

# U.S. Army Cost Benefit Analysis Guide



*2<sup>nd</sup> Edition*

*8 April 2011*

*Prepared by Office of the Deputy Assistant Secretary of the Army (Cost and Economics)*



DEPARTMENT OF THE ARMY  
WASHINGTON DC 20310

DEC 30 2009

MEMORANDUM FOR PRINCIPAL OFFICIALS HEADQUARTERS, DEPARTMENT  
OF THE ARMY

SUBJECT: Cost-Benefit Analysis to Support Army Enterprise Decision Making

1. As Army leaders, we must be responsible stewards of the funds entrusted to our care. This is particularly true now, as we strive to meet the challenges of persistent conflict in an era of constrained resources. We must make the best possible use of our limited funds and ensure that no significant resource-related issue is decided without a thorough review of its costs, its projected benefits, and the trade-offs that might be required to pay for it. In our decision making, we need to supplement professional experience and military judgment with solid data and sound analytical techniques.
2. Toward this end, we are directing that each unfunded requirement and new or expanded program proposal submitted to the Secretary of the Army, Chief of Staff, Army, Under Secretary of the Army or Vice Chief of Staff, Army, be accompanied by a thorough cost-benefit analysis (CBA). This must identify the total cost of the proposal, the benefits that will result, the bill-payers that would be used to pay for it, and the second and third level effects of the funding decision. The net result of the CBA should be a strong "value proposition" – a clear statement that the benefits more than justify the costs and required trade-offs. CBAs will be prepared using the attached template and reviewed and approved by the Deputy Assistant Secretary of the Army for Cost and Economics (DASA (CE)).
3. These measures will enable us to make better resource-informed decisions and will contribute to the Army's overall mission effectiveness.
4. The POC for this action is Mr. Stephen Bagby, the DASA (CE). He can be reached at 703-692-1722.

A handwritten signature in black ink, appearing to read "P. Chiarelli", followed by a horizontal line.

Peter W. Chiarelli  
General, U.S. Army  
Vice Chief of Staff

A handwritten signature in black ink, appearing to read "J. Westphal", followed by a horizontal line.

Joseph W. Westphal  
Under Secretary of the Army

Enclosure



THE SECRETARY OF DEFENSE  
1000 DEFENSE PENTAGON  
WASHINGTON, DC 20301-1000

DEC 27 2010

MEMORANDUM FOR SECRETARIES OF THE MILITARY DEPARTMENTS  
CHAIRMAN OF THE JOINT CHIEFS OF STAFF  
UNDER SECRETARIES OF DEFENSE  
DEPUTY CHIEF MANAGEMENT OFFICER  
ASSISTANT SECRETARIES OF DEFENSE  
GENERAL COUNSEL OF THE DEPARTMENT OF DEFENSE  
DIRECTOR, OPERATIONAL TEST AND EVALUATION  
DIRECTOR, COST ASSESSMENT AND PROGRAM EVALUATION  
INSPECTOR GENERAL OF THE DEPARTMENT OF DEFENSE  
ASSISTANTS TO THE SECRETARY OF DEFENSE  
DIRECTOR, ADMINISTRATION AND MANAGEMENT  
DIRECTOR, NET ASSESSMENT  
DIRECTORS OF THE DEFENSE AGENCIES  
DIRECTORS OF THE DOD FIELD ACTIVITIES

SUBJECT: Consideration of Costs in DoD Decision-Making

On August 9, 2010, I directed that any new proposal or initiative, large or small, be it policy, program, or ceremony, come with a cost estimate. To implement this plan, the Director, Cost Assessment and Program Evaluation, working with the military departments, established a Cost Guidance Group to develop guidance, methods, and tools that assist DoD employees in estimating costs associated with Department's business activities.

As of December 1, 2010, the resulting guidance and support tools have been made available on an internal DoD website (<https://www.cape.osd.mil/costguidance/>) to any DoD employee who has a Common Access Card. The site includes a tool that calculates the approximate costs associated with preparing and publishing a study or report. This tool is intended to improve the transparency of costs associated with reports and studies sponsored or prepared by the Department. The web site also includes tools for calculating government costs associated with personnel attending a conference, sponsoring a conference, hosting a conference, or hosting a DoD-related event or ceremony. In addition, the website includes guidance for performing business case analyses and economic analyses on proposed changes to Department policies or programs.

I urge you to begin using these tools now. I am directing that, effective February 1, 2011, all of these tools be used to calculate costs associated with the aforementioned business activities in the Department. After this date, every new proposal or initiative shall come with a cost estimate, and every report or study shall include the cost of that study on the front cover.



OSD 14152-10



All DoD Components are required to comply with this directive and are expected to fully support and cooperate with the guidance to ensure that costs are routinely considered in decision-making throughout the Department.

A handwritten signature in black ink, appearing to read "Robert M. Gates". The signature is written in a cursive style with a large initial "R" and a long, sweeping underline.

## Updates and Changes to Version 2.0

Date	Version	Description of the Change
4/8/2011	2.01	Updated example to reflect the use of constant and current dollars.

## Updates and Changes to Version 1.0

Added the Secretary of Defense’s memorandum on “Consideration of Costs in DoD Decision-Making” dated December 27, 2010.

### Introduction

- New location for CBA related documentation (The Cost and Performance Portal)
- Revised 8-Step methodology
- Who Can Perform a Cost Benefit Analysis?
- When Should a Cost Benefit Analysis Be Performed?
- Cost Benefit Analysis and Teamwork
- Cost Benefit Analysis and Value Proposition
- Cost Benefit Analysis and the Military Decision Making Process
- Pre-CBA Considerations

### Cost Benefit Analysis Steps—A Short Summary

- Divided former Step 4 (Define Alternatives with Cost Estimates) into two steps: Step 3 “Define Alternatives” and Step 4 “Develop Cost Estimates for Each Alternative under Consideration”

### Step 1—Renamed to Define the Problem/Opportunity

- Include the term “Opportunity” with the discussion of defining and scoping of the problem. It is common to be confronted with a favorable situation which could benefit an organization if it is taken advantage of.
- Moved the topic of “Scope” to Step 2. It is a better fit logically.
- New section “Background and Circumstances” to provide contextual information necessary to CBA reviewers.

Step 2 --- Renamed to “Define Scope; Formulate Facts and Assumptions.

### Step 3—Define Alternatives

- Reorganization—“Define the Status Quo” and “Define Alternative Courses of Action”. Detailed explanation of Status Quo including: “Status Quo as Baseline,” “Documenting the Status Quo,” “Other Functions of the Status Quo”. Major change: Status Quo is not the baseline against which all other COAs are measured. Status Quo is used as baseline for comparison to estimate savings, cost avoidance, other aspects of how a given COA represents improvement over baseline. Status Quo may be treated as COA if meets program requirements.
- Expanded list of questions for evaluation of alternatives provided.

### Step 4—Develop Cost Estimates for Each Alternative

- Cost estimating process completely overhauled.

- New discussion of constant and current dollars.
- Appendix 4A Special Topic: Cost Estimating Methodologies
- Appendix 4B Special Topic: Personnel Costing added
- Appendix 4B Special Topic: Installation Costing added

#### Step 5—Identify Quantifiable and Non-Quantifiable Benefits

- Discussion on non-quantifiable Cost.

#### Step 6—Alternative Selection Criteria

- How to Develop Selection Criteria
- “Quantitative Methods” re-titled “Financial Criteria”; Internal Rate of Return and Rate of Return removed from recommended methods has been moved to Step 7.

#### Step 7—Compare Alternatives

- The sub-elements have been re-organized for clearer presentation of the material.
- New decision matrix example has been added.
- New classification of risk as: Business/Programmatic, Operational, Process, Technical, Schedule, and Organizational.
- Discussion of Mitigation Plans.

#### Step 8 – Report Results and Recommendations

- Recommendation to document a CBA using a written narrative vs. PowerPoint briefing.
- Revised suggested briefing format for summarizing the results of a CBA.
- Reference to a tool to develop worksheets that are both logical and easy to maintain.
- New supplementary content re: glossary, timeline, and coordination.

#### Case Study

- New Case Study Narrative and example charts.

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## Purpose

The purpose of the *Cost Benefit Analysis (CBA) Guide* is to assist Army analysts and agencies in preparing CBA to support Army decision makers. Based on a structured process, this Guide will assist analysts in identifying, quantifying, and evaluating the future costs and benefits of alternative solutions. It will also assist in identifying the optimum course of action for decision-making purposes.

This Guide is intended for general use in functional areas where CBA guidance does not exist. In some areas, such as weapon systems acquisition, guidance for cost estimating has already been published; analysts in these areas do not need to follow this Guide.

## Introduction

In today's resource-constrained environment, the Army must exercise wise stewardship of every dollar it manages. A key element in that stewardship is to develop and use sound CBA practices throughout all requirement/resourcing processes. For every proposed program, initiative or decision point that will be presented to decision makers, it is important to provide an accurate and complete picture of both the costs estimates and the benefits to be derived.

The Secretary of Defense as well as the Senior Leaders of the Department of the Army have mandated the use of CBAs to support resource decision making. Two important memorandums on the subject of CBAs (particularly the use of cost in decision making), have been included in this Guide, just before the table of contents. The first memorandum was written by The Undersecretary of the Army and the Vice Chief of Staff of the Army and the other one by the Secretary of Defense. These two memorandums establish the imperative for the use of CBAs in decision making.

To implement the requirements as described in these two memorandums, the Office of the Assistant Secretary of the Army (Financial Management & Comptroller (OASA (FM&C)) developed this Guide. The Guide is applicable to a wide range of requirements, issues, tasks, and problems that require a deliberate analysis to arrive at the optimum course of action.

This Guide describes a CBA process that comprises eight major steps.

1. Define the problem / opportunity. Include background and circumstances.
2. Formulate Assumptions and Identify Constraints
3. Define and document alternatives (including the status quo if relevant)
4. Develop cost estimates for each alternative (including status quo if relevant)
5. Identify Quantifiable and Non-Quantifiable Benefits
6. Define Alternative Selection Criteria
7. Compare Alternatives
8. Report Results and Recommendations

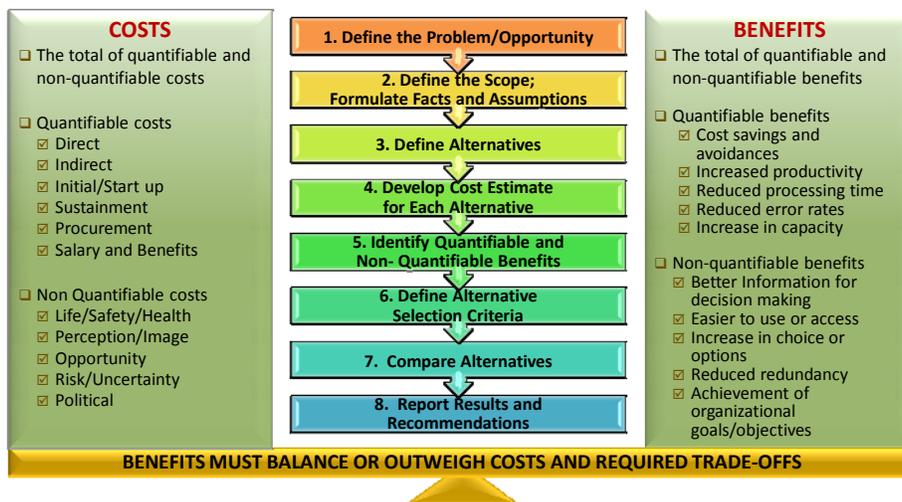
A short description of each step may be found at the end of this section (Pages 18-20).



## The CBA Eight-Step Process



Using analysis to make the case for a project or proposal:  
Weighing the total expected costs against the total expected benefits  
over the near, far, and lifecycle timeframes from an *Army enterprise* perspective.



When this Guide refers to the Army enterprise, it means that initiatives should be evaluated based on the benefits they provide to the Army as a whole, not to any individual organization. CBA makes the case for a project or proposal, weighing the total expected costs against the total expected benefits, over the near, far, and lifecycle timeframes, from an Army enterprise perspective.

### Documenting a CBA

The preferred method of documenting a CBA is through the use of narrative using a word processing application such as Microsoft Word with supporting documentation as required. Supporting documentation, in this sense, consists of files that capture the cost data, calculations, methodology and data references that were used to create the estimate. In addition, the use of presentation software such as Microsoft PowerPoint is acceptable but is not the recommended choice. PowerPoint is best used as a means of presenting summary

details of a CBA for briefing purposes. In general, a narrative description better details as the situation and analysis that are necessary for CBA.

This Guide includes an example CBA in narrative format and also includes a suggested PowerPoint briefing format for those who prefer or require it. However, using PowerPoint does not remove or lessen the requirement for a thorough CBA.

Appendix E, beginning on page 122 of this Guide, contains an example of a completed CBA and format that follows the eight-step CBA process. It is imperative to note that the format does not serve as a substitute for a well-written, documented CBA.

### **The CBA Guide Online**

This Guide, the briefing format, and other helpful resources may be found on the Cost and Performance Portal located at:

<https://cpp.army.mil>

Requirements to access the new CBA portal in the CPP:

1. You must have a current AKO account.
2. You must register and obtain a CPP account. Please go to <https://cpp.army.mil> and follow the registration instructions.

The goal of this Guide is to make CBA process as clear and user-friendly as possible. OASA (FM&C) will review and update the CBA Guide as necessary. Questions concerning the CBA process and formulation can be found on the CBA portal under the “help” tab. Comments from users are encouraged and should be submitted to:

[CBA@conus.army.mil](mailto:CBA@conus.army.mil)

### **What Is a Cost Benefit Analysis?**

All CBAs provide decision makers with facts, data, and analysis required to make an informed decision. There is no prescribed length to a CBA. Quality is genuinely more important than quantity.

A CBA:

- Is a decision support tool that documents the predicted effect of actions under consideration to solve a problem or take advantage of an opportunity.
- Is a structured proposal that functions as a decision package for organizational decision makers.
- Defines a solution aimed at achieving specific Army and organizational objectives by quantifying the potential financial impacts and other business benefits such as:

- Savings and/or cost avoidance
- Revenue enhancements and/or cash-flow improvements
- Performance improvements
- Reduction or elimination of a capability gap
- Considers all benefits to include non-financial or non-quantifiable benefits of a specific course of action (COA). This feature is important because although the financial data may favor one COA over another, there may be situations where the non-financial data/information is considered more important to the analyst or senior decision maker.
- Includes an analysis of business process performance and associated needs or problems, proposed alternative solutions, assumptions, constraints, and a risk analysis. It is process oriented. It will not only develop a set of choices that will be analyzed but will also lead the analyst to a recommended choice.
- Provides an evaluation and justification of a proposed solution (including any associated expenditures) before a significant amount of funds are invested.
- Documents the purpose for the investment and the options available and describes how the investment helps the organization reach its goals. Guides the decision maker to focus on the major issues surrounding the recommended solution and to not spend time on minor issues.
- Requires the consideration of billpayers.
- Must be tailored to fit the problem, because finding the optimal solution is the focus of the CBA.
- Supports the decision making process, but will not make a final decision. That will be the responsibility of the decision maker/leadership.
- Is not a substitute for sound judgment, management, or control.

Finally, a CBA is a living document. It is important for the preparer to keep the CBA updated so that the decision maker can make an informed decision based upon the best available information.

### **Who Can Perform a Cost Benefit Analysis?**

According to Army directives, cost benefit analyses must be performed by government employees. A CBA may be developed by a contractor but should be reviewed and validated by the government.

### **When Should a Cost Benefit Analysis Be Performed?**

A CBA must be performed in these situations:

- When required by USA/VCSA memo (see beginning of this guide).
- Per Army Program Guidance Memorandum (APGM)—new or enhanced program proposals that meet certain criteria to include, but not limited to, prescribed dollar thresholds.

- With Force Design updates and Concept Plans or as part of VCSA portfolio analyses.
- When issues will be considered by ACP, BRP, or AR2B.
- In response to directives from Army leadership, OSD (see SECDEF Memo at the beginning of this Guide), or Congress.
- In concert with acquisition actions not associated with a decision milestone or precedence.
- When other higher Headquarters, service regulations, or guidance requires a CBA.
- When the organization is requesting capital budget funds.
- When the decision involves a choice between two or more options.
- When it is prescribed by a specific functional agency.

### **Cost Benefit Analysis and Teamwork**

It is strongly recommended that development of a CBA should be accomplished as a team effort, not only by an individual. When decision makers or leadership assign the task of developing a CBA to an individual, it is the responsibility of that person to recruit a team to accomplish the goal. Team members should have expertise in the specific areas addressed by the CBA, or subject matter experts should be consulted. Subject matter expertise could be needed in any number of areas, such as cost estimating, personnel, equipment, facilities, and logistics. From the beginning of the process, expectations of performance and outcomes should be clear. The CBA must form a cohesive and comprehensive document: there must be clear understanding of how all individual points come together as a whole. Otherwise, the CBA may be too choppy or incomprehensible. The benefit of building a CBA as a team effort is the production of a better document: the different ideas of each team member make the final CBA stronger and richer.

### **Cost Benefit Analysis and Value Proposition**

The final CBA presented to the decision maker must provide a recommendation that meets the objective of the CBA, as well as a value proposition that supports the recommendation. A value proposition is a clear statement that the benefits more than justify the costs, risks, and tradeoffs/billpayers. In other words, **a value proposition is a short statement that describes the tangible results/value a decision maker can expect from implementing the recommended course of action and its benefit to the Army.** A value proposition should tell the decision maker exactly what can be achieved by implementing the recommended course of action.

An example of a strong value proposition: “By adopting the enhanced inventory management system, the command will be able to reduce the time it takes to fill orders for spare parts by 22% by FY 2012, leading to a cost avoidance of nearly \$2M per year.” It is specific, and reports tangible, attractive results.

An example of a weak value proposition: “Implementing this course of action will improve efficiency and morale.” While efficiency and improved morale are valid benefits, the statement is weak because it is vague and does not report tangible results. It provides no proof.

## **Cost Benefit Analysis and the Military Decision Making Process (MDMP)**

The CBA process and the MDMP have much in common. They are both designed to produce a well-reasoned solution to an identified problem. The MDMP is described in Appendix B of FM 5-0: “The Operations Process.” The MDMP helps leaders apply thoroughness, clarity, sound judgment, logic, and professional knowledge to understand situations, develop options to solve problems and reach decisions. Like the CBA methodology, it is an iterative process. The table below summarizes the seven steps of the MDMP.

### ***The Military Decision Making Process***

<b>Key Inputs</b>	<b>Steps</b>	<b>Key Outputs</b>
<ul style="list-style-type: none"> <li>Higher headquarters’ plan or order or a new mission anticipated by the commander</li> </ul>	Step 1: Receipt of Mission	<ul style="list-style-type: none"> <li>Commander’s initial guidance</li> <li>Initial allocation of time</li> </ul>
<ul style="list-style-type: none"> <li>Higher headquarters’ plan or order</li> <li>Higher headquarters’ knowledge and intelligence products</li> <li>Knowledge products from other organizations</li> <li>Design Concept</li> </ul>	Step 2: Mission Analysis	<ul style="list-style-type: none"> <li>Mission statement</li> <li>Initial commanders’ intent</li> <li>Initial planning guidance</li> <li>Initial CCIRs and EEFI’s</li> <li>Updated IPB and running estimates</li> <li>Assumptions</li> </ul>
<ul style="list-style-type: none"> <li>Mission statement</li> <li>Initial commanders’ intent, planning guidance, CCIRs, and EEFI’s</li> <li>Updated IPB and running estimates</li> <li>Assumptions</li> </ul>	Step 3: Course of Action (COA) Development	<ul style="list-style-type: none"> <li>COA statements and sketches</li> <li>Revised planning guidance</li> <li>Updated assumptions</li> </ul>
<ul style="list-style-type: none"> <li>Updated running estimates</li> <li>Revised planning guidance</li> <li>COA statements and sketches</li> <li>Updated assumptions</li> </ul>	Step 4: COA Analysis (War Gaming)	<ul style="list-style-type: none"> <li>Refined COAs</li> <li>Potential decision points</li> <li>War-game results</li> <li>Initial assessment measures</li> <li>Updated assumptions</li> </ul>
<ul style="list-style-type: none"> <li>Updated running estimates</li> <li>Evaluated COAs</li> <li>Recommended COA</li> <li>Updated assumptions</li> </ul>	Step 5: COA Comparison	<ul style="list-style-type: none"> <li>Evaluated COAs</li> <li>Recommended COAs</li> <li>Updated running estimates</li> <li>Updated assumptions</li> </ul>
<ul style="list-style-type: none"> <li>Updated running estimates</li> <li>Evaluated COAs</li> <li>Recommend COA</li> <li>Updated assumptions</li> </ul>	Step 6: COA Approval	<ul style="list-style-type: none"> <li>Commander-selected COA and any modifications</li> <li>Refine commander’s intent, CCIRs, and EEFI’s</li> <li>Updated assumptions</li> </ul>
<ul style="list-style-type: none"> <li>Commander-selected COA with any modifications</li> <li>Refined commander’s intent, CCIRs, and EEFI’s</li> <li>Updated assumptions</li> </ul>	Step 7: Orders Production	<ul style="list-style-type: none"> <li>Approved operation plan or order</li> </ul>

## The Military Decision Making Process (Cont.)

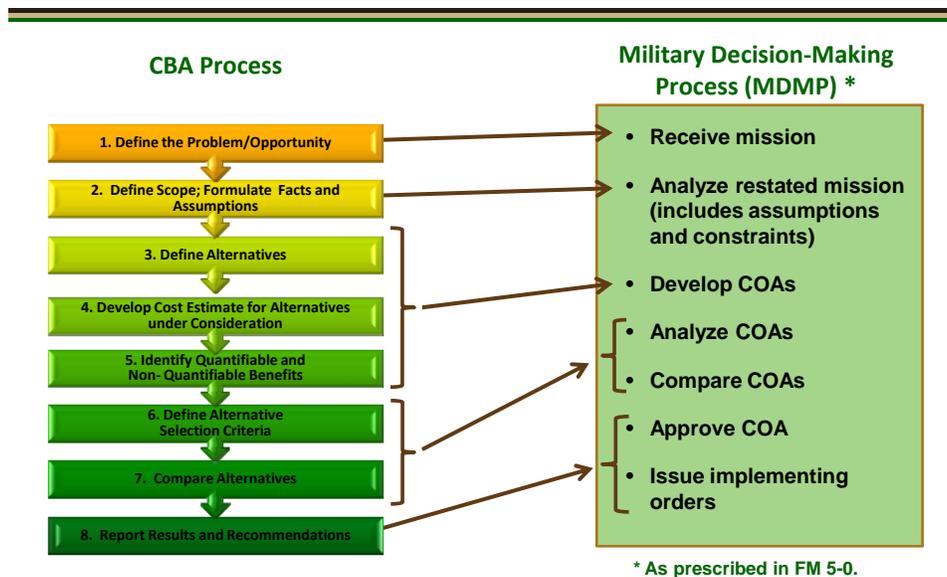
CCIR = Commander's critical information requirement

EEFI = Essential element of friendly information

IPB = Intelligence preparation of the battlefield

### CBA vs. the MDMP

## Cost Benefit Analysis and the MDMP



The two processes are essentially complementary. The only meaningful difference of note is that the MDMP does not specifically address financial cost as part of its analysis. Financial resourcing considerations are not required in the development of operation plans (OPLANs) and operation orders (OPORDs).

### Pre-Cost Benefit Analysis Considerations

Before beginning the task of developing a CBA, it is helpful to perform some pre-analysis which will improve the chances of a high quality product whose COAs best address the problem statement/opportunity. While these considerations are not a substitute for a fully developed CBA, this pre-analysis will often facilitate the development of the CBA.

First, determine whether there is a clear need for a CBA. Is it the best tool/methodology to address the situation? Second, identify and understand the authority (e.g., statutory, regulatory, directive) that is generating the requirement for the CBA. Third, the decisions that CBAs inform should support the goals and objectives of the organization and its leadership.

The person or persons responsible for preparing and submitting the CBA should know exactly who the decision maker will be and what he/she is expecting from the CBA. It is strongly recommended that the submitter meet with the decision maker prior to beginning the CBA and at regular intervals during the development of the CBA. A constant dialogue between the two parties ensures that the CBA will be on target.

It often saves time and improves the content of the CBA if the submitter, in consultation with the decision maker, develops an initial problem statement/opportunity, and identifies assumptions, constraints and selection criteria early in the process of developing the CBA. It is also helpful to develop an initial rough order of magnitude (ROM) cost estimate and the benefits to be derived. As the CBA evolves, these elements may be reviewed and improved upon as needed.

### **Quick Review**

The primary objective of developing a CBA is to identify and obtain approval of the optimum course of action to solve a specific problem or capitalize on a specific improvement opportunity. Keep the following in mind to increase the chance of success.

- A CBA is needed when there is a choice to be made between several options. A CBA is not needed if there are no other options, e.g. when legislation, directives, or instructions mandate the funding of a given project.
- The CBA team should include subject matter experts.
- The recommendation should include a concise value proposition, to catch the attention of the decision maker and emphasize why the recommended COA is the best choice.
- The MDMP methodology is very similar to that of the CBA. The essential difference between the two decision-making methodologies is the MDMP is not affected by financial resources.

## Cost Benefit Analysis Steps – A Short Summary

### **1. Define the Problem/Objective. Describe Background and Circumstances that have Contributed Towards the Need for a Cost Benefit Analysis.**

*The problem statement clearly defines the problem, need, or opportunity that requires a solution and describes what the effort intends to accomplish.*

*The objective of the effort is to improve, reduce, or increase some aspect of a process, procedure, or program. Objectives should be measurable, realistic, achievable, and results-oriented. Simply put, objectives are measurable outcomes.*

*The background and circumstances define and assess the current state/condition. They provide the contextual information needed to fully understand the problem, need, opportunity addressed in the Cost-Benefit Analysis.*

### **2. Define Scope; Formulate Facts and Assumption.**

*The Scope defines the range of coverage encompassed by an initiative or proposal along specific dimensions like time, location, organization, technology or function.*

*A fact is something that is empirically true and can be supported by evidence. Include only relevant facts – those items of information that have a direct bearing on the CBA being developed. Constraints which are facts usually refer to limits placed on resources to be devoted to the project. Constraints or barriers are normally beyond the control of the analyst and provide limitations within which analysis takes place.*

*Assumptions are factors or conditions that are essential to the success of the solution and are beyond the control of the organization. Assumptions define the ground rules and accepted statements in order to limit the scope of the CBA. They are explicit statements of conditions on which the CBA is based.*

### **3. Define Alternatives.**

*Alternatives (including the status quo) are potential solutions to the problem statement or means to achieve the objective.*

*Alternatives should reflect a review of the mission and strategic goals to verify that the alternative's objectives are consistent with the problem statement.*

*The status quo (also known as the "As-Is" state), is the "baseline" program, system, or situation against which the costs and benefits of all feasible alternatives are compared.*

#### 4. Develop Cost Estimates for Each Alternative (including status quo if relevant).

*A cost estimate captures the total cost of each alternative over its entire life cycle and is a summation of all relevant cost elements.*

*Cost estimates should reflect both direct and indirect costs as well as costs which will affect organizations and entities outside the intended scope of the cost benefit analysis.*

#### 5. Identify Quantifiable and Non-Quantifiable Benefits.

*Benefits are results expected in return for costs incurred for a given alternative. They are the quantitative and qualitative improvements expected or resulting from the implementation of an alternative.*

*Quantifiable benefits are benefits that can be assigned a numeric value such as dollars, physical count of tangible items, or percentage change.*

*Non-quantifiable benefits are subjective in nature and can make a positive contribution to the analysis. An example of non-quantifiable benefits is improvement in aesthetics.*

#### 6. Define Alternative Selection Criteria.

*Alternative selection criteria are those standards/bases on which a decision will be based. CBAs must contain documentation that outlines decision criteria and identifies the extent to which each alternative satisfies each of the criteria.*

#### 7. Compare Alternatives.

##### a. Risk Assessment and Mitigation

*Risk assessment describes all risks that can impact the achievement of stated benefits or the cost of solving the business problem. Each risk has an associated mitigation strategy and an assessment of likelihood of occurrence.*

##### b. Identify Second and Third Order Effects (Cause and Effect)

*Second and third order effects are the results (consequences and/or impacts) stemming from a decision. They identify what a decision maker may do or not do as a result of a decision. Where possible 2<sup>nd</sup> and 3<sup>rd</sup> order effects should be quantified, particularly as they relate to costs.*

### c. Compare Costs and Benefits

*The essence of the CBA process is in comparing the costs and benefits of two or more alternatives (including the status quo) in order to select the preferred alternative.*

*As a general rule, the preferred alternative is the alternative that provides the greatest amount of benefits in relation to its cost.*

### d. Perform Sensitivity Analysis

*Sensitivity analysis explains what the effect is on the cost/benefit model should assumptions change, risks become issues and/or dependencies not be met.*

### e. Resourcing Considerations (Billpayers)

*Billpayers are the funding sources that have been identified which will cover (partially or entirely) the costs of an alternative.*

*Note: This sub-step is closely related to sub-step (b.) “ 2<sup>nd</sup> and 3<sup>rd</sup> order effects as they can be quantified in \$ terms.*

## 8. Report Results and Recommendations.

*Results and recommendations summarize the findings of the analysis and make conclusive statements about the comparisons of alternatives.*

*The conclusions should demonstrate the cost/benefit relationships between each alternative.*

*The results address how the alternatives were ranked using the criteria developed in Step 6. Following a clear statement of the conclusions, there should be a firm recommendation regarding the preferred alternative.*

*Define the value proposition: a concise statement that describes the results or value a decision maker can expect from adopting a specific recommendation arising from the CBA.*

### • Identify Supporting Documentation

*All data and other information used in Steps 1-8 must be adequately documented. Supporting information should be identified so decision makers and analysts can understand how Steps 1-8 were developed.*

## **STEP 1 – Define the Problem/Opportunity**

This section discusses three areas:

- Define the initiative or proposal using a problem or opportunity statement
- Define the objective/goal
- Describe the background and circumstances

### **Problem or Opportunity Statement**

The first and one of the most important steps of the CBA process is to define the initiative or proposal using a problem or opportunity statement. A problem statement clearly defines the problem, mission need, and required capability. An opportunity statement is similar to a problem statement, but is focused on taking advantage of a favorable situation. When developing a problem or opportunity statement, the key is to state the problem or opportunity in terms of the organization's mission that requires a solution to describe what the effort intends to accomplish.

- What required performance or outcome is not being achieved?
- What is the perceived capability gap?
- Who and what are impacted by this problem?
- Specifically, who are the customers or stakeholders?
- Briefly describe the process for providing the procedure, product or service where the problem or improvement opportunity occurs and how and why it occurs.

Example of a weak problem statement: "The CAC, Common Access Card, Issuing Process needs to be improved. We've received numerous complaints from DA Civilians and Soldiers." This statement is vague, does not identify the problem, and does not propose a solution to the problem.

Another weak problem statement: "The CAC card processing office needs an increase of \$1M per year to support seven additional employees." This statement only requests a fund increase. It does not explain the problem or why the employees are needed. Requesting additional funding is not a catch-all solution.

Example of a strong problem statement: "The DA Civilians and Soldiers expect the CAC Issuing Process lead time not to exceed 2 hours and the current process lead time has averaged 6.2 hours. The CAC process has shown a steady increase in lead time since January 2006 at Ft. Washington." This statement identifies a problem in real terms. It states when and where the problem started and who is impacted.

## **Objective**

The objective describes what the effort intends to accomplish, why the issue is important to the organization, and who will benefit from the courses of action. The objective should be to fill a capability gap or improve some aspect of a process, procedure, or program. In defining objectives, various elements must be considered: mission needs, costs, level of effort, time schedules, allowable operational changes, and ease of future modification and expansion.

Objectives should be defined in a clear, specific, and measurable manner. Objectives should be realistic, achievable, and results-oriented. The more precisely the objective can be defined, the greater the likelihood that the analysis will meet the needs of the decision maker. The objective statement sets the tone and expectation for the CBA. Some objectives may be related to the correction or improvement of a specific challenge or difficulty which the Army has encountered. Other objectives may involve improvements in the quality, accuracy, and/or timeliness of programs and processes.

Examples of objectives that may be appropriate:

- Reduce number of man-hours of effort required for a mission by a minimum of X%.
- Increase output produced by the organization by no less than X units per month.
- Improve product quality against a given standard of X or less errors per page.
- Provide a new or increased level of service at a reasonable cost.

The objective statement in the CBA should be short and succinct. It is important to ensure that the descriptions for all objectives are easily related to the goals of the CBA.

The objective should be evaluated to ensure that it aligns with the mission and strategic goals of the organization. While defining initiative goals, ensure that they are verifiable through formal measurement.

## **Background**

The background and circumstances define and assess the current state/condition. They provide the contextual information needed to fully understand the problem, need, or opportunity addressed in the Cost Benefit Analysis. Defining the current state is the method of identifying system characteristics (current process or state of operations), users, and stakeholders, as well as the problems with the current system. The information should be detailed to a level where all stakeholders can understand and support conclusions drawn from the analysis. When the creator of the CBA neglects to spend time on the background and circumstances of the situation, stakeholders are given no understanding of the problem or why alternatives are being proposed. Background information must be incorporated into all areas of the introduction to the CBA: problem statement, objectives, scope, assumptions, and constraints.

## **Quick Review**

- The problem statement focuses the CBA.
- The problem statement clearly defines the problem, mission need, or required capability.
- The opportunity statement is focused on taking advantage of a favorable situation. Four attributes of a good problem statement:
  - Defines the problem
  - Identifies where the problem is appearing
  - Describes the size of the problem
  - Describes the impact the problem is having on the organization
- Objectives should be specific and measurable where possible.

## **STEP 2 – Define Scope; Formulate Facts and Assumptions**

This section discusses two areas:

- Define Scope
- Formulate Facts and Assumptions

### **Scope**

The scope of the analysis defines the range of coverage encompassed by the project along specific dimensions such as time, location, organization, technology or function. The CBA should state the involved stakeholders, period of time that the analysis covers, as well as organizations or requirements not covered or addressed in the analysis. Defining the scope of the CBA is critical because it keeps the CBA focused on the things that matter. A well scoped CBA should reinforce the problem statement defined in Step 1.

### **Formulate Facts and Assumptions**

A fact is something that is empirically true and can be supported by evidence. Include only relevant facts – those items of information that have a direct bearing on the CBA being developed. Facts can include constraints, which usually refer to limits placed on resources to be devoted to the project. All managers are faced with certain constraints within which they operate. Constraining organizational policies or procedures, funding considerations, physical limitations, and time-related considerations need to be addressed in the CBA. These policies/considerations could stem from technical, environmental, ethical, or political constraints. External constraints or barriers are normally beyond the control of the analyst and provide limitations within which analysis takes place. While constraints are usually beyond the control of the analyst, they are not necessarily beyond the control of the organization.

Assumptions identify conditions that must exist or events that must occur in order for the recommended COA to be successfully implemented. An assumption involves a degree of uncertainty. Assumptions play a critical role in explaining CBA results, in building credibility for the case, and in reducing and measuring uncertainty in projections. For this reason, regardless of the impact on the analysis, identify all pertinent assumptions. Do not confuse assumptions with facts or statements that, with research, could be presented as factual data.

Here are two examples of assumptions:

- If a landfill is being considered as an alternative to solving a disposal problem stemming from increased waste, the study might include the assumption that “sufficient land for the operation is available within a 20-mile radius of the installation.” In this particular

instance, however, there may have been no reason why this assumption could not be verified with research and presented as a fact.

- If the organization is considering a solution that would require a change to a federal law, the analysis might include an assumption that any required legislative changes would be approved by higher headquarters and enacted by Congress. This is something that is clearly beyond the local organization's ability to control or to know for certain.

In order to properly constrain the analysis, facts and assumptions should be established and fully documented early in the process. This is done to preclude a recommendation that is not feasible or cannot be implemented due to factors beyond the control of the implementing organization. An alternative is feasible only when it satisfies all the restrictions. Facts and assumptions should discuss anything that could impact or affect the quality of the cost estimate as well as be used to highlight cost issues of importance to decision makers. For example,

### **Quick Review**

- The scope should consider dimensions such as time, location, organization, technology or function.
- Facts are verifiable true statements.
- Constraints are factors that limit the number of potential alternatives (i.e. solutions to the problem statement). Constraints may come from outside the organization or may be established by the organization's leadership.
- Assumptions are statements used to describe conditions over which the organization has no control and which are essential to the success of a given solution.
- A CBA should formulate facts (including constraints) and assumptions before defining alternatives.

## **STEP 3 – Define Alternatives**

This section discusses the following areas:

- Define the Status Quo
- The Status Quo Baseline
- Documenting the Status Quo
- Define Alternative Courses of Action

### **Define the Status Quo**

Status quo means the current state or organizational capacity of the organization or program. It is the existing operational capability as of the program start date. It also takes into account the future plan of the organization, such as planned and scheduled changes and/or enhancements to the existing program. Generally, the only time that a status quo does not exist is when a solution is being proposed to address a new requirement or mission.

The status quo may be considered as an alternative, to be compared with other alternatives to find the best solution. Like all CBA alternatives, the status quo should reflect a review of mission and strategic goals. All alternatives should address the base requirement as outlined in the problem statement.

Not all situations requiring a CBA will include the status quo as a viable alternative. If the status quo does not conform to the mission and strategic goals, or does not capably address the requirements or objectives, then it should not be considered as an alternative. Also, higher leadership might direct against considering the status quo as an alternative, and recommend development of COAs in a different direction. A CBA that does not include the status quo as a COA must be fully justified to the organizations reviewing the documentation.

### **The Status Quo as Baseline**

The status quo is often used as a baseline for estimating cost, savings, cost avoidance, and other aspects of how a given COA represents improvement over the baseline. As a COA, the status quo serves to highlight any issues, defects, shortfalls, or strengths inherent in the current state. We compare all COAs, to include the status quo when it is a considered a COA with each other in Step 7. The decision maker can use this information to determine what choices need to be made or how to capitalize on the current situation. For example, if higher efficiency in delivering products to command posts is required, and the status quo shows that there are far too few vehicles to meet the new requirements, then alternatives can be drafted addressing the need for more vehicles.

## **Documenting the Status Quo**

In order to be used as a “measuring stick” the costs and benefits of the status quo must be fully documented and included in the analysis. If the status quo is not included in analysis, a thorough explanation is necessary. Without the status quo costs it is very difficult to evaluate the benefits associated with the new program. Where a status quo exists, omitting it from the cost benefit analysis will reflect negatively upon the analysis and the credibility of realizing any proposed quantifiable benefits.

Some potential sources of documentation are historical Government/contractor data, programmatic, financial and budgetary data/reports, tables of distribution and allowances (TDA), tables of organization and equipment (TOE), and modernization plans. Other sources are audit reports, operating procedures, field manuals, and Army publications. Review procedures and identify tasks and critical decision points within all appropriate organizations. Note that the parameters identified for the status quo must directly relate to, or closely parallel, those defined by the statement of objectives. If the status quo includes scheduled/planned/directed changes or enhancements, these should be included in the estimation/documentation. However, the analyst must be careful when considering factors that may in fact change in a few years. The cost of operating the status quo until the new system or project is fully operational (known as parallel operations) will be a part of the cost of all other alternatives in the cost-benefit analysis. These costs are referred to as Phase-out costs.

## **Define Alternatives / Courses of Action (COA)**

The CBA alternatives should reflect a review of the mission and strategic goals and should address the base requirement as outlined in the problem statement. The status quo alternative is always the first alternative. All alternatives should be viable solutions to the problem statement. Avoid using a COA that is clearly not a reasonable solution simply to offer more choice to the decision-maker. It is better to have fewer viable alternatives than many weak ones.

The number of alternatives can be controlled by avoiding similar but slightly different alternatives (variations on a theme) and by early elimination of non-viable alternatives. The reasons for eliminating potential alternatives should be included in the CBA documentation. Some of the criteria used as a basis for eliminating non-viable alternatives are listed below.

- Unacceptably high cost
- Non-compliance with CBA guidance
- Lack of compliance with established constraints

- Dependence on assumptions that are considered unrealistic
- Non-compliance with law, regulations and/or policy (not only acquisition)
- Unacceptable performance
- Inability to meet Initial Operation Capability (IOC) or full operational capability (FOC) requirements
- Political considerations such as environment, world opinion, treaty compliance, etc.

Because each project requiring a cost benefit analysis is different, the evaluator will have questions and concerns which impact specific aspects of that particular project. The following questions should be considered as guidelines during the preparation, review, and validation of CBA alternatives:

- Do the alternatives reflect a review of mission and strategic goals? Are the alternative's objectives still valid, rather than having been overcome by events or changed by legislation/direction?
- Have all feasible alternatives been considered? Are all alternatives presented feasible?
- Is the status quo presented as an alternative? If not, this needs to be explained in the documentation.
- Are the alternatives distinctly different, rather than restructuring a single course of action?
- Have the alternatives that were eliminated from the analysis been clearly identified and has a rationale been provided for their elimination?
- If other Government organizations can provide the desired product or service, have they been identified as alternatives? If the project increases productive capacity, has a contracting alternative been examined?
- Are the alternatives well defined?
- Are tradeoffs of each alternative clearly stated? Unavoidable and difficult tradeoffs should not be hidden.
- Have the alternatives been developed in cooperation with potentially affected organizations? Working with the organizations who will bear the tradeoff burden is beneficial to the CBA and decision making process.
- If the alternatives overlap one another, are there sufficient differences between them to make them distinctly different, or are they just variations on a theme?

## **Quick Review**

- The status quo presents the case and helps establish expectations for what is to follow.
- The status quo must be developed enough to understand the impact the alternatives will have on it.
- When a comparison is made between the current state and the future state (the optimal situation), the status quo allows for the identification of shortcomings which the CBA should address.
- All feasible alternatives are compared to each other to determine the best alternative.
- All reasonable ways of satisfying the objective should be documented and discussed.
- Alternatives dismissed as infeasible should be noted in the backup CBA documentation.
- Generating alternatives is an important step in the process of preparing a CBA.

## STEP 4 – Develop Cost Estimates for Each Alternative

This section discusses the following areas:

- Cost Concepts
- Cost Analysis / Estimating Process
- Cost Analysis Preparation
- Work Breakdown Structure
- Data Collection and Analysis
- Data Sources
- The Cost Estimate
- Cost Estimating Strategy
- Tradeoffs (Opportunity Costs)
- Organizing Cost Data for Display
- Inflation and Its Impact on Costing
- Special Topics
  - Cost Estimating Methods
  - Personnel Costing
  - Installation Costing

### Cost Concepts

Cost analysis is a critical element in the CBA process. Cost estimates support management decisions by translating resource requirements (e.g. equipment and personnel) associated with programs, projects, or processes, into dollar values. It is one of the most challenging steps in the CBA process. Using the best data available will result in the best estimate. Much of the analyst's time will be spent on obtaining data. Finally, it is important to capture all the costs related to the initiative or project for which the CBA is being developed.

Note: Developing a cost estimate is not the same as developing a budget. While a good cost estimate can be used to develop a budget, a cost estimate is developed without regard to funding source (e.g. appropriation also known as "colors of money"). A discussion of funding source is introduced in Step 7 of this Guide as it relates to the identification of Bill Payers.

**Total Costs = 1<sup>st</sup> Order Costs + 2<sup>nd</sup> and 3<sup>rd</sup> Order Effect Costs.**

1<sup>st</sup> Order Costs are specifically related or tied to the initiative or project under consideration (including direct and indirect costs):

- A **direct cost** is a cost that can be traced easily and conveniently to a specific cost element/object. Example: Salaries for employees or rent for the building the employees occupy.

- An **indirect cost** is a cost that cannot be traced readily to a specific cost object/element. Example: 1<sup>st</sup> Personnel Command occupies several buildings on Ft. Swampy. Direct costs include items such as salaries for military and civilian personnel. Indirect costs include items such as common area maintenance and road repair.

**2<sup>nd</sup> and 3<sup>rd</sup> Order Effect Costs** can be a challenge to identify and quantify as they are usually outside one's control and/or clear visibility. CBA preparers must often use their best judgment in the absence of good data/information.

Example: A need exists for a new non-tactical vehicle. The cost is \$40K per vehicle. But the vehicle will not fit in the maintenance bays. The bay entrances are too narrow. Therefore, the 2<sup>nd</sup> Order Effect of buying this new non-tactical vehicle will be the need to enlarge the entrances to the bays at a cost of \$5,000 per bay.

The topic of 2<sup>nd</sup> and 3<sup>rd</sup> order effects is discussed in Step 7 of this Guide. The important concept to take away from this discussion is the sum of all the direct, indirect, and 2<sup>nd</sup> and 3<sup>rd</sup> order costs should provide a reasonable estimate of the total costs of the COAs under consideration. Finally, when building and organizing a cost estimate, it should be done using cost elements.

### **Other Types of Costs**

As described above, costs can be categorized as direct or indirect. They also be categorized as fixed or variable and as recurring or non-recurring.

- A fixed cost is a cost that remains the same regardless of change in output, while a variable cost is one that changes with changes in output.
- A recurring cost is one that is incurred repeatedly for each organization and/or product/service. This cost must be programmed and resourced each year.
- A non-recurring cost is a cost that will happen only once.

### **The Cost Analysis / Estimating Process**

For our purposes, the terms Cost Analysis and Cost Estimating can be used interchangeably, though cost estimating is technically an activity within the cost analysis process. Cost estimating involves collecting and analyzing historical data and applying models, techniques, tools, and databases to predict a program's future cost. Cost Analysis and Estimation can be used for establishing and defending budgets and drive affordability analysis. Affordability is the degree to which a requirement fits within the Army's overall program and/or budget plan. The affordability of an initiative often depends greatly on the quality of its cost estimate.

Cost estimating is an iterative process that may require reevaluating previous steps, and a systematic approach is necessary to develop accurate and timely estimates. OMB's circular No.

A-94 and best practices established by professional cost analysis organizations identify four characteristics of a high-quality, reliable cost estimate: **It is well-documented, comprehensive, accurate, and credible.**

The following table which explains in greater detail the four characteristics of a cost estimate was adapted from United States Government Accountability Office, GAO Cost Estimating and Assessment Guide, March 2009.

<b>Well Documented</b>
The estimate is thoroughly documented, including source data and significance, clearly detailed calculations and results, and explanations for choosing a particular method or reference
<ul style="list-style-type: none"> <li>• Data are traced back to the source documentation</li> <li>• Documents all steps in developing the estimate so that a another analyst unfamiliar with the program can recreate it quickly with the same result</li> <li>• Documents all data sources for how the data were normalized</li> <li>• Describes in detail the estimating methodology and rationale used to derive each WBS element’s cost.</li> </ul>
<b>Comprehensive</b>
The estimate’s level of detail ensures that cost elements are neither omitted nor double counted.
<ul style="list-style-type: none"> <li>• It completely defines the program / initiative, reflects the current schedule, and contains reasonable assumptions</li> <li>• Details all cost-influencing ground rules and assumptions</li> <li>• It captures the complete scope of the work to be preformed, using a logical work breakdown structure (WBS) that accounts for all performance criteria and requirements. If required, provides a description of each element of the WBS.</li> </ul>
<b>Accurate</b>
The estimate is unbiased, not overly conservative or overly optimistic, and based upon an assessment of most likely costs.
<ul style="list-style-type: none"> <li>• It has few, if any, mathematical mistakes</li> <li>• It has been reviewed for errors like double counting and omitted costs</li> <li>• Cost drivers have been cross-checked to see if results are similar</li> <li>• It is timely</li> <li>• It is updated to reflect changes in technical or program assumptions and new phases or milestones</li> </ul>
<b>Credible</b>
Discusses any limitations of the analysis from uncertainty or bias surrounding data or assumptions.
<ul style="list-style-type: none"> <li>• Major assumptions were varied and other outcomes recomputed to determine their sensitivity to changes in assumptions.</li> <li>• Results were cross checked using a different methodology to determine whether they produce similar results</li> </ul>

## **Cost Analysis Preparation**

Preparation includes knowing the purpose of the estimate, understanding the program/system and establishing a plan to complete the estimate. It is critical that the analyst understands and knows what exactly is to be costed and what is not. Once the purpose is understood, it is important to agree on the end product (deliverable) to the customer. This is also the time to ensure that the scope of the cost estimate is understood and defined and the level the level of detail necessary is adequate to support the alternatives under consideration. Finally, the analyst should understand what the time constraints are that he/she will work under in preparing the CBA. The more cost detail required, the more time and staff the estimate will require.

The following is a short list of examples of documents that could be used to understand program requirements and their materiel and non-materiel solution:

- Organization strategic plans
- JCIDS documents/memo's outlining requirements (CDD, ICD, CPD etc)
- Management Decision Packages (MDEPs)
- Databases of current or historical costs.
- Cost Analysis Requirements Description (CARD)
- Army regulations, pamphlets, and technical manuals
- TRADOC guidance

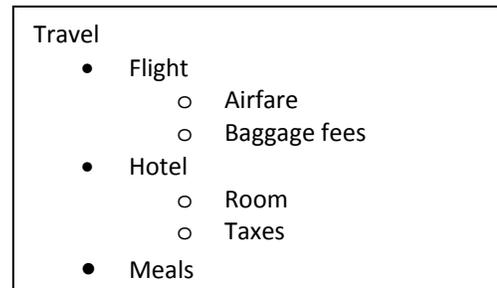
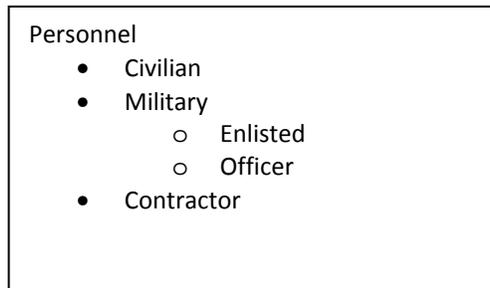
Once all available documents are reviewed, analysts should meet with subject matter experts (program office and contractor) to review and clarify any questions they may have.

## **Work Breakdown Structure (WBS)**

A work breakdown structure defines the detail of the work necessary to accomplish an initiative/proposal's objectives. A typical WBS reflects the requirements, what must be accomplished to develop the initiative/proposal, and provides a basis for identifying resources and tasks for developing a cost estimate. A WBS deconstructs an initiative/proposal's output (deliverables) into successive levels with smaller specific elements (cost elements) that can be analyzed. Cost elements are the lowest level of a cost estimate, and the cost estimate total is the sum of all the cost elements. A well-developed cost element structure helps ensure that no costs are missed or double counted and makes it easier to make comparisons to similar systems and programs.

For example, personnel costs can be further broken down into military and civilian personnel costs which in-turn can be analyzed as to what grade or rank make up these two cost sub-categories. A well defined WBS can be used to develop worksheets used in the cost estimating process (See Organizing Cost Data for Display below).

Examples:



### **Data Collection and Analysis**

Data is a critical component of the cost estimate. Data quality affects the estimate's overall credibility. This step includes the process of identifying, collecting, and analyzing data before applying cost estimating within the analysis process. Data collection can be a time consuming process and continues throughout the cost estimate. In general, data can be associated with activities that generate costs; activities that are defined or described using schedules or dates; and technical requirements of equipment and material.

Develop and implement a formal data collection plan. Data collection may entail the following tasks:

- Identify the types of data needed (e.g., cost, programmatic, schedule, technical).
- Determine and locate sources of data.
- Collect cost data with supporting documentation.
- Determine the sample size of data to be collected for each cost element.
- Determine which estimating methods, tools, and models will be used with which data sets.
- Verify, validate, and adjust (normalize) the data. Cost data are adjusted in a process called normalization, which improves the quality of the data. In short, normalization ensures apples to apples comparison vs. apples to oranges.
- Collect data continuously throughout the pre-cost estimating process.

## Data Sources

Below is a list of some potential data sources for cost estimates. Regardless of the nature of the data used, reference the source and the date of the data in the documentation of the CBA.

- The organization's headquarters and its subordinate elements
- Budget and Program Objective Memorandum (POM) submission
- Contract performance data
- Contractors and manufacturing plant visits
- Cost Analysis Requirements Document (CARD)
- Cost libraries
- Historical cost data reports
- Management Decision Evaluation Package (MDEP)
- Manpower utilization records/reports
- ODASA-CE Databases (AMCOS, OSMIS, FORCES and CKB)
- Program Management Offices (PMOs)
- Program Office Estimate (POE)
- Research Development and Engineering Centers (RDECs)
- Subject matter experts
- Trade Studies
- General Services Administration (GSA) Schedule
- Catalogs

In addition to evaluating available data for its utility in cost estimating, the analyst must look for relationships among data. A basic premise is that relationships among data may continue to exist in the absence of known facts and conditions. The presence of these relationships can form the basis for assumptions, cost factors, and CERs. Cost factors and CERs may be expressed in dollars, physical quantities, ratios, or percentages.

Various methods may be used to develop data. However, the chosen method should be relevant, valid, verifiable, and reasonable.

## **The Cost Estimate**

Once the data has been collected and analyzed, and the WBS structure established, it is time to build the estimate. Keep in mind that this is an iterative process and the GR&A data and WBS need to be continually reviewed to see if changes are needed. Normally, a cost estimate contains all costs from the start through implementation, operation, and disposal for a program or project. Collectively, these costs are the life cycle cost (LCC). All cost should use constant dollars (See the section titled “Inflation and Its Impact on Costing” later in this step for a discussion of constant dollars)

Note: From a budget perspective, the Army LCC is phased by the five appropriation groupings: Research, Development, Test and Evaluation (RDT&E), Procurement, Military Construction (MILCON), Military Personnel, and Operations and Maintenance (O&M) - each phase has its own inflation indices, and in many cases inflation indices are established for individual appropriations.

## **Cost Estimating Strategy**

Cost estimating should consider all possible costs of an alternative. The question of cost is separate from and must precede the question of budget. The cost question is: What is the full cost of the alternative? The budget question is: What impacts will the alternative have on the budget? For example, an analyst needs to prepare a cost estimate for the establishment of a new maintenance facility with 50 Soldiers and 50 Civilians. All Soldiers will transfer from other units and of the 50 Civilians, 30 will come from existing allocations. This means that the remaining 20 are brand new hires. The *cost* of this initiative includes the funding for 50 Soldiers and 50 Civilians as well as the negative impact on the mission capability on losing units. But *budget* impact is limited to the cost of the 20 Civilian new hires, because the costs of the 50 Soldiers and 30 Civilians are already reflected in the budget. More budgetary impacts will be addressed in Step 7 of this Guide under the heading called “Define Billpayers.”

The analyst must determine the specific time period that the CBA covers (e.g. the execution and POM years or something longer like the lifecycle). Life-cycle cost can be defined as the total cost to the government (Army) of a initiative/program over its full life, including costs for research and development, testing, production, facilities, operations, maintenance, personnel, environmental compliance, and disposal. A life cycle cost estimate helps decision makers assess the affordability of the initiative/program as it is the most comprehensive means of preparing a cost estimate.

**The preference is for the analyst to use life cycle costs when developing a cost estimates.** Some activities or cost elements do not lend themselves to life cycle costing. For example, a piece of equipment like a computer or generator has a definite life cycle. But standing up a new office is not necessarily suitable to life cycle cost analysis. In the event that an initiative is

not a good fit for life cycle analysis, the analyst should use the complete PPBE cycle (year of execution, budget year(s), and program years).

Finally, costs should be analyzed and organized with respect to their occurrence. That is, some costs are onetime costs (non-recurring) that only arise once in and others cost are recurring (costs are generated each time an item is produced or service performed).

### **Trade Offs**

Trade-offs (or opportunity cost) describe the situation where resources are limited, requiring the pursuit of one action over another. The opportunity cost of an item is what you give up to obtain that item. The opportunity cost of any action is simply the next best alternative to that action - or put more simply, "What you would have done if you didn't make the choice that you did". Incorporating a discussion of trade-offs is an important consideration of cost analysis. Each of the alternatives in a CBA should be evaluated in terms of what must be given up in order to be pursued. Identifying trade-offs is conducted by evaluating each COA individually and not by comparing one COA against another. That is, examine each COA in isolation.

Tradeoffs can be described in financial and non-financial terms such as describing an activity to carry out which precludes doing something else. Where feasible, the analyst should attempt to not only describe the tradeoffs but also quantify them. For example, an infantry company decides that weapons' training is the new Battalion Commander's top priority. This means that the company will go to the qualification ranges more frequently. As a result, they will have less time (XX hours or days per week) and/or opportunity to perform equipment maintenance.

Note: In Step 7 of the Guide, the term "Billpayers" is introduced. Often, it has the same meaning or nearly the same very similar in meaning as the term "Trade-off". For the purposes of this guide, the term of "Billpayer" refers to the "Trade-off" quantified in (\$) dollar terms (what will be used to fund (pay for) the recommended COA). Another way to look at "Billpayers" is that it will be used when evaluating/making resourcing decisions concerning a COA. For example, an installation commander wants to install a new AC unit at the post HQs. It exceeds what he has in his budget by \$2K. As a result, he offers to postpone buying \$2K in new workout gear for the post gym.

### **Organizing Cost Data for Display**

When developing a cost estimate, it is essential to use a spreadsheet to list cost elements, reference the sources of all data, and present the calculations and methodology. The Work Breakdown Structure developed earlier in this step can provide structure for the estimate and subsequent briefing charts for decision makers (which is discussed in Step 8 of the Guide).

The example below is a simple table that displays cost elements and years which the cost analysis covers across the top. The analyst should create a table for each alternative. While the focus of this step (4) is on costing alternatives, a summary table may be built for use in Step 7 to include both the costs and quantifiable benefits for each alternative to facilitate their comparison. The analyst can insert formulas that include the effects of inflation as well as discounting on the cash flows. The structure and content of the table are primarily influenced by the CBA itself and the needs of the decision maker and/or analyst.

Example of a simple table for illustration purposes only that aggregates cost by cost element and by year.

**Alternative A**

Cost Elements	Time Period								
	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY ...XX	Total
Personnel									
<i>Civilian</i>									
<i>Military</i>									
Facilities									
<i>Utilities</i>									
<i>Sustainment, Restoration , and Modernization</i>									
<i>Leases</i>									
Equipment									
<i>Vehicles</i>									
<i>Generators</i>									
Contracts									
Training									
<i>Travel</i>									
<i>Course Fees</i>									
MILCON									
Maintenance									
<i>Spare Parts</i>									
Supplies									
<i>Office</i>									
<i>Tool sets</i>									
Etc.									
<b>TOTAL</b>									

The cost elements shown to the left reflect some possible ones/ideas (very generic and high level) and not what must be used. The analyst should use specific cost elements applicable to his/her CBA. For example, if an initiative will be staffed with both military and civilian personnel, then show the break down between them. The cost elements selected will depend on the cost data used in the CBA.

## **Inflation and Its Impact on Costing**

Adjusting for inflation is the most common form of normalization of data. Inflation is the increase in costs (prices) of goods and services over time. It is also important for predicting annual budget requirements for funding multi-year activities, analyzing program alternatives (for a cost benefit analysis), and normalizing data for other uses. When adjusting for inflation, make certain all dollar/cost data is adjusted in the same way so that it is comparable. Guidance on inflation is found in OMB Circular A-94 (Revised) (which replaced OMB Circular A-104). Essentially, for budgeting purposes, cost data should be adjusted for the effects of inflation which turns the cost data (\$) into something called “Current Dollars” also known as “Then Year Dollars”. From a strict costing point of view (routinely used by the Acquisition community in developing weapon system cost estimates), cost data should be in the form of “Constant Dollars” or “Base Year Dollars” and then converted to “Current Dollars” for budgeting activities. **For the purposes of developing a cost estimate, Costs may be presented in current \$s, but in order to compare cost totals over a given length of time, they need to be normalized either by being converted to constant (base year) dollars or discounted using an appropriate discount rate.”**

See a full description of each type of “dollars” below.

**Constant dollars (which are also known as uninflated/real dollars)**, indicate constant purchasing power in terms of the dollar value in the base year of the CBA. In other words, constant dollar implies the purchasing power of the dollar remains unchanged (stable purchasing power) over the analysis period (It represents the buying power of the dollar in a specific year.). Base year dollars are constant dollars that reflect the cost of a program as if inflation had not occurred (deflated to a common base year, thereby removing the effects of inflation). The equivalent of “what a dollar buys today” will be the same in the future. A CBA is said to be in constant dollars if all costs are adjusted to reflect the level of process for the base year. To make valid comparisons of economic activity and prices over time, economists use constant dollars instead of current dollars, which are not adjusted for the impact of inflation.

**Current dollars (then-year dollars, inflated dollars)** which are also known as nominal dollars are expressed in the value of their year of occurrence. Past costs are simply expressed as the actual amounts paid out unadjusted for price changes. Future costs are expressed in amounts expected to be paid out in their year of occurrence. Current costs measure (and benefits) the future purchasing power of the dollars. More importantly, it accounts for future assumed inflation rates. DoD policy is that all budget estimates must be in current dollars. This would mean that costs estimates prepared using constant dollars will have to be converted to current dollars when building a budget.

Note: You cannot use constant and current dollars in the same analysis.

### Example of Constant Dollars Converted to Current Dollars

This is done using the weighted index where Then Year \$=Current Dollars \$ \* Weighted Index. Thus, if one plans to spend \$300,000.00 over ten years in CIVPAY funds, their costs would be calculated as follows:

	POM Years							
	FY 11 (CY)	FY 12 (BY)	FY 13	FY 14	FY 15	FY 16	FY17	Total
<b>(Constant) Civilian Pay</b>	\$50,000.00	\$50,000.00	\$50,000.00	\$50,000.00	\$50,000.00	\$50,000.00	\$50,000.00	<b>\$350,000.00</b>
<b>Inflation Rates</b>	1.000	1.037	1.060	1.085	1.110	1.135	1.160	
<b>(Current) Adjusted Civilian Pay</b>	\$50,000.000	\$51,830.000	\$53,020.000	\$54,240.000	\$55,490.000	\$56,765.000	\$58,000.000	<b>\$379,345.00</b>

This means for a \$300,000 civilian pay bill spent over FY11-FY16, \$321,345 will actually be spent. The civilian pay of \$50,000.00 each year is expressed as constant dollars (not yet adjusted for the impact of inflation).

For the purpose of life cycle comparison, begin your analysis with base year dollars (i.e. constant dollars) which allows for the comparison of base year to future year dollars. This is the standard scenario for CBAs because cost data is normally collected according to current year information. As has been mentioned, converting a constant dollar cost to current dollar cost for budgeting purposes is very straightforward. Just multiply the constant dollar amount by the inflation factor for each year in the cost estimate. But make sure the correct index for the type of cost being inflated.

A short training course on inflation prepared by the Defense Acquisition University has been placed on the CBA Portal for those who have a need or a desire to learn more on this topic.

The link to the inflation indices:

<http://asafm.army.mil/Documents/OfficeDocuments/Budget/Guidances/inflate//indices.xls>

The example located in Appendix E of this Guide includes cost calculations in using current and constant dollars.

## **Quick Review**

- Data is the foundation of every CBA. How good the data is affects the CBA's overall credibility.
- The data plan supports collection of the necessary data.
- Knowing the things that influence an alternative's costs and benefits will help the analyst in capturing the right data.
- Data collection can be a lengthy process and continues throughout the development of the cost estimate. Emphasis should be placed on gathering data that demonstrates the costs and benefits of the identified alternatives.
- The analyst should acquire the most recent data available.
- It is common practice to adjust data through a process called normalization, which is ensuring that the data is consistent (e.g. keeping units the same \$/hr vs. \$/Day – use one or the other, not both, in the analysis).
- Differentiate the nonrecurring (one- time costs) and recurring costs.
- Constant dollar implies the purchasing power of the dollar remains unchanged over the analysis period.
- Current dollars measures cost for future purchasing power of the dollar. It accounts for assumed inflation.

## Appendix 4A

### **Special Topic: Cost Estimating Methods**

*(The following was adopted in part from the GAO Cost Estimating and Assessment Guide and the DoD Sustainment Business Case Analysis Guidebook)*

Conceptually speaking, there are several general approaches to developing cost estimates. The four most common ones are: The engineering approach, the parametric approach, the analogy approach, and the expert opinion approach. The use of a specific approach varies with the amount and reliability of data available. Each approach may have limitations for a particular application. Normally, it is common to utilize more than one method when building a cost estimate and this is due in part to the availability of data.

- **Engineering Approach.** The engineering (bottom-up) approach can be broadly defined as an examination of separate segments of work at a low level of detail and a synthesis of the many detailed estimates into a total. Estimating by the engineering method requires the analyst to have an extensive knowledge of the system characteristics (the system, the production processes, and the production organization). Break the system, activity, or item of hardware into its lower level components and make estimates of each component. An analyst may use different estimating methods in estimating the costs of some components. Combine the costs of the components and the costs of integrating the components to get the total system cost. The detailed knowledge required for an engineering analysis is not always available, thus making this approach the most difficult to apply.
- **Parametric Approach.** In parametric cost estimating, the cost is based upon physical attributes or performance characteristics and their relationships to highly aggregated component costs. For example, the total estimated cost of an item will depend on such things as size, weight, speed, and so on. The lack of a significant number of data points can limit or preclude the use of parametric cost estimating. In the formal sense, the term "parameter" is a cost-related explanatory attribute, which may assume various values during a particular calculation. A parameter is a definable characteristic of one of the parts that can be added to give an expression of the value of the whole system, device, or item. The results of a parametric estimate depend upon the ability of the analyst to establish valid relationships between the attributes or elements that make up the alternative and its cost. Therefore, properly choose and describe the cost estimating relationship (CER). When documenting results that have used a CER, present the statistical characteristics of the CER, the source database, and all assumptions surrounding the CER development.

- **Analogy Approach.** The analogy approach is based on direct comparison with historical information of similar existing activities, systems, or components. The major disadvantage of this method is that it is a judgment process, requires considerable experience and expertise, and assumes that analogous systems are available. Use this method when the comparability of the analogous system and the product/process is well documented. The documentation should give a convincing argument that the product/process is similar enough to the source to make the methodology valid. A variation to this methodology is to make an adjustment to the source data to account for some variation in the estimate of the product/process. For example, if one used commercial vehicle data to estimate some aspect of a tactical vehicle, an adjustment could be made to the source data. Document the "adjustment technology" well so that there is no doubt about the methodology.
- **Expert Opinion Approach.** The expert opinion approach uses the judgment of an experienced individual or group. Estimates developed on this basis usually have a lack of detailed rationale and analysis. While estimates developed by expert opinion are occasionally both useful and necessary, they are normally highly uncertain and have a low confidence rating. Do not use expert opinion when times permit the preparation of a more thorough analysis. If expert opinion is used, the documentation should contain the sources of the opinion and a list of the attributes of the sources.

*Please see the GAO Cost Estimating and Assessment Guide (pages 118 to 121) for a discussion of other approaches such as Extrapolation from Actual Costs and Learning Curves.*

## **Appendix 4B**

### **Special Topic: Personnel Costing**

#### **1. Purpose**

The purpose of this Personnel Costing Guide is to provide assistance in developing personnel costs for a Cost Benefit Analysis (CBA). The objective of this guide is to provide the information needed to assist in the development of personnel cost estimates.

#### **2. OSD Guidance**

The Office of the Secretary of Defense (OSD) Cost Analysis Program Evaluation Group (CAPE) released Directive Type Memorandum (DTM) 09-007 “Estimating and Comparing the Full Costs of Civilian and Military Manpower and Contract Support” 29 January 2010. This appendix reflects the guidance in that document. Organizations should follow this cost guidance when creating the personnel cost estimates for their CBAs.

#### **3. Personnel Costs – Types and Impacts**

There are two major cost types that comprise personnel costs: civilian and military. The military personnel costs consist of Active Duty, Reserve, and National Guard components. Department of the Army Civilians (DACs) and Private Contractors constitute those employees labeled as “civilian”.

#### **4. Cost Estimate Inputs**

In order to estimate personnel costs you need at minimum to know the number of employees your organization is requesting. To provide the best cost estimate you should also know the grade, occupation and location where your personnel will be working.

#### **5. Army Military-Civilian Cost System (AMCOS)**

When putting together the personnel cost section of a CBA, organizations should take the following steps: (1) Identify the cost elements that will be needed to properly cost this Course of Action (COA), (2) Check the cost elements needed against OSD and Army cost guidance such as DTM 09-007 to make sure the estimate contains all required cost elements. (3) Determine whether actual costs must be used or not. If you are costing a legal action, you will need to use actual costs including steps for civilian personnel. If you are costing contractors, you will need to take personnel costs from the contract itself and provide the contract number. If you have actual costs easily available, you should use actual costs. If your situation is not one of the three described, then you can use personnel costs obtained from official sources such as the Office of Personnel Management website, DOD or HQDA approved models or analogous cost estimates.

## **6. Army Military-Civilian Cost System (AMCOS)**

AMCOS is an official Army tool that can be used to assist in estimating civilian and military (Active Duty, Reserve, and National Guard) costs. At this point in time, AMCOS does not contain all the cost elements in DTM 09-007, but we are working to make it compliant as soon as possible. You must have an Army Knowledge Online (AKO) account in order to be able to log on to AMCOS. Gaining access to the system should take no longer than one day after your initial request. To gain access to AMCOS:

- a. Go to <https://www.osmisweb.army.mil/>.
- b. Click on the AMCOS Name (located at the bottom of the page)
- c. A screen will appear requesting your User ID and Password
- d. Click on the New Account Link
- e. Select "Update with AKO Data" Button (Top Right Hand Corner)
- f. Enter Your Office Name and Job Title
- g. Click on the Submit Button (Top Right Hand Corner)
- h. Congratulations, you have successfully created an AMCOS account.

## **7. AMCOS Lite**

The principal component of AMCOS is AMCOS Lite. AMCOS Lite can be accessed by selecting either the AMCOS Lite link listed under the Applications heading or the AMCOS Lite heading that is shown on the initial home page. The AMCOS Lite page features four drop-down menus labeled Pay Plan, Summary, Group, and Sub-Group. You will choose the elements that are most suitable for your study within these menus.

The following provides an explanation of how to apply each category to your study:

- Pay Plan: Determine what pay plan your employees will have. Will they be Civilian General Schedule (GS), Active Military (Enlisted or Officer), etc.?
- Summary: Select "Default"
- Group: This list categorizes groups of related occupations. You will decide on the one occupation or military branch that your employees will use, e.g. GS-0500 (Accounting and Budget Group), GS-1500 (Mathematics and Statistics Group), or Infantry.
- Sub-Group: A subdivision of your selected occupational group, the sub-group is employees' actual occupation series or corps, e.g. GS-0510 (Accountant), GS-1515 (Operations Research Analyst), or Infantryman
- Locality: AMCOS provides a locality pay feature for General Schedule employees. Locality pay is applicable only for CONUS and non foreign areas (Hawaii, Alaska and U.S. Territories). Use the drop down list to choose the locality rate for the employees in your estimate. The drop-down list contains the locations used in the Office of Personnel Management's (OPM) locality tables. AMCOS Lite does not cost military by location.

Query Output: Once you have provided your inputs, AMCOS Lite provides the salary figures that apply to your pay grade or rank. This information can be downloaded into Microsoft Excel or Word by clicking on their respective icons in the “Download” category.

### **8. Overseas and Deployment Costs**

AMCOS can be used as a starting point for your personnel cost estimates for military and civilians stationed overseas or deployed. However, AMCOS does not contain Cost of Living Allowance and other costs that are needed to provide complete cost estimates for these locations at this time. Is there any additional guidance we could provide to help develop the costs for overseas personnel?

The following two screenshots display examples of AMCOS output for civilian and military personnel.

#### **AMCOS Lite Query Output for Civilian Employees for Wash., DC**

AMCOS Lite - Windows Internet Explorer  
 https://www.osmisweb.army.mil/amcos/app/lite/default.aspx

File Edit View Favorites Tools Help

AMCOS Lite

## AMCOS

The Army Military-Civilian Cost System

AMCOS Home Data Cost Details Applications Administration My Profile FeedBack RSS Exit

AMCOS Lite allows you to view costs for specified personnel. The grid in the upper right hand corner shows the totals by appropriation for the selected Cost Summary. The lower grid defaults to show the Appropriation, Category and Element (Cost Factor). You can select and deselect Category and Element (Cost Factor) check boxes to customize your view.

**Note:**  
 The Private Labor Market feature is for quick estimates and not to replace in depth analysis required for studies.  
 The factors guide excel worksheet is provided to help choose the correct level for the Private Labor Market. [Private Labor Market Factors Guide](#).

**All NSPS cost factors were removed from this module.**

Did you know AMCOS now provides a [GS by Zip Code Crosstab](#)?

**Version:** Mini Update Released February 11, 2011: FY 2011 Budget Materials, CY 2011 Pay Tables, FY 2010 Inventory

**SUPPORT:** For questions or suggestions, please contact us at [amcos@calibresys.com](mailto:amcos@calibresys.com)

Pay Plan: Civilian General Schedule  
 Summary: Default  
 Group: 01500 : MATHEMATICS AND STATISTICS GROUP  
 Sub Group: 01515 : OPERATIONS RESEARCH SERIES\*  
 Locality: Washington-Baltimore-Northern Virginia, DC-MDPA-VA-WV @ 24.22%  
 Group By:  APPN  Category  Element  
 Download:

APPN	GS7	GS9	GS11	GS12	GS13	GS14	GS15
Army-Funded Civilian	\$59,092.78	\$72,632.83	\$88,203.17	\$106,573.17	\$126,730.20	\$149,756.26	\$178,093.29
Gov't-Funded Civilian	\$6,399.80	\$7,866.20	\$9,552.48	\$11,541.97	\$13,725.00	\$16,218.74	\$19,287.67
<b>Total</b>	<b>\$65,492.58</b>	<b>\$80,499.03</b>	<b>\$97,755.65</b>	<b>\$118,115.14</b>	<b>\$140,455.19</b>	<b>\$165,975.00</b>	<b>\$197,380.96</b>

APPN	Category	Element	GS7	GS9	GS11	GS12	GS13	GS14	GS15
Army-Funded Civilian	Compensation	Avg Cost of Base Pay (Civilian)	\$47,603.80	\$58,511.35	\$71,054.46	\$85,852.91	\$102,090.95	\$120,640.23	\$143,467.89
Army-Funded Civilian	Compensation	Avg Cost of Holiday Pay	\$42.15	\$51.81	\$62.92	\$76.02	\$90.40	\$106.83	\$127.04
Army-Funded Civilian	Compensation	Avg Cost of Overtime Pay	\$689.80	\$847.85	\$1,029.61	\$1,244.04	\$1,479.34	\$1,748.13	\$2,078.91
Army-Funded Civilian	Other Benefits	Avg Cost of Cash Awards	\$567.17	\$697.12	\$846.57	\$1,022.88	\$1,216.35	\$1,437.35	\$1,709.33
Army-Funded Civilian	Other Benefits	Avg Cost of Former Employee Compensation	\$49.82	\$61.23	\$74.36	\$89.85	\$106.84	\$126.25	\$150.14
Army-Funded Civilian	Other Benefits	Avg Cost of Other Compensation	\$440.70	\$541.68	\$657.81	\$794.81	\$945.13	\$1,116.86	\$1,328.19
Army-Funded Civilian	Retired Pay Accrual	Avg Cost of Benefits	\$9,699.34	\$11,921.77	\$14,477.45	\$17,492.65	\$20,801.18	\$24,580.62	\$29,231.78
Gov't-Funded Civilian	Retired Pay Accrual	Government-Funded Retirement	\$6,399.80	\$7,866.20	\$9,552.48	\$11,541.97	\$13,725.00	\$16,218.74	\$19,287.67
<b>Total</b>			<b>\$65,492.58</b>	<b>\$80,499.03</b>	<b>\$97,755.65</b>	<b>\$118,115.14</b>	<b>\$140,455.19</b>	<b>\$165,975.00</b>	<b>\$197,380.96</b>

For questions or suggestions, please contact us at [amcos@calibresys.com](mailto:amcos@calibresys.com)

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## AMCOS Lite Query Output for Military Personnel

AMCOS Lite - Windows Internet Explorer
https://www.omisweb.army.mil/amcos/app/ite/default.aspx

File Edit View Favorites Tools Help
Live Search

Army Knowledge Online
AMCOS Lite
Results
AMCOS Lite
Page Tools

### AMCOS

The Army Military-Civilian Cost System

AMCOS Home
Data
Cost Details
Applications
Administration
My Profile
FeedBack
RSS
Exit

AMCOS Lite allows you to view costs for specified personnel. The grid in the upper right hand corner shows the totals by appropriation for the selected Cost Summary. The lower grid defaults to show the Appropriation, Category and Element (Cost Factor). You can select and deselect Category and Element (Cost Factor) check boxes to customize your view.

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**All NSPS cost factors were removed from this module.**

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**Version:** Mini Update Released February 11, 2011: FY 2011 Budget Materials, CY 2011 Pay Tables, FY 2010 Inventory

**SUPPORT:** For questions or suggestions, please contact us at [amcos@calibresys.com](mailto:amcos@calibresys.com)

Pay Plan	Active Officer		APPN	O1	O2	O3	O4	O5	O6	O7	O8	O9	O10
Summary	Default		MPA	\$91,049.28	\$109,120.99	\$137,623.96	\$167,267.47	\$192,569.24	\$224,651.63	\$261,767.60	\$237,134.16	\$287,722.32	\$323,141.63
Group	11: INFANTRY		OMA	\$23,747.84	\$23,747.51	\$26,960.26	\$28,173.57	\$30,744.63	\$30,231.95	\$27,383.05	\$15,598.13	\$15,598.13	\$15,598.13
Sub Group	11A: INFANTRY		Other	\$172.34	\$86.50	\$180.36	\$97.95	\$116.53	\$116.92	\$123.94	\$0.00	\$0.00	\$0.00
<b>Total</b>				\$114,969.46	\$132,955.00	\$164,764.59	\$195,558.99	\$223,430.39	\$255,000.50	\$289,274.59	\$252,732.29	\$303,320.45	\$338,739.76

APPN	Category	Element	O1	O2	O3	O4	O5	O6	O7	O8	O9	O10
MPA	Military Compensation	Avg Cost of Base Pay (Military)	\$34,540.74	\$46,234.12	\$61,116.04	\$79,924.25	\$94,351.66	\$115,933.35	\$139,774.00	\$162,379.80	\$200,502.00	\$227,242.80
MPA	Military Compensation	Avg Cost of Basic Allowance for Housing (n cash)	\$15,818.97	\$15,438.19	\$21,935.24	\$26,259.32	\$30,304.49	\$32,344.72	\$37,725.39	\$0.00	\$0.00	\$0.00
MPA	Military Compensation	Avg Cost of Basic Allowance for Subsistence	\$2,727.77	\$2,727.77	\$2,727.77	\$2,727.77	\$2,727.77	\$2,727.77	\$2,727.77	\$0.00	\$0.00	\$0.00
MPA	Officer Acquisition Costs	Avg Cost of Officer Acquisition (Amortized)	\$11,097.22	\$11,097.22	\$11,097.22	\$11,097.22	\$11,097.22	\$11,097.22	\$11,097.22	\$11,097.22	\$11,097.22	\$11,097.22
MPA	Other Benefits	Avg Cost of Other Benefits	\$10,294.95	\$10,320.50	\$10,345.66	\$10,349.02	\$10,335.19	\$10,323.96	\$10,349.02	\$10,349.02	\$10,349.02	\$10,349.02
MPA	Permanent Change of Station Costs	Avg Permanent Change of Station-annualized	\$1,322.76	\$3,966.20	\$4,106.36	\$4,997.92	\$5,039.89	\$5,100.35	\$5,053.21	\$0.00	\$0.00	\$0.00
MPA	Retired Pay Accrual	Avg Cost of Retired Pay Accrual	\$11,294.82	\$15,118.56	\$19,984.94	\$26,135.23	\$30,852.99	\$37,910.21	\$45,706.10	\$53,098.19	\$65,564.15	\$74,308.40
MPA	Separation Costs	Avg Cost of All Separation Incentives	\$84.87	\$226.18	\$943.50	\$654.95	\$1,711.35	\$3,206.18	\$3,414.28	\$0.00	\$0.00	\$0.00
MPA	Special Pays	Avg Cost of Special Pays	\$2,825.50	\$3,443.31	\$3,727.94	\$4,067.58	\$4,640.82	\$4,461.10	\$4,247.14	\$209.93	\$209.93	\$144.19
MPA	Training	Avg Cost of Training (Amortized)	\$1,041.66	\$548.95	\$1,639.29	\$1,074.20	\$1,507.84	\$1,546.78	\$1,673.48	\$0.00	\$0.00	\$0.00
OMA	Medical Support Costs	Avg Cost of Medical Support Cost	\$6,899.61	\$7,335.85	\$8,826.07	\$10,137.41	\$11,407.49	\$10,826.46	\$7,821.08	\$0.00	\$0.00	\$0.00
OMA	Morale, Welfare and Recreation Costs	Avg Cost of Morale, Welfare and Recreation	\$261.24	\$261.24	\$261.24	\$261.24	\$261.24	\$261.24	\$261.24	\$261.24	\$261.24	\$261.24
OMA	Officer Acquisition Costs	Avg Cost of Officer Acquisition (Amortized)	\$15,336.89	\$15,336.89	\$15,336.89	\$15,336.89	\$15,336.89	\$15,336.89	\$15,336.89	\$15,336.89	\$15,336.89	\$15,336.89
OMA	Training	Avg Cost of Training (Amortized)	\$1,450.10	\$813.54	\$2,536.07	\$2,438.03	\$3,739.01	\$3,807.36	\$4,163.84	\$0.00	\$0.00	\$0.00
Other	Training	Avg Cost of Training (Amortized)	\$172.34	\$86.50	\$180.36	\$97.95	\$116.53	\$116.92	\$123.94	\$0.00	\$0.00	\$0.00
<b>Total</b>			\$114,969.46	\$132,955.00	\$164,764.59	\$195,558.99	\$223,430.39	\$255,000.50	\$289,274.59	\$252,732.29	\$303,320.45	\$338,739.76

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## Appendix 4C

### **Special Topic: Installation Costing**

#### **1. Purpose**

The purpose of this Special Topic on Installation Costing is to provide a general understanding of the components used to generate ROM installation costs for military construction projects (MILCON), and sustainment, restoration, and modernization (SRM). It identifies information which should be included in the supporting cost documentation. It also identifies some references/sources of installation cost data/guidance and the MILCON and SRM Tool/Template. You can find this Tool/Template on the Cost and Performance Portal.

#### **2. Installation Costing – Military Construction (MILCON)**

MILCON and Army Family Housing – Construction (AFH-C) costs are generally associated with major construction projects. Per the Army Military Construction and Nonappropriated-Funded Construction Program Development and Execution Pamphlet (DA PAM 420-1-2), major construction projects are those that have a funded cost in excess of the statutory limitations on minor construction projects.

MILCON cost estimates are typically generated to reflect how much it will cost to construct new facilities within a POM Cycle. In some cases, the MILCON project or projects may be programmed in one or more fiscal years. As a result, the costs need to be outlined (in detail) for each fiscal year. Most MILCON estimates in the CBA packages are in summary format without any detailed cost documentation (in spreadsheet format) that can be traced to it.

There is specific information required in order to develop a MILCON estimate. For instance, if there is a requirement to construct a new building/facility at a particular location, you should first identify the type of building/facility and location. If construction of military housing is required, the requestor should specify whether or not it is enlisted, unaccompanied, personnel housing or enlisted barracks, transient training. Additionally, you should also consider the following details to generate a MILCON cost estimates (sources that are not identified will be referenced at the end of this guide):

- Facility type(s) - (e.g. enlisted unaccompanied personnel housing)
- Real property (facility) codes – ( e.g. 72111)
- Unit cost per quantity - (e.g. \$213 per sq. ft.)
- Quantity required – (e.g. 99,500 sq. ft. Source: program requirement information)
- Adjustment factors pertinent to the project’s features, technical requirements and location - (e.g. area cost factor - Fort Hood - .87, project cost factor 1.00 Sources: PAX Newsletter and DoD Facilities Pricing Guide, and technical complexity factor 1.050 Source: TM- 500-80)

- Inflation factors (e.g. 1.0650)

After you have determined all the appropriate details, components, and factors, the estimate should be computed as such:

***Unit Cost Per Quantity x Area Cost Factor x Project Cost/Size Adjustment Factor x Technology Complexity Factor = Adjusted Unit Cost.***

***Total Cost Before Inflation x FYXX MILCON Inflation Rate (Weighted Composite Rate) = Total Project Cost After Inflation.***

(There are other factors/adjustments and supporting facility costs that are built in to the true cost of MILCON projects that are programmed in the DD Form 1391 Processor and validated by the United States Corps of Engineers (USACE). However, your ROM estimate will only include the very basic factors excluding those factors and adjustments that are mainly used by the USACE. )

If there is a DD Form 1391 Processor for the MILCON project, you should include the project numbers or the actual DD Form 1391s and the USACE point of contact information in the CBA Package.

### **3. SRM Cost Components**

An SRM cost estimate reflects the annual operating costs that will be required for sustainment, restoration, and modernization of the facilities over the program years and life cycle. The following is a list of the components and the equations:

- Facility type(s) - (e.g. enlisted unaccompanied personnel housing);
- Real property (facility) codes – ( e.g. 7210 );
- Unit cost per quantity - (e.g. \$3.63 per sq. ft.);
- Quantity required – (e.g. 99,500 sq. ft. – program requirement information – you provide);
- Area cost factor - (e.g. – Fort Hood - .87 ) and ;
- Inflation factors (e.g. 1.0440 for FY12 OMA APPN )

***Adjusted Unit Cost x Quantity Required = Total Cost Before Inflation.***

***Total Cost Before Inflation x FYXX SRM Inflation Rate (Weighted Composite Rate) = Total Project Cost After Inflation.***

### **1. Guidance/Source References for Generating MILCON and SRM Estimates**

There is guidance available to assist in identifying and gathering the information necessary to generate a ROM cost estimate for MILCON and SRM.

- DA-PAM 415-28 - Guide to Army Real Property Category Codes. This pamphlet can assist the user in identifying real property codes, facility types, as well as provide a brief description of the facilities.
- PAX Newsletter 3.2.2 – For MILCON (new construction) unit costs with the desired facility types.
- DoD Facilities Pricing Guide – For SRM (sustainment, restoration, and modernization) unit costs.
- DoD Facilities Pricing Guide or PAX Newsletter 3.2.1. - Area cost factors for the desired facility types
- OSD Inflation Rates – For the inflation factors.

In addition, there is a MILCON and SRM Tool/Template accessible to assist the user in developing generic or rough order of magnitude (ROM) estimates to be included in their CBA packages. The use of the tool will not only prove beneficial in creating a basic estimate and it should be included in the cost documentation supporting the CBA Package. Please see the CBA page located on the Cost and Performance Portal.

## **2. Source References Locations**

DA PAM 420-1-2 - Army Military Construction and Nonappropriated-Funded Construction Program Development and Execution Pamphlet

[http://www.army.mil/usapa/epubs/420\\_Series\\_Collection\\_1.html](http://www.army.mil/usapa/epubs/420_Series_Collection_1.html).

DA PAM 415-28 - Guide to Army Real Property Category Codes

[http://www.army.mil/usapa/epubs/415\\_Series\\_Collection\\_1.html](http://www.army.mil/usapa/epubs/415_Series_Collection_1.html).

PAX Newsletter 3.2.2 – <http://www.usace.army.mil/CaEI/Documents/Forms/AllItems.aspx>.

PAX Newsletter 3.2.1 - <http://www.usace.army.mil/CaEI/Documents/Forms/AllItems.aspx>.

DoD Facilities Pricing Guide

[http://www.acq.osd.mil/ie/fim/programanalysis\\_budget/tool\\_metrics/FPG/fpg.shtml](http://www.acq.osd.mil/ie/fim/programanalysis_budget/tool_metrics/FPG/fpg.shtml).

TM-500-80 - [http://www.wbdg.org/ccb/ARMYCOE/COETM/ARCHIVES/tm\\_5\\_800\\_4.pdf](http://www.wbdg.org/ccb/ARMYCOE/COETM/ARCHIVES/tm_5_800_4.pdf).

OSD Inflation Indices - <http://www.asafm.army.mil/offices/CE/Rates.aspx?OfficeCode=1400>

## **STEP 5 – Identify Quantifiable and Non-Quantifiable Benefits**

This section discusses five areas:

- Benefits Analysis Overview
- Types of Benefits
- Identify, Estimate, and Evaluate Benefits
- Special Topic: Military Benefits Analysis

### **Benefits Analysis Overview**

Benefits of a chosen alternative are results expected in return for costs incurred. They are the quantitative and qualitative results expected or resulting from the implementation of a project/initiative (which may include but are not limited to the following: equipment, facilities, hardware, systems, etc.).

The following definitions or measurements describe benefits: effectiveness, physical yield, products, morale, quality of life, and timeliness. Benefits are either quantifiable or non-quantifiable results from implementing a COA.

When preparing a CBA, identify all benefits, whether quantifiable or non-quantifiable. Benefits justify the costs identified in the CBA. Identify both financial benefits (i.e., those measured in dollars) and non-financial or functional benefits. Both are essential to the analysis and selection of a preferred COA. Of course, all benefits must be relevant to the analysis. Each benefit must be clearly and distinctly identifiable, and should not duplicate any other measure.

The purpose of benefit analysis is to identify and measure, the results of each proposed COA. It should consider the DOTMLPF construct (Doctrine, Organization, Training, Materiel, Leader and Education, Personnel, and Facilities). Benefits analysis should support the Army in meeting its missions, functions and responsibilities.

## Types of Benefits

### Quantifiable Benefits

Quantifiable benefits have numeric values such as dollars, physical count of tangible items, or percentage change.

Financial benefits are always quantifiable and are measured in dollars:

- *Cost reduction.* A reduction in the number of dollars needed to meet a customer-established requirement by improving a process or function.
- *Savings.* A cost reduction that enables a manager to reallocate funds within the budget or program period.
- *Cost avoidance.* Any cost reduction that is not savings..
- *Revenue generation.* An increase in the dollars that flow into the Army, over and above appropriated funds, or over and above the expected amount of customer funding received through a revolving fund.
- *Productivity improvements.* A reduction in personnel time and effort requirements associated with a function or assigned task. In most cases, a productivity improvement will also result in a savings or cost avoidance.

Examples of other, non-financial, quantifiable benefits and methods of measurement include but are not limited to:

- Number of commodities or items produced for each alternative (such as the number of meals served, hours flown, or components manufactured).
- Number of items produced per a given period of time (such as flight hours per month, number of items per man-hour, or number of trucks serviced per year).
- System reliability in terms of probable failure ratio (such as mean-time-between-failure, or number of repairs per item per year).
- Number of errors per operating cycle or period (such as the number of errors per card punched, errors per 100 records, or errors per 100 items produced).
- Maintainability/supportability measures (such as mean-time-to-repair or average downtime).
- Accuracy, timeliness, and completeness of data produced by a system, resulting in efficient utilization of the Army's resources through more effective decisions made upon more accurate data.
- Performance and operational effectiveness.

## **Non-Quantifiable Benefits**

Non-quantifiable benefits do not lend themselves to direct and quantitative measures. These benefits, though difficult to assess, should be addressed qualitatively. Although subjective in nature, qualitative statements can make a positive contribution to the analysis. The CBA preparer should use the best analytical practices in order to include non-quantifiable benefits in the analysis. Some examples of non-quantifiable benefits are morale, compatibility, quality and security, and readiness. Generally speaking, non-quantifiable benefits do not provide as much support for a COA as quantitative benefits do.

For more information on types of benefits, a table of quantifiable and non-quantifiable benefits is provided at the end of this step.

## **Identify, Estimate, and Evaluate Benefits**

A CBA must include all significant benefits (quantifiable or non-quantifiable) in the benefit analysis portion. Non-quantifiable benefits should be described in narrative form. Be sure to validate and coordinate all the benefits by the functional proponent (or the organization responsible for the basic requirement) and appropriate activities. It is strongly recommended that identification and documentation of benefits begin early in the evaluation process.

### **Identifying Benefits**

The following steps are recommended to identify benefits and establish quantitative measures for benefits where possible.

- Identify all resources flowing into the project and the resulting outputs and outcomes flowing out of the project.
- Determine and list the benefits of each alternative, both quantifiable and non-quantifiable.
- Define each benefit in relation to the alternatives in the CBA. All benefits included must be relevant to the analysis. Each benefit must be clearly and distinctly identifiable from all other benefits; it should not duplicate or overlap any other measure.
- Develop a quantitative measure for each benefit where possible. This will allow direct comparison of alternatives for each benefit.

### **Benefit Categories**

The following list of categories may help define benefits. This list is not all inclusive, nor is it intended to provide precise definitions of the benefits listed. It is only meant to be illustrative of benefits categories that could be applicable to program objectives.

- *Acceptability* - Does the alternative contribute to the operation of parallel or higher level organizations? Does it improve the quality of the process?
- *Accuracy* – What are the error rates or accuracy of information?
- *Adaptability* - Is the system/project adaptable to existing DoD, industry, national, or international standards?
- *Availability* - When can the system/project be delivered or implemented; when is it needed to meet proposed output schedules? What is the mean time between failures?
- *Functionality* - How well does the system perform; how quickly can it process data or calculations, or other functions?
- *Compatibility* - How will existing operations, facilities, equipment, data requirements be affected? How much initial training will be required? How will work methods and procedures be altered?
- *Maintainability* - Is the system difficult to repair? Are parts readily available? How much staff will be required to maintain the software/hardware? What is the anticipated down time for maintenance? Is the maintenance downtime longer for any alternative?
- *Manageability* – To what extent will the COA require the involvement/need for supervisors or quality inspections? Will a different type of personnel than currently assigned be required? Are trained personnel available?
- *Morale* - will the system/project contribute to a positive employee attitude towards work?
- *Production* – What number of products will be produced?
- *Productivity* – What will the rate of production be? What number of staff resources will be needed to produce the same product, or what will the production be with existing staff resources?
- *Quality* – What level of quality, service, consistency, or customer satisfaction will be delivered?
- *Reliability* - how many (how often) system failures will occur over time?
- *Security* - What level of security precautions will be needed?
- *Service life* - How long will the equipment be able to support the operation? Will the equipment be obsolete before it reaches the end of its useful life?
- *Upgradeability* - How compatible will additional equipment, such as memory, terminals, workstations, or other equipment, be with existing equipment or users of the system?
- *Versatility* – What, if any, additional capacity or capability will be alternative provide beyond that required?

### **Estimating Quantifiable Benefits**

Make every effort to quantify benefits. The methods of measurement for quantifiable benefits are as follows, in order of desirability:

- Dollar quantifiable terms
- Physical count of tangible items (for example, units of output)
- Index or ratio (for example, 40 percent or greater)

Note: There is an infinite list of benefits, depending on the functional process being analyzed in the CBA. For example, a personnel function has certain benefits/results, and they will be different for a logistics process, for a transportation process, etc. It is recommended that that beyond financial benefits, benefits must be identified by functional SMEs.

The benefit estimating process is similar to the cost estimating (discussed in Step 4.) Data must be collected from appropriate sources and analyzed. Relationships among data must be identified. Inflation and discounting must be applied to annual dollar values via standard methods. Cost estimates should apply inflation indices and then benefits should be computed by comparing the status quo (with applied inflation indices) with the cost of the alternative(s). The economic life (the period during which the alternative provides benefits) of the alternatives and the fiscal years (FY) when benefits accrue must be carefully considered. Identify all benefits by the appropriation and the FY in which they are expected to occur. Some benefits may not be accrued until later in the economic life of the alternative.

During the quantifying analysis process, assumptions and judgments will influence the results. The analyst may have to make value judgments. They should inform the decision makers of how the benefits were identified and measured. The analyst must avoid double counting of any identified quantifiable benefits, which will lead to skewed estimates of benefits.

### **Evaluating Non-Quantifiable Benefits**

The following are techniques for evaluating non-quantifiable benefits:

- Enumeration is a simple listing of the non-quantifiable benefits associated with each alternative for comparison purposes.
- Rank non-quantifiable benefits by their relative importance to the goals and objectives. Such a ranking describes the degree to which each alternative achieves a given objective. The ranking provides a description of all benefits and how each contributes to the project's goals; it explicitly identifies the differences among alternatives. An example would be the quality of a report prepared automatically or manually. The judgment of which alternative yields the best quality report would assist in the overall ranking of alternatives. In addition to relative ranking, weights may be assigned to each benefit, so that a point total may be calculated for each alternative. Even if numeric scores are calculated, this analysis is by nature very subjective; it requires a consensus on the relative importance of the benefits.

## Examples of Quantifiable and Non-Quantifiable Benefits

The following is a list of common benefits. This list should not be construed as all-inclusive or exhaustive in nature. It only serves as a basis for establishing potential types of quantifiable and non-quantifiable benefits. Also, non-quantifiable benefits, in many cases, can become quantifiable with an appropriate measuring/counting methodology. For example, morale is often described in non-quantifiable terms such as good, bad, or something else. A survey or other measuring/counting methodology can be designed and used to measure the level of morale in more quantifiable terms like a value of 1 could equal a bad morale, 2 could be assigned to good morale and 3 to excellent morale and etc. Quantifying non quantifiable benefits facilitates making meaningful comparisons of the benefits.

Quantifiable	Non-Quantifiable
Cost savings or avoidance	Better information to facilitate policy making
Lower cost for future projects through shared infrastructure and knowledge	Allows more, greater and new data collection
Reduce need for future capacity expansion	Improved management
Improved security and fewer breaches	Policy alignment and outcomes
Reduce demand for service	Additional tools and functions
Reduced processing through common standards and processes	Customer service, service integration
Reduced error rates, re-work, complaints	Service consistency and quality
Reduced need for multiple data collection	User satisfaction, involvement, and participation
More flexibility, Reduce Time Required	Communication, More Flexibility
More accurate, up-to-date, cleaner, and reliable	Reputation, increased user trust and confidence
Additional capacity	Integrated view of customers , contribution and transparency
Increased productivity	More reliable and up-to-date
Decrease in manual functions	Greater use, Faster and easier access
Reduce redundancy through integration	Transparency and empowerment
Additional capacity, accuracy, up-to-date, cleaner, and reliable	Access range and increased choice
Reduced error rates	Improved management
Capacity waste reduction	Greater confidence and transaction certainty
More effective use of existing infrastructure	Service consistency
Reduced travel time Travel	Improved communications
Services (Consultation, software, equipment. etc.)	Reduced need for multiple data submission for services and events
Revenue generating activities (Soldiers, business, intermediaries, contractors, etc.)	Reduce redundancy through integration
Reduced user time	Improvement in morale
Reduced processing time	
Improved response time	
Reduced travel time	
Increase adoption of e-services	
Reduced services pricing, avoid future price increases	
Reduced information transmission (phone, post, paperless, etc.)	
Increased user involvement, participation	
Reduced processing through common standards and processes	

## **Quick Review**

- Benefits can be quantifiable or non-quantifiable.
- Quantifiable benefits will often carry more weight than non-quantifiable benefits with decision makers.
- Be consistent. Use the same standards to evaluate the benefits for each alternative or COA.

## Appendix 5A

### **Special Topic: Military Benefits**

Military worth or Military Benefits Analysis (MBA) of new concepts demonstrates value or a technology payoff to the warfighter. Systems analysts traditionally conduct MBA to evaluate the warfighter benefits resulting either from new asset development and implementation or from the establishment of new employment concepts for existing assets. The payoff or benefit must consider a clear interest of the user community in making an informed investment decision; therefore, determining the MBA for particular technologies is vitally important.

The scope ranges from the campaign to mission level and thus differs in magnitude, time frame, and level of detail. MBA typically includes parameters such as time to accomplish objectives, number of targets neutralized, amount of collateral damage, and volume of resources consumed (including dollars). It includes facilities, maintenance, resource reduction, and other parameter considerations.

If a new concept is similar to an existing concept in its performance and use, analysts can easily employ existing MBA tools and approaches to establish the concept weapon's warfighter benefit. However, most new concepts are radically different from existing ones. New concepts call for additional varying parameters and metrics. Evaluating the new concept military benefit is becoming increasingly difficult because existing analytical tools and techniques don't address these complex applications.

New concepts, technologies, and other developments cause the need for cooperative systems designs with multiple parameters. These are set against multiple mobile targets and intercepts while operating autonomously, cooperatively, and synchronously. These systems designs require high level analysis using stochastic, non-parametric, inferential, and statistical approaches including propagations of Markovian processes.

Effective MBA mission level constructs provide detailed insight to the scaled scenarios generated by compressed time, weapons effects (e.g., expected kills per \_\_\_\_\_), weapon's performance, and desired warfighter outcomes in a controlled space. MBA performed at the mission level effectively provides analysts with insight not attainable at the campaign level. Performing this dual (campaign and mission level) approach gives clarity for appropriate comparisons to refine parameters to the expected benefit range. This process enables interpretation of the benefit by providing a potential performance picture. Force structure, force mix (array), target mix, and performance in designated scenarios (must be operationally relevant) define and shape the warfighter benefits.

MBA is crucial for evaluating the warfighter technology benefits and, consequently, for making informed technology investment decisions. As a result, MBA capability to support investments

decisions is a necessary and sufficient collaborative tool for future technologies and integrating concept acquisition.

## STEP 6 – Define Alternative Selection Criteria

This section discusses five areas:

- Introduction
- Alternative Selection Criteria Overview
- How to Develop Selection Criteria
- Financial Criteria
- 

### Introduction

This step is a pre-requisite for the step that follows (Step 7 Compare Alternatives). The analysis and calculations developed in this step will be used in part or whole in the Decision Matrix discussed in the next step.

### Alternative Selection Criteria

Alternative selection criteria are the standards used to rank the alternatives in order of preference, and to make the decision. After collecting and analyzing data for the proposed alternatives, and completing cost estimates, the decision criteria for selecting the “preferred” alternative must be determined. **It is recommended that the listed cost and benefits for the COA is represented in the selection criteria.** Cost benefit analysis must contain documentation that defines decision criteria and their impact in making the recommendation of the preferred alternative. It is important to customize the criteria to the CBA. For example, if an organization wishes to buy a new passenger vehicle for its fleet, some of the criteria that would go into the evaluation of the alternatives could include size, mpg, number of seats and etc.

### How to Develop Selection Criteria

Use criteria to compare alternatives accurately and consistently; to prioritize needs; and to document rationale of decision making and thus increase transparency within the Army. Decision makers use criteria to examine the most important information and use it to evaluate the impact of the alternatives on the mission/objective. In addition to documentation that identifies the recommended decision criteria, every CBA must document the extent to which each alternative satisfies each of the decision criteria. Thus, the first requirement in this process is to develop a list of candidate selection criteria.

All criteria will be highly tailored to the specific CBA, but there are characteristics that make selection criteria more legitimate and qualified to support recommendation of alternatives.

Selection criteria should:

- Be related to the alternatives, and highlight differences between alternatives to support comparison. For example: if an important difference between Alternative A and Alternative B is product quality, one selection criteria should highlight the gap between the two alternatives.
- Selection criteria should reflect the costs and benefits listed in the analysis.
- Be unambiguous: the criteria must be clearly stated and all relationships must be transparent. All criteria must be understandable.
- Be concise and non-redundant.
- Provide a standard and consistency for comparison of alternatives.
- A means to expose all uncertainty, risk, and/or tradeoffs.
- Inclusive of enough information to allow for an informed decision.

Steps in developing candidate selection criteria are:

- Identify relevant cost issues (See Step 4).
- Identify relevant benefits (See Step 5).
- Identify negative impacts of each alternative course of action.
- Take into account any guidance/objectives specified or provided by higher command on what is especially important and what will rank heaviest in the decision making process (cost efficiency, level of product quality, etc.).

Next, pare the list of candidate criteria into a handful of the most meaningful factors that should be taken into account in selecting a course of action. This list will comprise the selection criteria according to which each COA will be ranked, weighed, or judged.

Some possible non-financial selection criteria include:

- Contribution to ARFORGEN
- Consistency with ACP
- Items produced
- Accuracy rate
- Time to delivery or fielding
- Cooperation with current systems
- Maintainability
- Political considerations
- Combat effectiveness

Some possible financial selection criteria include:

- Net Present Value (NPV)
- Benefit-Cost Ratio (BCR)
- Break-even Point (Payback Period)

*These financial selection criteria will be discussed in greater detail in Step 7 of this Guide.*

Note: If the level of risk is an important consideration to the analyst preparing the CBA or to decision maker who will use the CBA to select a solution to a problem, please see the section called “Risk Assessment and Mitigation” in the next Step (Step 7 Compare Alternatives) for more information.

CBA preparer must consider the following questions, to ensure that all important points have been addressed.

- Are the selection criteria appropriately tailored to the problem statement/ requirement?
- Has appropriate consideration been given to both cost and non-cost criteria? If weighting of selection criteria has been used, has leadership agreed with the weighting?
- Do the selection criteria appear unrealistically biased to favor one alternative? (This is unacceptable.)

### **Quick Review**

- The financial results are essential to building a persuasive CBA.
- The user must determine criteria to support the CBA.

## **STEP 7 Compare Alternatives**

This section discusses seven areas:

- Introduction
- Compare Costs and Benefits.
- Risk Assessment
- Describe Second and Third Order Effects.
- Decision Support Tools and Methods(Bringing the CBA Together)
- Perform Sensitivity Analysis
- Billpayers

### **Introduction**

This step is a continuation of the previous one. As was mentioned in that step, the analyst cannot successfully complete this step in the CBA development process without first defining the criteria which was the subject of Step 6 Define Alternative Selection Criteria. The analysis and calculations developed in Step 6 are critical to the tasks required in this step.

### **Compare Costs and Benefits**

The essence of the CBA process is comparing the costs and benefits of two or more alternatives (including the status quo) in order to select the preferred alternative. As a general rule, the preferred alternative is the alternative that provides the greatest amount of benefits in relation to its cost. In situations where it is difficult to quantify benefits and measures of effectiveness, it is important to provide as much useful information as possible to support decision as to which alternative yields the most benefits.

Before an analyst can perform a comparison that will lead to a recommendation, there are two remaining areas that must be discussed as they both may be considerations (criteria) for which a decision could be decided upon. They are risk analysis and 2<sup>nd</sup> and 3<sup>rd</sup> order effects. The analyst or the decision maker may want to base the decision on the level of risk, preferring the COA with the lowest identified risk or the “ripple effect” of a particular COA (among other criteria) preferring the COA with minimal 2<sup>nd</sup> and 3<sup>rd</sup> order effects.

## **Risk Assessment and Mitigation**

Risks/barriers are inherent in the implementation of any project/alternative. A risk is a factor that might cause a given COA to not be implemented as envisioned. For example, in a COA that depends on development of dramatically improved information technology, there would be a risk that the pace of development might be unable to produce the needed breakthrough. A risk assessment is the identification and analysis of relevant risks associated with achieving agency objectives. It is the first step toward improving management controls. It is a screening device that facilitates rapid identification of potential problems that may require corrective action. The analyst should use the CBA to demonstrate that the risks have been identified, and how to mitigate them. Based on the risk assessment analysis, the analyst must develop a statement of risks that will likely be encountered by the initiative/proposal, and identify methods for addressing each one. Finally, the CBA must also explain how the recommended approach reduces the risk or at least takes it into account.

The goal of a risk assessment is to answer questions such as:

- What risks may occur?
- What is the likelihood that the risk will occur?
- What is the source of these risks – internal or external?
- What is the cause of these risks?
- What are the consequences if the risks go uncontrolled?
- What assets, operations, activities, functions, etc. will be affected as a result?
- How much risk is tolerable?
- What should be done to anticipate or prevent occurrence or limit consequences?

Always measure the risk by the potential adverse impact on the associated course of action.

Below are the types of risks:

- Business/Programmatic Risk – The risk of undesirable consequences that affect the program viability and budget.
- Operational Risk – Risks affecting the ability to perform the mission.
- Process Risk – The potential for undesirable performance in a newly established process that could cause failure to meet the anticipated performance or standards.
- Technical Risk – The risk associated with failing to develop or implement the technology necessary to institute process change or technologies that may render an alternative useless. Typically, technical risk increases with the use of immature technologies.
- Schedule Risk – Risk associated with time allocated for performing the defined tasks. This factor includes the effects of programmatic schedule decisions, the inherent errors in schedule estimating, and external physical constraints.

- **Organizational Risk** – The risk associated with difficulties in implementing a change within an organization. Implementing an effective communication and change management strategy can mitigate organizational risks.

Risks are prioritized according to their potential implications for meeting the project’s objectives. The simple but effective approach to prioritizing risks is to use a Probability and Impact Assessment Matrix (see figure below). The specific combinations of likelihood and impact that lead to a risk being rated as high, medium/moderate, or low importance on a risk scale between 1-5 – with the corresponding important for planning responses to the risk are usually set by the organization. It should also include a description of the impact of the risk on the program or system (e.g. time delayed in days, loss of funds, etc). The risk score helps guide and prioritize risk responses. Ensure to evaluate each risk separately.

Impact Assessment Matrix					
Likelihood					
5	M	M	H	H	H
4	L	M	M	H	H
3	L	L	M	M	H
2	L	L	L	M	M
1	L	L	L	L	M
Impact	1	2	3	4	5

L = Low, M= Moderate, and H = High

### Mitigation Plans

Once risks are identified and ranked or prioritized, it is important to develop a risk mitigation plan. Important components of the risk mitigation plan include roles and responsibilities, risk analysis definitions, and risk thresholds for low, medium/moderate, and high risks. Risk mitigation implies a reduction in the probability and/or impact of an adverse risk event to an acceptable threshold. Taking early action to reduce the probability and/or impact of a risk occurring is often more effective than trying to repair the damage after occurring an unfavorable event/ result. Adopting less complex processes, conducting more tests, or choosing a more stable supplier are examples of mitigation actions. There may be cases that there are no viable risk mitigation strategies available. In such a case the analyst should document that and ensure the decision maker is aware of this situation.

In most cases, risk mitigation measures must be developed by the appropriate subject matter experts. For example, if there is a risk associated with timely development of new software, the IT developer should assist the user in identifying risk mitigation measures. In a software situation, typical risk mitigation measures could include a plan to run old and new systems in parallel before fully cutting over to the new system, or conducting a pilot project that uses the new system on a small sample size of the affected function or process.

Note: The statistical methods of calculating the probability of a risk occurring is beyond the scope of this guide.

### **Describe Second and Third Order Effects (Cause and Effect)**

The topic of second and third order effects was briefly discussed in Step 4 of the Guide as they related to developing more complete cost estimate. Second and third order effects can be analyzed in non-cost terms as well.

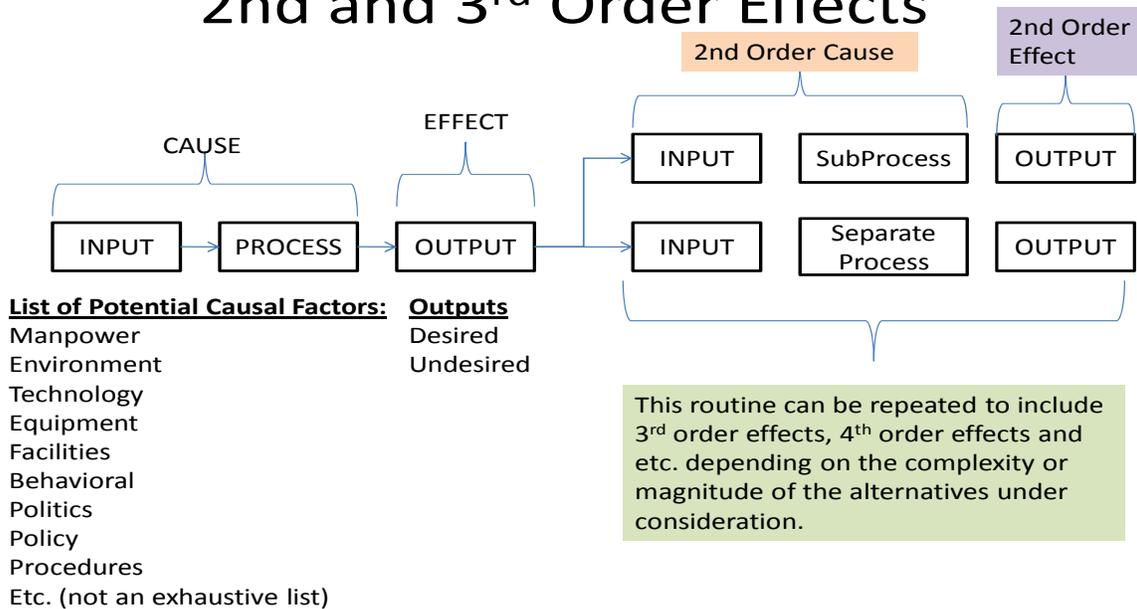
In addition to the primary intended result or consequence of a decision, there can be second- and third-order effects. The concept of second- and third-order effects is based on a sequential cause and effect relationship. When a decision is made, it is the cause of effects A, B, and C. Each of these effects can in turn become the cause of other effects, and so on as the full impact of the decision is felt. Ensure to analyze an alternative in terms of its second- and third-order effects. To identify second- and third-order effects, the analyst should ask questions such as: “If this action is implemented, what will happen? And what will happen as a result of that?” Because decisions have consequences, analysts must understand what those consequences are and assess their impacts not only within their immediate organization, but horizontally and vertically within the larger organization (Army-wide) as well. **Finally, one of the most important questions is: “If a recommendation is adopted, will it create a bill for another organization?”** Again, if it creates a bill for another organization, the analysis/recommendation should coordinate with that organization.

According to FM 6-22 Army Leadership: “Attempting to predict second-and third-order effects may result in identifying resource requirements and changes to organizations and procedures. For instance, when the Chief of Staff approves a new military occupational specialty code for the Army, the consequences are wide-ranging. Second-order effects may mean specialized schooling, a revised promotion system for different career patterns, and requirements for more doctrinal and training material to support new specialties. Third-order effects include resource needs for training material and additional instructor positions at the appropriate training centers and schools. All leaders are responsible for anticipating the consequences of any action (particularly evaluating what the costs will be). Thorough planning and staff analysis (i.e. conducting a CBA) can help, but anticipation also requires imagination, vision, and an appreciation of other people, talents, and organizations.” This extract from FM 6-22 is the reason the subject of second and third order effects was included in this Guide.

#### *Example of 2nd and 3rd Order Effects*

Due to funding constraints, a post commander reduces the number of shuttle bus routes from 3 per hour to 1 per hour. The second order effect is that more people decide to use Privately Owned Vehicles (POVs) instead of waiting for the bus. The third order effect is that traffic congestion becomes worse, leading to late supply deliveries to critical on-post facilities.

# 2nd and 3<sup>rd</sup> Order Effects



## Decision Support Tools/Methods

At this point, the analyst has carried out all the necessary analysis and should be ready to compare each COA with the intent of identifying a COA that best fulfills the objective/goal identified in Step 1 of this Guide. There are several tools / methods that an analyst can use to efficiently and effectively evaluate their analysis to determine the best COA to recommend. These tools / methods can utilize quantitative (financial) criteria, non-quantitative criteria, or some combination of both. **The analyst must determine which of the following selection tools/methods is most appropriate, if any, to support their CBA. There is a table that will assist the analyst in selecting the most suitable method(s) located in Appendix 7A.**

A conceptual look at evaluating alternatives:

<u>If</u> The costs of all alternatives are:	<u>And</u> The benefits of all alternatives are:	<u>Then use:</u>
Equal	Unequal	The alternative that provides greatest benefits for given level of costs
	Equal	Subjective reasoning and/or other analysis to select the best alternative.
Unequal	Unequal	The Alternatives ranked in order of benefit/costs ratios, or largest to smallest net present value
	Equal	The least costly alternative

## The Decision Matrix (Bringing the CBA Together)

With that said, one popular tool or technique for comparing and prioritizing a list of alternatives is the decision matrix. It is highly flexible tool able to effectively evaluate most quantitative and non-quantitative costs and benefits, especially the selection criteria identified in Step 6 and even the ones mentioned in this step.

### Example of a Decision Matrix

		COA 1			COA 2			COA3		
Criteria	Weight	Data	Rating	Score	Data	Rating	Score	Data	Rating	Score
Total Cost	.4	\$24M	1	.4	\$20M	3	1.2	\$22M	2	.8
Maintenance Downtime	.25	10 Hrs	3	.75	10 Hrs	3	.75	14 Hrs	2	.50
Reduced Error Rate	.15	5 per 100	2	.3	2.5 per 100	3	.45	8 per 100	1	.15
Suitability	.1	Very Good	2	.2	Good	1	.1	Excellent	3	.3
Improved Productivity	.1	240 per cycle	3	.3	230 per cycle	2	.2	200 per cycle	2	.1
Etc.	.0									
	<b>1.00</b>			<b>1.95</b>			<b>2.7</b>			<b>1.85</b>

The criteria for the above decision matrix would come from the previous step (Step 6) of this Guide. The criteria are user defined and should be coordinated with the decision maker to ensure that it meets with his or her intent or approval. It makes little sense to evaluate COAs using criteria that are of little important to the person using the CBA to make a decision.

Data values:

- Lower quantifiable data values are generally preferable. In some cases, they could be less desirable (see example above “Improved Productivity”)
- Better subjective ratings for non-quantifiable data values are preferable

Ratings do not necessarily have to equal the number of COAs (e.g. 1,2, and 3 as in the above example). You could also use a greater range of values such as a 1-10. This would help in reducing distortions in scoring criteria for data values of a criteria that are close together. For example, the costs for three COAs are: \$10,000, \$7,500, and \$7,800 respectively. You could weight this criteria as 1, 2, and 2.5 (assuming lower cost and higher the rating is preferred). Again, the analyst preparing the CBA will have to determine the appropriate weights and rankings to use. Finally, some of the financial criteria discussed in the previous step and later in this step should be used with some caution. For example, Cost and Net Present Value / Present Value should not be used together in the same decision matrix as they are duplicative (both are based on cost).

## Quantitative Tools /Methods

There is a variety of quantitative methods for project selection criteria that provide a definitive basis for ranking alternatives.

Some of the most common financial methods for project selection are described below. Usually, the analyst should include no more than one of the following criteria in their decision matrix as they are all very closely related to one another.

- *Net Present Value (NPV) or \*Present Value (PV)*

When the alternatives to satisfy a mission have the same economic life (time over which the benefits to be gained from the alternative may reasonably be expected to accrue), a NPV comparison can be used to determine the optimum alternative based on costs and benefits. With the NPV technique, all future cash flows are converted to present equivalent values then summed (also known as discounting). In the case that the benefits exceed the cost, the alternative with the **greatest** NPV is the preferred alternative. In those cases where benefits do not exceed cost, the preferred alternative is the one with the **lowest** NPV. The effects of inflation discussed in Step 4 of this Guide and discounting must be accounted for when performing current dollar analysis. Current dollars are expressed in the value of their year of occurrence (i.e. actual or projected amounts) Current dollars must be deflated and discounted to derive the present value of future cash flows.

\*Note: When there are no cash inflows but only outflows dollars (expenditures) or only inflows of dollars and no outflows , then instead of calculating NPV, the analyst would calculate the a simple Present Value (PV).

Guidance on discounting whether for preset value (PV) calculations or net present value (NPV) calculations is contained in OMB Circular A-94 Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs dated October 29, 1992 and DoDI 7041.3 Economic Analysis for Decision making dated November 7, 1995 .

According to DoDI 7041.3, the proper discount rate to use depends on whether the costs and benefits are expressed in current or constant dollars.

- If costs and benefits are expressed in constant dollars, then a real discount rate i.e. nominal rate that has been adjusted to exclude expected inflation, should be used to calculate a net present value / present value.
- If costs and benefits are measured in current dollars, then a nominal rate (which implicitly included inflation) should be used to calculate the net present value / present value.

Example of the impact of cashflows using Present Value (PV)

Alternatives A, B, and C each require equal investments, but the occurrence of costs varies by year as shown below.			
Year	A	B	C
1	\$7,500	\$0	\$5,000
2	\$7,500	\$0	\$12,000
3	\$7,500	\$0	\$16,000
4	\$7,500	\$0	\$3,000
5	\$7,500	\$37,500	\$1,500
<b>Total (Non-discounted)</b>	<b>\$37,500</b>	<b>\$37,500</b>	<b>\$37,500</b>
Alternative A:			
Year	Cost	10% Discount Factor	Net Present Value (NPV)
1	\$7,500	0.909	\$6,818
2	\$7,500	0.826	\$6,195
3	\$7,500	0.751	\$5,633
4	\$7,500	0.683	\$5,123
5	\$7,500	0.621	\$4,658
<b>Total (Discounted)</b>			<b>\$28,425</b>
Alternative B:			
Year	Cost	10% Discount Factor	NPV
1	\$0	-	-
2	\$0	-	-
3	\$0	-	-
4	\$0	-	-
5	\$37,500	0.621	\$23,288
<b>Total (Discounted)</b>			<b>\$23,288</b>
Alternative C:			
Year	Cost	10% Discount Factor	NPV
1	\$5,000	0.909	\$4,545
2	\$12,000	0.826	\$9,912
3	\$16,000	0.751	\$12,016
4	\$3,000	0.683	\$2,049
5	\$1,500	0.621	\$932
<b>Total (Discounted)</b>			<b>\$29,454</b>

The above example was adopted from DA PAM 415-3 Economic Analysis: Description and Methods dated 10 August 1992.

The lowest PV is the preferred alternative. From a time value of money perspective, alternative B is the cheapest.

Summary: Net Present Value (NPV):

- Used when all alternatives meet the mission requirement over the same period of analysis
- Value of future earnings in “today’s money”
- Calculated by applying a discount rate % to future costs

- *Benefit/Cost Ratio (BCR)*

How to conduct a BCR analysis: The BCR compares the present value of the total benefits associated with an alternative with the present value of its total costs. Alternatives that have a BCR greater than one (1) are considered viable. All other things being equal, projects with greater BCRs are usually given priority over those with smaller BCRs. A BCR provides the decision maker with the total benefit obtained per unit of cost, thus making it easier to compare different alternatives.

*Example of Benefit/Cost Ratio*

<i>Alternative</i>	<b>Discounted Costs (C)</b>	<b>Discounted Benefits (B)</b>	<b>Discounted Net (B-C)</b>	<b>Benefit Cost Ratio (B/C)</b>
1	\$1,800,000	\$2,200,000	\$400,000	1.22
2	\$1,850,000	\$1,750,000	(\$100,000)	0.95
3	\$2,000,000	\$2,100,000	\$100,000	1.05
4	\$2,200,000	\$2,100,000	(\$100,000)	0.95

Summary: Benefit/Cost Ratio

- Calculated by dividing discounted benefits by discounted costs
- Alternatives with ratios greater than one are cost effective
- The alternative with the highest discounted net benefits could be considered the best alternative

- *Break-even Point*

Break-even analysis can be used when a given COA has a significant investment cost and is expected to result in a cost reduction in future years. The break-even point is the point at which the cost reduction equals the upfront investment. At this point the savings in current dollars from the comparison of alternatives will equal the investment in current dollars. The break-even point is computed for each alternative. Break-even analysis is normally performed using undiscounted current dollars. Break-even analysis is not sensitive to the overall individual alternative benefits or streams of costs or benefits that occur after the break-even point is reached.

*Example of Break-even Point Analysis (In Thousands of Current Dollars)*

Year	STATUS QUO COST		ALTERNATIVE ONE COST		TOTAL COST		Cost Reduction
	Recurring	Non-recurring	Recurring	Non-recurring	Status Quo Costs	Alternative One Costs	
1	\$10,251	\$0	\$10,251	\$10,666	\$10,251	\$20,917	(\$10,666)
2	\$10,588	\$33,045	\$10,588	\$44,060	\$53,884	\$75,565	(\$21,681)
3	\$10,936	\$0	\$5,468	\$0	\$64,820	\$81,033	(\$16,213)
4	\$11,291	\$0	\$5,646	\$0	\$76,111	\$86,679	(\$10,568)
5	\$11,652	\$0	\$5,826	\$0	\$87,763	\$92,505	(\$4,742)
6	\$12,025	\$0	\$6,013	\$0	\$99,788	\$98,517	\$1,271
7	\$12,410	\$0	\$6,205	\$0	\$112,198	\$104,722	\$7,476
8	\$12,807	\$0	\$6,404	\$0	\$125,005	\$111,126	\$13,880
9	\$13,217	\$0	\$6,609	\$0	\$138,222	\$117,734	\$20,488
10	\$13,640	\$0	\$6,820	\$0	\$151,862	\$124,554	\$27,308

**NOTE:** Break-even point occurs in the 6<sup>th</sup> year.

Summary: Break-even Point

- Break-even point is the year where the savings become positive.
- Constant dollars are converted to current dollars using inflation indices.
- Savings are determined by calculating the difference between cumulative costs.

## Non-Quantitative Methods

Below are some terms and descriptions of non-quantitative (subjective) methods for alternative selection.

- *Subjective Reasoning*

The subjective reasoning method uses one or more of the following informal criteria for alternative ranking: urgency in attaining the alternative objective, filling a gap in existing mission requirements, maintaining existing mission objective levels, or whether or not the proposed alternative meets emergency needs.

Here is a simplified example.

A CBA team has identified three decision criteria: achieving mission requirements, cost, and response time. The analysts' assessment of the relative importance of the criteria is that achieving mission requirements is twice as important as cost, and cost is 1.5 times as important as response time. The analysts assign them scores of 6, 3, and 2, respectively. (These could be any numbers, as long as the relative importance is maintained.) The analysts are considering three alternatives. Based on their professional judgment, they determine that the extent to which each alternative satisfies the three criteria is as follows:

Alternative	Mission	Cost	Response Time
Alt A	0.8	0.8	0.5
Alt B	0.4	0.2	0.3
Alt C	0.7	0.7	0.7

The evaluation and ranking of the alternatives is captured in the following table:

	Mission	Cost	Response Time		
<b>Relative Importance of Criteria:</b>	6	3	2		
	Extent to which each Alternative Satisfies the Criteria			Calculation	Sum
<b>Alt A</b>	0.8	0.8	0.5	$6*0.8 + 3*0.8 + 2*0.5$	8.2
<b>Alt B</b>	0.4	0.2	0.3	$6*0.4 + 3*0.2 + 2*0.3$	3.6
<b>Alt C</b>	0.7	0.7	0.7	$6*0.7 + 3*0.7 + 2*0.7$	7.7

**This analysis clearly eliminates Alternative B from consideration, and enables decision makers to focus their subjective consideration on Alternatives A and C.**

- *A Fortiori Analysis*

An “a fortiori” analysis is applicable to decision problems where generally accepted intuitive judgment strongly favors one alternative. The a fortiori analysis involves the deliberate attempt to formulate assumptions that tend to uniformly favor or disfavor a particular alternative. The rationale is that if the assumptions uniformly favor an alternative and the alternative still does not rank above other alternatives, then any other set of assumptions would only tend to reduce the alternative's ranking. For example, a decision maker realizing personal bias to the status quo counteracts this bias by purposely formulating new assumptions that favor the competing alternatives. If the comparison of the alternatives still indicates the status quo is the most cost effective, the bias did not affect the decision process.

### **Perform Sensitivity Analysis**

Sensitivity analysis is a tool for assessing the extent to which the evaluations of courses of actions are affected by changes to any element of the CBA – assumptions, costs, benefits, etc.. To conduct a sensitivity analysis for a given element, repeat the analysis using different values for that element. If the change results in a relatively large change in the outcome of the analysis, then the analysis is sensitive to changes in that element. Sensitivity analysis provides the answer to an important question: When one or more factors changes, what happens to the recommended COA? Factors that have a strong impact on results obviously deserve the most attention.

All cost estimates should include sensitivity analyses. It is not sufficient to present the decision maker with a single recommendation that is based on the ‘most likely’ costs, benefits, assumptions, and other factors. The decision maker needs to be informed about how well the alternative’s rankings will hold up under reasonable changes to factors and assumptions. Describe how sensitive the recommendation is to changes. For example, a sensitivity analysis that addresses how sensitive the recommendation is to changes in cost might say, ‘The cost estimate for this COA is \$500K, but that estimate might prove to be incorrect. Analysis of this sensitivity has determined that as long as cost is \$800K or lower, the recommendation would not change.’ This gives the decision maker a ‘comfort level’ by assuring him/her that costs could vary considerably without changing the recommendation. On the other hand, if a recommendation is found to be extremely sensitive to small changes in cost, assumptions, or other factors, then a more in-depth analysis might be appropriate.

It is important to note that sensitivity analysis can address not only changes in cost and benefit, but changes in other factors as well, to include assumptions, constraints, scope, and weighting of selection criteria. A thorough sensitivity analysis should consider all these possible changes. It is recommended that sensitivity analysis be done especially on the most important selection criteria and the most important assumptions.

It may be helpful to divide analysis into two groups of factors:

- Those that are outside the control of an agency (i.e. assumptions) and,
- Those that an agency can influence or control to some degree.

Suggested steps for conducting a sensitivity analysis are:

- Choose several elements (costs, assumptions, benefits, etc) that appear to have the greatest impact on the results of the analysis and which are most subject to variance.
- Vary each one over a reasonable set of values while holding the other variables in the analysis constant relative to each other.
- Determine the impact of these changes on the net present value results and the ranking of alternatives.

Some factors that may warrant sensitivity analyses are:

- The effects of a shorter or longer economic life.
- The effects of variation in the estimated volume, mix, or pattern of workload; for example, the production rate or learning curve.
- The effects of potential changes in requirements resulting from either congressional mandate or changes in functional responsibilities.
- The effects of potential changes in requirements resulting from changes in organizational responsibility at the site, installation, base, or Army command/direct reporting unit/Army service component command level.
- The effects of changes in configuration of hardware, software, data communications, prime support equipment, and other facilities.
- The effects of alternative assumptions on areas such as project operations, inflation rate, residual value of equipment, and length of development.
- The effects of changing the fielding strategy.

### **Billpayers**

Billpayers are required in any situation where a given COA has a higher program/budget cost than is available with currently programmed/budgeted funds. This situation will apply in virtually all cases, since decision makers rarely find themselves with excess funds. To the contrary, most often they almost always must make “zero-sum” decisions, taking funds from an existing program to pay for a new initiative. The billpayer for an initiative is what a department/agency gives up to obtain that item. Rarely are there sufficient resources, financial and otherwise, to satisfy each and every requirement. As part of the CBA process, analysts and decision makers must explore the issue of how to support an alternative financially. The question is simple: if the decision maker decides to approve this new action, who or what will pay the bill? Billpayers must be internal to the organization preparing the CBA unless the

analysis has been coordinated with other affected organizations. An analyst preparing a CBA cannot assume that other organizations will pay for the recommended alternative. Identification of a billpayers entails identifying the currently programmed/budgeted capabilities the organization is willing to give up in order to get the benefits of the preferred COA in the CBA. In most cases, the functional subject matter experts on the CBA team will not be able to identify billpayers. Active participation by the organization's resource manager and prioritizer is essential. **A best practice is to ensure that these individuals are engaged early in the CBA development process to assist and advise the CBA analyst and his/her leadership in the identification of the appropriate billpayers to use in offsetting the costs of the alternatives under consideration.**

Example:

If one organization spends money to purchase ten tanks and decides to pay for the tanks by not buying trucks it had planned to purchase, then the billpayer for ten tanks is thirty trucks. It is important that leadership be willing to make such sacrifices if it means implementing a specific COA.

The CBA preparer must remember that the CBA must give primary consideration to estimating the full cost of each course of action, separately from considering the impact on the budget. The cost question is: What is the full cost of the alternative? The budget question is: What impacts will the alternative have on the budget? The budget consideration is addressed by estimating billpayers, resulting in the calculation of funded requirements and unfunded requirements (UFRs) for each course of action.

As a review, the cost and benefits steps use life cycle costs or full costs. When analyzing the CBA in terms of its budgetary / resourcing impacts, the time period of analysis should be associated with the appropriate POM cycle. For example, if the COAs under consideration have a life cycle of 20 years, the cost analysis portion of the CBA should reflect 20 years of cost data. But when determining billpayers, the CBA should use only the current or nearest appropriate POM cycle period.

Example of a simple way of displaying billpayers in context of a budgetary framework.

	Year of Execution	Budget Year	POM Years					
Budgetary Analysis	FY XX	FY XX+1	FY XX+2	FY XX+3	FY XX+4	FY XX+5	FY XX+6...	TOTAL
Cost Totals								
Less Funded								
= Unfunded Requirements								
Less Bill Payer								
= UFR	\$0	\$0	\$0	\$0			\$0	\$0

Billpayers should cover the cost of each COA.

**Quick Review**

- Comparing the costs and benefits of each alternative is a fundamental part of the CBA methodology.
- A decision matrix is an effective tool for performing a comparison as well as the rank ordering of alternatives.
- Second and third order effects are the results (consequences) stemming from a decision. Sensitivity analysis is a technique for analyzing whether changes in assumptions, quantitative values, or priorities will affect the recommendation.
- The CBA should include a discussion of all risks that can impact the implementation of a recommendation. For each risk identified, the analyst should identify an associated mitigation strategy that will explain how the risk will be minimized or eliminated.
- Billpayers are the funding sources that will cover the costs of an alternative.

## Appendix 7A

### Special Topic: Decision Support Methods

The following table summarizes the alternative selection criteria discussed in this section.

Method	Description	When Used
Decision Matrix	Allows for multiple criteria to be used to compare alternatives.	It is a very flexible tool that can be used under most circumstances. It can even account for other decision support methods described in this table.
Net Present Value (NPV)	Converts future cash flows into present equivalent values and then adds them together.	When alternatives have the same economic life.
Benefit/cost ratio (BCR)	Compares present value (PV) of benefits with present value of costs.	When competing alternatives have unequal costs and unequal benefits
Break-even Point	Identifies point at which cumulative cost of two alternatives equal the cumulative benefits.	When projects are high-risk, to show when investment costs need to be recovered quickly
Subjective reasoning	Applies professional judgment as a complement to, or to the exclusion of, quantitative data.	When professional judgment is considered to be more important than quantitative data.
Point System	Applies objective values to subjective criteria.	When decision makers wish to narrow the list of alternative solutions to the few that are most suitable.
<i>A Fortiori</i> Analysis	Determines whether a strongly favored alternative is still the best choice even when assumptions are formulated that put that alternative at a disadvantage.	When generally accepted intuitive judgment strongly favors one alternative.

## Appendix 7B

### Special Topic: Resourcing Considerations

The Under Secretary of the Army and Vice Chief of Staff of the Army, in their memorandum dated 30 December 2009, subject: Cost-Benefit Analysis to Support Army Enterprise Decision Making, mandate identification of billpayers along with 2nd and 3rd order effects of the COAs in a CBA. Further, Concept Plan (CP) guidance (31 March 2010) states that "the CP will be resource-informed and will include a resourcing strategy for manpower and equipment authorizations."

The Army is operating in a constrained resource environment; additional resources (manpower and dollars) may not be available to support new or directed TDA or AUGTDA mission requirements. If funding for the year of execution or first budget year is being requested, varying funding strategies may be considered. A command would typically want to work its funding decisions within a concentric circle framework; the innermost circle represents internal reprioritization which would preclude a UFR. The outermost circle requires congressional intervention and appropriation level reprogramming of funds. Most funding strategies fall somewhere in between and include billpayers from within the command's approved Total Obligation Authority (TOA) and end strength or trades with other commands. Typically a Memorandum of Agreement (MOA) and headquarters approval by the PBAT or BRP process is required for intercommand transfers. Documentation must also be provided to include schedule 8's that identify the AMSCO/MDEP/UIC and PPBE CYCLE and/or MOAs for approved efforts.

Funding strategies are coordinated within the decision making framework of headquarters. A CP is mandatory for the request of new manpower requirements. Approval of Schedule 8's and any CP that requests 'new' manpower requirements rests with the Program Budget Assessment Team (PBAT). The PBAT is a working-level forum that meets throughout the PPBE process. It makes the first comprehensive review of most of the Army's manpower resourcing issues generated by the Army Commands, PEGs, HQDA staff, senior leaders and other PPBE participants. The PBAT approves or rejects changes to manpower resources within its authority and determines which resourcing issues need to be referred to higher authority such as the BRP process. The BRP process provides a tiered decision-making authority to address those efforts that could not be resolved in the PBAT, have significant impact, or are of significant scope and complexity. The BRP may also review efforts that do not have manpower impacts but require a coordinated funding strategy approval.

If HQDA or higher authority has directed the mission and the Command is not resourced to execute a mission which requires additional requirements and authorizations, the command must provide a mission directive authority and a memorandum signed by a general officer for consideration by FM&C for resourcing. Alternatively, the G-37FM may direct the realignment of military authorizations from lesser priority missions within the command to resource the concept plan. If requesting new resources, the Command needs to be aware of the timing of the PPBE cycle, i.e. authorization documents are published approximately two years prior to their effective date.

## STEP 8 – Report Results and Recommendations

This section discusses three areas:

- Documenting the CBA
- Supplementary Content
- Briefing the Results of the CBA

### Documenting the CBA

A CBA preparer should document the CBA, including all tables, charts, and diagrams, according to the 8-Step Method discussed in this Guide (see CBA Case Study in Appendix E for an example) preferably using a word processing application such as Microsoft Word. A CBA presented in presentation such as PowerPoint is also acceptable, but it must be as thorough and comprehensive as if the CBA were prepared in Word. Ideally, the analyst should prepare a CBA using Word or similar application and then use in PowerPoint to facilitate a briefing for the decision maker. A suggested format for a set of briefing slides has been included later in this section of the Guide. It is emphasized that the suggested format is just that – a suggestion. The actual format and content of a briefing should be determined by several factors, to include the nature of the content, the briefing style of the briefer, and the preferences of the decision maker being briefed. It is beyond the scope of this guide to mandate what should or should not be briefed to a decision maker.

It is essential to thoroughly document the CBA. There must be sufficient documentation of all assumptions, costs, methodology, results, and data to enable a person unfamiliar with the project to arrive at the same conclusion as the person who prepares it. **All documentation, including all supporting spreadsheets and calculations attached separately must accompany the CBA document and charts when they are submitted for review.**

CBA documentation should describe the functional process performed; define the requirement; identify significant assumptions, constraints, and key variables. The CBA documentation should also identify feasible alternatives, and present total costs and differential savings expected in constant, discounted, and current dollars over the project life. **The CBA must address estimating methods/relationships and data sources; treat sensitivity, risk, and uncertainty of key cost drivers and assumptions; and address all quantifiable benefits as well as any non-quantifiable benefits influencing the recommended course of action.** Furthermore, clearly document all alternatives and the differences between them to include the justification for their deletion.

Documentation supporting the results of the analysis must include the computations, data sources, and methodologies used to estimate the costs and benefits. For example, if cost

factors are used, indicate their source and/or the basic assumptions used in their derivation. All data sources should be specifically identified for all costs and benefits. Support documentation should be sufficient to allow an independent reviewer to recreate the estimate and reach the same conclusions. In addition, it is important to identify the sources of benefit data, methods used to collect the data, and quality of data.

Present all costs in constant and/or current dollars as the case may be, and display by fiscal year for the entire project life, beginning with the first fiscal year in which costs will be incurred. Cost estimates must reflect the Army's true requirement for a system or project, not just available funding. Explain to the decision maker of the strategy for obtaining needed funding for any unfunded program or project and options for implementation within current funding levels.

The comparison of alternatives should show differences in costs and benefits by fiscal year. Some of the commonly used tools (discussed in Step 6) are: Benefit/COST Ratio (BCR) and Break-even Point (Payback Period). Also to identify other factors that may quantitatively or non-quantitatively affect the assessment of costs and benefits for one or more of the alternatives. Examples include non-quantifiable benefits such as improved morale, better quality of life, customer satisfaction, etc.

**A recommendation as to the preferred alternative, with all appropriate supporting justification, should accompany the comparison of alternatives.**

In addition to a recommendation, a value proposition should accompany the results of the CBA. See page 13 for more information on value propositions. In short, they are concise statements presenting tangible results and services of the recommended COA.

### **Supplementary Content**

At this point in the CBA development process, the CBA is nearly complete and ready to be used for a decision. But before this happens, the following additional elements can improve the overall quality and completeness of a well-documented CBA. Moreover, the decision maker may find them of particular value. They are not required but suggested.

- **Glossary** – Define unfamiliar abbreviations, acronyms, and terms used in the CBA. This is important because an analyst should not assume the reader or reviewer has the background or experience necessary to understand the CBA without additional explanation.
- **Timeline** – A timeline is a chart displaying the key dates and actions associated with the CBA in terms of its development and/or implementation. Often times, decision makers have questions or concerns about the schedule of events that will take place once a COA is selected and implemented.

- **Coordination sheet / form**– The table displays who has reviewed the CBA and what their assessment is of the CBA. Similar to the DA Form 5, there are three possible responses: Concur, Concur with Comment and Non-Concur (also includes comments). Normally, the coordination form is required of a CBA going before a senior leader to ensure that it has been thoroughly staffed. The coordination form can accompany the CBA as an additional attachment, as part of a cover sheet, or even as part of the briefing. Note: CBAs coming to HQDA for review and validation should be thoroughly staffed as lower levels prior to submission.

The analyst must use their judgment in coordination with stakeholders to determine if the above supplementary content is needed.

### **Briefing the Results of the CBA**

The purpose of the briefing format is to provide a tool to summarize a CBA, as well as to present the results and recommendations to senior leadership. The format is in the form of a decision briefing that will lead the decision maker through a logical sequence of how a course of action was identified. It includes a “main” section as the basic briefing, and a “backup” section to contain additional supporting information. This is the standard briefing presentation structure used within the Army. This format intends to present the critical, “must-have,” analysis essential for arriving at a recommended course of action to the decision maker.

It is understandable that the content of CBAs will vary because the proposals or initiatives are not the same. The data and methodology used in building the CBA often influence the content and layout of a CBA briefing. Moreover, the user’s leadership may direct the type of format with specific data, which may differ from the template. Therefore, users are encouraged to customize the template to fit the unique requirements of their CBA and/or the decision maker. Note: The briefing format is not a substitute for a well documented CBA in narrative form.

Users may adopt the template exactly as it appears or may build their own briefing based upon the template. Furthermore, users are encouraged to include explanatory footnotes that help readers understand the information displayed. The only requirement is that organizing the briefing similar to the template structure shown above. For example, don’t place the decision matrix slide before the Course of Action slide. Don’t leave out major sections, such as eliminating the Problem Statement or Assumptions and going right into a discussion of the COAs immediately after the cover page. Again, the CBA should present the results of the analysis in an organized and logical manner.

If there is a need to expand beyond one slide, then do so. Users are not restricted as to how many slides they may use per each step of the CBA process. The analyst should consider the overall length of the main part of the briefing and control the slide growth where possible. The backup section of the briefing can be as long/comprehensive as necessary.

The following page shows a suggested briefing format to brief decision makers on the CBA or to document a CBA:

Slide 1

 **AMERICA'S ARMY:**  
THE STRENGTH OF THE NATION

Organization

The following set of slides reflects suggested content for a briefing to a decision maker. These slides are a format rather than a template. CBA preparers may use this set to build their own briefing slides.

This slide deck reflects the guidance in the Army's Cost Benefit Analysis Guide V2 (which will be released soon) but it can work with V1 of the Guide equally as well. While it is designed as a briefing, it may also be used to document a CBA so long as all the elements are fully developed.

Note: This set of slides replaces the those used in V1 of the Army's CBA Guide dated 12 January 2010.

**Organization**  
**Point of Contact**  
(Include name with email address  
and/or phone number)

**Date:**

Slide 2

 **AMERICA'S ARMY:**  
THE STRENGTH OF THE NATION

Organization

**Executive Summary**

One slide dedicated to describing the CBA and why a particular course of action is being recommended. Include summary cost and benefit information as well as a strong value proposition.

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Slide 3

AMERICA'S ARMY: THE STRENGTH OF THE NATION Organization

## Problem Statement and Objective

Problem (Opportunity) Statement:	Objective:
Describes the problem or opportunity which the CBA addresses	What is the objective of the CBA? This can be stated in terms of improved performance, reduced cost, or desired end state for the issue under consideration.

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Slide 4

AMERICA'S ARMY: THE STRENGTH OF THE NATION Organization

## Background

Describe the background / situation that led to the need for a CBA. Include the contextual details to help the reader understand the content of the CBA. This material should be tailored for the decision maker who will receive the briefing. If this requires additional slides, please use them.

Note: When CBA is being prepared for a 3<sup>rd</sup> party to review, the analyst should assume the reader has no knowledge or experience with the subject of the CBA.

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Slide 5

## CBA Scope, Facts and Assumptions

<p><b>Scope</b></p> <p>Timeframe, location, and organizational impacts of the CBA. Also mention aspects or organizations not included in the analysis.</p>	<p><b>Facts</b></p> <p>A fact is something that is empirically true and can be supported by evidence. Include only relevant facts – those items of information that have a direct bearing on the CBA being developed. Constraints are schedule, resource, budget, staffing, technical, and other limitations that may impact the success of the CBA. They can be described in terms of facts or even assumptions.</p>
<p><b>Assumptions</b></p> <p>An assumption is something that is essential to the success of the recommended COA and over which we have no control.</p>	

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Slide 6

 **AMERICA'S ARMY:**  
THE STRENGTH OF THE NATION Organization

## Courses of Action

- COA 1:** (Status Quo - Title of COA 1)  
Narrative/Description of COA 1
- COA 2:** (Title of COA 2)  
Narrative/Description of COA 2
- COA 3:** (Title of COA 3)  
Narrative/Description of COA 3
- Etc**

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Slide 7

**AMERICA'S ARMY:**  
THE STRENGTH OF THE NATION

Organization

## COA # and Title

<p><b>Costs:</b></p> <p>List/summarize the major costs of the proposed COA , include the years which the pertain. The costs that appear should also include those 2<sup>nd</sup> and 3<sup>rd</sup> order effects cost that can be identified/analyzed.</p>	<p><b>Benefits (Advantages):</b></p> <p>Include both quantifiable and non-quantifiable benefits.</p>
<p><b>Disadvantages:</b></p> <p>List or describe the quantifiable, non-quantifiable disadvantages, and risks associated with the COA.</p>	<p><b>2nd and 3rd Order Effects</b></p> <p>This block will include a discussion of 2<sup>nd</sup> and 3<sup>rd</sup> order effects arising from the COA. Costs and benefits not included in the above blocks on this slide should be discussed here.</p>

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Slide 8

**AMERICA'S ARMY:**  
THE STRENGTH OF THE NATION

Organization

## COA # & Title Cost Analysis

Cost Analysis	FY XX	FY XX+1	FY XX+2	FY XX+3	FY XX+Etc...	TOTAL
Cost Element 1						
Cost Element 2						
Cost Element 3						
Cost Element XX...						
<b>Total</b>						

Whenever possible, users should use this chart to display an initiative's life cycle costs. In the event that the use of lifecycle costs is not the best way/appropriate fit for the cost data, users should complete the above chart using the appropriate POM cycle years. Include the year of execution and/or budget year plus the FYDP. For example, if today's date is 1 Oct 10, the year of execution is FY11. The budget year is FY 12 and the POM cycle is FY13-FY17. Cost elements could be things related to personnel, training, supplies, equipment, and etc. As a reminder, analysts should provide the supporting worksheets for the above Cost Elements. **ALL COSTS SHOULD BE ENTERED IN CONSTANT DOLLARS.** See Step 4 of the Guide for more information on constant dollars.

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AMERICA'S ARMY:  
 THE STRENGTH OF THE NATION

Organization

## COA # & Title

### Resourcing Analysis

Budgetary Analysis	FY XX	FY XX+1	FY XX+2	FY XX+3	FY XX+Etc...	TOTAL
Cost Totals <i>(Using current dollars)</i>						
Less Funded						
= Unfunded Requirements						
Less Bill Payer						
= UFR	\$0	\$0	\$0	\$0	\$0	\$0

This chart picks up where the previous (Cost Analysis) chart ends with one exception. **The above chart should display the appropriate POM cycle / years and not the entire life cycle including year of execution and budget year** if applicable. They **costs should be converted into current dollars** (a.k.a then year dollars) via the use of an inflation factor. Ensure that Billpayers cover the full cost of each COA. Resourcing decisions are normally made from a POM perspective. See Step 4 of the guide for more information on constant vs. current dollars.

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**AMERICA'S ARMY:**  
THE STRENGTH OF THE NATION

Organization

## Cost & Benefits Comparison

	COA 1	COA 2	COA 3
Total Cost			
Benefits (Quantifiable)			
Trade-off and Billpayers			
Unfunded Requirements	Billpayers should cover the cost of each COA.		
Other 2nd and 3rd Order Effects			

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Slide 11

**AMERICA'S ARMY:**  
THE STRENGTH OF THE NATION

Organization

## Risk Assessment and Mitigation

Identify the significant risks affecting the successful implementation of the recommended COA and describe the risk mitigation strategy for each identified risk.

If you are documenting your CBA using this suggested briefing format, this slide should be inserted before the decision matrix. On the other hand, if you are simply using the suggested briefing slide as part of an actual briefing the risk assessment slide may be moved to the background.

Bottom line, it is up to the analyst in coordination with their leadership / decision maker to determine what content should be included in the CBA or CBA briefing.

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Slide 12

**AMERICA'S ARMY:**  
THE STRENGTH OF THE NATION

Organization

## Decision Matrix

Criteria	Weight	COA 1			COA 2			COA3		
		Data	Rating	Score	Data	Rating	Score	Data	Rating	Score
	1.00									

Highest score is best. The criteria would come from Step 6 & 7 of the Guide. They are user defined.

Data values:  
 Lower quantifiable data values are preferable.  
 Better subjective ratings for non-quantifiable data values are preferable

Please include a description /definition of each criteria used in the Decision Matrix.

Slide 13

**AMERICA'S ARMY:**  
THE STRENGTH OF THE NATION

Organization

## Recommendation

Describe the recommended COA with a strong value proposition.

Slide 14

 **AMERICA'S ARMY:**  
THE STRENGTH OF THE NATION

Organization

# Backup

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Slide 15

 **AMERICA'S ARMY:**  
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Organization

# Timeline

This slide is the way ahead for the subject CBA. It should reflect the key dates critical to the successful selection and implementation of the recommended COA. This slide is optional but encouraged.

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Slide 16

 **AMERICA'S ARMY:**  
THE STRENGTH OF THE NATION

Organization

## Glossary

**Glossary** – Describes all terms including abbreviations, acronyms, and concepts used in the CBA. The CBA preparer should not assume the reader or reviewer has the background of experience to understand the CBA without this additional.

This slide is optional but encouraged.

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Slide 17

 **AMERICA'S ARMY:**  
THE STRENGTH OF THE NATION

Organization

## Sensitivity Analysis

This slide is optional but encouraged.

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Slide 18

AMERICA'S ARMY:  
THE STRENGTH OF THE NATION

Organization

## Coordination

CMD/ORG	POC	CONCUR	Concur w/Comment	Non Concur	Comments
<p><b>Coordination slide / form</b>– The table displays who has reviewed the CBA and what their assessment is of the CBA. Normally, the coordination form is required of things going to a senior leader to ensure that the CBA has been thoroughly staffed before coming to him/her for decision. This slide / form may accompany the CBA as an additional attachment or even as part of the briefing. Note: CBAs coming to HQDA for review and validation should be thoroughly staffed as lower levels prior to submission.</p>					

This slide is optional but encouraged.

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### Quick Review

- Layout the CAB in an organized and logical structure using the suggested slides.
- Include/insert additional slides if they are necessary to support the CBA.
- Using notes to better explain the contents of a slide(s) is acceptable.
- While the briefing template is flexible for a wide variety use of CBA topics, it should tailor to the particular needs of the CBA by following the 8-Step and the briefing outline described in this Appendix. Leaving out steps may weaken the case for the recommended alternative/COA.
- The Detail DECMAT is the recommended slide for most briefings below senior level decision makers while the Summary DECMAT is for briefings to general officer and above.
- **CBA preparers must receive assistance from the agency's resource manager and prioritizer in order to identify organizational billpayers.**
- Document the CBA in a narrative form rather than as a PowerPoint presentation. PowerPoint is best used to present summary information from the CBA.
- Keep it clear and concise.
- Minimize jargon and conjecture.
- Communicate all facts as part of the overall story.

- Demonstrate the value that the initiative will bring to the organization and the enterprise (key stakeholders).

## Appendix A

### References

#### Office of Management and Budget and Government Accountability Office

- OMB Circular No. A-11, Part 7, Planning, Budgeting, Acquisition, and Management of Capital Assets
- OMB Circular A-94, Guidelines and Discount Rates for Benefit-cost Analysis of Federal Programs
- GAO Cost Estimating and Assessment Guide, March 2009  
(<http://www.gao.gov/products/GAO-09-3SP>)

#### Department of Defense References

- The Secretary of Defense Memorandum, “Consideration of Costs in DoD Decision-Making” dated December 27, 2010
- DoD Cost Guidance and Tools (<https://www.cape.osd.mil/costguidance/>)
- DoDI 5000.02 Operation of the Defense Acquisition System, December 2008
- DoDI 7041.3, Economic Analysis for Decision-making
- DoD Business Case Development Guide, V2, November 2003
- DoD Business Case Model for the DoD Logistics Community, September 2009

#### U.S. Army References

- AR 11-18, The Cost and Economic Analysis Program
- AR 70-1 Army Acquisition Policy, April 2009
- AR 700-127 Integrated Logistics Support
- ASA(ALT) Performance-Based Logistics (PBL) Business Case Analysis
- Department of the Army Pamphlet (DA PAM) 70-3, Army Acquisition Procedures, April 2009

### **Guidance Prepared By DASA (Cost and Economics Directorate)**

- Economic Analysis Manual, February 2001
- Cost Management Handbook, April 2009
- Budgetary and Cost Template to Support Legislative Proposals, March 2009
- Cost Benefit Analysis Portal ( <https://cpp.army.mil>)

### **Miscellaneous Documents and Other Sources**

- Enhanced Defense Financial Management Training Course, Module 2, Competency Area 2: Cost and Economic Analysis
- Defense Acquisition Guidebook, Chapter 3, Affordability and Life Cycle Resource Estimates, Defense Acquisition University
- Weapon Systems Acquisition Reform Act of 2009, House of Representatives, 111<sup>th</sup> Congress, May 2009
- CJCSI 3170.01G, 1 March 2009
- FM 5-19, Composite Risk Management, HQDA, August 2006
- FM 5-0, The Operations Process, HQDA, March 2010

## Appendix B

### Acronyms

<b>ADM</b>	Acquisition Decision Memorandum
<b>APB</b>	Acquisition Program Baseline
<b>AS</b>	Acquisition Strategy
<b>BCR</b>	Benefit/Cost Ratio
<b>CARD</b>	Cost Analysis Requirements Description
<b>CBA</b>	Cost Benefit Analysis
<b>CDD</b>	Capability Development Document
<b>CER</b>	Cost Estimating Relationship
<b>CES</b>	Cost Element Structure
<b>COA</b>	Course of Action
<b>CPD</b>	Capability Production Document
<b>DAES</b>	Defense Acquisition Executive Summary
<b>DOTMLPF</b>	Doctrine, Organization, Training, Materiel, Leader and Training, Personnel, and Facilities
<b>FOC</b>	Full operational capability
<b>FY</b>	Fiscal Year
<b>GFE</b>	Government Furnished Equipment
<b>GR&amp;A</b>	Ground rules and assumptions
<b>ICD</b>	Initial Capabilities Document
<b>IOC</b>	Initial Operation Capability
<b>IRR</b>	Internal Rate of Return
<b>JCIDS</b>	Joint Capabilities Integration and Development System

<b>LCC</b>	Life cycle cost
<b>MDEP</b>	Management Decision Package
<b>MER</b>	Manpower Estimate Report
<b>MILCON</b>	Military Construction
<b>NPV</b>	Net Present Value
<b>O&amp;M</b>	Operations and Maintenance
<b>O&amp;S</b>	Operations and Support
<b>OASA(FM&amp;C)</b>	Office of the Assistant Secretary of the Army (Financial Management & Comptroller)
<b>ORD</b>	Operational Requirement Document
<b>POE</b>	Program Office Estimate
<b>POM</b>	Program Objective Memorandum
<b>POV</b>	Privately Owned Vehicle
<b>PPBE</b>	Planning, Programming, Budget and Execution
<b>RDT&amp;E</b>	Research, Development, Test and Evaluation
<b>ROR</b>	Rate of Return
<b>SAR</b>	Selected Acquisition Report
<b>SEPM</b>	Systems Engineering and Program Management
<b>STRAP</b>	System Training Plan
<b>TDA</b>	Table of Distribution and Allowances
<b>TEMP</b>	Test and Evaluation Master Plan
<b>TOE</b>	Table of Organization and Equipment
<b>WBS</b>	Work Breakdown Structure

## Appendix C

### Glossary

#### **Acquisition strategy**

Conceptual framework for conducting materiel acquisition, encompassing broad concepts and objectives that direct and control overall development, production, and deployment of system.

#### **Automated Information System (AIS)**

Is a system of computer hardware, computer software, data and/or telecommunications that performs functions such as collecting, processing, storing, transmitting and displaying information; however, systems that are an integral part of a weapon or weapon system are excluded from this definition. AIS programs that meet the specified dollar thresholds in DoD Instruction 5000.02, Enclosure 3, Table 1, qualify as Major Automated Information System (MAIS) programs.

#### **Alternative**

One of two or more approaches, programs, or projects that are the means of fulfilling a stated objective, mission, or requirement.

#### **Alternative cost**

The total cost associated with developing, producing, fielding (including military construction), and sustaining the system. The alternative cost also includes the phase-out cost of the status quo. It does not include sunk cost.

#### **Appropriation**

A legislative process setting aside a designated amount of public funds for a given purpose. Jointly, the Senate Appropriations Committee and House Appropriations Committee annually establish funding levels through an appropriations bill, which ultimately is enacted into law upon signing by the President.

#### **Army Acquisition Executive**

The Secretary of the Army designated principal advisor and staff assistant for acquisition of Army systems. The Assistant Secretary of the Army for Research, Development, and Acquisition is currently designated as the Army Acquisition Executive responsible for overall management of Army acquisition programs.

#### **Army Cost Position**

The results of the comparative analysis of the Program Office Estimate or Economic Analysis and the Component Cost Analysis or an Independent Cost Estimate. The ACP is documented in the Cost Analysis Brief and approved by the Assistant Secretary of the Army for Financial Management and Comptroller. It is the approved cost position for all subsequent programming, budgeting, and cost analysis activities.

### **Army Systems Acquisition Review Council**

A panel composed of regular, special members, and participants designated by the chairman whose mission is to review DoD major programs and DAPs at specific milestones and provide Army approval prior to the next phase of system acquisition.

### **Assumption**

A statement or hypothesis that is essential to the success of a plan or alternative and is beyond the control of the organization making the analysis. Assumptions should never be confused with facts.

### **Benefit**

Results and outputs expected in return for costs and inputs incurred or used. A positive output of an alternative. It includes measures of utility, effectiveness, and performance. Benefits focus on the purpose and the objectives of a project.

### **Benefit/cost ratio**

The ratio of the present value of the total benefits (savings and cost avoidances) divided by the present value of the total costs. It does not include sunk cost. A benefit/cost ratio (BCR) of 1.0 indicates that the present value of the benefits is equal to the present value of the total costs. The calculation for BCR begins by applying the discount factor to the constant-dollar benefits and the constant-dollar costs to arrive at the present value of the total benefits and the present value of the total costs.

### **Benefit/investment ratio**

The ratio of the present value of the dollar quantifiable benefits (savings and cost avoidances) divided by the present value of the investment (development, production, military construction, and fielding) cost of the alternative. It does not include benefits that are associated with sunk cost. A benefit/investment ratio of 1.0 indicates that the present value of the benefits is equal to the present value of the investment. The calculation begins with constant dollars.

### **Break-even point**

The point in time at which the cost reduction achievable with a given COA equals the investment or one-time cost for that COA. It does not include sunk cost.

### **Component Cost Analysis (this term is not used anywhere else in the guide)**

A complete and fully documented life cycle cost estimate for a system that is developed externally and independently from the acquisition proponent, or an independent estimate of major cost drivers and or cost elements. The Component Cost Analysis or Independent Cost Estimate is used to test the reasonableness of the POE/EA and provide a second opinion of the system's cost.

### **Constant dollars**

All prior year, current, and future costs that reflect the level of prices of a base year. Constant dollars have the effects of inflation removed.

### **Cost analysis**

The act of developing, analyzing, and documenting cost estimates through various analytical approaches and techniques. It is the process of analyzing and estimating incremental and total resources required to support past, present, and future systems. In its application to future resource requirements, it becomes an integral step in selection of alternatives by the decision maker.

### **Cost avoidances**

All cost reductions that are not savings.

### **Cost Benefit Analysis**

A structured methodology that determines the costs and benefits of one or more alternatives and compares them in order to identify the best alternative to achieve a stated goal/objective.

### **Cost estimate**

- a. A prediction of costs consisting of:
  - (1) A clearly defined requirement.
  - (2) A statement of cost assumptions.
  - (3) A source identification for basic cost data.
  - (4) A documentation of the methodologies used.
- b. The estimated cost of a component or aggregation of components that is developed by using historical cost data and/or mathematical models.

### **Cost-estimating relationship**

A mathematical expression relating cost as the dependent variable to one or more independent cost-driving variables. The expression may be represented by several functions, such as linear, power, exponential, and hyperbolic.

### **Cost factor**

A cost-estimating relationship where the cost estimate is determined by performing a mathematical operation on some other related cost element. It is a brief arithmetic expression where cost is determined by application of a factor such as a percent, and so on.

### **Cost reduction**

A reduction in the number of dollars needed to meet an established requirement. All cost reductions are categorized as savings or cost avoidance.

### **Current dollars**

Dollars that reflect the purchasing power of the dollar in the year the cost or savings is to be realized or incurred. That is, current dollars reflect the effects of inflation. Prior-year costs stated in current dollars are the actual costs incurred in those years. Future costs or savings stated in current year dollars are the projected values that will be paid out in the future years.

### **Defense Acquisition Board**

A senior DoD corporate body for systems acquisition that provides advice and assistance to the DAE and the Secretary of Defense.

### **Defense acquisition program**

A program designated by OSD management or the AAE for DAB or ASARC review.

### **Director of Cost Assessment and Program Evaluation**

An OSD committee which serves as the principal advisory body to the Defense Acquisition Board on matters related to cost estimates.

### **Discounting**

A technique for converting various annual cash flows occurring over time to equivalent amounts at a common point in time, considering the time value of money, to facilitate comparison. (This is an alternative definition of present value.)

### **Discount rate**

The interest rate used to discount or calculate future costs and benefits so as to arrive at their present values. This term is also known as the opportunity cost of capital investment. OMB Circular A-94 presently uses a discount rate tied to the Government's cost of capital.

### **Economic analysis**

A systematic approach to identify, analyzes, and compare costs or benefits of alternative courses of action that will achieve a given set of objectives. This approach is taken to determine the most efficient and effective manner to employ resources. In the broad sense, the systematic approach called economic analysis applies to new programs as well as to the analysis of ongoing actions.

### **Economic life**

The period of time over which the benefits to be gained from deployment or use of a resource may be reasonably expected to accrue. The economic life of a project begins in the year it starts producing benefits and ends when the project no longer accomplishes its primary objective.

### **Full Cost- See Total Cost**

**Independent assessment/sufficiency review**

An evaluation and validation of the PEO's and PM's cost or economic analysis, short of performing a full CCA, for a program scheduled to be reviewed by the ASARC (Army Systems Acquisition Review Council) or Army MAISRC (Major Automated Information Systems Review Council). This review includes a thorough analysis of the problem definition, alternatives, assumptions, cost estimate, benefit analysis, risks, conclusions, and recommendations.

**Independent cost estimates**

A complete and fully documented life cycle cost estimate for a system that is developed external of, and independent from the acquisition proponent. The ICE is used to test the reasonableness of the POE /EA and provide a second opinion of the system's cost.

**Information systems**

Organized assembly of resources and procedures designed to provide information needed to execute or accomplish a specific task or function. It applies to those systems that evolve, are acquired, or are developed that incorporate information technology. It applies to all five Information Mission Area disciplines and encompasses AIS (Automated Information Systems). Information system equipment consists of components to create, collect, process, store, retrieve, transmit, communicate, present, dispose, and/or display information.

**Inherited assets**

Operational equipment or software that becomes part of a system irrespective of original funding or "ownership."

**In-process review**

Review of a project or program at critical points to evaluate status and make recommendations to the decision authority; accomplish effective coordination; and make cooperative, proper, and timely decisions bearing on the future of the project.

**Investment cost**

Includes the research and development phase and the production and deployment phase (to include military construction) costs of the system.

**Life cycle cost estimate**

A document that:

- a. Includes all costs incurred during the total life (from project initiation through termination) of a system or aggregation of systems.
- b. Includes cost for research and development, production, military construction, deployment, and operating and support.

**Major system**

- a. Systems estimated by the Secretary of Defense to require a total expenditure for RDT&E of more than \$200 million (FY 80 constant dollars) or an eventual total expenditure for procurement of more than \$1 billion (FY 80 constant dollars).

b. Materiel system acquisition programs recommended by HQDA to be managed as MDAPs or ADAPs. Designation is normally a part of the required operational capability.

c. Army systems designated by the Secretary of Defense for DAB review are automatically identified as Army major systems.

### **Management Decision Package**

A structured life cycle process that represents the most current approved funding position developed through the PPBES. A separate MDEP will normally be created for each major system. Each MDEP covers a 9-year period.

### **Markovian process**

A simple stochastic process in which the distribution of future states depends only on the present state and not on how it arrived in the present state.

### **Materiel system**

A combination of hardware components that function together as an entity to accomplish a given objective. A materiel system includes the basic items of equipment, support facilities, and services required for operation and sustainment.

### **Milestone decision review**

An event (meeting) composed of top military and civilian managers, including the program manager. Its purpose is to address and resolve major program issues before approval is granted to proceed to the next life cycle management phase.

### **Net cost**

Total cost less any off setting cost reductions (e.g. cost avoidance and/or cost savings).

### **Net present value**

The difference between the present value of the benefits and the present value of the costs.

### **Non-quantifiable benefits**

A benefit that does not lend itself to numeric valuation, such as better quality of services. Non-quantifiable benefits are to be addressed in narrative form in the documentation.

### **Operating tempo**

The annual operating miles or hours for systems in a particular unit required to execute the commander's training strategy.

### **Payback period**

The number of years required for the cumulative savings to equal the cumulative investment costs (development, procurement, military construction, and fielding) in current dollars. The payback period is normally stated in non-discounted terms; however, a discounted payback period may also be shown (See Break-even point).

**Phase-out cost**

That cost required for the parallel operations of the status quo while the new system is being developed, fielded, and accepted. This cost occurs from the time the development of the new system begins to when fielding is completed.

**Present-value dollars**

Dollars that have had their annual cash flow occurring over time converted to equivalent amounts at a common point in time in order to account for the time value of money. The normal discount rate is 7% (this percentage amount is not addressed elsewhere), as prescribed by OMB. The computation begins with constant dollars.

**Productivity improvements**

Cost avoidances that are in the form of personnel time savings and are dollar quantified, and that do not represent an opportunity to reduce a force structure or MDEP.

**Program baseline**

A description of a specific program containing the following key elements:

- a. Requirements. A concise statement of prioritized functional needs.
- b. Program content. A concise description of the program capabilities and products to be provided, including required technical and operational characteristics, within the approved funding.

**Program cost**

Consists of research and development, procurement, and deployment (includes military construction) costs (including sunk) that are in direct support of the system or project. Included within this definition are operations and maintenance funds for expenditure directly related to concept development, design, and deployment. Program cost and program acquisition cost are synonymous terms.

**Program/project/product manager**

An individual assigned the responsibility and delegated the authority for the centralized management of a specific system acquisition program/project/product.

**Program Office Estimate**

A complete, detailed, and fully documented materiel system life cycle cost estimate updated throughout the acquisition cycle and the Planning, Programming, Budgeting, and Execution System. The Program Office Estimate, as accepted or modified by the Army Cost Position, provides the basis for subsequent tracking and auditing.

**Quantifiable benefit**

A benefit that can be assigned a numeric value, such as dollars, physical count of items, or percentage change.

**Rate of return**

The discount rate at which the present value of the investment cost equals the present value of the savings. The calculation begins from constant dollars. The ROR does not include sunk cost.

**Savings**

Any cost reduction that enables a manager to remove programmed or budgeted funds and apply them to other uses.

**Savings/investment ratio**

The ratio of the present value of the savings to the present value of the investment required to produce the savings. It does not include sunk costs. An SIR of 1.0 indicates that the present value of the savings is equal to the present value of the investment. The calculation begins with constant dollars.

**Sunk costs**

Sunk (past or unavoidable) costs are past expenditures or irrevocably committed costs that are not avoidable and, therefore, should not be considered in the decision process.

**System**

A combination of all components and tangible items that function together as an entity to accomplish a given objective.

**System-specific cost**

Hardware, software, and related costs that can be directly attributable to a particular system.

**Total cost**

Sum of all the costs incurred. In economics and/or managerial accounting, it is the sum of fixed and variable costs – direct and indirect costs related to the activity.

**Uniform annual cost**

A measure of the relative cost of a project that represents the average yearly cost, and is derived from the total discounted cost figure. The average yearly cost (UAC) is the total project cost discounted, divided by the sum of the discount factors for the years in which the system provides benefits (economic life).

**Validation**

A review of all elements in a cost estimate to confirm that they are sound, developed using acceptable cost estimating methods, adequately documented, and capable of being justified, supported, and defended. The validation will be performed by an organization external and independent from that of the functional proponent and preparer of the estimate.

## Appendix D

### **Cost Estimating Models and Tools**

The following cost estimation tools, databases and financial models are currently licensed by the U.S. Army. The analyst is not required to use these tools, databases or models to complete a CBA.

#### **Automated Cost Data Base (ACDB)**

ACDB is part of the suite of Automated Cost Estimating Integrated Tools (ACEIT). ACDB is a source of commodity based cost, technical and performance data. Commodities include communications/electronics, rotary wing aircraft, missiles and munitions, wheeled and track vehicles. ACDB provides the unique capability to enter, search, and retrieve standardized cost, schedule, technical, and programmatic data with easy interface with the ACEIT Cost Analysis Statistic Package (COSTAT) or Excel. The ACDB system includes two components, the Database Developer Kit (DDK) and the Report Wizard. The Report Wizard allows analysts to access existing ACDB databases, review raw data reports, and extract data for analysis. The DDK is designed to allow an analyst with little or no database development training to build a cost/schedule/technical/programmatic database to support cost research. Additional ACDB information is available from the Office of the Deputy Assistant Secretary of the Army (Cost and Economics) website at <http://www.asafm.-army.mil/ODASA-CE.htm> and in the Reference section of this Handbook.

#### **Automated Cost Estimating Integrated Tools (ACEIT)**

ACEIT is a PC-based model which provides standard framework for cost estimating and risk analysis tasks. ACEIT automates the storage, retrieval, and analysis; facilitates building cost models, risk analysis, budget time phasing and narrative documentation of the cost estimates. ACEIT is an integrated suite of tools (ACDB, COSTAT, ACE, POST, POSTDOC and LIBRARIAN). ACE automates all of the steps of the estimating process, including building a Cost Element Structure (CES), specifying estimating methods, performing learning, time phasing, inflation, and documentation. ACE also provides access to on-line databases and knowledge bases of cost estimating relationships (CERs), models, and source references. Some of ACEIT's new features include Plug-Ins for ACE, Excel, MS Project, PRICE S, H/HL, SEER H, SEER-SEM and NAFCOM.

ACEIT is widely used by Army organizations from the headquarters to small cost shops. Additionally the Air Force, Navy, OSD, other government agencies and support contractors use it. For more information see the Office of the Deputy Assistant Secretary of the Army (Cost and Economics) website at <http://www.asafm.army.mil/ceac.htm>, <http://www.aceit-.com/> or telephone ACEIT Sales at (281) 333-0240.

## **Army Military-Civilian Cost System (AMCOS)**

AMCOS is an automated tool that helps users estimate the costs associated with personnel and personnel requirements for different components, grades and skills. AMCOS Lite performs quick estimates of military, civilian and the private labor market. AMCOS is located on the OSMIS website <http://www.osmisweb.com/>.

## **The Cost and Performance Portal (CPP)**

The Cost and Performance Portal (CPP) program is run by ODASA-CE and helps Army organizations with cost estimating, modeling, metric development, performance tracking and process automation. The program's mission is to support effective cost and performance management in the Army, to promote visibility and transparency into Army spending and operations, and to promote an organizational culture that maximizes cost effectiveness. The CPP consolidates data from disparate data sources, configures reporting and analytical tools, creates data models and automates processes for users throughout the Army. The CPP is Common Access Card (CAC) enabled and is accessible anywhere in the world via the Internet.

The CPP program is run by Army civilians with contractor support. Although ODASA-CE works extensively with and has expertise in cost and accounting information, it is not limited to any specific functional area. The CPP program integrates data from legacy systems, emerging systems and individual analytical products.

Most of the CPP's products are available to everyone in the Army with an AKO email account. The CPP serves a wide variety of Army users throughout HQDA and beyond ranging from Army senior leaders to functional analysts. Organizations that are directly supported by the CPP include: DASA-CE, ABO, ACSIM, IMCOM, G-1, G-3, ASA (M&RA) and others+. Many senior leaders use the specialized reports and tools found on the portal to inform decision making and track the management of cost and performance outcomes.

Some of the products available on the CPP are: Appropriation execution scorecards - Tracks overall execution levels in comparison to spending plans and available funds. OACSIM Dashboard - Tracks execution data against planned execution for the entire II PEG. Specialized focus area displays are available for deep dives into contracts; Future phases will link execution to performance outcomes.

MPA Overview - Shows high level MPA execution metrics with the ability to drill-down. Also shows costs by activity, entitlement, and grade as well as end strength.

MPA Analysis - Modeling products that get into specific data and assumptions used to project cost rates for the MPA appropriation. Also contains the Army's reports for MPA overseas contingency operations spending. OPTEMPO - Reports showing total OPTEMPO obligations by]

and total spending for each major ground and air system. Additional metrics include \$/aircraft, \$/flying hour, \$/tank, \$/mile.

Generating Force Census - A semi-annual census of the Generating Force of the Army that displays required, authorized, and on hand military, civilians and contractors by command and UIC. Also identifies the functional activity that is associated with each position.

Capabilities Knowledge Base (CKB) - A capability-based costing and analytical tool that contains program data for ACAT 1 systems across all military components. The CKB supports the development of service component cost estimates at Milestone-A as required by the December 2008 DoDI 5000.02. Future phases will incorporate ACAT II & III systems.

### **Base Operations Requirements Model (BRM)**

ACSIM uses BRM to develop baseline requirements for Base Operations Support for POM input. ISR - Services and ISR – Services Cost data are used in the Standard Service Costing (SSC) model to calculate Cost Estimating Relationships (CERs) that are used in the Base Operations Support Requirements Model.

### **Facilities Operation Model (FOM)**

The FOM is an OSD mathematical Budget Planning Tool to identify, advocate and defend funding for Facilities Operations (FO) Functions over the Future Years Defense Plan (FYDP). Costs based on commercial cost factors researched by Whitestone Research and other sources. Provides annual cost for each of ~ 400 facility analysis categories (FACs) within the facilities operation program (utilities, custodial, grounds maintenance, etc.) It includes: Fire & Emergency Services Utilities (Energy + Water & Waste Water), Pavement Clearance, Refuse Collection & Disposal, Real Property Leases, Grounds Maintenance & Landscaping, Pest Control Custodial, Real Property Management & Engineering Services and Readiness Engineering. Formerly called Real Properties Services (RPS)

### **Facilities Sustainment Model (FSM)**

The FMS is an OSD mathematical model used to calculate maintenance and repair activities necessary to keep a typical inventory of DoD facilities in good working order throughout their allocated service life. Includes regularly scheduled adjustments and inspections, preventive maintenance, emergency response and service calls for minor repairs and major repairs and replacement of facility components expected to occur periodically throughout the facility life cycle, i.e. regular roof replacement, refinish wall surfaces, repair/replace electrical, heating, and cooling systems, replacing tile/carpets, etc. Excludes repair/replace non-attached equipment-furniture, or building components that typically last more than 50 years (such as foundations and structural members).

## **Facility Modernization Model (FMM)**

The FMM is an OSD mathematical model used to predict the average annual funding required modernizing DoD facilities inventory on a continual, ongoing basis. Recapitalization replaces or renovates a facility to a “like new” condition so that its useful life may be extended. Modernization updates/renews a facility to current standards without changing the fundamental size or function. The model does not include: expansion or enlargement; restoration/repair to facilities prematurely deteriorated due to lack of sustainment; and restoration /repair due to unforeseen events such as fire or hurricane.

## **Facility Planning System (FPS)**

The FPS module provides planners and other users with an automated tool to assist in determining and analyzing facility allowances and requirements for Army organizations. The FPS also provides valuable reference material about Army organizations, facility space planning criteria, Army school course data and other information. Access to FPS is generally available to RPLANS users. FPS allows the user to obtain personnel and equipment (P&E) lists for DA approved OTOE, as well as the mission statement for OTOE. A list of SRC (OTOE) is available to select from, or selection can be made by branch of the OTOE or by searching for key words in the title of the unit. P&E lists are also available for TDA organizations by entering the UIC of the TDA, or searching for key words in the organization’s title. In both cases, FPS shows the category code(s) that are assigned to each paragraph of the OTOE and TDA. This is a major help in understanding why an organization is getting a certain allowance for certain category codes. A search feature also allows a user to look for specific information, such as a Line Item Number (LIN), or Military Occupational Specialty (MOS), in the OTOE and TDA documents. Information on courses run by the TRADOC schools and other commands is also available on FPS. Each year, the FPS data on OTOE, TDA and courses is updated from DA sources to provide the user with current reference material.

FPS calculates the allowances for OTOE and TDA for over 50 category codes. These category codes are primarily those used at the unit level, such as general purpose admin, unit headquarters, maintenance facilities, instructional buildings, and organizational parking. This calculation is done by algorithms that use DA approved criteria and the various data elements from the OTOE or TDA document, such as strength figures, equipment counts, and position or job codes. By selecting the category code and organization, FPS will not only show the allowance, but the details of how that allowance was calculated. In most category codes, this allowance is fed into, and reflected by RPLANS.

FPS provides valuable help to a user in determining what the requirement should be for a specific organization when it is determined, by careful analysis, that the allowance calculated is not correct for a specific unit or situation. This feature allows the user to modify a number of data elements, such as strength figures, equipment counts, or maintenance availability, to

reflect the specific situation that applies to the organization. By changing these data elements, the user can immediately determine for a category code, the impact of the change. This new figure may be used, with justification, as input to a requirement edit in RPLANS.

### **Force & Organization Cost Estimating System (FORCES)**

FORCES is a suite of tools available on the OSMIS website <http://www.osmisweb.com/>. The tools that are available are the FORCE Cost Model (FCM), End-Strength Cost Model (ESCM), Cost and Factors Handbook (CFH) and the Army Contingency Cost Model (ACM). FORCES data includes financial and non-financial data such as OPTEMPO/cost factors, equipment costs, force structure, personnel costs, base operations, movement costs and indirect training costs.

### **Headquarters Real Property Planning and Analysis System (HQRPLANS)**

HQRPLANS module provides planners at HQDA, Army Commands and IMCOM Regions with an automated tool to assist in determining and analyzing facility allowances and stationing initiatives for all Army installations. The Headquarters module calculates facility allowances at all Army locations worldwide by FCG. The system tracks installation assets via the Headquarter Executive Information System (HQEIS), to include the Army National Guard (ARNG) real property inventory, and calculates facility allowances based on existing and projected force structures as defined in the Army Stationing and Installation Plan (ASIP). Unit driven allowances are provided to the module by the Facility Planning System (FPS) module which bases calculations on unit personnel and equipment. Allowances are also calculated for the on-going Reserve Component training missions at each installation.

### **Installation Real Property Planning and Analysis System (INSTRPLANS)**

INSTRPLANS module is an integrated, automated planning tool that provides installation planners with the capability to readily and efficiently calculate peacetime facility space allowances and compare them to available real property assets for a wide range of facility types. The Installation module provides automated support for master planning activities, to include site planning, satisfying the requirement for an installation Tabulation of Existing and Required Facilities (TAB) outlined in AR 210-20, construction program development, stationing analysis, unit/organization facility allowances analysis, functional area assessments and space utilization. The module tracks installation assets and calculates facility allowances based on existing and projected force structures for seven years. Allowances are also calculated for the on-going Reserve Component training missions at each installation. An edit utility provides the capability to edit requirements in cases where calculated allowances do not fully account for mission, equipment or personnel impacts on infrastructure.

### **Joint Integrated Analysis Tool (JIAT)**

The Joint Integrated Analysis Tool (JIAT) concept is an architecture that allows models in the functional areas of cost estimating, engineering design, requirements, capability, and

performance analysis to be linked together. JIAT provides real-time cost estimating capability to the cost, acquisition, requirements and modeling and simulation (M&S) communities. JIAT provides seamless linkages to cost estimating software packages such as ACEIT, SEER, PRICE and OSMIS, AMCOS, FORCES and Capability-based costing databases.

JIAT provides the capabilities for cost and requirements analysts to develop cost estimates and perform cost-performance trades at the system level with the limited amounts of data available early in a program's life cycle. The architecture also allows analysts to perform Cost as an Independent Variable (CAIV) analysis and capabilities costing. JIAT incorporates various Army analysis models to perform trade-off analysis with optimization techniques.

Information regarding JIAT's capabilities can be accessed at: <http://asafm.army.mil/offices/CE/Jiat.aspx>

### **Operating and Support Management Information System (OSMIS)**

OSMIS is the Army's portion of the Department of Defense (DoD) Visibility and Management of Operating and Support Costs (VAMOS) Program. OSMIS is managed by the Office of the Deputy Assistant Secretary of the Army (Cost and Economics). It is the U.S. Army's source of standardized historical operating and support (O&S) cost information for more than 500 systems deployed in tactical units – Active, Guard, and Reserve. It is easily accessible and widely used by Department of Defense analysts in developing O&S cost analyses, preparing O&S estimates and cost reduction initiatives. The types of analyses and comparisons include: Component Cost Analyses (CCAs), Program Office Estimates (POEs), Cost Estimating Relationships (CERs), Alternative of Analyses (AOAs), Economic Analyses (EAs), and weapon/materiel system O&S cost comparisons between legacy and new systems. It is available on the OSMIS website <http://www.osmisweb.com/>.

### **PRICE TruePlanning Suite**

The PRICE *TruePlanning Suite* is the umbrella for all of the PRICE systems' toolsets. *True H and PRICE H* (Hardware Acquisition and Development) estimates costs, resources and schedules for hardware projects. *True S* (Software Acquisition and Development) predicts costs, resources, and schedules for all types and sizes of software projects. *True IT* (Information Technology Project Modeling and Management) provides a framework for devising and executing and enterprise IT strategy that can include one or many projects. The PRICE suite of cost estimating models also includes *True COCOMO*, an implementation of USC's COCOMO II, for estimating software engineering requirements analysis, design, construction, and verification at the software configuration item level. More information regarding the PRICE *TruePlanning Suite* can be obtained at <http://www.pricesystems.com/> or telephone (703) 740-0080.

## **Real Property Planning and Analysis System (RPLANS)**

The Real Property Planning and Analysis System (RPLANS) is an integrated planning tool that allows installation and higher level planners to efficiently calculate peacetime facility space allowances and compare them to available real property assets for a wide range of facility types. RPLANS provides automated support for master planning activities, to include site planning, satisfying the requirement for an installation Tabulation of Existing and Required Facilities (TAB) outlined in AR 210-20, construction program development, stationing analysis, unit/organization facility allowances analysis, functional area assessments and space utilization. An editing utility allows the installations to modify the calculated facility allowances to reflect special mission, equipment or personnel impacts on their infrastructure.

RPLANS uses installation infrastructure assets via the Headquarter Executive Information System (HQEIS), to include the Army National Guard (ARNG) real property inventory, and calculates facility allowances based on existing and projected force structures as defined in the Army Stationing and Installation Plan (ASIP) using approved business rules.

RPLANS supports a number of other Army systems including the Installation Status Report and the Facilities Degradation

RPLANS is comprised of four modules designed to meet the needs of users at installation, Installation Management Command (IMCOM) Region, Army Commands and Headquarters, Department of the Army (HQDA) level. Users at each level share a common need to correlate data about real property assets, installation force structure and populations, and facility allowances and requirements. The four modules are levels or views in the RPLANS Suite that provide different degrees of detail. The Installation module (INSTRPLANS) provides unit and facility level of detail; the Region module (RGNRPLANS) provides unit level of detail; the Headquarters module (HQRPLANS) provides Facility Category Group (FCG) summary level of detail; and, the FPS module provides unit level detail, to include personnel duty position and Line Item Number (LIN) detail for Army organizations. Data from the RPLANS Suite support a number of other Army automated systems including ISR Infrastructure and FDM.

## **Region Real Property Planning and Analysis System (RGNRPLANS)**

RGNRPLANS module is an integrated, automated planning tool that provides IMCOM Regions with a UIC level detail view of Installation RPLANS sites within their Region. The Region module is used for reviewing and approving installation requirement edits, analyzing proposed construction projects and similar management tasks. Approved requirements in the Region module support ISR facility quantity ratings. The Region module provides each IMCOM Region with maximum flexibility to manage the requirement approval process for their assigned Installation RPLANS sites, to include a variety of options for managing users, requirements and Major Subordinate Commands (MSCs) within the module.

### **Software Estimation, Planning and Project Control (SEER-SEM)**

SEER-SEM estimates the software development and maintenance effort, cost, schedule, staffing, reliability, and risk. There are several basic drivers behind SEER-SEM's estimating engine. These driver values are established by a choice of knowledge bases and parameter settings. Parameter categories include those for size and other, more qualitative factors. Qualitative inputs rate programmer and analyst capabilities and experience, the use of automated tools, anticipated volatility, etc. Other SEER cost estimation tools include SEER-SSM (Software Size Estimation), SEER-H (Hardware Estimation, Planning, and Project Control), SEER-IC (Integrated Circuit Cost and Yield Analysis) and SEER-DFM, Cost Design for Parts, Process and Assembly. More information regarding SEER can be obtained at <http://www.galorath.com> or telephone (310) 414-3222.

### **Software Life cycle Management (SLIM)**

SLIM-Estimate is a software project estimation, presentation and analysis tool that generates estimates of cost, schedule, effort and quality. SLIM-Estimate is one of a family of tools offered by Quantitative Software Management ([www.qsm.com](http://www.qsm.com)). The other tools in the family support planning roll-ups (MasterPlan), project oversight (SLIM-Control) and historical data collection (DataManager) and analysis (SLIM-Metrics).

## Appendix E

### CBA in Narrative Form

#### Practical Exercise: Army Prepositioned Stocks (APS)

*Note: This narrative should be used in conjunction with the APS Practical Exercise Case Study, which provides essential background material and data.*

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10 September 2011

#### Problem Statement and Scope

Anticipating the draw-down of combat operations in Afghanistan, the Army has decided that 4000 Mine-Resistant, Ambush-Protected vehicles (MRAP) will be transferred from Afghanistan to five APS locations. The Army has identified the five sites, has determined how many vehicles will be moved to each site, and has established a schedule for moving equipment from Afghanistan to each of the locations. *The purpose of this CBA is to develop a recommended course of action for providing storage facilities at the five sites.*

The five locations are identified as L1 through L5. L1 and L2 are located in the Continental United States (CONUS), and L3 through L5 are outside CONUS (OCONUS).

The scope of this analysis is limited to the 4000 MRAPs to be moved from Afghanistan and to the five predetermined sites. It does not encompass any other equipment currently in Afghanistan or in APS storage or any other APS locations. It also does not include the actions required to move the equipment from Afghanistan to the APS sites, and does not include the means that will be used to deploy the equipment if/when needed from the APS sites to subsequent contingency areas.

#### Assumptions and Facts Bearing on the Problem

There are factors that are beyond our ability to control and are essential to the successful implementation of all courses of action. These factors are captured in two assumptions.

- First, it is assumed that the pace of drawdown of combat operations in Afghanistan will enable the Army to move MRAPs to the five APS sites on the planned timeline.
- Second, as discussed in the following section, four types of storage facilities are being considered: new facilities built using the Army's military construction (MILCON) program, facilities leased from property owners adjacent to the APS sites, large-area maintenance shelters (LAMS), and outside storage. We cannot control the availability of

these facilities; it is therefore assumed that they will be available as needed to support the requirement.

The following facts bearing on the problem represent constraints for the CBA.

- The APS sites to receive MRAPs, the number of vehicles to be moved to each site, and the timeline for their movement have been predetermined by Army decision makers. This information is reflected in Table 1, which shows the percentage of each site’s capacity that will be used over time. When site utilization reaches 100%, it stabilizes at that level for the foreseeable future.

**Table 1: Site Utilization**

Site No.	Location	FY12	FY13	FY14 and Beyond
L1	CONUS	0%	50%	100%
L2	CONUS	0%	50%	100%
L3	OCONUS	0%	100%	100%
L4	OCONUS	0%	100%	100%
L5	OCONUS	100%	100%	100%

- There are four possible storage options: new facilities built using the Army’s MILCON program, facilities leased from property owners adjacent to the APS sites, LAMS, and outside storage. Due to local conditions, leased facilities are not feasible at the OCONUS sites. Any of the options may be used at the CONUS locations.
- Based on past experience in overseeing projects of this type, senior decision makers are concerned about the ability of the staff to manage too broad a mix of storage facilities. They have therefore constrained the solution set by limiting the analysis to four courses of action. These are identified in the following section.

**Alternative Courses of Action**

Because there are four available storage solutions at each CONUS site and three available solutions at each OCONUS site, there are over 400 possible permutations that will satisfy the requirement. In large, complex actions such as this one, senior managers have found that overseeing multiple types of solution has proven to be exceptionally challenging for the headquarters staff. Managers have therefore directed that the cost-benefit analysis be limited to the following four alternative courses of action (COA):

- COA #1: Use MILCON to build permanent storage facilities at all five locations. We have learned that it takes five years for constructed facilities to be available from the date the

funds are obligated. In the five-year interim, under this COA we will lease facilities at CONUS sites and purchase LAMS for OCONUS sites.

- COA #2: Lease warehouses at CONUS locations and purchase LAMS for OCONUS locations.
- COA #3: Purchase LAMS for all five locations.
- COA #4: Use outside storage at all five locations.

The status quo would leave the MRAPs in Afghanistan. Since the requirement is to determine the optimum storage option at the APS sites, the status quo clearly does not address the problem. Therefore, the status quo is not a viable option for further consideration.

### **Cost Estimates for Courses of Action**

#### **Cost Elements – What’s Included**

We have identified the cost elements involved in the storage facilities issue. This is based on the problem statement (to include the defined scope), and research we have conducted into the various facility alternatives. The cost elements are as follows:

- **MILCON**: The US Army Corps of Engineers (USACE), which manages MILCON for the Army, advises that MILCON funds will be available for obligation on 1 October 2011. From the time a decision is made to proceed with a construction project, it takes five years for the facilities to be available for use. APS commanders have submitted DD Form 1391s for the required construction projects, and these have been reviewed and approved by USACE. The total cost of MILCON at all five APS sites is \$343.5 million in FY12 dollars. USACE advises that MILCON funds are not expected to be available in FY13 and beyond. USACE also advises that buildings constructed in the APS locations are expected to have a useful life of 20 years. MILCON is a cost element only in COA 1.
- **Warehouse leases**: As stated earlier, the leasing of warehouses is an option at the two CONUS sites. Lease costs include all required maintenance and upkeep for the leased facilities. Table 2 shows the expected lease costs, which were determined via price estimates we obtained from the owners of suitable property adjacent to the APS locations. The costs shown in the table are in FY12 constant dollars. We have conducted market surveys at the CONUS APS sites and determined that lease costs are likely to increase by 2% per year. Warehouse leases are a cost element in COAs 1, 2, and 3.

- LAMS purchase: Large-area maintenance shelters may be used at any CONUS or OCONUS location. The purchase price includes complete shelters, to include hardstand and internal utilities connections (water, power, heating, etc.). Table 2 shows the purchase costs, which were determined by contacting the LAMS vendor and requesting price estimates for our specific requirements at each location. The costs shown in the table are in FY12 constant dollars. The vendor has a GSA-approved price list that shows prices increasing 2% per year. The vendor advises that LAMS have an expected useful life of 20 years; we have verified this estimate by consulting with current LAMS users elsewhere in the Army, and they have confirmed that a 20-year useful life is a reasonable estimate based on the climate at the five APS locations and on the kind of function we intend to conduct in the shelters. LAMS purchases are a cost element in COAs 1, 2, and 3.
- Care of supplies in storage (COSIS): COSIS consists of routine inspections and maintenance functions that are performed on equipment while stored in APS facilities. An effective COSIS program helps to ensure that the equipment is in operational condition when deployment is required. At all APS locations, COSIS is performed by contractor personnel, and there are no plans to change this to government personnel. We have discussed the contracts with supporting contract offices and determined that the additional COSIS work that would be required at all five locations is within the scope of the existing contracts. This will enable us to cover the COSIS costs through simple contract modifications, with no requirement to re-compete the contracts. We determined the cost of COSIS at each location by identifying the site-specific requirements and asking current COSIS providers for their price estimates. Table 2 shows the costs at each site in constant FY12 dollars. As shown on the table, COSIS costs are determined in part by whether storage will be indoor or outdoor. Indoor storage includes the facilities that would be built using the MILCON program, leased facilities, and LAMS. The outside storage cost applies only to the outside storage option. All contracts are written with multiple option years; in the option years, the contract price increases 3% per year. COSIS is a cost element in all COAs.
- LAMS refurbishment: Each shelter requires refurbishment every five years. Refurbishment costs are paid when the refurbishment is performed. The cost is 20% of the original purchase price, with price growth applied at the same 2% annual rate as is used for purchase cost. For example, if we purchase LAMS for \$10 million in FY12, we will have a refurbishment requirement every five years (FY17, FY22, etc), and each time the cost will be \$2 million plus 2% per year in price growth. These costs are reflected in Table 2. Refurbishment is potentially a cost element in all COAs that include purchasing LAMS. However, refurbishment costs are incurred only if the shelters are used beyond five years. Since COA 1 calls for LAMS to be used for only five years while waiting for construction to be completed, refurbishment is not a factor. Thus, LAMS refurbishment is a cost element only in COAs 2 and 3.

- **Building repair and maintenance:** Repair and maintenance costs for leased facilities are included in the lease price. For facilities constructed using the MILCON program we have consulted with functional experts in the Office of the Assistant Chief of Staff for Installation Management, who have informed us that repair and maintenance costs for the type of buildings envisioned for the APS function will be \$2.5 million per year beginning in the second year of use and then continuing annually for the useful life of the building. This is stated in FY12 dollars. These costs are reflected in Table 2. There is no specific cost growth factor for repair and maintenance, so we determined the annual inflation by consulting the official inflation indexes. These costs are funded with Operations and Maintenance, Army (OMA) funds. Consulting the current inflation index indicated that the OMA inflation rate for the foreseeable future is 4% per year. Building repair and maintenance is a cost element only in COAs where MILCON is used, which limits this cost element to COA 1.
- **Impact of site utilization on cost:** In Table 2, the costs for leases, LAMS purchase, and COSIS are for full utilization of the sites. These costs will be incurred on a partial or full basis as determined by the site utilization factors shown in Table 1. For example, Table 2 shows that full utilization at Site L1 it will call for \$43.5 million to purchase LAMS and \$8.0 million per year to provide COSIS. At the same time, Table 1 indicates that only 50% of the capacity of site L1 will be used in FY13. Thus, if we choose the LAMS option for site L1, the purchase price in FY13 will be \$21.75 million (50% of \$43.5 million) and the COSIS cost will be \$4.0 million (50% of \$8.0 million). In FY14, when site utilization at L1 increases to 100%, we will complete the LAMS purchase by spending an additional \$21.75 million for shelters, and the COSIS cost would increase to \$8.0 million. (These figures are in constant FY12 dollars. The costs in FY13 and beyond would, of course, be increased by the annual cost growth factors of 2% for LAMS and 3% for COSIS.)

**Table 2: Investment and Operating Costs**

Investment and Operating Costs (Millions of FY12 Dollars, Except Where Noted)						
Location	Lease Warehouses (Annual Cost)	Purchase LAMS (One-Time Cost)	Annual COSIS Cost for Indoor Storage	Annual COSIS Cost for Outdoor Storage	MILCON Repair and Maintenance Cost	LAMS Refurbishment Cost (Current Dollars)
L1	19.2	43.5	8.0	14.5	2.5 per year, beginning in second year of use	20% of original purchase price, every five years
L2	14.9	32.7	15.4	27.8		
L3	Not an option	3.7	0.7	1.3		
L4		3.7	0.7	1.3		
L5		14.5	2.8	9.7		

Cost Elements – What’s Not Included

The following items are not part of the cost element structure because they are outside the scope of the problem: the acquisition cost of the MRAPS, the cost of shipping the vehicles from Afghanistan to the APS locations, the cost of shipping the vehicles from the APS sites to potential contingency locations, and the cost of port handling operations at the APS sites.

### POM/Budget Offsets

When we translate our cost estimate into POM/budget decisions, we must take into account any funds that are already available to support this APS requirement. These funds will create an offset that decreases the amount of new funding that will have to be found. There are two such cost offsets. First, we have determined that our senior executive anticipated this requirement over a year ago and set aside OMA funds as a place-holder in the program and budget. The dollar amount is \$10 million per year, FY12-FY19, in current dollars. Second, because USACE has advised that the MILCON funds will be readily available in FY12, we will treat that dollar amount (\$343.5 million) as a POM/budget offset in any COA that includes the MILCON option.

### Cost Estimate Lifecycle

The lifecycle for this analysis is determined primarily by the projected useful life of the MILCON facilities, which is stated as 20 years. The start point for the costing lifecycle is FY12, the first year when costs will be incurred. The end point for the costing lifecycle is 20 years after the facilities become ready for use in FY17; this equates to the end of FY36. Thus, the complete costing lifecycle is FY12-FY36.

### Cost Estimate Calculations

The cost estimate is shown on Tables 3.1 through 3.5. The estimate was developed in *constant dollars* (Tables 3.1 through 3.5) by determining the cost for each cost element in each year by combining the site utilization factors from Table 1 with the investment and operating costs from Table 2. This yielded a cost estimate in constant FY12 dollars.

The estimate in Table 3.5 is in *current dollars*. This estimate was developed by applying appropriate growth or inflation rates to the constant-dollar estimate. Table 3.5 also displays the existing funding available to meet the facilities requirement and the net unfunded requirement.

Here is an example of our cost calculation methodology. This example determines the cost of COSIS under COA 1 in FY19.

- In Step 1 we computed the cost in constant FY12 dollars: Table 1 tells us that in FY19 all five sites will be used to 100% of capacity. Table 2 provides the cost of COSIS at each of these sites, with a total for all sites of \$27.6 million.

- In Step 2 we computed the cost in current dollars: The period of time from our base year (FY12) to the costing year (FY19) is seven years, and the annual cost growth is 3%. Therefore, to convert \$27.6 million from FY12 constant dollars to FY19 current dollars we must multiply it by 1.03, seven times. In algebraic notation, this is shown as  $27.6 * (1.03)^7$ . The result is \$33.9 million; this is the value shown in Table 3.5 for COA 1.

For each COA, Tables 3.1 through 3.4 show the total cost over the lifecycle in constant dollars. Table 3.5 displays the cost in current dollars and also shows the net POM/budget impact after existing funding is included.

**Table 3.1: Cost Estimate for COA 1  
(Use MILCON at all sites. While waiting for MILCON, lease in CONUS and use LAMS OCONUS.)**

For the COA tables, all data are in millions of constant (FY10) year dollars.

**COA 1: Use MILCON at all sites. While waiting for MILCON, lease facilities in CONUS and buy LAMS OCONUS.**

	FY12	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22	FY23	FY24
MILCON	343.5	-	-	-	-	-	-	-	-	-	-	-	-
Lease warehouses	-	17.1	34.1	34.1	34.1	-	-	-	-	-	-	-	-
Purchase LAMS	14.5	7.4	-	-	-	-	-	-	-	-	-	-	-
COSIS	2.8	15.9	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6
LAMS refurbishment	-	-	-	-	-	-	-	-	-	-	-	-	-
Building repair / maint	-	-	-	-	-	-	2.5	2.5	2.5	2.5	2.5	2.5	2.5
<b>Total cost</b>	<b>360.8</b>	<b>40.4</b>	<b>61.7</b>	<b>61.7</b>	<b>61.7</b>	<b>27.6</b>	<b>30.1</b>						

	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	FY35	FY36	Total L/C (FY12-FY36)
MILCON	-	-	-	-	-	-	-	-	-	-	-	-	343.5
Lease warehouses	-	-	-	-	-	-	-	-	-	-	-	-	119.4
Purchase LAMS	-	-	-	-	-	-	-	-	-	-	-	-	21.9
COSIS	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6	653.5
LAMS refurbishment	-	-	-	-	-	-	-	-	-	-	-	-	-
Building repair / maint	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	47.5
<b>Total cost</b>	<b>30.1</b>	<b>1,185.8</b>											

**Table 3.2: Cost Estimate for COA 2  
(Lease in CONUS and use LAMS OCONUS.)**

**COA 2: Lease facilities in CONUS and buy LAMS OCONUS.**

	FY12	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22	FY23	FY24
MILCON	-	-	-	-	-	-	-	-	-	-	-	-	-
Lease warehouses	-	17.1	34.1	34.1	34.1	34.1	34.1	34.1	34.1	34.1	34.1	34.1	34.1
Purchase LAMS	14.5	7.4	-	-	-	-	-	-	-	-	-	-	-
COSIS	2.8	15.9	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6
LAMS refurbishment	-	-	-	-	-	2.9	1.5	-	-	-	2.9	1.5	-
Building repair / maint	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Total cost</b>	<b>17.3</b>	<b>40.4</b>	<b>61.7</b>	<b>61.7</b>	<b>61.7</b>	<b>64.6</b>	<b>63.2</b>	<b>61.7</b>	<b>61.7</b>	<b>61.7</b>	<b>64.6</b>	<b>63.2</b>	<b>61.7</b>

	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	FY35	FY36	Total L/C (FY12-FY36)
MILCON	-	-	-	-	-	-	-	-	-	-	-	-	-
Lease warehouses	34.1	34.1	34.1	34.1	34.1	34.1	34.1	34.1	34.1	34.1	34.1	34.1	801.4
Purchase LAMS	-	-	-	-	-	-	-	14.5	7.4	-	-	-	43.8
COSIS	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6	653.5
LAMS refurbishment	-	-	2.9	1.5	-	-	-	-	-	-	-	-	13.1
Building repair / maint	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Total cost</b>	<b>61.7</b>	<b>61.7</b>	<b>64.6</b>	<b>63.2</b>	<b>61.7</b>	<b>61.7</b>	<b>61.7</b>	<b>76.2</b>	<b>69.1</b>	<b>61.7</b>	<b>61.7</b>	<b>61.7</b>	<b>1,511.8</b>

**Table 3.3: Cost Estimate for COA 3  
(Use LAMS at all sites.)**

COA 3: Buy LAMS for all sites.

	FY12	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22	FY23	FY24
MILCON	-	-	-	-	-	-	-	-	-	-	-	-	-
Lease warehouses	-	-	-	-	-	-	-	-	-	-	-	-	-
Purchase LAMS	14.5	45.5	38.1	-	-	-	-	-	-	-	-	-	-
COSIS	2.8	15.9	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6
LAMS refurbishment	-	-	-	-	-	2.9	9.1	7.6	-	-	2.9	9.1	7.6
Building repair / maint	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Total cost</b>	<b>17.3</b>	<b>61.4</b>	<b>65.7</b>	<b>27.6</b>	<b>27.6</b>	<b>30.5</b>	<b>36.7</b>	<b>35.2</b>	<b>27.6</b>	<b>27.6</b>	<b>30.5</b>	<b>36.7</b>	<b>35.2</b>

	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	FY35	FY36	Total L/C (FY12-FY36)
MILCON	-	-	-	-	-	-	-	-	-	-	-	-	-
Lease warehouses	-	-	-	-	-	-	-	-	-	-	-	-	-
Purchase LAMS	-	-	-	-	-	-	-	14.5	45.5	38.1	-	-	196.2
COSIS	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6	653.5
LAMS refurbishment	-	-	2.9	9.1	7.6	-	-	-	-	-	-	-	58.9
Building repair / maint	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Total cost</b>	<b>27.6</b>	<b>27.6</b>	<b>30.5</b>	<b>36.7</b>	<b>35.2</b>	<b>27.6</b>	<b>27.6</b>	<b>42.1</b>	<b>73.1</b>	<b>65.7</b>	<b>27.6</b>	<b>27.6</b>	<b>908.6</b>

**Table 3.4: Cost Estimate for COA 4  
(Use outside storage at all sites.)**

**COA 4: Use outside storage at all sites.**

	FY12	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22	FY23	FY24
MILCON	-	-	-	-	-	-	-	-	-	-	-	-	-
Lease warehouses	-	-	-	-	-	-	-	-	-	-	-	-	-
Purchase LAMS	-	-	-	-	-	-	-	-	-	-	-	-	-
COSIS	9.7	33.5	54.6	54.6	54.6	54.6	54.6	54.6	54.6	54.6	54.6	54.6	54.6
LAMS refurbishment	-	-	-	-	-	-	-	-	-	-	-	-	-
Building repair / maint	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Total cost</b>	<b>9.7</b>	<b>33.5</b>	<b>54.6</b>										

	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	FY35	FY36	Total L/C (FY12-FY36)
MILCON	-	-	-	-	-	-	-	-	-	-	-	-	-
Lease warehouses	-	-	-	-	-	-	-	-	-	-	-	-	-
Purchase LAMS	-	-	-	-	-	-	-	-	-	-	-	-	-
COSIS	54.6	54.6	54.6	54.6	54.6	54.6	54.6	54.6	54.6	54.6	54.6	54.6	1,299.0
LAMS refurbishment	-	-	-	-	-	-	-	-	-	-	-	-	-
Building repair / maint	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>Total cost</b>	<b>54.6</b>	<b>1,299.0</b>											

**Table 3.5: Cost Estimate for All COAs in Current Dollars**

**COA 1: Use MILCON at all sites. While waiting for MILCON, lease facilities in CONUS and buy LAMS OCONUS.**

	FY12	FY13	FY14	FY15	FY16	FY17	FY18	FY19	Total POM/Budget Cost (FY12-FY19)
MILCON	343.5	-	-	-	-	-	-	-	343.5
Lease warehouses	-	17.4	35.5	36.2	36.9	-	-	-	126.0
Purchase LAMS	14.5	7.5	-	-	-	-	-	-	22.0
COSIS	2.8	16.4	29.3	30.2	31.1	32.0	33.0	33.9	208.6
LAMS refurbishment	-	-	-	-	-	-	-	-	-
Building repair / maint	-	-	-	-	-	-	3.2	3.3	6.5
<b>Total cost</b>	<b>360.8</b>	<b>41.3</b>	<b>64.8</b>	<b>66.3</b>	<b>68.0</b>	<b>32.0</b>	<b>36.1</b>	<b>37.2</b>	<b>706.5</b>
Existing funding	353.5	10.0	10.0	10.0	10.0	10.0	10.0	10.0	423.5
<b>Budget impact / UFR</b>	<b>7.3</b>	<b>31.3</b>	<b>54.8</b>	<b>56.3</b>	<b>58.0</b>	<b>22.0</b>	<b>26.1</b>	<b>27.2</b>	<b>283.0</b>

**COA 2: Lease facilities in CONUS and buy LAMS OCONUS.**

	FY12	FY13	FY14	FY15	FY16	FY17	FY18	FY19	Total POM/Budget Cost (FY12-FY19)
MILCON	-	-	-	-	-	-	-	-	-
Lease warehouses	-	17.4	35.5	36.2	36.9	37.6	38.4	39.2	241.2
Purchase LAMS	14.5	7.5	-	-	-	-	-	-	22.0
COSIS	2.8	16.4	29.3	30.2	31.1	32.0	33.0	33.9	208.6
LAMS refurbishment	-	-	-	-	-	3.2	1.7	-	4.9
Building repair / maint	-	-	-	-	-	-	-	-	-
<b>Total cost</b>	<b>17.3</b>	<b>41.3</b>	<b>64.8</b>	<b>66.3</b>	<b>68.0</b>	<b>72.8</b>	<b>73.0</b>	<b>73.1</b>	<b>476.7</b>
Existing funding	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	80.0
<b>Budget impact / UFR</b>	<b>7.3</b>	<b>31.3</b>	<b>54.8</b>	<b>56.3</b>	<b>58.0</b>	<b>62.8</b>	<b>63.0</b>	<b>63.1</b>	<b>396.7</b>

**COA 3: Buy LAMS for all sites.**

	FY12	FY13	FY14	FY15	FY16	FY17	FY18	FY19	Total POM/Budget Cost (FY12-FY19)
MILCON	-	-	-	-	-	-	-	-	-
Lease warehouses	-	-	-	-	-	-	-	-	-
Purchase LAMS	14.5	46.4	39.6	-	-	-	-	-	100.5
COSIS	2.8	16.4	29.3	30.2	31.1	32.0	33.0	33.9	208.6
LAMS refurbishment	-	-	-	-	-	3.2	10.2	8.8	22.2
Building repair / maint	-	-	-	-	-	-	-	-	-
<b>Total cost</b>	<b>17.3</b>	<b>62.8</b>	<b>68.9</b>	<b>30.2</b>	<b>31.1</b>	<b>35.2</b>	<b>43.2</b>	<b>42.7</b>	<b>334.8</b>
Existing funding	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	80.0
<b>Budget impact / UFR</b>	<b>7.3</b>	<b>52.8</b>	<b>58.9</b>	<b>20.2</b>	<b>21.1</b>	<b>25.2</b>	<b>33.2</b>	<b>32.7</b>	<b>251.3</b>

**COA 4: Use outside storage at all sites.**

	FY12	FY13	FY14	FY15	FY16	FY17	FY18	FY19	Total POM/Budget Cost (FY12-FY19)
MILCON	-	-	-	-	-	-	-	-	-
Lease warehouses	-	-	-	-	-	-	-	-	-
Purchase LAMS	-	-	-	-	-	-	-	-	-
COSIS	9.7	34.5	57.9	59.7	61.5	63.3	65.2	67.2	418.8
LAMS refurbishment	-	-	-	-	-	-	-	-	-
Building repair / maint	-	-	-	-	-	-	-	-	-
<b>Total cost</b>	<b>9.7</b>	<b>34.5</b>	<b>57.9</b>	<b>59.7</b>	<b>61.5</b>	<b>63.3</b>	<b>65.2</b>	<b>67.2</b>	<b>418.8</b>
Existing funding	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	80.0
<b>Budget impact / UFR</b>	<b>(0.3)</b>	<b>24.5</b>	<b>47.9</b>	<b>49.7</b>	<b>51.5</b>	<b>53.3</b>	<b>55.2</b>	<b>57.2</b>	<b>338.8</b>

**Benefits Estimate**

With one exception, each of the COAs delivers the following benefits in varying degrees:

- **Deployment response time:** This reflects the extent to which the type of storage facility will affect the amount of time needed to bring the equipment to deployable condition if it becomes necessary to deploy the vehicles from APS to a new contingency location. This is primarily a reflection of the extent to which the vehicles are protected from the elements while in storage. While COSIS is intended to keep the vehicles in fully deployable condition at all times, experience has shown that greater exposure to the elements increases the rate of equipment degradation and thus increases the amount of time required to bring the equipment up to deployable standards when a contingency is implemented.
- **LAMS resale value:** We have determined that there is a viable resale market for the shelters. The resale value is an estimate of the revenue that could be generated from the sale of the shelters after we no longer need them, minus any refurbishment costs to put the shelters in saleable condition. Based on other situations where LAMS have been resold, we estimate that the dollar value of this benefit is relatively minor, but it does represent a factor that might make a given COA more attractive to one or more members of our stakeholder community. Because we expect the resale value to be so minor, we did not attempt to quantify the value; rather, we treated it as a non-financial criterion and determined only whether each COA provides resale value. This benefit is the exception that does not apply to all COAs. It applies only to COA 1, because this is the only alternative that calls for using the LAMS on a temporary basis. In all other COAs, LAMS will be used either permanently or not at all.

- **Long-term site impact:** This is an estimate of the impact the storage facility will have on the real property at the APS site. Impact represents a balancing of two potentially offsetting influences. First, the nature of the storage facilities will determine the extent to which the site must be disturbed initially. At one extreme is MILCON, which requires excavating for building foundations and similar activities, while at the other extreme is outside storage, the establishment of which has virtually no adverse impact on the site. Second, the nature of the storage facilities will also determine the extent to which the long-term presence of the vehicles will adversely impact the site. In this case, the construction alternative has the least negative impact on the site, because a newly constructed building will do the best possible job of preventing contamination from fluid leaks, spillage, and similar damage. The outside storage outside has the greatest adverse impact because this option provides no structure or hardstand to protect the site from potential damage.

We evaluated the extent to which each COA provides these benefits by using an adjectival rating scale. From best to worst, the ratings we used are Outstanding, Acceptable, Marginal, and Poor. Not applicable (N/A) was used to rate LAMS resale value for the three COAs which do not entail disposing of LAMS. Applying this rating scheme, we evaluated the COAs as shown in Table 4.

**Table 4: Adjectival Evaluation of Benefits**

Benefit	COA 1	COA 2	COA 3	COA 4
Deployment response time	Outstanding	Acceptable	Marginal	Poor
LAMS resale value	Outstanding	N/A	N/A	N/A
Long-term site impact	Poor	Marginal	Acceptable	Outstanding

### **Alternative Selection Criteria**

In consultation with our stakeholder community – logistics planners, war planners, APS operators, Army service component commands, and resource managers – we developed selection criteria that address all their major needs and concerns. This resulted in establishment of the following selection criteria:

- **Financial criteria:** In terms of importance, the overwhelming criterion is total cost over the relevant lifecycle. Because APS is a long-term requirement, our responsibility as resource stewards demands that we place heavy emphasis on the complete lifecycle cost in making our decision. An additional but less important financial criterion is POM/budget impact. As described in the Cost Estimate section, this value is determined by subtracting funds already programmed or budgeted from the total lifecycle cost. This tells us how much additional funding a given COA would require.

- **Non-financial criteria:** The benefits identified in the preceding section – deployment response time, LAMS resale value, and long-term site impact – are the non-financial criteria we used.

**Comparison of Alternatives**

To evaluate the COAs, we began by applying the adjectival rating scheme used above (Outstanding, Acceptable, Marginal, and Poor) to the evaluation of the two financial criteria. Our evaluation is shown in Table 5.

**Table 5: Adjectival Evaluation of Financial Criteria**

Criterion	COA 1	COA 2	COA 3	COA 4
Total lifecycle cost	Acceptable	Poor	Outstanding	Marginal
POM/budget impact	Acceptable	Poor	Outstanding	Marginal

To rank-order the COAs and select the optimum solution, we chose to use a two-step, numeric evaluation system. The first step in this process was to assign numeric values to the adjectival ratings, as follows:

- Outstanding ..... 4
- Acceptable ..... 3
- Marginal ..... 2
- Poor ..... 1
- Not applicable ..... 0

Converting the adjectival ratings to numeric ratings resulted in the array in Table 6.

**Table 6: Extent to Which Each COA Satisfies Each Criterion**

Criterion	COA 1	COA 2	COA 3	COA 4
Total lifecycle cost	3	1	4	2
POM/budget impact	3	1	4	2
Deployment response time	4	3	2	1
LAMS resale value	4	0	0	0
Long-term site impact	1	2	3	4

We then assigned relative weightings to the selection criteria, using decimal values that total to “1.” As discussed above, we gave the highest weight to total lifecycle cost and lower weightings to the remaining criteria based on our assessment of their importance in the decision. We developed the following weightings:

Total lifecycle cost .....	0.65
POM/budget impact .....	0.10
Deployment response time .....	0.15
LAMS resale value .....	0.05
Long-term site impact .....	0.05

Then we combined the weighted selection criteria with the numeric evaluation ratings to develop a total score for each COA. One COA at a time, we multiplied the individual numeric rating for a given criterion by the relative weighting of that criterion and then added the results. Table 7 demonstrates the process for COA 1.

**Table 7: Example of Evaluation Methodology**

Criterion	Rating	Relative Weighting	Score (Col 2 x Col 3)
Total lifecycle cost	3	0.65	1.95
POM/budget impact	3	0.10	0.30
Deployment response time	4	0.15	0.60
LAMS resale value	4	0.05	0.20
Long-term site impact	1	0.05	0.05
Total score			3.10

The bottom-line number – in this case, 3.10 – has no unit of measure. It is simply a composite score on a scale of 1 to 4, where 1 would indicate that a COA does a poor job of satisfying each of the criteria and 4 would indicate that a COA does an outstanding job of satisfying each of the criteria.

Applying this same approach to all four COAs yielded the results in Table 8.

**Table 8: Scoring of All COAs**  
(Dollar figures are in millions of dollars)

Criteria	Weight	COA #1-MILCON			COA #2-Leases and LAMS			COA #3-LAMS			COA #4-Outside Storage		
		Data	Rating	Score	Data	Rating	Score	Data	Rating	Score	Data	Rating	Score
Total lifecycle cost (constant dollars)	.65	1185.8	3	1.95	1494.3	1	.65	830.1	4	2.60	1299.0	2	1.30
POM/budget impact (current dollars)	.10	283.0	3	.30	397.3	1	.10	254.8	4	.40	338.8	2	.20
Deployment response time	.15		4	.60		3	.45		2	.30		1	.15
LAMS resale value	.05		4	.20		0	0		0	0		0	0
Long-term site impact	.05		1	.05		2	.10		3	.15		4	.20
<b>Total Score</b>				<b>3.10</b>			<b>1.30</b>			<b>3.45</b>			<b>1.85</b>

Based on this analysis and scoring, the recommended solution is to adopt Course of Action 3, which calls for using LAMS at all sites.

**Billpayers**

Because the APS solution is so important to the Army, and because the bill is so large, we believe that no single agency or functional area should be required to finance the entire amount. In our view this should be considered an Army-level bill to be addressed at HQDA.

However, if the billpayer must come from within our functional area, we recommend billpayers as shown in Table 9.

**Table 9: Bill-Payers (millions of current dollars)**

	FY12	FY13	FY14	FY15	FY16	FY17	FY18	FY19
Total cost (Table 3.5)	17.3	62.8	68.9	30.2	31.1	35.2	43.2	42.7
Existing funding (Table 3.5)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
<b>Remaining UFR</b>	<b>7.3</b>	<b>52.8</b>	<b>58.9</b>	<b>20.2</b>	<b>21.1</b>	<b>25.2</b>	<b>33.2</b>	<b>32.7</b>
Billpayer 1: Program X	2.0	2.5	3.0	3.0	3.0	3.0	3.0	3.0
Billpayer 2: Program Y	2.5	25.0	27.0	8.5	9.0	10.5	14.6	13.7
Billpayer 3: Program Z	2.8	25.3	28.9	8.7	9.1	11.7	15.6	16.0
<b>Total bill-payers</b>	<b>7.3</b>	<b>52.8</b>	<b>58.9</b>	<b>20.2</b>	<b>21.1</b>	<b>25.2</b>	<b>33.2</b>	<b>32.7</b>

While Programs X, Y, and Z are extremely important to the Army, using them as billpayers will not have a direct, adverse impact on the Army's ability to provide trained, ready units to combatant commands or to maintain the all-volunteer force. If these programs are used as billpayers, the adverse impacts will be reduced staffing levels within certain installation service functions, less timely repair and maintenance of administrative support equipment, and increased processing time for property book-related documents and transactions. If our customers and stakeholders are willing to accept these degradations of service, then the billpayers are acceptable.

### **Second- and Third-Order Effects**

We have identified several follow-on effects, depending on the course of action that is adopted. These are:

- Positive impact from MILCON projects. If COA 1 is selected, there will be a significant economic impact at the five APS locations as additional civilian jobs become available to support the construction requirement. This impact will affect all sites, but will be most important at the CONUS locations. This is because bringing jobs to local communities in the U.S. is, in the judgment of most individuals, of greater value than bringing jobs to overseas locations.
- Similar but lesser impact from leases. If COA 1 or 2 is selected, there will be a positive impact on the local community with the influx of leasing dollars. This positive impact will be significantly less than the MILCON impact, because leases will affect a small handful of property owners, while MILCON would affect dozens (perhaps hundreds) of individual workers at each APS location.
- Possible loss of OCONUS facilities. If at some point in the future host-nation agreements in OCONUS locations cannot be extended, and if COA 1 is selected, the Army might be required to abandon newly constructed buildings before receiving the full economic benefit from the facilities.

### **Sensitivity Analysis**

In our analysis, we have assigned a very high weighting (65% of the total weighting) to the total lifecycle cost criterion. We decided that it would be appropriate to conduct a sensitivity analysis on this issue, to determine whether a different weighting would result in a different course of action being recommended.

We performed this sensitivity analysis by conducting several excursions in which we gave reduced weighting to the total lifecycle cost criterion and held the weightings of the other criteria constant relative to each other. The results of these excursions are shown in Table 10.

**Table 10: Sensitivity Analysis On Weighting Factors**

Weighting of Total Lifecycle Cost Criterion	Scores Based on Changing Weighting of Total Cost Criterion			
	COA 1	COA 2	COA 3	COA 4
.65	3.10	1.30	3.45	1.85
.50	3.14	1.43	3.21	1.79
.40	3.17	1.51	3.06	1.74
.30	3.20	1.60	2.90	1.70

In this table, the first row of data captures the total score for each COA from the original analysis shown in Table 8. The remaining rows show the impact on the total scores if the weighting for the lifecycle cost criterion is changed to 0.50, to 0.40, and to 0.30. In each row, the highest scoring COA is shaded. This sensitivity analysis reveals that the COA recommendation is moderately sensitive to changes in the weighting. The recommendation to adopt COA 3 is supported at a 0.50 weighting, but at a weighting of 0.40, COA 1 becomes the preferred course of action. Doing a rough interpolation between these two points, we conclude that the recommendation to adopt COA 3 is sound so long as the weighting for total lifecycle cost is approximately 45% or higher; below that level, the scoring favors COA 1.

Senior decision makers have stated that they are confident that the total lifecycle cost criterion should be given a weighting of at least 0.50. At this level, COA 3 remains the highest scoring COA. Thus, we conclude that while the results are moderately sensitive to a change in the weights, the recommendation to adopt COA 3 is sound based on senior decision makers’ assessment of relative priorities among the criteria.

**Risk Assessment**

We have identified three risks that should be addressed. The risks and their mitigation strategies are defined here.

- **Risk:** Labor issues or adverse weather might cause construction delays. This applies only to COA 1.
  - **Mitigation:** During construction we must monitor the situation closely. As a minimum this would entail consulting reputable long-range weather forecasts to determine the likelihood of adverse weather that would affect construction and conducting frequent IPRs with the USACE on-site overseers in order to get early notification of any emerging labor issues that might become problems. If either or both of these risks appears to become increasingly likely, we must mitigate the risk by being prepared to extend leases and/or purchase additional LAMS to cover a possible delay in construction.

- **Risk:** The drawdown in Afghanistan might go more slowly than expected, thus delaying the arrival of the MRAPs at the APS sites. This applies to all COAS.
  - **Mitigation:** We must monitor the situation closely, primarily via frequent communication with the Army service component commander (USARCENT) and with war planners at HQDA. If it appears likely that the drawdown will proceed more slowly than expected, we must be prepared to postpone leases and LAMS purchases as needed. Under COA 1, it is unlikely that the drawdown would proceed so slowly as to delay the need for construction, since the buildings will not be ready until FY17. However, we should also be prepared for this extreme situation and be prepared to request postponement of the construction.
  
- **Risk:** Exposure to the elements might have greater adverse impact on deployment response time than expected. This applies to COA 4, which calls for outside storage at all locations.
  - **Mitigation:** We must develop and implement a focused recurring inspection program to ensure negative trends are identified early and corrective action is taken in a timely manner.

### **Final Recommendation**

We recommend that COA 3, the purchase of LAMS for all five sites, be implemented. We also recommend that HQDA treat the UFR for COA 3, which begins at \$7.3 million in FY12 and peaks at approximately \$60 million in FY14, as an Army bill to be funded by HQDA.

## Acronyms

The following acronyms are used in this CBA.

Acronym	Meaning
APS	Army Prepositioned Stocks
COA	Course of Action
CONUS	Continental United States
COSIS	Care of Supplies in Storage
FY	Fiscal Year
GSA	General Services Administration
HQDA	Headquarters, Department of the Army
LAMS	Large-Area Maintenance Shelter
MILCON	Military Construction
MRAP	Mine-Resistant, Ambush-Protected vehicle
OCONUS	Outside the Continental United States
OMA	Operations and Maintenance, Army
POM	Program Objective Memorandum
USACE	US Army Corps of Engineers
USARCENT	US Army Central Command