



Developing a Milestone-A Analysis of Alternatives Cost Estimate

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**Joint ISPA / SCEA Conference
June 8 - 11, 2010**



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Milestone-A Cost Analysis Policy

- ❖ **Weapon Systems Acquisition Reform Act of 2009**
- ❖ **DoDI 5000.02 Revision (8 December 2008)**
 - Mandatory Materiel Development Decision (MDD)
 - Milestone-A Independent Cost Estimates
 - Milestone-A Component Cost Estimates
 - **Milestone-A Analyses of Alternatives (AoA)**

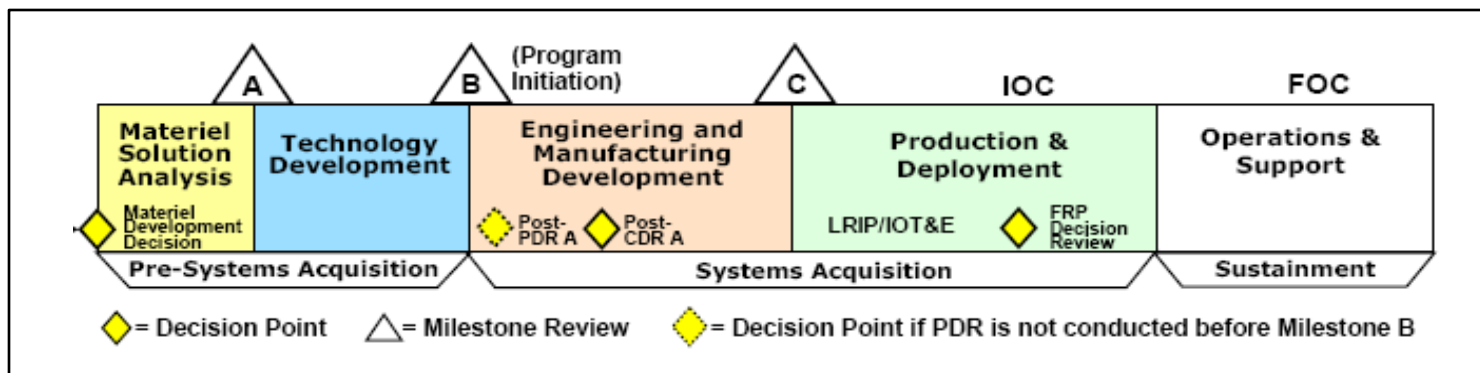


Figure 1: The Defense Acquisition Management System
(Source: DoDI 5000.02 Dated 8 December 08)



Analysis of Alternatives (AoA)

❖ What is an AoA?

- A key element of the Defense acquisition process.
- Analyzes a spectrum of solutions to fill a set of identified capability gaps.
 - Each alternative is analyzed and rated not only based on its military utility but also its cost effectiveness.
- Used by senior leadership to debate and assess a program's necessity, desirability and affordability.
- Most commonly is conducted in the Milestone-A timeframe before an acquisition program is established.

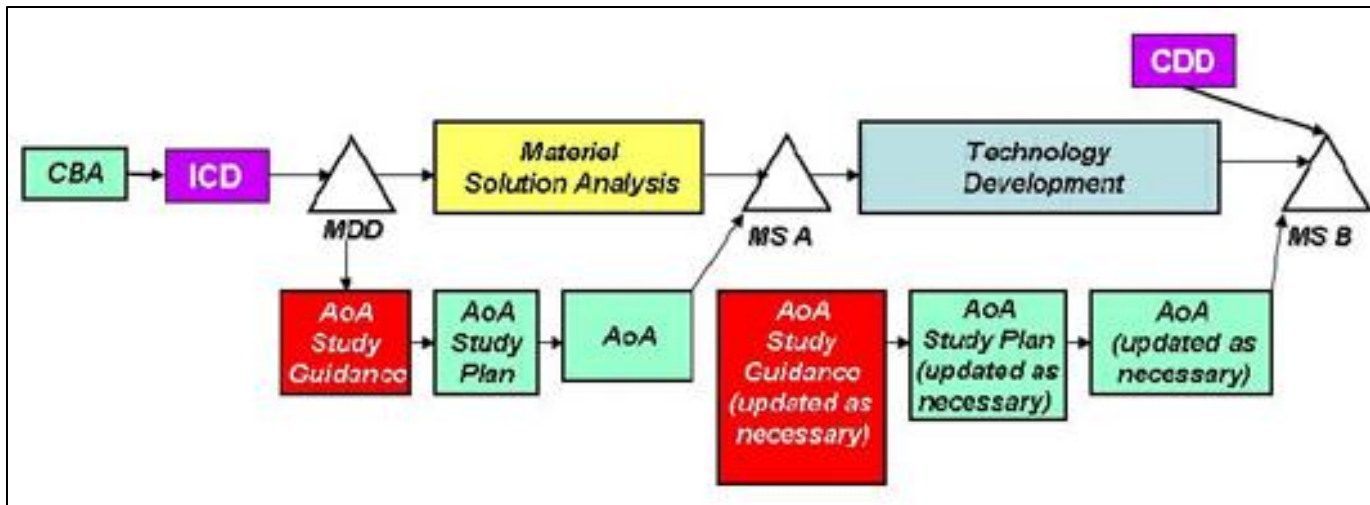


Figure 2: The AoA Within the Defense Acquisition Management System
(Source: Defense Acquisition Guidebook Dated 19 March 10)



Milestone-A Cost Analysis Challenges

❖ Data Availability and Suitability

- Limited system definition and lack of design maturity
 - Typically only requirements or desired capabilities are known
- Lack of data traditionally used in cost analysis
 - Quantities, schedules, and acquisition strategy are typically lacking
 - Program office typically not available to support cost analysis or data inputs



Figure 3: Cost Analysis Data Progression

❖ Aggressive Study Timelines

- 3-6 month duration to complete cost analysis

❖ Partial or Inadequate Understanding of Alternatives

- 4-10 alternatives per AoA

❖ Leadership Expectations Management



Case Study

Integrated Air and Missile Defense (IAMD) System of Systems (SoS) Analysis of Alternatives (AoA)

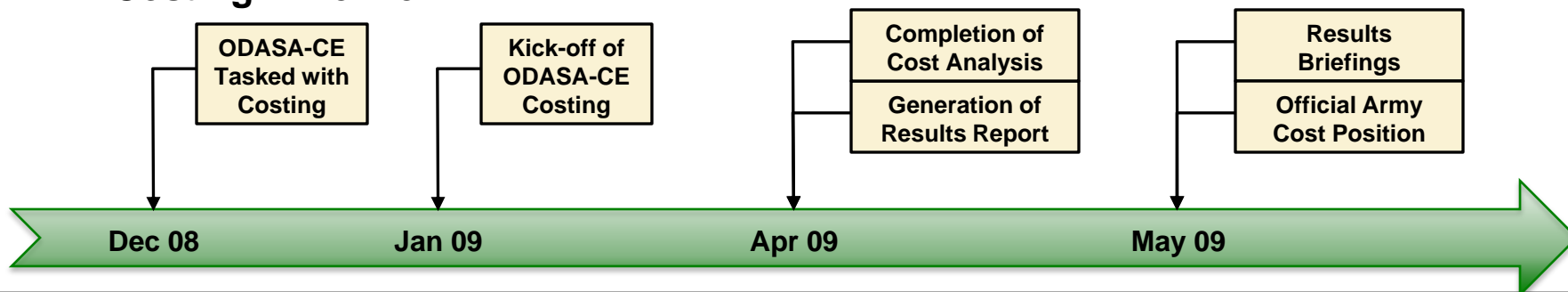
December 2008 – May 2009



IAMD AoA Study Background

- ❖ Future ACAT I program.
- ❖ Objective was to fully integrate (make interoperable) sensor, shooter, and command/control capability within the Army.
- ❖ Total of four alternatives to be evaluated.
 - Status Quo
 - Consisted of fielded and/or funded systems and technology.
 - Enhanced Status Quo
 - Required an additional (fielded) system to be integrated into the Status Quo.
 - Upgrade
 - Upgrade of a recently fielded system.
 - New Material Solution

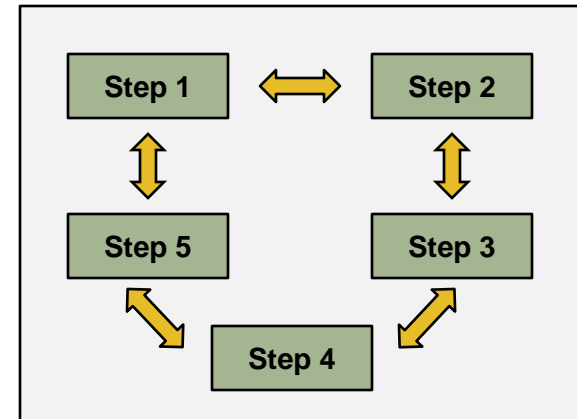
❖ Costing Timeline:





AoA Analysis Steps

- ❖ **Step 1: Project Familiarization**
- ❖ **Step 2: Cost Driver Identification**
- ❖ **Step 3: Data Collection**
- ❖ **Step 4: Methodology Development and Execution**
 - Research, Development, Test, and Evaluation (RDT&E)
 - Procurement
 - Operations and Support (O&S)
 - Risk Analysis
- ❖ **Step 5: Documentation and Presentation of Results**





Step 1: Project Familiarization

IAMD AoA

- ❖ **Obtained and reviewed all available documentation:**
 - Initial Capabilities Document (ICD); OSD Study Guidance; Army Study Guidance; etc.
- ❖ **Conferred with the other functional areas of the AoA team.**
- ❖ **Considerable analytical effort was spent on determining and verifying the composition of the alternatives.**
 - Worked closely with system engineers to obtain and review necessary system architecture diagrams.
 - Worked closely with alternatives architect to develop simplified alternative architecture diagrams.

Lessons Learned

- ❖ **Existing analysis or specifications are extremely beneficial and serve as a natural starting point.**
- ❖ **Typical documents available pre-Milestone-A are:**
 - Functional Needs Analysis (FNA); Functional Solutions Analysis (FSA), and Initial Capabilities Document (ICD).
- ❖ **Alternative Development and Effectiveness Analysis components of the AoA team are of particular importance.**



Step 2: Cost Driver Identification

IAMD AoA

- ❖ Identified cost drivers for the various systems included within alternatives as well as the alternatives as a whole.
- ❖ Cost drivers were composed of capabilities and/or performance parameters.
- ❖ Utilized existing documentation where applicable.
- ❖ Knowledge of the four alternatives as well as the systems within them was critical.
 - Knowledge obtained from project familiarization.
- ❖ Identification and use of subject matter experts (SMEs) was critical.
- ❖ Cost drivers used to better define data to be collected (Step 3).

Lessons Learned

- ❖ Existing documentation such as the ICD or FSA usually reference key performance parameters or gaps, which may assist in the identification.
- ❖ Being 'well versed' in regards to the alternatives is extremely helpful.
- ❖ Assistance of SMEs is extremely helpful.
 - Utilize the expertise within the various AoA teams as much as possible.



Step 3: Data Collection

IAMD AoA

- ❖ **Data to be collected correlated to cost drivers identified previously (Step 2).**
- ❖ **Data collected for both systems included within alternatives, as well as system analogues.**
- ❖ **Collected cost, schedule, software, and relevant performance/technical data.**
- ❖ **Utilized several authoritative DoD data sources:**
 - Program Office/Program Executive Office-source data such as a CARD; Selected Acquisition Reports (SARs); and budget exhibits.
- ❖ **Utilized Subject Matter Experts (SME) to gather additional data.**

Lessons Learned

- ❖ **Critical to focus data collection.**
 - Strike a balance between the body of data desired in an ideal situation and the data call magnitude that will yield the most comprehensive response.
- ❖ **Is a time-intensive effort.**
- ❖ **Will be on-going throughout the analyses.**
 - Important to establish SME contacts and identify data sources.
- ❖ **Will likely need to be initiated prior to alternative development in order to maintain timelines.**



Step 4: Methodology Development and Execution

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IAMD AoA

- ❖ Largely based off of cost drivers identified and data collected in previous steps.
- ❖ Developed and applied consistent methodology as well as common ground rules and assumptions across all alternatives within the AoA.
 - Enables equal comparison of alternatives and allows for quality decision-making.
- ❖ Utilized parametric and analogy cost estimating techniques.
- ❖ Costs were estimated at the major appropriation level.

Lessons Learned

- ❖ Each AoA will likely have a somewhat unique costing approach.
- ❖ Selection of cost methodologies depends heavily upon:
 - Cost drivers identified; alternative composition; and the quality and quantity of data collected previously.
- ❖ Often methodology formulation cannot begin until the majority of data is collected.
- ❖ It is critical to use identical methodology as well as common ground rules and assumptions across all alternatives within an AoA.
- ❖ Important to avoid over-specifying or over-assuming.



RDT&E

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IAMD AoA RDT&E

❖ Integration, test, and systems engineering within RDT&E were central to the system's timely delivery and crucial to program success.

❖ Two different approaches taken and cross-checked:

➤ System Interdependency Research Model

- Model leverages the quantity and type of nodes and links, respectively, within a given alternative.
 - *Node*: An element of architecture that produces, consumes, or processes data.
 - *Link*: A representation of the physical realization of connectivity between Nodes.
- On-going research effort initiated in 2003 by ODASA-CE, currently sponsored by OSD AT&L, and largely being conducted by Technomics.
- Analyzed architecture overview charts and DoDAF artifacts.
- Utilized CER to develop initial RDT&E estimates.
 - Factored estimates as appropriate to account for historical growth trends and previous effort completed.

➤ Software Development

- Determined the SLOC needed by each program / alternative to generate the desired functionality.
- Costs were developed from these additional SLOC counts.



Procurement / Operations and Support (O&S)

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IAMD AoA Procurement

- ❖ Utilized actual costs for existing hardware obtained from previous data collection (Step 3).
- ❖ Identified costs for analogous hardware and adjusted for complexity when actual costs not available.
- ❖ Each alternative was consistently burdened to account for government non-recurring effort, systems engineering, systems test, program management, training, data, and fielding.
- ❖ Costs were estimated at the individual system, alternative, and Composite Battalion (BN) level.

IAMD AoA O&S

- ❖ O&S strategy was based on that of a close analogue.
- ❖ 20-year life cycle was assumed.
- ❖ An annual software maintenance factor, per studies leveraged at ODASA-CE, was also applied.
- ❖ Disposal cost per battalion was also calculated and included.
- ❖ Costs were estimated and presented as a cost per battalion per year.



Risk Analysis

IAMD AoA Risk Analysis

- ❖ CER standard error used to build a cost range to capture the uncertainty associated with the estimate.
- ❖ Conducted a schedule risk analysis to assess the Initial Operating Capability (IOC) and later milestone (Milestone-B, C) requirements targets specified.
 - Compared the specified timeline to the actual schedules of analogous programs.

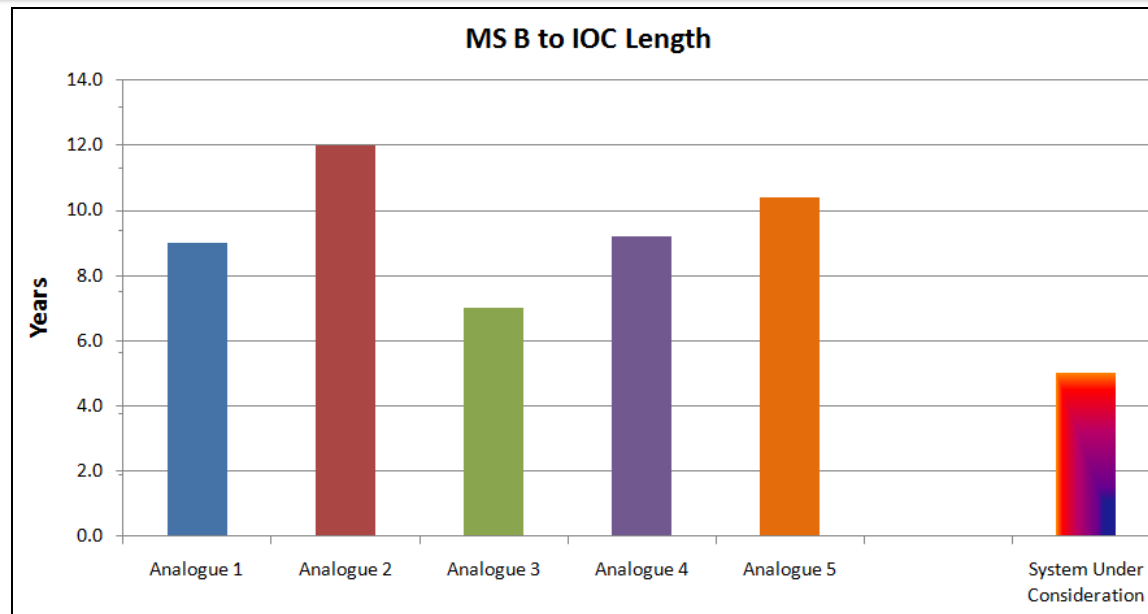


Figure 4: Schedule Risk Analysis Output (Notional Values)



Step 5: Documentation and Presentation of Results



IAMD AoA

- ❖ Costs are displayed at a major appropriation level.
- ❖ Costs displayed at ranges in order to communicate the risk and uncertainty associated with these estimates.

\$M (2008)	Base Case	Alternative 1	Alternative 3	Alternative 4
RDT&E (Total Cost)	\$ 10.1 – 25.7	\$ 628.9 – 693.4	\$ 176.1 – 254.2	\$ 1,456.6 – 1,640.9
Procurement (Total Cost for 15 BN)	\$ 257.1 – 270.2	\$ 1,247.6 – 1,281.8	\$ 725.5 – 756.8	\$ 1,442.31 – 1,510.1
O&S (Total Cost for 15 BN)	\$ 738.6 – 751.8	\$ 2,812.0 – 3,032.7	\$ 1,752.0 – 1,878.0	\$ 4,243.0 – 4,664.0
Total Costs	\$ 1,005.8 – 1,047.7	\$ 4,689.4 – 5,007.9	\$ 2,653.6 – 2,889.0	\$ 7,141.9 – 7,815.0

Table 1: AoA Cost Results with Risk Ranges (Notional Values)



Summary

- ❖ **Key DoD guidance recently revised mandating Milestone-A decision points and analysis.**
- ❖ **AoA is a key element of the Defense acquisition process.**
 - Analyzes the military utility and cost of a spectrum of solutions intended to fill a set of identified capability gaps.
- ❖ **Milestone-A cost analysis has inherent complexities and challenges.**
 - Lack of data, system definition, etc.
- ❖ **Each pre-Milestone-A project will be different, and different scenarios may call for different analysis approaches.**
- ❖ **ODASA-CE conducted the independent cost analysis for the IAMD AoA.**
 - Consisted of four alternatives.
- ❖ **Five analysis steps were followed to complete the cost analysis.**
 - Project Familiarization;
 - Cost Driver Identification;
 - Data Collection;
 - Methodology Development and Execution; and
 - Documentation and Presentation of Results.



Questions or Comments?

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