</sup> that integrates requirement analysis based on problem definition/mission need (which also should be verified and validated), function and requirements analysis, alternative analysis, risk identification and analysis (including application-specific technical maturity, safety, security, health and environmental considerations), acquisition strategies, and concept exploration in order to evolve a cost effective, preferred solution to meet a mission need.



Source: DOE O 413.3B

**Figure 1. Conducting AoA as Part of the DOE's Acquisition Management Process for Capital Asset Projects**

<sup>7</sup> For direct comparison of the DOE adapted AoA process to the GAO AoA process, as described in GAO-22-16, see Appendix C.

<sup>8</sup> References: DOE O 413.3B, DOE G 413.3-1, *Managing Design and Construction Using Systems Engineering for Use with DOE O 413.3B*, and DOE G 413.3-13, *DOE Acquisition Strategy Guide for Capital Asset Projects*.

## **Systems Engineering**

The DOE Systems Engineering Process is a comprehensive, iterative problem solving process that is used to:

- Transform validated customer needs and requirements into a life-cycle balanced solution set of system product and process designs;
- generate information for decision-makers; and
- provide information for the next acquisition phase.

The problem (the gap in the mission need) and success criteria are defined through requirement analysis, functional analysis/allocation, and system analysis and control.

Alternative solutions, evaluation of those alternatives, selection of the best life-cycle balanced solution, and the description of the solution, through the design package are accomplished through synthesis and system analysis and control. This guide emphasizes the AoA process, within the framework of DOE O 413.3B, as adapted from the GAO-16-22 best practices to support CD-1 as shown in Figure 1. DOE programs should conduct early systems engineering analysis when selecting alternatives prior to CD-1 to provide an assessment of whether the proposed candidate materiel solution approaches are technically feasible and have the potential to effectively address capability gaps, desired operational attributes, and associated external dependencies.

## **2.0 OVERVIEW OF THE DOE AOA PROCESS**

This section presents a sequential process consistent with the GAO-16-22 best practices for identifying alternatives, analyzing alternative and selecting the preferred alternative. The GAO best practices add consistency and reliability to the overall process.

### **2.1 GAO Characteristics of High-Quality AoA**

The GAO has identified four characteristics that help identify high-quality, reliable AoA. The AoA should be **well-documented, comprehensive, unbiased, and credible**. By well-documented it is meant that the AoA process is thoroughly described in the relevant documents (e.g., the AoA Study Plan and Final AoA Report), which collectively should include as applicable: the data sources used, reliability of the data, stated assumptions, clearly detailed methodologies, sufficiently detailed calculations and results, as well as explanations for evaluation criteria. An AoA is comprehensive if the AoA process is predicated on a mission need statement that is well defined (i.e., CD-0 requirements in DOE 413.3B), but independent of any particular solution such that a robust set of alternatives can be considered, with no viable alternatives omitted and that each alternative is examined thoroughly for the project's entire expected life-cycle. 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. As for credibility, this requires that the AoA process thoroughly discusses the limitations of the analysis resulting from the uncertainty that surrounds both the data and the assumptions for each

alternative. This is often supported through uncertainty analyses on assumptions, criteria weighting, etc., that are included as part of the AoA documentation.

## 2.2 Adaptation of the GAO-16-22 Best Practices for DOE AoAs

The GAO-16-22 best practices can be applied to a broad range of capability areas, projects, and programs in which an alternative should be selected from a set of possible options. These best practices can provide a framework to help entities select the project alternatives that best meet mission needs. However, the structure, terminology, and use of those best practices will be dependent on the project management framework in which they are applied. For the acquisition of capital assets in the DOE, this is provided in DOE O 413.3B and its related guides. The following describes how the 22 AoA best practices defined by GAO are implemented by the Department.

The best practices, as adapted by DOE, are grouped into six sequential phases, the first of which occurs prior to initiation of the formal AoA process (refer to Appendix C for comparison to the overall five-phase process as described by GAO):

1. **Pre-AoA process – CD-0, Approve Mission Need:** includes best practices that are applied before starting the AoA process of identifying, analyzing, and selecting alternatives. This includes determining the mission need and functional requirements, which are part of the DOE O 413.3B CD-0 requirements for capital asset projects. For DOE capital asset projects, AoA should not begin until after CD-0 approval.
2. **Initialize the Formal AoA process:** includes best practices that develop the study time frame, create a study plan, and determine who conducts the analysis. Deliverables in this phase should be an AoA Charter, which may include a Study Guidance Document, initializing the planning process, selection of the AoA team who will conduct the AoA, and the AoA Study Plan with resources and schedule.
3. **Identify alternatives:** includes best practices that help ensure the alternatives to be analyzed are sufficient, diverse, and viable.
4. **Analyze alternatives:** includes best practices that compare the alternatives to be analyzed. The best practices in this category help ensure that the team conducting the analysis use standard quantitative and, when appropriate, qualitative processes to assess the alternatives.
5. **Document and review the AoA process:** includes best practices that would be applied throughout the AoA process, such as documenting all steps taken to initialize, identify, and analyze alternatives and to select a preferred alternative in a single document. This phase includes an **independent review** of the AoA process by a team or organization independent of the proponent program office and the project's chain of command to validate the analytical quality and process of the AoA. This process verifies that the AoA adequately reflects the program's mission needs and provides a reasonable assessment of

the cost and benefits associated with the alternatives. The main deliverable in this phase should be the AoA Final Report validated by the independent review team.

6. **Select a preferred alternative:** includes a best practice that is applied by the decision maker to compare alternatives and to select a preferred alternative. The decision maker (the Project Management Executive) reviews the alternatives presented in the validated AoA Final Report and chooses the preferred alternative.

Being consistent with the 22 best practices for an AoA listed in GAO-16-22 helps entities select the project alternatives that best meet mission needs. The following Table 1 lists the 22 best practices within each of the six sequential phases, as defined for DOE applications:

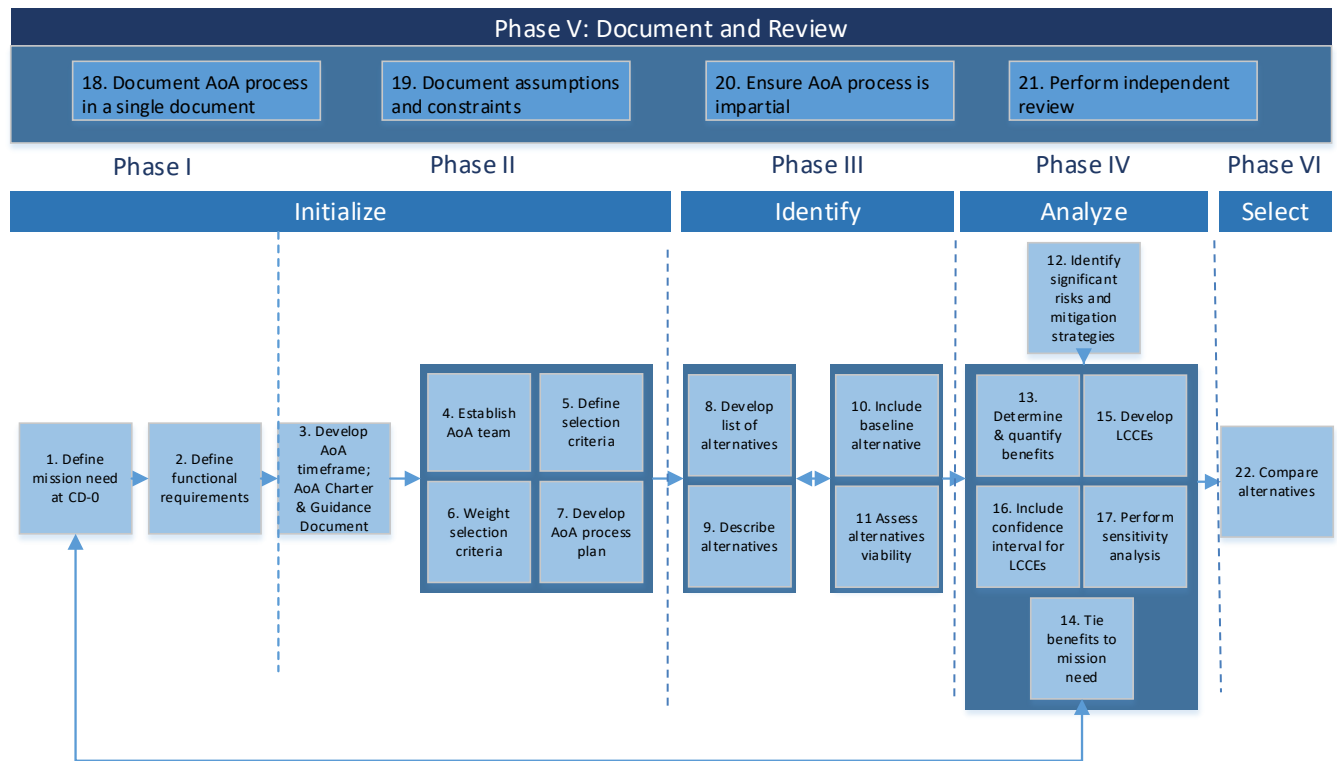
**Table 1. GAO Best Practices for the AoA Process**

<b>Best Practices for the AoA Process</b>
<b>Phase I. Pre-AoA - CD-0 Mission Need</b>
1. Define mission need
2. Define functional requirements
<b>Phase II. Initialize the Formal AoA Process</b>
3. Develop AoA timeframe
4. Establish AoA team (the AoA team should be independent of the contractor organization responsible for managing the construction or constructing the capital asset project)
5. Define selection criteria
6. Weight selection criteria
7. Develop AoA process plan
<b>Phase III. Identify alternatives</b>
8. Develop list of alternatives
9. Describe alternatives
10. Include baseline alternative
11. Assess alternatives' viability (initial screening of alternatives)
<b>Phase IV. Analyze alternatives</b>
12. Identify significant risks and mitigation strategies
13. Determine and quantify benefits/effectiveness
14. Tie/benefits/effectiveness to mission need
15. Develop life-cycle cost estimates (LCCEs)
16. Include a confidence interval or range for LCCEs
17. Perform sensitivity analysis
<b>Phase V. Document and review the AoA process</b>
18. Document the AoA process in a manner to best convey the information (e.g., single document or multiple volumes, as appropriate).
19. Document assumptions and constraints
20. Ensure AoA process is impartial
21. Perform independent review
<b>Phase VI. Select a preferred alternative</b>
22. Compare alternatives

Appendix C presents a brief description for each of the best practices in the AoA process. Adherence to these definitions/descriptions in the execution of the AoA process should assist in meeting the four characteristics that identify a high-quality, reliable AoA. (Appendix G provides a crosswalk of the AoA four characteristics and the relevant AoA best practices useful for an entity, independent of the AoA process and outside the project's chain of command, conducting an independent review of the AoA process (GAO best practice #21).

## 2.3 AoA Process Flowchart

Figure 2 illustrates the recommended AoA process flow as it progresses systematically through the DOE six phases of development, which is an adaptation of the GAO five phases for DOE applications (DOE Phases I and II are combined under the GAO Initialize Phase, which implements the recommended 22 best practices within each phase (see Appendix C). Notice that Phase V, Document and Review, should be implemented from the start of the process through the selection of the best alternative (for quality assurance and control of the process). In DOE, the formal AoA process starts after CD-0, *Approve Mission Need*, and definition of functional requirements, and ends at the selection of the best alternative by the PME at CD-1, *Approve Alternative Selection and Cost Range*. Some of the best practices included in a phase can take place concurrently and do not have to follow the order presented in Table 1. The phases should occur in sequence (with the exception of Phase V; documentation and review should be executed across the AoA process as a quality assurance best practice) to prevent bias from entering the analysis and adding risk that the AoA team will analyze alternatives that have not been defined. For example, best practice #5 (define selection criteria) can be done at the same time as best practice # 6 (weight selection criteria). On the other hand, best practice #20 (ensure AoA process is impartial) can be done at the end of every step or every phase to ensure the impartiality of the AoA as it progresses. The best practices represent an overall process that results in an AoA that can be easily and clearly traced, replicated, and updated.



AoA Analysis of Alternatives  
LCCE Life-Cycle Cost Estimate  
Numbers are the GAO Best Practices

**Note:** The figure displays the AoA process by phase and step. The “Initialize, Identify, Analyze, and Select” phases should be done in order, but the “Document and review” phase can be done throughout the AoA process. The arrows indicate that the “Document and review” phase is related to the other four phases. Within each phase, there are steps that can be done concurrently rather than consecutively. The concurrent steps are grouped together in dark blue boxes. Furthermore, there are steps in later phases that are related to steps in earlier phases; these are connected with a two way arrow.

**Figure 2. AoA Process Flowchart<sup>9</sup>**

## 2.4 AoA Process DOE Key Entities

There should be four key entities that are involved in the AoA process: the customer [**the Project Owner**], the decision maker [**the Project Management Executive (PME)**], the **AoA team** conducting the AoA analysis, and the **Independent Review team** reviewing the study plan and reviewing/assessing the AoA final report. The Project Owner normally refers to the program secretarial office, service, or agency that identifies a mission need (e.g., a credible gap between current capabilities and those required to meet the goals articulated in the strategic plan) and coordinates the budget. The decision maker (PME) is the person or entity that signs off on the final decision and analysis documented by the AoA report. The AoA

<sup>9</sup> Adapted to DOE from the GAO-16-22 report; DOE splits the Initialization stage into the Pre-AoA Process and the Initialize the AoA Formal Process because of the CD-0 requirement (see Figure 1) but the 22 best practices steps follow as presented by GAO.

team is the group of subject matter experts who are involved in the day-to-day work of the AoA process and work to develop the analysis that is the foundation of the AoA process. The AoA team must be independent of the contractor organization responsible for managing the construction or executing the capital asset project, but as appropriate may receive support from the contractor organization in providing subject matter expertise in operational and/or site information. The Independent Review team (GAO best practice #21) determines the extent to which the best practices were followed. The review team consists of individuals or entity independent of the AoA process and outside of the project's chain of command selected by the PME.

Table 2 is a generic example of the role of the key entities in the AoA process. DOE Programs should define the role of the key entities in the AoA process by an AoA Charter or Study Guidance or any other formal means.

**Table 2. Example of DOE Key Entities Roles in the AoA Process and Deliverables**

DOE Stage	AoA Initiation	AoA Kick off	AoA Planning	AoA Analysis	AoA Preliminary Results Review	AoA Finalization	AoA Documentation and Review	Alternative Selection
Description	After CD-0, the <u>PME</u> tasks the <u>Project Owner</u> to conduct the AoA. The PME chooses an <u>AoA Team</u> and selects a Federal AoA Lead as the team lead.	The <u>Project Owner</u> conducts a kick-off meeting with the AoA Team relevant stakeholders, and other SME's as required.	The <u>AoA Team</u> describes the structure and methodology of the AoA, to include selection criteria and weighting, in a Study Plan.	The <u>AoA Team</u> conducts the AoA analysis based on the project functional and technical requirements, initial screening and evaluating alternatives, conducting a cost analysis, risk and opportunity identification, and a sensitivity analysis, and documenting the results.	The Project Owner and AoA Team present initial results to the PME who may provide additional guidance as necessary. An <u>Independent Review Team</u> may also conduct a review of the <u>AoA Team's</u> initial results, providing additional guidance as necessary.	The <u>AoA Team</u> compiles the results of the AoA analysis into one document with all supporting information and previous deliverables. The <u>Independent Review Team</u> reviews the Final Report and prepares the Sufficiency Memo.	The <u>Project Owner</u> reviews the validated Final Report and Sufficiency Memo and forward to the Program <u>PME</u>	The <u>PME</u> selects an alternative based on the results of the AoA
Deliverable	AoA Charter and Study Guidance Document		AoA Study Plan			AoA Study Final Report	Sufficiency Memo	Alternative Selection Document; CD-1 Authorization

### 3.0 OVERVIEW OF THE AOA KEY DOCUMENTATION DELIVERABLES

Table 2 lists the key deliverables at each stage of the of the DOE AoA process. Key documentation deliverables at the initiation/planning stage are:

- Study Guidance. Usually called the Charter Memo or the Tasking Memo. The attachment to the Charter Memo is the Study Guidance which describe the mission need and gaps approved at CD-0, the purpose and scope of the analysis; the management expectations from the analysis; assumptions, constraints and limitations; resources available to the AoA team and the target schedule; expected deliverables, and the AoA

membership composition. A Federal lead for the AoA team should also be selected. GAO best practices criteria # 1-6.

- Study Plan. The Study Plan establishes the roadmap for how the AoA analysis should proceed; details who is responsible for what; structure and methodology to be followed; assumptions, constraints and limitations; including an initial list of alternatives to be evaluated along with screening criteria as well as selection and evaluation criteria with respective weighting for viable alternatives; and resources required. GAO best practice criteria # 7

The next key deliverable is at the AoA finalization stage:

- Study Final Report. The Study Final Report should be a standalone document (or documents, depending on the complexity of the project and the AoA) that integrates the results of the analysis, justifications, supporting documentation, and all previous project deliverables including the AoA Study Plan. GAO best practice criteria # 18.

Another suggested document deliverable presented in Table 2 is the Sufficiency Memo which is essentially a transmittal from the Independent Review Team to the PME of the Study Final Report with their endorsement and certification that it has been deemed sufficient by the Independent Review team.

### 3.1 Study Guidance Document

**Responsible Party:** Project Management Executive

A Charter Memo or Study Guidance is drafted for the PME to authorize the conduct of an AoA and clarifies the expectations of the AoA process (see Appendix D: “Suggested Template for the AoA Charter Memo and Study Guidance Document”). As a minimum, this memorandum and the Study Guidance attachment should describe the mission need and gaps approved at CD-0, the purpose and scope of the analysis; the management expectations from the analysis; assumptions, constraints and limitations; resources available to the AoA team and the target schedule; expected deliverables; and the AoA membership composition. A Federal lead for the AoA team should also be selected.

#### **Additional information that may be included in the guidance for the study.**

Guidance for the AoA Study that may be included in the Charter or as an attachment document:

- The guidance should set time limits on the analysis timeline. If the AoA analysis is expected to take longer than a specified time, the scope of work should be reconsidered to ensure the analysis planned is truly necessary to inform the key milestone decision maker (CD-1).
- The guidance should establish an early milestone/date for the AoA team to present their detailed methodology and data approaches, tools, scenarios, metrics, and data in-depth to the Program Office, other stakeholders, and the independent review team of the AoA process.
- The guidance should instruct the AoA team to spell out the selection and evaluation criteria to be used in the study plan. Although not required, weighting factors applied to



these metrics should be defined and the rationale for applying each weighting factor explained. Metrics should include comparisons between the (weighted) metrics to facilitate cost, performance and schedule tradeoff discussions.

- The guidance should instruct the AoA team that in addition to the project risks, full treatment to non-operational risks, with particular focus on integration risks, should be provided.
- Guidance regarding the use of critical new technologies and their maturity level to be considered during risk identification and mitigation in the AoA analysis.
- Guidance regarding affordability and projected budget available for the project.

### 3.2 Study Plan Document

**Responsible Party:** The AoA Team

The Study Plan Document is prepared by the AoA Team and is reviewed and endorsed by the Project Owner. Approval should be granted by the PME prior to proceeding with the study. For large complex projects or programs the Study Plan may have another volume called the Analysis Plan for a more in depth discussion of the analytical approach, down-selection strategy for the alternatives and the cost estimating methodology. See Appendix E for a generic suggested template for the Study Plan Document.

Study Plan. The study plan is a key project deliverable that describes how the AoA will be conducted. It includes the ground rules and assumptions for the planned AoA process; describes the composition, roles, and responsibilities of the AoA team, working groups, and stakeholders; and describes the oversight and review process for the AoA. The Study Plan should include an initial list of preliminary alternatives to be evaluated along with proposed screening and evaluation criteria. The study plan should also identify the data (programmatic, technical, test and cost) and other resources the AoA team will need to complete the study and/or describe the governance and program/project management processes through which data will be requested and provided. Other important considerations that should be covered in the Study Plan, if applicable, are a description of how to incorporate applicable requirements of the National Environmental Protection Act (NEPA) in accordance with the DOE regulations and guidance; other health, security, and nuclear safety considerations; and, sufficiently detailed description of the methodology the AoA team intends to use for each phase of the analysis.

Since an AoA typically embarks in a path of discovery, it may be expected for the team to identify additional alternatives as the plan is implemented and as the team becomes more knowledgeable on the problem at hand. It may be possible, that through this learning process, not only the number of alternatives may increase, but also the data and resource requirements. At this point, the team should revisit the schedule and resources required to complete the analysis and negotiate these new requirements with the decision makers and the stakeholders. Similarly, during the actual evaluation of alternatives, weaknesses and/or missing elements may be identified related to the criteria and related measure and weights. The AoA process should be flexible to incorporate these types of modifications to the extent that they are justified and well documented. The Study Plan serves as the skeleton for the final AoA report.

**Note:** The purpose of the Study Plan is not to provide a discussion on how to perform an analysis of alternatives, or recommend specific tools and models for constructing decision support methodologies. The selection of such tools and methodology is dependent on the program/project being evaluated.

### **Some Considerations in Planning the AoA**

- The independence of the AoA team is vital to the defensibility of the AoA results.
- The AoA results inform the decision-making process but may not identify one definitive solution.
- Who should conduct the AoA (i.e., the study team lead and composition of the study team)?
- How will the study team be organized (i.e., use of the core team members versus engaging outside Subject Matter Experts for input and advice)?
- Roles and responsibilities of the team members

Maintain continuity of the core team membership from organization and initiation of the AoA (and beyond). Having enduring team membership will help provide continuity, greatly facilitate AoA planning, and ensure the stakeholder communities are properly represented.

Capture other information about the solution space (alternatives) in addition to that found in the mission need document. Some examples of other information to help define the solution space include:

- Overarching assumptions (these are the assumptions that are specific to the problem and apply to all potential solutions)
- Overarching operational concept/deployment concept
- Overarching operational considerations (this is problem specific and applies to all potential solutions equally)
- Overall implications that apply regardless of solution

The structure of the AoA study team depends upon the scope of the AoA and the level of effort required. Depending on the scope of the AoA, the team is usually organized along functional lines to conduct the effectiveness, risk, and cost analyses.

Recognize that risk identification is the responsibility of every member of the AoA team, and should occur throughout the conduct of the study.

### **Some Considerations in Scoping the AoA**

An iterative development process with explicit reconsideration of study scope at critical junctures should be adopted. The study phases and key considerations or constraints are listed below:

- **AoA context:** program deadlines, contractual arrangements for the various participants, and government oversight expectations.

- **Analytic starting point:** AoA governance, especially the AoA study team in relation to other program activities; key reference and background documents, anticipated scope, and scale of the alternatives.
- **Analytic study plan and execution:** identification of alternatives; degree and depth of analysis; specification of analytic methodology, especially determination.

The following are typically used to establish the scope of the AoA:

- Capability gaps and any identified prioritization.
- Mission areas and tasks.
- Operational concepts and environment.
- Project/Program risks
- Measures and standards.
- Approaches and alternative concepts, including the baseline
- Maturity of the new technologies
- Operational risk.
- Timeframes.
- Ground rules, constraints, and assumptions.
- Science and Technology (S&T) activities.
- Resource availability
- CERCLA, RCRA and NEPA requirements

### 3.3 Study Final Report Document

**Note:** This is the final key deliverable for the AoA process. Before the preparation of this document, the conduct of the AoA analysis should be made (GAO best practices Phases II and III, Identify Alternatives; and Analyze Alternatives) <sup>10</sup>as described in Section 4.0. Upon its conclusion the results feed into the preparation of the AoA Study Final Report (GAO best practices Criteria # 18). However, since Section 3.0 describes the key documentation deliverables for the AoA process, the AoA Study Final Report is discussed herein. See also Table 2 for the sequence of activities and schedule of deliverables by DOE stages.

**Responsible Party for the Study Final Report:** The AoA Team.

The AoA Team should document and present the results of the AoA to the Independent Review Team (see Table 2) for review and validation (GAO best practices Criterion # 18). The Independent Review Team consists of members or an entity independent of the AoA process and outside of the project chain of command selected by the DOE Program or the PME. The Project Owner reviews the final report, endorses it, and submits the final report to the PME for selection of the best alternative (Note: the various DOE Programs may have different procedures for the review, validation and approval chain). The AoA Study Final Report should be a standalone document that integrates the results of the analysis, justifications, supporting documentation, and

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<sup>10</sup> See Appendix C for the GAO AoA Phases descriptions. In the DOE adaptation of phases these are Phases III and IV; see Section 2.2, Table 1.

all previous project deliverables including the AoA Study Plan. A recommended template for this final report is provided in Appendix E. The Final Report should include the following:

- Names of all AoA Team members with corresponding affiliations and roles;
- Description of the mission need, program requirements, gap analysis, and assumptions and constraints that are driving the AoA, as set out by the Charter Memo and the Study Guidance Document, as applicable (see Section 3.1);
- Descriptions of all alternatives considered;
- The justifications driving the initial screening (down-select) process and the results;
- All evaluation criteria and relation to the program requirements;
- Complete life-cycle assessment costs of each alternative (after the initial down-select) including calculations and rationale;
- Summary of risks for each alternative;
- Sensitivity analysis;
- The final results of the evaluation, and;
- All previous final deliverables (e.g., Study Plan).

#### **4.0 SUGGESTED DOE AOA ANALYSIS STEPS**

The subsequent sections of this guide will focus on the formal suggested best practices process of identification and analysis of alternatives prior to compiling the final results for the PME to make the final determination for the best value alternative. See Appendix I, Suggested DOE AoA Analysis Steps, for the recommended sequence of activities to follow after approval of the Mission Need at CD-0. This recommended sequence of steps is compatible with the GAO AoA Process Flowchart in Figure 2.

##### **4.1 Develop Screening and Evaluation Criteria**

The AoA team reviews the mission need and functional requirements to define the screening criteria, which should be used to pre-screen the alternatives (see Appendix I for the sequence of activities – GAO best practices # 5-7). The screening criteria are based on the mission need and program requirements independent of a particular asset or technological solution.

The AoA team develops evaluation criteria based on the unique characteristics and program requirements of the assessed project and assigns weights to each criterion based on its relative importance to the mission need. At a minimum, these criteria should account for performance, risks (to include application-specific technical maturity, security, environment, safety and health considerations early in the alternatives evaluation process), costs, and schedule while directly reflecting mission need and program requirements.<sup>11, 12</sup> The selection and evaluation criteria should be documented in the AoA Study Plan.

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<sup>11</sup> DOE WSRC-IM-2002-00002, *Guidebook to Decision-Making Methods*, Washington, DC, December 2001.

<sup>12</sup> DoD Air Force Office of Aerospace Studies, *Analysis of Alternatives (AoA) Handbook*, Kirtland AFB, NM, June 2013. Treatment of the tools and models for decision making methods and analysis of alternatives is outside the scope of this guide. The references quoted in this page are a good starting point. Each AoA should address these issues in a manner commensurate with the size and complexity of the effort.

This guide advocates a sound practical analytical process not specific tools.<sup>13</sup> Detailed analytical tools are often necessary for key parts in the AoA, but it is often more practical to adhere to simpler approaches such as parametric analysis and requirements gathering. The key is early identification of the key requirements and assumptions for selection of the best alternatives and following a process that avoids the pitfalls of biased analysis.

## **4.2 Develop Preliminary Alternatives and Screen Preliminary Alternatives**

The AoA team develops a diverse range of plausible and preliminary alternatives that could potentially meet the mission need. One alternative should represent the status quo (no alterations to current efforts) in order to provide a basis of comparisons for the other alternatives (GAO best practices # 8-11). All alternatives and their descriptions should be documented (GAO best practices, Document and Review umbrella phase – see Figure 2).

The AoA team screens the list of preliminary alternatives against the set of screening criteria developed under Section 4.1. Alternatives are screened against the selection criteria, which should be based on mission need and requirements. The status quo should not be screened out in order to continue to provide a basis for comparison. The justification for the results of the screening process should also be documented. The primary purpose of the initial screening process is to contribute to identifying which alternatives should be carried forward for further analysis.

### **Some Key Considerations in Identifying Alternatives**

- The status quo (baseline) should always be included as one of the alternatives to be evaluated and a description of the baseline system should be included.
- Viability of alternatives - identify objective criteria for inclusion of alternatives.
- Feasibility of comparison:
  - Develop consistent concepts for system alternatives.
  - Identify prospective measures for prospective alternatives.
- Reasonable study scope:
  - Establish or define system scope.
  - Define the “scale” of alternatives – Alternatives should be defined with the same level of specificity. The development stage of the alternative will impact the level of specificity i.e., a conceptual system will have fewer detailed characteristics than one that is in service elsewhere. A short deployment timeline may require more specific alternative definition, thus a conceptual system may not have the specific data necessary to put it on equal analytic footing. As a result, this definition of scale often leads to a decision about whether to characterize alternatives as specific, vendor-available systems or models or as more general classes. When considering classes, the study team should still describe how the representative systems are defined (i.e., performance specifications and costs). To properly portray the wider class of systems the team may have to relax specificity. In some cases a summary level Technology Readiness Assessment may be required to provide a basis for relative technical maturity of the alternatives.

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<sup>13</sup> Ibid.

- Beware of subdivision into subsystems – minimize the possible combination of subsystems.
- Process for eliminating alternatives:
  - Identify Predetermined qualitative technical and operational factors to determine viability of alternatives
  - All alternatives are examined against the predetermined factors
  - Alternatives found viable are examined fully in the AoA process
  - All assumptions and factors regarding nonviable status of alternatives are fully documented

### 4.3 Evaluate and Rank Alternatives

The AoA team quantitatively, to the extent practicable, analyses and ranks the screened alternatives using the set of evaluation criteria developed under Section 4.1 and documented in the AoA Study Plan (GAO best practices #12-16). This analysis should be informed by a summary of quantified benefits, life-cycle cost estimates generated for each alternative, and a list of associated risks with mitigation strategies for each alternative. The team should use methods and techniques from industry standards and best practices as well as any applicable DOE policies, procedures and processes.<sup>14,15,16</sup>

- If applicable, the AoA team determines each alternative's benefits using a standardized process and documenting the rationale behind the assessment. Benefits should be quantifiable and determined over the alternative's full life cycle. Benefits should relate and support the mission need.
- The life-cycle cost estimates for each alternative should include all costs from inception of the project through design, development, deployment, operation, maintenance, and disposition. Life-cycle cost estimates should be shown in present value terms over the entire life-cycle. Cost estimates should be expressed as a range or with confidence interval, not solely as a point estimate (consistent with requirements under DOE O 413.3B; cost estimates to support AoA at CD-1 should be expressed as a range). The AoA team should document the basis, assumptions, and calculation used.
- The AoA team identifies a list of significant risks (programmatic, technical, and operational) and mitigation strategies for each alternative.<sup>17</sup>

### 4.4 Conduct Sensitivity Analysis

The AoA team conducts a sensitivity analysis that tests the sensitivity of the cost and benefit estimates and the evaluation criteria to changes in the key assumptions.

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<sup>14</sup> DOE Guide 413.3-21A, *Cost Estimating Guide*, dated 6-6-2018.

<sup>15</sup> GAO-09-3SP, *GAO Cost Estimating and Assessment Guide*, dated March 2009.

<sup>16</sup> DOE Handbook Life Cycle Cost Handbook, *Guidance for Life Cycle Cost Estimation and Analysis*, September 2014. <https://community.max.gov/download/attachments/1129612735/LCC%20Handbook%20Final%20Version%209-30-14.pdf?version=1&modificationDate=1473195527425&api=v2>

<sup>17</sup> Each AoA should address these risks and mitigation strategies in a manner commensurate with the size of the effort and should adhere to guidelines provided in DOE G 413.3-7A, *Risk Management Guide*, dated 01-08-2011.

Alternatives whose effectiveness is stable over a range of conditions provide greater utility and less risk than those lacking such stability. Alternatives are typically defined with certain assumptions made about their performance parameters. These alternatives may then be assessed against defined scenarios under a set of defined assumptions. This analysis results in specific cost and performance estimates, but does not assess the stability of an alternative's performance to changes in system parameters, scenarios, employment, and other assumptions. A sensitivity analysis is not just important for stability but is critical to ensuring that the AoA process was not unduly biased (example: by weighting certain evaluation criteria too heavily).

Stability can be investigated through sensitivity analyses in which the most likely critical parameters are varied; for instance: reduced waste disposal rate or increased waste storage, greater or less accuracy, or when overarching assumptions are changed. This form of parametric analysis can often reveal strengths and weaknesses in alternative performance that are valuable in making decisions to keep or eliminate alternatives from further consideration.

#### **4.5 Compile Preliminary Final Results and Submit the Validated Final AoA Report**

The AoA team documents all steps taken to identify, analyze, and select alternatives in a single preliminary final report (GAO best practices #18-21). The Independent Review Team (see Table 2) reviews the initial results and provides additional guidance as necessary to assure the AoA is well documented, comprehensive, unbiased and credible following the GAO 22 criteria of best practices. Also, the early initial involvement by the Independent Review Team to weigh in on the process is important to reduce time and energy if the AoA team has to re-do something. The AoA team presents the results of the analysis with accompanying justifications, calculations and supporting documentations in the AoA final report for validation by the Independent Review Team. The Independent Review Team reviews the Final Report, reconciles final adjustments to the report with the AoA Team, and presents its findings through a Sufficiency Memo to the PME. The Project Owner reviews the AoA Final Report and prepares a transmittal Memo concurring with the completeness, quality, and technical soundness of the AoA process. The Sufficiency Memo is presented to the PME in conjunction with the AoA Final Report to select a preferred alternative as part of the CD-1 approval package (GAO best practices # 21 and #22).

#### **Summary Key Considerations for Selecting the Preferred Alternative**

The final presentation of AoA results should provide decision makers with a detailed view of the alternatives considered. This enables decision makers to identify and potentially eliminate alternatives that do not meet one or more of the basic performance requirements. After making this initial cut (if any), decision makers should conduct a more nuanced down-selection process that involves balancing not only the remaining alternatives' costs and operational effectiveness results, but also their risks, schedule, flexibility, and any other factors of concern to the decision maker. This may (and often does) require the decision maker to consider other sources of information in addition to the AoA results. In this way, the AoA significantly informs the government's final selection, but does not by itself necessarily result in the preferred solution being chosen.

## **5.0 AOA REVIEWS**

According to the GAO-16-22 best practices it is important that the AoA process and its results (see key documentation deliverables in Section 3.0 of this guide) are validated by an organization independent of the AoA team and the program office to ensure that a high-quality AoA is developed, presented, and defended to management. This independent review of the AoA process and deliverables verifies that the AoA adequately reflects the program's mission needs and provides a reasonable assessment of the costs and benefits associated with the alternatives. Section 2.4, Table 2, in this guide provides a generic example of the key entities in the AoA process, to include the role of the Independent Review team. DOE Programs may define the role of the key entities, or other intermediate organizations and additional entities, in the AoA process by a tasking memo or any other formal means.

### **In-Process Reviews**

At the discretion of the DOE Program Office or the PME, usually based on the size and complexity of the project, other reviews besides the AoA Preliminary and Final Report independent reviews may be conducted such as at the following points:

- Development of the AoA Study Plan – evaluation of the scope, structure and methodology proposed for the study.
- Development of the criteria and their weighting – evaluation of proposed methodology.
- Preliminary Results (prior to independent review) – evaluation of the execution of the study, preliminary results, completeness, credibility, and alignment with the characteristics of a well-executed AoA.

The reviews may use the review checklists suggested at the Appendices to this guide to assist in evaluating AoA.

## **6.0 AOA REVIEW TEMPLATE TOOLS**

The following suggested template tools were developed to assist in the review process which can be found in the Appendices Sections to this guide:

Appendix C – GAO Best Practices Used to Inform the DOE AoA Process.

Appendix D – Suggested Template for the AoA Charter Memo and Study Guidance Document.

Appendix E – Suggested Template for the AoA Study Plan and Final Report.

Appendix F – Suggested DOE AoA Analysis Steps.

Appendix G – Crosswalk of GAO Characteristics of High-Quality AoA and the Relevant AoA Best Practices.



## APPENDIX A: ACRONYMS

AoA	Analysis of Alternatives
BOP	Business Operating Procedures
CD-0	Critical Decision-0, Approve Mission Need
CD-1	Critical Decision-1, Approve Alternative Selection and Cost Range
CD-2	Critical Decision-2, Approve Performance Baseline
CD-3	Critical Decision-3, Approve Start of Construction/Execution
CD-4	Critical Decision-4, Approve Start of Operations or Project Completion
CDP	Concept Development Plan
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DoD	US Department of Defense
DOE	US Department of Energy
EVMS	Earned Value Management System
FPD	Federal Project Director
GAO	Government Accountability Office
IPT	Integrated Project Team
LCCE	Life-Cycle Cost Estimate
M&S	Modeling and Simulation
MNS	Mission Need Statement
MOE	Measure of Effectiveness
MOP	Measure of Performance
MT	Mission Tasks
NEPA	National Environmental Policy Act
NNSA	National Nuclear Security Administration
NPV	Net Present Value
PEP	Project Execution Plan
PME	Project Management Executive
PO	Project Owner
RCRA	Resource Conservation and Recovery Act
SME	Subject Matter Experts
SE	Systems Engineering
SE&I	Systems Engineering and Integration
TEC	Total Estimated Cost
TPC	Total Project Cost
V&V	Verification and Validation
WBS	Work Breakdown Structure

**Refer to *DOE Project Management Terms and Acronyms*, for additional information.**  
**<https://community.max.gov/x/TYFUQw>**



## APPENDIX B: REFERENCES

**77 FR 14473**, Council on Environmental Quality, *Improving the Process for Preparing Efficient and Timely Environmental Reviews under the National Environmental Policy Act*, dated 03-12-2012.

**DOE O 413.3B**, *Program and Project Management for the Acquisition of Capital Assets*, U.S. Department of Energy, Washington, D.C., dated 11-29-2010.

**DOE G 413.3-1**, *Managing Design and Construction Using Systems Engineering*, U.S. Department of Energy, Washington, D.C., dated 09-23-2008.

**DOE G 413.3-7A**, *Risk Management Guide*, U.S. Department of Energy, Washington, D.C., dated 01-08-2011.

**DOE G 413.3-13**, *Acquisition Strategy Guide for Capital Asset Projects*, Washington, D.C., dated 07-22-2008

**DOE G 413.3-17**, *Mission Need Statement Guide*, U.S. Department of Energy, Washington, D.C., dated 06-20-2008.

**DOE G 413.3-21A**, *Cost Estimating Guide*, U.S. Department of Energy, Washington, D.C., dated 6-6-2018.

**DOE Guidebook**, *Guidebook to Decision-Making Methods*, WSRC-IM-2002-00002, dated December 2001.

**DoD Air Force Office Aerospace Studies**, *Analysis of Alternatives (AoA) Handbook*, dated June 2013.

**GAO-09-3SP**, *GAO Cost Estimating and Assessment Guide for Best Practices for Developing and Managing Capital Program Costs*, Washington, D.C: dated 03-02-2009.

**GAO-15-37**, *DOE and NNSA Project Management: Analysis of Alternatives Could Be Improved by Incorporating Best Practices*, dated 12-11-2014.

**GAO-16-22**, *Amphibious Combat Vehicle, Some Acquisitions Activities Demonstrate Best Practices; Attainment of Amphibious Capability to be Determined*, dated 10-28-2015

**Office of Management and Budget (OMB)** Circular No. A-11, *Preparation, Submission, and Execution of the Budget*, July 2016.

**Office of Management and Budget (OMB)** Capital Programming Guide, Supplement to Circular A-11, Part 7, *Preparation, Submission and Execution of the Budget*, 2016.



## APPENDIX C: GAO BEST PRACTICES USED TO INFORM THE DOE AOA PROCESS

Appendix C presents a brief description for each of the best practices in the GAO described AoA process. Adherence to these definitions/descriptions in the execution of the AoA process should assist in meeting the five characteristics that identify a high-quality, reliable AoA. As defined by GAO, the entire AoA process includes five phases, although these are accomplished differently within DOE, as discussed in the main body of the report (see Section 2.2). The GAO five phases are described as follows:

1. **Initialize the AoA process**: includes best practices that are applied before starting the process of identifying, analyzing, and selecting alternatives. This includes determining the mission need and functional requirements, developing the study time frame, creating a study plan, and determining who conducts the analysis. Deliverables in this phase should be a Study Guidance Document initializing the planning process, selection of the AoA team who will conduct the AoA, and the AoA Study Plan with resources and schedule. In DOE the mission need is established and approved at CD-0 in accordance with the requirements of DOE O 413.3B for capital asset projects. To meet requirements in DOE O 413.3B, the AoA team must be independent of the contractor organization responsible for managing the construction or constructing the capital asset project.
2. **Identify alternatives**: includes best practices that help ensure the alternatives to be analyzed are sufficient, diverse, and viable.
3. **Analyze alternatives**: includes best practices that compare the alternatives to be analyzed. The best practices in this category help ensure that the team conducting the analysis uses a standard, quantitative process to assess the alternatives.
4. **Document and review the AoA process**: includes best practices that would be applied throughout the AoA process, such as documenting all steps taken to initialize, identify, and analyze alternatives and to select a preferred alternative in a single document. This phase includes an **independent review** of the AoA process by a team or organization independent of the proponent program office and the project's chain of command to validate the results of the AoA process. This process verifies that the AoA adequately reflects the program's mission needs and provides a reasonable assessment of the cost and benefits associated with the alternatives. The main deliverables in this phase should be the AoA Final Report and the document or report validating the AoA Final Report by the independent review team.
5. **Select a preferred alternative**: includes a best practice that is applied by the decision maker to compare alternatives and to select a preferred alternative. The decision maker (the Project Management Executive) reviews the alternatives presented in the validated AoA Final Report and chooses the preferred alternative.

These phases are broken down into more detailed steps in the following table. The information under "*Effect*" provides a description of the potential effects to the AoA process if the best practice criterion is not met. Appendix J provides a crosswalk of the AoA five characteristics and the relevant AoA best practices useful for analyzing the extent to which best practices were followed.

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**Definitions/Descriptions for Best Practices for the Analysis of Alternatives (AoA) Process**

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**Phase I. Initialize the AoA Process**

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**1. Define Mission Need.**

*Definition:* The customer defines the mission needs (i.e., a credible gap between current capabilities and those required to meet the goals articulated in the strategic plan) without a predetermined solution. To ensure that the AoA process does not favor one solution over another, the AoA is conducted before design and development of the required capabilities. In DOE the Mission Need is defined at CD-0 (Approve Mission Need) for projects under DOE O 413.3B. The AoA process starts after CD-0 during Conceptual Design and is completed prior to CD-1 (Approve Alternative Selection and Cost Range).

*Effect:* Allowing mission needs to be defined in solution-specific terms creates a potential bias and could invalidate the analysis.

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**2. Define Functional Requirements.**

*Definition:* The customer defines functional requirements (i.e. the general parameters that the selected alternative should have to address the mission need) based on the mission need without a predetermined solution. The customer defines the capabilities that the AoA process seeks to refine through characterized gaps between capabilities in the current environment and the capabilities required to meet the stated objectives for the future environment. These functional requirements should be realistic, organized, clear, prioritized, and traceable. It is advisable that functional requirements be set early in the AoA process and agreed upon by all stakeholders.

*Effect:* The AoA process is tied to the identified mission needs. Setting functional requirements to a standard other than mission needs allows bias to enter the study because the requirements might then reflect arbitrary measures. Additionally, requirements not tied to mission needs make it difficult to quantify the benefits of each alternative relative to what is required and make it challenging for decision makers to assess which capability gaps will be met for each alternative.

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**3. Develop AoA Timeframe.**

*Definition:* The customer provides the team conducting the analysis enough time to complete the AoA in order to ensure a robust and complete analysis. Since an AoA process requires a large team with many diverse resources and expertise, dependent of the complexity of the project being analyzed, the process requires sufficient time to be accomplished thoroughly. A detailed schedule is developed prior to starting the AoA process. The duration of the AoA process depends on the number of viable alternatives and availability of the team members. The time frame is tailored for the type of system to be analyzed and ensures that there is adequate time to accomplish all of the AoA process steps robustly.

*Effect:* The AoA process identifies and thoroughly analyzes a comprehensive range of alternatives. Recommending an alternative without adequate time to perform the analysis is a contributing factor to high dollar acquisitions that have significantly overrun both cost and schedule while falling short of expected performance.

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**Definitions/Descriptions for Best Practices for the Analysis of Alternatives (AoA) Process**

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**4. Establish AoA Team.**

*Definition:* After the customer establishes the need for the AoA in steps 1 through 3, a diverse AoA team is established to develop the AoA. This team consists of members with a variety of necessary skill sets, specific knowledge, and abilities to successfully execute the study. For example, the AoA team includes individuals with skills and experience in the following areas: program management; federal contracting; cost estimating; risk management; sustainability; scheduling; operations; technology development; environment, safety, health and security; budget analysis; and any other necessary areas of expertise. To meet the requirements of DOE O 413.3B, the AoA team must be independent of the contractor organization responsible for managing the construction or constructing the capital asset project.

*Effect:* An AoA process includes a diverse group of subject matter experts (SMEs) to perform the analysis. Since each SME brings their knowledge to the team, without the appropriate expertise on the team, errors in the results could occur and gaps in the analysis could be created, causing the AoA's completion to be delayed as more SMEs are identified and tasked to work as part of the AoA process.

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**5. Define Selection Criteria.**

*Definition:* The AoA team or the decision maker defines selection criteria based on the mission need and are independent of a particular capital asset or technological solution. Care should be taken to avoid “double impacts”, positive and negative, for overlapping criteria. This can be validated by implementing Best Practice # 17, as described below.

*Effect:* It is essential that the selection criteria be based on the mission needs. If there are no preset criteria based on documented requirements, bias can enter the AoA process and prevent the decision maker from forming an impartial and unbiased decision. Care should be taken to develop criteria that mitigate “double counting” impacts, negative and positive, due to overlap of criteria definitions or interpretations.

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**6. Weight Selection Criteria.**

*Definition:* The AoA team or the decision maker weights the selection criteria to reflect the relative importance of each criterion. While the selection criteria are ranked in importance, the alternatives are based on trade-offs between costs, operational effectiveness, risks, schedules, flexibility, and other factors identified by the team or the decision maker.

*Effect:* An unjustified weighting method can oversimplify the results and potentially mask important information leading to an uninformed decision.

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**Definitions/Descriptions for Best Practices for the Analysis of Alternatives (AoA) Process**

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**7. Develop AoA Process Plan.**

*Definition:* The AoA team creates a plan to include proposed methodologies for identifying, analyzing, and selecting alternatives prior to beginning the AoA process. This plan establishes the critical questions to be explored, the selection criteria, the basis of estimates, and measures that are used to rate, rank, and decide among the alternatives. Additionally, the plan includes the criteria used to determine each alternative's viability. A road map and standard work breakdown structure (WBS) are used to compare the alternatives with the baseline and with each other.

*Effect:* The functional requirements and selection criteria are identified prior to the beginning of the analysis. If criteria to select the preferred alternative are established after the analysis has begun bias may influence the study's results. Furthermore, if planned methodologies for the remaining phases of the AoA study are not established, the risk of applying poor methodologies as part of the AoA analysis increases.

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**Phase II. Identify alternatives**

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**8. Develop List of Alternatives.**

*Definition:* The AoA team identifies and considers a diverse range of alternatives to meet the mission need. To fully address the capability gaps between the current environment and the stated objectives for the future environment, market surveillance and market research (i.e., lessons-learned from other similar projects) are performed to develop as many alternative solutions as possible for examination. Alternatives are mutually exclusive, that is, the success of one alternative does not rely upon the success of another.

*Effect:* An AoA process encompasses numerous alternatives in order to ensure that the study provides a broad view of the issue. If the AoA team does not perform thorough research to capture diverse alternatives, the optimal alternative could be overlooked and invalidate the AoA's results and bias the process.

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**9. Describe Alternatives.**

*Definition:* The AoA team describes alternatives in sufficient detail to allow for robust analysis. All alternatives' scope is described in terms of functional requirements. This description is detailed enough to support the viability, cost, and benefit/effectiveness analyses.

*Effect:* Documentation is essential for validating the AoA process and defending its conclusions. Unless the AoA team adequately describes and documents the alternatives, the analysis will not provide sufficient detail to allow for valid cost-benefit estimates and will not be credible.

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**Definitions/Descriptions for Best Practices for the Analysis of Alternatives (AoA) Process**

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**10. Include Baseline Alternative.**

*Definition:* The AoA team includes one alternative to represent the status quo to provide a basis of comparison among alternatives. It is critical for the AoA team to first understand the status quo, which represents the existing capability's baseline where no action is taken, before comparing alternatives. The baseline is well documented as an alternative in the study and is used to represent the current capabilities and also for explicit comparison later in the study.

*Effect:* It is essential that the AoA process compare the current environment with the possible future environment. If no status quo is examined, then there is no benchmark for comparison, allowing arbitrary comparisons between alternatives and hindering the credibility of the study.

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**11. Assess Alternatives' Viability.**

*Definition:* The AoA team screens the list of alternatives to eliminate those alternatives that are not viable, and it documents the reasons for eliminating any alternatives. All alternatives are examined using predetermined qualitative technical and operational factors to determine their viability. Only those alternatives found viable are examined fully in the AoA process. However, all assumptions regarding the alternatives' viable and nonviable status are fully documented, including reasons that an alternative is not viable, in order to justify the recommendation. Additionally, viable alternatives that are not affordable within the projected available budget are dropped from final consideration.

*Effect:* Not eliminating alternatives based on viability could needlessly extend the study's duration and burden the AoA team or lead to the selection of a technically nonviable alternative. Furthermore, unless the AoA team considers affordability as part of the final recommendation, an alternative that is not feasible based on the current fiscal environment could be selected. Documenting the alternatives that are deemed nonviable is important so that decision makers can clearly see why those alternatives are not considered for further analysis.

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**Phase III. Analyze alternatives**

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**12. Identify Significant Risks and Mitigation Strategies.**

*Definition:* The AoA team identifies and documents the significant risks and mitigation strategies for each alternative. Risks are ranked in terms of significance to mission needs and functional requirements. All risks are documented for each alternative along with any overarching or alternative specific mitigation strategies. Schedule risk, cost risk, technical feasibility, risk of technical obsolescence, dependencies between a new project and other projects or systems, procurement and contract risk, and resources risks are examined.

*Effect:* Since AoA processes typically occur early in the planning process, risk is inherently a part of every alternative. Not documenting the risks and related mitigation strategies for each alternative prevents decision makers from performing a meaningful trade-off analysis necessary to choose a recommended alternative.

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**Definitions/Descriptions for Best Practices for the Analysis of Alternatives (AoA) Process**

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**13. Determine and Quantify Benefits/Effectiveness.**

*Definition:* The AoA team uses a standard process to document the benefits and effectiveness of each alternative. The AoA team drafts a metric framework that details the methods used to evaluate and quantify the Measures of Effectiveness and Measures of Performance for all mission needs. The AoA team quantifies the benefits and effectiveness of each alternative over the alternative's full life-cycle, if possible. Just as costs cover the entire life-cycle for each alternative, the benefits and effectiveness measures cover each alternative's life-cycle, if possible, in order to determine each alternative's net present value (NPV)—the discounted value of expected benefits minus the discounted value of expected costs. In cases where the means to monetize a benefit are too vague (for example, intangibles like scientific knowledge), the AoA team treats those benefits as strategic technical benefits and uses scalability assessments to quantify those benefits so that they are compared across all viable alternatives. In situation where benefits cannot be quantified, the AoA team explains why this is the case as part of their analysis.

*Effect:* Determining a standard process to quantify benefits is an essential part of the AoA process. If the AoA team does not clearly establish criteria against which to measure all alternatives, bias is introduced to the study. Additionally, if the AoA team does not examine effectiveness over the entire life-cycle, decision makers cannot see the complete picture and are prevented from making an informed decision.

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**14. Tie Benefits/Effectiveness to Mission Need.**

*Definition:* The AoA team describes the way the current environment is expected to evolve to meet the desired environment; the team also shows how the measures of effectiveness are tied to specific mission needs and functional requirements. This is the hierarchy that connects the overarching requirements to the data that are needed.

*Effect:* Unless the AoA team thoroughly documents how the measures of effectiveness relate to specific mission needs and functional requirements, decision makers will not have proper insight into the impact of each alternative.

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**Definitions/Descriptions for Best Practices for the Analysis of Alternatives (AoA) Process**

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**15. Develop Life-Cycle Cost Estimates (LCCEs).**

*Definition:* The AoA team develops a LCCE for each alternative, including all costs from inception of the project through design, development, deployment, operation, maintenance, and disposal. The AoA team includes a cost expert who is responsible for development of a comprehensive, well-documented, accurate, and credible cost estimate for each viable alternative in the study. The LCCE for each alternative follows the GAO 12-step guide<sup>18</sup> and uses a common cost element structure for all alternatives and includes all costs for each alternative. Costs that are the same across the alternatives (for example, training costs) are included so that decision makers can compare the total cost rather than just the portion of costs that varies across all viable alternatives. The AoA team expresses the LCCE in present value terms and explains why it chose the specific discount rate used. The AoA team ensures that economic changes, such as inflation and the discount rate are properly applied, realistically reflected, and documented in the LCCE for all alternatives. Furthermore, the present value of the estimate reflects the time value of money—the concept that a dollar today can be invested and earn interest.

*Effect:* An LCCE that is incomplete (i.e. does not include all phases of an alternative's life-cycle) does not provide an accurate and complete view of the alternatives' costs. Without a full accounting of life-cycle costs, decision makers will not have a complete picture of the costs for each alternative and will have difficulty comparing the alternatives because comparisons may not be based on accurate information. Additionally, applying a discount rate is an important step in cost estimating because all cost data should be expressed in like terms for comparison. Unless the AoA team properly normalizes costs to a common standard, any comparison would not be accurate, and any recommendations resulting from the flawed analysis would be negated. Properly normalizing costs is particularly important if various alternatives have different life-cycles. For DOE programs with projects where true LCCEs may get very complicated or with limitations, then it should be appropriate for the DOE program to develop AoA guidance for their tailored approach to this GAO best practice and others related, explained fully with all assumptions taken, and documented to enable decision makers to make comparisons among alternatives following a set criteria. This approach should also be included in the AoA Study Guidance and/or the AoA Study Plan and the results fully discussed in the AoA Final Report.

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<sup>18</sup> GAO, *GAO Cost Estimating and Assessment Guide for Best Practices for Developing and Managing Capital Program Costs*, GAO-09-3SP (Washington, D.C: Mar 2, 2009)

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**Definitions/Descriptions for Best Practices for the Analysis of Alternatives (AoA) Process**

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**16. Include a Confidence Interval or Range for LCCEs.**

*Definition:* The AoA team presents the LCCE for each alternative with a confidence interval or range, and not solely as a point estimate. To document the level of risk associated with the point estimate for each viable alternative, the confidence interval is included as part of the LCCE for each viable alternative (in accordance with the GAO Cost Estimating Practice #9, risk, and uncertainty analysis)<sup>19</sup>. Decision makers should have access to the confidence interval associated with the point estimates for all viable alternatives in order to make informed decisions. Additionally the AoA team uses a consistent method of comparing alternatives in order to present a comparable view of the risk associated with each alternative. For example, the comparison can be based on an established value across alternatives (in order to observe the confidence level for each alternative at that dollar value). Alternatively, the comparison can be based on a predetermined confidence level across all alternatives (in order to observe the dollar value associated with that confidence level for each alternative)

*Effect:* For decision makers to make an informed decision, the alternatives' LCCEs should reflect the degree of uncertainty. Having a range of costs around a point estimate is useful because it conveys a level of confidence for each alternative to achieve a most likely cost. Without cost risk and uncertainty analysis the LCCEs for the viable alternative are not credible.

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**17. Perform Sensitivity Analysis.**

*Definition:* The AoA team tests and documents the sensitivity of the cost and benefit and effectiveness estimates for each alternative to risks and changes in key assumptions. Major outcomes and assumptions are varied in order to determine each alternative's sensitivity to changes in key assumptions. This analysis is performed in order to rank the key drivers that could influence the cost and benefit estimates based on how they affect the final results for each alternative. Each alternative includes both a sensitivity and risk and uncertainty analysis that identifies a range of possible costs based on varying key assumptions, parameters, and data inputs. As explained in best practice #16 above, life-cycle cost estimates are adjusted to account for risk and sensitivity analyses.

*Effect:* Failing to conduct a sensitivity analysis to identify the uncertainties associated with different assumptions increases the chance the AoA team will recommend an alternative without an understanding of the full impacts on life-cycle costs, which could lead to cost and schedule overruns. An important component of the "effect" of the sensitivity analysis is that it provides a qualitative statement of the overall objectivity of the AoA assumptions and weighted criteria. Prior experiences in DOE have shown that, if major swings in overall ranking of an option are seen during the sensitivity analysis, it is usually because a pre-determined solution existed and the system has been "gamed" to ensure it comes out on top. An objective and robust process will demonstrate some swapping between the top tiered options due to the sensitivity analysis; however, major shifts (e.g., from first to last) will generally not be observed.

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**Phase IV. Document and Review the AoA Process**

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<sup>19</sup> GAO-093SP

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**Definitions/Descriptions for Best Practices for the Analysis of Alternatives (AoA) Process**

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**18. Document AoA Process in a Single Document.**

*Definition:* The AoA team documents all steps taken to identify, analyze, and select alternatives in a single document. This document clearly states the preferred alternative and provides the detailed rationale for the recommendation based on analytic results. The report includes sections detailing the steps taken to initialize the AoA process, and to identify, analyze, and select alternatives. For example, one section lists the overall selection criteria and rationale for nonviable or viable ratings for alternatives, assumptions for each alternative, risk drivers and mitigation techniques, analysis of the costs and benefits associated with each alternative, and the trade-offs between costs, benefits, and risks.

*Effect:* Documentation is essential for validating and defending the AoA process. Without clear reports that compile all information, including standards used to rate and perform the analysis, the study's credibility could suffer because the documentation does not explain the rationale for methodology or the calculations underlying the analysis. Having all the information related to all best practices of the AoA process in one single document also makes it easier for an independent reviewer to assess the AoA process. The amount of rigor, formality, and volume of the documentation should be tailored to the project cost and complexity. For large projects the documentation may be split into volumes. For example, Volume 1 can be a summary report, with more detail than an executive summary report, but a significant shorter and more digested document. Volume 2 can be the detailed analysis report with all of the supporting documentation described in the best practice, as well as any addendums such as the Study Charter and Guidance (if used); and the Study Plan.

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**19. Document Assumptions and Constraints.**

*Definition:* The AoA team documents and justifies all assumptions and constraints used in the AoA process. Assumptions and constraints help to scope the AoA. Assumptions are explicit statements used to specify precisely the environment to which the analysis applies, while constraints are requirements or other factors that cannot be changed to achieve a more beneficial approach. Both assumptions and constraints are detailed and justified for each alternative in the AoA Study Plan.

*Effect:* Without documented and justified assumptions and constraints it will be difficult for decision makers to evaluate between the alternatives.

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**20. Ensure AoA Process is Impartial.**

*Definition:* The AoA team conducts the analysis without a predetermined solution. The AoA process informs the decision-making process rather than reflecting the validation of a predetermined solution. The AoA process is an unbiased inquiry into the costs, benefits, and capabilities of all alternatives.

*Effect:* An AoA process is not considered valid if it is biased. Performing a study with a predetermined solution distorts the results. The validity of the analysis is affected if bias is introduced to the inputs.

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**Definitions/Descriptions for Best Practices for the Analysis of Alternatives (AoA) Process**

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**21. Perform Independent Review.**

*Definition:* An entity independent of the AoA process reviews the extent to which all best practices are followed. The AoA process is completed with enough thoroughness to ensure that an independent organization outside of the project's chain of command can review the AoA documentation and clearly understand the process and rationale that led to the selection of the recommended alternative. Part of the documentation includes approval and review from an office outside of the one that asked for or performed the AoA process. For certain projects, in addition to an independent review at the end of the AoA process, additional independent reviews are necessary at earlier stages of the process, such as reviews of the AoA process plan of the identification of viable alternatives. While early reviews are not a substitute for the independent review conducted at the end of the AoA process, they help ensure that bias is not added throughout the course of the AoA process.

*Effect:* An independent review is one of the most reliable means to validate an AoA process. Without an independent review, the results are more likely to include organizational bias or lack the thoroughness needed to ensure that a preferred solution is chosen and not a favored solution.

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**Phase V. Select a Preferred Alternative**

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**22. Compare Alternatives.**

*Definition:* The AoA team or the decision maker compares the alternatives using NPV, if possible, to select a preferred alternative. NPV can be negative if discounted costs are greater than discounted benefits. NPV is the standard criteria used when deciding whether an alternative can be justified based on economic principles. In some cases, NPV cannot be used, such as when quantifying benefits is not possible. In these cases, the AoA team documents why NPV cannot be used. Furthermore, if NPV is not used to differentiate among alternatives, the AoA team should document why NPV is not used, and describe the other method that is used to differentiate, and explain why that method has been applied.

*Effect:* Comparing items that have not been discounted (or normalized) does not allow for time series comparisons since alternatives may have different life cycles or different costs and benefits.

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## **APPENDIX D: SUGGESTED TEMPLATE FOR THE AOA CHARTER MEMO AND STUDY GUIDANCE DOCUMENT**

This generic template is provided as a sample of an equivalent Charter Memo and Study Guidance for authorizing the AoA Analysis Team to initiate the study (in some cases a Charter Memo or Tasking Memo will be sufficient such as for conventional projects of low complexity and risks). This template guidance should help to ensure completeness of the basic topics that should be addressed in a similar charge memo. The final product or artifact should be approved by decision makers prior to proceeding with or completing study.

The Charter Memo and Study Guidance should be produced by the Program/Project Office, succinctly summarizing:

1. Mission Need Gap and AoA Study Objectives
2. Core Composition of AoA Analysis Team and Team Lead
3. Preliminary Schedule of Expected Deliverables
4. Resources Required (material, intellectual, human, facilities, etc.)
5. Mission Need Statement Considerations (metrics for measuring the gap – success criteria)
6. Assumptions and Constraints
7. Evaluation Criteria
8. Core composition of the AoA Independent Review Team.
9. Governance and Approval Chain
10. Other Miscellaneous Issues.

The Charter Memo and Study Guidance bounds the trade space the AoA Analysis Team (A-Team) has to work on and set guidelines regarding expectations on the deliverables. This approach saves times and resources by assuring that the program understand its needs, and that those needs are current and have been vetted within the program chain of command. In addition, to assist in assuring that the resources for the study is available and sufficient.

The amount of documentation, formality and rigor should be tailored to the cost and complexity of the program/project.

DOE programs should tailor this suggested template to their organization and business operational procedures for managing projects/programs. Some programs may only have a Charter Memo with only the minimum basic requirements such as (the rest from above should be covered subsequently in the Study Plan):

1. Mission Need Gap and AoA Study Objectives
2. AoA Team Lead
3. Assumptions and Constraints
4. Preliminary Schedule of Expected Deliverables
5. Resources
6. Other Miscellaneous Issues.

**MEMORANDUM FOR** [Distribution]

**THROUGH:** [Name/Project Owner]  
[Position or Title]  
[Organization]

**FROM:** [Name of Decision Maker/Project Management Executive]  
[Position Title]  
[Organization]

**SUBJECT:** [Charter Memo and Study Guidance for the XXX  
Program/Project Analysis of Alternatives]

Please, be informed that I have named [Dr. /Mr. /Ms. Full Name] to initiate an analysis of alternatives (AoA) in support of the [YYY Program/Project] and be the AoA Team Lead. [Dr. /Mr. /Ms. Last Name] will be reporting progress to the Project Owner and the Program Manager [Name, Federal Program Manager for YYY Program/Project]. This AoA study is expected to last for a period of [XX months], with final completion date by [yy/yy/yyyy].

[Dr. /Mr. /Ms. Last Name] will be requiring your support on staffing [his/her] Analysis Team by borrowing SME's from your organization as consultants. Please, make sure you also make available material, information and other resources as required.

Enclosed is the Study Guidance Document for this effort providing further details. If you have any questions regarding this process, feel free to contact [Dr. /Mr. /Ms. Full Name (add contact information) or Dr. /Mr. /Ms. Alternate Full Name (add contact information)].

Attachment:

[Regularly, there is only one attachment and that is the Study Guidance Document, however, the decision maker might want to add other relevant information as appropriate, i.e., a white paper, SOW in the case of a contractor providing cost estimating support, etc.].

**Distribution:**

[Include leadership of the Program/Project Office (P/PO), Analysis Team Lead, SME's that might be involved in the analysis, responsible parties and their leadership accountable for providing information and other resources to the Analysis team and other stakeholders as determined by the decision maker.]



## GENERIC ANALYSIS OF ALTERNATIVES STUDY GUIDANCE DOCUMENT

[XXXX PROGRAM/PROJECT]

- I. Introduction / Background:** [Provide a short intro/background of the program/project, to include the objective of this study, and discussion on the role of the study outcome in the rest of the acquisition effort]

**II. Proposed Team Composition:**

ROLE	NAME	ORGANIZATION	CONTACT INFORMATION
Analysis Team Lead			
Cost Estimating Lead			
SME #1			
SME #2			
SME #3			
Add as many individuals known at this point.... The team lead will make final selection later in the process and report during Study Plan Review of the final team composition.			

**III. Preliminary Schedule:**

KEY MILESTONE	TAKING PLACE NLT...	COMMENTS/CAVEATS
Kick-Off Meeting	Enter dates	Flexibilities? Tailored in/out?, etc.
Study Plan Review		
Analysis Plan Review		
Preliminary Results Review		
Final AoA Report Review		
These are preliminary dates and will be finalized by mutual agreement during Study Plan Review		

**IV. Resources Required:** (tailored to cost and complexity of the program/project)

RESOURCE	RESOURCE OWNER	CONTACT INFORMATION	REQUIRED NLT
Mission Need Statement (CD-0 Authorization and Mission Need Documentation)			Provide a target date.
Program Requirements Document			“
[Conceptual Design(s)]			“

RESOURCE		RESOURCE OWNER		CONTACT INFORMATION		REQUIRED NLT	
[Pre-Concept of Operations]						“	
[White Papers]						“	
[Modeling tools]						“	
[Test Data]						“	
[Facility Inspection(s)]						“	
FUNDING							
Total:		FY[X X]:		FY[Y Y]:		FY[Z Z]:	
						B&R:	
SUPPORT CONTRACT							
CONTRACT OR TASK ORDER #:		TITLE:		PERIOD OF PERFORMANCE		Value	
				Base	[Mo/Yr – Mo/Yr]		
				Op#1	[Mo/Yr – Mo/Yr]		
				Op#2	[Mo/Yr – Mo/Yr]		
<p><b>COMMENTS/SPECIAL INSTRUCTIONS:</b></p> <p>Provide a preliminary list of resources that will be available to the Analysis Team and the POC that will be responsible for providing this. Ensure that both the resource owner and leadership in that organization are part of the distribution list since they need to be aware that they are responsible to provide this to the team.</p> <p>In some cases, an existing contract/task order might be available or funding may be provided by decision maker or P/PO to fund independent assessments or independent cost estimates in support of the Analysis Team.</p>							

**V. Mission Need Statement Considerations**

MISSION NEED	MISSION PARAMETER	SUCCESS CRITERIA
<p>The mission needs are those taken directly from the MNS and PRD. Since at this point we do not have formal requirements (just mission parameters), describe the metrics that will be used for measuring the mission need or the gap. Mission success criteria refer to what value or level should the mission parameters be achieved to consider the mission successful or the gap closed.</p>		

## VI. Assumptions and Constraints:

The AoA Team should consider, as a starting point the following set of alternatives (not all inclusive), which may be expanded or modified through the course of this exercise:

ALTERNATIVE NAME	DESCRIPTION	OWNER OR REFERENCE

These alternatives should be bounded by the following assumptions and constraints: (the following are generic; the program/project should generate the appropriate ones)

TRADE SPACE	DESCRIPTION
<b>Directives</b>	Provide brief description, tradable/non-tradable, N/A, etc.
<b>Organization</b>	
<b>Training</b>	
<b>Materiel</b>	
<b>Leadership &amp; Education</b>	
<b>Personnel</b>	
<b>Facilities</b>	
<b>Grants</b>	
<b>Regulations</b>	
<b>Authorizations / Appropriations</b>	
<b>Standards</b>	
<b>Statutes</b>	
<b>Policies</b>	
<b>Other Issues to Consider:</b>	[i.e.: Technology Readiness Levels (TRLs) for new technologies under consideration, cost not to exceed (NTE), schedule constrained (system or technology required to be delivered by ...), etc.]

OTHER ISSUES TO CONSIDER	
Not to Exceed (NTE) Cost	
Expected System/Product Delivery Date (s)	
Minimum TRL to be considered	
Others	

## VII. Evaluation Criteria

For this AoA exercise, the team should use as a guidance the evaluation criteria prescribed in the following reference, directive, or standard. These evaluation criteria will be used by the independent review team assessing this effort prior to formal AoA technical reviews (i.e., Study Plan Review, Analysis Plan Review, Preliminary Results Review and Final AoA Report Review). An exception is taken on the following criterion, which will be tailored the following way:

Best Practice		Tailoring Description	Issue Owner or POC
#	Title		

## VIII. Governance and Approval Chains

An independent review team will be created to assess and validate progress on this AoA to assure that the AoA is well documented, comprehensive, unbiased and credible. The following individuals form the core AoA Independent Review Team which are outside of the project's chain of command and independent of the AoA process:

NAME	Org	Contact Info.		ROLE	Signature Authority
		Phone #	email		

**Roles:** Chair (C), Member (M), Subject Matter Expert (SME), Independent Assessor (IA)

**Signature Authorities:**

Approve (A) – Provides assurances to the Project Management Executive (PME) and the Project Owner that the effort has been conducted with sufficient technical rigor and resources may be committed to support this effort in subsequent stage.

Endorse (E) – Provides assurances to the PME and the Project Owner that the effort has been conducted with sufficient technical rigor. Endorsement means that these members considered all technical merits and completeness of the work performed. Unanimous endorsement is a prerequisite for PME’s approval. Endorsements occur from members outside the Program/Project Office chain of command. This may include external stakeholders (e.g., Sponsors, etc. Endorsements carry same weight as an approval and may only be overwritten by a higher individual in the chain of command (e.g., the PME).

Concur (w or w/o comments) [C (w/c) or C (w.o./c)] – These are stakeholders, such as SMEs, indicating that they have reviewed all artifacts and submittals supporting entrance criteria to this review. They also indicate that they have been consulted and given the opportunity to express their point of view to the rest of the AoA Team. Although some of these stakeholders and/or SMEs might agree or disagree with the readiness of the program/project to proceed, their inputs are taken by the “endorsers” and “approver” before making a final decision. Concurrence does not have to be unanimous. Dissenting opinions are captured through meeting minutes and if action items are required to correct issues, they should be recorded in the final report.

**Other:** All artifacts and completion letters of the AoA effort have to be signed by the AoA Team Lead and the Project Owner. This includes Study Plan and the Final AoA Report. The Final AoA Report should be validated by the Independent Review Team and documented in a report to the PME endorsed by the Project Owner.

Any deviation from recommendations provided in this Guidance Document should be requested in writing by the AoA Analysis Team Lead, endorsed by the Project Owner and approved by the PME.



## **APPENDIX E: SUGGESTED TEMPLATE FOR THE AOA STUDY PLAN AND FINAL REPORT**

This template is provided as guidance to the user. This guidance template may assist the user in organizing the Study Plan and Final Report assuring coverage of all areas that need to be addressed. The Study Plan should be reviewed and endorsed by the Project Owner before beginning the AoA. The Study Plan should be approved by the PME prior to proceeding with the study.

The AoA Study Plan captures the approach, significant steps/activities of the study, schedule, staff and resources required for the completion of the study. At the completion of the study, these documents should be integrated into the AoA Final Report, with a full discussion of the caveats, and deviations from the original plans to the final implementation of the study and analysis. This final report should document that “historical perspective for the record”, and discuss the final results.

While the Study Plan “looks into the future”, the AoA Final Report should capture all those decisions and rationale for deviation from the original plans. The Final report should document that “historic perspective for the record”, and in addition discuss final results and provide recommendation on alternative(s). In other words, the AoA Final Report should be a stand-alone document (GAO best practice #18).

**Generic Template for Study Plan and Final Report  
Analysis of Alternatives (AoA) for  
[PROGRAM/PROJECT XYZ]**

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[AUTHOR(s)]

[PERFORMING ORGANIZATION]



ANALYSIS OF ALTERNATIVES

for

[TITLE]

Submitted by:

\_\_\_\_\_  
AoA Team Lead

\_\_\_\_\_  
Date

(All Applicable)

Endorsed by:

\_\_\_\_\_  
Title and Organization/Project Owner

\_\_\_\_\_  
Date

Approved by:

\_\_\_\_\_  
Project Management Executive

\_\_\_\_\_  
Date

## REVISION SUMMARY

Rev. No.	Date	Change Description	Pages Affected
0	XXXX	Initial Draft Report	
1	XXXX	Updated and added text and tables based on comments received	All

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## **EXECUTIVE SUMMARY**

Provide a brief (two to three pages) summary of the Analysis of Alternatives. Highlight the salient points of each section in the document.

## **ACRONYMS**

Self explanatory – include all applicable acronyms used in the plan or report.

## **SECTION 1: SCOPE**

Describe the purpose of the study and highlight developments that provide the necessity for the AoA. Identify any tailoring or streamlining used to focus the study. Describe broadly the nature of the possible alternatives to be considered.

### **1.1 Approach**

Describe the overall process and methodology planned for the analysis. This should include the high level description of overall steps to be used that helps orient the reader on what to expect to find in the document.

### **1.2 GAO Best Practices**

Highlight how the Government Accountability Office (GAO)'s 22 Best Practices for the AoA were followed to the extent possible and where in the document this assessment is documented. The review process should also comply with the review section of the DOE AoA Guide as well as the DOE Program Office requirements and the review requirements in DOE O 413.3B.

## **SECTION 2: INTRODUCTION AND MISSION NEED**

### **2.1 Introduction**

Briefly describe the background and history of the project. Summarize any relevant analyses that precede this study.

### **2.2 Mission Need**

Summarize approval dates and provide overview of the key aspects of the Mission Need Statement.

## **SECTION 3: REQUIREMENTS AND ASSUMPTIONS**

### **3.1 Requirements**

Summarize the identified and established mission and program requirements (i.e., the

general parameters that the selected alternative must have to address to meet the mission need and close capability gaps) for the project and their sources. Use tabular formats or other methods to best communicate the functional requirements for the project. These functional requirements should be realistic, organized, clear, prioritized, and traceable.

### **3.2 Assumptions and Constraints**

Identify the most significant (i.e. fundamental) assumptions made in the course of the analysis and any potential impact on the results. The description of these assumptions should be at a very high level and include the items with the most influence on the AoA analysis. Identify any constraints or limitations of the analysis and identify any potential impact on the results. Examples may include:

- Operational limitations
- Geographic, organizational and environmental location
- Standardization and standards requirements
- Environmental, Safety, and Health
- Safeguards and Security
- Interfaces with existing and planned acquisitions
- Consistent application of estimating sources
- Funding type
- Affordability limits on investment
- System design and life design life
- Legal and regulatory constraints or requirements
- Stakeholder considerations
- Additional assumptions and constraints

## **SECTION 4: ALTERNATIVES IDENTIFIED AND DESCRIBED**

Identify and provide a detailed description of each possible alternative that was analyzed. A summary level list of alternatives may be provided as a table in the body of the document with more detailed description included in an Appendix. Identify the legacy status quo baseline (current system and its funded improvements) that is being replaced, if applicable. Include a discussion of the role of Regulations, Authorizations/Appropriations, Standards, Statutes and Policies played in the selection of alternatives, if significantly different/changed from the MNS discussion.

## **SECTION 5: INITIAL SCREENING OF ALTERNATIVES**

Summarize the initial screening of alternatives against the predetermined mission and program requirements (these should align with section 3.1). Describe the process and analysis used to determine the viability of an alternative. This is only used to perform an initial screening of those alternatives not able to meet, or partially meet, the requirements. Appendices may be used to further describe the screening conducted and rationale for scoring.

## **SECTION 6: EVALUATION CRITERIA**

This section describes the criteria (hierarchy of metrics and desired attributes) selected to assess the relative effectiveness and performance of the alternatives. The analysis team should use a standard practice to document the benefits and effectiveness of each alternative. The AoA team drafts a metric framework that details the methods to be used to evaluate and quantify the effectiveness and performance for all mission needs. How these measures and any weighting used are tied to specific mission needs and functional requirements should also be explained and documented. This is the hierarchy that connects the overarching requirements to the data that are needed. Appendices may be used to further describe the evaluation criteria and rationale for ratings of importance.

## **SECTION 7: COST AND SCHEDULE ESTIMATES**

Summarize the techniques and data sources used in development of the LCCE, e.g. indexes, parametric cost estimating relationships and models, etc. The following items are examples of information that should be addressed in this section:

- Life-Cycle Cost Estimate Methodology, NPV and Estimate Ranges
- Schedule Methodology
- Models and Data employed
- Cost Sensitivity and/or Risk Analysis

Include a summary tabular format or other easily consumed presentation of the Cost and Schedule information for each alternative considered. The detailed LCCEs should be attached to the AoA Final Report as an appendix. Additionally the appendix should address how these estimates were developed in accordance with the best practices for developing and managing the capital program costs found in the Government Accountability Office (GAO) Cost Estimating and Assessment Guide.

## **SECTION 8: ALTERNATIVE EVALUATION**

### **8.1 Risk Assessment**

Describe the methodology and results for how project execution risks (both opportunities and threats) were analyzed for each alternative.

### **8.2 Alternatives Scoring**

Provide an objective presentation of the results of the analysis. Results should be shown in tabular or graphical form to clearly show differences in the results for each analyzed alternative. Explain how the evaluation criteria from Section 6 was used along with all other sources which informed the criteria. This should include the risk assessments of each alternative, subject matter expertise as appropriate and cost/schedule estimates. The primary purpose of this section is to concisely and objectively present how the AoA team employed the evaluation/performance criteria, cost and risk analyses in the analysis and

their results. Use appendices as necessary to maintain the readability of this section while providing necessary documentation and traceability of the analysis.

### **8.3 Sensitivity Analysis**

Plan for and conduct sensitivity analysis as a check on the results in Section 8.2 to determine the impacts of both the weighting and input scores used in the scoring. Summarize significant findings and conclusions from this analysis.

## **SECTION 9: CONCLUSIONS**

Provide the recommended ranking of alternative(s) and provide the detailed rationale for this recommendation, based on analytic results. Identify key parameters and conditions from the analysis that drove the ranking, and may impact the acquisition.

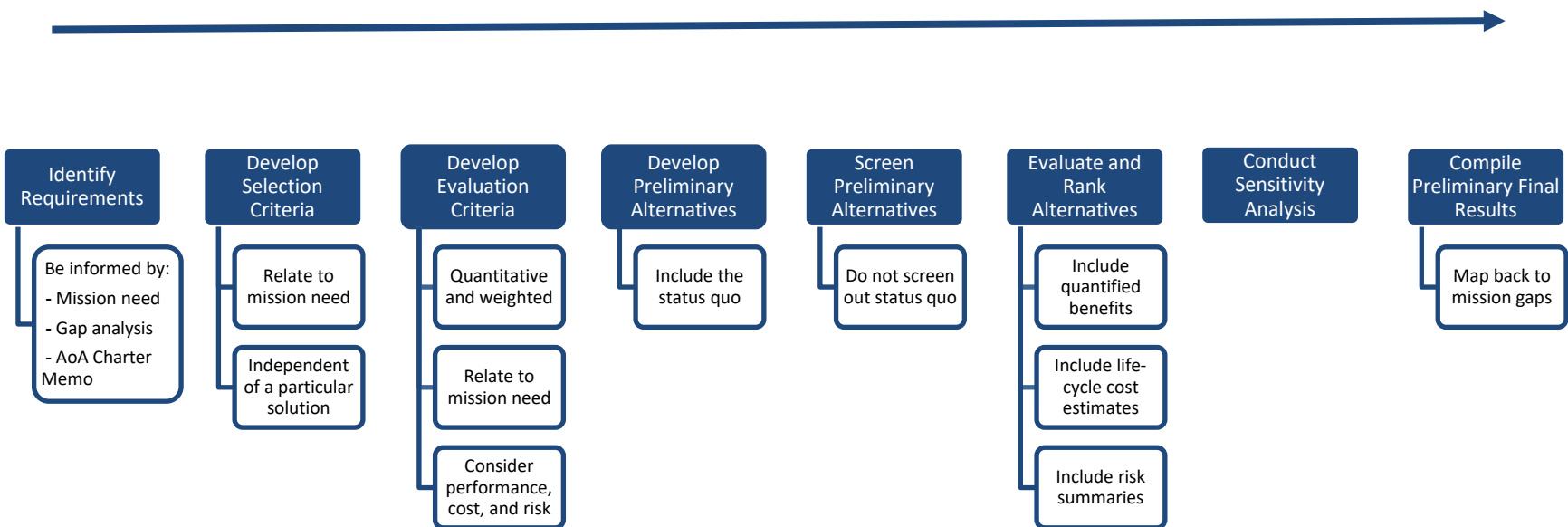
## **SECTION 10: TEAM MEMBERS AND SUBJECT MATTER EXPERTS**

Provide role and short summaries on the qualifications and experience of the study team lead and key personnel. The program office provides support to the Analysis Team. Briefly summarize the oversight and review process for the AoA in this section as well. The review process should comply with the review section of this guide as well as the DOE Program Office requirements, and the review requirements in DOE O 413.3B.





## APPENDIX F: SUGGESTED DOE AOA ANALYSIS STEPS





## APPENDIX G: CROSSWALK OF THE GAO CHARACTERISTICS OF HIGH-QUALITY AOA AND THE RELEVANT AOA BEST PRACTICES

Characteristics	AOA process best practice
<b>Well documented:</b> The analysis of alternatives (AOA) process is thoroughly described, including all source data, clearly detailed methodologies, calculations and results, and selection criteria are explained. <ul style="list-style-type: none"> <li>Includes a detailed list of ground rules, assumptions, risks, and mitigation strategies needed to provide a robust analysis for all alternatives.</li> <li>Explains how each alternative's identified measures of benefits/effectiveness support the mission needs.</li> <li>Details in a single document all processes, criteria, and data used to support the AOA process's final decision.</li> <li>Describes the estimating methodology and rationale used to build costs and benefits for all alternatives.</li> </ul>	12. Identify significant risks and mitigation strategies 14. Tie benefits/effectiveness to mission need 18. Document AOA process in a single document 19. Document assumptions and constraints
<b>Comprehensive:</b> The level of detail for the AOA process ensures no alternatives are omitted and that each alternative is examined thoroughly for the project's entire life-cycle. <ul style="list-style-type: none"> <li>Identifies and screens a diverse range of alternatives.</li> <li>Compares alternatives across their entire life-cycle rather than focusing on one phase of the acquisition process.</li> </ul>	1. Define mission need 3. Develop AOA timeframe 8. Develop list of alternatives 11. Assess alternatives' viability 15. Develop life-cycle cost estimates (LCCs)
<b>Unbiased:</b> The AOA process does not have a predisposition towards one alternative over another but is based on traceable and verified information <ul style="list-style-type: none"> <li>Defines the mission needs and functional requirements independently of an operational solution.</li> <li>Ensures that the appropriate personnel are assigned to the task and there is enough time to complete a thorough study.</li> <li>Documents a standard process that defines selection criteria based on mission need and quantifies the benefit/effectiveness measures to ensure the AOA process is conducted without a pre-determined solution in mind.</li> <li>Compares solutions based on pre-established weighted selection criteria and net present value techniques.</li> </ul>	2. Define functional requirements 4. Establish AOA team 6. Weight selection criteria 7. Develop AOA process plan 13. Determine and quantify benefits and effectiveness 20. Ensure AOA process is impartial 22. Compare alternatives
<b>Credible:</b> The AOA process discusses any limitations of the analysis resulting from the uncertainty surrounding the data to assumptions made for each alternative. <ul style="list-style-type: none"> <li>Includes a baseline scenario as the benchmark to enable comparison between alternatives.</li> <li>Life-cycle cost estimates developed for each alternative include a confidence interval or range developed based on risk/uncertainty analysis.</li> <li>Details the sensitivity of both costs and benefits to changes in key assumptions for all alternatives.</li> <li>Independent review of the AOA process is performed to ensure that the study's results are logical and based on the documented data, assumptions, and analyses.</li> </ul>	5. Define selection criteria 9. Describe alternatives 10. Include baseline alternative 16. Include a confidence interval or range for LCCs 17. Perform sensitivity analysis 21. Perform independent review