Analysis Handbook

A Guide for Performing Analysis Studies:

For Analysis of Alternatives
or Functional Solution Analyses

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Office of Aerospace Studies
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About OAS

The Office of Aerospace Studies (OAS) provides technical, analytical, and costing support to the operational commands, Air Force Materiel Command (AFMC) and the Air Staff in planning, conducting, and reviewing Analysis of Alternatives (AoAs), and related studies supporting acquisition decisions. In addition, we support the MAJCOMs and AFMC product centers with analytical investigations and evaluations of systems and related issues. For additional information, visit our web site at (www.oas.kirtland.af.mil).

Preface

The Analysis Handbook is produced by the Air Force Materiel Command's Office of Aerospace Studies (OAS). OAS is designated the Air Force Center of Expertise for AoAs. This handbook embodies 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 frequently to reflect any major evolution in the frequently changing acquisition, and capabilities/requirements processes. As changes occur, the individual chapters are updated to reflect the latest analysis techniques required to support

acquisition efforts. 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.

1 – Introduction

The DoD acquisition process is a structured, logical approach designed to identify and acquire the best systems necessary to support the needs and capability requirements of the operational warfighter. In cases where there are known or identified shortfalls in operational capabilities, the acquisition community will look to new acquisitions that can eliminate the shortfalls at the earliest possible date.

There are three milestones and a number of other decision points within the DoD systems acquisition process. At any of the milestones or decision points, a new system 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.

AoAs are an important element of the defense acquisition process and as such, the DoD is demonstrating increased involvement and oversight in AoA activities. 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 capabilities and military utility that acquiring the most cost-effective alternative(s) will provide. In short, the AoA has become an important vehicle to provide information that can be used by senior Air Force leaders to debate and assess a potential program's capability and affordability.

An AoA is an analytical comparison of the operational effectiveness and cost of proposed materiel solutions to shortfalls in operational capability (these capability shortfalls are also known as mission needs). AoAs document the rationale for identifying and recommending a preferred solution or solutions to the identified shortfalls. Threat changes, deficiencies, advances in technology or the obsolescence of existing systems can trigger an AoA. This handbook deals with Air Force-specific AoAs and those Joint AoAs where the Air Force is designated as the lead service.

The current DoD Acquisition process identifies OSD/Program Analysis and Evaluation's (PA&E's) role in the AoA process. Their role will be addressed further in the next chapter. Likewise, the Joint Staff has a defined role through the Functional Control Board 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 a sister service, the Air Force will follow the lead service's procedures and guidance. The Air Forces 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.

When directed, AoAs are normally required and tasked as part of the acquisition process for identified programs. For other programs, AoAs may be downward directed because they are Joint, Service, or Command special interest or have congressional visibility.

The most common AoA is conducted before an acquisition program is established and before the ICD is developed. This type of AoA is often referred to as an Analysis of Materiel Approaches (AMA) and typically explores numerous conceptual solutions with

the goal of identifying one or more promising options. In the current acquisition process, the AMA will be conducted as a part of the Functional Solution Analysis (FSA). The AoA, which is directed after Milestone (MS) A, provides a more detailed definition and a limited comparison of remaining options to support a MS B decision. An AoA is unlikely to be required after MS B or C unless significant threat and/or technology changes have occurred or if MS A and/or B analysis needs to be extended. The process for completing this type of AoA is similar to a pre-MS A AoA effort.

The analysis needed to complete either an AMA or an AoA is very similar. Therefore, the approach described for an AoA would likewise be conducive for use during an AMA. This handbook focuses on both the AMA and MS A AoA. AoAs to support a MS B or C decision would be very focused and would likely address additional issues that the decision maker(s) may have. Items such as: quantity to produce; number of operating locations needed; bed-down approaches for the system; and refinement of maintenance and operational concepts may be addressed.

Why AoAs?

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 meeting mission needs. AoAs identify potentially viable solutions and provide comparative cost-effectiveness assessments of each solution to a baseline; this baseline is typically the current operating system.

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 and military worth, but also domestic policy, foreign policy, technological maturity of the solution, the environment, the budget, treaties, and a host of additional factors. AoAs also provide a foundation for developing operational requirements, concepts of operational employment, a test and evaluation plan for the preferred alternative(s), and additional information for the program office when and if one is formed.

Who Looks at AoAs?

AoAs influence the investment of very large sums of defense funds. 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. AoA results are usually briefed at high levels in the Air Force and the DoD, and are used in the decision making process to support acquisition of new capabilities and systems for the warfighters. The nature of an AoA will also reveal understanding and insights into the needed operational capabilities in order to accomplish the desired military effects.

The AoA Study Team

A study director leads the study team performing the AoA. The director is appointed from the Air Force command (operational user) that is designated as the lead for the AoA. The study director forms the study team—as appropriate—from members of the Command, other Air Force commands, Air Force Agencies, the Army and Navy, 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 inherent 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 consider identification of alternatives, threats and scenarios, effectiveness, 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 are usually more productive.

The Air Force Materiel Command's (AFMC's) Office of Aerospace Studies (OAS) helps by supplying an assistant to the study director, which is normally oriented in operational effectiveness analysis. OAS also supplies a second assistant experienced in cost analysis. Both OAS assistants provide help in planning, administering, executing and facilitating the accomplishment of the AoA and required reviews. OAS has been designated Air Force AoA Center of Expertise (COE). This is to ensure quality, consistency and value in Air Force AoAs.

Comparing Alternatives

An AoA compares alternatives by estimating their ability to satisfy the identified mission needs through an effectiveness analysis and by estimating their life cycle costs (LCC) through cost analysis. The results of these two analyses are used together to produce a cost-effectiveness comparison that allows decision makers to assess cost and effectiveness simultaneously.

The effectiveness analysis is built on a hierarchy of:

?? Broad mission tasks (MTs) derived from the mission needs (e.g., kill tanks)
?? Measures of effectiveness (MOEs) indicating how well the mission tasks are performed (e.g., weapons expended for each tank killed)
?? Measures of performance (MOPs) describing fundamental capabilities (e.g., weapon delivery error)

The LCC cost analysis estimates how much each alternative will cost to develop, produce, operate and retire during its projected lifetime.

Both effectiveness and cost analyses can be lengthy and require a significant investment of resources.

AoA Relationship to Architectures and CONOPS

The nature of the analysis to be accomplished when executing the AoA will dictate the need for considering the use of the Air Force and DoD architecture's along with Joint and Air Force Concepts of Operations (CONOPS). Selecting realistic architectures and CONOPS will help set the pace and focus for evaluating the alternatives during the AoA. Through both architectures and CONOPS, OAS will help provide within the AoA a clear understanding of potential C4I interfaces and interoperability needed during military operations. Architectures and CONOPS also provide an approach for how the Air Force and Joint community perform military operations based on known capabilities and shortfalls. To fully appreciate the potential uses of architectures and CONOPS, we need to look at what the requirements and acquisition directives have to say about these approaches. These are summarized as follows:

?? Joint Capabilities Integration and Development System (JCIDS) - CJCS 3170.01C

- Joint concepts and integrated architectures provide the construct for analysis and for prioritizing competing demands to improve joint warfighting capabilities.
- Initial Capabilities Documents (ICDs), Capability Development Documents (CDDs) and Capability Production Documents (CPDs) should be presented in the context of and include products from integrated architectures.

?? The Defense Acquisition System - DoDD 5000.1 & DoDI 5000.2

- Integrated architectures are the basis for roadmaps to conduct capability assessments, guide systems development, and define the associated investment plans as the basis for aligning resources and as an input to the Defense Planning Guidance, Program Objective Memorandum development, and Program and Budget Reviews.
- System concepts shall be founded in an operational context, consistent with the National Military Security Strategy, Defense Planning Guidance, Joint Concepts, and joint integrated architectures.

Importance of C4ISR Architecture

A properly constructed command, control, communications, computers, intelligence, surveillance and reconnaissance (C4ISR) architecture provides a mechanism for understanding and managing complexity. Architectures integrate visions, requirements, and capabilities while providing unique insight to senior leadership to help them make informed decisions for mission capabilities' enhancement and sustainment, timely technology insertion, and sound C4ISR investment. The ability to compare, analyze, and integrate C4ISR architectures developed by specific mission areas, MAJCOMs, and functional components provides a cross-functional perspective that is critical to achieving the Air Force mission and objectives. Specific benefits to the Air Force, MAJCOMs, agencies and Functionals include:

?? Providing effective interoperable deployable capabilities for the Expeditionary Air and Space Forces.

?? Capturing facts about the mission and functions in an understandable manner to drive better planning and decision-making.

?? Supporting AoAs, risks, and trade-offs for the investment management process, which reduces the risks of:

  ?? Building systems that do not meet mission needs.

  ?? Expending resources on developing unnecessary duplicative functionality.

?? Improving consistency, accuracy, and timeliness of information shared collaboratively across the Air Force enterprise.

Assessment Methodology

One of the key shortfalls in fielding C4ISR capabilities is that they are not adequately integrated into the existing or “to-be” C4ISR architectures. The AF/XI integration process must ensure that C4ISR components are required, documented within the architectures, developed, acquired and fielded to operate coherently with each other as part of a larger, integrated force, designed to deliver specific warfighting capabilities. This process must ensure that there are no major disconnects between each step in this cycle. A series of built-in assessments are conducted in the Capabilities Integration Development, Acquisition, and Planning, Programming, Budgeting Execution System (PPBES) phases to ensure proper integration and determine the most efficient use of resources to gain the greatest increase in capability. These assessments are designed to ensure new and existing

C4ISR requirements/capabilities are properly aligned and adequately support each of the Air Force CONOPS missions.

Modeling and Simulation

In the course of performing the effectiveness analysis during MOE evaluation, it may be necessary to assess the alternatives, friendly and hostile forces, the environment, etc. with computer models and simulations (M&S). The planning and execution of required M&S can be difficult, costly and time-consuming. In most AoAs, the effectiveness modeling is the dominant activity—so much that the cost and duration of the AoA are largely driven by the complexity and magnitude of the effectiveness analysis. The second most demanding activity in the AoA is usually the cost analysis. The cost analysis normally employs models also. Experienced personnel in both effectiveness and cost modeling are essential.

The study team must look to the most simple and straight forward approach in selecting M&S which can best support the analysis. If a simple equation or formula serves that purpose, then that is the process that should be employed. In most AoAs, a number of models must be used together, working in a federated form to accomplish the M&S function. This connectivity will dictate that study team understands the linkage of the models, the MOE values employed, and the quality of the data being collected and used in the M&S. To contribute to the understanding of the M&S employed during the AoA, and to obtain assurance that the M&S will provide reasonable and acceptable results, the study team should assure that the responsible MAJCOM has developed an accreditation process for the required M&S necessary for the accomplishment of the AoA.

AoA Products

Most AoAs produce four major products:

?? A study plan which defines the background, goals, methodology, tools, schedule, etc. of the AoA
?? A midterm progress briefing to summarize early work and future plans
?? A final briefing to summarize the final results of the AoA
?? A final report to document the AoA in detail

The study plan is important because it defines what will be accomplished during the AoA and how it will be done. The study plan should be updated and/or corrected throughout the AoA as the study team learns more and to reflect changes when they occur during the study in areas like threat, computer models, MOEs, methodology, and criteria for selection, and other areas as they happen.

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

The final briefing carries the most impact, and hence generates the most interest, because it addresses what was found and the implication of the findings to the decision maker(s).

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 will require significant time and effort to produce. Frequently, the study plan and/or the final report will be accompanied by supporting documents providing detailed descriptions of the

alternatives, threats, cost documentation, intermediate analysis results, and so forth. It is important to remember that soon after the study is concluded, team members start to disburse. If the final report is not accomplished soon after the analysis is accomplished, 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."**

2 – Support to Decision Making

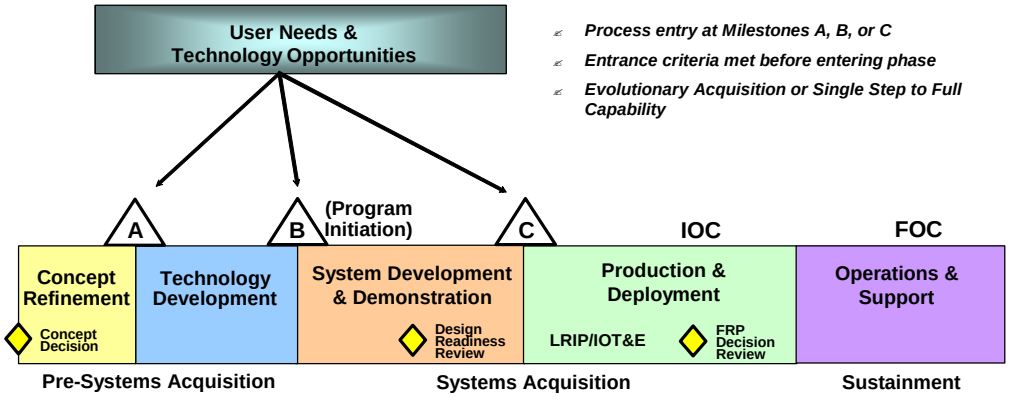
The Defense Acquisition Management Framework

The Defense Acquisition System is structured to manage the nations 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 forces of the future.

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. The latest DoD acquisition guidance was approved May 12, 2003 in the form of DoDD 5000.1 and DoDI 5000.2. The DoD acquisition system is built on policies that provide for "Flexibility, Responsiveness, Innovation, Discipline, and Streamlined and Effective Management"; other more detailed policy can be found in DoDD 5000.1, Enclosure 1.

The Acquisition Management Framework for DoD consists of three activities as shown on Figure 2-1. These include: Pre-Systems Acquisition, Systems Acquisition, and Sustainment. In addition, 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 there is a Concept Decision made at the start of first phase (Concept Refinement); a Design Readiness Review made in the third phase (System Development & Demonstration); and a Full Rate Production Decision Review made in the forth phase (Production & Deployment).

Figure 2-1. The Defense Acquisition Management Framework.



The above framework allows the Program Manager (PM) and the Milestone Decision Authority (MDA) to exercise discretion and prudent business judgment in order to structure a tailored, responsive and innovative program. In executing the acquisition system, the MDA may authorize entry into the process at any point consistent with phase specific entrance criteria and statutory requirements.

Proceeding through the acquisition process depends on obtaining sufficient knowledge to continue to the next stage of acquisition. This is where AoAs contribute significantly to the MDA's decision process, providing critical information needed by the MDA to help support his/her decisions. For additional insight on the acquisition process visit the guidebook at (http://dod5000/dau/.mil/).

It is not the intent or goal of this handbook to repeat the details of DoD 5000 guidance. Should the reader require additional information related to the Defense Acquisition Management Framework, the DoD 5000 series documents are available for further review. The objective of this handbook is to demonstrate how the Air Force AoA process contributes and supports the Defense Acquisition Management Framework. The Air Force AoA system will be discussed in the following paragraphs, along with insights on how operational capabilities and requirements are developed and how they relate to acquisition.

Acquisition Categories (ACATs)

Weapons system programs along with Command, Control, Communications, and Intelligence (C3I) or Information Technology (IT) programs are placed in ACATs based on the dollar value and required level of decision authority. These categories were established to facilitate decentralized decision making while complying with Congressional mandates for appropriate oversight.

ACAT I

ACAT ID and ACAT IC programs are known as Major Defense Acquisition Programs (MDAPs). ACAT ID and IC programs must meet one of two cost thresholds: more than $365 million in Research, Development, Test, and Evaluation (RDT&E) or more than $2.190 billion in procurement (both in constant FY00 dollars). The level of decision authority further differentiates these programs. The Undersecretary of Defense for Acquisition, Technology and Logistics, USD (AT&L), also called the Defense Acquisition Executive (DAE), approves ACAT ID programs at the DoD level. ACAT IC programs are approved at the service level. This approval comes from either the Head of the DoD Component or, more likely for the Air Force, the Assistant Secretary for Acquisition (SAF/AQ) who is the Air Force Component Acquisition Executive (CAE). The CAE and DAE can elevate the ACAT level of any program to reflect its visibility and/or importance. Thus, a program that does not meet the dollar thresholds, but has high Congressional interest, may be established as an ACAT ID or IC program by the decision authority.

ACAT IA (IAM and IAC) programs are called Major Automated Information System Acquisition Programs (MAISAP). They must have a total life cycle cost exceeding $378 million, or a total program cost exceeding $126 million or cost more than $32 million (constant FY00 dollars) in a given year. The MDA for ACAT IAM programs is the DoD Chief Information Officer (CIO) who is ASD (C3I). The MDA for ACAT IAC programs is the CAE, as delegated by the DoD Component Chief Information Officer (CIO).

ACAT II

ACAT II programs fall below ACAT I dollar thresholds but require more than $140 million in RDT&E or $660 million in procurement funds (both in constant FY00 dollars). The decision authority is at the DoD Component Acquisition Executive (CAE), normally SAF/AQ, or an individual designated by the CAE.

ACAT III

ACAT III programs fall below ACAT II dollar thresholds and are approved at the lowest appropriate level. This decision authority would normally be delegated by the DoD CAE to the lowest level appropriate.

AoA Related Activities

Most AoAs accomplished after 2002 will be conducted during the Concept Refinement Phase of the acquisition process. A Milestone A decision will normally be the prevalent requirement for the AoA. At a lesser frequency, AoAs may also be tasked and accomplished to support Milestones B and C decisions. Specifically, AoAs will be accomplished to support Milestones B or C if the information they provide is needed by the MDA.

The Air Force capabilities and requirements offices in conjunction with the Joint Staff offices are developing a series of documents to replace the Mission Needs Statement (MNS) and the Operational Requirements Documents (ORD). These new documents include the Initial Capabilities Document (ICD), the Capability Development Document (CDD), and the Capability Production Document (CPD).

For ICD initiation, the Air Force will develop a Stage I ICD addressing the first five items of the ICD. The Stage I ICD will be completed before initiating the Analysis of Materiel Approaches (AMA), which is a part of the Functional Solution Analysis (FSA). The Stage I ICD is accomplished to identify operational shortfalls in capabilities that will be analyzed and documented during the AMA/FSA. The Stage II ICD, which is developed from the results of the AMA/FSA, will provide the foundation for the AoA to support Milestone A activities.

An AoA study plan shall be developed to formulate and guide the analysis during the AoA. The focus of the AoA is to analyze and refine the selected concept(s) documented in the approved ICD. The AoA shall assess the critical technologies associated with these concepts including technology availability, technology maturity and technical risk. To achieve the best possible system solution, emphasis shall be placed on innovation and competition. Existing commercial-off-the-shelf (COTS) products and solutions drawn from a diversified range of large and small businesses shall be considered.

The results of the AoA shall provide the basis for the Technology Development Strategy (TDS) that is approved by the MDA at Milestone A for potential ACAT I and IA programs. The TDS documents the following: (1) the rationale for adopting an evolutionary strategy (for most programs) or (2) a single-step-to-full-capability strategy (e.g., for common supply items or COTS items). For evolutionary acquisition, either spiral or incremental, the TDS shall include a preliminary description of how the program will be divided into technology spirals and development increments. This will include an appropriate limitation on the number of prototype units that may be produced and deployed during technology development. It will also define how these units will be supported and provide specific performance goals and exit criteria that must be met before exceeding the number of prototypes that may be produced under the research and development program. A program strategy including overall cost, schedule, and performance goals for the total research and development program will be included. Specific cost, schedule and performance goals, including exit criteria, for the first technology spiral demonstration will

be defined. In addition, a test plan to ensure that the goals and exit criteria for the first technology spiral demonstration are met. Concept Refinement ends when the MDA approves the preferred solution resulting from the AoA and approves the associated TDS.

Pre-Concept Refinement Activities

Acquisition programs and AoAs have roots in the Air Force Capabilities Planning Process. The recurring process is conducted by Air Force Headquarters and the Major Commands (MAJCOMs) and consists of three steps:

- ?? Functional Area Assessment (FAA) to convert national strategies to Air Force tasks (strategies-to-tasks)
- ?? Functional Need Analysis (FNA) to identify deficiencies of the current force to perform the identified tasks (tasks-to-needs)
- ?? Functional Solution Analysis (FSA) to identify possible remedies for the deficiencies (needs-to-solutions)

A MAJCOM's first choice to resolve a deficiency is to identify a non-materiel solution. Non-material solutions often result in relatively low costs when compared to material solutions. Such non-material solutions could be a change in organization, doctrine, tactics, or additional/modified training. If the MAJCOM determines that a non-material solution is insufficient and that a materiel solution is required (something must be acquired), it generates an ICD. The ICD documents the deficiencies in terms of operational capabilities. The appropriate decision authority must validate the ICD. Depending on service, DoD or national priorities, a validated ICD may or may not lead to an AoA and a Milestone A decision (a decision to begin the acquisition cycle). The early analysis activities—FAA, FNA and FSA—precede the AoA and provide the analytical foundation for the AoA. In addition, these activities form the analysis to support the Joint Capabilities Integration and Development System (JCIDS) process defined in CJCSI 3170.01C and CJCSM 3170.01. The JCIDS process is the responsibility of the Joint Staff, Headquarters Air Force and the MAJCOMs. The AoA should exploit results from this work including identification of needs, possible alternative solutions, supporting analyses, data and tools.

Air Force needs and requirements may come from a variety of sources within or outside the Air Force. Deficiencies that can be satisfied by non-materiel changes in doctrine, tactics, training, or organization are sent to organizations in the department for consideration and action. Deficiencies that could be satisfied with the establishment of a new acquisition program (materiel solutions) are documented along with the CONOPS and the threat in an ICD. The process may then continue to a Milestone A decision.

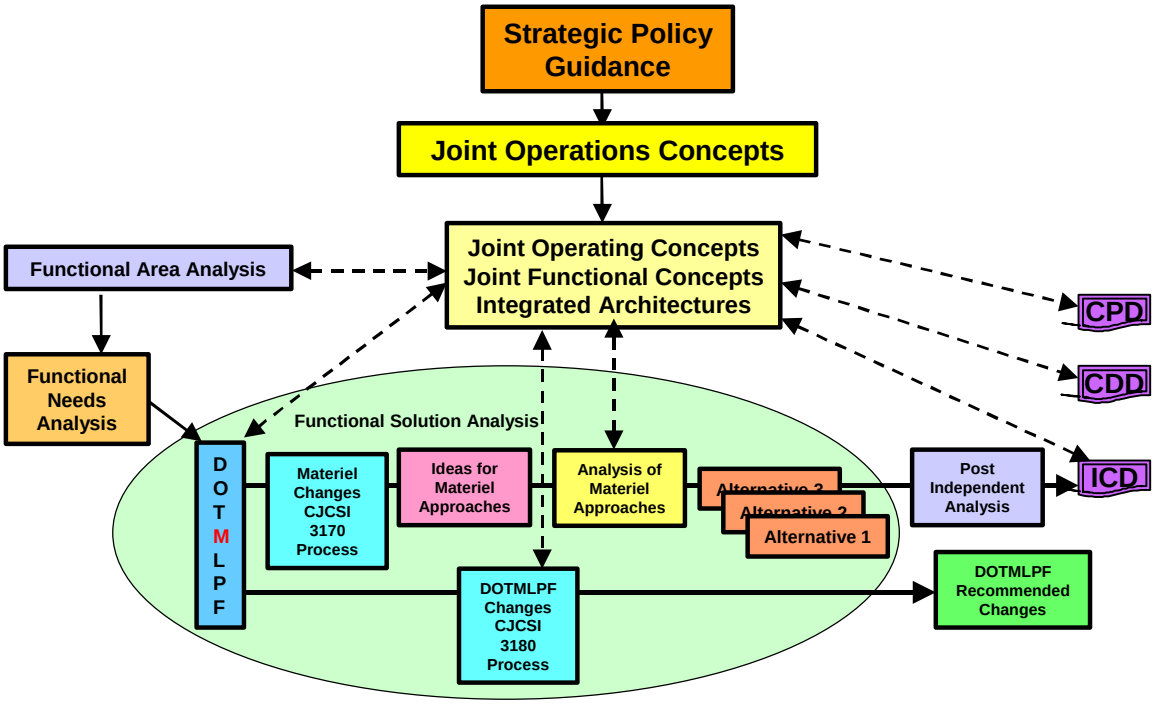
Joint Capabilities Integration and Development System (JCIDS) Analyses (Addressed in CJCSM 3170.01 and CJCSI 3170.01C)

The JCIDS analysis process is composed of a structured, four-step methodology that defines capability gaps, capability needs and approaches to provide those capabilities within a specified functional or operational area. Based on national defense policy and centered on a common joint warfighting construct, the analyses initiate the development of integrated, joint capabilities from a common understanding of existing joint force operations and doctrine, organization, training, materiel, leadership and education, personnel and facilities (DOTMLPF) capabilities and deficiencies.

While JCIDS analyses may be initiated by any number of organizations, to include combatant commanders and Functional Capability Board (FCB) Working Group, this analysis needs to be teamed as early as possible with a sponsor. The term "sponsor" as used in this document is broadly applied to describe this collaborative effort between the analytical author of the analysis and the organization that will eventually lead the funding of any resulting materiel solutions.

The assistance and advise of appropriate FCB should be sought out as early as possible during analysis to facilitate the collaborative effort across many organizations. The JCIDS analyses are led by the sponsor and provide the necessary information for the development of the ICD. Figure 2-2 depicts the JCIDS analysis process.

Figure 2.2. JCIDS Analyses.



Functional Area Analysis (FAA)

The first step in the JCIDS analysis begins when the sponsor initiates an FAA. An FAA identifies the operational tasks, conditions and standards needed to achieve military objectives. It uses the national strategies, Joint Operating Concepts (JOC), Joint Functional Concepts (JFC), Integrated Architectures (as available), and the Universal Joint Task List (UJTL) as input. Its output results in the tasks to be reviewed in the follow-on functional needs analysis. The FAA includes cross capability and cross-system analysis in identifying operational tasks, conditions and standards. The FAA should be conducted as a collaborative effort.

Functional Needs Analysis (FNA)

The FNA is the second step of the JCIDS analysis process. Like the FAA, the sponsor initiates the FNA. The FNA assesses the ability of the current and programmed joint capabilities to accomplish the tasks that the FAA identified, under the full range of operating conditions and to the designated standards. Using the tasks identified in the FAA as primary input, the FNA produces as output a list of capability gaps or shortcomings that require solutions, and indicates the time frame in which those solutions are needed. The FNA should accomplish the following:

?? Describe the capability gap, overlap or problem in operational and/or broad effects-based terms. It will include consideration of gaps or problems identified in combatant commander issues and Integrated Priority Lists (IPL). Future adversarial threat capabilities and scientific and technological developments should be considered. Contact the Defense Intelligence Agency's (DIA) Defense Warning Office, Acquisition Support Division for assistance (DSN 428-4526; JWICS: http://www.dia.ic.gov/homepage/homepages/ta2/homepage.htm; SIPRNET: http://www.dia.smil.mil/homepage /homepages/homepage.htm).

?? Describe what additional functional areas may be involved in the problem or solution.

?? Describe the key attributes of a capability or capabilities that would resolve the issue in terms of purpose, tasks and conditions. This description should address the elements of time, distance, effects and obstacles to overcome. Link the discussion to the UJTL, adjusting for situations not covered within the UJTL. These descriptions will enable the development of measures of effectiveness (MOE).

?? Identify the Joint Requirements Oversight Council (JROC) approved functional area MOE, as derived from the integrated architectures (as available), which the proposed capability improves or degrades. If integrated architectures do not yet exist for this functional area, propose appropriate MOEs.

Functional Solution Analysis (FSA)

The FSA is the third step of the JCIDS analysis process. Again, the sponsor leads the FSA. It is an operationally based assessment of potential DOTMLPF approaches to solving (or mitigating) one or more of the capability gaps (needs) identified in the FNA. The needs identified in the FNA are inputs to the FSA. The FSA's outputs are potential solutions to needs, including in order of priority: integrated DOTMLPF changes; product improvements to existing materiel or facilities alone; adoption of interagency or foreign materiel solutions that have limited non-materiel DOTMLPF consequences; and finally, new materiel starts that have limited non-materiel DOTMLPF consequences. The FSA is composed of three sub-steps:

DOTMLPF Analysis

The first sub-step in the FSA is to determine whether an integrated DOTMLPF approach can fill the capability gaps identified in the FNA. If the sponsor determines that the capability can be partially or completely addressed by an integrated DOTMLPF approach, the sponsor will coordinate with the appropriate DOD component to take action through the process outlined in reference. If the sponsor determines that a materiel approach is required, the FSA process continues to sub-step 2 below. Routinely, capability

proposals will involve combinations of DOTMLPF changes and materiel changes. These proposals will also continue through the FSA process at sub-step 2.

Ideas for Materiel Approaches

In sub-step 2, the expertise of the entire Department and other resources should be engaged to identify materiel approaches necessary to provide the required capabilities. The collaborative nature of this effort is meant to develop potential solutions in an integrated fashion that reflect the future requirements of joint force commanders. The process should leverage the expertise of all government agencies, as well as industry, in identifying possible materiel approaches. It should always include existing and future materiel programs that can be modified to meet the capability need. The integrated DOTMLPF implications of any proposed materiel solution will always be considered throughout the process.

Analysis of Materiel Approaches (AMAs)

In sub-step 3, the AMA will determine the best materiel approach or combination of approaches to provide the desired capability or capabilities. The AMA will determine the best way(s) to use materiel approach(s) to provide a joint capability. Generally, it will not consider which specific "systems" or "system components" are the best. For example, the AMA may determine that a capability is best satisfied by an unmanned aerial vehicle (UAV) with bombs vice approaches employing submarine launched missiles, artillery or air launched missiles. The AMA will not assess the best alternatives for UAVs or bombs. <u>That analysis will occur in an analysis of alternatives (AoA) after the ICD is approved.</u>

Key AMA considerations are, (1) the sponsor will collate the information obtained during the FAA, the FNA, the DOTMLPF analysis and the remaining ideas for materiel approaches. At this point, a number of approaches may be available to provide the desired capabilities. Therefore, the sponsor, with support from the Joint Staff J-8 Requirements and Acquisition Division (RAD) and the appropriate Joint Warfighting Capability Assessment (JWCA) teams, will determine whether to submit the information to an appropriate research agency (such as a Federally Funded Research and Development Center) for independent analysis or to conduct the AMA itself. An independent analysis may be required to provide an objective review that serves the capability needs of the joint forces. (2) The AMA will consider the capability gap, the specified range of military operations, the conditions under which they must be performed and other factors that are relevant to support of JFCs and integrated architectures. (3) The AMA will determine how well the proposed materiel approaches address the identified capability gaps and provide the desired effects. The materiel approaches may include a family of systems (FoS) or system of systems (SoS) that take different approaches to filling the capability gap, each addressing operational considerations and compromises in a different way. The approaches shall include the overarching DOTMLPF changes necessary to meld the FoS and SoS into an effective capability. The FoS and SoS materiel approaches may require systems delivered by multiple sponsors and materiel developers. (4) The product of the AMA is a prioritized list of materiel approaches (or combinations of approaches) ranked by how well each provides the desired capabilities. The prioritized list will consider technological maturity, technological risk, supportability and the affordability of each approach using the best data available in the pre-ICD process.

The AMA will also assess the operational risk associated with each approach. It will also consider the integrated DOTMLPF implications of each approach, to the extent that those implications can be identified. Finally, it will consider the overall impact of the proposed materiel approach on the functional and cross-functional areas. The AMA must: (1) Confirm the nature of the capability or broad-based effect(s) and the applicable operational environment to be provided when the capability is required. This capability confirmation must include a rough assessment of the sustainability/supportability of the end item system or SoS. (2) Examine the ability of the identified ideas for materiel approaches to provide the desired capability or capabilities under the conditions specified. (3) Evaluate the delivery time frame for each approach. In doing so, AMAs must consider the following:

- ?? For approaches that use existing capabilities or capabilities that are already scheduled for delivery, examine how the delivery of the proposed capability ties in to the existing program.
- ?? For new materiel approaches, evaluate when a useful capability could be delivered to the warfighter through the use of existing technology.
- ?? For approaches based on FoS and SoS solutions, evaluate the necessity to synchronize the development of systems and integrated DOTMLPF considerations across sponsors and materiel developers.
- ?? Evaluate when a new or increased capability could be delivered by bringing together existing or new systems in new ways.

(4) Identify technologies that, if matured, would provide a more effective approach in the future. (5) Examine additional approaches, as required. Conduct market research to determine if commercial items or non-developmental items are available to meet the desired capability, or could be modified to meet the desired capability. If market research indicates commercial or non-developmental items are not available to satisfy the need, re-evaluate the need and determine whether it can be restated to permit commercial or non-developmental items to satisfy the required capability.

Post-Independent Analysis

The final step in the JCIDS analysis process is the post independent analysis. In this step, the sponsor will consider the compiled information and analysis results to determine which integrated materiel approach or approaches best address the joint capability gap(s) in the functional area. This information will be compiled into an appropriate recommendation, either a materiel change recommendation or an ICD.

DoD Space System Acquisition Process (National Security Space Acquisition (NSSA) Policy 03-01 (July 28, 2003)

The NSSA Acquisition Policy 03-01 falls under the authority of DoD Directive 5000.1 and is used for DoD Space Major Defense Acquisition Programs, replacing processes and procedures described in DoD Instructions 5000.2 under the jurisdiction of the Under Secretary of Defense for Acquisition Technology and Logistics (USDAT&L). The Under

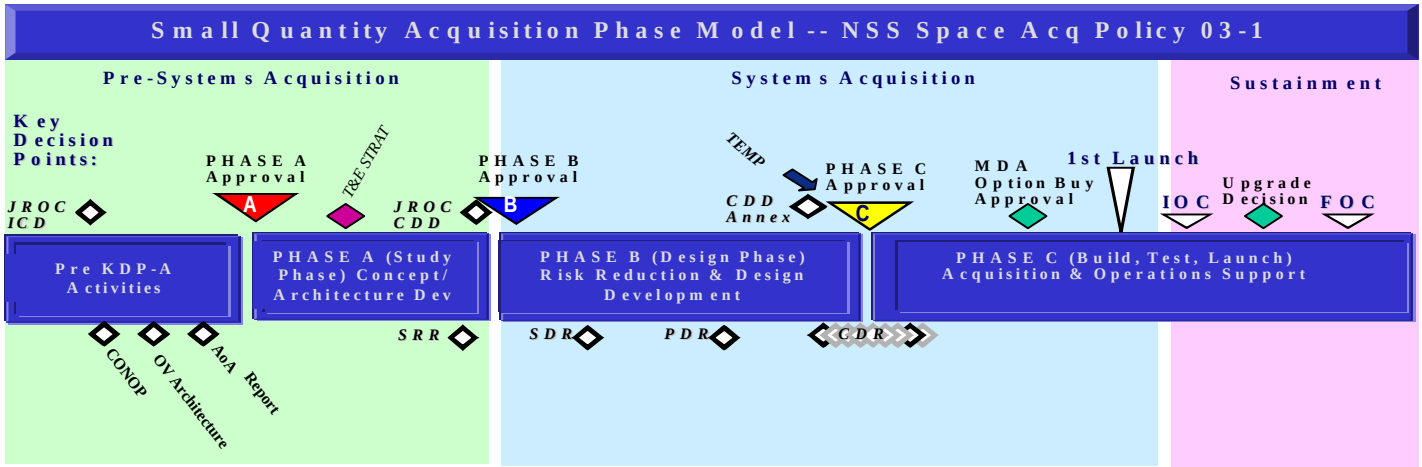
Secretary of the Air Force (UsecAF) is the DoD Space Milestone Decision Authority (MDA) for all DoD Space Major Defense Acquisition Programs.

The acquisition of Space programs will be accomplished in a process as shown in Figure 2.3. There are similarities of this process to the one identified in the DoD 5000 series acquisition documents, with allowances made for the way space systems are acquired and supported.

This handbook will not go into much detail related to AoAs, except to point out that the AoA Report is shown in Figure 2.3 as being available to support a Key Decision Point A, at which time approval of the Phase A allows the start of the Study Phase during Concept/Architecture Development.

Discussions with AF/XOR and UsecAF offices have confirmed that AoAs done for Space System under NSSA Policy 03-01 will be reviewed by the AFROCC, as are other AoA being done to support AF acquisitions.

Figure 2.3. Evolutionary Acquisition.



Air Force Operational Capability Planning and Requirements Development (AFI 10-601 Operational Capability Requirements – Currently under revision following subject to change.)

Figure 2.4 below depicts the various planning elements that influence and define Air Force operational capability requirements. Each of these elements identifies potential and core capabilities that the Air Force may invest and field in the future.

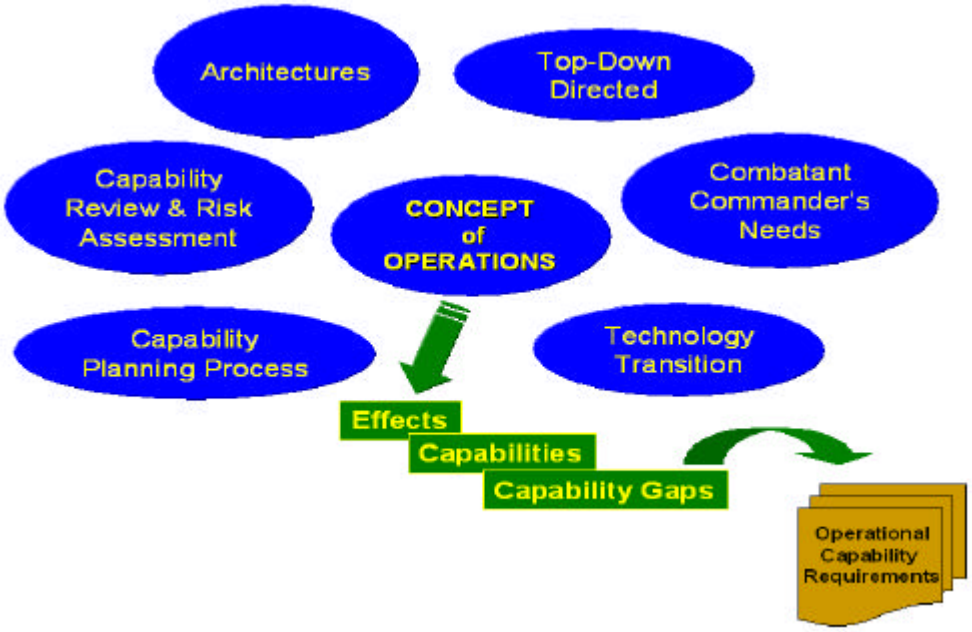


Figure 2.4. Influential Planning Elements to Operational Capability Requirements.

Capability Planning

Capability planning is based upon defense planning guidance, Joint Vision, Joint Operations Concepts, Air Force long range planning inputs, and the effects and capabilities contained in specific Air Force CONOPS. Its objective is to develop capabilities-focused planning products that ensure future air forces have the operational capabilities to fight and prevail anytime, anywhere. Capability gaps identified during capability planning are reviewed and prioritized by the Capability Review and Risk Assessment (CRRA) process to determine if a solution(s) is necessary and feasible. If a solution is deemed necessary, AF/XOR may direct a MAJCOM/Agency to develop an ICD. The ICD will become the foundation of the analysis for the AoA.

Capability Review and Risk Assessment

CRRAs are conducted to evaluate the Air Force's ability to employ capabilities and accomplish its mission when called upon as described by Air Force CONOPS. Based on previous investment decisions and operational risk, CRRAs are report cards that assess how well the Air Force is doing in developing, fielding and maintaining needed capabilities. Each CRRA is a collaborative effort between the planning, requirements, and acquisition communities and is designed to identify and prioritize Air Force capability needs. The CONOPS are evaluated separately and then in aggregate in the Integration CRRA. Results of the Integration CRRA are used to identify the capability gaps that may initiate the decision to start development of an ICD.

Architectures

As they are developed, architectures provide a framework for conducting analysis to identify capability gaps, compare alternatives for improving joint warfighting capabilities and identify associated resource implications. Architectures use detailed information on the capabilities of existing and planned systems to depict functionality and to identify capability gaps or unnecessary redundancies. Until the development of joint functional concepts and integrated architectures are complete, Capstone Requirements Documents (CRDs) are used. They provide a common framework for the operational concepts necessary to guide operational capability requirements document development. The DoD *C4ISR Architecture Framework* describes the key components and principles for development of architectures and architectural products/views.

To achieve substantive improvements in interoperability, the Air Force needs an integrated approach to requirements, resourcing and acquisition. There is only one activity that usefully relates to key elements of capability integration development, PPBS, and acquisition -- that of developing an integrated architecture for a capability. Therefore, we must use architectures as the unifying activity to ensure that C4ISR capability is adequately and efficiently addressed. The alignment and assessment process is designed to encompass the entire development and funding cycle and employs architectures to accomplish this effort.

Top-Down Direction

Higher authority may direct a MAJCOM to initiate the development and fielding of a new capability. Written direction from the CSAF, or higher authority, fulfills the AFPD 10-6 requirement for identifying a capability need. However, the designated requirements sponsor is still responsible for producing the appropriate operational capability requirements documents. In addition, the JCIDS process may direct multiple materiel solutions due to a SoS or a FoS approach which could result in driving top-down or 'born joint' Air Force capability requirements. AF/XOR reviews all top-down directed initiatives before the sponsor initiates an ICD.

Combatant Commander's Needs

A Combatant Commander's needs may identify a capability gap that may be met through the normal acquisition process or through the Rapid Response Process (RRP) as described in Attachment 3 and AFI 63-114. For a normal acquisition, the Combatant Commander forwards their need to the resource providing MAJCOM. In turn, the MAJCOM (through their CONOPS organization) works with the AF/XOR CONOPS office to evaluate the need before initiating ICD development.

Technology Transition Activities

Throughout the operational capability requirements generation process, the Air Force maximizes efforts to provide operators with new capabilities based on superior and affordable technology. Current sources for capitalizing on technology transition are Advanced Technology Demonstrations (ATDs), Advanced Concept Technology Demonstrations (ACTDs), Joint and Air Force Battle-lab experiments, operational exercises, wargaming, DoD and Air Force laboratory and research projects, and

commercial sources identified within the Defense Science and Technology (S&T) Program. AF/XOR (through the AFROCC) reviews potential technology transition initiatives and, in turn, may direct its AF/XOR CONOPS office to evaluate the initiatives as possible solutions to fill capability gaps. Results of the evaluation may initiate the decision to start development of an ICD.

Implementation

The Air Force defines operational capability requirements based on effects and capabilities CONOPS. All stakeholders in the acquisition framework must know why the Air Force needs a particular capability, how it will be used, who will use it, when it is needed, and how it will be supported and maintained. Fielding an operational capability starts with sound requirements, acquisition, and test and evaluation (T&E) strategies. To be viable, these three strategies must be developed in concert and require early and ongoing collaboration among operators, developers, acquirers, sustainers and testers. No one strategy can stand alone and still be viable since all three are interdependent and require the integration of the other two to be effective.

AoA-Related Documentation

The acquisition cycle generates a number of documents related to AoAs. Several of the documents including the MNS and the ORD are addressed below. Note, however these soon to be obsolete documents are being replace by the ICD, CCD, and CPD. This section expands on that discussion and introduces other documentation important to AoAs.

Acquisition Decision Memorandum (ADM)

The ADM is a document issued by the MDA directing and outlining the scope of the next acquisition step. The ADM is key to the AoA process. AoAs should be initiated with an ADM.

Acquisition Program Baseline

The Acquisition Program Baseline (APB) describes what will be done, when it will be done, and at what cost. It establishes a commitment among the Program Director, PEO, and the CAE and serves as the basis for accountability of the Program Director and PEO.

Cost Documents

One of the most important cost documents is the Cost Analysis Requirements Description (CARD). The CARD identifies and quantitatively describes system characteristics, establishing the basis for the cost estimates. The technical staff of the program office prepares the formal CARD. The AoA team may be required to develop a "card-like" document to support the AoA effort and insure consistent and quality cost estimates for the AoA. Often the AoA cost estimates are developed before the establishment of a new program office that normally occurs after Milestone B. Other key cost documents similar to the AoA cost estimates include, the Program Office Estimate (POE), the Independent Cost Estimate (ICE), the Component Cost Analysis (CCA), and the Service Cost Position (SCP). While these documents may not be directly related to the AoA, the cost estimates developed during the AoA should be consistent with these cost documents developed later to support milestone decisions.

Initial Capabilities Document (ICD)

The ICD makes the case to establish the need for a materiel approach to resolve a specific capability gap derived from the JCIDS analysis process. The ICD supports the AoA (for ACAT I/IA programs), the Technology Development Strategy, the Milestone A acquisition decision, and subsequent Technology Development phase. The ICD defines the capability gap in terms of the functional area(s), the relevant range of military operations, time, obstacles to overcome and key attributes with appropriate measures of effectiveness, e.g., distance, effect, etc. ICDs will eventually be based entirely on integrated architectures.

The ICD also captures the evaluation of different materiel approaches that were identified to provide the required capability. The ICD proposes the recommended materiel approach(s) based on analysis of the relative cost, efficacy, sustainability, environmental quality impacts and risk posed by the materiel approach(s) under consideration. The analysis contained in the ICD is the starting analysis for the AoA results that will be used through the life of the system. In order to be informed of areas considered critical to their analysis, sponsors should consult with appropriate FCBs while developing their ICD. The FCB, in turn, will advise the Director/Program Analysis and Evaluation (D/PA&E) of anticipated proposals. D/PA&E may provide specific AoA guidance, as approved by the MDA. The ICD describes how the recommended approach best satisfies the desired joint capability. It supports the AoA by providing operational context for assessing the performance characteristics of the alternatives.

Capability Development Document (CDD)

Guided by the ICD, the AoA (for ACAT I/IA programs), and technology development activities, the CDD captures the information necessary to develop a proposed program(s), normally using an evolutionary acquisition strategy. The CDD outlines an affordable increment of capability. A capability increment is a militarily useful and supportable operational capability that can be effectively developed, produced or acquired, deployed and sustained. Each increment of capability will have its own set of attributes and associated performance values with thresholds and objectives established by the sponsor with input from the user. The CDD supports the Milestone B acquisition decision.

The CDD provides the operational performance attributes, including supportability, necessary for the acquisition community to design the proposed system, including key performance parameters (KPPs) that will guide the development, demonstration and testing of the current increment. Because the operational performance attributes provided in a CDD apply only to a single increment of a program's development, the KPPs shall apply only to the current increment (or to the entire program when only a single increment is required to achieve full capability). The AoA should be reviewed for its relevance for each program increment requiring a Milestone B decision and, if necessary, the AoA should be updated or a new AoA initiated.

Capability Production Document (CPD)

The CPD addresses the production attributes and quantities specific to a single increment of an acquisition program. When the CPD is part of a FoS/SoS solution, the CPD will reference the originating ICD and provide the linkages to related CDDs/CPDs and supporting analyses (e.g., AoA). This is to ensure that system production is

synchronized with the related systems required to fully realize the capability(ies). The sponsor finalizes a CPD after critical design review when projected capabilities of the increment in development have been specified with more accuracy. The CPD must be validated and approved before the Milestone C decision review.

Performance and supportability attributes in the CPD will be specific to the increment. The design trades from the SDD phase will have been completed and a specific production design determined for the increment. The threshold and objective performance values of the CDD are superseded by the specific production values detailed in the CPD for the increment. Reduction in threshold KPP performance will require an assessment of the military utility of the reduced capability and, possibly, a reexamination of the program to determine if an alternative materiel or nonmaterial solution should be adopted.

Integrated Logistics Support Plan

The Integrated Logistics Support Plan (ILSP) describes and documents the Integrated Logistics Support (ILS) program. It is the principal logistics document for an acquisition program and serves as a source document for summary and consolidated information required in other management documents. The ILSP describes the overall ILS program including requirements, tasks, and milestones for the immediate acquisition phase and plans for succeeding phases. Specifically, the purpose of the ILSP is to:

?? Provide a complete plan for support of the fielded system

?? Provide details of the ILS program and its relationship with overall program management

?? Provide decision making bodies with ILS information necessary for sound decisions regarding further development and production

?? Provide the basis for preparation of ILS sections of the procurement package (e.g., Statement of Work, Specifications, and Source Selection and Evaluation Criteria)

Mission Need Statement (Old document still circulating, being replaced with ICD)

A MNS may be prepared by any DoD component (Air Force, Army, Navy or Marines), which has identified a specific mission area need or deficiency. The MNS identifies the need to establish a new operational capability, improve existing capabilities, or exploit an opportunity that cannot be satisfied with non-materiel solutions. It applies to all materiel acquisition programs, not just major programs, and is developed by major operating commands. For potential major defense ACAT ID programs, the MNS is sent to the Joint Requirements Oversight Council (JROC) for validation. Submission to the JROC is the first step in program initiation. The MNS is then submitted to the USD (AT&L) for Defense Acquisition Board (DAB) review and approval to proceed with concept studies in CTDP.

Milestone A decisions are documented in an ADM. For other ACAT I programs, approval is at the DoD Component Head or DoD CIO level. The MDA for a non-ACAT I MNS is the DoD CAE, or the lowest level deemed appropriate by the DoD CAE.

Operational Requirements Document and Requirements Correlation Matrix (Old documents still Circulating, being replaced with CDD and CPD)

The Operational Requirements Document (ORD) replaced all service unique documents—e.g., Statement of Operational Need (SON), Tentative Operational Requirement (TOR), Required Operational Capability (ROC), etc. It addresses performance and related operational parameters of the proposed system or concept and discusses how the system will be operated, deployed, employed and supported. It provides initial guidance for the implementing, supporting, and participating commands and agencies. The ORD is prepared during CTDP by the user, approved by the service chief, and submitted at Milestone B to the JROC. At the beginning of Milestone B, the JROC reviews the ORD and the APB. The ORD will be updated and expanded for Milestone C and must be approved to meet Milestone C criteria. The ORD is used to develop requirements for contract specifications during each acquisition phase.

The Requirements Correlation Matrix (RCM) is a mandatory Air Force three-part matrix attached to the ORD and is used to provide a system audit trail of the capabilities and characteristics identified in the ORD. It lists user-identified system capabilities and characteristics with accompanying thresholds and objectives, identifies user-recommended key performance parameters, and provides supporting rationale for justifying each threshold level and any changes in requirements that may occur as the system matures.

Single Acquisition Master Plan

The Single Acquisition Master Plan (SAMP) is a comprehensive Air Force-unique plan, which discusses all relevant aspects of a program. Written at the strategic level, the SAMP meets the program oversight and statutory requirements contained in other management plans such as the TEMP, the Integrated Logistics Support Plan (ILSP), etc.

Threat Assessment Report

The Threat Assessment Report (TAR) for Air Force component programs, or Threat Planning Document (TPD) for PEO programs, is the key threat document supporting milestone reviews and program management. The intelligence office of the implementing command initially prepares the System Threat Assessment Report (STAR) at Milestone B. The Defense Intelligence Agency (DIA) (for ACAT ID) or the Assistant Chief of Staff for Intelligence (AF/IN) then validates the document. The STAR, TAR, or TPD becomes the primary document for current, projected, and reactive threats against the system. Additional information on these documents is contained in AFR 200-13, *Threat Support to the Weapon System Acquisition Process*.

Test and Evaluation Master Plan

Projects that receive a favorable Milestone A decision are required to have an evaluation strategy. The evaluation strategy has no mandatory format. It follows the same approval process as prescribed for a Test and Evaluation Master Plan (TEMP). The strategy is due to the Office of the Secretary of Defense (OSD) (or to the MDA for less than ACAT I, IA, or non-OSD T&E oversight programs) not later than 180 days after the Milestone A decision. A TEMP is required for programs entering Milestone B. The TEMP identifies and integrates the overall structure and objectives of the test and evaluation program. It also identifies responsibilities, resources, and schedules to be

accomplished prior to future milestone decision points. The draft TEMP is submitted 45 days prior to Milestone B DAB reviews for ACAT ID and IC programs or within 90 days for programs designated less than ACAT I. It is updated at each milestone. The TEMP is prepared by the Program Manager and the T&E WIPT in support of Milestone B and Milestone C and approved by DOT&E and the appropriate OIPT for all ACAT I programs, selected ACAT IAM programs, and other designated programs.

Acquisition Cycle Exceptions

Acquisition Streamlining

The Federal Acquisition Streamlining Act (FASA) of 1994 ushered in changes in acquisition regulations; these changes are often referred to as "acquisition reform." For programs designated as streamlined acquisition programs, FASA provides DoD with the authority to use commercial practices in acquisition programs. Often these practices result in fewer government "specs" and decrease the overall cost of the weapon system. Streamlined programs are characterized by their short duration and use of a "rolling down-select" concept which starts with many competitors, down-selects to two, then finally to one. By their nature, streamlined acquisition programs can go from Pre-Milestone A to initial operationally capability (IOC) in as little as six years. These programs often use competition in the down-select process to reduce risk and to lower program cost.

Advanced Concept Technology Demonstrations

The Advanced Concept Technology Demonstration (ACTD) is an effort to assemble and demonstrate a significant new military capability based on maturing technologies in a real-time operation at a scale adequate to clearly establish operational utility and system integrity. A major benefit of an ACTD is the ability to field an operational capability much faster than current (non-streamlined) acquisition processes. ACTD programs are required to demonstrate and field a new capability in two to four years. A war-fighting sponsor accepts the capability in their command as an ACTD "leave-behind" or "residual." Although usually fielded in small numbers (i.e., fielded prototypes), these residual items can be complex in nature and may require significant intelligence infrastructure integration. Successful ACTDs frequently enter the mainstream acquisition process at an appropriate milestone for further development and fielding.

3 – AoA Structure

An AoA is conducted by a working group (WG), staffed by a diverse group of government and contractor personnel and led by a study director. This working group is referred to as a study team. Throughout the AoA the study team will interact with individuals and groups that provide assistance and direction. This chapter discusses study group composition, responsible parties, and the names and roles of companion players.

Study Team Structure

Study Team Director

The lead operating command responsible for the AoA appoints an AoA study team director to lead the AoA. The AoA directorship is 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) from the lead command. Typically, a deputy from the same command supports the director, along with experienced analysts to lead the effectiveness and cost analysis processes. OAS provides an assistant to the director. The assistant's responsibilities are to provide procedural guidance for AoAs and to serve the director in whatever capacity required to ensure a quality AoA.

Study Team

Guided by a high-level Overarching Integrated Product Team (OIPT) and working-level IPTs, the director establishes the study team to plan and execute the AoA. Study team membership is determined by the needs of the AoA, and 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 and life cycle costs.

Organizations who typically contribute members to an AoA study team are:

- ?? Operating Command (OC)
    - Financial Management (FM)
    - Operations (DO)
    - Planning (XP)
    - Requirements (DR, XR)
    - Intelligence (IN)
    - Logistics (IL)
    - Weather (DOW)
    - Engineering (CE)
    - Personnel (DP)
    - Information Management (IM)
    - Security (SP)
    - etc.
- ?? Implementing Command (IC)
    - AFMC/DR/FM
    - OAS (AFMC)
    - Product Centers
    - Labs
    - ALCs
    - SPOs

    - etc...
- ?? Non-DoD Organizations
    - DOE
    - DOI
    - NASA
    - KTRs
    - FAA
    - DOT
    - NIMA
    - etc...
- ?? Other DoD Organizations
    - USA, USN, USMC
    - CINCs
    - DIA
    - DTRA
    - DLA
    - etc...
- ?? Other AF Organizations
    - USAF/XOI
    - USAF/XOW
    - SAF/AQ/FM
    - AFCAA
    - MAJCOMs
    - AFOTEC
    - AFSAA
    - AFFSA
    - AIA
    - AFGWC
- ?? Oversight/Advisory Organizations
    - IPTs
    - AFC
    - AFROCC
    - TRG
    - COE (OAS)
    - OSD (DPA&E)

The study team is generally organized along functional lines into panels with a chair for each panel. See Figure 3.1 below. Typical functional areas for the panels are threat and scenarios, technology and alternatives (responsible for defining the alternatives), operations concepts (of the alternatives), effectiveness analysis, and cost analysis. While the work of all the panels is vital to the AoA, the effectiveness analysis panel—chief integrator of the work of the other panels—occupies the pivotal position.

Figure 3.1.1 Typical Study Team Structure

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

The panels meet separately to address their fundamental issues. They also meet in conjunction with other panels or the study team as a whole to exchange information. Frequent and open exchange of ideas and data is key to a successful AoA. The importance of this is greatest when the team is geographically dispersed—a common happenstance.

Documenting questions, answers, and decisions made in the various panels enhances open communication. This can be done through taking and distributing minutes of panel 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.

Here is a suggested division of responsibilities between the study team, the operating command (OC), the implementing command (IC), and the supporting organizations:

?? **Responsibilities of the Operating Command (OC)**

- Appoint AoA study team director (CC)—Lead OC designates an appropriate directorate (XP, DO, DR, XR) to provide study director; OAS provides assistant to designated director
- Define operations concepts (DO or DR, supported by XP and IN)
- Develop threat scenarios (IN, supported by DIA, USAF/IN, AIA)
- Identify/define critical environmental factors (DO or DR with DOW, supported by IC's DOW)

- Identify environmental impacts (CE, supported by SG and the IC's CE, SG)—The OC identifies key environmental compliance requirements and pollution prevention issues, supported by the Surgeon General's office (SG); all proposed projects must be evaluation using the environmental impact process in AFR 19-2
- Determine constraints and assumptions (XP or DR with FM, supported by DO, IC's DR and FM, AFSAA, and AFCAA)
- Identify mission tasks (DO, DR, XP, supported by AFSAA)—The OC's DO or DR leads; AFSAA, supported by OAS and AFOTEC, may also help
- Develop MOEs and MOPs (DO, DR, XP, supported by AFSAA, OAS, and AFOTEC)—Either the OC's DO, XP, or Dr leads
- Identify/develop logistics issues (LG or DR, supported by DO and the IC's LG)—The OC leads work on supportability and maintainability issues
- Select and develop models (OC operations analysts, supported by IC's DR and FM, AFSAA, AFCAA, and OAS)—If the OC doesn't have an operations analysis group, AFMC DR may provide support
- Conduct cost analysis (FM, supported by IC's FM and OAS)—IC provides acquisition cost estimates for development and production of concepts (including modification costs); for AoAs involving AFMC, the FM shop is the POC; both the OC and AFMC provide the O&S cost estimates; AFMC Human Systems Center (HSC) assists with O&S cost estimates in manpower, personnel, training, and safety (MPTS) for new or upgraded systems; OAS may also provide support; when foreign military materiel are included as alternatives, AFMC's product center(s) provide costing assistance

?? **Responsibilities of the AoA Study Director**

- Develop AoA study plan (supported by study team)—Director coordinates efforts of study team in developing the plan
- Develop alternatives (supported by OC's XP or DR and the IC's DR)—The appropriate AFMC FM or DR directorate should coordinate inputs from AFMC centers and labs
- Conduct effectiveness analysis and integrate cost analysis (supported by the study team; the OC's DO, DR, FM and operations analysts; the IC's DR and FM; and by AFSAA and AFCAA)—The study director, team members, and OC analysts determine who conducts the analysis; for AoAs involving AFMC, DR or FM acts as POC for the Concept and Technology Development Phase (drawing inputs from centers and labs); beyond that phase, the appropriate AFMC center is POC; OAS may help OCs who don't have analytical organizations
- Write final report (supported by the study team)

AoA Oversight and Review

AoAs are subject to substantial oversight and review because of their importance. The AoA supports program decisions at the OIPT and Defense Acquisition Board (DAB) level. Integrated product teams (IPTs) perform much of the oversight. For ACAT ID and ACAT IAM programs, there are the OIPTs and one or more working-level IPTs (WIPTs). The Cost Performance IPT (CPIPT) is perhaps the most important from an AoA oversight and review perspective.

Major AoA elements such as the study plan, findings, and results will have many

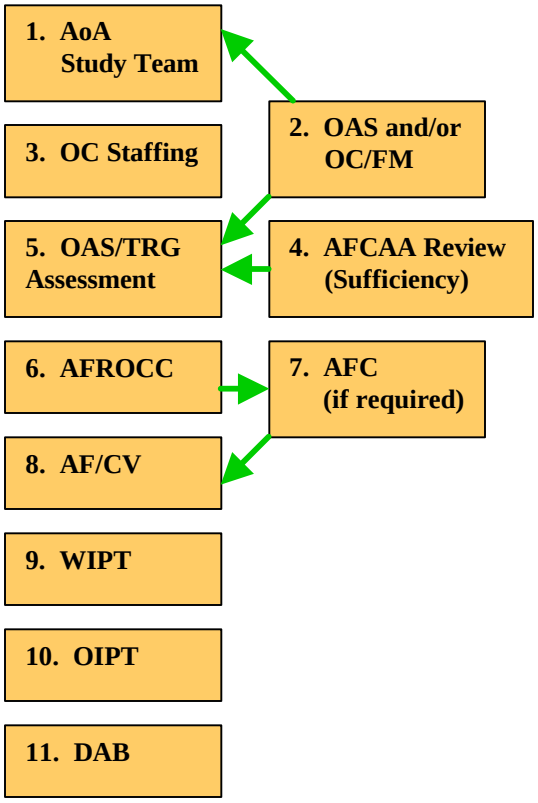


Figure 3.2. USAF AoA Oversight and Review Process

opportunities for review. Figure 3.2 shows the steps followed to obtain the review and oversight appropriate for the AoA.

Step 1. The study team originates 1) the AoA study plan, 2) mid-term results, and 3) final analysis results. These items must flow through the oversight and review process, along with any status and program updates that may be asked for outside the normal review and oversight.

Since the study team is the source of any original AoA information, the study team is the starting place for the oversight and review process. The complete study team should be involved in developing all of the material that is presented to outside organizations.

Step 2. The coordination, review and oversight process relies on outside functional experts for unbiased constructive evaluation and recommendations to correct and revise the AoA material. Both OAS and the operating command financial management evaluations

shown in this step are critical to ensure quality and consistency in the AoA study plan, midterm, and final results.

OAS is focused on the overall quality of the cost and effectiveness analysis and the clarity and soundness of the results and findings of the study. To accomplish this, OAS supports the MAJCOM's development of the study plan, briefings, and the final report.

The MAJCOM financial management specialists are concerned in this step with the appropriateness of the cost estimates developed for each of the alternatives in the AoA. Because the AoA is executed by the MAJCOM, it is critical that the AoA address the concerns of the MAJCOM, a command that may ultimately have to use the final system in the field.

Step 2 is also the handoff point of the cost estimates from the operating command to the Air Force Cost Analysis Agency (AFCAA) for sufficiency reviews of each estimate. This step also presents an opportunity to work out potential disconnects for the information being developed and reviewed in steps 4 and 5.

Step 3. This is the starting place for the formal coordination and review process. Once a quality product is available from the AoA study team based on actions completed in steps 2 and 4, the staff of the operating command will review and coordinate on the study plan or the results briefing. This ensures that any operating command concerns about the study have been addressed before being passed to the next level.

Step 4. This step focuses on the cost aspect of AoAs. A significant effort is undertaken to ensure the quality and consistency of the ACAT I cost estimates contained within the AoA. To accomplish this end, the AFCAA will complete a sufficiency review of the cost estimates. These estimates are normally made for each alternative considered within the AoA. AFCAA will also evaluate the data and specific techniques and methodologies being used.

Step 5. In this step, the study director can call a Technical Review Group (TRG) of technical experts, if desired. In most cases OAS analysts are used to assess the quality and consistency of the study plan or the quality of the results being briefed. In any case, consideration is based on established standards for the study plan and the results of the study.

Step 6. This is the step where corporate oversight and review really begins. At this point the study plan, midterm, and final results are presented to the Air Force Requirements Operational Capabilities Council (AFROCC) to ensure the quality and focus of the study and that the results are realistic and believable. The AFROCC tries to resolve all problems. They also provide interest and support for the potential capability being analyzed and evaluated with the AoA.

Steps 7 & 8. The findings of the AFROCC review for the study plan, midterm, or final results are documented and presented to the AF/CV. If there are unresolved issues from the AFROCC, the AF/CV may call the Air Force Council (AFC) into session to resolve these issues. Once all remaining issues are resolved, the council provides the results to AF/CV to continue the review and oversight process. At this point the AoA information found in the study plan, midterm, or final results from the AoA can be provided to the acquisition community.

Step 9. The AoA information is provided here to WIPT, which needs it to execute the acquisition process. Note that the WIPT may also have helped to focus and provide guidance early in the process to ensure that the study provides the needed analysis to allow

decision making for the acquisition of the new system. When the WIPT has received the AoA results, it can direct that the results be presented to the OIPT.

Step 10. In this step, the OIPT receives the AoA information it needs in order to precede with the acquisition of the program. If the OIPT is happy with the AoA findings and the other information asked for by the MDA, they make a milestone decision at this point or direct the finding on to step 11, the Defense Acquisition Board (DAB), for the milestone decision.

Step 11. The DAB is the normal system acquisition decision point and AoAs are a major input to those decisions. The MDA listens to all the findings and results, and together with information and recommendations submitted by the MDA staff, makes the acquisition decision for the milestone.

DoD Review

Overarching Integrated Product Team (OIPT)

An OIPT is formed for ACAT ID and ACAT IAM programs to provide assistance, oversight, and review as the program proceeds through its acquisition life cycle. The OIPT for ACAT ID programs is led by the appropriate Office of the Secretary of Defense (OSD) official—typically the Director of Strategic and Tactical Systems, the Assistant Deputy Under Secretary of Defense (ADUSD, Space and Acquisition Management), or the Deputy Assistant Secretary of Defense (DASD, C3I Acquisition). The DASD, C3I Acquisition designates the OIPT leader for each ACAT IAM program.

The OIPT consists of senior representatives from DOD, principal operating command organizations, implementing and supporting commands, SAF/AQ, SAF/FM, USAF/XO, AFSAA, AFOTEC, and others as required. The OIPT reviews the AoA effort at the following points:

?? Completion of AoA study plan
?? Completion of AoA final results briefing
?? When significant problems or changes arise

Working-Level Integrated Product Teams (WIPTs)

WIPTs are formed to support a particular process or functional area. WIPTs supporting the AoA process may be focused on test, operational requirements, logistics, etc. A WIPT formed to oversee the development of the AoA and other cost/effectiveness issues is generally called a Cost Performance IPT (CPIPT) or an Analysis IPT (AIPT).

Each WIPT consists of mid-level representatives from DOD, principal operating command organizations, implementing and supporting commands, SAF/AQ, SAF/FM, USAF/XO, AFSAA, AFOTEC, and others as required. WIPTs review the AoA at the following points:

?? Completion of AoA study plan
?? Completion of AoA
?? As a result of any changes, updates, or problems related to the AoA effort

The Integrating Integrated Process Team (IIPT) is a special WIPT. The IIPT is not a standing IPT, but one called into being to solve problems common to a number of WIPTs.

The membership is composed of the chairs of all the standing WIPTs. The chair of the IIPT is normally taken by one of the WIPTs that have identified the problem.

Air Force Review

Air Force Requirements Operational Capabilities Council (AFROCC)

The AFROCC assists the Chief of Staff Air Force (AF/CC), the Vice Chief of Staff Air Force (AF/CV), and AF/XO in their responsibilities to assess Air Force operational requirements. This includes review and oversight of requirement aspects of the AoA.

The AFROCC may recommend that AF/CV approve the study plan, midterm, or final results without going to the Air Force Council (AFC).

The membership of the AFROCC consists of senior members from USAF/XOR (chair), SAF/AQ, SAF/FM, AFMC, AFOTEC, AF/XOI, USAF/IL, USAF/XP, USAF/XOF, and USAF/XIW. Ad hoc members include USAF/CE, USAF/SC, USAF/SG, and USAF/SP, the MAJCOM Requirements Principal, and other service representatives as required. Specific functions include:

- ?? Ensure Air Force needs and requirements are being met
- ?? Ensure MNS and ORD/ICD/CCD/CPD are developed to DoD, AF, and JROC standards
- ?? Review all warfighting deficiencies
- ?? Resolve cross-service issues for joint programs
- ?? Ensure consistency throughout the MAA, MNA, MNS, and AoA documents

Air Force Council (AFC)

The AFC is the senior deliberative body of the Air Force. After review and deliberation on key issues, it provides recommendations to the final decision making authorities of the Air Force-Secretary of the Air Force (SAF) and AF/CC.

The purpose of the AFC is to ensure that Air Force AoAs reflect senior leadership consensus on the AoA's analytical foundations before submitting them to the OIPT, the JROC, and OSD. The study team then provides AoA review information to the OIPT, supported by the senior Air Force member. The AFC is convened by the Vice Chief of Staff Air Force (VCSAF) through the Air Force Executive Review Secretariat, AF/CVS. For joint programs (where the Air Force is the lead service) and Special Access Required (SAR) programs, the Special Programs Oversight Council (SPOC) reviews the AoA instead of the AFC.

AF/CVS is solely responsible for coordinating and scheduling briefings for the AFC or SPOC. The AFROCC may recommend additional membership for AoA reviews through AF/XIWA to AF/CVS. The AFC is supported by the AFROCC and the Technical Review Group (TRG) or COE. Specific AFC functions include:

- ?? Review ACAT I AoAs (and other AoAs as deemed appropriate by AF, OSD, Congress, or the AFC chair); approve study plan and results going to OIPT
- ?? Ensure adequacy and completeness of analysis
- ?? Emphasize consistency of analysis across Air Force AoAs with respect to alternatives, scenarios, assumptions, requirements, etc.
- ?? Resolve cross-service issues for joint programs
- ?? Recommend changes in direction, additional work, modifications, and acceptance as appropriate to the operating command/CC, Air Force, and/or DOD approval authority

Technical Review

OAS conducts ongoing oversight of the technical adequacy of the AoA through day-to-day participation in the study and through reviews of the study plan, midterm, and final results. At the option of the AoA study director or the AFROCC, a TRG may be convened to assess the technical adequacy of the AoA.

The Chief Scientist, HQ USAF, Director of Command and Control (AF/XIW) chairs the TRG. TRG membership consists of senior technical representatives from the MAJCOM, OAS, AFSAA, AFOTEC, AF/XOI, AF/XOR, AF/ILE, SAF/AQX, SAF/FMC, and others as required. AF/XIWA provides the TRG secretariat.

The TRG will normally focus on the draft study plan, midterm, or final study results. Their assessment is provided to the AFROCC and Air Force Council.

Interacting Organizations

Program Executive Officer (PEO)

The PEO, in support of the OIPT, provides an early interface between the operational and acquisition communities, facilitates execution of a streamlined acquisition process (when appropriate), provides direction to the IIPT, and provides senior level coordination with the sister services for joint programs. The PEO resolves AFC concerns and problems elevated by the IIPT and may elevate issues to the OIPT.

Air Force AoA Center of Expertise (COE)

The AFMC Office of Aerospace Studies (OAS) is the Air Force COE for AoAs. In the absence of a TRG, OAS assesses the AoA for technical adequacy and completeness and provides the AFROCC with an evaluation of the AoA product. To support top quality AoAs, OAS may:

- ?? Designate an OAS staff member to serve as assistant to the AoA study team director
- ?? Help obtain Air Force resources from the product centers, logistics centers, laboratories, etc. to support AoA development
- ?? Provide limited analytical support for operational effectiveness and cost analyses
- ?? Assist in writing AoA plans and final reports
- ?? Help obtain and administer funds to initiate the AoA
- ?? Identify potential contractors and contract vehicles
- ?? Project funding needs for future AoAs
- ?? Support policy development as requested by the Air Staff
- ?? Help standardize Air Force AoAs by interpreting guidance and recommending standard practices
- ?? Publish, maintain, and distribute the ***Analysis Handbook***
- ?? Develop AoA standards and guidelines in concert with the Air Force analysis community for inclusion in the ***Analysis Handbook***
- ?? Provide introductory and follow-on training on AoA development
- ?? Provide technical advice and support to the AoA Study Team on:
    - Procedures
    - Organization
    - Analysis techniques
    - Application of appropriate M&S
- ?? Advise the AoA study team, the oversight IPTs, the AFROCC, and the AFC on the findings of any AoA product assessment
- ?? Develop and maintain the Air Force "corporate memory" on AoAs

?? Maintain a file of AoA "lessons learned"

SAF/AQ

SAF/AQX directs the appropriate SAF/AQ organization to prepare the ADM prior to PMD issuance. AQX and HQ USAF/XIW assist HQ USAF/XOR with the required direction, funding, and tasking necessary for concept studies and AoA preparation. SAF/AQ provides assistance to AF/XO in the development of the PMD for pre-MS B programs. The applicable SAF/AQ mission area director, in coordination with AF/XO, develops the PMD for post-MS B programs. AQX participates on the AoA study team or appropriate IPT as required.

SAF/FMC and AFCAA

SAF/FMC convenes the Air Force Cost Analysis Improvement Group (AFCAIG) and reviews the AoA report as required. SAF/FMC provides policy guidance pertaining to the Air Force cost community and participates on the appropriate IPTs as required. They also provide the Air Force interface with the OSD Cost Analysis Improvement Group (CAIG) on AoA costing issues.

The AFCAA, SAF/FMC's Field Operating Agency, conducts Air Force Component Cost Analyses (CCA) for weapon system and automated information system acquisition programs as required by DoD directives. They develop cost models, methodologies, and databases necessary to ensure credible CCAs (and other cost estimates and analyses) throughout the Air Force.

AFCAA may participate on the AoA study team. They conduct sufficiency reviews of ACAT I AoA cost estimates. They also coordinate with the AoA study team to ensure the AoA cost analysis is consistent with the Program Office Estimate (POE). Finally, AFCAA is responsible for establishing and maintaining the Air Force cost library.

HQ USAF/XIW

XIW provides specific oversight of all Air Force AoAs. XIW develops and issues guidance related to the Air Force AoA process. XIW also develops policy and processes for Air Force modeling, simulation, and analysis and forms Process Action Teams (PATs) to resolve AoA issues.

HQ USAF/XOR

XOR serves as the executive agent for managing Air Force-wide mission needs and operational requirements that may result in research, development, test and evaluation (RDT&E) and procurement appropriations. They review all requirements related to the MNS, AoA, ORD/RCM /ICD/CCD/CPD, TEMP, and STAR before a milestone decision. XOR also participates on the AoA study team and appropriate IPT as required.

XOR chairs the AFROCC during presentation of the AoA study plan, midterm results, and final results. XOR prepares and issues the MS A PMD for starting concept studies. The PMD:

?? Designates the lead operating command to develop the AoA
?? Identifies and directs all participating organizations
?? Identifies funding sources
?? Identifies a minimum set of alternatives for consideration

HQ USAF/SC

SC develops command, control, communications, computers, and information (C4I) policy on architecture, integration, and interoperability. They review the MNS, ORD/ICD/CCD/CPD, and AoA to ensure C4I requirements are adequately addressed.

HQ USAF/TE

HQ USAF/TE reviews the final MNS, ORD/ICD/CCD/CPD, and AoA for test and evaluation issues. They also provide overall policy guidance for the development of test and evaluation strategies.

HQ USAF/XI

HQ USAF/XI conducts analyses of requirements documents to ensure C4ISR requirements are adequately integrated into the existing/future C4ISR Architecture. Newly generated requirements documents oftentimes fail to address integration because the operational community assumes the info structure, data links, ground stations, processing capabilities, warfighting skill sets, and so on will naturally be available.

HQ USAF/XOW

XOW reviews the MNS, ORD/ICD/CCD/CPD, and AoA to ensure that sensitivities and aerospace environmental support are adequately addressed.

Air Force Studies and Analysis Agency (AFSAA)

AFSAA reviews and evaluates the MNS, ORD/ICD/CCD/CPD, and AoA documents as required. AFSAA provides selected AoA support and analytical consultation to the participating operational commands and support agencies throughout the AoA process.

Office of the Secretary of Defense Director of Program Analysis and Evaluation (OSD/DPA&E)

OSD/DPA&E provides guidance to the AoA, reviews ACAT ID AoAs, and advises the DAB on the results. Early OSD/DPA&E involvement in AoAs is essential because they review the operating command's approach and recommendation on the most cost effective alternative. They provide current policy and guidance related to costing, campaign analysis, and selection of alternatives. In their costing role, OSD/DPA&E chairs the OSD CAIG. The CAIG reviews selected program costs (usually ACAT ID programs) and reports the results to the DAB.

Defense Intelligence Agency (DIA)

DIA is the DoD authority for threat intelligence and approves threats and threat laydowns used in study scenarios.

Joint Service AoAs

The USA, USAF, USN, USMC, BMDO, and USSOCOM have signed a Memorandum of Agreement (MOA) for Joint COEA Policies, Procedures, and Responsibilities (COEA, for Cost and Operational Effectiveness Analysis, is an older term for an AoA). This MOA identifies how the services will conduct joint AoAs. The central concept is that the lead-service analysis and oversight processes will apply, but will be augmented with

participation of the other services. Modification of lead service procedures, appointment of study team members and oversight board membership, division of duties and funding, and program-specific methodologies, analysis issues, and guidance will be articulated in the Joint COEA Tasking Directive (JCTD). The JCTD is developed and staffed similarly to the Air Force's PMD; the differences are that JCTD direction is AoA specific and that organizations outside the Air Force are tasked.

The designated lead service provides the study team director, while a sister service provides a study team co-director. Each service supplies study team members based on needs and available technical expertise. A shortage of technical expertise may require contractor participation. Oversight members are also provided by each service. The study team director and co-director develop the JCTD as early as possible after the milestone decision. Initial efforts identify:

?? Service agencies responsible for facilitating the AoA process
?? Service agencies responsible for development of the joint AoA
?? Service program offices responsible for each of the alternatives
?? The OSD/DPA&E contact responsible for the joint AoA

Contract Support for AoAs

Assistance from technical support contractors to conduct substantial parts of the effectiveness and/or cost analysis is frequently necessary. All too often, unfortunately, a contractual arrangement is entered into *before* it is clear what course the AoA will follow. This promotes 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 MAJCOM, and it should not be delegated to the contractor.

Principal considerations for deciding on contract support are:

?? Is there adequate capability already available within the government?
?? 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 are the Air Staff, the operating commands, and existing program offices.

AFMC can provide advice on experienced and qualified contractors through the product center XRs 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 R&D Centers (FFRDCs) 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.

The operating command study team director may brief qualified contractors on the proposed AoA tasks using the initial AoA study plan as a guide. The contractors then provide proposals for the time, costs, and personnel to perform the tasks. If there are no traditional or existing contract vehicles that are suitable, it may be possible to quickly get a

contractor on board through existing flexible Government Services Administration (GSA) contracts.

AFMC contracting office personnel should advise on the scope of work, cost of the contract, and the writing of the statement of work (SOW) or statement of objectives (SOO) for the AoA. AFMC is available to act as the Contracting Office Technical Representative (COTR) to administer the contract.

In summary, if contract support is essential, the AoA study team director should work closely with the appropriate IPTs, the Program Element Monitor (PEM), product center (XR), and program offices to resolve the complex issues of funding, contract vehicles, and other contract administration issues.

4 – The Study Plan

A major step leading to a successful AoA is the creation of a well-considered study plan. The study plan establishes a roadmap of how the analysis must proceed, who is responsible for doing what, and why they are doing it. Time and effort spent on the study plan before beginning the analysis helps to ensure a high quality AoA, on schedule and within budget. By design, the study plan is structured so much of it can be used later directly in the final AoA report. The study plan must be updated—it's a "living document"—throughout the AoA to reflect new information and changing study perceptions and direction.

Study Plan Preparation and Review

Preparation of the study plan is the responsibility of the using command, and the study director has the ultimate responsibility. 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 Air Force study team members should be dedicated to drafting an initial study plan. This has proven to be a valuable step in expediting the AoA process, and also defines the focus and schedule for the AoA study. It also provides an opportunity for the Air Force 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.

Outside review can be solicited from a variety of agencies, including OAS, AF/XIW, AF/XOR, AFMC/DR, AFOTEC/XP (when appropriate), and DPA&E (for ACAT ID and IA programs). If AF corporate review is appropriate, OAS, the AFROCC, AFC, WIPTs, and the OIPT are available for support.

Appendix A of this handbook lists criteria for judging the adequacy of a study plan in 11 areas. OAS works with each AoA to ensure the study plan is satisfactory. For those study plans that are briefed to the AFROCC, OAS provides the AFROCC a formal assessment using these 11 criteria.

Study Plan Organization

Here's a suggested outline for the study plan:

1. Introduction
    1. Background
    2. Purpose
    3. Scope
2. Acquisition Issues
    1. Mission Need
    2. Scenarios
    3. Threats
    4. Environment
    5. Constraints and Assumptions

3. Alternatives
    1. Description of Alternatives
    2. Nonviable Alternatives
    3. Operations Concepts
4. Determination of Effectiveness Measures
    1. Mission Tasks
    2. Measures of Effectiveness
    3. Measures of Performance
5. Effectiveness Analysis
    1. Effectiveness Methodology
    2. Models, Simulations, and Data
    3. Effectiveness Sensitivity Analysis
6. Cost Analysis
    1. Life Cycle Cost Methodology
    2. Models and Data
    3. Cost Risk Methodology
7. Cost-Effectiveness Comparisons
    1. Cost-Effectiveness Methodology and Presentations
    2. Cost-Effectiveness Criteria for Screening Alternatives
8. Organization and Management
    1. Study Team/Organization
    2. AoA Review Process
    3. Schedule

A. Acronyms
B. References
C. Lessons Learned
D. Other Appendices as Necessary

For flexibility and ease of access, it is best to include any classified information in separate classified appendices.

Only the first few sections of the study plan are discussed below; others are considered in subsequent chapters of this handbook.

Background

This section describes the developments that initiated the AoA, summarizes relevant analyses that preceded it, and addresses the MNS, ADM, and PMD for the AoA. It also identifies intended results in general terms and notes any applicable ACTDs.

Purpose

This section identifies major acquisition issues to be studied and the milestone supported by the AoA.

Scope

This section identifies the level (engineering, one-on-one, few-on-few, mission, or campaign) and scope of the planned analysis. It identifies any applicable "tailoring" and "streamlining" and the general nature of possible alternative solutions under consideration. The scope should address the extent and depth of the planned analysis in order to provide relevant information for the decision-makers.

Mission Need

This section describes deficiencies in operational capabilities and required system capabilities. It refers to the MNS and ORD/ICD/CCD/CPD (if an ORD exists) and the timeframe of the mission need.

Tailoring and Streamlining

Every AoA is unique and may afford the option to tailor and/or streamline the AoA process for a given situation. The AoA need not be all things to all people, but its audience and their questions must be kept in mind. By focusing the AoA on the appropriate areas, many resources may be saved. The AoA may also be streamlined by either combining or eliminating steps—for example, by compressing review cycles, eliminating unnecessary mid-term reviews, etc.

Memorandums of Agreement and Understanding (MOAs/MOUs)

The AoA process can be helped by MOAs/MOUs between participants. While the PMD locks in the responsibilities of the AoA participants, this may not be adequate in defining responsibilities. MOAs and MOUs can remedy this situation. They can line up analytic support for the effort, assign parties specific responsibilities, provide evidence of a firm commitment from all players, and help the study director when progress is not smooth.

It is important to execute the MOA or MOU at the time the initial study plan is completed—remember, plan "up front and early."

5 – Preparing for Analysis

In this chapter we discuss some of the major inputs to the analysis: the scenarios and threats, the physical environment, constraints and assumptions, the alternatives, and the operations concepts for the alternatives. The decisions made in each of these areas shape the analysis methodology (or plan) and the execution of that plan. Ideally, these inputs would be fixed before the development of the analysis methodology. Almost universally, however, the inputs and plan are developed in parallel, leading to a convergence of the methodology to its final form over time.

Scenarios and Threats

AoA alternatives must be modeled in realistic operational settings to provide reasonable comparisons of their relative performances. The AoA does this by 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 the intelligence community. MAJCOM intelligence organizations, DIA, and other intelligence organizations support the AoA and provide detailed threat and target information. Involvement with the intelligence community should be sought early in the AoA. Although the STARs (or STAs) are typically available only after MS B, when they become 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 must be identified and explained. The details of these excursions must be approved by DIA after OC/IN and 497 Intelligence Group coordination.

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. 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

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

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—this can drive the selection of scenarios.

These environments reflect both human 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. Conditions caused by humans—jamming and chemical/biological warfare are a few examples—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.

Constraints and Assumptions

In engineering and the physical sciences, many problems are solved subject to specific boundary conditions, or enforced values of physical parameters at spatial boundaries. The analytical analogs of boundary conditions are constraints and assumptions, which affect the nature of the analysis.

Constraints—actual imposed system limitations—can be physical or programmatic. Specifying an operating frequency for a communication system is an example of a physical constraint. Specifying a latest acceptable initial operational capability (IOC) date illustrates a programmatic constraint. Assumptions, in contrast, specify conditions that apply to the analysis. Examples include inclusion of a target type that will proliferate in the future, or forcing consideration of a specific threat system.

Constraints and assumptions 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. Other constraints and assumptions may be dictated in the ADM or other AoA guidance. Regardless of the source, each constraint and assumption must be explicitly identified by the study team, checked for consistency with other constraints and assumptions, and then accounted for in the analysis methodology. Just as with boundary conditions in a physical problem, analysis results may change significantly with changing constraints and assumptions.

Operations Concepts (Details of Employment)

Evaluating both the effectiveness and cost of an alternative requires a significant level of understanding of the operations of the alternative. 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 complexity of the operations concept will vary with the nature of the alternative and the scope of the tasks. An aircraft will have a more complex operations concept than a

munition it carries, and the same munition will have a more complex operations concept than an attack-warning sensor protecting the aircraft.

The following list details many of the potentially appropriate issues an operations concept 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 operations concept to existing CONOPS
- ?? Operations concept feasibility
- ?? Linkage of the operations concept to Air Force doctrine

It is difficult to produce operations concepts for developmental and conceptual systems. 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 operations concepts. It is best to define the requirements for the operations concepts early in the AoA to maximize the available development time.

Selection and Development of Alternatives

There can be no analysis of alternatives unless there are alternatives to consider. Typically, the ORD/ICD/CCD/CPD, ADM and PMD 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 insert yet other 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). Selecting too few or too many are both possibilities, but experience has shown that selecting too many is the greater danger. The goal is to consider a comprehensive set of alternatives representing all reasonable solutions.

The number of alternatives can be controlled by avoiding similar but slightly different alternatives (avoiding variations on a theme) and by early elimination of alternatives for legitimate cause. Legitimate causes are:

- ?? Non-compliance with AoA guidance
- ?? Non-compliance with treaties or other national policy
- ?? Unacceptable high cost
- ?? Unacceptable performance
- ?? Inability to meet IOC/FOC requirements

Evidence for the last three shortcomings may come from previous studies, expert judgment, or early results from the AoA. Because these criteria are open 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 excluding non-viable alternatives.

For the same reason, it is important to document the alternatives well; every alternative in the analysis must be supported by these descriptions. To minimize overstatement of alternative capabilities, all descriptions should be made available to all system advocates for peer review.

A base case is always the first alternative, called Alternative 1. The base case represents the existing, currently programmed system funded and operated according to current plans. The base case offers a yardstick against which to measure the potential improvements provided by the other alternatives.

A second frequently included alternative, called Alternative 2, is based on potential yet unfunded improvements to the base case.

All the alternatives after this 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; these latecomers are generally conceptual solutions based on immature technology and which are still being tuned.

6 – Effectiveness Analysis

Effectiveness analysis is normally the most complex element of the AoA and consumes a significant fraction of AoA resources. The goal of the effectiveness analysis is to determine the military worth of the alternatives in performing mission tasks (MTs). The MTs are derived from the mission needs identified in the MNS. 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

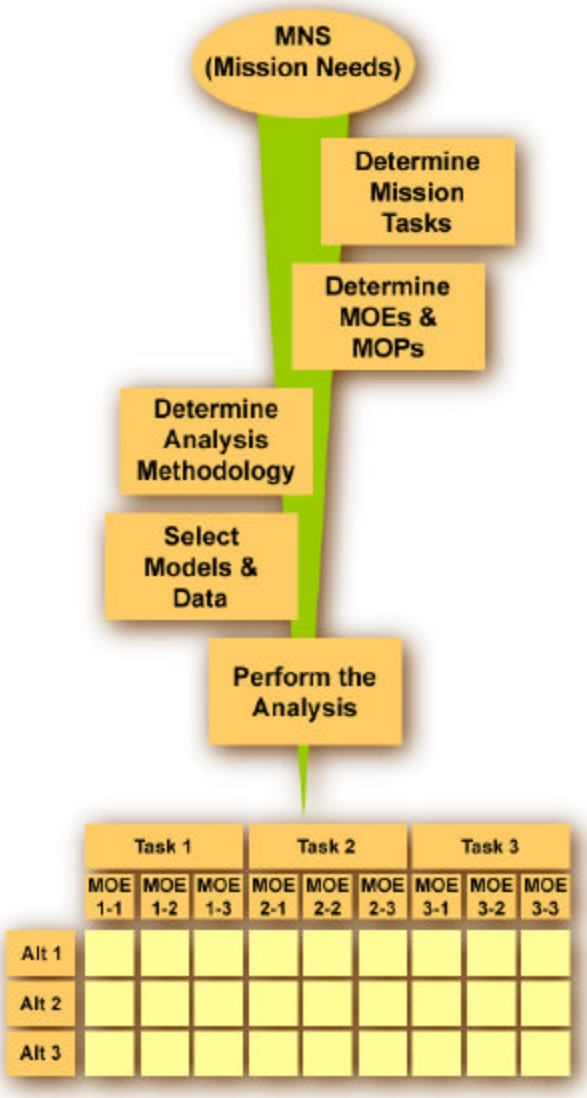


Figure 6.1. General Approach for Effectiveness Analysis

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, and what is necessary to support the AoA decision.

Figure 6.1 shows the flow of analysis tasks discussed in this chapter.

Measuring the Effectiveness of Alternatives

Mission Tasks (MTs)

MTs are derived directly from the deficiencies (mission needs) identified in the MNS. They are usually expressed in terms of general tasks to be performed to correct the deficiencies (e.g., hold targets at risk, provide countermeasures against surface-to-air missiles, or communicate in a jamming environment). The specific nature of the tasks is captured by the MOEs, which are developed to measure success in performing the tasks. Because MTs are tasks, cost is never a MT or an MOE, and cost is never considered in the effectiveness analysis.

All tasks discussed in the MNS should be addressed in the MTs, and only the tasks set forth in the MNS should be addressed by the MTs (barring direction from the ADM or PMD or arising from later oversight of the AoA).

Because the AoA tries to identify the most promising solution(s), MTs must not be stated in solution-specific language. Neither should MTs call for optimizing aspects of a task, because optimizing one aspect of a task usually has unintended impacts on cost or other aspects of task 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.

Measures of Effectiveness (MOEs)

MOEs contain the details of measuring proficiency in performing a task described by an MT. Though the figure above shows three MOEs supporting each MT, in some cases there may be only one or two MOEs to support the MT.

Each alternative is evaluated against each MOE, and the results are used to for comparison among the alternatives. While it is generally not advisable to base the analysis on a single MOE/MT, an extensive number of MOEs/MTs may complicate the analysis and make interpretation of the results more difficult.

MOEs are developed by the operating command with assistance from AFMC, AFOTEC, and others. 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 OSD 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 are quantitative (e.g., "how many targets are held at risk?" or "the number of targets by type that you can hold at risk in daytime and nighttime conditions"); MOEs may be qualitative or subjective, calling on the opinion of a knowledgeable person or group, (e.g., "in your opinion does the solution provide a day-night capability?")

?? Each MOE supports at least one MT and each MT will have at least one MOE supporting it

?? MOEs may support other MOEs as well as MTs; when using hierarchical MOEs, a clear roll-up methodology should be described

?? MOEs must be independent of the nature 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 MOEs only in relation to an MT (no quantity is inherently an MOE)
?? MOEs are often supported by one or more MOPs

Ideally, 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, reduce the information content and may 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.

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 ORD/ICD/CCD/CPD requirements. These results can also be used to investigate the robustness (stability of performance) of alternatives whose defining parameters are subject to significant uncertainty.

Measures of Performance (MOPs)

An MOP is 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 (and possibly other MOPs). MOPs may apply universally to all alternatives or, unlike MOEs, they may be system specific in some instances. MOPs may be directly or indirectly reflected in system performance parameters in the ORD/ICD/CCD/CPD. MOPs and the methodology for evaluating their impact on MOEs frequently help determine ORD/ICD/CCD/CPD requirements. As with MOEs, MOPs should be linked, where possible, to future testing of the alternatives.

Military Worth

The goal of all defense acquisitions is to assist the warfighter. Success at providing assistance 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." For lack of better terms, we will refer to the former as "system worth" and the latter as "military worth." While system worth tells a useful story, military worth has become central to evaluating alternatives in AoAs. Both system and military worth are expressed through MOEs. In this handbook, military worth will refer to a small set of highly significant measures of military performance that are used most frequently at mission and campaign levels. Among these performance measures are:

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

AoAs, especially those employing mission or campaign modeling, should have MOEs relating directly to one or more of these measures. These MOEs will play a leading role in both the effectiveness analysis and the cost-effectiveness comparisons. In the cost-effectiveness comparison, they are typically used to display effectiveness versus cost.

Time to Accomplish High-Level Objectives

The ultimate objective of war is to win. Winning faster means fewer lives lost, less materiel expended, and a lower dollar cost. At a lower level, the time to draw down enemy forces (an air defense system, for example) are potentially significant measures of military worth.

Targets Placed at Risk

Many AoAs examine non-lethal alternatives that improve the lethality of another system. For example, the Global Positioning System (GPS), in providing accurate aircraft positions, has the potential to increase targets placed at risk. A target is at risk when an aircraft arrives undamaged at the weapon release point. Targets at risk are a measure favored by the Electronic Warfare (EW) Partnership.

Targets Negated

Targets negated ("killed") is an obvious measure which introduces complexities not considered in determining targets at risk. Using targets killed requires modeling the interaction of munitions and target, as well as delivery system survivability.

Level of Collateral Damage

For humanitarian and political reasons, there is always concern about the level of collateral damage, both to humans and property, caused by attacking a target. Collateral damage has taken on more importance as military targets have been intentionally integrated into civilian surroundings to deter attack. Estimating collateral damage has become a critical measure for AoAs that examine lethal or lethality-enhancing alternatives.

Friendly Survivors

Some AoAs consider non-lethal, non-lethality-enhancing alternatives. Two examples are the Combat Survivor Evader Locator (CSEL) aircrew survival radio and the Joint Precision Approach and Landing System (JPALS). In such case, military worth may best be measured by the number of "survivors" associated with each alternative in a scenario. For CSEL, an obvious measure is how many downed aircrew members are recovered. For JPALS, the question could be: how many successful landings are achieved?

Number and Types of Resources Consumed

AoAs are often asked to focus on the resources needed to execute the war or accomplish certain missions during the campaign. These resources are many times measured or stated in terms of number of sorties flown, or numbers and types of targets destroyed. AoAs may require determination of the number aircraft lost (attrition rate), the number of bombs dropped, or the number of weapons to defeat a single target. Often the results are limited to a single target or to a phase of the war.

Number of Operating Locations Needed

AoAs are often the first consideration for the methods for using the different types of systems in a deployed or representative operational environment. Therefore an important consideration is for how the impact of the number and dispersement of the numbers and types of operating locations may have in the conduct of operations. This maybe measures in a number of ways, such as the time to engage targets in theater. A specific location at extreme distances will impact sortie generation rates, number of sorties flown, time to engage the adversary, etc. This type of military utility can be applied not only to aircraft operations, but spacecraft operations, supply and logistics systems, communications and intelligence systems.

Impact on C4ISR networks

These measures of military utility are important in this area for it's consideration on the effect on operations that result from use of our Communications, Control, Computers, Intelligence, Surveillance and Reconnaissance assets. What they add to our capability, how they allow us to do or not do specific mission tasks or operations during the conduct of military can be related to this category of military utility.

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, study schedule, and available analysis resources—all the elements of the AoA except cost estimates. The methodology must be systematic and logical. It must be doable, and it must not be biased for or against any alternative. It must also be able to separate the wheat from the chaff (i.e., allow informed decisions). Preparing and executing this methodology is not for the neophyte or the faint of heart.

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. In other words, you have to know what you are doing before you can decide how to do it—and that includes selecting modeling and simulation software to support the AoA. In fact, final software selection must await development of the MTs, MOEs, and selection of the alternatives.

The basic issues shaping the methodology are:

?? Selection of MTs, MOEs, and MOPs
?? Selection of the threats and scenarios
?? Nature of the alternatives
?? Determination of the appropriate level of detail required in the analysis
?? Identification of suitable models and data

OAS also publishes the ***Air Force Analyst's Handbook***. This document describes the nature of analysis and provides a clear description of the basic elements and practices of operational analysis as it's conducted in the Air Force. The document is available from the OAS web site, www.oas.kirtland.af.mil. Use it as an additional source for understanding the analysis way ahead.

Levels of Analysis

In the world of military modeling, levels of effectiveness analysis are characterized by the number and types of alternatives and threat elements modeled. A typical four-level classification is shown in Figure 6.2.

At the base is the engineering analysis performed on individual components of an

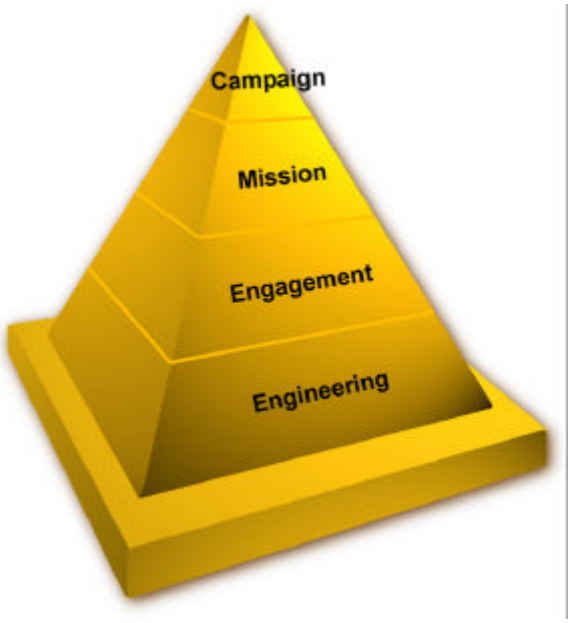


Figure 6.2. Analysis Hierarchy

alternative or threat system. One level up, one-on-one analysis models the interaction between a single element of the alternative and a single threat system. Examples of one-on-one analyses are weapon versus target or aircraft versus aircraft. This level also looks at interactions of larger quantities of the same elements, or "few-on-few." At the top two levels, mission ("many-on-many") and theater/campaign, the analysis becomes very complex involving the modeling of most or all of the forces in a specific, complex scenario.

At each higher level, the focus of the analysis changes, the applicable models change, and the complexity of the analysis changes. Analysis at one level will generally require supporting analysis at the lower levels. While the supporting analysis may come from sources outside the AoA, it will be 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. This said, most ACAT I AoAs would require a minimum of mission/battle level modeling.

Hard vs. Soft Analysis

Analytical techniques can be classified as "hard" or "soft." Hard analytical techniques are based on the ability to describe issues in terms of mathematical relationships that allow the use of quantitative modeling and simulation. Soft techniques rely on judgments based on experience. These judgments are usually made by a group of knowledgeable individuals

designated as "experts."

The list below describes some advantages and disadvantages of both hard and soft analysis.

?? **Hard Analysis**

- ***Advantages***
  - Repeatable
  - Supports parametric analysis
  - Reduces bias
  - Makes existing biases more visible
- ***Disadvantages***
  - Requires significant input data
  - Requires significant time and skill to produce and interpret answers
  - Requires understanding mathematical relationships

?? **Soft Analysis**

- ***Advantages***
  - Provides quick answers
  - Requires little quantitative input data
  - Doesn’t require understanding mathematical relationships
  - Applicable to complex subjective issues
  - Requires roughly the same effort regardless of issue complexity
- ***Disadvantages***
  - Influenced by selection of experts (no guarantee of repeatability)
  - Not well-suited to parametric analysis
  - Variable expertise
  - Experts with narrow or widely-divergent interests
  - May not use best qualified experts (not identified, not available, can’t afford)
  - Results difficult to interpret relative to quantitative goals

The advantages of one technique are often the disadvantages of the other. In general, hard techniques, when practical, are significantly preferable to soft techniques. Exclusive use of soft techniques such as Delphi, Analytical Hierarchy Process (AHP), and Value Focused Thinking in an AoA are justifiable only when the suitable input data, time, or funds to carry out a quantitative analysis are lacking.

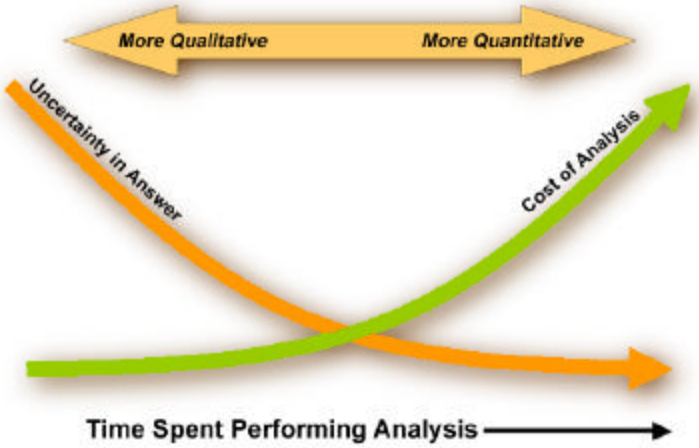


Figure 6.3. Analysis Time vs. Results

Figure 6.3 illustrates the perception (reality) that uncertainty in the analysis results is inversely related to the level of effort. The bottom line: while experience can be invaluable, it is nearly impossible for humans to consider accurately the simultaneous interactions of multiple complex factors. That experience is better used to shape the mathematical model of the interactions.

As a practical example, do you want the crash safety features of your car determined by experts based solely on their experience? Or would you rather have their experience used to interpret modeling and testing of competing options? Now, imagine yourself as a decision maker and ask yourself a similar question about the AoA results you are judging.

Selection of Models and Data

Models and simulations (collectively referred to as models for this discussion) are idealized representations of reality. They 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. Whatever their complexity or form, however, there comes a point when the AoA team must decide which ones to use to generate comparisons of the alternatives.

The first rule of model selection is: Select models that deliver what is needed. Breaking this rule for convenience (for example, because of easy accessibility to a particular model) may result in the wrong issues being investigated and the wrong alternatives being identified. What is needed is defined primarily by the MOEs. Once the MOEs are known, the necessary level(s) of analysis, engineering through campaign, can be identified and a search can be conducted for models suitable for MOE calculations.

The search for models considers:

?? Model inputs and outputs
?? Who is available to run the model
?? Data availability and quality
?? What vehicles are available to fund running the model

?? Whether or not the model can support the projected volume of runs within time and funding constraints

?? What level of acceptance the model has in the analysis community

Model inputs come from all aspects of the AoA: threats and scenarios, alternative definitions, operations concepts, constraints and assumptions, etc. Inputs are also derived from the outputs of other models. Before selecting a model, the sources of all inputs should be identifiable. Model outputs help determine a model's suitability to calculate MOEs and their supporting MOPs.

Before settling on a final integrated set of models, one must have "proof" that the set is sufficient for the AoA; this "proof" can be obtained by constructing a linkage diagram. Such a figure shows the source of every MOP and MOE value and is a system level diagram of how the models are supposed to work together. Like the diagrams of the space shuttle or other complicated piece of equipment, no single person has an "in-depth" understanding of all the pieces. However, it does show how the pieces are expected to fit together and what signals or information should be handed-off between them. Since models are often extremely complicated and rarely can one individual know the detailed workings of all the models (or perhaps even one or two), it is critical that a team approach be used. A review of the linkage diagram should also ensure that a common set of assumptions is made across the models.

Experienced, competent analysts must run every model. Experienced analysts are the best guarantee of obtaining reliable, consistent results. Unfortunately, experienced analysts are in limited supply; this shortage is even more severe for the complex models. Availability of analysts will impact model support options, specifically the choice of a support agency or contractor. This choice may be further limited by sources of funding and available contracting vehicles. It is unusual for an AoA to be both funded and have a schedule able to accommodate competitive bidding for technical support.

Every model requires time and effort to set up and run: a particular model should be selected only if the resources are available to perform all necessary runs in a timely manner. Unfortunately, early in the AoA an accurate judgment of tasks versus resources is difficult to make; there are no clouds on the horizon and optimism reigns. Reality intrudes only later when input data are late or unavailable, when previously unidentified bugs are found in the software, or when the model expert retires. As undesirable as it is, it is not unusual for the scope of the analysis to be reduced due to such problems.

The last area of consideration is model acceptance. Does the analysis community deem the model suitable for the intended usage? If not, is it reasonable to believe that the model can be accredited for that usage? If the model is a legacy model used in an accepted way, the answer will be easy. If not, the analysis community may need to be convinced of the appropriateness of the proposed usage. Regardless, accreditation (vv&A) must be performed for each model.

When suitable existing models cannot be found, either old models must be modified or new models must be developed. Because of the need to find funds for this work and the likelihood of delays, these are options of last resort.

AFMC product centers, as well as other analysis agencies and modeling centers, can provide modeling and data support. OAS can provide advice related to appropriate models and data to the operating commands.

Due to its enduring value in the analysis and in the system's continuing development, testing and operation, the use of contractor proprietary models and databases is strongly discouraged.

Legacy Model Toolkit and Pedigreed Data Bases

USAF/XIW has defined a standard Air Force modeling and simulation toolkit that contains 18 legacy models. The purpose of the toolkit is to meet the needs of the analysis community while minimizing the costs of model proliferation. The toolkit models all have a long history of use (lending them credibility) and they are assumed to be verified and validated for uses consistent with their history. The toolkit model managers are asked to provide a standard version of the model and a corresponding "pedigreed" database. They are also expected to work with system program offices (SPOs) to ensure that current and new weapons systems are represented accurately in their models. Any study that uses a model not in the toolkit will need to justify that use.

Engineering level models are beyond the scope of the toolkit. The Air Force recognizes that these are so specific in application and so numerous as to preclude tracking and controlling them in a centralized manner.

XIW has a plan to transition from the toolkit to the next generation models: JMASS, JWARS, and JSIMS. Before transitioning, each next generation model will have to demonstrate the functionality of all of the models it is replacing.

Selecting and Evaluating Individual Models for the Accreditation Process

As AoAs expand the use of M&S to reduce risk and resources expended in the acquisition process, there is an increasing need to ensure the credibility of models and simulations, including input data. As a result, DoD and Air Force regulations now require that software and data be accredited for each major acquisition. This section presents a practical and affordable approach to VV&A. Model verification is the process of determining that the model accurately represents the model developer's conceptual description and specification. Model validation is the process of determining the extent to which the model is an accurate representation of the real world with respect to its intended uses. 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 validated to ensure credibility of the output. If a model has undergone prior V&V that will satisfy the plan developed for the AoA, the results of the prior effort can be used in the accreditation of the model. A review of the V&V results will support the accreditation recommendation. Typically, the accreditation process uses a categorical grading scheme to describe suitability. An example of a categorical suitability range would be:

?? Use
?? Use with limitations
?? Conduct additional V&V
?? Additional model development needed
?? Do not use

The accreditation report contains the V&V plan, a description of the accreditation process, and the accreditation recommendation. The report is sent to the accreditation authority (usually the DR of the AoA lead MAJCOM) for approval. The accreditation report is included as an appendix to the AoA final report. As with models, data should be subjected to a formal VV&A process. Developing a validated database for the AoA does this. Performance data must be

technically and operationally validated by engineering assessments or performance tests. Additionally, current tactical and employment doctrine must be reflected in the database. Collection, validation, and maintenance of the AoA database are the responsibility of the operating command. Any organization creating, maintaining, using, and disseminating cost or effectiveness data must ensure the reliability of the data for their intended use. The cost data selected to support the AoA should be accredited by the responsible costing agency. The Defense Intelligence Agency (DIA) should validate the threat data. Data is a long lead item—start the collection process early. The accreditation report will identify model strengths and weaknesses, as well as describe the MOEs analyzed by the model. Each model will be analyzed independently using assessment criteria and rating scales similar to those in the table (next page). Although still primarily qualitative in nature, such criteria help to quantify the confidence assessment. The first four criteria are assessment drivers. That is, a "red" in any of these four areas should warn the accreditation authority that the credibility of the model for this use is questionable. The accreditation report should, at a minimum, address the following:

?? Specify M&S reference version number, plus all hardware and software identification or version numbers used in supplying inputs
?? Identify model input data suppliers
?? Identify key V&V planning, technical review, and implementation participants or organizations and their V&V responsibilities
?? Describe V&V methodologies, implementations, and their results
?? Describe verification, validation, and certification (VV&C) activities performed on input data sets used in V&V activities
?? Identify V&V criteria (MOEs/MOPs)
?? Describe additional model strengths, weaknesses, or limitations identified as a result of the V&V activity, with recommended remedial actions

OAS personnel are available to help AoA teams develop the accreditation recommendation report.

Criteria	Rating Scale
Risk	
Input Data	
Critical Elements Modeled	
User Experience	
History	
Configuration Management	
Documentation	
User Community	
Prior V&V	

Table 6-1. Tools for Evaluating Individual Models

Model Selection and Accreditation

In this chapter we discuss some of the logical steps to be used in the selection and accreditation of model(s) to be used in your analysis. By accreditation we mean the formal process whereby a panel of Modeling and Simulation (M&S) professionals review the Models and associated Architectures to insure the analysis plan is complete and workable. This is not to say that we Validate, Verify, and Accredit (VV&A) all of the models to be used in the study. There is not enough time for such an undertaking. Actual VV&A for any model is a long, expensive process whereby rigorous methods are used to ensure the model provides valid output data that simulates the real world. Our accreditation effort is meant to show the analysis community that the "Tools" we are using are of acceptable fidelity and that this fact is documented. This gives credibility to the AoA and documents the risk that has been identified concerning the analysis. The key issues here are that during the AoA process, we evaluate the selected models to ensure that they will provide quality output data to the decision makers for use in the evaluation of alternatives process and, more importantly, that foreseeable problems are identified early in the analysis process so those issues can be resolved or steps taken to mitigate risk. For the simplest case, this may mean accrediting only one or two models. However, in most cases, you may be using ten or more models that must interact with one another. Careful planning is required to ensure that models selected for accreditation are of acceptable quality and are compatible with one another in the overall architecture (e.g. model linkages, correct level of fidelity, etc…) of the analysis plan. We must always keep in mind what questions we want the analysis to answer and which Measures of Effectiveness and Measures of performance (MOE's/MOP's) need to be measured. Each AoA will have its own analysis requirements and therefore its own model requirements, but the following can be used as an overall guide for such an effort.

Model Selection

As is the case with most things in the world of Modeling and Simulation, there are many ways to acquire models for use in an AoA. Before selecting models for an AoA we must first define exactly what we are studying. It is only after the required output is defined can we proceed with model section.

The first, and possibly the most inexpensive way to acquire models is to use well-known and previously accredited models found in the Air Force's Standard Analysis Tool Kit. These models have been used in numerous studies and have extensive documentation and a functioning user's group for support. Also, these models, used with a pedigreed database should provide the analyst with a high quality output with little or no additional programming. However, the questions that must be answered before deciding to use Tool Kit Models (or any model) are: can we provide the correct input data and does the model produce the correct output for our needs? The output must be able to either stand alone if that is the study plan, or be able to feed into the next model with little or no off-line manipulation (or have such required processing explicitly understood and prepared for). Only by having the modelers talking among themselves early on and often in the selection process regarding how they fit into the analysis can we be assured of correct and adequate linkage between the models involved.

A second way to acquire models for an AoA is to use a model that is currently not accredited for the use you intend to put it to or that you will modify to fit your needs. Both of these options may incur more costs than using an off the shelf model already accepted by the analysis community. Also, additional risk will be introduced into the analysis in that the model(s) will have to be closely looked at for such things as fidelity, functionality, and methodology. In other words, will the model really do what we want it to?

The third way that we can acquire a model for an AoA is to build one (or more) from scratch. Obviously this is the most expensive and time consuming of the three options. Risk is increased in that we now must ask, can we produce a model(s) in a timely manner, within cost constraints, and will it do what we want it to?

Which of the three model acquisition options (or combination) we choose will ultimately depend on the availability of appropriate models within the M&S community. A thorough search by the Model Selection Working Group (MSWG), usually a subset of the Effectiveness Analysis WG, will begin this process. Selection should begin in earnest after the overall analysis architecture has been defined. This overall analysis architecture, in concert with the Concepts of Operations (CONOPS) documents (as well as with the Concepts of Employment (CONEMPS) documents that will be created once alternatives have crystallized), will dictate what type and number of models (engineering, campaign, etc.) you will need, how they must link, and exactly what they must produce as output. This is sometimes called a Design of Experiments (DOE), though that term is discouraged because that term actually means something different in non-AoA analysis circles. Again, at least one must directly address each Measure of Effectiveness and Measure of Performance defined in the study plan. It is only after you satisfied this association would you have produced a functioning, linked, overall model architecture. At this point you can say initial model selection is complete and you are now ready for formal review and accreditation by the selected Accreditation Panel.

All models should be accredited prior to the start of the analysis. Even though a model has been previously validated and used in prior studies, it must be looked at in terms of how it is to be currently used and linked in this study to other models within the overall model/analysis architecture. Past model usage and/or inclusion in the Analyst Tool Kit does not imply that the model is appropriate for use in the current analysis. Such things as data input, scenarios, model output, model linkages, and overall rigor are different for each analysis and must be evaluated in light of current requirements. Therefore, all models included in the analysis model architecture, and their linkages, must be reviewed by the accreditation team during the formal AoA validation process.

Accreditation Panel

The formal Accreditation Panel is appointed by the AoA Study Director to review and evaluate the models selected by the MSWG and insures that they will function as a unit to produce the desired quality and quantity of output for the planned AoA analysis. The panel is normally comprised of experts from within the Air Force and Contractor communities that have an extensive background in M&S, or specific knowledge related to the AoA subject matter (or both). Some or all of the members present may be identified as voting members. This means they will be called upon to cast a vote as to whether or not a model is suitable for the AoA based on a predefined set of criteria. There should be approximately 5 to 10 voting members on the panel. Any more would be hard to manage, any less would not

provide for a broad base of experience. The non-voting members on the panel are present strictly in an advisory capacity. All voting members must have a broad background in Modeling and Simulation since their task is to evaluate the suitability and capabilities of models proposed by the MSWG. Non-voting, subject matter experts can provide information as needed to explain technical, non-M&S questions. This is particularly important when the Accreditation Panel discusses the individual models and associated linkages with the modelers on a face-to-face basis.

One of the first tasks that the panel must perform is to agree upon the set of criteria with which all of the models will be judged. There is no set group of criteria established for all AoAs. Each Study Director must decide what criteria are important in his mind. Examples of possible critical criteria are:

Functionality - The model construct adequately portrays the required natural environment, behavior, and system capabilities.
Fidelity - The model output provides appropriate levels of detail/granularity to gain sound analytical insights in the definition of the system and discriminating between alternatives.
Methodology - The planned analysis process is complete in light f the model's application and use.
Input Data - What is the quality/pedigree of acquired data.
Linkage The technical and contextual interface between processes to include overall architecture.
Some criteria may be important, but not critical. Some examples are:
User experience - Assess the modeler's experience, credibility, and capabilities.
Prior Model VV&A - Model's development history, past applications and accreditations.
Documentation/support - What documentation exists? Is there an active user's group? User's guide? Programmer/Analyst's guide?
Configuration Management - Does a formal CM board exist? Is there any CM ongoing with the model?

It would be against these types of criteria that the voting members of the panel would judge the models and linkages. The scoring process and procedures are up to the Accreditation Panel to define; however, they should be designed to impart information on the risk assumed if the models are used. Processes have used the stoplight red, yellow, green scheme, and some have used a more useful scheme which considers poor, fair, good, or very good gradations. All scales have their own plusses and minuses – the idea should always be to identify risk, not obscure or bury it. The accreditation process should be more a tool for the Study Lead to identify and resolve problems and mitigate risk than it is a box to check on a requirements list! Then, based upon an agreed upon bean counting scheme, the votes would be tallied and an overall score would be assigned to the model. One approach to this count would be to try and achieve a unanimous vote on each criterion. If this were not possible, then it would be prudent to list the number of, and reason for, all dissenting votes for each critical criterion. Also, if a model were judged to be lacking as the result of critical criteria, changes would have to be made to the model, or to its care and feeding, to provide for a better score on those criteria (to be voted on when the changes are made, or be included in the final report under sections that deal with analysis confidence and risk mitigation).

The overall score for each model and for their linkages would be shown on a "Stoplight" type chart (Table 6-2) with each criterion and model's overall score displayed as a color (in this example, red, yellow, green). Good and Very Good scores would rate a green color assignment which indicates the model can be basically used "as is" in the analysis. Fair would rate a yellow and require additional work on the model if the cause of the yellow was the result of critical criteria. Poor would merit a red color assignment. This would indicate the model, in its current form, is unsuitable for use in the analysis. This type of chart is very useful as an overview chart showing the status of the overall analysis plan when the results of the Accreditation Panel are briefed to the various stakeholders. It is the primary task of the Accreditation Panel to show the M&S approach is sound and risk has been mitigated to greatest extent possible. In all cases, OAS is available to help in setting up and conducting Accreditation Panels. OAS has the separate responsibility to report to the AFROCC on the soundness of AoA analysis, so getting OAS involved early in the process could save time and headaches for those involved from the aspects of both helping organize the accreditation team based on experience in past AoAs and also from the aspect of knowing what the AFROCC expectations are.

Table 6-2. Linkages of Models and Effect on Accreditation Recommendation

	Criteria 1	Criteria 2	Criteria 3	Criteria 4	Etc. *	Total
		Very Good				
	Very Good			Very Good		
				Very Good		
						Fair
			Very Good			
	Very Good					
		Very Good				
(Other)					*	

Accreditation Timing

Model accreditation should be accomplished before analysis for the AoA has begun. Many times problems surface during the accreditation process that are not otherwise evident. Careful screening of candidate models must be accomplished before the analysis plan is formulated to ensure only the most applicable models are selected for inclusion. It is only after the Concept of Operations and overall analysis architecture are defined can we say that we need a model(s) that can produce a certain output. Therefore it would be premature to call together an Accreditation Panel with only a list of loosely connected models identified and no idea as to how they will have to interface. The modelers for the

selected models must get together and decide how their models must interface to produce the desired results. Individual model linkages must be addressed and defined and the overall architecture with MOE and MOP connections displayed. Also, a vehicle should be in place that allows Accreditation Panel members to review documents describing all candidate models and ask questions of the modelers prior to the accreditation meeting. This will insure that most of the obvious questions have been asked (and answered) prior to the panel members interviewing the modelers face-to-face. Ideally, it should be a face-to-face meeting between the modelers and panel members during the accreditation process. It is much easier to visualize model characteristics with the use of graphics than just a voice on the phone. Likewise, it is easier for the modelers to answer questions with the help of such visual aids.

The Accreditation Panel is required to produce an Accreditation Report at the conclusion of its activities. The Accreditation Authority, usually the lead command's DR, is required to sign off on this report. It is encouraged that another look be taken by the Accreditation Panel at the analysis plan and how it actually worked about 2/3 of the way through the AoA in order to get an idea of risk actually encountered. Often this is referred to as a Phase II Risk Assessment (and the original report would be the Phase I Accreditation Report). This Phase II activity is done as a way to take a step back from the analysis and take another big picture look at the risks being incurred, hopefully in time to redirect efforts into thus identified required areas, if necessary (for risk mitigation, or perhaps to answer "newer" important questions that have come up). This Phase II may have an associated formal report, or it could just be an input into the AoA Final Report, at the discretion of the Study Lead or other leadership directive.

Conducting The Analysis

Analysis Team Leadership

Choosing the leader of the analysis team may be the most critical choice made by the study team leader. Ideally, the candidate will be an experienced analyst possessing creativity, management and organizational skills, and able to work well with people having disparate backgrounds, interests, and prejudices. Unfortunately, few meet all these criteria. Thus, the study team leader must be flexible, considering contractor leadership or shared government and contractor leadership for the analysis. For similar reasons, contractor personnel may also make up a significant proportion of the analysis team.

Technology Advocates

Frequently, technologies are incorporated into system designs of alternatives before the analysis methodology (especially definition of MTs and MOEs) is complete. As a result, it may be necessary to revise the original alternative designs as the methodology matures. To ensure the refinements to the alternatives reflect the best performance the technology can provide, every alternative needs an enthusiastic advocate to make the necessary adjustments.

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.

Dealing with Contentious Issues

As a practical matter, decisions on controversial issues must have buy-in from everyone. This may frequently be obtained through compromise or by adding "excursions" to the planned set of options to be examined. Avoid trying to formulate these solutions in a large group. If possible, have potential solutions in hand, ready for consideration. If a solution cannot be agreed upon quickly, allow the pros and cons of different points of view to be raised, then cut off discussion and return to the issue later. Groups are far better at solving problems at lunch or during breaks than in the formal setting of a meeting.

Presenting the Effectiveness Results

Effectiveness results need to be clearly and succinctly packaged, and their presentation must minimize opportunities to mislead. The basic effectiveness results are the MOE evaluations for each alternative. These results do not consider cost and are therefore intermediate results. However, the effectiveness results should still be presented because they have not been sullied by interpretation and because they are usually the most easily understood—hence most easily questioned—results you have to present.

Rolling Up the Results

Once the MOE evaluations have been presented, it may also make sense to "roll up" these results. Rolling up results describes any process that aggregates results for individual alternatives. A roll up allows comparing the alternatives using a smaller number of measures. The advantage of having a smaller number of measures carries the obvious disadvantage: information, and along with it potential insight, is lost in the roll up process. Aggregation is acceptable only when the rationale for doing it is sound. This means:

- ?? The aggregation arises naturally from relationships among the MOEs
- ?? The significance of the aggregates is clear
- ?? The aggregates tell a clearer story than the individual MOEs

These are difficult criteria to meet, but nothing less makes good sense. The message is: don't aggregate just to aggregate.

Weighting MOEs

In the roll up process, a frequent issue is whether or not to weight the MOEs. Weighting assigns different values (weights) to different MOEs. It is a seductive idea: clearly not all MOEs are created equal. A difficulty with weighting, however, is that an analyst's weights may not be a decision maker's weights. By weighting, the analyst is proclaiming judgment superior to that of the decision maker.

Weighting is strongly discouraged. Almost invariably, weighting is an attempt, conscious or otherwise, to avoid thinking through alternative methods of presenting the results in a clearer manner. Better presentations almost always can be found; take the time to look for them.

7 – Cost Analysis

A cost analysis is performed in parallel with the operational effectiveness analysis. It is equal in importance in the overall AoA decision process. It estimates the total life cycle cost (LCC) of each alternative and its results are combined with the results of the effectiveness analysis to identify the alternative(s) that represent the best Air Force or joint 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 disposal at end of system life. It does not include sunk costs (money already spent) that do not affect the decision. Sunk costs may be of interest to decision makers, however, 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.

LCC Elements

Research and Development Cost

The costs of all R&D phases—concept and 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 supporting R&D efforts.

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.

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 manpower office. For more information, refer to the OSD Cost Analysis Improvement Group's *Operations and Support Cost Estimating Guide*, May 1992.

Disposal Cost

Disposal cost is the cost of getting rid of 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.

Cost Analysis Responsibility

The operating command financial management office is responsible for conducting the AoA cost analysis, and they will normally chair the Cost Working Group (CWG). The CWG should include representatives from specific operating and implementing command organizations with expertise in cost analysis and knowledge of the system alternatives. A logistics analyst on the CWG can assess the cost implications of logistics support approaches. OAS will sit on the CWG to assist and advise the operating command financial management team. AFCAA will attend the kick-off meeting to provide overall costing guidance, and may conduct a sufficiency review of each ACAT I AoA estimate. Typically, the CWG will be responsible for the following cost analysis tasks:

- ?? Developing appropriate costing ground rules and assumptions and ensuring they are consistent with effectiveness ground rules and assumptions
- ?? Defining the Work Breakdown Structure (WBS) to be used in the cost analysis; the WBS is a hierarchical organization of the items to be costed
- ?? Determining availability of models and data necessary for the cost analysis
- ?? Defining the logistics elements necessary for the cost analysis
- ?? Providing LCC estimates for the baseline system and each alternative
- ?? Sufficiently documenting the cost analysis so that a qualified cost analyst can reconstruct the estimate using only the documentation and references provided in the final AoA report
- ?? Reviewing estimates to ensure the methodology and the ground rules and assumptions are consistent and the LCC estimate is complete (i.e., all relevant costs are included and all programmatic, technical, and schedule issues are addressed)
- ?? Bounding all LCC point estimates with uncertainty ranges
- ?? Including programmatic data in the LCC analyses, such as quantities and delivery schedules (when known)
- ?? Identifying cost drivers (those elements to which LCC is most sensitive) and performing sensitivity analyses on significant cost drivers
- ?? Providing funding and affordability constraints and specifying any limitations imposed by schedule
- ?? Providing necessary cost data to implement Cost as an Independent Variable (CAIV) strategy to arrive at an affordable balance among cost, performance, and schedule
- ?? Presenting 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; identifying the appropriate inflation indices used (normally the most current OSD indices published on the SAF/FMC web page)
- ?? Where possible, separately identifying sunk costs for each alternative
- ?? Addressing manpower implications for each alternative in the O&S costing, including contract support where applicable
- ?? Addressing appropriate environmental regulations, treaties, etc., in determining disposal costs
- ?? Addressing sources that are driving cost risk and uncertainty for each alternative
- ?? Consulting with OAS on the latest guidance related to the AoA report format for cost

Table 7.1. Cost Responsibility Matrix

	OC/FM	OAS	AFCAA	SPO 1, Product Center	SPO 2, Product Center	Logistics Center
Develop ground rules and assumptions						
Develop WBS						
Develop/review cost methodology						
Identify cost models and data sources						
Write cost section of study plan						
Provide data requirements to other working groups						
Develop, amend, and document LCC						
Identify cost drivers						
Identify phase-in and steady state periods and quantities						
Assess AoA milestone schedules						
Perform cost and schedule risk analysis						
Perform sensitivity analysis						
Time phase estimates, convert to TY$						
Analyze cost results						
Write cost section of AoA report						
Prepare cost briefings for reviews						
Provide guidance, conduct sufficiency reviews						

Table 7.1 shows a notional "cost responsibility matrix" which may be useful to assign and track CWG tasking. Specific responsibilities will vary with each AoA.

LCC 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 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. 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, a preliminary list of ground rules and assumptions should address the following:

- ?? Cost basis of the estimate (specified 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, etc.)
- ?? Basing, logistics, and maintenance concepts
- ?? MILCON & intelligence support requirements
- ?? Environmental cost considerations
- ?? Personnel requirements and constraints
- ?? Affordability constraints

Work Breakdown Structure

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. Here's a notional WBS for an aircraft system; it illustrates the typical elements found at the first three WBS levels (succeeding levels contain greater detail).

- ?? **Aircraft System**
  - o Air Vehicle
    - ✍ Airframe
    - ✍ Propulsion
    - ✍ Air Vehicle Software
    - ✍ Armament
    - ✍ Weapons Delivery
    - ✍ etc.
  - o Systems Engineering & program Management
    - ✍ *(no Level 3 breakdown)*
  - o System Test & Evaluation (T&E)
    - ✍ Development T&E
    - ✍ Operational T&E
    - ✍ T&E Support
    - ✍ Test Facilities
  - o Training
    - ✍ Equipment
    - ✍ Services
    - ✍ Facilities
  - o 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 each WBS element and the LCC estimates developed for each alternative. AoA alternatives are not normally estimated below WBS Level 3.

For a complete WBS, consult MIL-HDBK 881B, 2 January 1998.

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 is performed at a detailed level of the WBS. 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—the modeled processes must be well understood—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). Usually less detail is required for this approach than for other methods. 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 (for example, training costs might be estimated as 20% 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.

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, often as a cost range rather than as a discrete point estimate.

Cost Models and Data

Cost models incorporating these three methodologies are available to help the cost analyst derive the LCC estimates. The LCC databases used in these models should be accredited by the responsible agencies. The models and data intended for use in the AoA should be identified and described in the study plan. For a list of models thoroughly tested in the weapons development and O&S communities, contact the Air Force Cost Analysis Agency (AFCAA).

Cost Presentations

The format illustrated here is typically used to display the AoA cost analysis results; it allows the costs to be directly compared. This format should be used to present both BY$

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

General LCC Summary (All Alternatives)

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

Cost Documentation

	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						

General LCC Summary (By Alternative)

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 lack credibility. Chapter 3 of Air Force Instruction (AFI) 65-508 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.

Cost Reviews

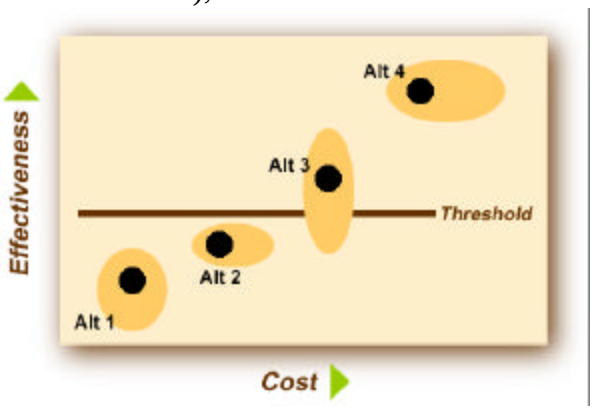
The CWG and AoA study team review the cost estimates for consistency and completeness. OAS also reviews the cost section of the study plan and the final results as part of the overall AoA assessment they provide to the AFROCC. For ACAT I AoAs, the AFCAA will perform a cost sufficiency review for all viable alternatives. These sufficiency reviews assess the completeness, reasonableness, and consistency of the estimates and provide a confidence rating for the estimate; they also highlight any problem areas. For these reasons, it is strongly recommended that the study director request a sufficiency review of the AoA estimates.

8 – Cost-Effectiveness Comparisons

Cost-effectiveness comparisons simultaneously consider alternatives' cost and effectiveness. As consumers, we are all familiar with the concept of cost-effectiveness. Whether buying laundry detergent, a new car, or a home, we collect data on cost and make assessments on how well the alternatives will meet our needs (how "effective" they are). With data in hand, we make our comparisons and select a winner. In an AoA the process is essentially the same, although usually more formal.

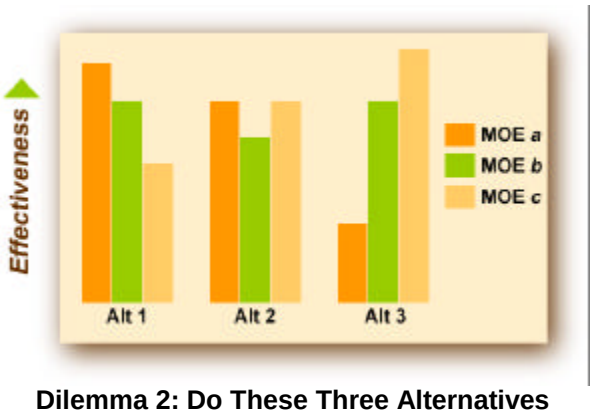
While this kind of cost-effectiveness "analysis" is quite sensible, from experience we are also aware that it has difficulty in addressing some items: the need to determine if additional effectiveness is worth additional cost and the need to assess the relative values ("weights") of different measures of effectiveness. The first of these problems, or dilemmas, are illustrated here:

From the diagram of Dilemma 1 we could safely conclude that we would not select Alternative 2, but the issue is not clear for Alternative 3 and Alternative 4. Alternative 3 and Alternative 4 will be chosen if the increase in effectiveness is judged to be worth the cost. The decision may be somewhat easier if there is a minimum acceptable effectiveness threshold (for example, from the ORD); this would allow the use of a number of the MOEs



Dilemma 1: Is the Increase in Effectiveness Worth the Increase in Cost?

that are considered critical to accomplishing the mission tasks. With these MOEs, you may be able to consider the alternatives that meet or exceed all of the critical MOEs as the final step leading to selecting the preferred alternative. However, the threshold may be exceeded by more than one alternative as illustrated, and having a threshold does not eliminate the option of "buying nothing" if all alternatives meeting the threshold are deemed too costly.



Dilemma 2: Do These Three Alternatives Really Have Significant Differences in Overall Effectiveness?

The next figure shows the second type of dilemma. In this illustration, if the MOEs have equal weight, there is little to differentiate among the choices. If, on the other hand, they are not weighted equally, then the three alternatives may differ substantially in overall effectiveness. The question is, "Who makes the judgment?"

The decision maker should be making the judgment concerning the important aspects of the analysis, not the analysts.

In this case we may solve the problem by asking the decision makers to provide the weighting for the MOEs, identifying the important ones with higher weights. Often, however decision makers are reluctant to provide these weighted values until the final results are known, choosing to apply the weight themselves rather than allowing the analyst to apply the weighting. To aid this process, the analyst should show the raw values for the MOE results, without weighting; this would remove any question of biasing the results for any alternative, and allow the decision maker to do the weighting.

The error bands representing the uncertainty of the point estimates for cost and effectiveness complicate the issue even further. In the diagram of Dilemma 1, for example, the error band surrounding Alternative 3 indicates that it may not achieve the effectiveness threshold when the uncertainty of the estimate is considered. Similarly, Alternative 4's costs may be even greater than the point estimate indicates. Often when these uncertainties are considered the differences in cost and effectiveness may be substantially reduced or eliminated, making it even more difficult to differentiate between alternatives. This is particularly true for an AoA I, when estimates of cost and effectiveness have the most uncertainty.

In this chapter we focus on the cost-effectiveness comparison process, what it should and shouldn't be, and how to make sense of it. Our guiding principle will be that the one and only goal of the process is to identify the most promising candidates for consideration by decision makers.

Equal Effectiveness or Equal Cost?

Equal Effectiveness

Cost-effectiveness comparisons are made most easily if all alternatives are configured to produce equal effectiveness. The analysis is then reduced to a simple cost comparison.

Unfortunately, equal effectiveness is usually difficult—if not impossible—to define because of the number and complexity of AoA issues.

For example, suppose an AoA is comparing alternative munitions effectiveness against a class of targets. We might propose equal effectiveness means killing a fixed percentage of the targets in a fixed time. While this may sound reasonable, it raises questions:

- ?? What if some munitions require more sorties to meet the goal than the force can generate?
- ?? What if the delivery of the different types of munitions results in significantly different aircraft attrition rates?
- ?? What if the delivery of the different types of munitions results in differing rates of kill of other targets in theater due to a shift of resources?

Almost surely, all these or other significant "what ifs" will arise and erase any perception of equal effectiveness.

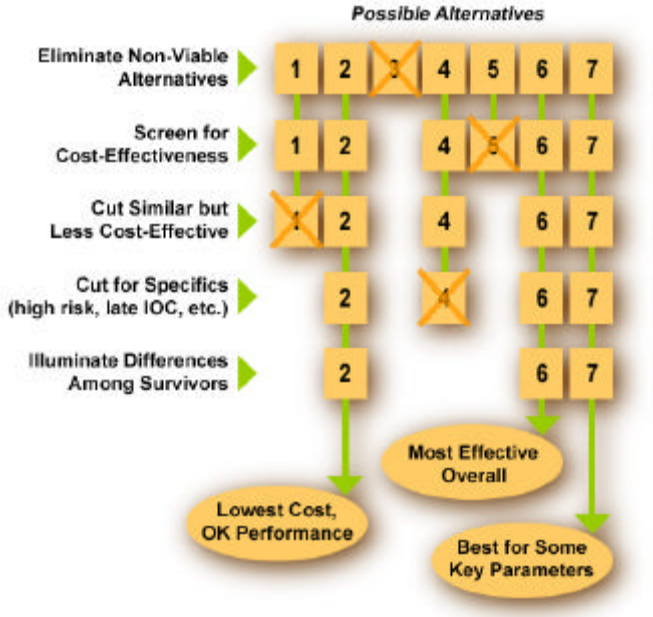
Equal Cost

An alternative to the equal effectiveness approach is the equal cost approach. In this instance, a straightforward comparison of alternatives is possible because all alternatives are designed with equal cost. In general, however, this is as difficult to implement as equal effectiveness.

We can see this using the same goal proposed for the equal effectiveness discussion: killing a class of targets in theater. We will assume that it is possible to set a fixed value for life cycle cost and calculate the number of munitions bought for each alternative based on this value. Unfortunately, we have to face "what ifs" similar to those raised in the equal effectiveness case.

Effectiveness vs. Cost

The obvious alternative to the generally unattainable equal effectiveness or equal cost ideal is a scatter plot of effectiveness versus cost (or vise versa) as in Dilemma 1. As we have implied, however, this seldom gives an unambiguous answer. Worse, it implies that Dilemma 2 has been solved and effectiveness has been successfully reduced to a single



An Example of the Art of Eliminating Alternatives in an AoA

number through weighting—a practice we strongly discourage. So what do we do?

The figure below suggests typical procedures an AoA might use to reduce the original set of potential alternatives to a small set of viable alternatives for decision makers to consider. In some cases the reduced set will contain only a single alternative. In other cases, there will be several alternatives, each with different cost and effectiveness pluses and minuses. Remember: ***there is generally no requirement for an AoA to identify a single most cost-effective solution***.

The Art of Eliminating Alternatives

The figure above 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, and each AoA must adapt its methods to circumstances. A constant, however, is the need to document the reasons and rationale for eliminating each alternative from further consideration. This audit trail may be very important in the event the results of the AoA are questioned later.

In AoAs with few alternatives, all may be carried through to the final assessment. When there are many alternatives, it is often necessary to screen alternatives early to limit the number considered in detail later.

In all analyses, the study team's understanding of the issues and the techniques to deal with them increases as the study progresses. The same is the true for alternatives; especially in an AoA I where many alternatives are poorly understood concepts at the beginning. As

the AoA progresses, these concepts are often reengineered 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.

Non-Viable Alternatives

The first screening eliminates non-viable alternatives, alternatives that do not adhere to the ground rules of the study. You should identify them in the study plan and indicate the reasons for their elimination. Occasionally, a non-viable alternative may be carried forward to provide a reference point. Criteria defining non-viability are frequently defined in the ADM or PMD. They often reflect political considerations: the environment, world opinion, treaty compliance, desired IOC, etc.

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 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 MNS, high level AoA direction, and the experience and expectations of the warfighters. This is a step in an AoA when there is a premium on rational, creative thinking.

Later Screening

As the AoA progresses and more reliable cost and effectiveness 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 two 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 system may be very sensitive to a key parameter, indicating excessive risk in performance; it may go as well.

Final Selection

There comes a time in the AoA when the remaining alternatives all have positive attributes that make them attractive in some way (think of a scatter plot similar to that in Dilemma 1); they are all true contenders. 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 MNS 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 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 told the story, the easier it becomes to understand the differences among the alternatives. Even with all cost and effectiveness 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.

Cost Effectiveness Dos and Don'ts

Sensitivity Analysis

Alternatives whose performance 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. This form of parametric analysis can often reveal strengths and flaws 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. Of course, it is always necessary to balance the amount of sensitivity analysis against its potential value and the available resources.

	MOE Summary									Decision Cost BY94 $(M)
	Critical						Non-Critical			
	MT 1 Air Superiority			MT 2 Supportability			MT 3 Interoperability			
	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										
Alt 2										
Alt 3										

Cost-Effectiveness Matrix

Provide the Basic Cost and Effectiveness Data

The completed AoA should provide basic life cycle cost and MOE effectiveness data for all candidate alternatives that have been analyzed. The table below shows a straightforward format for presentation. By their nature, these data are fundamental to understanding the logic of any additional winnowing of alternatives.

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, right? That sounds significant, but is it...?

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 of any sort.

9 – Final Results

The final results of an AoA are presented initially in a series of briefings. For an ACAT I program, the briefings are typically given to the CPIPT, AFROCC, AFC, OIPT, and DAB.

The purpose of these briefings is to logically present the case for selection of the best alternative(s) in meeting the mission needs in the MNS. 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, is due 180 days after the presentation of the final results. This is an important volume, for 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; team members will begin to disband and critical information will begin to dissipate.

The final report should follow the same format as the study plan (in Chapter 4), with the addition of these sections:

- ?? 5.4 Effectiveness Results
- ?? 6.4 Life Cycle Cost Results
- ?? 7.3 Cost-Effectiveness Comparison Results
- ?? 7.4 Recommendation of Preferred Alternative(s)

This format corresponds closely to that of the study plan to help adapt material from the study plan to the final report.

Criteria for Assessing the Final Results

The criteria used to judge the adequacy of the both the briefings and report are in Appendix B. One of these criteria clearly states that the conclusions of the briefings and report must be supported by the results of the AoA's cost and effectiveness analyses. To this end, throughout this handbook we have strongly supported the need to present the unadulterated individual MOE values and basic life cycle cost results, no matter in what other form this information is presented. This is critical because any rationale and its subsequent conclusions in a briefing (or the report) must be compatible with this basic data.

We have also strongly discouraged the weighting of MOEs and admonished against rolling up data when the roll up does not obviously contribute to a better understanding of the comparison of the alternatives.

Advocacy

It is important to keep in mind that the AoA does not make a decision; it develops information and presents a recommendation. This information is used in conjunction with other significant information to allow the Milestone Decision Authority or other decision maker to make a choice, which may differ, from the recommendation. Thus, it is best if

presenters of the final results advocate the completed AoA process and its results, not a particular solution.

A – Study Plan Assessment

This appendix contains the AoA study plan assessment criteria used by the Technical Review Group (TRG) or OAS in their independent assessment of study plans being presented to the Air Force starting with the AFROCC and to OSD/PA&E. Normally, OAS members, those analysts not directly supporting the AoA, are called upon to read and assess the study plan, review its contents, and evaluate its capability and completeness to support an executable AoA.

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 written for the uninitiated, it 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 approach for the analysis that will be executed by the study team. It is an agreed to roadmap for "what, when, where, who, and how" the study team plans to accomplish the analysis in order to provide needed answers at the right time for the decision makers.

OAS uses a three-color "stop light" assessment for each criterion: "green" means no limitations or concerns, "yellow" means some limitations or concerns, and "red" means significant limitations or concerns. 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. As an example, there is no formal tasking through a documented ADM and/or PMD that requires that an AoA be executed. This may cause concern over "why are we doing the AoA?" It may also cause concern as whether all the decision maker's issues have been addressed in the proposed AoA. Without clear guidance, it may also identify concerns related to the scope, size and time allotted for AoA execution.

What follows are the eleven specific assessment categories of criteria in a convenient checklist format:

1. Mission Tasks and Measures Based on MNS/ICD/CDD/CPD

Derive mission tasks from MNS/ORD/ICD/CDD/CPD and other relevant guidance on requirements or capabilities.

Mission Task should reflect the military worth of the alternatives (capability provided to the warfighter).

Derive MOEs from the mission tasks.

MOEs are independent of the nature of the alternatives (all MOEs are used for all alternatives).

Make each MOE solution independent (i.e., no MOE depends on the specifics of a subgroup of alternatives).

Derive MOPs from the MOEs.

Address MOE and MOP threshold requirements (if any).

2. All Relevant Issues and Constraints Are Addressed

The AoA study has been responsibly tasked or directed by the MDA, CSAF, SAF, and/or OSD.
Address all Issues in the PMD, ADM and any other guidance providing insight from the decision makers and impact on the nature of AoA.
Discuss previous related studies that might have provided answers, defined relevant constraints or have addressed important related issues.
Discuss key MDA or other issues that will not be considered or addressed in the analysis.
Discuss key milestones for the AoA and their impact on the analysis.
Make differences in IOC/FOC clear and identify their impact on the alternative solutions.

3. Range of Alternatives Is Comprehensive

Define the baseline alternative.
Consider a reasonable range of alternatives.
Consider reasonable technologies that can be available.
Discuss the screening criteria for selecting and excluding alternative solutions.
Describe each alternative solution in a reasonable level of detail.
If used, describe categories of alternatives and how a single alternative may be used to represent a category.

4. Operational Concepts Are Reasonable

Outline alternative(s) employment concepts (basing, deployment, tactics, infrastructures, interoperability, other limitations, etc.).
Consider logistics concepts (maintenance, supply, personnel, etc.).
Identify interdependencies with existing operational support systems (navigation, communications, weather, etc.) and key support systems (defense suppression, escort, etc.).
Address the impact on the analysis of operational, system, and technical architectures.
Address the impact on the analysis from Joint and AF CONOPS perspectives.

5. Threats and Scenarios Are Realistic

Discuss nature and sources of threats and scenarios.
Discuss threat and scenario validation.
Discuss threat variations with time.
Discuss integration of threats into scenarios.
Identify threat and scenario aspects most influential to outcome of the analysis.
Discuss possible reactive countermeasures to each alternative.
Consider contributions of other services and our allies.
Consider the impact of architectures and Joint and AF CONOPS.
Consider a broad range of environmental and hostile operating environments.

6. AoA Measures Will Support Capabilities Documents/TEMP

Ensure key MOEs and MOPs are measurable/testable and that they support development of the ICD, CDD, CPD and TEMP documents.

7. Effectiveness Analysis Approach Is Acceptable

Discuss effectiveness assumptions/constraints.
Describe potential Designs of Experiments to identify critical areas of the study.
Discuss the suitability of the "level of analysis" (mission, campaign, etc.).
Define effectiveness methodology to be used.
Identify AoA resources required to execute the methodology.
Discuss the ability of the effectiveness analysis to differentiate among alternatives.
Outline methodology and decision criteria for making the final selection.
Discuss sensitivity analyses addressing threats, alternative performance, etc.
Identify effectiveness methodology shortcomings and possible fallbacks.

8. Cost Analysis Approach Is Acceptable

Describe life cycle cost (LCC) effort to be accomplished during the AoA.
Discuss costing assumptions/constraints.
Define cost methodology to be used.
Describe the cost WBS for the alternatives.
Discuss the cost risk methodology
Outline the cost review process.
Describe the appropriate CAIV methodology for the AoA.

9. Use Acceptable Models/Simulations and vv&A

Identify existing effectiveness and cost models needed for the analysis.
Identify model functions and reasons for selection.
Identify how models are to be used.
Identify major inputs and outputs of each model
Identify model limitations.
Discuss needed model modifications.
Identify new models needed for the analysis.
Identify data sources and availability.
Discuss interrelationships of models linkages, model inputs and outputs.
Illustrate interrelationships among models, mission tasks, MOEs and MOPs.
Discuss model and data accreditation procedures (see AFI 16-1001).
As appropriate for each study, MAJCOM/DR/XP/XR will accredit models.

10. Cost-Effectiveness Comparison Methodology Approach Is Sound

Discuss integration of effectiveness, cost, and cost-effectiveness methodologies.
Discuss the ability of cost-effectiveness comparison methodology to differentiate among alternatives.
Discuss how final results will be presented.
Identify how the preferred alternative(s) will be selected.

11. Overall Risk and Schedule Is Reasonable

Include a schedule for AoA activities.
Address potential milestones that are driving the AoA.
Identify available resources (money, manpower, tools, data, expertise, etc.).

Assess the ability of the AoA study team to execute the study plan.
Identify potential areas of risk pertinent to the study.
Discuss potential roadblocks (new model or methodology development, reasonable scenario/threat availability, lack of data, etc.).

B – Final Results Assessment

This appendix contains the AoA assessment criteria used by the Technical Review Group or OAS for the AoA Final Results in their independent assessment of final reports being presented to the AFROCC. OAS uses a three-color "stop light" assessment for each criterion: "green" means no limitations or concerns, "yellow" means some limitations or concerns, and "red" means significant limitations or concerns. The list is presented in a convenient checklist format.

1. **Important Aspects of the Study Plan Followed**
    - Deviations from the planned effectiveness and cost analyses are understood and documented to conform to AoA study plan standards.
    - Address how oversight guidance and all appropriate issues were addressed.
    - Study Plan has been updated over the course of the study.
    - Purpose and tasking were appropriate for the study.
2. **Threats and Scenarios Appropriate and Approved**
    - Address threat and scenario validation and DIA approval.
    - Threats and scenario were appropriate, providing reasonable results.
    - AF and Joint architectures have been considered for impact.
3. **Models, Simulations and Accreditation Reasonable**
    - Accreditation report covering models and data certification signed.
    - Models, simulation and data worked appropriately.
    - Identify models and simulation shortfall; include workarounds.
4. **Final Operational Concepts Are Reasonable**
    - Have the warfighter sanction employment concepts (basing, deployment, tactics, treaties and other limitations, etc.) been identified?
    - Verify the viability of logistics concepts (maintenance, supply, personnel, etc.).
    - Account for interdependencies with existing operational support systems (navigation, communications, weather, etc.) and key support systems (defense suppression, escort, etc.).
5. **Effectiveness Methodology Successfully Executed**
    - Determine the military worth of alternatives for warfighters.
    - Discuss effectiveness assumptions.
    - Follow a logical and reasonable analysis approach.
    - Evaluate a range of independent alternatives for the final analysis.
    - Give a convincing rationale for early elimination of alternatives.
6. **Cost Analysis Methodology Successfully Executed**
    - Discuss costing assumptions.
    - Identify sources for cost inputs.
    - Summarize the cost review process.
    - Present cost results by alternative.
    - Discuss CAIV implications.
7. **Presentation of Final Results Support the AoA Findings**

- Discuss the ability of the cost-effectiveness comparison methodology to differentiate among alternatives.
- Outline decision criteria and its impact in making the final selection.
- Present cost-effectiveness comparison results at the MOE level and at higher levels of aggregation if appropriate.
- Present clear and reasonable results.
- Present and interpret sensitivity analyses addressing the threats, alternative performance, etc.
- Identify and interpret methodology shortcomings relative to each alternative.
- All AoA conclusions are supported with briefed results?

C – OAS AoA Guidance

OFFICE Of AEROSPACE STUDIES ANALYSIS OF ALTERNATIVES (AOA): GUIDANCE IN SUPPORT OF AFI 10-601 (Revised 19 September 2003)

Analysis of Alternatives (AoA) Definition

An AoA is an analysis of the operational effectiveness and estimated life cycle costs for alternative materiel systems required to meet or eliminate identified gaps/shortfalls in operational capabilities or mission needs.

The AoA provides the rigorous analysis and foundation needed to develop and support meaningful requirements development and acquisition processes, and normally, supports a Milestone decision. Additionally, the AoA supports detailed development of documents, like the Initial Capabilities Document (ICD), the Capabilities Development Document (CDD), and the Capabilities Production Document (CPD).

The ICD, CDD, and CPD, normally provide a problem statement for the AoA that helps focus and support a firm foundation for the analysis to be executed, developing answers to the Milestone Decision Authority's (MDA's) issues. Also, the AoA documents the analytical and operational rationale for choosing the preferred alternative(s) materiel system(s) and the necessary capabilities they provide to meet a mission need.

The AoA also provides the means to establish Measures of Effectiveness (MOEs) for the materiel system(s), with the required values for operational capabilities requirements (thresholds and objectives). These MOEs are often stated in terms of military utility, and based on value provided to the warfighters. With these MOEs, one can begin to further identify models, simulations, and other analysis tools required to execute the study.

The Purpose of an AoA

The AoA provides information that helps the decision makers select the most cost-effective alternative(s) in order to satisfy a mission need or eliminate an operational gap/shortfall in capability. It compares alternative solutions on the basis of operational effectiveness and cost. It documents the analytical and operational rationale for choosing the preferred alternative(s). It also helps to justify the need for starting, stopping or continuing an acquisition program.

AoAs and other studies also serve as important tools for developing the Stage I and Stage II Initial Capabilities Documents (ICDs), the Concepts of Operational Employment (CONOPS or CONEMP), and Test and Evaluation Master Plans (TEMPs).

The AoA contributes to the " Warm Base of Analysis" by keeping together the analysis results, tools, methods and data used to support the program over its lifetime.

Study Types

There are a series of studies done to support the requirements development and acquisition process. The first of these studies is a Functional Area Assessment (FAA), followed by a Functional Needs Analysis (FNA). The FAA and FNA represent the capabilities planning process identified in DoDD 5000.1/DODI 5000.2, the Joint

Capabilities Integration and Development System in CJCSM 3170.01/CJCSI 3170.01C, and AFI 10-601.

The output of the capabilities planning process for the Air Force will result in a Stage I ICD (addressing the first five items of the ICD). The stage I ICD documents the broad operational shortfalls in capabilities that will be examined during the Functional Solution Analysis (FSA).

The specific study analysis conducted during the FSA, is called the Analysis of Materiel Approaches (AMA). The AMA normally considers a broad range of alternatives that could eliminate the gaps/capability shortfalls and documents the findings in the ICD Stage II.

Later, an AoA may be directed that starts the Concept Refinement Phase based on the completed information provided in the ICD (Stage II ICD). The AoA is normally done during the Concept Refinement Phase in order to support a Milestone A decision. AoAs may also be done to support Milestones B and C.

Analysis of Materiel Approaches (AMA)

An AMA considers a broad range of alternative concepts to satisfy a mission need. It defines the performance, operational characteristics and capabilities necessary to accomplish the mission tasks. It identifies which alternatives are clearly unacceptable and which have the potential capability to meet mission needs and requirements.

The cost estimates are made on the basis of life cycle cost (LCC), which includes the costs of research and development (R&D) supporting engineering design, estimates of the investment costs (Investments), projections of costs for operations and support (O&S), and disposal/decommissioning (Disposal) costs. Normally, at this early stage in the study process, the cost estimates may be done at a Rough Order of Magnitude (ROM) level.

If, known, specialized intelligence support required for a new system should also be reflected in the cost. These early cost estimates will be qualified to highlight their weaknesses and any possibility source for gross errors.

The AMA will identify risk of uncertainties in cost and performance and, to the extent known, the characteristics of each concept that drives the cost and performance associated with each alternative.

The AMA and later AoAs implement Cost as An Independent Variable (CAIV) by developing the initial trade space for cost and effectiveness that can be used in the decision making process. The early cost-effectiveness comparisons may allow the MDA to set the original cost objectives for the potential program.

The AMA will also provide direction and focus for the AoA to follow after the ICD Stage II is completed and will further support the MDA during Milestone A.

AoA

The AoA is accomplished to analyze and evaluate a very small range of specific hardware/software alternatives, resulting from the AMA. The AoA starts once the technologies to be used and type of alternatives have been selected by the MDA.

Alternatives are based on the solution set identified in the ICD and focus on how to provide the needed capabilities while reducing cost and risk. The AoA evaluates the cost and operational capabilities during Concept Refinement and provides an answer to issues the MDA may have at Milestone A.

The AoA establishes acceptable bounds of risk for possible combinations of cost and performance, using point estimates consistent with the cost-estimating techniques appropriate for the alternatives' technical maturity. The AoA further helps to document and refine CAIV objectives. This is done through the development of cost and effectiveness trade spaces for each alternative, contributing to the decisions made by acquisition personnel and participating MAJCOMs.

AoAs also consider affordability of individual alternatives for Milestone A, examining the impact of continuing or terminating the alternatives being studied. AoAs may be required to support Milestones B and C, based on the needs of the MDA and as documented in the Acquisition Decision Memorandum (ADM).

Direction

Under DoDD 5000.01/DoDI 5000.02, AoAs are required for all ACAT I programs and may be directed for ACAT II and III programs.

The MDA makes all final acquisition program decisions. When the MDA determines that an AoA is required to support the next milestone he/she issues an ADM requiring an AoA.

The ADM provides guidance on the required scope and level of detail in the AoA. Air Force tasking for AoAs will be provided to organizations in the form of a Program Management Directive (PMD).

The MDA also may direct an update of an existing AoA for Milestones B and C, if the threat or mission changes or if new information on performance or cost is needed.

In AoAs which OSD/PA&E has a major role, they will provide direction, guidance and review of the AoA Study Plan and Final Results, in support of the MDA.

The AoA is subject to tailoring and streamlining based on the type and size of the program, maturity of the system concepts and other considerations as determined by the MDA. An AoA should be sized and scoped for the MDA in light of the issues he or/she needs answered.

Not all AoAs are the same, some are more focused and will be smaller in scope while others may address complex overarching issues and will be much larger studies. If the MDA has no complex issues or fully understands the issues that may arise at the Milestone, they may waive or eliminate the need for an AoA.

Improving the AoA Process

In order to improve the quality and consistency of AoAs, we need to ascertain if the information being generated in AoAs makes a meaningful contribution to the decision making process.

In order to determine this, OSD/PA&E, SAF/AQ and the Office of Aerospace Studies (OAS) should work together to address and document pre-AoA conditions and the possible decisions that would be facilitated before starting an AoA. Later, upon completion of the AoA and prior to presentation of the results to the MDA, OSD/PA&E and SAF/AQ, OAS will assess the results of the AoA.

Items demonstrating AoA value may include: (1) did the AoA effect the decision; (2) did the AoA allow the MDA to make a different decision; (3) was there an appropriate use of AoAs; and (4) was the analysis complete? Based on the results provided, we should be able to identify changes needed to improve the AoA process.

AoA Reviews

The Air Force Requirements for Operational Capabilities Council (AFROCC) and the Air Force Council (AFC), if necessary, review and validate AoA study plans, midterm status and draft final results. Also, the AFROCC 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 C1-1 should help in determining what reviews are needed for the AoA process. Note: In the table C1-1 where it shows items as having to be "Approved to go to OSD" by AF/CV refers to the formal documents. 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.

TABLE C1-1. The AoA Review and Approval Process.

	MAJCOM	AFROCC	AF/XOR	AF/XO	AF/CV	JROC	PA&E	MDA
ACAT I Study Plan	Reviews All	Reviews All	Coord on package	Coord on package	Approve to go to OSD	Not normally req'd*	Review prior to AoA initiation**	Approve
ACAT II/III Study Plan	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	As Required	As Required	As Required	As Required
ACAT II/III Midterm Status	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	Reviews All	Reviews All	Coord on package	Coord on package	Approve to go to OSD	Validate Results	Review at least 60 days prior to M/S B	Approve
ACAT II/III Final Results	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

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

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

?? The document sponsor must ensure that PA&E 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 DoDD5000.1 and DODI 5000.02 requirements.
?? The Air Staff Subject Matter Expert should assist in staffing the package through appropriate channels to XOR/XO/VCSAF as appropriate. Some AoAs may require a presentation to either the Air Force Council, and the VCSAF or both prior to approval for release to OSD.
    - Staffing of ACAT II/III AoA "documents" beyond XOR/XO is determined on a case-by-case basis.

If the nature of the AoA is extremely technical or politically sensitive, either the MAJCOM or the AFROCC may request a formal technical assessment by the Technical Review Group (TRG). OAS and AFSAA will help the AoA Study Director schedule reviews with the TRG and followed by the AFROCC (and AF Council 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 AFROCC 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 for which the Air Force is the lead service must have AF/CV approval before being briefed to OSD. On approval by AF/CV, information will be forwarded to working level IPTs, the Overarching Integrated Product Team (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 AF review process (e.g., for special access programs). If the AoA results are being forwarded to OSD/PA&E, the Final Results/Final Report on the study must be submitted 60 days before the scheduled Defense Acquisition Board (DAB) or Information Technology Acquisition Board (ITAB). 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)

When requested by the MAJCOM study team or the AFROCC, the TRG assesses ACAT I and selected ACAT II or ACAT III AoAs for technical adequacy and completeness of the analytical approach and results. The Director, Air Force Studies and Analysis (AFSSA), will chair the TRG. The Air Force Operational Test and Evaluation Center (AFOTEC) is responsible for reviewing the linkage between the TEMP and ICD (as outlined in the AoA final report) and for presenting a linkage assessment to the TRG. In the absence of the TRG, the Office of Aerospace Studies (OAS) will perform technical assessments.

AFROCC and AF Council

On occasion, the AFROCC may determine if it is appropriate for the Air Force Council to review the AoA study plan, midterm or the final results. To ensure proper representation on specific issues, the AFROCC through AFSAA may provide attendance recommendations to AF/CVA.

The AFROCC may recommend that AF/CV approve the AoA study plan, midterm or final results without going to the AF Council. AF/CV will make the final decision. The senior Air Force members of the OIPT should be invited to the AFROCC and AF Council 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/PA&E may be invited to the AFROCC and AF Council reviews to ensure their interests and perspectives are addressed when AoA information is presented.

Integrated Product Teams and AoAs

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

Air Force AoA Center of Expertise

AFMC's Office of Aerospace Studies (AFMC/OAS) is the Air Force Center of Expertise (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 Analysis Handbook providing detailed guidance on how to accomplish an AoA. OAS's role is also described in the Analysis Handbook. In cases where the MAJCOM elects not use a TRG, OAS will provide the AFROCC with an assessment of the AoA products.

To support the AoA planning process, OAS will work with the MAJCOMs to document and track AoA costs, including M&S costs occurring during the study, the number of resources expended, cost of contractor support, and cost of travel and administrative support used during the study.

Execution of the AoA

The lead MAJCOM is responsible for executing the AoA. The MAJCOM will appoint a Study Director and assemble the AoA study team. OAS will appoint an assistant to the AoA Study Director.

The MAJCOM Study Director is the focal point for all study activities and exercises overall responsibility for these efforts. The Study Director is responsible for ensuring that the study team functions under the IPT process.

The AoA study team is composed of members from the MAJCOM staff, Air Staff, support commands, OAS, contractors, and others services and government agencies as necessary.

For joint programs, if the AF is designated as the lead service, Study Team membership will include representatives from the appropriate services, (who may or may not be designated as study co-leads).

OSD/PA&E participation on the AoA study team is strongly encouraged. In cases where OSD/PA&E does not have members on the study team, the AoA Study Director is

encouraged to maintain face-to-face communications with OSD/PA&E action officers and applicable management.

Study Plan

The AoA study team will develop a study plan of sufficient detail to address the issues established by the MDA and to ensure a rigorous analysis process. The study plan is intended to be a living document and should be updated periodically. The AoA study plan should follow a format similar to the final report found in the Analysis Handbook, which can be obtained from the OAS Web site www.oas.kirtland.af.mil. AoA study plans must be reviewed and validated by the AFROCC. OSD/PA&E will review and assess ACAT ID, ACAT IM AoA study plans or any other plans under their purview.

Final Report

The final report and briefing of final results will be developed by the MAJCOM and forwarded through the AFROCC, XOR, XO, AF/CV and to OSD/DPA&E at least 60 days prior to the DAB. The final report is to document work done, to help establish support for the new program, and to help the MDA address issues concerning the program. The MAJCOMs should submit a copy of the AoA Final Report to: (1) the Defense Technical Information Center (DTIC); (2) the System Program Office; and (3) OAS. The MAJCOM shall also prepare and deliver all Distributed Product Description (DPD) data and models accredited for use in the AoA as directed per AFI 16-1002.

AoA Planning

Once a year AFSAA and OAS will sponsor an AoA Planning Conference for the using commands and other appropriate agencies to discuss AoA issues and projected AoA activities for the next two years. Information gathered at this conference should be documented in a multi-year forecast that will be used for budgeting and other AoA planning efforts.

A critical use of this multi-year forecast is to identify potential data and modeling and simulations (M&S) needs for future AoAs. To provide for this forecasted need for data, supportive information should be included in the Acquisition M&S Master Plan to allow for tools and data to be available at the AoA start.

Analysis Handbook

Additional guidance on the AoA process, organization, execution, reporting, and review is available in the Air Force Analysis Handbook obtained from the AFMC/OAS web site (www.oas.kirtland.af.mil), or from the OSD On-Line Deskbook.

Standard Models and Methodologies

Every attempt should be made to use accepted Air Force models, simulations, databases, and methodologies. The standard “Suite of Analytical Models” in the Air Force Standard Analysis Tool Kit is listed in the Analysis Handbook.

The standard electronic methodology for campaign worth analysis was developed through the SAF Electronic Warfare Partnership Process and is based on standard Air Force baselines that are available from the Air Force Studies and Analyses Agency

(AFSAA). Therefore, electronic combat AoAs will include assessment of campaign level military worth developed through the SAF Partnership Process and based on the standard Air Force campaign baseline.

AoA Scenarios and Data

AoAs require viable scenarios and intelligence data in order to accomplish the rigorous analysis needed. This requires AFSAA involvement to ensure appropriate scenarios and data are developed for the AoAs.

Likewise, through the AoA process, the intelligence community and the Air Force can provide keen insights and significant intelligence details associated with potential new weapon systems and technologies. This should provide a baseline for future intelligence requirements that will be driven by procurement of new weapon systems.

D – Sources of Information

AoA Policy Index

Joint Capabilities Integration and Development System (JCIDS)

JCIDS Overview Briefing
CJCSI 3170.01 – Operation of the JCIDS
CJCSI 3170.01C - JCIDS

DoD Acquisition Process

DoDD 5000.1 – The Defense Acquisition System
DoDI 5000.2 – Operation of the Defense Acquisition System
Interim Defense Acquisition Guidebook (formerly DoD 5000.2-R)
DoDD 5101.2 – DoD Executive Agent for Space
National Security Space Acquisition (NSSA) Policy
DoD 5000.4-M – Cost Analysis Guidance & Procedures

Air Force Specific Implementation

AFPD 63-1 – Capability-Based Acquisition System
AFI 10-601 – Mission Needs and Operational Rqmts Guidance & Procs
AFI 10-604 – Effects Based, Capabilities Focused Planning

AoA Course Selections

Chapter 2 AoA Coure(s) *Support to Decision Making*

Information Technology (IT) Related Policies

Clinger-Cohen Act
CJCSI 6212.01C - Interoperability and Supportability of IT and NSS
DoDD 4630.5 – Interoperability and Supportability of IT and NSS
DoDI 4630.8 – Procedures for Interoperability and Supportability of IT and NSS
DoDD 8100.1 – Global Information Grid (GIG) Overarching Policy
Joint Pub 6-0 – Doctrine for C4 Systems Support to Joint Operations

E – Acronyms

ACAT - Acquisition Category
ACTD - Advanced Concept Technology Demonstration
ADM - Acquisition Decision Memorandum
ADUSD - Assistant Undersecretary of Defense
AF - Air Force
AF/IN - Assistant Chief of Staff for Intelligence
AF/XOR - Director of Requirements
AFC - Air Force Council
AFCAA - Air Force Cost Analysis Agency
AFCAIG - Air Force Cost Analysis Improvement Group
AFI - Air Force Instruction
AFROCC - Air Force Requirements Operational Capability Council
AFSAA - Air Force Studies and Analyses Agency
AHP - Analytical Hierarchy Process
ALC - Air Logistics Center
AMA – Analysis of Materiel Approaches
AoA - Analysis of Alternatives
APB - Acquisition Program Baseline
ATDs – Advanced Technology Demonstrations
AVCSAF - Assistant Vice Chief of Staff Air Force
BY - Base Year
BY$ - Base Year Dollars
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
CARD - Cost Analysis Requirement Description
CCA - Component Cost Analysis
CCB - Configuration Control Board
CDD - Capability Development Documents
CE - Concept Exploration
CE - Civil Engineering
CER - Cost Estimating Relationship
CIO - Chief Information Officer
CIPT - Cost Integrated Process Team
CM – Configuration Management
COE - Center of Expertise
COEA - Cost and Operational Effectiveness Analysis
CONEMPS – Concept of Employment
CONOPS - Concept of Operations
COTR - Contracting Office Technical Representative
COTS – Commercial Off the Shelf

CPD - Capability Production Documents
CPIPT - Cost Performance Integrated Product Team
CRD – Capstone Requirements Document
CRRA – Capability Review and Risk Assessment
CSAF - Chief of Staff Air Force
CSEL - Combat Survivor Evader Locator
CWG - Cost Working Group
DAB – Defense Acquisition Board
DAE - Defense Acquisition Executive
DASD - Deputy Assistant Secretary of Defense
DIA - Defense Intelligence Agency
DoD - Department of Defense
DoE – Department of Energy
DOTMLPF – Doctrine, Operations, Training, Material, Leadership, Education, Personnel, and Facilities
DPA&E - Director of Program Analysis and Evaluation
DPG/IPS - Defense Planning Guidance/Illustrative Planning Scenario
DT&E - Developmental Test & Evaluation
EMD - Engineering and Manufacturing Development
EW - Electronic Warfare
FAA – Functional Area Analysis
FASA - Federal Acquisition Streamlining Act
FFRDC - Federally Funded R&D Center
FNA - Functional Needs Analysis
FOC - Full Operational Capability
FoS – Family of Systems
FSA - Functional Solution Analysis
GPS - Global Positioning System
HSC - AFMC Human Systems Center
ICD - Initial Capabilities Document
ICE - Independent Cost Estimate
ILS – Integrated Logistics System
IIPT - Integrating Integrated Product Team
ILSP - Integrated Logistics Support Plan
IOC - Initial Operational Capability
IPT - Integrated Product Team
ISR - Intelligence, Surveillance, Reconnaissance
JCIDS – Joint Capabilities Integration and Development System
JCTD - Joint COEA Tasking Directive
JFL – Joint Functional Concepts
JOC – Joint Operations Concepts
JPALS - Joint Precision Approach and Landing System
JROC - Joint Requirements Oversight Council
JWCA – Joint Warfighting Capabilities Analysis
KPP – Key Performance Parameters
LCC - Life Cycle Cost

LRIP - Low Rate Initial Production
M&S - Models & Simulations
MAA - Mission Area Assessment
MAISAP - Major Automated Information Systems Acquisition Programs
MAISRC - Major Automated Information Systems Review Council
MAJCOM - Major Command
MAP - Mission Area Planning
MDA - Milestone Decision Authority
MDAP - Major Defense Acquisition Program
MER - Manpower Estimate Report
MILCON - Military Construction
MIL-STD - Military Standard
MNA - Mission Need Analysis
MNS - Mission Need Statement
MOA - Memorandum of Agreement
MOE - Measure of Effectiveness
MOP - Measure of Performance
MOU - Memorandum of Understanding
MPTS - Manpower, Personnel, Training & Safety
MS - Milestone
MSA - Mission Solution Analysis
MSWG – Model Selection Working Group
MSFD - Multi-Service Force Deployment
MSFD - Multi-Spectral Force Deployment
MSWG – Model Selection w
MT - Mission Task
M&S – Modeling and Simulation
NSSA – National Security Space Acquisition
O&S - Operations and Support
OAS - Office of Aerospace Studies
OC - Operating Command
OC/FM - Operating Command Financial Management
OIPT - Overarching Integrated Product Team
ORD - Operational Requirements Document
OSD - Office of the Secretary of Defense
OSD/DPA&E - OSD/Director of Program Analysis and Evaluation
OT&E - Operational Test & Evaluation
P3I - Pre-Planned Product Improvement
PAT - Process Action Team
PDRR - Program Definition and Risk Reduction
PEM - Program Element Monitor
PEO - Program Executive Officer
PF/DOS - Production, Fielding/Deployment & Operational Support
PM – Program Manager
PMD - Program Management Directive
POC - Point of Contact

POE - Program Office Estimate
PPBES - Planning, Programming, Budgeting Execution System
RAD – Requirements and Acquisition Division
R&D - Research and Development
RCM - Requirements Correlation Matrix
RDT&E - Research, Development, Test & Evaluation
ROC - Required Operational Capability
RRP – Rapid Response Process
S&T – Science and Technology
SAE - Service Acquisition Executive
SAF/AQ - Assistant Secretary for Acquisition
SAMP - Single Acquisition Master Plan
SCP - Service Cost Position
Sec AF - Secretary of the Air Force
SDD – System Design Document
SETA - Scientific, Engineering, Technical, and Analytical
SG - Surgeon General
SON - Statement of Operational Need
SOO - Statement of Objectives
SoS – System of Systems
SOW - Statement of Work
SPD - System Program Director
SPO - System Program Office
STA - System Threat Assessment
STAR - System Threat Assessment Report
T&E – Test and Evaluation
TAR - Threat Assessment Report
TDS – Technology Development Strategy
TEMP - Test and Evaluation Master Plan
TOR - Tentative Operational Requirement
TPD - Threat Planning Document
TRG - Technical Review Group
TY - Then Year
TY$ - Then Year Dollars
UAV - Unmanned Aerial Vehicle
UJTL – Universal Joint Task List
USD (AT&L) - Undersecretary of Defense for Acquisition, Technology and Logistics
VCSAF - Vice Chief of Staff Air Force
VV&A - Validation, Verification, and Accreditation
VV&C - Validation, Verification, and Cretification
WBS - Work Breakdown Structure
WG - Working Group
WIPT - Working-Level Integrated Product Team
XR – Requirements

F – Study Plan (Outline Format)

DRAFT

<Name of Project Here>

Analysis of Alternatives (AoA)

Study Plan

Office of Aerospace Studies

15 Mar 2004

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

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10. Schedule
11. Review Process
12. Acronyms
13. References

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 Mission Need Statement (MNS), Acquisition Decision Memorandum (ADM), and Program Management Directive (PMD) that required the AoA
?? Identify intended results in general terms
?? Identify any applicable Advanced Concept Technology Demonstrations (ACTDs)

1.2. Purpose

?? Identify major acquisition issues to be studied
?? Identify the Milestone to be supported

1.3. Scope

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

2. Acquisition Issues

2.1. Mission Need

?? Describe deficiency in system capabilities and refer to MNS or Operational Requirement Document (ORD) (if ORD exists)
?? Identify the timeframe for the mission need
?? Describe any applicable ACTDs

2.2. 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)

2.3. 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
?? Identify other sources of projections
?? Plan to approve or validate the threat through the Defense Intelligence Agency (DIA)
?? Identify areas of uncertainty, if possible

2.4. Environment

?? Describe expected operating environment, including terrain, weather, location, and altitude
?? Paraphrase, quote, and reference applicable sections in the ORD (if it exists)

?? Consider the environmental impacts of alternative solutions with the environment

2.5. Constraints & 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 MNS and ORD

?? Identify the AoA resources available (people, funds and time) and how they affect the scope of the AoA

2.6. Operations Concepts

?? Identify organizational functions and operations performed during mission

?? Reference applicable section in ORD (if it exists)

?? 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

?? Identify "day-to-day" and "contingency" operation implications

?? Consider any recent field or test experiences that might be relevant

?? Describe how the Concepts of Operations (CONOPS) fit each alternative

3. Alternatives

3.1. 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

3.2. Nonviable Alternatives

?? Delineate major alternatives that were not included in this analysis

?? Describe the rationale for non-selection

4. Determination of Effectiveness Measures

4.1. Mission Tasks (MTs)

- ?? Identify what task or tasks need to be achieved to satisfy the MNS
- ?? Endeavor to keep MTs independent of one another
- ?? Try to avoid MTs that use words such as “minimize,” “maximize,” and “optimize”

4.2. Measures of Effectiveness (MOEs)

- ?? Derive 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

4.3. Measures of Performance (MOPs)

- ?? Derive 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
- ?? Define MOPs by system performance characteristics, if possible

5. Effectiveness Analysis

5.1. 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 testable and will support the development of the ORD and the Test and Evaluation Master Plan (TEMP)
- ?? Add details as the plan matures

5.2. Models, Simulations, 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
- ?? Give evidence that data for the scenarios, threats, and each of the alternatives will be current, accurate, and unbiased (technically sound and doctrinally correct)

?? Discuss any potential model biases, such as “man-in-the-loop” biases
?? Describe the Verification, Validation and Accreditation (VV&A) processes to be used for the models
?? Describe how models interface and how they are used to calculate MOEs and MOPs (use figures for clarity)

5.3. Effectiveness Sensitivity Analysis
?? Identify potential Key Performance Parameters (KPPs) based on military utility

5.4. Results and Conclusions
?? Expect Rough Order Magnitude (ROM) results in early phases; refine as possible
?? Explore details at differing levels of analysis
?? Use sensitivity analysis, if possible
?? Present supporting analyses as they pertain to the AoA
?? Include notional graphics for presenting results
?? Rank-order alternatives based on reasonable criteria
?? Add results to these sections as the data becomes available

6. Cost Analysis

6.1. 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
?? Add details as the plan matures

6.2. Models 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 SAF/FMC, in lieu of extensive VV&A for cost models

6.3. Life Cycle Cost (LCC) Analysis
?? Consider the possibility of doing equal cost and equal effectiveness analyses
?? Identify the baseline year used for costing
?? Evaluate using base year (or constant) dollars (Evaluate then-year dollars if production schedules exist)

?? Identify 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
?? Identify "sunk costs" for information purposes only
?? Discuss the application of Cost as an Independent Variable (CAIV) to LCC

6.3.1. Research and Development (R&D) Cost
?? Describe RDT&E costing methodology (include MILCON costs)

6.3.2. Investment Cost
?? Describe investment costing methodology (include MILCON costs)

6.3.3. Operations and Support (O&S) Cost
?? Describe O&S costing methodology, considering personnel, operations, maintenance, recurring procurement, and spares

6.3.4. Disposal Cost
?? Describe disposal costing methodology, considering redistribution, hazardous waste, and environmental cleanup

6.3.5. Total LCC
?? Plan to show comparative LCC for each alternative, both by element cost and by total cost

6.3.6. Cost Sensitivity Analysis
?? 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

6.4. Results and Conclusions
?? Plan to display graphic representations of cost in relationship to the baseline case
?? Provide reminder and caution: <u>An AoA is not a budget document</u>

7. Cost-Effectiveness Analysis

7.1. Methodology
?? Outline the approach and scope of the analysis, including the proper level of modeling military operations (e.g. campaign, mission, engineering, etc.)
?? Consider cost and effectiveness as equal players in the analysis
?? Plan to carry the baseline alternative through the final cost-effectiveness analysis
?? Compare all alternatives on the basis of equal cost or equal effectiveness, if possible
?? Plan to combine the cost and effectiveness analyses
?? Describe the cost-effectiveness rank ordering methodology

?? Describe the methodology, including the models 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. Models and Data Used
?? Optional

7.3. Cost-Effectiveness Summary

7.3.1. Ranking and Decision Criteria
?? Discuss criteria for selecting among alternatives
?? Describe possible cost and performance thresholds

7.3.2. Tradeoff Analysis
?? Array MOEs and cost to show how marginal changes in one affect the other
?? Plan to show sensitivity of results to uncertainties in threat, baseline parameters, quantities purchased, or decision criteria
?? Plan to identify possible cost and performance thresholds for each alternative

7.4. Results and Conclusions
?? Rank-order alternatives based on reasonable criteria
?? Display graphical representations of cost vs. Effectiveness

8. Organizational Responsibilities
?? Identify who is doing what
?? Include a phone number list for all organization points-of-contact

8.1. Study Team/Organization
8.2. Study Advisory Group (SAG) (if used)
8.3. Technical Oversight Advisory Group
8.4. Working Level Integrated Product Team
8.5. Overarching Integrated Process Team
8.6. Milestone Decision Authority

9. Study Report Outline

The Study Plan can be easily converted to a Study Report with the addition of the executive summary, the conclusions, and a little reorganization.

i. Cover
ii. Table of Contents

iii. Executive Summary – a summation (1-5 pages) of the report which should address:

1. Purpose -- why the AoA was accomplished
2. Background -- history and mission of current system
3. Deficiencies -- changes to mission needs or requirements
4. Alternatives -- describe ways the mission can be done
5. Evaluation -- identify analysis performed
6. Summary of Results -- describe the results for each alternative for both cost and operational effectiveness
7. Conclusions -- present the conclusions derived from the analysis

1. Introduction
…
2. Acquisition Issues
…
3. Alternatives
…
4. Rationale for Choosing Effectiveness Measures
…
5. Effectiveness Analysis
…
6. Cost Analysis
…
7. Cost-Effectiveness Analysis
…

* Notice that Study Plan Section 8 (Organizational Responsibility) has been moved to Appendix E.

Add:

8. Summary of Results
- ?? Summarize major findings
- ?? Highlight factors influencing acceptability
- ?? Highlight factors influencing cost of alternatives
- ?? Sensitivity analysis on significant cost drivers
- ?? Restate insights provided by the analysis in the study

Distribution List – included between the main body and the appendices
- ?? Include CPIPT offices, OAS, AoA members, etc.
- ?? Study Plan (SP) Sections 8 & 10-13 are reorganized into the following appendixes:

Appendix A: Documentation for the Operational Effectiveness Analysis
Appendix B: Documentation for the Cost Analysis
Appendix C: Documentation for Other Supporting Analyses
Appendix D: Other Supporting Documentation

Appendix E: Responsible Team Members and Organizations (SP Section 8)
Appendix F: Acronyms (SP Section 12)
Appendix G: References (SP Section 13)

10. Schedule – Provide the schedule you want to follow for this study. Below are typical duration ranges (from easy to difficult AoAs):

			Planned Date	Actual Date
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	2-2	Months		
Study Report Preparation	1-2	Months		
Oversight: Review of Study Report	1-2	Months		
Total	13-24	Months		

11. Review Process – Describe what coordination you plan for reviews and who will approve both the Study Plan and the Study Report.

12. Acronyms

ACTD - Advanced Concept Technology Demonstration
ADM - Acquisition Decision Memorandum
AFI - Air Force Instruction
AFP - Air Force Pamphlet
AoA - Analysis of Alternatives
APB - Acquisition Program Baseline
CAIV - Cost as an Independent Variable
CONOPS - Concepts of Operations
CPIPT – Cost Performance Integrated Product Team
DIA - Defense Intelligence Agency
DoDD - Department of Defense Directive
DPG/IPS - Defense Planning Guidance / Integrated Program Summary
DT/OT - Development Testing / Operational Testing
KPP - Key Performance Parameter
LCC - Life Cycle Cost
MAA - Mission Area Assessment
MAP - Mission Area Planning
MDA - Milestone Decision Authority
MILCON - Military Construction

MOE - Measure of Effectiveness
MOP - Measure of Performance
MNA - Mission Need Analysis
MNS - Mission Need Statement
MSA - Mission Solution Analysis
MT - Mission Task
OAS - Office of Aerospace Studies
OIPT - Overarching Integrated Product Team (IPT)
ORD - Operational Requirement Document
O&S - Operations and Support
PMD - Program Management Directive
R&D - Research and Development
RDT&E - Research, Development, Testing, and Evaluation
ROM - Rough Order of Magnitude
SAF/FMC - Secretary of the Air force / Deputy Assistant Secretary for Cost and Economics
SAG - Study Advisory Group
SP - Study Plan
STA - System Threat Assessment
STAR - System Threat Assessment Report
STINFO - Scientific & Technical Information
TEMP - Test and Evaluation Master Plan
VV&A - Verification, Validation, and Accreditation

13. References

1. MNS
2. ADM
3. PMD
4. ORD
5. Analysis 1…

G. – ACCREDITATION of MODELS FOR THE AoA

The following Appendix is provide as an example of the Accreditation Report for an AoA, which should develop to document and validate the individual and federated models being used in the AoA. This process is accomplished to provide confidence to the Models and Simulations (M&S) Accrediting Authority that the tools being used in the AoA will accomplish reasonable analysis and deliver results that are believable to the operational and acquisition community.

It is critical that this process be done only after the study team has determined the important measures that must be evaluated in the study. The selection of the M&S must occur only after a clear understanding has been developed as to the important things that must be measures by the tools in the accomplishment of the analysis

This appendix provides several items to get the study team going: 1) Accreditation Statement– Transmittal Cover MEMO; 2) Cover for the "Model and Data Accreditation Report"; 3) Table of Contents for the Report; 4) an Executive Summary; and 5) the body of the report "Model and Data Accreditation Report for *Project name* AoA".

ACCREDITATION STATEMENT – TRANSMITTAL COVER MEMO

DD-MMM-YY
MEMORANDUM FOR HQ *MAJCOMs*/DR

FROM: HQ *MAJCOMs*/DRA
Address

SUBJECT: Accreditation Report for *Project name* Analysis of Alternatives (AoA).

I have reviewed the recommendations contained in the attached model accreditation report. On the basis of this review, I accredit the use of the following model(s) by HQ *MAJCOMs*/DRA for the *Project name* AoA:

List the Model(s)

List any restrictions

Signature Block for HQ *MAJCOMs*/DR
Attachments:
1: Title Page for the **Model and Data Accreditation Report**
2. TABLE OF CONTENTS, **Model and Data Accreditation Report**
3. Executive Summary for **Model and Data Accreditation Report** for *Project name* AoA
4. **Model and Data Accreditation Report** for *Project name* AoA

Model and Data Accreditation Report

For

Project name

Analysis of Alternatives (AoA)

Date 01-05-04

Prepared by

MAJCOM/**DR**

Author

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EXECUTIVE SUMMARY
For
Model and Data Accreditation Report
For
Project name **Analysis of Alternatives (AoA)**

1. Problem Statement
State the Mission Tasks (MTs) from the AoA, list the proposed models that will evaluate the corresponding measures of effectiveness (MOEs), and explain what you expect the analysis to provide in terms of alternative solutions.

2. Usage of Selected Models
Write a description of each model giving a quick look at its proposed utility. Explain the MOEs that the model will address, and how they relate to the Mission Tasks or functional objective. Show the overall model architecture and associated federations.

3. Key Participants
List the participants in the accreditation process. Identify the voting and non-voting members that were included on the panel. Also include their organizations and their roles/responsibilities. Finally, state who the overall accreditation officer is and provide his/her office symbol.

4. Model selection and Data Requirements
Explain the selection process that led to the identification and selection of the model(s) to be used in this analysis. Describe the overall data requirements for the analysis, the intended sources, and the expected pedigree of the data.

5. Accreditation Methodology
Give a brief explanation of the accreditation plan and process. Include a list of criteria that will be used to evaluate the acceptability of the model(s). You can find examples of appropriate criteria in the OAS Handbook on-line. If possible, some type of collaborative system should be used during the accreditation meeting so that comments and discussions can be captured and included in the final accreditation document. Also, during the meeting, such things as how data linkages between models are established need to be addressed in detail. The best way to confirm models will work together is to have the model user's talk face to face on their models capabilities and data requirements. Also, explain which MOEs are addressed by which models. All MOEs should be supported by analysis and support specific mission tasks.

6. Summary of Model(s) Accreditation Results
List each model and summarize the accreditation results. Show how each model scored against the chosen selection criteria. This is best shown by the use of a "stop-light chart". Models that have scored well on specific criteria are given a green color for that area. Models that have some problems concerning specific criteria are given a yellow. A green/yellow indicates minor changes can be made that would allow the score to become green. A yellow/red indicates significant changes to the model must be made in order for it to be useful in the analysis. The color red is given to criteria that make the model unacceptable for use in the analysis. For models other than green and green/yellow, the extent of changes required needs to be explained. Such things as cost, schedule delays, and risk need

to be shown in detail. Remember also, the overall model architecture (to include all model linkages) must be reviewed and accredited; and that any major model change will affect this overall federation. Again, this architecture is best evaluated by face-to-face discussion between the accreditation panel and the model operators during the accreditation process.

7. Acceptability Criteria and Model Assessments

Provide a statement of confidence for each model(s) resulting from the accreditation process. At this point it would be best to show a chart displaying the models to be used (based on this accreditation), their linkages, and the MOEs associated with each model. This will provide a clear picture of the planned analysis process. Any perceived risks in using the accredited models should be fully explained and proposed ways to mitigate the risks should be addressed.
OAS will be able to provide samples of past reports for other AoAs if requested to do so

8. Summary Comments and Recommendations

Summarize the success potential for the models selected along with the potential federated model architecture for the study being executed. Include pertinent comments on the accreditation process used and the potential of the models to successfully support the planned study. Provide the recommendation from the MAJCOM DR/XR on the desired accreditation of all the models being evaluated for this study.

Model and Data Accreditation Report for *Project name* AoA

1. Problem Statement
    1.1. State the goal of this report in terms of model(s) accreditation for your AoA analysis architecture in terms of Mission Tasks
    1.2. Provide a statement that this document will fulfill the requirement for formal accreditation of all models and their architecture proposed for the AoA analysis.
    1.3. Describe AoA and analysis requirements
    1.4. Explain what you expect the model(s) to produce in terms of alternative solutions

2. Usage of Selected Models
    2.1. Describe the expected utility of each listed model
    2.2. Identify MOEs
    2.3. Indicate that each MOE will be addressed by at least one model
    2.4. Show overall model federation for the analysis

3. Key Participants
    3.1. List all participants and their office symbols in the accreditation process
    3.2. Highlight voting members
    3.3. State who is the Accreditation Officer and his/her office symbol

4. Model selection and Data Requirements
    4.1. Threat and Scenarios
    - Explain the selection process for scenarios to be used in the analysis
    Discuss the pedigree of the threat databases to be used in the analysis
    Identify any expected problems with either scenario or threat data
    4.2. Model Architecture
        4.2.1. Input data
        - Discuss input data requirements for models and where this data will come from
        - Discuss pedigree of input data
        4.2.2. Output Data
        - Describe expected output data from each model and how it will flow as input to the next model
        4.2.3. Linkage Diagram
        - Provide a detailed chart explaining the data linkages and associated MOEs for he analysis

5. Accreditation Methodology (Model Evaluations)
    5.1. Model Name and Short Description **(First Model)**
        5.1.1. Evaluate model in terms of supporting Mission Tasks and MOEs
        5.1.2. Explain history and past model usage
        5.1.3. V&V History
            5.1.3.1. Configuration Management (CM)
            - Evaluate quality of CM
            5.1.3.2. Version Changes and Enhancements
            - Evaluate CM in terms of major changes (if any)

5.1.3.3. User Documentation Available
- Evaluate quality of User Manuals, etc
5.1.3.4. Assumptions, Limitations, and Possible Errors
- Assess any limiting assumptions, shortcomings, and obvious errors in the V&V process

5.1.4. Evaluate model in terms of all other criteria selected for evaluation in the Accreditation process

5.1.4.1. User Experience e.g.
5.1.4.2. Functionality e.g.
5.1.4.3. Other Supportive information on the Model, Etc

5.2. Model Name and Short Description **(Second Model)**
- Repeat paragraph 5.1 for each model under consideration for each criterion

5.2.1. Evaluate model in terms of supporting Mission Tasks and MOEs
5.2.2. Explain history and past model usage
5.2.3. V&V History

5.2.3.1. Configuration Management (CM)
- Evaluate quality of CM
5.2.3.2. Version Changes and Enhancements
- Evaluate CM in terms of major changes (if any)
5.2.3.3. User Documentation Available
- Evaluate quality of User Manuals, etc
5.2.3.4. Assumptions, Limitations, and Possible Errors
- Assess any limiting assumptions, shortcomings, and obvious errors in the V&V process

5.2.4. Evaluate model in terms of all other criteria selected for evaluation in the Accreditation process
5.2.5. User Experience e.g.
5.2.6. Functionality e.g.
5.2.7. Other Supportive information on the Model, Etc

NOTE, FOR MORE INSIGHT ON A REASONABLE METHOD FOR EVALUATION OF INDIVIDUAL MODELS, AND THE FEDERATION OF A GROUP OF MODELS, PLEASE REFER TO CHAPTER 5, OF THE OAS ANALYSIS HANDBOOK, DATED MARCH 2004, PAGES 58-65, SEE LINK: http://www.oas.kirtland.af.mil/AoAHandbook/AoAHandbook.pdf .

6. Summary of Model(s) Accreditation Results

6.1. List models
- Show how they fared with respect to accreditation criteria

6.1.1 Provide Rationale

6.2. Show “Stoplight Chart”
6.3. Linkage Assessment

7. Acceptability Criteria and resultant Model Assessments

7.1. Risk Assessment

7.1.1. Assess Risks
- Address risk involved in using planned models/architecture
- Explain plan for mitigating risk

7.2. Show summary of total architecture to include all MOEs and associated linkages
7.3. Summary Comments

8. Summary Comments and Recommendations
8.1. Accreditation Comments
- Summarize success potential of model architecture
8.2. Recommendations
- MAJCOM DR/XR or Study Sponsor