Analysis of Alternatives (AoA) Handbook

A Practical Guide to Analyses of Alternatives

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Preface

The Analysis of Alternatives (AoA) Handbook embodies the Air Force's current guidance for planning and executing Air Force and Air Force-led AoAs within the Department of Defense (DoD) acquisition process. This handbook is revised to reflect any major evolution in the frequently changing acquisition and capabilities/requirements processes. Individual chapters are updated to reflect the latest analysis techniques and regulatory requirements required to support acquisition efforts. This update to the *AoA Handbook* reflects changes due to:

- DoD Instruction (DODI) 5000.02 dated 2 December 2008
- CJCSI 3170.01G dated 1 March 2009
- Weapon Systems Acquisition Reform Act (WSARA) of 2009

It is not the intent or goal of this handbook to repeat the details of established guidance. Its objective is to demonstrate how the Air Force AoA process contributes and supports the Defense Acquisition Management Framework.

The AoA Handbook is produced by the Air Force Materiel Command's (AFMC) Office of Aerospace Studies (OAS). OAS is designated the Air Force Center of Expertise (CoE) for AoAs. We'd like to hear what you think about the AoA Handbook, especially if you have suggestions for improvements in organization, accuracy, and/or content.

About OAS

OAS provides guidance, technical, analytical, and costing support to the operational commands, AFMC, and the Air Staff in planning, conducting, and reviewing AoAs and related studies supporting acquisition decisions. In addition, OAS supports the major commands (MAJCOMs) and AFMC product centers with analytical investigations and evaluations of systems and related issues. For additional information, visit the OAS web site at (http://www.oas.kirtland.af.mil).

1 Introduction

An AoA is an analytical comparison of the operational effectiveness, cost, and risks of proposed materiel solutions to gaps and shortfalls in operational capability. AoAs document the rationale for identifying and recommending a preferred solution or solutions to the identified shortfall(s). Threat changes, deficiencies, advances in technology or the obsolescence of existing systems can trigger a capabilities based assessment (CBA) and consequently an AoA. This handbook deals with Air Force-specific AoAs and those Joint AoAs where the Air Force is designated as the lead service. For AoAs where a Combatant Command (COCOM) is the lead, the methodology for conducting the AoA can be used to guide the analysis; however, the oversight and approval will be the responsibility of the COCOM. AoAs are an important element of the defense requirements and acquisition processes and as such, the Office of the Secretary of Defense (OSD) is demonstrating increased involvement and oversight in AoA activities.

AoAs are essential elements of the three processes in the DoD that work in concert to deliver the capabilities required by warfighters: the requirements process, the acquisition process, and the Planning, Programming Budgeting and Execution (PPBE) process.

During the requirements process, the Joint Capabilities Integration and Development System (JCIDS) is initiated and executed through a CBA. The CBA identifies shortfalls or gaps in operational capabilities. The CBA analysis then provides the framework for the development of the Initial Capabilities Document (ICD). Once this document is approved through the JCIDS approval process, it acts as the foundation for the acquisition process.

Within the DoD acquisition process, there are multiple milestones and decision points. At each acquisition milestone or decision point, an acquisition program can be initiated, continued, revised, or cancelled. The acquisition process involves a number of acquisition phases following the milestones and/or decision points in which the development of the program proceeds.

The PPBE process is how the DoD allocates its resources. It enables the DoD and their contractors to stay within their fiscal budget while they follow the Secretary of Defense's policy, strategy and goals. DoD budget issues are impacted by the AoA process.

In the Air Force, the AoA has taken on an increasingly important role in determining whether or not a system should be procured and if so, what would be the nature of the technologies and capabilities available for acquisition. Air Force AoAs must not only make a case for having identified the most cost-effective alternative(s), they must also make a compelling statement about the associated risk and the capabilities and military worth that acquiring those alternative(s) will provide. In short, the AoA has become an important vehicle providing information that can be used by senior DoD leaders to debate and assess a potential program's feasibility.

The current DoD Acquisition process identifies the Office of the Secretary of Defense Cost Assessment and Program Evaluation (OSD/CAPE) and Acquisition, Technology and Logistics (OSD/AT&L) roles in the AoA process. Their roles will be addressed further in the next chapter. Likewise, the Joint Staff has a defined role through the Functional Control Board (FCB) review of Initial Capabilities Documents (ICDs).

Other services have their own processes for executing AoAs. When the Air Force is directed to support an AoA led by another service, the Air Force will follow the lead service’s

procedures and guidance. The Air Force's direct involvement in the lead service's process will ensure that Air Force interests are considered and addressed in the AoA. Likewise, for AoAs where the Air Force is identified as the lead service, it is imperative that the Air Force openly support and defend the supporting service's issues and concerns.

1.1 Purpose of the AoA

AoAs help justify the need for starting, stopping, or continuing an acquisition program. They are done because decision makers need reliable, objective assessments of the options for providing required capabilities. AoAs identify potentially viable solutions and provide comparative cost, effectiveness, and risk assessments of each solution to a baseline; this baseline is typically the current method of providing the required capabilities for the defined Mission Tasks (MTs).

AoAs are a big factor in selecting a final solution, but they aren't the only factor. The final decision must consider not only cost, effectiveness, risk, and military worth, but also domestic policy, foreign policy, technological maturity of the solution, the environment, the budget, treaties, and other factors. AoAs also provide a foundation for developing operational requirements, concepts of operational employment, a test and evaluation strategy for preferred alternatives, and additional information invaluable to a program office when and if one is formed.

1.2 Who Looks at AoAs?

AoA results are usually briefed at high levels in the Air Force and the OSD, and are used in the decision making process to support acquisition of new capabilities and systems for the warfighters. AoA results influence the investment of significant DoD resources. As a result, they receive multi-layered direction and oversight from start to finish. This direction and oversight is necessary to achieve a credible AoA and subsequent buy-in of the results and findings. The nature of an AoA will also reveal understanding and insights into the needed operational capabilities in order to accomplish the desired military effects.

1.3 The AoA Study Team

A study director leads the study team performing the AoA. The director is normally appointed from the Air Force Major Command (the operational user) that is designated as the lead for the AoA. However, if that organization does not have the resources to supply the director, another appropriate organization may lead. The study director forms the study team from appropriate members of the Command, other Air Force commands, Air Force Agencies, the Army, Navy and Marines, DoD, civilian government agencies, and contractors.

Not all study teams will be identical, either in size or makeup of members. Each team should be tailored based on the nature of the AoA to be accomplished, along with the time and money available to complete the AoA. The study team is organized along functional lines to develop alternatives, threats and scenarios, effectiveness, risk, and cost. Small AoA teams with dedicated full-time members, working at a common location, are often better able to react to the timeline demands of the AoA tasking, and may be more productive.

OAS helps by supplying an advisor to the study director. This advisor assists in training, planning, administering, executing, and facilitating the accomplishment of the AoA and required reviews. OAS is focused on ensuring quality, consistency, and value in Air Force AoAs.

1.4 AoA Products

Most AoAs produce four major products:

- A Study Plan which defines the background, direction, goals, methodologies, tools, schedule, and other elements of the AoA
- A midterm progress briefing to summarize early work and future plans
- A Final Report to document the AoA process and results in detail
- A final briefing to summarize the final results of the AoA

While the AoA is not a "Source Selection" effort, the products of the AoA are "Source Selection Sensitive." This means that the products of the AoA should not be released outside the AoA study team and approval process. The AoA process and their products should not be influenced by or released to anyone who may have a stake in the outcome.

The Study Plan is critical to the AoA process because it defines what will be accomplished during the AoA and how it will be done.

The midterm progress briefing is designed to provide an interim report of the study results and to permit redirection of the AoA by senior reviewers, if necessary.

The Final Report is the repository for AoA information describing what and how the AoA was accomplished and the results or findings from the analysis process. It requires significant time and effort to produce. The Final Report should include detailed descriptions of the analysis and results of the AoA effort. It is important to continuously document the process and results throughout the study, because the team members will disperse quickly after the study is completed. We have learned that if the Final Report is not finalized shortly after the end of the study, there may be little to show for what was accomplished during the AoA. **A study not documented is just as good as a study not done!**

The final briefing carries the most impact, and hence generates the most interest, because it will provide answers to important questions and issues, and summarize the findings for the decision makers.

2 Support to Decision Making

2.1 The Defense Acquisition Management Framework

The DoD Acquisition System is structured to manage the nation's investments in technologies, programs, and product support which allows the achievement of National Security Strategy and support for the United States Armed Forces. This investment strategy is structured to support today's force and future forces.

The main purpose of the DoD Acquisition System is to acquire quality products that satisfy the user's needs with measurable improvements to mission capability and operational support in a timely manner and at a fair and reasonable price. AoAs are critical analyses that support the DoD acquisition process. DoD acquisition guidance is outlined in DODD 5000.01 and DODI 5000.02.

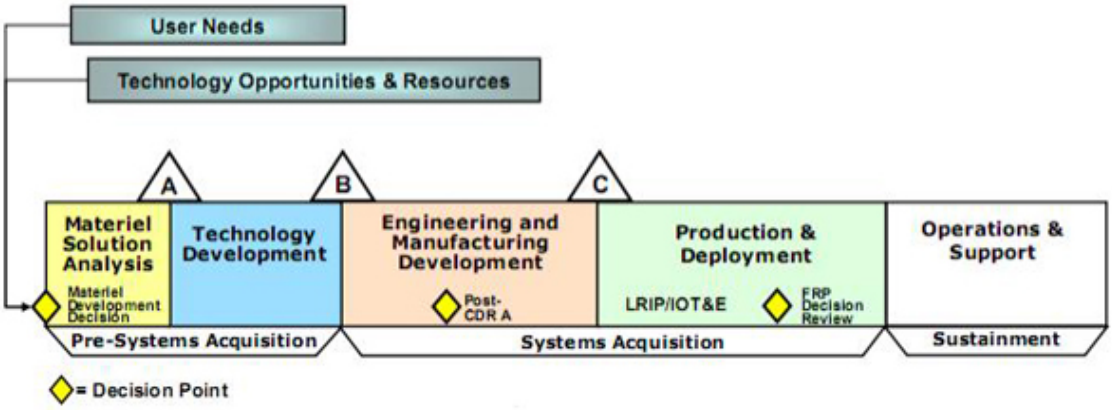

Figure 2-1: The Defense Acquisition Management Framework

The Acquisition Management Framework for DoD consists of three activities as shown in Figure 2-1. The activities are Pre-Systems Acquisition, Systems Acquisition, and Sustainment. These activities consist of a total of five phases and have three milestones. The milestones (A, B, and C) are positioned at the end of each of the first three phases. In addition to the milestones, there is a Materiel Development Decision (MDD) made at the start of the first phase (Materiel Solution Analysis), a Design Review made in the third phase (Engineering and Manufacturing Development), and a Full Rate Production Decision Review made in the fourth phase (Production & Deployment).

Proceeding through the acquisition process is dependent upon obtaining sufficient knowledge to continue to the next stage of acquisition. This is where AoAs contribute significantly to the Milestone Decision Authority (MDA) decision process, providing critical information needed by the MDA to help support his/her decisions. The MDA may authorize entry into the process at any point consistent with phase specific entrance criteria and statutory requirements. AoAs are typically done in the Materiel Solution Analysis phase, but can also be done in any of the subsequent phases to answer questions which were not addressed by a previous AoA. Results from the AoA provide information that allows the Program Manager (PM) and the MDA to exercise discretion and prudent business judgment to structure a tailored, responsive, and innovative program.

For additional insight on the acquisition process, visit the Defense Acquisition Guidebook at https://dag.dau.mil/Pages/Default.aspx.

2.2 Acquisition Categories (ACATs)

Weapons system programs along with Command, Control, Communications, Computers and Intelligence (C4I) or Information Technology (IT) programs are placed in ACATs based on the estimated program life-cycle cost. These categories were established to facilitate decentralized decision making while complying with Congressional mandates for appropriate oversight. The most significant effect of the ACAT is that it determines the level of the Material Decision Authority (MDA) for the program. Oversight and decision-making authority for large programs is retained by OSD, while management of smaller programs may be delegated to Service-level or below. This decision also affects the level of review and approval of AoA plans and results. Table 2-1 gives the description for the ACAT designation and the associated decision authority.

If a program meets one of the dollar thresholds for it to be designated a Major Defense Acquisition Program (MDAP), then the program is designated an MDAP. If the program is below the dollar threshold for designation as an MDAP, the Defense Acquisition Executive (DAE) may still designate the program an MDAP if the DAE deems oversight with statutory reporting is needed. An MDAP is designated ACAT I and its oversight comes from the DAE. The DAE can either retain MDA or delegate it to a Component Acquisition Executive (CAE). If the DAE retains MDA, the program is an ACAT ID program. If the DAE delegates MDA to the CAE, then the program is an ACAT IC program. As an MDAP, the program must meet all statutory reporting requirements for MDAP programs.

If the DAE desires oversight of a program that falls below MDAP dollar thresholds, and deems that statutory reporting associated with MDAPs is not needed, the program is designated a Special Interest Program. If the DAE retains MDA, the program is an ACAT ID Special Interest program. If the DAE delegates MDA to the Component Head or CAE, then the program is an ACAT IC Special Interest program. The CAE may also designate Special Interest programs that are ACAT II or below. For such Special Interest programs, the reporting requirements are tailored to meet the specific oversight needs.

Acquisition Category	Reason for ACAT Designation	Decision Authority

ACAT I	• MDAP (section 2430 of Reference (k))
	  o Dollar value: estimated by the USD(AT&L) to require an eventual total expenditure for research, development, test and evaluation (RDT&E) of more than $365 million in fiscal year (FY) 2000 constant dollars or, for procurement, of more than $2.190 billion in FY 2000 constant dollars
	  o MDA designation
	• MDA designation as special interest
		ACAT ID: USD(AT&L)
		
		ACAT IC: Head of the DoD Component or, if delegated, the Component Acquisition Executive (CAE) (not further delegable)

ACAT IA[1, 2]	• MAIS (Chapter 144A of Reference (k)): A DoD acquisition program for an Automated Information System[3] (either as a product or a service) that is either:
	• Designated by the MDA as a MAIS; or
	• Estimated to exceed:
	  o $32 million in FY 2000 constant dollars for all expenditures, for all increments, regardless of the appropriation or fund source, directly related to the AIS definition, design, development, and deployment, and incurred in any single fiscal year; or
	  o $126 million in FY 2000 constant dollars for all expenditures, for all increments, regardless of the appropriation or fund source, directly related to the AIS definition, design, development, and deployment, and incurred from the beginning of the Materiel Solution Analysis Phase through deployment at all sites; or
	  o $378 million in FY 2000 constant dollars for all expenditures, for all increments, regardless of the appropriation or fund source, directly related to the AIS definition, design, development, deployment, operations and maintenance, and incurred from the beginning of the Materiel Solution Analysis Phase through sustainment for the estimated useful life of the system.
	• MDA designation as special interest
		ACAT IAM: USD(AT&L) or designee
		
		ACAT IAC: Head of the DoD Component or, if delegated, the CAE (not further delegable)

ACAT II	• Does not meet criteria for ACAT I • Major system o Dollar value: estimated by the DoD Component Head to require an eventual total expenditure for RDT&E of more than $140 million in FY 2000 constant dollars, or for procurement of more than $660 million in FY 2000 constant dollars (section 2302d of Reference (k)) • MDA designation[4] (paragraph (5) of section 2302 of Reference (k))	CAE or the individual designated by the CAE[4]

Acquisition Category	Reason for ACAT Designation	Decision Authority
ACAT III	• Does not meet criteria for ACAT II or above • AIS that is not a MAIS	Designated by the CAE[4]

1. In some cases, an ACAT IA program, as defined above, also meets the definition of an MDAP. The USD(AT&L) shall be the MDA for such programs unless delegated to a DoD Component. The statutory requirements that apply to MDAPs and MAIS shall apply to such programs.
2. The MDA (either the USD(AT&L) or, if delegated, the ASD(NII)/DoD CIO or another designee) shall designate MAIS programs as ACAT IAM or ACAT IAC. MAIS programs shall not be designated as ACAT II.
3. Automated Information System: A system of computer hardware, computer software, data or telecommunications that performs functions such as collecting, processing, storing, transmitting, and displaying information. Excluded are computer resources, both hardware and software, that are:
    a. an integral part of a weapon or weapon system;
    b. used for highly sensitive classified programs (as determined by the Secretary of Defense);
    c. used for other highly sensitive information technology programs (as determined by the ASD(NII)/DoD CIO); or
    d. determined by the USD(AT&L) or designee to be better overseen as a non-AIS program (e.g., a program with a low ratio of RDT&E funding to total program acquisition costs or that requires significant hardware development).
4. As delegated by the Secretary of Defense or Secretary of the Military Department.

Table 2-1: Description and Decision Authority for ACAT I – III Programs.

2.3 JCIDS Analysis and AoAs

The CBA is the analytic basis of the JCIDS process. It identifies capability needs and gaps and recommends non-materiel and/or materiel approaches to address gaps. A CBA may be based on the following: an approved Joint Concept; a concept of operations (CONOPS) endorsed by the JROC, a combatant command recommendation, Service recommendation, or defense agency recommendation; results of a Senior Warfighters' Forum (SWarF); or an identified operational need. The CBA becomes the basis for validating capability needs and results in the potential development and deployment of new or improved capabilities. Figure 2-2 shows the general flow of JCIDS as initiated by the CBA and the relationship of the JCIDS process to the acquisition process.

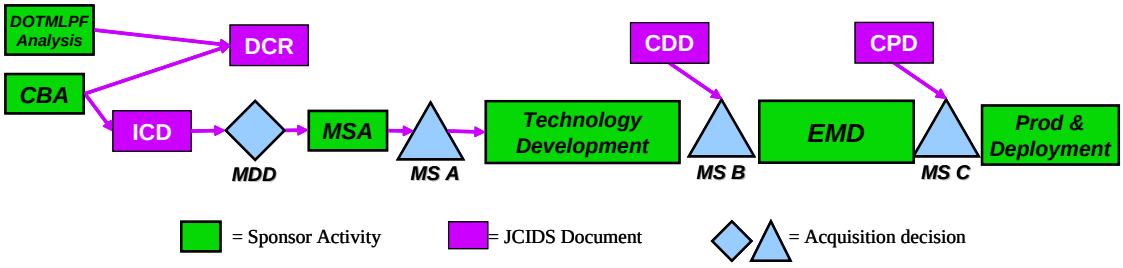

Figure 2-2: Interrelationship of the JCIDS and Acquisition Processes

Once the CBA is completed, it is used to generate the Initial Capabilities Document (ICD). The ICD provides the necessary foundation for AoA study guidance and the AoA Study Plan. The ICD and the pertinent study guidance are presented at the MDD. Based on the information presented, if the MDA determines that an AoA should be conducted, he will issue an Acquisition Decision Memorandum (ADM) that approves the AoA Study Guidance, determines the acquisition phase of entry, identifies the initial milestone review and designates a lead component to conduct the AoA.

The DOD 5000 series documents state that AoAs are required for all ACAT programs. Air Force Instruction (AFI) 10-601, *Capabilities-Based Requirements Development*, outlines the Air Force AoA process and responsibilities.

The processes outlined in this handbook apply to all AoAs regardless of ACAT level. They ensure that the recommendations from the AoA represent credible, defensible results. The only difference between ACAT I and ACAT II/III AoAs is the level of effort, oversight and approval required. These differences will be noted within each applicable section of this handbook.

OAS has developed a Pre-MDD Analysis handbook which is available on our website at http://www.oas.kirtland.af.mil. The JCIDS process is governed by the Chairman, Joint Chiefs of Staff Instruction (CJCSI) 3170.01. Detailed information on the entire process is available at https://dag.dau.mil/ Pages/Default.aspx.

3 AoA Structure

An AoA is conducted by a Working-level Integrated Product Team (WIPT), which is typically composed of a diverse group of government and contractor personnel and led by a study director. This group is referred to as the AoA study team. Throughout the AoA, the study team will interact with individuals and groups that provide assistance and direction. This chapter discusses typical study team composition, responsible parties, and the names and roles of associated participants.

3.1 Study Team Structure

3.1.1 Study Director

The lead operating command responsible for the AoA usually appoints an AoA study team director to lead the AoA. However, if that organization does not have the resources to supply the director, another appropriate organization may lead. The AoA directorship is nearly a full-time job benefiting from mature leadership skills and continuity of service. Ideally, the study director is a major or lieutenant colonel (or civilian equivalent). Typically, a deputy from the same command supports the director, along with experienced analysts to lead the effectiveness, risk, and cost analysis processes.

The Study Director is responsible for all aspects of the Study Plan and Final Report, and briefs the AFROC and other key stakeholders. If a Developmental Planning (DP) effort is not underway the Study Director should immediately submit a request to AFMC/A5 and ask for DP support and resources.

3.1.2 OAS

OAS provides an advisor to the director. The OAS advisor's responsibilities include AoA training for the participants, providing procedural guidance for AoAs and working with the director to ensure a quality AoA.

3.1.3 Study Team

The study director establishes the study team to plan and execute the AoA. Study team membership is determined by the needs of the AoA; members with appropriate skills are usually drawn from many organizations. Members often include contractors who provide critical skills and resources. The team focuses on defining alternatives, then assessing and comparing their operational effectiveness, life cycle costs and risks. Organizations who typically contribute members to an AoA study team include:

Operating Command (OC)

- Financial Management/Comptroller (FM)
- Manpower and Personnel (A1)
- Intelligence, Surveillance, and Reconnaissance (A2)
- Air and Space Operations (A3)
- Maintenance and Logistics (A4)
- Plans and Programs (A5)
- Communications and Information (A6)
- Installations and Mission Support (A7)
- Requirements (A5/A8)

- Analysis, Assessments, and Lessons Learned (A9)
- Security (A3)
- Weather (A3/5)
- Engineering (A7)

Implementing Command (IC)

- AFMC/A3/FM
- Product Centers
- Laboratories
- Air Logistics Centers (ALCs)
- System Program Offices (SPOs)

Other Air Force Organizations

- AF/A2
- AF/A5R (Functional SMEs)
- SAF/AQ/FM
- AF Cost Analysis Agency (AFCAA)
- MAJCOMs
- AF Operational Test & Evaluation Center (AFOTEC)
- AF/A9
- AF Flight Standards Agency (AFFSA)
- Global Cyberspace Integration Center (GCIC)
- Air Force Intelligence, Surveillance, Reconaissance Agency (AFISRA)
- AF Global Weather Center (AFGWC)

Other DoD Organizations

- USA, USN, USMC
- Combatant Commanders (COCOMs)
- Defense Intelligence Angency (DIA)
- Defense Threat Reduction Agency (DTRA)
- Defense Logistics Agency (DLA)
- National Geospatial Intelligence Agency (NGA)

Non-DoD Organizations

- Department of Homeland Security (DHS)
- Department of State (DoS)
- Department of Energy (DoE)
- Department of Interior (DoI)
- National Aeronautics and Space Administration (NASA)
- Contractors (KTRs)
- Federal Aviation Administration (FAA)
- Department of Transportation (DoT)
- National Imagery Mapping Agency (NIMA)

Oversight/Advisory Organizations

- OSD-level integrated product teams (IPTs)
- Air Force Council (AFC)
- Air Force Requirements Oversight Council (AFROC)

- OAS (AF AoA Center of Expertise (CoE))
- OSD/CAPE

The study team is generally organized along functional lines into working groups with a chair for each working group. Typical functional areas for the working groups are threats and scenarios, technology and alternatives (responsible for defining the alternatives), employment concepts (of the alternatives), effectiveness analysis, risk analysis, and cost analysis. Typically, management and integration of the products from each work group is undertaken by a "core" group usually composed of the study director and deputy along with the lead and deputy from each of the study team's panels, and the OAS representative.

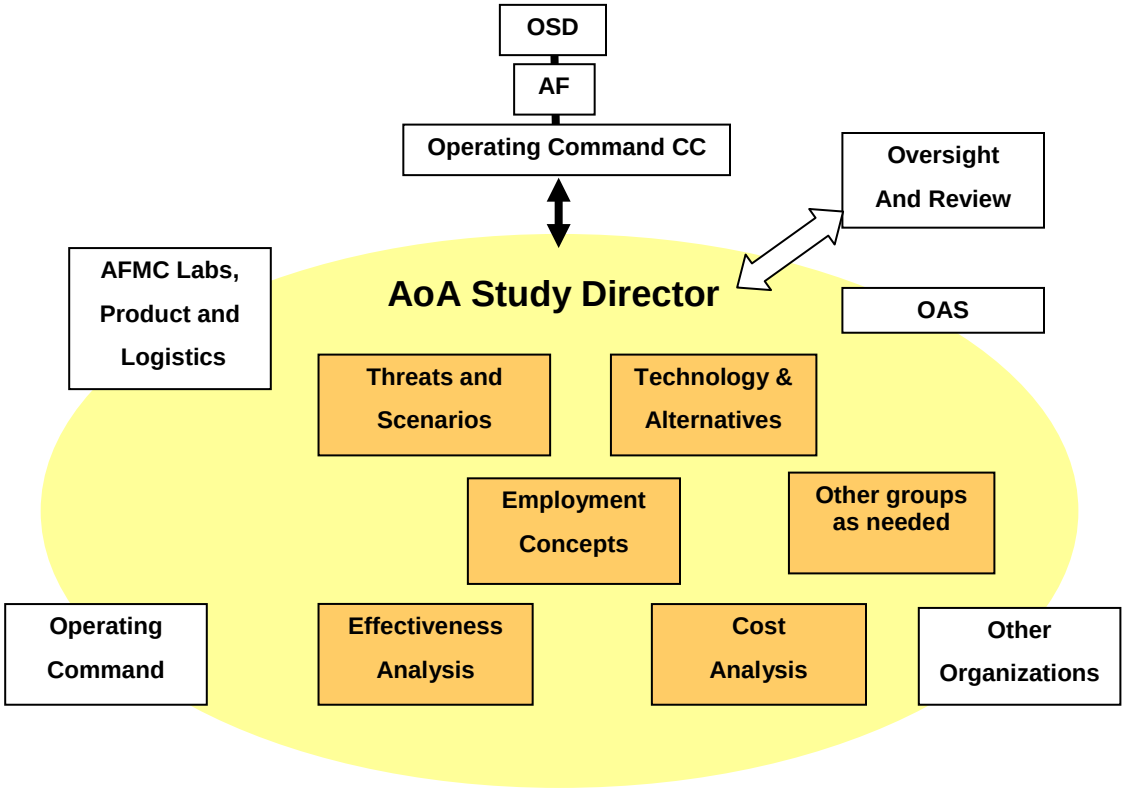

Figure 3-1: Typical Study Team Structure

The structure of a typical study team showing study groups and various players is shown in Figure 3-1. While other study structures may be more appropriate to a particular AoA, the use of functionally oriented groups has been used successfully for years to perform large, complex studies.

The work groups meet separately to address their fundamental issues. They also meet in conjunction with other groups or with the study team as a whole to exchange information. Frequent and open exchanges of ideas and data are keys to a successful AoA. The importance of communication is greatest when the team is geographically dispersed, which is a common occurrence. Documenting questions, answers, and decisions made in the various work groups enhances open communication. This can be done through taking and distributing minutes of study group meetings. Frequent interaction via telephone and e-mail at all levels should also take place. Another key to success is keeping the AoA study team intact throughout the AoA. A

changing membership diminishes the corporate memory and creates delays as new personnel are integrated into the effort.

3.2 The AoA Process Outline

Although the AoA process involves many iterative steps, the general flow from start to finish can be summarized in terms of the interchange of intermediate products between the Study Team working groups shown in Figure 3-1. Details on these products and the internal working group processes are described in greater detail in the following chapters. Table 3-1 shows the major steps in completing an AoA.

LEAD	STEP
DIRECTION AND PREPARATION	
MDA	Directs AoA to be performed and assigns lead component (LC)
CAPE	Provides guidance
LC	Assigns study lead (SL)
SL	Forms Working Integrated Product Team (WIPT)
OAS	Conduct AoA training for Study Team
WIPT	Determines scope, ground rules, constraints, and assumptions
WIPT	Writes and staffs Study Plan
OAS	Assesses Study Plan
AFROC	Validates Study Plan
MDA	Reviews Study Plan
CAPE	Approves Study Plan
DATA COLLECTION	
TSWG	Threats and scenarios selected
TSWG	Physical environment defined
TAWG	Request for Information submitted
TAWG	Select and screen viable alternatives and created/updated CCTDs
ECWG	Employment and operations concepts created/updated
EFFECTIVENESS ANALYSIS	
EAWG	Develop and define methodology
EAWG	Create MT, MoE, and MoP
EAWG	Select analysis tools
EAWG	Conduct effectiveness analysis
EAWG	Conduct sensitivity analyses
EAWG	Report results
COST ANALYSIS	
CAWG	Select analysis methodology
CAWG	Select cost modeling tools
CAWG	Perform cost analysis
CAWG	Report results
AFCAA	Perform sufficiency review
RISK ANALYSIS	

WIPT	Perform risk analysis
ALTERNATIVE COMPARISON	
WIPT	Select comparison technique
WIPT	Perform alternative comparison
REPORTING RESULTS	
WIPT	Complete and staff Final Report
OAS	Assesses Final Report
AFROC	Validates Final Report
CAPE	Assesses Final Report
MDA	Approves Final Report

Table 3-1: Major AoA Process Steps

3.3 Contractor Support for AoAs

It is frequently necessary to employ technical support contractors to conduct substantial parts of the analysis. All too often, a contractual arrangement is entered into *before* it is clear what course the AoA will follow. This increases the likelihood that the chosen contractor is not well suited to the tasks at hand. The general rule is: *know your needs and then contract.* In the final analysis, the responsibility for the AoA rests with the lead command and this responsibility should not be delegated to the contractor.

Principal considerations for deciding on contractor support are:

- Is there adequate capability already available within the government?
- Which support areas do I need to contract?
- Are sources of funding available?
- Which contractors are qualified?
- What are the available contract vehicles?
- How will the contract be administered?

AoAs are not usually budgeted items. Funding sources include the Air Staff, the operating commands, and existing program offices.

AFMC can provide advice on experienced and qualified contractors through the product centers and program offices. For most product centers, access to technical support contractors is available through scientific, engineering, technical, and analytical (SETA) contracts. Also, Federally Funded Research and Development Centers (FFRDC) are available to some product centers. Use of an existing contract for the best-qualified contractor can reduce the AoA initiation and development time considerably.

3.4 Flexibility in Analysis

The need to scale back the planned analysis in an AoA is common; reasons range from delays in obtaining data to mismatches between available resources and desired outputs. This makes it important to design an analysis that is flexible in scope. Without flexibility, often the only choice is to slip the AoA schedule. While at times this can be tolerated, often it cannot.

4 AoA Study Plan

One of the critical steps to a successful AoA is the creation of a comprehensive Study Plan. The Study Plan establishes a roadmap of how the analysis must proceed, who is responsible for the different elements, and why they are doing it. Quality time and effort spent on the Study Plan before beginning the analysis helps to ensure a high-quality AoA that is completed on schedule and within budget. **The Study Plan is a "living document" and must be updated throughout the AoA effort to reflect new information and changing study perceptions and direction.** By design, the Study Plan is structured so that it can evolve into the AoA Final Report.

4.1 Study Plan Preparation and Review

The study director has the ultimate responsibility to ensure the Study Plan is drafted. The study team writes the plan, often with substantial contractor participation. OAS can also provide experienced help in preparation of Study Plans. An intense effort early on by the study director, OAS, and a small group of the core study team members dedicated to drafting an initial Study Plan will expedite the study effort. This approach has proven to be a valuable step in expediting the AoA process and also defines the focus and schedule for the AoA study. This also provides an opportunity for the team members to understand the complexity and focus of the study in order to define 1) if contractor support is needed and 2) what the contractor could contribute to the AoA study.

A widespread review of the plan is useful in improving the plan and ensuring support for its execution. Review should start within the originating command. This review will ensure that the study plan has the stakeholder inputs necessary to address key issues.

Outside review can be solicited from a variety of agencies, including OAS, AF/A5R, AFMC/A3, and OSD/CAPE (for ACAT ID and IC programs). Appendix F contains a matrix of agencies that review and approve AoAs for different ACAT levels.

OAS assessment of the AoA Study Plan and AoA Final Report is required prior to submission to the AFROC. The OAS assessment criteria are applied to determine the completeness and accuracy of the Study Plan/Final Report. The rating OAS gives to the plan or final results depicts the overall study risk and does not necessarily reflect the effort of the AoA Study Team. Typically, assessment of mature Study Plans or Final Reports indicates less risk than immature Study Plans or Final Reports. Appendix D of this handbook lists criteria for assessing the adequacy of a Study Plan and Appendix C contains a Study Plan template.

5 Preparing for Analysis

In this section we discuss some of the major inputs to the analysis: the scenarios and threats, the physical environment, the technical description of the alternatives, and the concepts of operations and employment for the alternatives. The decisions made in each of these areas shape the analysis methodology and the development of the plan. These inputs will come from the CBA and the ICD that were accomplished to set the stage for the AoA.

5.1 Scoping the Analysis

The intent of the JCIDS analyses and AoAs are to provide information for our decision makers. The scope of analysis at each phase of the process should be driven by the information decision makers need as well as the resources and time constraints of the study teams involved.

The following are examples of key overarching questions that most decision makers need answered by an AoA:

- What alternatives provide validated capabilities?
- Are the alternatives operationally effective and suitable?
- Can the alternatives be supported?
- What are the risks associated with each alternative?
- What are the life-cycle costs for each alternative?
- How do the alternatives compare to one another?

Understanding what information the MDA needs for making a “good decision” is key to appropriately scoping an AoA. Therefore, it is essential that the study director have frequent interaction with the MDA (or the MDA staff). If the study team is given an ADM or other AoA guidance, these documents should identify the issues/objectives and interest levels for the AoA. If the team has not yet been given an ADM or other AoA guidance, the study director should establish a collaborative effort with the MDA staff to clarify expectations between the MDA and the study team.

The study team should ensure that all scoping issues are coordinated with the decision makers, and that the level of effort and resources required are well understood. The results of any discussions with leadership should be documented so that everyone both inside and outside of the AoA understands what is within the scope of the study and what is not.

Many of the items that define the scope of the AoA will come from the JCIDS analysis that preceded the AoA. Items that are typically used to bound the scope of the AoA are:

- Required capabilities
- Capability gaps
- Mission areas
- Threats and scenarios
- Approaches used to develop alternatives
- Time frames

5.2 Ground Rules, Constraints and Assumptions (GRC&A)

Ground rules, constraints and assumptions are some of the scoping decisions that must be carefully documented and coordinated with the MDA staff. These are boundary conditions that define the limits of the “box” in which the AoA is enclosed. Some GRC&A will be general in nature and encompass the entire study, while other GRC&A will be more specific and cover only

a portion of the analysis. Many of these limits and assumptions will be described in the AoA Study Guidance provided to the team prior to creation of the Study Plan.

AoA study ground rules are broadly-stated procedures that govern the general process, conduct, and scope of the study. For example:

- The WIPT will review and approve the results from each study group
- A non-disclosure agreement (NDA) will be signed by all study participants

Constraints are actual imposed limitations that can be physical or programmatic. For example:

- Specifying an operating frequency range for a required communication capability is an example of a physical constraint
- Specifying the latest acceptable initial operational capability (IOC) date illustrates a programmatic constraint

Assumptions are specific conditions that apply to the analysis. Examples are:

- Inclusion of a target type that will proliferate in the future, forcing consideration of a specific threat system
- Certain infrastructure or architectures that will be provided by another program

GRC&A arise from many sources. IOC time constraints, for example, may be imposed by an estimated fielding date of a new threat or by the need to replace an aging system. Net-centricity or interoperability with the Global Information Grid (GIG), for example, may be dictated in the ADM. Regardless of the source, each GRC&A must be explicitly identified, checked for consistency, and then accounted for in the scope of the AoA. Later they will need to be accounted for in the analytical methodologies.

The ground rules, constraints and assumptions are the one area of the AoA that will come under special scrutiny, especially if not discussed up front with the MDA. It is critical that the team thoroughly document each GRC&A. The Study Plan will contain an initial set of GRC&A but these may change as the study progresses.

5.3 Threats and Scenarios

AoA alternatives must be studied in realistic operational settings to provide reasonable comparisons of their relative performances. The AoA does this by adopting or developing one or more appropriate military scenarios. Scenarios define operational locations, the enemy order of battle, and the corresponding enemy strategy and tactics ("the threat"). Scenarios are chosen with consideration of AoA mission need, constraints and assumptions, and the physical environments expected.

The threat is most often developed and defined by the AoA study team working in conjunction with the intelligence community. Engagement of the intelligence community should begin early in the AoA process. MAJCOM intelligence organizations, DIA, and other intelligence organizations can provide detailed threat and target information. If System Threat Assessment Reports (STARs or STAs) are available they should serve as the basis for the AoA threat description.

The Defense Planning Guidance/Illustrative Planning Scenario (DPG/IPS) provides broad context for a limited number of scenarios and should be used as a starting point for scenario development. The DPG contains a strategic framework and general description of potential

military operations in several areas of the world and for various contingencies. Variance from the DPG/IPS (called scenario excursions) must be identified, explained, and approved by DIA after Operating Command A2 review.

The Multi-Service Force Deployment (MSFD) or other digital force projections are resources providing details on enemy, friendly, and non-aligned forces in these areas. In joint AoAs, Army, Navy, and Marine forces must be considered, as well as the Air Force. The order of battle and roles of allied and non-aligned forces must also be considered. Environmental factors that impact operations (e.g., climate, atmospherics, vegetation and terrain) are important as well.

Typical threat elements addressed in an AoA are:

- The enemy order of battle
- Limitations on threat effectiveness, such as logistics, command and control, operational capabilities, strategy or tactics, and technology
- Countermeasures and changes in enemy strategy and tactics in response to the new system's capabilities (i.e., reactive threats)
- A range of threats to account for uncertainties in the estimates
- A target set representing a cross section of all possible targets
- Threat laydown showing potential threat systems and their location

When there are several scenarios that can be used to evaluate the performance of the alternatives, it may be necessary to determine if a subset can be used and still provide the necessary data. Evaluation of the alternatives in every scenario can be time-consuming and unnecessary. There is an exercise that is used to evaluate the scenarios for the stressors that are necessary to gather the data for the effectiveness evaluation. This method enables the effectiveness analysis to be done correctly using the minimum number of scenarios. OAS can help with the details of this exercise.

In summary, scenarios must portray realistic operational environments. A range of scenarios may be needed to investigate the full potential of the alternatives and their sensitivities to variations in constraints and assumptions, particularly with regard to threats.

5.4 Physical Environment

Threats and scenarios determine the nature of the physical environment in which the alternatives operate. However, there is often a need to operate in a range of physical environments and this can drive the selection of scenarios.

The environment reflects both man-made and natural conditions. Natural conditions include weather, climate, terrain, vegetation, geology, etc. Depending on the alternative, these conditions can impact the target selection process, the aircraft and munitions selection process, aircraft sortie rate, aircraft survivability, navigation and communications capabilities, logistics, etc. Man-made conditions such as jamming and chemical/biological warfare, have their own impacts. Chemical or biological warfare, for example, may impact the working environment for operational crews and logistics support personnel. This can impact the results of the war or how it is executed. Such real or potential threats may in turn affect aircraft basing decisions and sortie rates.

5.5 Selection and Development of Alternatives

There can be no analysis of alternatives unless there are alternatives to consider. Typically, the pre-MDD analysis and ICD will identify approaches that should be used to develop the alternatives. The ADM or other AoA guidance may also identify a minimum set of alternatives. The study team can augment this set with other appropriate existing systems, modifications to existing systems, systems in development, and conceptual systems. Additional direction during various AoA reviews may provide additional alternatives.

Practically, the range of alternatives must be manageable. If there are too many alternatives, there will be inadequate resources to perform the analysis. If not enough alternatives are considered, the AoA may not be credible or may not identify the most promising alternative(s). The goal is to consider a comprehensive set of alternatives representing all reasonable solutions.

The number of alternatives can be controlled by grouping together similar but slightly different alternatives (avoiding variations on a theme) and by early elimination of non-viable alternatives. Some of the criteria used as a basis for eliminating non-viable alternatives are:

- Non-compliance with AoA guidance
- Non-compliance with treaties or other national policy
- Unacceptable performance
- Unacceptably high cost
- Inability to meet IOC or full operational capability (FOC) requirements

Data for the last three criteria may come from previous studies, expert judgment, or early analytical results from the AoA. Since these criteria are subject to interpretation, a disciplined approach for selecting the set of alternatives should be developed and followed to forestall second-guessing. This includes documenting the rationale for selecting the viable alternatives and eliminating the nonviable alternatives.

The Concept Characterization and Technical Description (CCTD) document is developed as a repository for information that completely describes each alternative. The CCTD, which may have been created originally as part of the Developmental Planning (DP) and Early System Engineering (SE) processes, is an effective method for documenting and maintaining data on alternatives. The AoA team uses the CCTD to update information on alternatives throughout the AoA process as each alternative becomes more clearly defined. The format for the CCTD can be found in Appendix H. To ensure accuracy of alternative definitions and capabilities, all descriptions should be made available to all system advocates for peer review.

A baseline is always the first alternative. The baseline represents the existing, currently programmed system funded and operated according to current plans. This alternative offers a yardstick against which to measure the potential improvements provided by the other alternatives.

A second frequently included alternative is based on potential, yet unfunded improvements to the baseline.

The remaining alternatives are developed from concepts that can come from a variety of sources. A request for information (RFI) can be used to gather concepts from industry as well as government sources. These concepts are usually grouped into two categories for evaluation purposes: (1) Mature or fielded systems, and (2) new starts or immature systems. Once the concepts are evaluated for viability, the alternatives that remain are numbered in sequence so

they may be tracked and compared in an unbiased manner. New or revised alternatives may need to be included after the analysis is under way.

The AoA is not a "Source Selection" process. Therefore, care must be taken in describing the alternatives in a generic fashion. Even though a viable alternative may have been received through the RFI process from contractor X, all references to the contractor and specific model numbers should be changed to generic labeling. This will avoid any appearance of bias when the real "Source Selection" process begins.

5.6 Screening Alternatives

Figure 5-1 shows how an original set of alternatives is reduced to a small number of serious contenders. There is no formula for doing this; it is an art whose practice benefits from experience. Each AoA must adapt its methods to circumstances peculiar to that AoA. However, in general, it is prudent to continuously screen the alternatives throughout the AoA process. This has the advantage of eliminating non-viable alternatives before a lot of scarce AoA resources are expended on analyzing them. It is imperative to document the basis for eliminating each alternative from further consideration at the time it becomes clear that it is non-viable. This documentation will need to be included in the final AoA report and provides an audit trail which may be very important in the event the AoA results are questioned.

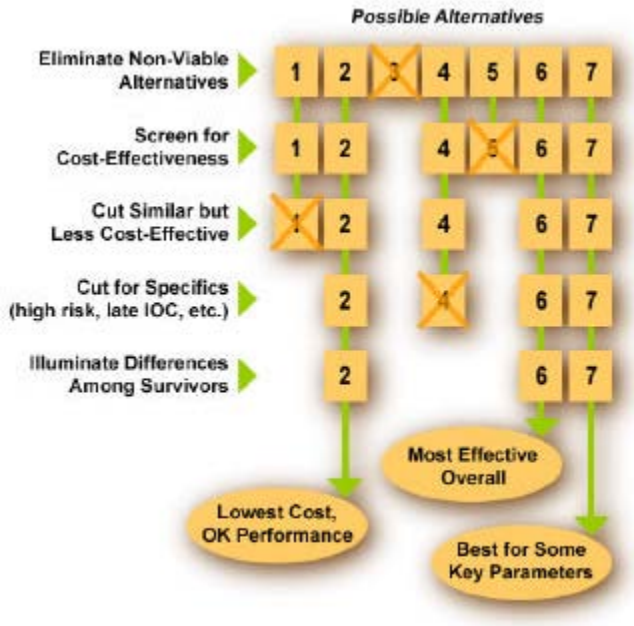

Figure 5-1: Eliminating Alternatives in an AoA

In all AoAs, the study team's understanding of the issues and the techniques to deal with them increases as the study progresses. The same is true for understanding the alternatives. As the AoA progresses, these concepts are often re-engineered to reflect better understanding of requirements, technologies, threats, and scenarios. Improved performance and lower cost usually accompany these changes—thus alternative cost and effectiveness are moving targets. The uncertainty can be limited by setting a cutoff date for concept redefinition, but remember that the charter of the AoA is to find the most cost-effective alternatives, not the most cost-effective alternatives defined up to an arbitrary time. Thus, the AoA should revisit discarded alternatives

from time to time when new information promises significantly increased attractiveness. This is most important when a large number of concepts have been screened early in the AoA.

5.6.1 Non-Viable Alternatives

The first screening eliminates non-viable alternatives, such as alternatives that have a critical flaw. An alternative should ***not*** be considered "non-viable" because it fails to close 100 percent of the shortfall. For many AoAs, the non-viability criteria are defined in the AoA guidance and often reflect political considerations (environment, world opinion, treaty compliance, etc.) or IOC and FOC requirements due to technology maturity. Non-viable alternatives should be identified in the Study Plan and the reasons for eliminating these alternatives should always be documented.

5.6.2 Preliminary Screening

When a preliminary screening is necessary, it is usually done with limited data derived for alternatives whose definitions are still in transition. This suggests erring on the conservative side by giving alternatives the benefit of any doubt. The exact screening criteria will depend on available analysis resources, the number of alternatives to be carried forward, the perceived uncertainty in cost, risk, and effectiveness estimates, and a host of other factors such as similarity of alternatives, advocacy for alternatives, and technology maturity. Other factors that might be considered are sensitivity of system performance to key assumptions, vulnerability to countermeasures, flexibility in future scenarios, contributions to longer-term goals, reliability and maintainability, and time phasing of resource requirements. The best selection criteria may not be obvious, but they can usually be deduced from the ICD, high level AoA direction, and the experience and expectations of the warfighters. This is a step that is very beneficial to the AoA when there is a premium on rational, creative thinking.

5.6.3 Later Screening

As the AoA progresses and more reliable cost, effectiveness, and risk data become available, there will be opportunities to do additional ad hoc screening. This is typically done on a case-by-case basis using any appropriate criteria. For example, one of the alternatives may be demonstrated to be more costly or less effective than the others; if it has no redeeming qualities it can be removed. Another alternative may be very sensitive to a key parameter, indicating excessive risk in performance; it may then be determined as non-viable.

5.6.4 Remaining Alternatives

There comes a time in the AoA when the remaining alternatives all have positive attributes that make them contenders in some way. The next step is to find a way to clearly state for the decision makers the advantages and disadvantages of each, especially how the alternatives address the ICD or Capability Development Document (CDD) requirements and satisfy high-level guidance. In doing this, the final selection may also consider the impact of risk to help or support the final selection of the preferred alternative(s). Another approach for the final selection is to use the minimum acceptable threshold for critical Measures of Effectiveness (MoEs), choosing the preferred alternative(s) based on whether or not the alternative meets or exceeds the threshold for all critical MoEs. Any process should present a clear, unbiased picture of the analysis results, findings, and recommendations. The more straightforward and clearly the story is told, the easier it becomes to understand the differences among the alternatives. Even with all results in hand, it is not unusual for this final story to take several weeks or more of intense effort to develop. Again, rational thinking plays an indispensable role. In some cases this

final assessment may point to a single "recommended winner." In other cases, no such clear-cut conclusion emerges. In either event, the decision maker will have the best available information and understanding of the alternatives that the AoA can provide.

5.7 Operations and Employment Concepts

Evaluating an alternative requires significant understanding of how the alternative will be used in the context of the selected scenarios. For each alternative, an operations concept must describe the details of the employment of the alternative as it will function within established military organizations. The concept of employment (CONEMP) for each alternative should be described in the CCTD. The complexity of the CONEMP will vary with the nature of the alternative and the scope of the tasks. For example, an aircraft will have a more complex CONEMP than a munition it carries.

The following list details many of the potentially appropriate issues a CONEMP may discuss:

- Deployment plans, including how the system will be deployed and its deployment schedule
- When and how the system will be employed, including tactics
- Logistics concepts for peacetime and wartime
- Interoperability with other Air Force, sister service, and allied systems
- Incorporation into existing organizational structures, including manpower impacts
- The relationship of the CONEMP to relevant Air Force or Joint CONOPS
- Peacetime and wartime operations concept

It is difficult to produce operations concepts for developmental and conceptual systems. The CONEMPs for conceptual systems have the potential for high risk. Typically, system developers are more concerned with the system technology than its employment. The operations concepts for these systems must often be developed from scratch. The operational community must work closely with the technical experts to develop reasonable and realistic CONEMPs. It is best to define the requirements for the operations concepts early in the AoA to maximize the available development time.

6 Performing the Effectiveness Analysis

Effectiveness analysis (EA) is normally the most complex element of the AoA and consumes a significant fraction of AoA resources. The effectiveness analysis working group (EAWG) is responsible for accomplishing the EA tasks. The goal of the effectiveness analysis is to determine the military worth of the alternatives in performing MTs. The MTs are typically derived from the capabilities identified in the ICD. A CDD may exist for the current baseline, and can be useful in determining MTs and measures for the EA effort. The ability to satisfy the MTs is determined from estimates of alternatives' performance with respect to measures of effectiveness (MoEs) and their supporting measures of performance (MoPs).

The effectiveness methodology is the sum of the processes used to conduct the effectiveness analysis. The development of the effectiveness methodology is almost always iterative: a methodology will be suggested, evaluated against the resources and data available to support it, and then modified to correspond to what is both possible and adequate. As the AoA progresses, this development sequence may be repeated as more is understood about the nature of the alternatives, the models or analysis tools, and what is necessary to support the AoA decision. Figure 6-1 shows the flow of analysis tasks discussed in this chapter.

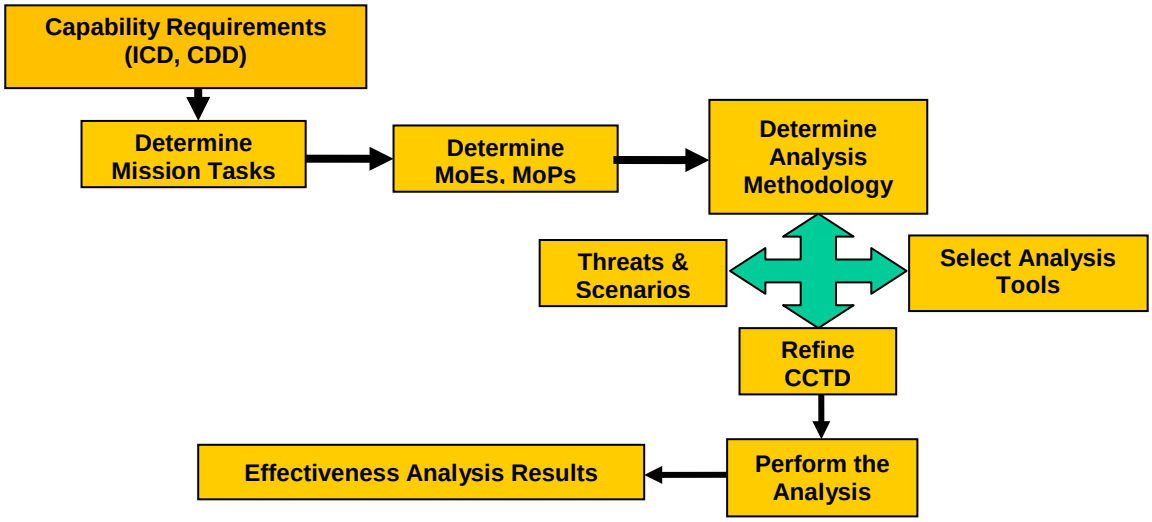

Figure 6-1: General Approach for Effectiveness Analysis

OAS does not recommend the use of the Analytical Hierarchy Process (AHP) or similar methods which implement weighting schemes as part of AoA effectiveness methodology. Typically, employing AHP/weighting adds complexities to the study results which are difficult to understand and difficult to explain to decision makers. OAS suggests keeping the effectiveness methodology as simple as possible in order to evaluate and present accurate, informative results.

6.1 Effectiveness Analysis Methodology

The effectiveness analysis methodology is designed to compare the effectiveness of the alternatives based on military worth. It encompasses and is influenced by the MTs, MoEs, MoPs, alternatives, threats, scenarios, operations concept, prior analysis, study schedule, and available

analysis resources. The methodology must be systematic and logical. It must be executable, and it must not be biased for or against any alternative.

Discussion of the analysis methodology begins very early in the AoA, perhaps even before the AoA officially begins. Because of its dependence on many factors, it can approach its final form only after these other factors are defined. Final analysis tool selection must await development of the MTs, MoEs, and selection of the alternatives.

The issues shaping the effectiveness analysis methodology are:

- Selection of MTs, MoEs, and MoPs
- Selection of the threats and scenarios
- Description of alternatives
- Determination of the appropriate level of detail required in the analysis
- Identification of suitable analysis tools and input data sources

6.1.1 Mission Tasks (MTs)

MTs are derived directly from the capability requirements identified in the ICD or CDD (Figure 6-1). They are usually expressed in terms of general tasks to be performed or effects to be achieved (e.g., hold targets at risk, provide countermeasures against surface-to-air missiles, or communicate in a jamming environment). The MoEs are then developed to measure “how well” each alternative performs the tasks or achieves the desired effects. Because MTs are tasks, cost is never an MT or MoE, and cost is never considered in the effectiveness analysis. All capabilities discussed in the ICD or CDD should be addressed in the MTs and MoEs for the AoA.

Because the AoA tries to identify the most promising solution(s), MTs must not be stated in solution-specific language. MoEs should not call for optimizing aspects of a task or effect, because this often has unintended impacts on cost or other aspects of the alternatives’ performance. For example, one solution to minimizing aircraft attrition could be not flying missions; this solution would hardly be conducive to placing targets at risk. Similarly, maximizing targets destroyed may result in unacceptable attrition.

6.1.2 Measures of Effectiveness (MoEs)

MoEs are a qualitative or quantitative measure of a system’s performance or characteristic that indicates the degree to which it performs the task or meets a requirement under specified conditions. They are a measure of operational success that must be closely related to the objective of the mission or operation being evaluated. There will be at least one MoE to support each MT. Each alternative is evaluated against each MoE, and the results are used for comparison among the alternatives.

MoEs are developed by the study team. If possible, MoEs should be chosen to provide suitable assessment criteria for use during later developmental and operational testing. This "linking" of the AoA to testing is valuable to the test community and the decision maker.

MoEs should be reviewed by principal stakeholders during development of the AoA Study Plan. Suitable selection of MoEs helps later independent review and evaluation of the AoA Study Plan and results.

In general:

- MoEs should be quantitative when feasible. For example:
  - How many targets are held at risk?
  - The number of targets by type that you can hold at risk in daytime and nighttime conditions
- MoEs may also be qualitative or subjective. For example:,
  - Ability to detect obscured targets
  - Ability to collect on Electromagnetic Emissions
- Each MoE supports at least one MT and each MT will have at least one MoE supporting it
- MoEs must be independent of the alternatives, as all alternatives are evaluated using all MoEs
- MoEs should not be strongly correlated with one another (to avoid overemphasizing particular aspects of the alternatives)
- MoEs are relative to the MT they support (no quantity is inherently an MoE)
- MoEs may be supported by one or more MoPs

MoEs should normally represent raw quantities like numbers of something or frequencies of occurrence. Attempts to disguise these quantities through a mathematical transformation (for example, through normalization), no matter how well meaning, may reduce the information content and might be regarded as "tampering with the data." This same reasoning applies to the use of MoEs defined as ratios; a ratio essentially "hides" both quantities.

All AoAs are required to compare the following measures for all alternatives considered:

- Reliability
- Availability
- Maintainability

Results from MoEs not only make it possible to compare alternatives, they also can be used to investigate performance sensitivities to variations of key assumptions and MoP values. Such analyses help define input to follow-on requirements documents:

- CDD
- Capabilities Production Document (CPD)
- Technology Development Strategy (TDS)

6.1.3 Measures of Performance (MoPs)

MoPs are typically a quantitative measure of a system characteristic (e.g., range, velocity, mass, scan rate, weapon load-out, etc.) chosen to enable calculation of one or more MoEs. MoPs may apply universally to all alternatives or, unlike MoEs; they may be system specific in some instances. In order to determine how well an alternative performs, each MoP should have a threshold value. The threshold value is the minimally accepted value of performance. This value might come from a requirement document, or can be determined by subject matter experts (SMEs). Each MoP might also have an objective value which is more demanding than the threshold value. The threshold and objective values and the rationale for their selection should be well documented. The MoPs and their threshold and objective values may be directly or indirectly reflected in system performance parameters in the ICD/CDD/CPD. MoPs and the methodology for evaluating their impact on MoEs frequently help determine CDD/CPD inputs. As with MoEs, MoPs should be linked, where possible, to future testing of the alternatives.

6.1.4 Creating MT, MoE, and MoP

Figure 6-2 shows the MTs and MoEs that can be derived from the following Mission Statement in the ICD**:**

> Theater commanders need a means to obtain *responsive intelligence, surveillance, targeting and BDA information*. The system should be *usable against all theater targets* with a *short tasking time* and be *reliable* over the mission with limited risk to personnel. It should provide *reasonable coverage* and *have multi-spectral capability* with *near real-time information supplied to the Joint Force Air Component Commander (JFACC)* and allow for *automation* of critical mission elements *to increase capability*.

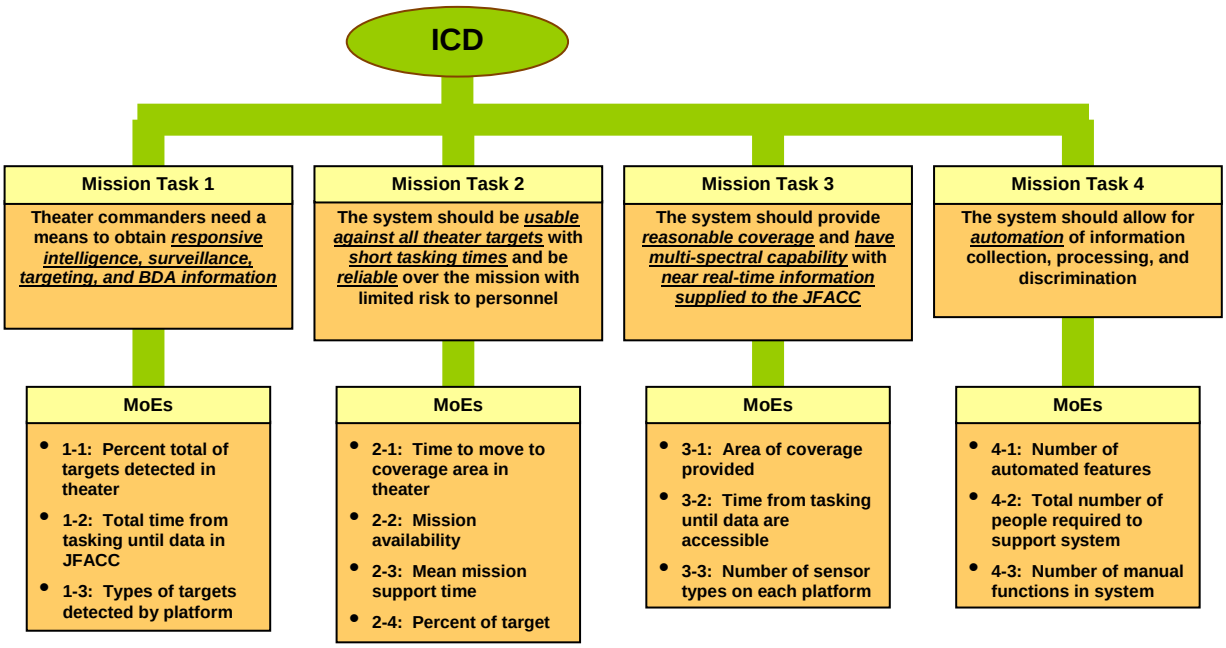

Figure 6-2: Notional MTs/MoEs

6.2 Military Worth

Measures should be stated in terms of their military worth to the warfighter. Success can be measured relative to the immediate goals of the system (attack, communicate, detect, etc.) or relative to high-level goals related to "winning the war." Some examples of measures demonstrating military worth are:

- Time to accomplish high level objectives
- Targets placed at risk
- Targets negated
- Level of collateral damage
- Friendly survivors
- Attrition
- Quantity (and types) of resources consumed
- Number of Operating Locations Needed
- Impact on C4ISR network

6.3 Levels of Analysis

In the world of military operations analysis, levels of effectiveness analysis are characterized by the number and types of alternatives and threat elements to be studied. A typical four-level classification is shown in Figure 6-3.

At the base of the triangle is the engineering analysis performed on individual components of an alternative or threat system. One level up, engagement analysis can model the interaction between a single element of the alternative and a single threat. An example of this analysis is weapon versus target, or aircraft versus aircraft. Engagement analysis also looks at interactions of larger quantities of the same elements, or few-on-few.

At the top two levels, mission/battle and theater/campaign (many on many), the analysis becomes very complex involving the modeling of most or all of the forces in a specific, complex scenario. At these higher levels the focus of the analysis changes. The applicable models and simulations (M&S) will also change, as does the complexity of the analysis. Analysis at higher levels may require inputs from supporting analysis at lower levels.

While the supporting analysis may come from sources outside the AoA, it will often be performed by the AoA team. MoP values tend to be produced from engineering and one-on-one analyses. MoE values tend to come from higher levels of analyses. There are no hard and fast rules, though, because of the range of issues considered in AoAs.

Given the increasing complexity of the analysis encountered in moving up the pyramid, every effort must be made to use the lowest level needed to answer the AoA's questions.

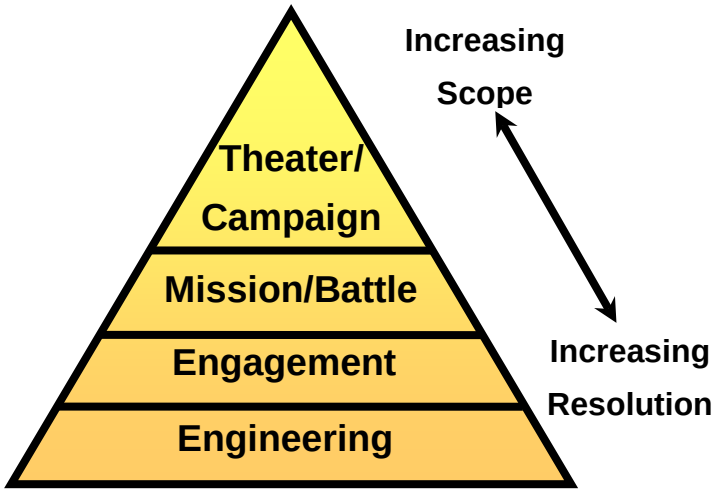

Figure 6-3: Hierarchy of Analysis

6.4 Selection of Effectiveness Analysis Tools and Data Sources

Once MoEs and MoPs have been identified and the methodologies to be used for each analytical effort determined, it is time to determine what “tools” will be used to develop MoE and MoP data. The term “tools” is defined as spreadsheets, SMEs, methods, processes, and M&S. The analysis tools are the heart and soul of analysis and can consist of everything from hand-written steps executed with a "stubby pencil" to elegant mathematical formulations

represented by thousands of lines of computer code. In some cases, they may include person-in-the-loop simulations or the informed judgment of SMEs. Whatever their complexity or form, there comes a point when the AoA team must decide which tools to use to generate MoE/MoP data for comparisons of the alternatives.

The MoEs/MoPs developed for the analysis should dictate which tools are needed vice developing MoEs/MoPs based on a particular analysis tool. Doing the latter (for example, because of easy accessibility to a particular M&S) may result in the wrong issues being investigated and the wrong alternatives being identified as promising. Once the MoEs/MoPs are known, the necessary level(s) of analysis can be identified and a search conducted for tools suitable for MoE/MoP calculations.

When selecting analysis tools consider the following:

- Information or input data requirements and the quality of the data sources
- Credibility and acceptance of the tool output or process results (e.g. SME assessments)
- Who is available to run the M&S, develop/manipulate the spreadsheets or participate in SME assessments
- Whether or not the tool can be applied to support the analysis within time and funding constraints
- Cost of running M&S

Tool inputs come from all aspects of the AoA: threats and scenarios, alternative definitions, employment concepts, constraints and assumptions, etc. These may also be derived from the outputs of other tools. Before selecting an M&S tool, the sources of all inputs should be identifiable and credible. Commonly accepted models from the AFSAT Toolkit (https://www.my.af.mil/gcssaf/USAF/ep/browse.do?programId=t6925EC2F6AD70FB5E044080020E329A9&channelPageId=s6925EC13500D0FB5E044080020E329A9) include:

- AMOS
- BRAWLER
- CFAM
- EADSIM
- ESAMS
- GIANT
- GTSIMS
- ISAA AV
- JIMM
- JSEM
- LCOM
- MOSAIC
- RADGUNS
- SEAS
- SHAZAM
- SPAAT
- SUPPRESSOR
- THUNDER

Before settling on a final integrated set of tools, it is useful to check that the toolset is adequate for evaluating all measures in the AoA. Constructing a linkage diagram as illustrated in Figure 6-4 may be useful for this.

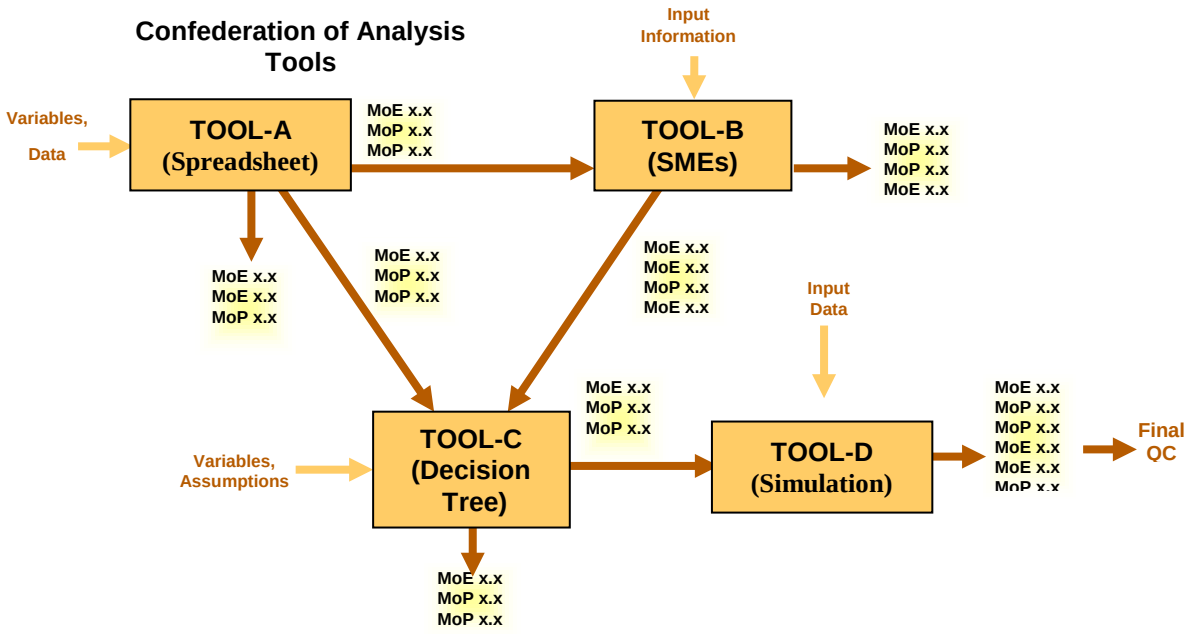

Figure 6-4: Analysis Tools to Measure Linkage

As shown, this diagram depicts the source of MoP and MoE values and is a system level diagram of how the selected analysis tools are expected to work together. It should also show what information is expected to flow from one tool (or process) to another. A review of the linkage diagram should also ensure that a common set of assumptions is made across all the tools. Including a linkage diagram in the Study Plan should also enhance the understanding of those reading or reviewing the plan.

6.4.1 M&S Accreditation

The DODI 5000 series requires that digital M&S used in support of acquisition decisions be formally accredited for use by an Accreditation Authority. Accreditation involves reviewing the applicability of M&S tools within an analysis. The study team should allow time for the M&S accreditation process within the AoA schedule; this process should be discussed in the Study Plan. OAS can help tailor an appropriate accreditation plan.

Accreditation is an official determination that a model is acceptable for a specific purpose. Model accreditation begins with development of the accreditation plan. The plan contains criteria for model assessment based on the ability of the model to accept the required input data and to provide appropriate output information to resolve the MoEs. All data used for model input and scenario configuration should also be accredited to ensure credibility of the output. Once the model assessment is complete, a final accreditation report is prepared.

OAS has prepared a handbook for M&S selection and accreditation. The handbook contains criteria for accreditation as well as templates that can be used for summarizing model adequacy for AoA analysis. The purpose of the handbook is to help expedite and standardize the

AoA M&S accreditation process. The handbook is available from the OAS web site at http://www.oas.kirtland.af.mil.

6.5 Sensitivity Analysis

Alternatives whose effectiveness is stable over a range of conditions are more adaptable than those lacking such stability. Alternatives in an AoA are typically defined with certain appropriate assumptions made about their performance parameters: weight, volume, power consumption, speed, accuracy, impact angle, etc. These "monolithic" alternatives are then assessed against AoA-defined threats and scenarios under a set of AoA-defined assumptions. This provides very specific cost and performance estimates, but does little to assess the stability of alternative performance to changes in system parameters or AoA threats, scenarios and assumptions.

Stability can only be investigated through sensitivity analyses in which the most likely critical parameters are varied: reduced speed or increased weight or 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. Sensitivity analyses should be performed whenever time and resources allow, with an emphasis on alternatives that survived early screening processes. Sensitivity analysis can also add credibility to the information developed during the effectiveness analysis. Of course, it is always necessary to balance the amount of sensitivity analysis against its potential value and the available resources.

6.6 Effectiveness Analysis (EA) Results Presentation

Once the EA has been completed, the values for the measures of each alternative need to be presented in a comprehensive manner. Figure 6-5 shows a single method for presenting each alternative using a color scheme indicating how well each MoE was accomplished. If a presentation method similar to Figure 6-5 is used, then a methodology needs to be developed to map measured values to the colors displayed. But the mapping should be based on the measured value in relation to the threshold value and associated changes in military utility. This requires a structured process to roll the MoP values up to MoE representation. Weighted averaging of MoPs is discouraged, as it is almost always a misleading method.

	MT 1			MT 2			MT 3		
	MoE 1-1	MoE 1-2	MoE 1-3	MoE 2-1	MoE 2-2	MoE 2-3	MoE 3-1	MoE 3-2	MoE 3-3
Alternative 1									
Alternative 2									
Alternative 3									

Figure 6-5: Effectiveness Analysis Results Presentation

7 Performing the Cost Analysis

The purpose of the AoA life cycle cost estimate (LCCE) is to provide the decision makers (MDA, AFROC, etc.) with the estimated total ownership cost associated with each alternative. A cost analysis is synchronized with the operational effectiveness analysis and is done only on viable alternatives. The cost analysis estimates the total life cycle cost (LCC) of each viable alternative and these results are combined with the effectiveness analysis results to identify the alternative(s) that represent the best value. The LCC approach captures the total cost of each alternative over its entire life cycle and includes costs incurred for research and development (R&D), investment, operations and support (O&S), and end of life disposal. Sunk costs (money already spent or obligated) are not included in the LCC estimates; however, they may be of interest to decision makers and should be identified separately. The AoA LCC analysis is based on peacetime operations and does not include any war-related costs such as replacement of expended or destroyed assets. The impact of consumed assets is reflected as diminished effectiveness in the operational effectiveness analysis. Those alternatives failing to meet minimum effectiveness analysis criteria (non-viable alternatives) are normally not costed.

7.1 Life Cycle Cost Considerations

7.1.1 Sunk Costs

Sunk costs are those that have either already occurred or that will be incurred before the AoA can inform any decisions on their usage. The best method of determining the cut off for sunk costs would be to use the fiscal year in which the AoA is to be completed.

7.1.2 Research and Development Cost

The costs of all R&D phases, including concept development, technology development, system development, and demonstration, are included in this cost element. There are many types of R&D costs: prototypes, engineering development, equipment, test hardware, contractor system test and evaluation, and government support to the test program. Engineering costs for environmental safety, supportability, reliability, and maintainability efforts are also included, as are support equipment, training, and data acquisition supporting R&D efforts.

7.1.3 Investment Cost

The cost of investment (low rate initial production, production, and deployment) includes the cost of procuring the prime mission equipment and its support. This includes training, data, initial spares, war reserve spares, pre-planned product improvement (P3I) program items, and military construction (MILCON). MILCON cost is the cost of acquisition, construction, or modification of facilities necessary to accommodate an alternative. The cost of all related procurement, such as modifications to existing equipment, is also included.

7.1.4 Operating and Support Cost

O&S costs are those program costs necessary to operate, maintain, and support system capability. This cost element includes all direct and indirect elements of a defense program and encompasses costs for personnel, consumable and repairable materiel, and all appropriate levels of maintenance, facilities, and sustaining investment. Manpower estimates should be consistent with the Manpower Estimate Report (MER), which is produced by the operating command’s manpower office. For more information, refer to the OSD Cost Analysis Improvement Group's *Operations and Support Cost Estimating Guide*.

7.1.5 Disposal Cost

Disposal cost is the cost of removing excess or surplus property or materiel from the inventory. It may include costs of demilitarization, detoxification, redistribution, transfer, donation, sales, salvage, or destruction. It may also reflect the costs of hazardous waste disposition (including long-term storage) and environmental cleanup. Disposal costs may occur during any phase of the acquisition cycle.

7.1.6 Baseline Extension Costs

These are the costs associated with maintaining the current capabilities, or Baseline alternative, through the life cycle of the other alternatives being considered. This may require Service Life Extension Program (SLEP) efforts, additional maintenance, or other efforts to continue to provide the baseline level of capability. Capabilities that may be provided by other alternatives but not the Baseline alternative should be addressed as continued shortfalls in the baseline capability.

7.1.7 Life Cycle Time Frame

Each alternative (Baseline and all proposed alternatives) must be evaluated for both cost and effectiveness for the same time frame. This time frame should begin at the end of the AoA and end at the expected end of the useful life of the alternative providing the capability for the longest duration. This allows for a fair comparison of each alternative and may require service life extension efforts for other alternative (including the baseline) with expected shorter useful lives or the calculation of residual values for alternatives that may continue to provide capability past any other study cut off dates.

7.1.8 Pre-fielding Costs

These are costs associated with maintaining the capabilities being analyzed in the AoA until a specific alternative can be fielded to provide them. In order to fairly compare the Baseline alternative with all others, the time from the end of the AoA being conducted through the end of the life cycle for all alternatives must be included in each respective LCCE. To accomplish this for alternatives that may be fielded in the future, it is necessary to include the costs of maintaining the current baseline alternative until such time as the other alternatives can be fielded (FOC).

7.2 Cost Analysis Responsibility

The chair of the Cost Analysis Working Group (CAWG) should be a government cost analyst familiar with the type of system being studied. The CAWG should include representatives from operating and implementing command organizations with expertise in cost analysis and knowledge of the system alternatives. A logistics analyst on the CAWG can assess the cost implications of logistics support approaches. OAS will serve as advisor to the CAWG Lead and assist the cost team throughout the AoA process. The CAWG should request cost support from the Air Force Cost Analysis Agency (AFCAA). In response to this request, AFCAA will usually provide a representative to support the cost team throughout the AoA process. AFCAA will also provide regulatory guidance, review and approve proposed cost analysis methodology, and perform a Non-Advocate Cost Assessment (NACA) for ACAT I and ACAT II AoAs if they are high profile. NACAs were previously referred to as “sufficiency reviews;” however, AFPD 65-5 (August 2008) changed this terminology. The CAWG will be responsible for the following cost analysis tasks:

- Develop appropriate cost ground rules and assumptions and ensure they are consistent with effectiveness ground rules and assumptions
- Develop the Work Breakdown Structure (WBS) to be used in the cost analysis; the WBS is a hierarchical organization of the items to be costed
- Develop cost analysis approach and methodology
- Determine suitability and availability of cost models and data required
- Define the logistics elements necessary for the cost analysis
- Prepare LCC estimates for the baseline system and each alternative
- Document the cost analysis so that a qualified cost analyst can reconstruct the estimate using only the documentation and references provided in the Final Report
- Review the estimates to ensure the methodology and the ground rules and assumptions are consistent and the LCC estimate is complete
- Bound LCC point estimates with uncertainty ranges
- Include programmatic data in the LCC analyses, such as quantities and delivery schedules (when known)
- Identify cost drivers (those elements to which LCC is most sensitive) and perform sensitivity analyses on significant cost drivers
- Provide funding and affordability constraints and specify schedule limitations
- Provide necessary cost data to implement Cost As An Independent Variable (CAIV) strategy to arrive at an affordable balance among cost, performance, and schedule
- Present all costs in base-year dollars (BY$)—normally the year in which the decision will be made—and also in then-year dollars (TY$) if a production schedule is known
- Identify the appropriate inflation indices used (the most current OSD indices are published on the SAF/FMC web page)
- Separately identify sunk costs for each alternative
- Address manpower implications for each alternative in the O&S costing, including contractor support where applicable
- Address appropriate environmental regulations, treaties, in determining disposal costs
- Address sources that are driving cost risk and uncertainty for each alternative
- Consult with OAS on the latest guidance related to the AoA report format for cost
- Write cost section of the Study Plan, Final Report and AFROC cost briefings

7.3 Cost Analysis Methodology

LCC analysis allows alternatives to be compared to the baseline system based on their relative estimated costs. The LCC methodology is initially outlined in the Study Plan and updated as the AoA proceeds. While the LCC analysis of all viable alternatives must be based on the same WBS, the level of alternative description available to the cost analyst—and thus the fidelity of the estimate—will vary depending on the detail of system definition and its technological maturity. The system definition of each alternative in the CCTD will serve as the foundation for the cost analysis. As part of the cost methodology, the AoA Study Plan should identify general ground rules and assumptions underlying the analysis as well as those specific to particular cost elements or life cycle phases (e.g., an assumption that no additional manpower is required to employ any alternative). At a minimum, the preliminary list of ground rules and assumptions should address the following:

- Cost basis of the estimate (specified in base-year dollars (BY$)
- Specific inflation indices used

- Definition of sunk costs (date separating costs expended or contractually committed from those to be included in the LCC estimate)
- Schedule issues, including major milestones and significant events (IOC and FOC dates, production schedules and quantities)
- Basing, logistics, and maintenance concepts
- Fully Burdened Cost of Fuel (FBCF)
- MILCON
- Intelligence support requirements
- Environmental cost considerations
- Personnel requirements and constraints
- Affordability constraints

7.3.1 Work Breakdown Structure (WBS)

The LCC methodology is generally based on a WBS. A WBS is a product-oriented (as opposed to functionally-oriented) tree composed of hardware, software, services, data, and facilities that define the product to be developed and produced. The following is a notional WBS for an aircraft system; it illustrates the typical elements found at the first three WBS levels (succeeding levels contain greater detail).

<u>Aircraft System</u>

- **Air Vehicle**
  - Airframe
  - Propulsion
  - Air Vehicle Software
  - Armament
  - Weapons Delivery
  - etc.
- **Systems Engineering & program Management**
  - *(no Level 3 breakdown)*
- **System Test & Evaluation (T&E)**
  - Development T&E
  - Operational T&E
  - T&E Support
  - Test Facilities
- **Training**
  - Equipment
  - Services
  - Facilities
- **Data**
  - Technical Publications
  - Engineering Data
  - Management Data
  - Support Data
- **Peculiar Support Equipment**
  - Test & Measurement Equipment
  - Support & Handling Equipment
- **Common Support Equipment**
  - Test & Measurement Equipment

        - Support & Handling Equipment
    - **Operational/Site Activation**
        - System Assembly, Installation & Checkout
        - Contractor Technical Support
        - Site Construction
    - **Industrial Facilities**
        - Construction, Conversion or Expansion
        - Equipment Acquisition or Modernization
        - Maintenance (industrial facilities)
    - **Initial Spares & Repair Parts**
        - (no Level 3 breakdown)

Once the WBS has been created, costs are collected for the WBS elements and the LCC estimates are then developed for each alternative. AoA alternatives are not normally estimated below WBS Level 3. For further information on WBS, refer to MIL-HDBK 881B (July 2005).

7.3.2 Cost Estimating Methodologies

There are several cost estimating methodologies available to the analyst. The three formal approaches include the engineering build-up (or bottom-up technique), the parametric estimating technique, and the analogy technique. Informal approaches like expert opinion can also be used when the formal techniques are not practical.

The engineering build-up approach may be used when a detailed WBS is available. Cost can be estimated for basic tasks like engineering design, tooling, fabrication of parts, manufacturing engineering, and quality control. The cost of materials may also be estimated. The disadvantages of this approach are its time-consuming nature and the need for detailed, actual cost data.

The parametric method is normally appropriate at the early stages of a program when there is limited program and technical definition. It involves collecting relevant historical data at an aggregated level of detail and relating it to the area to be estimated through generally simple mathematical equations known as cost estimating relationships (CERs). CERs relate cost to one or more variables (e.g., volume, weight, or power). Since CERs are based on actual program cost history, they reflect the impacts of system growth, schedule changes, and engineering changes. When costs are captured at a very high level however, visibility into more detailed levels is lost. The use of a factor or ratio relating the cost of one entity to another is also considered a form of parametric estimating (e.g., training costs might be estimated as 20 percent of production costs). Factors and ratios allow the estimator to capture a large part of an estimate with limited descriptions of both the historical database used to develop the factor and the program to be estimated. This method is often used for training, data, peculiar support equipment, and systems engineering and program management.

The analogy method uses actual costs from a similar program and adjusts for the new program's complexity and technical or physical differences to derive the estimate. This method is normally used early in a program cycle when there is insufficient actual cost data to use as a basis for a detailed approach. Engineering assessments are necessary to ensure the best analogy has been selected and proper adjustments are made. These engineering judgments are the mainstay of the approach and can also be a limiting factor.

7.3.3 Cost Models and Data

Cost models incorporating the three methodologies are available to assist the cost analyst in developing the LCC estimates. The models and data intended for use in the AoA should be identified and described in the Study Plan. Cost models and data generally accepted by the Air Force cost analysis community will be used. AFCAA and the OSD CAIG can provide a comprehensive list of acceptable cost models and databases. Cost models frequently used include:

- ACEIT (integrated)
- COCOMO (software)
- CRYSTAL BALL (risk)
- LSC (logistics)
- SEER (software/hardware)
- SEM (software)
- PRICE-H (hardware)
- PRICE-S (software)

7.3.4 Cost Risk and Uncertainty

Because a cost estimate is a prediction of the future, there is a significant concern that actual costs may differ from the costs developed in the estimate; risk and uncertainty analyses address this concern. Most cost estimates are a composite of both risk (known-unknowns) and uncertainty (unknown-unknowns). However, "risk" is often used generically to address both types of "unknowns." Risk stems from three primary sources: configuration changes, technical and schedule problems, and cost estimating error. Technical and schedule risk and cost estimating error can be accounted for in the risk analysis, but major configuration changes may require a new estimate rather than trying to compensate by applying a risk approach. Several approaches are available to treat risk in an estimate; they range from very subjective to those with complex statistics. Whatever risk methodology the cost analyst decides to employ, it should be adequately described in the Study Plan. The results of the risk analysis will be included in the final cost estimates.

7.4 Cost Results Presentation

The format illustrated in Figure 7-1 is used to display the AoA cost analysis results; it allows the costs for each alternative and LCC element to be directly compared. This format can be used to present both Base Year (BY$) and Then Year (TY$) costs.

	R&D	Investment	O&S	Disposal	Total LCC
Alt 1					
Alt 2					
Alt 3					
...					
Alt *n*					

Figure 7-1: General LCC Summary (All Alternatives)

Figure 7-2 presents each alternative's cost in terms of fiscal year spread and appropriation. Again, this format can be used for both BY$ and TY$. The results should also be analyzed graphically in a presentation. Sunk costs are excluded from the estimates in all tables.

	FY01	FY02	FY03	...	FY *n*	Total LCC
3010 Aircraft Procurement						
3020 Missile Procurement						
3080 Other Procurement						
3300 Military Construction						
3400 Operations & Maintenance						
3500 Military Personnel						
3600 RDT&E						
Total LCC						

Figure 7-2: General LCC Summary (By Alternative)

7.5 Cost Documentation

A complete set of cost documentation is an essential part of the AoA cost analysis. Without an explanation of the data sources and methodology used for each element of the estimates, the costs cannot be replicated and therefore may lack credibility. Chapter 3 of AFI 65-508, *Cost Analysis Guidance and Procedures,* provides guidance on the level of documentation required. Attachment 5 to the same instruction contains a cost documentation checklist useful in determining the completeness of the cost documentation.

7.5.1 Cost Reviews

The CAWG and AoA study team review the cost estimates for consistency and completeness. OAS also reviews the cost section of the Study Plan and the final results as part of the overall AoA assessment provided to the AFROC. For ACAT I AoAs, the AFCAA will perform a NACA for all viable alternatives. NACAs may also be performed for high profile ACAT II AoAs. NACAs assess the completeness, reasonableness, and consistency of the estimates and provide a confidence rating for the estimate; they also highlight any problem areas. It is strongly recommended that the study director request AFCAA cost support early in the AoA process to conduct a NACA of the cost estimates for the viable alternatives.

8 Performing the Risk Analysis

The Risk Analysis that is done for the AoA should be accomplished using the SAF/AQ Guidance Memorandum on *Life Cycle Risk Management* as based on the *Risk Management Guide for DoD Acquisition* (http://www.dau.mil/pubs/gdbks/risk_management.asp).

Risk is defined as the likelihood of an adverse event and the severity of the consequences should that event occur. The first step in the risk analysis process is to determine what factors, under each risk category, are relevant to each alternative. There are three categories of risks that should be assessed for each alternative in the AoA.

8.1 Risk Categories

The following are the three risk categories and potential risk elements that may be appropriate to assess under each category:

Performance/Technical

- Performance. The ability of the system to satisfy the capability gap in the operational environment. This factor addresses the risk with respect to completeness of the definition of the capability need statement and associated metrics (MOEs, MOPs, KPPs, etc.) and includes elements such as known/projected threats, infrastructure Command, Control, Communications, and Intelligence (C3I), policy, and compliance issues.
- Technical. The degree to which the technology proposed for the program has been or is expected to be demonstrated as capable of meeting all of the program's objectives.

Schedule

- The adequacy of the time allocated for performing the defined tasks, e.g., developmental, production, etc. These elements include the effects of programmatic schedule decisions, the inherent errors in the schedule estimating technique used, and external physical constraints.

Cost

- The ability of the system to achieve the program's life-cycle cost objectives. These elements include the effects of budget and affordability decisions and the effects of inherent errors in the cost estimating technique(s) used (given that the technical requirements were properly defined).

8.1.1 Risk Elements

The following is a list of possible additional risk elements that could be evaluated in one or more of the risk categories. This list is not all-inclusive and an AoA may have additional risk elements not listed here.

Threats. The sensitivity of the program to uncertainty in the threat description, the degree to which the system design would have to change if the threat's parameters change, or the vulnerability of the program to foreign intelligence collection efforts (sensitivity to threat countermeasure).

Requirements. The sensitivity of the program to uncertainty in the system description and requirements except for those caused by threat uncertainty.

Design. The ability of the system configuration to achieve the program's engineering objectives based on the available technology, design tools, design maturity, etc.

Test and Evaluation (T&E). The adequacy and capability of the T&E program to assess attainment of significant performance specifications and determine whether the systems are operationally effective and suitable.

Modeling and Simulation (M&S). The adequacy and capability of M&S to support all phases of a program using verified, valid, and accredited M&S tools.

Logistics. The ability of the system configuration to achieve the program's logistics objectives based on the system design, maintenance concept, support system design, and availability of support resources.

Production. The ability of the system configuration to achieve the program's production objectives based on the system design, manufacturing processes chosen, and availability of manufacturing resources such as facilities and personnel.

8.2 Risk Methodology

Risk analysis may be accomplished by a separate working group, but is often done as a collaborative effort by the Operations Concepts WG (OCWG), Effectiveness Analysis WG (EAWG) and Technology and Alternatives WG (TAWG). Each risk identified should be documented in the CCTD. The risk analysis summary can then be done by the WIPT.

8.2.1 Risk Element Probability

For each alternative the qualitative evaluation of probability for individual risk elements will be determined by the criteria shown in Table 8-1 below.

Level	Likelihood	Probability (P) of Occurrence
1	Not Likely	P <= 20%
2	Low Likelihood	20% < P <= 40%
3	Likely	40% < P <= 60%
4	Highly Likely	60% < P <= 80%
5	Near Certainty	P > 80%

Table 8-1: Standard Air Force Criteria for Risk Probability

8.2.2 Risk Element Consequence

For each alternative, the consequence of individual risk elements will then be evaluated according to their impact (or effect) on concept performance/ technical attributes, production schedule, and cost. The qualitative evaluation of risk consequence will be determined by the criteria shown in Table 8-2 below. Realizing that every risk element could have multiple consequences, the overall consequence of any given risk element will be the maximum of its

score from the three given categories; however, the lesser consequences still need to be recorded, understood, and addressed during mitigation planning.

Level	Performance / Technical	Schedule	Cost
1	Minimal consequences to technical performance but no overall impact to the program success.	Negligible schedule slip.	Pre-MS B: <= 5% increase from previous cost estimate. Post MS B: limited to <= 1% increase in Program Acquisition Unit Cost (PAUC) or Average Procurement Unit Cost (APUC).
2	Minor reduction in technical performance or supportability, can be tolerated with little or no impact on program success.	Schedule slip, but able to meet key dates (e.g., PDR, CDR, FRP, FOC) and has no significant impact to slack on critical path.	Pre-MS B: > 5% to 10% increase from previous cost estimate. Post MS B: <= 1% increase in PAUC/APUC with potential for further cost increase.
3	Moderate shortfall in technical performance or supportability with limited impact on program success.	Schedule slip that impacts ability to meet key dates (e.g., PDR, CDR, FRP, FOC) and/or significantly decreases slack on critical path.	Pre-MS B: > 10% to 15% increase from previous cost estimate. Post MS B: > 1% but < 5% increase in PAUC/APUC
4	Significant degradation in technical performance or major shortfall in supportability with moderate impact on program success.	Will require change to program or project critical path.	Pre-MS B: > 15% to 20% increase from previous cost estimate. Post MS B: >= 5% but <10% increase in PAUC/APUC
5	Severe degradation in technical/supportability threshold performance; will jeopardize program success.	Cannot meet key program or project milestones.	Pre-MS B: > 20% increase from previous cost estimate. Post MS B: >= 10% increase in PAUC/APUC danger zone for significant cost growth and Nunn-McCurdy breach)

Table 8-2: Standard Air Force Criteria for Risk Consequence

Consequence level 5 of the Performance/Technical category is further clarified by any event which causes one or more of the following triggers:

- Concept will not meet a KPP threshold
- A concept Critical Technology Element (CTE) will not be at Technology Readiness Level (TRL) 4 or the Manufacturing Readiness Level (MRL) will not be at 4 at Milestone (MS) A

- NOTE: Pre-acquisition analytical efforts (e.g., CBAs, MUAs, AoAs, etc) are typically limited to TRL and MRL 3 (e.g., analytical proof of concept).

- A CTE will not be at TRL 6 or the MRL will not be at 6 at MS B
  - NOTE: MRL 6 is specified in the MRA Deskbook and DoDI 5000.02, but not in the SAF/AQ memo
- A CTE will not be at TRL 7 or the MRL will not be at 8 by MS C
- A CTE will not be at TRL 8 or the MRL will not be at 9 by the Full-Rate Production (FRP) Decision

8.2.3 Risk Element Severity

The final step of risk element evaluation is the determination of risk severity. For each concept, the severity of individual risk elements is determined by plotting the respective probability and maximum consequence levels on the matrix shown in Figure 8-1. The cell at the plot coordinates provides an overall qualitative risk severity score of low (L), moderate (M), or high (H). Note that the standard Air Force criteria differs somewhat from that specified in the Risk Management Guide for DoD Acquisition, specifically for the severity of cell P=1, C=5.

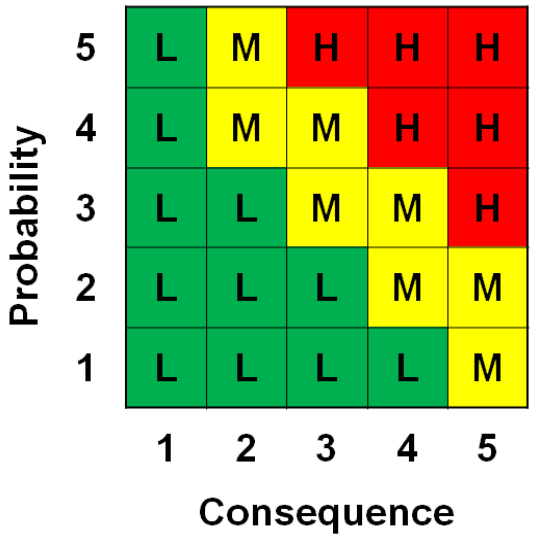

Figure 8-1: Risk Element Severity Matrix

8.3 Risk Assessment Presentation

Once the risk has been assessed for all risk items, a methodology should be developed in order to present risk elements for the alternatives. Because risk assessment in AoAs is relatively new, the approaches used to present the assessment are still being developed.

If an AoA has relatively few risk elements that have severity levels that are not green, then it is possible to develop a methodology that represents the risk associated with each alternative as a single color. However, if an AoA has several risk elements that are not green associated with several alternatives, the presentation needs to be more in-depth. Figure 8-2 provides a method of displaying the evaluation of all risk elements for each of the alternatives.

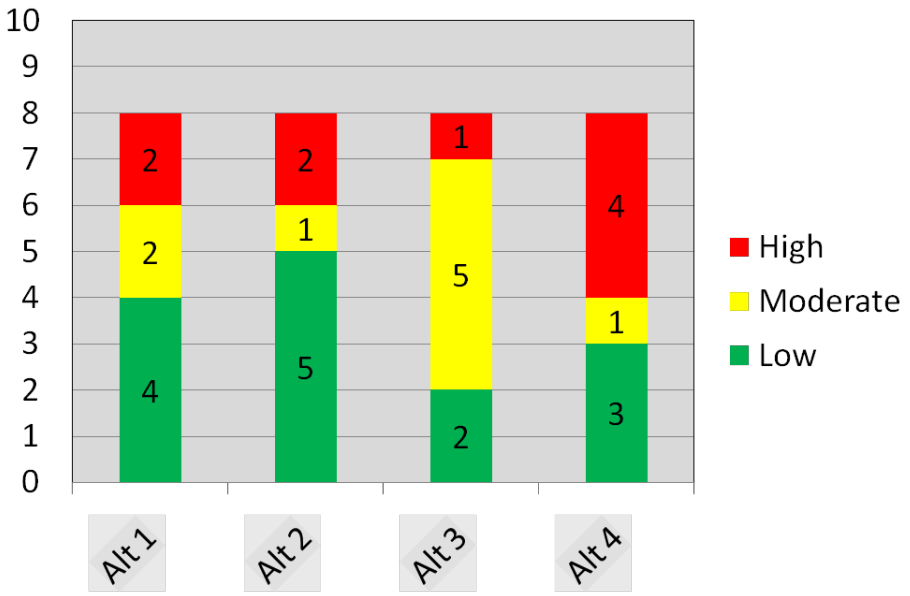

Figure 8-2: Notional Risk Comparison

In Figure 8-2 there are eight risk elements that have been assessed for each alternative. The chart shows the number of elements and their severity for each of the four alternatives. Alternative 2 has the greatest number of risk elements that are low in severity, and Alternative 3 has the least number of risk elements that are high in severity. This method of presentation works best when risk elements are equal in importance.

8.4 Aggregate Impact of Concept Risk Elements

8.4.1 Operational Risk

The analyst should document risks of the materiel concept satisfying the capability gap in the operational environment. Also address risk with respect to completeness of the definition of the capability need statement and associated metrics (MOEs, MOPs, KPPs, etc.). Be sure to address items such as threats, infrastructure (C3I), policy, compliance issues, etc. Provide a risk assessment and risk mitigation plan for each.

8.4.2 Program Risk

Assess the risk in the proposed program using guidance in the "Risk Management Guide for DOD Acquisitions." If an Integrated Risk Assessment (IRA) has been performed, provide results and reference the applicable IRA report. Baseline the risks in cost, schedule, and performance and provide a risk mitigation plan. Identify in an event driven manner when additional IRAs will be accomplished.

8.4.3 Technology Risk

Based on the CTEs and the technology maturation plan, quantify the risks associated with the technology challenges including the impact the technology risk may have on cost and schedule. Specifically address how the tech maturation plan mitigates risk with an event driven

schedule (e.g., risk waterfall chart). As part of the technology risk assessment, describe the consequence of a technology not being matured to the point of inclusion in the concept. Describe the backup approach if applicable, and any impact to the concept satisfying the capability need.

8.5 Risk Summary

The final step in assessing the overall risks associated with each alternative is to identify risks that cannot be managed or mitigated. This is particularly useful information for the high to moderate risk factors and is excellent information for the decision makers (and program office). The overall risk assessment for each alternative will feed into the alternative comparisons with the effectiveness analysis results and the LCCEs.

9 Alternative Comparisons

Once the effectiveness results, cost estimates, and overall risk information has been generated and the sensitivities and tradeoffs studied, it is time to bring all of the information together and interpret its meaning through comparative analysis.

Comparing the alternatives means the simultaneous consideration of the alternatives' cost, effectiveness, and associated risks and interpreting what it means for making a decision. As consumers, we are all familiar with the concept of comparing alternatives, whether buying laundry detergent, a new car, or a home. As a consumer, we collect data on costs and make assessments on how well the alternatives will meet our needs (how "effective" they are) and any potential risks associated with bringing a particular product home. With data in hand, we make our comparisons and select an alternative. In an AoA, the process is essentially the same, but there is rarely a clear-cut 'best' alternative.

9.1 Alternative Comparison Dilemmas

As the team conducts the alternative comparisons, the need to determine if additional effectiveness is worth additional cost and the need to assess the relative values of different measures of effectiveness will arise. Figure 9-1 notionally illustrates a common AoA dilemma. From this notional diagram, (assuming we could roll the MoEs up to an overall effectiveness) we can safely conclude that we would not select Alternatives 1 or 2, but the issue is not clear for Alternative 3 and Alternative 4. Alternative 4 will be chosen if the increase in effectiveness is judged to be worth the cost.

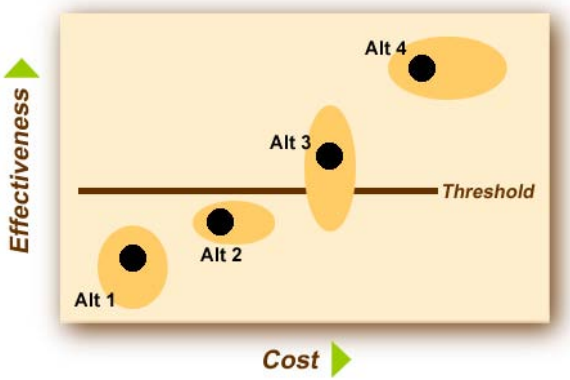

Figure 9-1: Dilemma 1 - Is the Increase in Effectiveness Worth the Increase in Cost?

The decision may be somewhat easier if the AoA guidance has identified the minimum acceptable effectiveness threshold. This would allow us to focus on alternatives that meet or exceed that threshold. This is rarely, if ever, seen for an AoA. Figure 9-1 also illustrates that the analysis results will have ranges representing the uncertainty (yellow ovals) of the estimates for cost and effectiveness. When the team develops its conclusions, it needs to ensure that the presentation explains what those error bands represent and identify the drivers behind the uncertainties.

Figure 9-2 shows the second type of dilemma. In this illustration, if the MoEs are all critical, there is little to differentiate among the choices. Thus costs and/or risks could be the more significant discriminating factors. If the MoEs are not all critical, then the three alternatives may differ substantially in overall effectiveness.

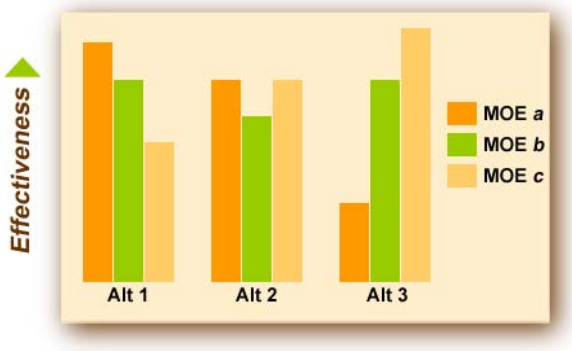

Figure 9-2: Dilemma 2 - Do These Alternatives Have Significant Differences in Overall Effectiveness?

As the comparative analysis is conducted, the team must remember that the goal of the process is to identify the most promising candidates for consideration by decision makers. In some cases this may mean a single alternative. In other cases, there will be several alternatives, each with different cost, effectiveness, and risk pluses and minuses. **There is generally no requirement for an AoA to identify a "single" solution.**

The next step in this process is to find a way to clearly identify for the decision makers the advantages and disadvantages of each alternative, especially how the alternatives address the required capabilities and answer the high-level issues/questions in the AoA guidance. In doing this, address the impact of the overall risk of each alternative to help or support the final selection of the preferred alternative(s).

Ensure that the information presented is clear and unbiased, and that it depicts the analysis results, understandable interpretations, and defensible recommendations. The more straightforward and clear the results are described, the easier it becomes to understand the differences among the alternatives. The study team's job is to help the decision makers understand the differences among the alternatives.

The study director should ensure that there is sufficient time set aside in the AoA schedule to conduct sensitivity analysis on the final alternative comparisons. This will allow the results of the final analysis to be vetted with stakeholders before the results are written into the AoA report.

9.2 Alternative Comparison Methodology

9.2.1 Provide the Basic Cost, Effectiveness and Risk Data

The completed AoA should provide basic life cycle cost, MoE, and risk assessment data for all candidate alternatives that have been analyzed. By their nature, these data are fundamental to understanding the logic of any additional winnowing of alternatives.

9.2.2 Avoid Using Ratios for Comparisons

Ratios—cost/kill, kills/sortie, etc.—are frequently proposed for comparing alternatives. Unfortunately, ratios can be misleading because they frequently hide necessary information. As an example, suppose that one alternative kills 0.01 targets per sortie and a second alternative kills 0.1 targets per sortie. The second alternative is ten times better than the first, but the truth is, we can't tell from the ratio alone. If there are 10 targets to be killed, the answer is likely to be a resounding yes—100 sorties may be acceptable, but probably not 1,000. However, if there are 1,000 targets to be killed, the answer is almost certainly no, for we are looking at very large numbers of sorties even for the better alternative. By using the ratio instead of the numbers of sorties required, there has been a loss of understanding without a corresponding gain.

9.2.3 Alternative Comparison Matrix

Once all of the analysis has been presented in the report or briefings, it is useful to present a summary of the key discriminators for each alternative side-by-side before presenting the conclusions and recommendations drawn from all of the analysis. Figure 9-3 shows an example of this sort of presentation. This kind of depiction ensures that the report reader or briefing audience has a summary picture of the results in mind (and for reference) as the conclusions and recommendations are made.

Because the alternative comparison matrix has become the de-facto method of results presentation to decision makers, it is imperative that the color scheme is well-defined and truly representative of the analysis. Because the color used for the MoE is representative of the values of the MoPs, the methodology for determining the colors from the values must be discussed and agreed upon by the core study team. Once the methodology has been applied, a thorough review should determine whether the methodology is sound, or has to be revised. The same goes for the methodology used to roll up the values for all risk elements to a single color representation. The associated costs should be presented with a confidence level (X) that indicates to the decision maker that the real cost value has an X% chance of being within that estimate.

	Critical						Non-Critical			Risk	Total LCC
	Mission Task 1			Mission Task 2			Mission Task 3				
	MoE 1.1	MoE 1.2	MoE 1.3	MoE 2.1	MoE 2.2	MoE 2.3	MoE 3.1	MoE 3.2	MoE 3.3		
Alt 1	G	Y	R	G	Y	G	G	R	G	R	
Alt 2	R	G	G	Y	G	G	G	Y	Y	G	
Alt 3	Y	Y	R	Y	R	Y	Y	G	G	R	
Alt 4	G	R	G	G	Y	Y	Y	G	R	G	

Figure 9-3: Notional Matrix of Alternative Comparison Results

10 Final Results

The final results of an AoA are presented initially in a series of briefings. The briefings are typically given to the AFROC, Air Force Council, Integrating Integrated Product Team (IIPT), and the Overarching Integrated Product Team (OIPT) chaired by the MDA.

The purpose of these briefings is to logically present the case for selection of the best alternative(s) in meeting the capability requirements outlined in the ICD or CDD. The quality of the presentations—and perhaps more so, the quality of the underlying AoA work—is critical to the initiation or continuation of the program.

In addition to the final briefings, the entire AoA process and results must also be documented in a written Final Report. This report, approved by the MAJCOM and fully coordinated at Air Force and joint (if appropriate) levels, is due at the time of presentation of the final results to the AFROC. The Final Report is extremely important; it is the principal supporting documentation for any decisions made as a result of the AoA. It also may be the basis for any subsequent AoAs at later milestones and different (but similar) AoAs in the future. We recommend that the Final Report be written as soon as possible after the analysis is complete. Delaying finalization of this document will only make it more difficult to produce as team members will begin to disband and critical information will begin to dissipate once the analysis is completed.

The Final Report should follow the same format as the Study Plan template (Appendix C) with the sections in red being the Final Report additions.

For all AoAs, OAS is required to provide an independent assessment of the Final Report and briefing prior to the study director's required briefing to the AFROC. Appendix E describes the criteria OAS uses for this assessment. OAS analysts not directly supporting the AoA are called upon to read and assess the report, review its contents, and evaluate its credibility and completeness in light of the AoA guidance given and accepted analysis principles. The study director should plan to present the briefing to OAS at least 1 month before the scheduled AFROC and after OAS has had sufficient time to review and assess the report (5-6 weeks before the AFROC briefing).

Appendix A: Acronyms

ACAT	Acquisition Category
ACEIT	Automated Cost Estimating Integrated Tools
ACTD	Advanced Concept Technology Demonstration
ADM	Acquisition Decision Memorandum
AF	Air Force
AF/A2	AF Assistant Chief of Staff for Intelligence
AF/A5R	AF Director of Requirements
AF/A9	AF Studies and Analysis Agency
AFC	Air Force Council
AFCAA	Air Force Cost Analysis Agency
AFFSA	AF Flight Standards Agency
AFGWC	AF Global Weather Center
AFI	Air Force Instruction
AFISRA	Air Force Intelligence, Surveillance, Reconnaissance Agency
AFMC	AF Materiel Command
AFOTEC	AF Operational Test & Evaluation Center
AFP	AF Pamphlet
AFROC	Air Force Requirements Oversight Council
AFSAT	Air Force Standard Analysis Toolkit
AHP	Analytical Hierarchy Process
ALC	Air Logistics Center
AMOS	Air Mobility Operations Simulation
AoA	Analysis of Alternatives
APUC	Average Unit Procurement Cost
ASD(NII)	Assistant Secretary of Defense for Networks and Information Integration
BDA	Battle Damage Assessment
BY$	Base Year Dollars
C3I	Command, Control, Communications and Intelligence
C4I	Command, Control, Communications, Computers, and Information
C4ISR	Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance
CAE	Component Acquisition Executive
CAIG	Cost Analysis Improvement Group
CAIV	Cost As an Independent Variable
CAWG	Cost Analysis Working Group
CBA	Capabilities Based Assessment
CCTD	Concept Characterization and Technical Description
CDD	Capability Development Document

CDR	Critical Design Review
CER	Cost Estimating Relationship
CFAM	Combat Forces Assessment Model
CINC	Commander in Chief
CIO	Chief Information Officer
CJCSI	Chairman Joint Chiefs of Staff Instruction
CJCSM-	Chairman Joint Chiefs of Staff Manual
CoE	Center of Expertise
COCOM	Combatant Command
COCOMO	Comprehensive/Constructive Cost Model
CONEMP	Concept of Employment
CONOPS	Concept of Operations
CPD	Capability Production Document
CPIPT	Cost Performance Integrated Product Team
CRRA	Capability Review and Risk Assessment
CSAF	Chief of Staff Air Force
CTE	Critical Technology Element
DAB	Defense Acquisition Board
DAE	Defense Acquisition Executive
DCR	Doctrine Change Request
DHS	Department of Homeland Security
DIA	Defense Intelligence Agency
DLA	Defense Logistics Agency
DoE	Department of Energy
DoD	Department of Defense
DODD	Department of Defense Directive
DODI	Department of Defense Instruction
DoI	Department of the Interior
DoS	Department of State
DoT	Department of Transportation
DOTMLPF	Doctrine, Operations, Training, Material, Leadership/Education, Personnel, and Facilities
DP	Developmental Planning
DPG/IPS	Defense Planning Guidance/Illustrative Planning Scenario
DTRA	Defense Threat Reduction Agency
EA	Effectiveness Analysis
EADSIM	Extended Air Defense Simulation
EAWG	Effectiveness Analysis Working Group
ECWG	Employment Concepts Working Group
ESAMS	Enhanced Surface-to-Air Missile Simulation
FAA	Federal Aviation Administration
FBCF	Fully Burdened Cost of Fuel

FCB	Functional Control Board
FFRDC	Federally Funded R&D Center
FM	Financial Management
FoS	Family of Systems
FOC	Full Operational Capability
FRP	Full-Rate Production
GCIC	Global Cyberspace Integration Center
GEO	Geosynchronous Earth Orbit
GIANT	Global Positioning System (GPS) Interference And Navigation Tool
GIG	Global Information Grid
GRC&A	Ground Rules, Constraints & Assumptions
GTSIMS	Georgia Tech Simulations Integrated Modeling System
IC	Implementing Command
ICD	Initial Capabilities Document
IIPT	Integrating Integrated Product Team
IOC	Initial Operational Capability
IPT	Integrated Product Team
IRA	Integrated Risk Assessment
ISSA AV	Integrated Space Situational Awareness – Analyst Version
IT	Information Technology
JCIDS	Joint Capabilities Integration and Development System
JCD	Joint Capabilities Document
JCTD	Joint Concept Technology Demonstration
JFACC	Joint Force Air Component Commander
JIMM	Joint Integrated Mission Model
JROC	Joint Requirements Oversight Council
JSEM	Joint Services Endgame Model
KPP	Key Performance Parameter
KTR	Contractor
LCOM	Logistic Composite Model
LEO	Low Earth Orbit
LC	Lead Command
LCC	Life Cycle Cost
LCCE	Life Cycle Cost Estimate
LSC	Logistics Support Cost
M&S	Models & Simulations
MAIS	Major Automated Information System
MAISAP	Major Automated Information Systems Acquisition Programs
MAJCOM	Major Command
MDA	Milestone Decision Authority
MDAP	Major Defense Acquisition Program

MDD	Materiel Development Decision
MER	Manpower Estimate Report
MILCON	Military Construction
MoA	Memorandum of Agreement
MoE	Measure of Effectiveness
MoP	Measure of Performance
MOSAIC	Modeling System for Advanced Investigation of Countermeasures
MoU	Memorandum of Understanding
MRL	Manufacturing Readiness Level
MS	Milestone
MSFD	Multi-Service Force Deployment
MT	Mission Task
MUA	Military Utility Assessment
NACA	Non-Advocate Cost Assessment
NASA	National Aeronautics and Space Administration
NDA	Nondisclosure Agreement
NGA	National Geospatial Intelligence Agency
NIMA	National Imagery Mapping Agency
NSSA	National Security Space Acquisition
O&S	Operations and Support
OAS	Office of Aerospace Studies
OC	Operating Command
OC/FM	Operating Command Financial Management
OCWG	Operations Concepts Working Group
OIPT	Overarching Integrated Product Team
OSD	Office of the Secretary of Defense
OSD/AT&L	Office of the Secretary of Defense for Acquisition Technology & Logistics
OSD/CAPE	OSD/Cost Assessment and Program Evaluation
P3I	Pre-Planned Product Improvement
PAUC	Program Acquisition Unit Cost
PDR	Preliminary Design Review
PM	Program Manager
PMD	Program Management Directive
PPBE	Planning, Programming, Budgeting, and Execution
RADGUNS	Radar Directed GUN Simulation
R&D	Research and Development
RCT	Requirements Correlation Table
RDT&E	Research, Development, Test & Evaluation
RFI	Request for Information
SAF	Secretary of the AF
SAF/AQ	Secretary of the AF for Acquisition

SAF/FMC	Secretary of the AF for Financial Management
SAG	Study Advisory Group
SE	Systems Engineering
SEAS	System Effectiveness Analysis Simulation
SEER	Systems/Software Estimating and Evaluation of Resources
SEM	Software Estimating Model
SETA	Scientific, Engineering, Technical, and Analytical
SL	Study Lead
SLEP	Service Life Extension Program
SME	Subject Matter Expert
SoS	System of Systems
SPAAT	Sensor Platform Allocation Analysis Tool
SPO	System Program Office
STA	System Threat Assessment
STAR	System Threat Assessment Report
STINFO	Scientific & Technical Information
SWarF	Senior Warfighters Forum
T&E	Test and Evaluation
TAWG	Technology & Alternatives Working Group
TDS	Technology Development Strategy
TEMP	Test and Evaluation Master Plan
TES	Test and Evaluation Strategy
TRG	Technical Review Group
TRL	Technology Readiness Level
TSWG	Threats and Scenarios Working Group
TY($)	Then-year (dollars)
USD (AT&L)	Undersecretary of Defense for Acquisition, Technology and Logistics
USA	United States Army
USAF	United States Air Force
USMC	United States Marine Corps
USN	United States Navy
VCSAF	Vice Chief of Staff Air Force
WBS	Work Breakdown Structure
WG	Working Group
WIPT	Working-Level Integrated Product Team

Appendix B: References and Information Sources

A. Joint Capabilities Integration and Development System (JCIDS) Manual
B. CJCSI 3170.01G, JCIDS Instruction
C. Capabilities-Based Assessment (CBA) User's Guide
D. DODD 5000.01, The Defense Acquisition System
E. DODI 5000.02, Operation of the Defense Acquisition System
F. Defense Acquisition Guidebook
G. DODD 5101.2, DoD Executive Agent for Space
H. National Security Space Acquisition (NSSA) Policy
I. DOD 5000.4-M, Cost Analysis Guidance & Procedures
J. Risk Management Guide for DoD Acquisition
K. Air Force Specific Implementation
L. AFPD 63-1 – Capability-Based Acquisition System
M. AFI 10-601 – Capabilities-Based Requirements Development
N. AFI 10-604 –Capabilities-Based Planning
O. Information Technology (IT) Related Policies
P. Clinger-Cohen Act 1996
Q. CJCSI 6212.01C - Interoperability and Supportability of IT and NSS
R. DODD 4630.5 – Interoperability and Supportability of IT and NSS
S. DODI 4630.8 – Procedures for Interoperability and Supportability of IT and NSS
T. DODD 8100.1 – Global Information Grid (GIG) Overarching Policy
U. Joint Pub 6-0 – Doctrine for C4 Systems Support to Joint Operations
V. MIL-HDBK-881B

Appendix C: Study Plan/Final Report Template

This appendix contains the AoA Study Plan and Final Report template required for the AoA. Sections not needed for the initial Study Plan but required for the Final Report are listed in red.

----------Cover Page ----------

<Name of Project Here>

Analysis of Alternatives (AoA)
Study Plan/Final Report

<Lead MAJCOM>

<Date>

Distribution Statement

Refer to these sources for more information:

1. Department of Defense Directive (DODD) 5230.24, "Distribution Statements on Technical Documents"

2. Air Force Pamphlet (AFP) 80-30, "Marking Documents with Export-Control and Distribution-Limitation Statements" (to be reissued as Air Force Instruction (AFI) 61-204)

Ask your Scientific & Technical Information (STINFO) Officer for help in choosing which of the available statements best fits your AoA

REMEMBER -- AoA information may be PROPRIETARY, SOURCE SELECTION

SENSITIVE, OR CLASSIFIED

----------Table of Contents----------

AoA Study Plan Template

Note: Additional sections highlighted/underlined in red above to be added to the Final Report (Executive Summary, 5.4, 6.4, 7.3, 8.3, 8.4).

----------Plan/Report Contents----------

AoA Study Plan/Final Report Section Content

Executive Summary

- Describe the purpose of the study
- Identify key organizations associated with the study
- Summarize the results of the study

1. Introduction

1.1. Background

- Describe the history of developments that provide the necessity for the AoA
- Summarize relevant analyses that precede this study
- Paraphrase, quote, and refer to Initial Capabilities Document (ICD), Acquisition Decision Memorandum (ADM), and Program Management Directive (PMD) that required the AoA
- Identifies any applicable Joint Concept Technology Demonstrations (JCTDs) or Advanced Concept Technology Demonstrations (ACTDs)

1.2. Purpose

- Identifies major acquisition issues to be studied
- Identifies intended results in general terms
- Identifies the Milestone to be supported

1.3. Scope

- Identifies the level (engineering, one-on-one, few-on-few, mission, or campaign) and scope of the analysis planned
- Identifies the "tailoring" and "streamlining" used to focus the study
- Describe broadly the nature of possible alternative solutions to be considered

1.4. Study Guidance

- Include the study direction from the AoA guidance and ADM

1.5. Capability Gaps

- Describe deficiency in system capabilities and refer to ICD or CDD as appropriate
- Identify the timeframe for the mission need
- Describe any applicable ACTDs

1.6. Stakeholders

- Describe the organizations who have an interest in the capabilities being studied

1.7. Constraints and Assumptions for the AoA

- Describe AoA constraints and assumptions, including Initial Operating Capability, Full Operating Capability, and Life Cycle Cost
- Describe the implications of the constraints and assumptions
- Reference applicable sections in the ICD, CDD or AoA guidance
- Identifies the AoA resources available (people, funds and time) and how they affect the scope of the AoA

1.8. Supporting Analysis

- Describe any analysis which may be leveraged to support this AoA

2. Threats and Scenarios

2.1. Scenarios

- Describe scenarios and rationale for selection

- Discuss how alternatives are evaluated and compared using scenarios
- Discuss how scenarios are traceable back to DPG/IPS (Defense Planning Guidance/Integrated Program Summary)

2.2. Threats

- Describe briefly enemy tactics (include potential countermeasures)
- Paraphrase, quote, and reference the System Threat Assessment Report (STAR) or System
- Threat Assessment (STA), if it exists
- Identifies other sources of projections
- Plan to approve or validate the threat through the Defense Intelligence Agency (DIA)
- Identifies areas of uncertainty, if possible

2.3. Environment

- Describe expected operating environment, including terrain, weather, location, and altitude
- Paraphrase, quote, and reference applicable sections in the ICD, CDD or AoA guidance documentation
- Consider the environmental impacts of alternative solutions with the environment

2.4. Methodology

- Describe the methodology used for down-selecting the threats and scenarios used for evaluation of the alternatives

3. Alternatives

3.1. Determining Alternatives

- Describe the procedures used to determine alternatives which might provide the necessary capabilities

3.2. Description of Alternatives

- Identify the baseline case (this is usually the system in use today)
- Categorize alternatives based on technology, delivery platform, kill mechanism, etc., if productive
- Summarize each alternative
- Use figures to show system functions or interfaces
- Discuss operational concepts variations for individual alternatives
- Describe how alternatives perform their function
- Describe the steps taken to ensure an adequate range of alternatives
- Consider whether the alternative systems are reasonable and feasible
- Discuss the availability of the alternatives within the assumed timeframe
- Describe the economic operating life of each alternative, both expected and required

3.3. Screening Methodology

- Describe the methodology used to eliminate non-viable alternatives

3.4. Operational Concepts

- Identify organizational functions and operations performed during mission
- Reference applicable sections in ICD or CDD
- Describe how maintenance will be accomplished
- Discuss specific tactics and doctrine used
- Discuss deployment issues
- Discuss interfaces with other systems
- Address needs for inter-operation of the services
- Identifies "day-to-day" and "contingency" operation implications
- Consider any recent field or test experiences that might be relevant
- Describe how the Concepts of Operations and Concepts of Employment fit each alternative

3.5. Concept Characterization and Technical Description (CCTD)

- Describe the format and types of data that will be in the CCTD

4. Effectiveness Analysis

4.1. Determination of Effectiveness Measures

4.1.1. Mission Tasks

- Identifies what task or tasks need to be achieved to satisfy the ICD
- Endeavor to keep MTs independent of one another
- Try to avoid MTs that use words such as "minimize," "maximize," and "optimize"

4.1.2. Measures of Effectiveness

- Derives MoEs from MTs
- Make military worth a prime consideration in the selection of MoEs
- Strive to form MoEs that measure and compare the most meaningful quantities that affect performance of MTs
- Support each MT with at least one MoE
- Consider that an MoE may support more than one MT, and may even support other MoEs
- Form 'unbiased' MoEs that are comparable across all alternatives
- Give preference to quantitative versus qualitative MoEs

4.1.3. Measures of Performance

- Derives MoPs from MoEs
- Support each MoE with at least one MoP
- Consider that an MoP may support more than one MoE, and may even support other MoPs
- Make sure MoPs are "knowable" either analytically or through testing
- Defines MoPs by system performance characteristics, if possible

4.2. Effectiveness Methodology

- Outline the approach and scope of the analysis, including the proper level of modeling military operations (e.g. campaign, mission, engineering, etc.)
- Plan to carry the baseline alternative through the final effectiveness analysis
- Plan to use MT and, as appropriate, MoE values in the cost-effectiveness analysis
- Consider the influence of threshold performance criteria, if any, in the methodology
- Describe the methodology, including models and simulations to be used
- Assign organizational responsibility for each step
- Describe the mechanisms to be used to obtain the buy-in to the methodology by the appropriate communities
- Plan to perform sensitivity tradeoff analysis, as appropriate
- Discuss how measures used in the AoA are measurable (or testable) and will support the development of the post-AoA documents (e.g., CDD, CPD, TES, TEMP)
- Add details as the plan matures

4.3. Sensitivity Analysis

- Discuss planned methodologies

4.4. Analysis Tools, and Data

- Describe briefly the analysis tools and processes that are planned, and the reasons for selection, the input data to be used, and the corresponding sources of the input data
- Give evidence that data for the scenarios, threats, and each of the alternatives will be current, accurate, and unbiased (technically sound and doctrinally correct)
- Describe how models interface and how they are used to calculate MoEs and MoPs (use figures for clarity)
- If M&S are to be used:
    - Discuss who will be running the models
    - Discuss any potential model biases, such as “man-in-the-loop” biases
    - Describe the planned Accreditation process to be used for the models

4.5. Accreditation

- Describe any accreditation issues with the models that will be used
- Describe the accreditation process for those models

4.6. Requirements Correlation Table (RCT)

- Formatted summary of required operational characteristics
    - Performance characteristics
    - Threshold and objective values
    - Assists operational and system requirements traceability
    - Supports the development of follow-on requirements and acquisition documents

4.7. Effectiveness Results

- Describe the results of the effectiveness analysis

5. Cost Analysis

5.1. Life Cycle Cost Methodology

- Outline the approach and scope of the analysis
- Plan to carry the baseline alternative through the final cost analysis
- Consider the influence of threshold performance criteria, if any, in the methodology
- Use the same operational concepts for cost and effectiveness analyses
- Describe the methodology, including the models used
- Assign organizational responsibility for each step
- Describe the mechanisms to be used to obtain the buy-in to the methodology by the appropriate communities
- Plan to perform risk and sensitivity tradeoff analysis, as appropriate
- Identifies the economic operating life of the alternatives (i.e., 10 yr., 20 yr., 25 yr. sustained Operations and Support cost)
- Discuss the methodology for costing Research, Development, Testing, and Evaluation
- (RDT&E), Investment, Operations and Support (O&S), Disposal, and Total LCC for each alternative
- Identifies "sunk costs" for information purposes only
- Discuss the application of Cost as an Independent Variable to LCC
- Add details as the plan matures

5.2. Cost Tools and Data

- Describe briefly the models used, their reason for selection, the input data to be used, and the corresponding sources of the input data
- Discuss any potential model shortfalls
- Request sufficiency review from AFCAA

5.3. Cost Risk Methodology

- Plan to identify cost drivers (usually not the most expensive items – see handbook)
- Describe the methodology for determining the level of uncertainty for each element of LCC, as applicable

5.4. Life Cycle Cost Results

- Describe the results of the cost analysis

5.5. Non-Advocate Cost Assessment (NACA)

6. Risk Assessment

6.1. Risk Assessment Methodology

- Describe the planned methodology for conducting risk analysis and who will be responsible for conducting the analysis

6.2. Risk Assessment Tools

- Discuss risk assessment tools or models which may be used in the analysis

6.3. Risk Analysis Results

- Describe the results of the Risk analysis

7. Alternative Comparisons

7.1. Alternative Comparison Methodology and Presentations

- Outline the approach and scope of the analysis, including the proper level of analyzing military operations (e.g., campaign, mission, engineering, etc.)
- Consider cost, effectiveness and risk as equal players in the analysis
- Plan to carry the baseline alternative through to the final analysis
- Plan to combine the cost, effectiveness and risk analyses
- Describe the comparison rank ordering methodology
- Describe the methodology, including the analysis tools used
- Assign which organization is responsible for each step
- Describe the mechanisms to be used to obtain the buy-in to the methodology by the appropriate communities
- Plan to perform sensitivity tradeoff analysis, as appropriate
- Plan to use figures and graphics for clarity

7.2. Criteria for Final Screening of Alternatives

- Discuss criteria for selecting among alternatives
- Describe possible cost and performance thresholds

7.3. Alternative Comparison Results

- Compare the alternatives using effectiveness, cost and risk

7.4. AoA Conclusions and Recommendations

- Provide conclusions and recommendations based on the analysis

8. Organization and Management

8.1. Study Team Organization

8.1.1. Team Membership

- Identify who is doing what
- Include a phone number list for all organization points-of-contact
- Study Advisory Group (SAG) (if used)

8.1.2. Team Responsibilities

- Describe the responsibilities and products for each study team

8.2. AoA Review Process

- Describe the review process for this particular AoA (use pictorial if appropriate)
- Working Level Integrated Product Team
- Overarching Integrated Process Team
- Milestone Decision Authority

8.3. Schedule

- Study Plan Preparation 1-4 Months

- Oversight: Review of Study Plan 1-2 Months
- Analysis 3-5 Months
- Oversight: Mid-term Review of Results 1-2 Months
- Any Further Analysis 3-5 Months
- Evaluate Results 1-2 Months
- Study Report Preparation 1-2 Months
- Oversight: Review of Study Report 1-2 Months
- Total 13-24 Months

APPENDICES

A. Acronyms

B. References

C. Lessons Learned

D. CCTD

E. Accreditation Plan/Final Report

F. Other appendices as necessary

Appendix D: Study Plan Assessment

This appendix contains the AoA Study Plan assessment criteria used by OAS in their independent assessment of Study Plans presented to the AFROC and OSD/CAPE.

In general, the initial Study Plan must be reasonably complete; however, in some cases complete Study Plan details may not be finalized or are not yet available. In any case, a believable approach for obtaining the missing details should be in the Study Plan. The Study Plan must be organized and concise, be grammatically correct to avoid ambiguity, and contain accurate, easy to interpret figures and tables. It must represent an understandable and logical approach for the analysis that will be executed by the study team. OAS uses a three-color "stop light" assessment for each criterion: "green" means no limitations or risks, "yellow" means some limitations or risks, and "red" means significant limitations or risks. The assessment is based on the supporting statements found in each category and how well the individual parts contribute to overall category. In some cases for a specific AoA, a single item about the AoA may become overarching and critical to the ability of the analysis to be executed.

The following assessment criteria are currently used in evaluating Study Plans:

1. AoA purpose, definition and scope are consistent with guidance and relevant capability documents.

a. Addresses who tasked/directed study and contents of direction/guidance documents
b. Addresses what validated/approved capability documents (ICD(s), CDD(s), etc.) were the foundation of AoA purpose (Address warfighter need and problem definition)
c. Shows that all issues in the ADM and/or other guidance are sufficiently addressed
d. Discusses any key issues that will not be considered or addressed in the analysis and why (i.e. - previously addressed, time constrained)
e. Purpose and scope are appropriate for the tasked study to include identification of areas outside of current scope
f. Discusses previous related studies and their relevance to this study

2. Appropriate stakeholders, issues, assumptions and constraints are addressed.

a. Identifies organizations that comprise stakeholder and oversight communities
b. Discusses stakeholders identified in the ADM and/or other guidance
c. Identifies level of jointness, multi-Service or interagency for study
d. Identifies how each part of the stakeholder and oversight communities will participate in the study and review processes
e. Describes process to have baseline definition reviewed by stakeholder and oversight communities
f. Describes process to have screening and down select criteria reviewed by stakeholder and oversight communities
g. Addresses all assumptions and constraints in guidance. Additional assumptions and constraints are reasonable and do not artificially constrain the outcome of the study. (Key milestones, IOC/FOC, etc.)

3. Range of alternatives is comprehensive.

a. Defines the baseline alternative. Identifies pedigree of data for non-AF baseline systems in the baseline alternative definition
b. Considers a reasonable range of alternatives to include DOTLPF (non-materiel) implications
c. Considers reasonable technologies that can be available in the timeframe needed
d. Discusses the down select and screening criteria for selecting and excluding alternatives
e. Describes each alternative in a reasonable level of detail
f. If used, describes categories of alternatives and how a single alternative may be used to represent a category
g. Considers life extension of existing systems (i.e. - extend current system to allow technology development), less than 100% options of alternatives, and system of systems alternatives
h. Includes alternatives identified in ADM and/or other guidance

4. Operational concepts are reasonable.

a. Outlines overall operational concepts (basing, deployment, tactics, infrastructures, interoperability, other limitations, etc)
b. Outlines alternative-specific employment concepts as appropriate
c. Considers logistics concepts (maintenance, supply, personnel, etc)
d. Considers enabling concepts (human systems integration, intel, cyberspace, etc)
e. Identifies interdependencies with existing operational support systems (navigation, communications, weather, etc) and key support systems (defense suppression, escort, etc)
f. Identifies the appropriate linkages to Joint and Air Force CONOPS
g. Addresses doctrine, organization, training, leadership/education, personnel and facilities (DOTLPF) requirements/characteristics

5. Threats and scenarios are appropriate and realistic.

a. Discusses nature and sources of threats and scenarios
b. Discusses threat and scenario validation and approval processes to be used
c. Discusses threat evolution over time (to include reactive countermeasures)
d. Discusses integration of threats into scenarios and considers contributions of other services, agencies, and our allies as appropriate
e. Identifies threat and scenario aspects most influential to outcome of the analysis
f. Considers a complete range of threats and scenarios and identifies appropriate stressors (to include environmental factors) for the study

6. Development of Analysis measures is acceptable.

a. Derives Mission Tasks from the ICD/CDD and other relevant guidance on requirements or capabilities
b. Derives MoEs from the mission tasks and derives MoPs from MoEs.
c. MoEs are independent of the alternatives (all MoEs are based on the capability required and applied to all alternatives)
d. Addresses MoE and MoP threshold requirements (if any)

e. Ensures key MoEs and MoPs are measurable, testable and that they support future capability and test documents
f. Identifies linkage of MTs/MoEs/MoPs to specified gaps/shortfalls (draft Requirements Correlation Table)

7. Effectiveness Analysis approach is acceptable.

a. Discusses effectiveness analysis assumptions/constraints
b. Defines effectiveness methodology to be used
c. Discusses the suitability of the "level of analysis" (mission, campaign, etc)
d. Identifies resources required to execute the methodology
e. Discusses sensitivity analyses addressing threats, alternative performance, etc
f. Outlines methodology and decision criteria for making the final recommendation
g. Identifies effectiveness methodology contingency plans (i.e., using a SME panel if data is unavailable for a preferred model)

8. Cost Analysis approach is acceptable.

a. Describes LCC effort to be accomplished during the AoA
b. Discusses costing assumptions/constraints
c. Defines cost analysis methodology to be used
d. Describes the cost WBS for the alternatives
e. Discusses the cost risk methodology
f. For ACAT I (or OSD tasked) contacted AFCAA to ensure they approve/support the CA approach
g. For ACAT II/III, identifies how and who will conduct the independent assessment of the cost analysis results

9. Tool and data selection and accreditation is acceptable.

a. Identifies existing effectiveness and cost analysis tools needed
b. Identifies analysis tool functions and reasons for selection
c. Identifies how each analysis tool is to be used
d. Identifies major inputs and outputs of each tool/process
e. Identifies tool limitations, if applicable
f. Discusses needed tool modifications
g. Identifies new M&S needed for the analysis, if applicable
h. Identifies data sources and availability
i. Discusses interrelationships among tools, MTs, MoEs, and MoPs
j. Discusses M&S and data accreditation procedures (AFI 16-1001)
k. Identifies the appropriate M&S Accreditation Authority and approval process, if appropriate

10. Risk Analysis approach for alternatives is acceptable.

a. Discusses risk analysis assumptions
b. Defines methodology for identifying and assessing risk (recommend approach outlined in SAF/AQ 4 Nov 08 Memorandum and/or OSD Risk Analysis Handbook)
c. Methodology addresses the complete range of risk areas (technical, operational, integration, cost, etc)

d. Discusses the ability of the risk analysis to highlight discriminating risks between alternatives

11. Alternative comparison methodology is sound.

a. Discusses integration of effectiveness, risk and cost methodologies
b. Discusses the ability of alternative comparison methodology to differentiate among alternatives
c. Discusses how final results will be presented
d. Identifies how the preferred alternative(s) will be selected

12. Overall study risk is reasonable.

a. Includes a schedule for AoA activities
b. Addresses potential milestones that are driving the AoA
c. Identifies available resources (money, manpower, tools, data, expertise, etc)
d. Addresses the ability of the AoA study team to execute the Study Plan
e. Identifies potential areas of risk and/or roadblocks pertinent to the study (particularly schedule risk, lack of required data, lack of stakeholder participation, etc.)

Once the Study Plan is reviewed and assessed by OAS, the AoA team will prepare a Study Plan briefing for OAS review and presentation to the AFROC. Table A-1 describes the actions and timeframe leading to the presentation of the Study Plan to the AFROC for approval. OAS members are available to assist the study team to develop the AoA plan and to review the plan before formal coordination begins.

TIMEFRAME	ACTION
5 weeks prior to AFROC	Study Director sends final Study Plan and draft AFROC briefing to OAS for assessment.
4 weeks prior to AFROC	Study Director presents AFROC briefing to OAS. OAS presents the Study Plan assessment to the study team.
	OAS and study team discuss/address any identified issues, and determine a get-well plan.
3 weeks prior to AFROC	Study Director sends coordinated/updated Study Plan/briefing to OAS and AFROC. OAS re-assesses the updated Study Plan.
2 weeks prior to the AFROC	OAS sends assessment chart and point paper to AFROC and Study Director.
Week of the AFROC	OAS attends DC area pre-briefs to support MAJCOM briefer.

Table D-1: Recommended Timeframe to Brief the AoA Plan to the AFROC

Appendix E: Final Results Assessment

This appendix contains the AoA assessment criteria used by OAS for the AoA final results in their independent assessment of Final Reports and briefings being presented to the AFROC. The three-color "stop light" assessment for each criterion is also used to assess the final AoA results. It is recommended that the study team review these criteria prior to Final Report/final briefing coordination. The current assessment criteria are listed below:

1. Scope and problem definition consistent with guidance

a. Addressed who tasked/directed the study and contents of direction/guidance documents
b. Addressed all issues in the ADM and/or other guidance
c. Discussed key MDA or other issues that were not considered or addressed in the analysis (if applicable)
d. Important aspects of the Study Plan were followed
e. Purpose and scope were appropriate for the study
f. Discussed previous related studies and how they related to this study, identified relevant constraints or have addressed important related issues

2. Appropriate stakeholder & oversight communities participation

a. Identified organizations that comprise stakeholder and oversight communities
b. Addressed which organizations from the stakeholder and oversight communities participated in study
c. Identified level of jointness, multi-Service or interagency for study
d. Discussed stakeholders identified in ADM and/or guidance
e. Discussed the criteria and process for screening and down selecting alternatives (i.e., selecting and/or excluding alternatives) for this analysis
f. Described process used to have criteria and process reviewed and accepted by stakeholder and oversight communities
g. Identified results of stakeholder and oversight communities reviews
h. Identified how each part of the stakeholder and oversight communities participated in the review process

3. Range of alternatives is comprehensive

a. Defined the baseline alternative
b. Described process used to have baseline definition reviewed by stakeholder and oversight communities
c. Identified results of stakeholder and oversight communities review process for baseline definition
d. Identified how each part of the stakeholder and oversight communities participated in the review process
e. Identified pedigree of data for non-AF baseline systems in the baseline alternative definition
f. Considered a reasonable range of alternatives to include DOTLPF implications
g. Considered reasonable technologies that can be available in timeframe needed
h. Considered alternatives identified in ADM and/or other guidance

i. Considered life extension of existing systems, less than 100% options of alternatives and systems of systems alternatives
j. Made differences in IOC/FOC clear and identified their impact on the alternative solutions
k. Provided a convincing rationale for elimination of alternatives

4. Final Operational concepts are reasonable

a. The appropriate warfighter community and stakeholders vetted the operational and employment concepts (basing, deployment, tactics, treaties and other limitations, etc.)
b. Logistics concepts are reasonable and viable (maintenance, supply, personnel, etc.)
c. Enabling concepts are reasonable and viable (HSI, intel, etc.)
d. Interdependencies with existing operational support systems have been accounted for (navigation, communications, weather, etc.) and key support systems (defense suppression, escort, etc.)
e. DOTLPF characteristics have been addressed and documented

5. Threat and scenarios appropriate and approved

a. Addressed threat and scenario validation and approval process utilized
b. Threats and scenarios were appropriate, providing reasonable results
c. Architectures and Joint and Air Force CONOPS have been considered for impact
d. Discussed threat variations with time and possible reactive countermeasures to each alternative
e. Discussed integration of threats into scenarios and considered contributions of other services and our allies
f. Considered a broad range of environmental and hostile operating environments

6. Analysis Measures are acceptable

a. Mission tasks derived from the ICD/CDD and other relevant guidance on requirements or capabilities
b. Mission tasks reflect the military worth of the alternatives (capability provided to the warfighter)
c. MoEs derived from the mission tasks
d. MoEs are independent of the alternatives (all MoEs are used for all alternatives)
e. MoPs derived from the MoEs
f. MoE and MoP threshold requirements addressed (if any)
g. MTs/MoEs/MoPs linked to approved gaps/shortfalls (Requirements Correlation Table)
h. Ensured key MoEs and MoPs are measurable/testable and that they support development of the CDD, CPD and Test & Evaluation Strategy (TES) or Test & Evaluation Master Plan (TEMP) documents.

7. Effectiveness analysis methodology successfully executed

a. Deviations from the planned effectiveness analyses are understood and documented
b. Determined the military worth of alternatives for warfighters
c. Discussed effectiveness analysis assumptions
d. Followed a logical and reasonable analytical approach
e. Evaluated a range of independent alternatives for the final analysis

f. Described "level of analysis" used for each part of methodology
g. Defined how scenarios were utilized within effectiveness methodology executed
h. Identified which measures discriminated/differentiated among alternatives
i. Outlined methodology and decision criteria utilized for effectiveness analysis findings
j. Discussed sensitivity analyses conducted addressing threats, alternative performance, etc.
k. Presented effectiveness analysis results for each alternative by differentiating measures

8. Cost analysis methodology successfully executed

a. Deviations from the planned cost analyses are understood and documented
b. Discussed cost analysis assumptions and ground rules
c. Described the cost WBS for each alternative and identified sources for cost inputs
d. Discussed cost risk and sensitivity analyses conducted
e. Summarized the review process of the cost analysis
f. Presented cost results by alternative and discusses any CAIV implications
g. For ACAT I, AFCAA approved the methodologies and cost estimating models/methods; Sufficiency Review is complete
h. For ACAT II/III, standard cost methodologies and models were utilized; an independent assessment of the cost analysis results was conducted and is complete

9. Analysis Tools & Methodologies are reasonable; M&S were appropriately accredited

a. Tools and methodologies were applied appropriately
b. Results are credible and defensible
c. Accreditation report covering models and data certification signed
d. M&S worked as intended
e. Identified M&S shortfalls including workarounds

10. Risk analysis methodology successfully executed

a. Deviations from the planned risk analyses are understood and documented
b. Discussed risk analysis assumptions
c. Followed a logical and reasonable analytical approach
d. Evaluated a range of risk areas (technical, operational, etc) for the final analysis
e. Identified risk factors evaluated
f. Presented risk results by alternative, highlighting discriminating risks (i.e., risk drivers)

11. Presentation of final results support AoA findings

a. Described alternative comparison methodology utilized
b. Presented alternative comparison results as appropriate
c. Presented clear and reasonable results
d. Presented and interpreted sensitivity analyses addressing the threats, alternative performance, etc.
e. Identified and interpreted methodology shortcomings relative to each alternative
f. All conclusions are supported with analysis results
g. Results, conclusions and recommendations are credible and defensible
h. Final Report has been fully coordinated with appropriate Air Force and stakeholder agencies

The AoA team shall document the final results of the AoA in a Final Report and complete coordination of the report prior to the AFROC. OAS shall review the Final Report and prepare a documented assessment to be included in the final results briefing that will be presented to the AFROC. The AoA team will present their AFROC briefing to OAS for review and recommendations. Both the Final Report and final results briefing shall be submitted to the AFROC prior to their scheduled presentation. The timeframe and taskings to be completed prior to the AFROC are described in Table B-1.

TIMEFRAME	**ACTION**
5 weeks prior to AFROC	Study Director sends Final Report and draft AFROC briefing to OAS for assessment.
4 weeks prior to AFROC	Study Director presents AFROC briefing to OAS. OAS presents the Final Report assessment to the study team.
	OAS and study team discuss/address any identified issues, and determine a get-well plan
3 weeks prior to AFROC	Study Director sends coordinated/updated report and briefing to OAS and AFROC. OAS re-assesses the updated Final Report.
2 weeks prior to the AFROC	OAS sends assessment chart and point paper to AFROC and Study Director.
Week of the AFROC	OAS attends DC area pre-briefs to support MAJCOM briefer.

Table E-1: Recommended Timeframe to Brief Results to the AFROC

Appendix F: Review and Approval of AoAs

This appendix contains information related to the review and approval of AoA documentation.

The AFROC and the Air Force Council (AFC), if necessary, reviews and validates AoA Study Plans, midterm status reports, and draft final results. Also, the AFROC may direct AoA products be presented to a specific Air Force Group or Board. This action would normally be accomplished to promote advocacy or enhance corporate understanding of the particular program supported by the AoA.

The information presented in Table C-1 should help in determining what reviews are needed for a particular AoA. It should be noted that AoA documents must be approved by AF/CV prior to submission to OSD. It is expected that work at the Action Officer level would be an ongoing process and the sharing of information would have started as early as possible. This would also be true of sharing information with all stakeholders who have an interest in the study.

	OAS	MAJCOM	AFROC	AF/A5R	AF/A5	AF/CV	JROC	CAPE	MDA
ACAT I Study Plan	Assesses All	Reviews All	Reviews All	Coord on package	Coord on package	Approve to go to OSD	Not normally req'd*	Approve prior to AoA initiation**	Coord
ACAT II/III Study Plan	Assesses All	Reviews All	Reviews All	ACAT III Air Staff validation	ACAT II Air Staff validation	Not normally req'd*	Not normally req'd*	Not normally req'd**	Approve
ACAT I Midterm Status	Reviews All	Reviews All	Reviews All	Reviews ALL	Reviews ALL	As Required	As Required	As Required	As Required
ACAT II/III Midterm Status	Reviews All	Reviews All	Reviews All	Reviews ALL	Reviews ACAT II	Not normally req'd	Not normally req'd*	Not normally req'd	Not normally req'd
ACAT I Final Results	Assesses All	Reviews All	Reviews All	Coord on package	Coord on package	Approve to go to OSD	Validate Results	Approve	Approve
ACAT II/III Final Results	Assesses All	Reviews All	Reviews All	ACAT III Air Staff validation	ACAT II Air Staff validation	Not normally req'd*	Not normally req'd*	Approve	Approve

* JROC Special Interest Programs may require JROC presentation; Joint Impact Programs may require an FCB presentation.

** CAPE shall informally review the AoA Study Plan prior to taking it to the AFROC. This will ensure that the analysis planned addresses issues important to CAPE and the MDA, and represent an executable analysis approach.

- The document sponsor must ensure that CAPE is included as early as possible in AoA development
- The document sponsor is responsible for ensuring AoA "documents" are staffed in a timely manner to meet DODD 5000.1 and DODI 5000.02 requirements
- The Air Staff SME should assist in staffing the package through appropriate channels to A5R/A5/VCSAF as appropriate. Some AoAs may require a presentation to either the AFC, and the VCSAF, or both, prior to approval for release to OSD.
    - Staffing of ACAT II/III AoA "documents" beyond AF/A5R is determined on a case-by-case basis

Table F-1: The AoA Review and Approval Process

If the AoA is extremely technical or politically sensitive, either the MAJCOM or the AFROC may request a formal technical assessment by the Technical Review Group (TRG). OAS and AF/A9 will help the AoA Study Director schedule reviews with the TRG, followed by the AFROC and AFC reviews if necessary.

If an AoA midterm status briefing is not required outside of Air Force channels and the AoA study is proceeding as originally intended, the study team may request the AFROC waive the requirement to present the midterm status update.

All ACAT I and selected special interest ACAT II Study Plans, midterm reviews and final results for Air Force or Joint AoAs which the Air Force is the lead service must have AF/CV approval before being "formally" briefed or presented to OSD. On approval by AF/CV, information will be forwarded to working level IPTs, the OIPT, the Defense Acquisition Board (DAB) and/or equivalent higher bodies. The AF/CV (through AF/CVA) is the approval authority for modifications to this Air Force review process (e.g., for special access programs). If the AoA results are being forwarded to OSD/CAPE, the final results/Final Report must be submitted 60 days before the scheduled Milestone Decision briefing.

The AoA schedule should be structured to accommodate the timeline needed to get the AoA final results/Final Report to OSD.

Technical Review Group (TRG)

If a TRG is requested by the MAJCOM study team or the AFROC, the TRG will assess ACAT I and selected ACAT II or ACAT III AoAs for technical adequacy and completeness of the analytical approach and results. The Director, AF/A9, will chair the TRG. AFOTEC is responsible for reviewing the linkage between the TES/TEMP and ICD/CDD (as outlined in the AoA Final Report) and for presenting a linkage assessment to the TRG. A formal TRG is a very rare occurrence. In the absence of the TRG, OAS will perform technical assessments.

AFROC and AFC

On occasion, the AFROC may determine if it is appropriate for the AFC to review the AoA Study Plan, midterm or the final results. To ensure proper representation on specific issues, the AFROC through AF/A9 may provide attendance recommendations to AF/CVA.

The AFROC may recommend that AF/CV approve the AoA Study Plan, midterm or final results without going to the AFC. AF/CV will make the final decision. The senior Air Force members of the OIPT should be invited to the AFROC and AFC reviews of AoAs.

If the Air Force is identified as the lead service for a Joint Program, AoA members from the other services and OSD/CAPE may be invited to the AFROC and AFC reviews to ensure their interests and perspectives are addressed when AoA information is presented.

OSD-level Integrated Product Teams and AoAs

DODD 5000.1/DODI 5000.2 and associated interim guidance refer to three levels of IPTs. The OIPT provides top-level oversight and review, adjudicates issues, and advises the MDA on acquisition issues. The IIPT integrates critical aspects of the program. A specific WIPT, usually the Cost Performance IPT (CPIPT), works AoA issues. The WIPTs may establish WGs to perform specific tasks such as oversight of the study team formed to conduct the AoA.

Air Force AoA CoE

OAS is the Air Force CoE for AoAs. The AoA CoE supports the MAJCOM study director in helping administer, plan, execute, and facilitate AoAs and their reviews.

OAS is also responsible for the Air Force AoA training courses and the AoA Handbook providing detailed guidance on how to accomplish an AoA. In cases where the MAJCOM elects not to use a TRG, OAS will provide the AFROC with an assessment of the AoA products.

Joint Service AoAs

For Joint Service AoAs, the central concept is that the AoA process of the lead service will apply, but will be augmented with participation of the other services.

Appendix G: Lessons Learned

This appendix provides rationale and guidance for capturing and documenting lessons learned. Lessons learned provide current and future AoA study teams with valuable knowledge derived from past and present AoA efforts. This knowledge includes information about the strengths and weaknesses of initiating, planning, and executing an AoA. Lessons learned from the beginning of the AoA to completion of the AoA process should be thoroughly documented. By capturing and documenting lessons learned, each AoA team can add to and benefit from the collective wisdom and best practices related to the AoA process.

Some of the most commonly recurring Study Team lessons learned include:

1. Meet regularly either in person or virtually
2. Team composition of both Air Force and contractor personnel provides good complementary technical support
3. Study Advisory Groups can provide guidance, support and sanity checks
4. The Study Director and his core team must lead the entire effort
5. Small numbers of people meeting are more productive
6. Buy-in of the senior leaders at all levels is critical
7. Things will change – documentation and communication is critical
8. Utilization of High Performance Teams can increase efficiency and has the potential to shorten timelines. They are especially useful when a team is faced with a very aggressive schedule

Appendix H: Concept Characterization and Technical Description (CCTD) Template

1.		**Mission / Capability Need Statement / CONOPS (MoEs)**
	1.1	Stakeholders
2.		**Concept Overview (OV-1)**
3.		**Trade Space Characterization**
	3.1	Scope
	3.2	Assumptions and Constraints
	3.3	Interfaces
	3.4	Operating Environment (Draft Enabling CONOPS ref. AFPD 10-28)
	3.5	Key Parameters /Attributes / MoPs
	3.6	Compliance Issues
4.		**Evaluation (Studies, Analyses, Experiments)**
	4.1	Common Assumptions & Methodologies
	4.2	Parametric Studies
	4.3	Analyses
	4.4	Experiments
	4.5	Modeling & Simulation (and Associated Data)
	4.6	Evaluation Results
	4.7	Conclusions
5.		**Concept Characterization / Design**
	5.1	Design Description & Variants
	5.2	Concept of Employment
	5.3	Architecture Considerations (Interfaces / Interoperability / SoS Approach / Integration)
	5.4	Critical Design Constraints
	5.5	Critical Technology Elements
	5.6	Supportability / Sustainment / Logistics Features
	5.7	Cost Drivers
	5.8	Required Enabling Capabilities (Human Systems Integration [HSI], communications, intelligence, etc.)
6.		**Program Characterization**
	6.1	Critical Technologies (including S&T needs / feed-forward)
	6.2	Technology Maturation Approach
	6.3	Test & Evaluation (T&E) / Verification & Validation (V&V) Approach
	6.4	Prototyping Approach
	6.5	Manufacturing / Producibility Approach

	6.6	Sustainment / Supportability Approach
	6.7	Other Relevant Considerations (intelligence, HSI, security, etc.)
	6.8	Schedule Assumptions and Methodologies (needed IOC from ICD)
	6.9	Cost Analysis Assumptions and Methodologies
	6.10	Cost Estimates
7.		**Risk Assessment & Decision-Certain Consequences (must support MAJCOM endorsement)**
	7.1	Operational Risk
	7.2	Program Risk
	7.3	Technology Risk
8.		**DOT_LPF Implications and other interdependencies**
9.		**Conclusions (Capability Description; Traceability to Need Statement)**