
U.S. Army

Cost Benefit Analysis Guide



3rd Edition
(V3.3)

Updated as of:

23 FEB 2018

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

The goal of this Guide is to make the 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 Army Cost Management (ACM) portal Knowledge Center Cost Benefit Analysis Information page:

<https://acm.army.mil/webcenter/portal/ACMPortalDev/Knowledge Center/Cost Benefit Analysis Information>

Comments from users are encouraged and should be submitted to:

usarmy.pentagon.hqda-asa-fm.mbx.army-cost-benefit-analysis@mail.mil



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 "Peter W. Chlarelli".

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

A handwritten signature in black ink, appearing to read "Joseph W. Westphal".

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 tail.

Updates and Changes to Version 3.2 dated 26 October 2016

- Updated the 'How to Develop Selection Criteria' portion of 'STEP 6 – Define Alternative Selection Criteria'.

Updates and Changes to Version 3.1 dated 24 April 2013

- Updated embedded links for access to the Army Cost Management (ACM) portal.

Updates and Changes to Version 3.0 dated 1 February 2013

- Moved the CBA mailbox contact information to Page 2 from the Introduction to give it greater visibility.
- Provided additional guidance on developing the Objective Statement
- Reorganized all the appendices.
- Added additional acronyms to (New) Appendix B
- Revised (New) Appendix C
- Continued to correct typos, spelling errors, and usage/word choice.

Table of Contents

Purpose.....	10
Introduction.....	11
Documenting a CBA.....	12
The CBA Guide Online.....	13
What Is a Cost Benefit Analysis?	13
Who Can Perform a Cost Benefit Analysis?	14
When Should a Cost Benefit Analysis Be Performed?	14
Identify Stakeholders (a.k.a the Customers).....	14
Cost Benefit Analysis and Teamwork	14
Work Schedule	15
Cost Benefit Analysis and Value Proposition	15
Cost Benefit Analysis and the Military Decision Making Process (MDMP)	15
CBA vs. the MDMP	17
Pre-Cost Benefit Analysis Considerations.....	17
Quick Review.....	18
Cost Benefit Analysis Steps – A Short Summary	19
STEP 1 – Define the Problem/Opportunity; Describe the Background	22
Problem or Opportunity Statement.....	22
Objective	23
The Voice of the Stakeholder (Customer) and Decision Criteria	24
Background.....	25
Quick Review.....	25
STEP 2 – Define Scope; Formulate Facts and Assumptions.....	26
Scope	26
Formulate Facts and Assumptions.....	26
Quick Review.....	27
STEP 3 – Define Alternatives.....	28
Introduction	28
Define the Status Quo	28
The Status Quo as a Baseline	29
Documenting the Status Quo.....	29
Define Alternatives / Courses of Action (COA).....	30

Describe Second and Third Order Effects (Cause and Effect)	31
Quick Review.....	33
STEP 4 – Develop Cost Estimates for Each Alternative.....	34
Cost Concepts.....	34
Other Types of Costs	35
The Cost Analysis / Estimating Process.....	35
Cost Analysis Process.....	37
Cost Estimating Strategy	41
Trade Offs	42
Organizing Cost Data for Display	42
Inflation and Its Impact on Costing	44
Quick Review.....	46
STEP 5 – Identify Quantifiable and Non-quantifiable Benefits	47
Benefits Analysis Overview.....	47
Quantifiable Benefits	47
Non-quantifiable Benefits.....	48
Identify, Estimate, and Evaluate Benefits	48
Identifying Benefits.....	48
Benefit Categories	49
Estimating Quantifiable Benefits	49
Evaluating Non-quantifiable Benefits	50
Quantifying Benefits	50
Quick Review.....	50
STEP 6 – Define Alternative Selection Criteria	51
Introduction	51
Alternative Selection Criteria	51
How to Develop Selection Criteria.....	51
Quick Review.....	53
STEP 7 Compare Alternatives.....	54
Introduction	54
Compare Costs and Benefits.....	54
Risk Assessment	54
Risk Mitigation.....	57

Decision Support Tools/Methods	57
The Decision Matrix.....	58
Other Quantitative Tools /Methods	61
Perform Sensitivity Analysis.....	64
Billpayers	65
Quick Review.....	66
STEP 8 – Report Results and Recommendations.....	67
Documenting the CBA.....	67
Supplementary Content.....	68
Briefing the Results of the CBA	69
Quick Review.....	70
Appendix A	71
Glossary.....	71
Appendix B	79
Acronyms.....	79
Appendix C	84
Cost Estimating Methods	84
Appendix D	87
Cost Estimating Models and Tools.....	87
Appendix E.....	95
References.....	95

Purpose

The purpose of the *Cost Benefit Analysis (CBA) Guide* is to assist Army analysts and agencies in preparing a 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 our 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-informed 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. Define the Scope and Formulate Facts and Assumptions.
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

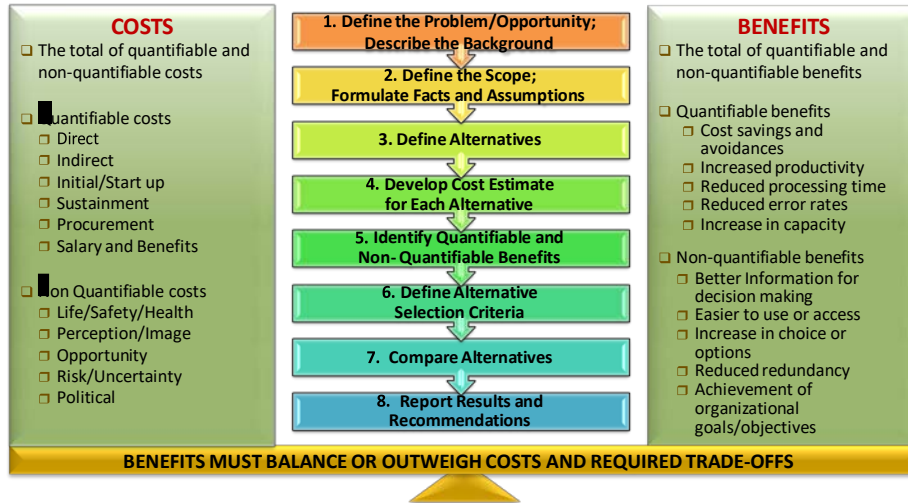
A short description of each step may be found at the end of this section.



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. A CBA makes the case for a project or proposal, weighing the total expected costs against the total expected benefits, over the near, far, and life-cycle 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, PowerPoint should not be the main format of the CBA; it is best used as a means of presenting summary details of a CBA for briefing purposes. In general, a narrative description better details the situation and analysis that are necessary for a CBA.

An example CBA in narrative format and also includes a suggested PowerPoint briefing format for those who prefer or require it can be found on the CBA Portal. However, using PowerPoint does not remove or lessen the requirement for a thorough CBA.

The CBA Guide Online

This Guide, the briefing format, and other helpful resources may be found on the Cost and Performance Portal. Requirements to access the new CBA portal in the ACM:

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

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) or alternative.
- An analysis of needs and problems, their proposed alternative solutions, and a risk analysis to lead the analyst to a recommended choice before a significant amount of funds are invested by the billpayer.
- 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?

Cost benefit analyses may be performed by government employees and/or contractors. However, any CBA developed by a contractor should be reviewed and validated by the government.

When Should a Cost Benefit Analysis Be Performed?

A CBA must be performed to support leadership decisions, specific examples are:

- Per Army Program Guidance Memorandum (APGM)
- 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
- When the organization is requesting capital budget funds.

Identify Stakeholders (a.k.a the Customers)

Stakeholders or customers are the functional process owners or the end users of the products and/or services flowing from the CBA. In other words, it is any person or organization who will be directly affected by the outcome of the CBA. They are the audience. While there may be many stakeholders, the decision-maker(s) are usually the most important. The analyst responsible for preparing a CBA should make every effort to identify the primary (most affected) stakeholders in order for them to be consulted through the CBA building process. This helps to ensure that the CBA is meeting their needs and requirements (which will be covered later in this step). This is done by soliciting their input at key points. Finally, a clear understanding of the stakeholders is very helpful to selecting team members with the right skills and knowledge. The next section discusses the benefits of preparing CBAs using a team approach.

Cost Benefit Analysis and Teamwork

It is strongly recommended that the 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. The size of the team may be influenced by factors such as the scope, size and complexity of the subject of the CBA. 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 a 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.

Work Schedule

One of the first tasks the CBA team must address is coming up with a schedule and timeline for completing the CBA. The time it will take to finish a CBA is dependent on the complexity of subject matter as well as the skills and experience of the individual team members amongst other factors. Discuss a tentative deadline with the sponsor/decision-maker. The team will know more about the work effort after they have had time to work through the first couple of Steps.

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 is: “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 savings of nearly \$2M per year compared to the current process.” It is specific, and reports tangible, attractive results.

An example of a weak value proposition is: “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

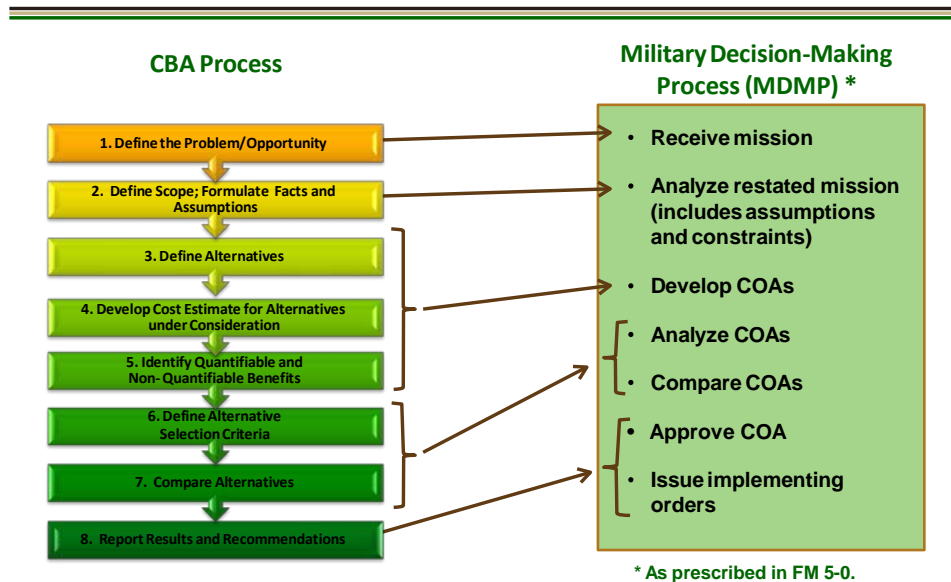
judgment, logic, and professional knowledge to understand situations, develop options to solve problems and reach decisions. Like the CBA methodology, it is an iterative process. The table below summarizes the seven steps of the MDMP.

The Military Decision Making Process

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

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 (See The “Voice of the stakeholder” in Step 1), 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 statement describes the role of the CBA: what is the decision to be made, and how does the CBA inform and support it? What is the purpose of the analysis?

The “Voice of the stakeholder” (a.k.a. Voice of the Customer) is the term used to describe the stated and unstated stakeholder needs or requirements. It is an important input to the development of decision criteria.

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.

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 2nd and 3rd order effects should be quantified, particularly as they relate to costs.

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.

Difficult to quantify benefits are subjective in nature and can make a positive contribution to the analysis. An example of Difficult to quantify 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. 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.

c. 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.

d. 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.) "2nd and 3rd 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; Describe the Background

This section discusses four areas:

- Define the initiative or proposal using a problem or opportunity statement
- Define the objective/goal
- Capture the Voice of the Stakeholder (a.k.a the Customer) and Decision Criteria
- 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 question being asked and the associated choice to be made. 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 or improvement in question?
- Who and what are impacted by this problem?
- Briefly address 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 CAC process at Ft. Washington has shown a steady increase in lead time from 2 hours to 6.2 hours since January 2006 due to changes in policy, organizational changes and total number of CAC transactions. This analysis presents costs and benefits of the potential solutions in addressing this issue.” This statement identifies a problem in real terms. It states when and where the problem started and who is impacted. In defining the problem/opportunity, various elements must be considered: mission needs, costs, level of effort, time schedules, allowable operational changes, and ease of future modification and expansion.

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 describe the role of the CBA: what is the decision to be made, and how does the CBA inform and support it. Depending on the problem statement and the role of the CBA, the objective could 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. A key aspect of establishing an objective is whether or not actually addresses the problem/opportunity statement or whether it identifies a symptom of the problem.

Objectives should also be defined using clear, results-oriented language and be unbiased as to a recommend solution. 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.

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.

Whenever possible, objectives should be:

- Specific
- Measurable
- Achievable
- Realistic
- Time Bound

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.
- To inform Congressional decision on funding for winter storage of HMMWVs at Fort Benning.
- To inform senior leader decision on the allocation of DAC, contractor, and military labor to perform the physical security function at Camp Victory

The Voice of the Stakeholder (Customer) and Decision Criteria

The Introduction to this guide addressed Stakeholders, making the point that the CBA preparer should identify Stakeholders early in the CBA development process. The decision-maker is one of the most important, if not the most important, stakeholder. Stakeholders are the ones who best define the problem/opportunity and determine if the CBA is solving the right problem (or capitalizing on the right opportunity). The stakeholders' opinions in terms of what is important to them are of critical importance in shaping the CBA. The decision-maker must have an understanding of how to use the CBA once it is complete and how it will be implemented. The decision-maker does not need to understand the detailed analysis techniques used in the CBA, but should feel comfortable with the conclusions offered.

The term "Voice of the Stakeholder" (VOS) is a phrase that is often used to describe the in-depth process of capturing stakeholders' expectations, preferences and aversions. The VOS is an important input for developing the selection criteria (also known as evaluation / decision criteria) and identifying the benefits that will result from solving the problem (or capitalizing on the opportunity). Besides providing guidance to the CBA preparer, the stakeholders also help determine/validate the criteria which will be used to evaluate and compare CBA COAs. The "Voice of the Stakeholder" process produces an initial set of decision criteria. In other words, the needs and requirements of the Stakeholders are a means of evaluating COAs.

While the topic of selection criteria is introduced as part of Step 6 of this Guide, it is clear that there are benefits to discussing them with the stakeholders earlier in the CBA development process. Developing a short list of potential selection criteria now will assist the analyst preparing the CBA in developing COAs that matter to the stakeholders. The decision Criteria developed in Step 1 will be reviewed in Step 6 to determine if they are still valid. The CBA preparer, in coordination with the Stakeholders, will also incorporate any new selection criteria determined to be important based upon the knowledge and understanding of the topic gained through the CBA development process.

Note:

A criterion is a standard, rule, or test by which something can be judged—a measure of value. CBA preparers develop criteria to assist them in formulating and evaluating possible solutions to a problem. Criteria are based on mission need and required capability from the problem statement as well as on facts, assumptions, and the Voice of the Stakeholder or anything else that provides separation between courses of action. CBA preparers will normally develop two types of criteria: screening and selection / evaluation criteria. Screening criteria are used to assess the merits of alternatives (COAs). Step 3 of the Guide contains a more detailed discussion of this type of criteria. Selection / evaluation criteria are developed in order to differentiate among COAs under consideration.

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 to be addressed in the Cost Benefit Analysis. The definition of the current state includes 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 and/or opportunity statement clearly addresses the decision to be made.
Four attributes of a good problem/opportunity statement:
 - Defines the problem/opportunity
 - Identifies the decision to be made
 - Describes the size of the problem
 - Describes the impact the problem is having on the organization
- The objective of the analysis should be specific and address the audience and forum for which the analysis will be used.
- Understanding the Voice of the Stakeholder is essential to defining the criteria used to evaluate alternatives.
- The background and circumstances define and assess the current state/condition. It provides the contextual information needed to fully understand the problem, need, or opportunity to be addressed in the CBA.

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 CBA 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, or limits placed on resources for the project. These may include: organizational policies or procedures, funding considerations, physical limitations, and/or time-related considerations. 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.

Quick Review

- The scope should consider dimensions such as time, location, organization, technology or function.
- Facts are verifiable true statements that have a direct bearing on the CBA.
- 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:

- Introduction
- Define the Status Quo
- The Status Quo Baseline
- Documenting the Status Quo
- Define Alternative Courses of Action
- Identify the second and third order effects

Introduction

As was mentioned earlier in this Guide, one of the most important goals of the CBA is to prepare an unbiased solution or recommendation for the decision maker, based on critical reasoning and reliable information (data). Alternatives can be intuitively obvious to the analyst or team preparing the CBA or they may take a determined effort to define. There is no magic to coming up with a sufficient number of alternatives. Creativity is key to developing effective solutions. Often, groups can be far more creative than individuals. However, those working on solutions should have some knowledge of or background in the problem area.

At those times when courses of action seem to be just out of reach, a technique that may produce results is Brainstorming. Brainstorming is a proven way of generating unconstrained ideas/solutions and engaging team members in the CBA development process. The good news is that the analyst or analytical group usually has the Status Quo upon which to rely as an alternative. Ideally, a CBA should consider three or more COAs (one of which may be the Status Quo). Decision-makers need/expect options to choose from.

Define the Status Quo

Functionally, the status quo is the existing operational capability of the program on the 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 and should reflect a review of mission and strategic goals. 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.

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 a 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 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 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 or Transition costs.

Define Alternatives / Courses of Action (COA)

The CBA alternatives (or COAs) 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. **It is better to have fewer viable alternatives than many weak ones.**

The CBA preparer should use screening criteria to ensure solutions being considered can solve the problem. Screening criteria defines the limits of an acceptable solution. As such, they are tools to establish the baseline products for analysis. A solution may be rejected based solely on the application of screening criteria. Five categories of screening criteria are commonly applied to test a possible solution:

- **Suitability**—solves the problem and is legal and ethical. The COA can accomplish the mission within the decision-maker’s intent and guidance.
- **Feasibility**—fits within available resources.
- **Acceptability**—worth the cost or risk.
- **Distinguishability**—differs significantly from other solutions.
- **Completeness**—contains the critical aspects of solving the problem from start to finish.

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/performance
- Lack of compliance with established constraints
- Dependence on assumptions that are unrealistic
- 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 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? Have all feasible alternatives been considered? Are all alternatives presented feasible?
- Are the alternatives distinctly different?
- 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?

- Are tradeoffs of each alternative clearly stated? Unavoidable and difficult tradeoffs should not be hidden.

Describe Second and Third Order Effects (Cause and Effect)

As part of a thorough discussion of each COA/ alternative, an analyst should also pay careful consideration to the “effects” that any COA may cause if implemented.

Note: Any 2nd and 3rd order effects which produce costs should be fully analyzed in Step 4 of the Guide. Similarly, any 2nd and 3rd order effects that produce benefits should be fully analyzed (and quantified if possible) in Step 5 of the Guide.

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/assumptions should be vetted with that organization.

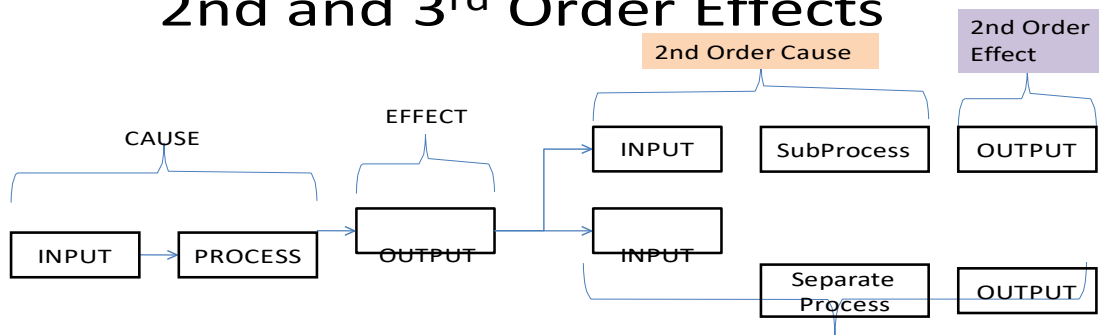
According to FM 6-22 Army Leadership: “Attempting to predict second-and third-order effects may result in identifying resource requirements and changes to organizations and procedures.” For instance, when the Chief of Staff approves a new military occupational specialty code for the Army, the consequences 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 need to be addressed.

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.

Note: Any second and third order effects that have not been captured as costs in the cost estimating step of the CBA process, should be identified and discussed in this section of the Guide.

2nd and 3rd Order Effects



- List of Potential Causal Factors:**
- Manpower
 - Environment
 - Technology
 - Equipment
 - Facilities
 - Behavioral
 - Politics
 - Policy
 - Procedures
 - Etc. (not an exhaustive list)
- Outputs**
- Desired
 - Undesired

This routine can be repeated to include 3rd order effects, 4th order effects and etc. depending on the complexity or magnitude of the alternatives under consideration.

Quick Review

- Brainstorming is an effective method of developing potential COAs.
- 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.
- Second and third order effects are the results (consequences) stemming from a decision.

STEP 4 – Develop Cost Estimates for Each Alternative

This section discusses the following areas:

- Cost Concepts
- Cost Analysis / Estimating Process
- Cost Estimating Strategy
- Tradeoffs (Opportunity Costs)
- Organizing Cost Data for Display
- Inflation and Its Impact on 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: The cost estimate should be used to develop the budget. Funding is only considered when an affordability analysis is conducted. A discussion of funding source is introduced in Step 7 of this Guide as it relates to the identification of Bill Payers.

Total Costs = 1st Order Costs + 2nd and 3rd Order Effect Costs.

1st 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: 1st 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.

2nd and 3rd 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 2nd 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 2nd and 3rd 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 2nd and 3rd 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 can 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

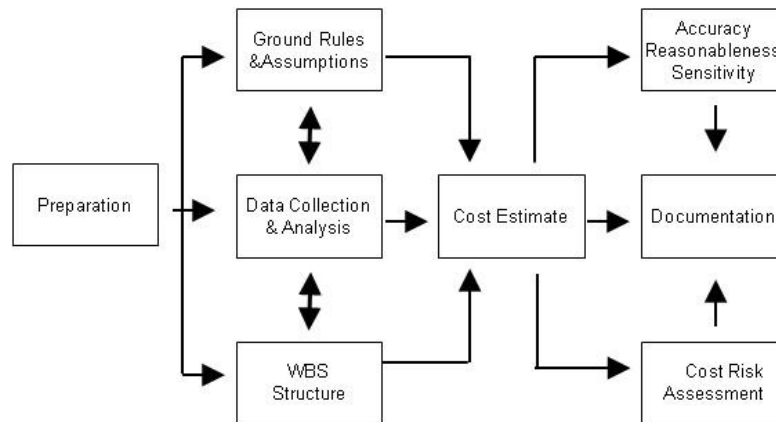
For our purposes, the terms Cost Analysis and Cost Estimating can be used interchangeably, though cost estimating is technically an activity within the cost analysis process. Cost estimating involves collecting and analyzing historical data and applying models, techniques, tools, and databases to predict a program's future cost. Cost Analysis and Estimation are 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.

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

Well Documented
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"> • Data are traced back to the source documentation • Documents all steps in developing the estimate so that another analyst unfamiliar with the program can recreate it quickly with the same result • Documents all data sources for how the data were normalized • Describes in detail the estimating methodology and rationale used to derive each work breakdown structure (WBS) element's cost
Comprehensive
The estimate's level of detail ensures that cost elements are neither omitted nor double counted.
<ul style="list-style-type: none"> • It completely defines the program / initiative, reflects the current schedule, and contains reasonable assumptions • Details all cost-influencing ground rules and assumptions • It captures the complete scope of the work to be performed, using a logical WBS that accounts for all performance criteria and requirements. If required, provides a description of each element of the WBS.
Accurate
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"> • It has few, if any, mathematical mistakes • It has been reviewed for errors like double counting and omitted costs • Cost drivers have been cross-checked to see if results are similar • It is timely • It is updated to reflect changes in technical or program assumptions and new phases or milestones
Credible
Discusses any limitations of the analysis from uncertainty or bias surrounding data or assumptions.
<ul style="list-style-type: none"> • Major assumptions were varied and other outcomes recomputed to determine their sensitivity to changes in assumptions • Results were cross checked using a different methodology to determine whether they produce similar results

Cost Analysis Process

Cost analysis is an iterative process that may require reevaluating previous steps, with a systematic approach to develop accurate and timely estimates. Listed below are the steps in the cost analysis process.



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) that is going to the customer. This is also the time to ensure that the scope of the cost estimate is understood and defined and 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
- Joint Capabilities Integration and Development System (JCIDS) documents/memo outlining requirements (Capability Development Document (CDD) or Capability Production Document (CPD))
- Management Decision Packages (MDEPs)
- Databases of current or historical costs.
- Cost Analysis Requirements Description (CARD)
- Army regulations, pamphlets, and technical manuals
- TRADOC guidance

Ground Rules and Assumptions (GR&A). To be comparable the cost estimates for the COAs need to be consistent. Relook the CBA ground rules and assumptions established in Step 2 and add additional GR&A for the cost estimates as needed. Examples include:

- Inflation indices used
- Maintenance concept
- Acquisition strategy
- Procurement/Fielding schedules
- Technological assumptions

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 tools 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 entails the following tasks:

- Identify the types of data available (e.g. cost, programmatic, schedule, technical).
- Collect cost data with supporting documentation.
- Determine which estimating methods, tools, and models will be used with which data sets.
- Verify, validate, and adjust (normalize) the data. Cost data is 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.

- Budget and Program Objective Memorandum (POM) submission
- Contractors and manufacturing plant visits
- Historical cost data reports
- Management Decision Package (MDEP)
- Manpower utilization records/reports
- Program Management Offices (PMOs)

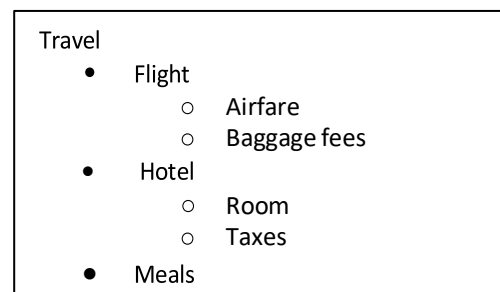
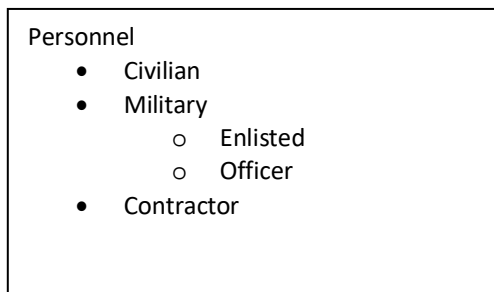
In addition to evaluating available data for its utility in cost estimating, the analyst must look for relationships among data. A basic premise is that relationships among data may continue to exist in the absence of known facts and conditions. The presence of these relationships can form the basis for assumptions, cost factors, and cost estimating relationships (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.

Work Breakdown Structure (WBS). A WBS 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 element structures (CESs) are the lowest level of a cost estimate, and the cost estimate total is the sum of all the cost elements. A well-developed CES 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:



Cost Estimate. Once the GR&A are completed, the data has been collected & analyzed and the CES/WBS structure established it is time to build an estimate for each alternative. This is an iterative process and the GR&A data and WBS need to be continually reviewed to see if changes are needed. 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). There are four cost estimating methods; engineering, parametric, analogy and expert opinion. (See Appendix 4A). Decisions on which method to use for a specific CES element will be influenced by the data available, data quality and time constraints. Estimating methods may change over time as the product becomes better defined and new information becomes available.

Normally a cost estimate contains all costs from the start through implementation, operation, and disposal for a program or project. Collectively, these five costs are the Life-cycle Cost (LCC).

- Research, Development, Test and Evaluation (RDT&E), sometimes called Engineering Manufacturing Development (EMD) or System Development Effort (SDE), includes government and contractor costs. These costs are directly for the research, develop and test equipment, material, and computer application software necessary to bring a system from concept to production regardless of the color of money or who pays for the effort.
- Procurement includes all costs for the Prime Mission Equipment (PME) and its support. Procurement costs cover production through introduction (fielding) of the materiel system into the Army's operational inventory.
- Military Construction (MILCON) includes all costs of system-specific construction. Only projects that are required for the materiel system and would be canceled upon termination of the materiel system are included here.
- Military Personnel (MP) includes all military personnel costs associated with the development, production, fielding, operations and support of the materiel system that is not reimbursed by any other appropriation.
- Operations and Support (O&S) include all direct and indirect cost of a system; manpower, fuel, maintenance and support that starts after fielding and ends when the materiel system leaves the Army inventory.

Accuracy/Reasonableness/Sensitivity. See Step 7 for detailed discussion on Sensitivity Analysis. Checking the cost estimate for reasonableness will help identify potential errors and highlight cost estimating methodologies that may need to change. For instance, if contractor System Engineering and Program Management (SEPM) cost doubles from one year to the next there may be a valid reason it increases; there could be an error in the estimate; or you may be using a CER or factor that does not reflect what is going on in the Program.

Documentation. The cost estimate must be documented detailing the source of all data and the processes used to analyze the data. Documentation should provide enough detail for another person to track the cost-estimating process from definition to conclusion, enabling an analyst (even unfamiliar with the original analysis), to modify the analysis at a later date.

Documentation should be clear and concise. The goal of the cost documentation process is to provide cost-estimating reports that are readable, auditable, and useful. Documentation should include:

- All ground rules and assumptions used in developing the estimate
- The data used in the estimate and their sources
- The analyst's treatment of the data (for example, normalization and cause-and-effect determinations)

- The CERs used in the estimate, their sources and limitations
- Track from the data to WBS element cost
- Track from the WBS elements to the total cost estimate

Cost Risk Assessment. Cost estimates predict future events and thus by nature have risk and uncertainty. The key is to identify the risk so it can be managed and controlled. There are many tools and techniques, such as probability theory, game theory, Monte Carlo technique, Delphi technique, and decision trees to aid in making quantified risk assessments. Risk analysis examines the likelihood that actual results will fall within a specified range around a predicted point estimate, using probability concepts. Once the analysis is complete, the risk must be explicitly defined for the decision maker. Every life-cycle cost estimate should have a risk analysis. See **Step 7** for detailed discussion on risk.

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 life-cycle). Life-cycle cost can be defined as the total cost to the government (Army) of an 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 estimate. 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 may choose to use the complete Planning, Programming, Budget and Execution (PPBE) cycle (year of execution, budget year(s), and program years), time to break even or time to transition.

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 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 that aggregates cost by cost element and by year.

Alternative A

Cost Elements	Time Period								
	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	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.									
TOTALS									

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 or programming 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, cost data should be in the form of “Constant Dollars” or “Base Year Dollars” for the current FY 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 base year (BY)), 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 (TY) 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 compare 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 \$350,000.00 over **six** years in CIVPAY funds, their costs would be calculated as follows:

	POM Years							
	FY 12 (CY)	FY 13 (BY)	FY 14	FY 15	FY 16	FY 17	FY18	Total
(Constant) Civilian Pay	\$50,000.00	\$50,000.00	\$50,000.00	\$50,000.00	\$50,000.00	\$50,000.00	\$50,000.00	\$350,000.00
Inflation Rates	1.000	1.037	1.060	1.085	1.110	1.135	1.160	
(Current) Adjusted Civilian Pay	\$50,000.000	\$51,830.000	\$53,020.000	\$54,240.000	\$55,490.000	\$56,765.000	\$58,000.000	\$379,345.00

This means for a **\$350,000** civilian pay bill spent over FY12-FY18, **\$379,345** 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 Joint Inflation Calculator to determine the indices:

<http://asafm.army.mil/Documents/OfficeDocuments/CostEconomics/rates/JinflateC.xlsm>

The example located in Appendix B 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 collection plan supports identification and 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.

STEP 5 – Identify Quantifiable and Non-quantifiable Benefits

This section discusses three areas:

- Benefits Analysis Overview
- Types of Benefits
- Identify, Estimate, and Evaluate Benefits

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.). Benefits include quantitative and qualitative measures such as: effectiveness, physical yield, products, morale, quality of life, and timeliness.

When preparing a CBA, identify all benefits. 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.

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 saving.
- *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).
- Flight hours per month or number of trucks serviced per year.
- System reliability in terms of probable failure ratio Maintainability/supportability measures (such as mean-time-to-repair or average downtime).
- Accuracy, timeliness, and completeness of data produced by a system, performance and operational effectiveness.

Non-quantifiable Benefits

Non-quantifiable benefits do not lend themselves to direct and quantitative measures. 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 difficult to quantify benefits in the analysis. Some examples of non-quantifiable benefits are morale, compatibility, quality, security, and readiness. Generally speaking, non-quantifiable benefits do not provide as much support for a COA as quantitative benefits do. It is important to note that the term “non-quantifiable” is not meant to imply that the benefit is impossible to quantify, only that the resources and methodologies required to produce a useful measure may be impractical for the scope of the CBA.

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.

- *Accuracy* – What are the error rates or accuracy of information?
- *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?
- *Production* – What number of products will be produced?
- *Reliability* - how many (how often) system failures will occur over time?

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 beyond financial benefits, benefits must be identified by functional SMEs.

The benefit estimating process is similar to cost estimating (discussed in Step 4.) Data must be collected from appropriate sources and analyzed. Relationships among data must be identified. The economic life (the period during which the alternative provides benefits) of the alternatives and the fiscal years (FY's) when benefits accrue must be carefully considered. 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 (See Step 7 “Compare Alternatives” for further information). The assignment of numeric scores is by nature very subjective; the analyst should consult multiple SMEs and get a consensus on the relative importance of the benefits.

Quantifying Benefits

Non-quantifiable benefits, in many cases, can become quantifiable with an appropriate measuring/counting methodology. For example, morale is often described in difficult to quantify 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. For example, a value of 1 could equal bad morale, 5 could be assigned to good morale and 9 assigned to excellent morale. Quantifying difficult to quantify benefits facilitates making meaningful comparisons of the alternatives.

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.

STEP 6 – Define Alternative Selection Criteria

This section discusses three areas:

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

Introduction

This step is a pre-requisite for Step 7 (Compare Alternatives). The analysis and calculations developed will be used in part or whole in the Decision Matrix. The topic of decision criteria was first introduced in Step 1 Define the Problem and Objective. The expectation is that the analyst preparing the CBA should have consulted with the decision maker (and perhaps other stakeholders) to determine what they will base their decision on. The purpose of this step is not only to develop the criteria but also to review criteria developed previously making any necessary changes to them before moving on to the next step in the CBA development process.

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. In many cases, the total cost or primary benefits are part of the selection criteria. A 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, 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.
- Reflect the costs and benefits listed in the analysis.
- Be unambiguous: the criteria must be clearly stated and the relationships transparent.
- Be concise and non-redundant.
- Provide a standard and consistency for comparison of alternatives.
- Provide a means to expose all uncertainty, risk, and/or tradeoffs.
- Include enough information to allow for an informed decision.

Steps in developing candidate selection criteria are:

- Identify candidate selection criteria early in concert with decision makers and other stakeholders (See Step 1).
- Identify possible screening and selection criteria during the process of defining alternative COAs (See Step 3).
- Identify relevant cost issues that may change selection criteria or add new criteria (See Step 4).
- Identify relevant benefits that may change selection criteria or add new criteria (See Step 5).
- Identify negative impacts of each COA and determine whether any selection criteria should be changed or added based on those impacts.
- Define and scale each selection criteria sufficiently so that the relative difference between assigned ratings is easily understood, i.e. if rating on a 1-9 scale, what does a '6' mean relative to a '7'.

Next, pare the list of candidate criteria down to 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 against 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)
- Break-even Point (Payback Period)
- Cost avoidance or Savings
- Revenue generation

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

Note: Ordinarily, risk is not chosen as a selection criterion. If the level of risk is an important consideration to the analyst preparing the CBA or to the 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 the following areas:

- Introduction
- Compare Costs and Benefits
- Risk Assessment
- Risk Mitigation
- Decision Support Tools and Methods
- Decision Matrix
- Other Quantitative Tools/Methods
- Perform Sensitivity Analysis
- Billpayers

Introduction

This step is a continuation of the previous one. During this step, the analyst compares alternatives using the criteria defined during Step 6. Moreover, 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 one that provides the greatest reward in relation to its cost. In situations where benefits are difficult to quantify, it is important to provide as much useful information as possible to identify every benefit of each alternative.

Risk Assessment

The risks associated with each COA are not usually included in a comparison of costs and benefits. Before an analyst makes a final recommendation based on the costs and benefits, he/she must perform a risk analysis. The analyst may choose to recommend, or the decision maker may want to select the COA with the lowest identified overall risk.

The process of comparing alternatives is not complete until they are evaluated in terms of risk. 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 risks and associated mitigating actions have been identified. 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 are the consequences if the risks go uncontrolled?
- 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 assessed according to their potential implications for meeting the project's objectives. There are many methods and tools for assessing risk. A simple but effective approach to assessing 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 importance for planning responses to the risk -- are usually set by the decision maker. Each risk assessment 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 that each risk is evaluated 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

Level	What is the Likelihood the Risk Event will occur?	Level	What is the Impact of the Risk Event?
5	Near Certainty	5	Catastrophic
4	Highly Likely	4	Severe
3	Likely	3	Moderate
2	Unlikely	2	Minimal
1	Remote	1	Negligible

Red	High	Unacceptable. Major disruption likely; different approach required.
Yellow	Moderate	Some disruption; different approach may be necessary.
Green	Low	Minimum impact; some level monitoring likely.



Risk Mitigation

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.

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 available decision support tools/methods is most appropriate, if any, to support the CBA.**

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 Equal	The alternative that provides greatest benefits for given level of costs 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

One popular tool or technique for comparing and prioritizing a list of alternatives is the decision matrix or DECMAT. It is a 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.

Alternative selection criteria are often either financial, which are objective or quantifiable, or non-financial, which are subjective and not directly quantifiable. While both types of criteria must be used in most CBAs, the financial criteria demand a more rigorous analysis specifically because they are objective and quantifiable, less influenced by subjective assessment. If we were to incorporate the financial criteria and non-financial criteria in a single DECMAT, we would have to apply subjective evaluation to the financial data, which would weaken or degrade the value of the data. Therefore, cost and benefits should be kept separate from one another, not combined in a single DECMAT. The optimum approach is to use a matrix to evaluate the subjective criteria, evaluate the financial data separately, and then consider both financial and non-financial data in order to develop a recommendation or decision.

Example of a Decision Matrix to Evaluate Non-Financial Selection Criteria

Criteria	Weight	COA 1			COA 2			C		A 3
		Data	Rating	Score	Data	Rating	Score	Data	Rating	Score
Maintenance Downtime	.40	10 Hrs	9	3.6	7 Hrs	7	2.8	14 Hrs		4
Reduced Error Rate	.25	5 per 100	5	1.25	2.5 per 100	7	1.75	8 per 100		2
Suitability	.20	Very Good	4	.80	Good	2	.40	Excellent		6
Improved Productivity	.15	240 per cycle	8	1.20	230 per cycle	7	1.05	200 per cycle		6
Total Weight	1.00	Total Score 6.85			Total Score 6			Total Score		4.2

For each selection criterion, the COA score is determined by multiplying the weight for the criterion by the rating for the COA. The cost of the COAs would be divided by the total scores in the bottom row to produce a cost-benefit index (CBI) in order to arrive at a recommendation or decision.

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 the criteria and their relative weighting satisfy his or her intent. It makes little sense to evaluate COAs using criteria that are of little importance to the person using the CBA to make a decision.

Data values:

- For quantifiable data values, determine whether lower or higher values are better. For example note that in the table above lower “Maintenance Downtime” values are better while higher “Improved Productivity” values are better. Assign a rating score so better values receive a higher rating.
- Assign ratings for non-quantifiable data values so that “better” values have higher ratings.

Ratings are different from rankings. The range of values for ratings must be the same for each criterion and should be greater than the number of COAs (e.g., 1, 2, and 3 as in the above example). This will help reduce distortions in ratings for data values of a criterion that are close together. Experience has shown that an odd-numbered scale (e.g., 1 to 7 or 1 to 9) is preferable. This is because most evaluators want the option of using a mid-point rating, and an even-numbered scale doesn't allow this. **Rate each COA independently without comparing them to each other. For instance, on a scale of 1-9, your three COA's may receive ratings of 7, 8, and 9; but a 1-3 ranking automatically introduces a 300% relative increase between two COAs.**

Combining Financial and Non-Financial Criteria

As noted above, financial and non-financial criteria should not be combined in the same decision matrix. To demonstrate how financial and non-financial criteria should be compared in order to arrive at a decision or recommendation, we'll continue the above example. We'll add cost to the evaluation and display the financial and non-financial criteria in two separate tables as shown below. In each of the tables, the yellow-shaded cell indicates the preferred COA if non-financial or financial data were used as the only selection criterion.

Non-Financial Data		Rating		
Benefit Criteria	Weight	COA 1	COA 2	COA 3
Maintenance downtime	.40	9	7	4
Reduced error rate	.25	5	7	2
Suitability	.20	4	2	6
Improved productivity	.15	8	7	6
Total score		6.85	6	4.2

Financial Data	COA 1	COA 2	COA 3
Life-cycle cost (millions of constant dollars)	24	20	19

A decision can be made by using these two tables. Applying his/her expertise and professional judgment, the decision maker can, for example, compare COA 1 and COA 2 and decide whether the higher benefit to be achieved with COA 1 justifies the \$4 million cost difference.

If a decision maker finds this approach to be unacceptable and wants to evaluate the COAs by combining cost and benefit data in a single measure, a "cost-benefit index" or CBI can be developed as shown in the table below. Using this measure, the preferred COA is the one with the lowest CBI (highlighted in yellow).

Cost-Benefit Index (CBI)	COA 1	COA 2	COA 3
Cost	24	20	19
Benefit Score	6.85	6	4.2
Cost-Benefit Index	3.50	3.33	4.52

Other Quantitative Tools /Methods

There is a variety of other quantitative methods for converting financial data into criteria that provide a definitive basis for ranking alternatives (Possibly used in lieu of a Decision Matrix). Some of the most common financial methods for project selection are described below.

- ***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 (also known as discounting), then summed. 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 includes inflation) should be used to calculate the net present value / present value.

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

<i>Alternatives A, B, and C each require equal investments, but the occurrence of costs varies by year as shown below.</i>			
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
Total (Non-discounted)	\$37,500	\$37,500	\$37,500
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
Total (Discounted)			\$28,425
Alternative B:			
Year	Cost	10% Discount Factor	NPV
1	\$0	-	-
2	\$0	-	-
3	\$0	-	-
4	\$0	-	-
5	\$37,500	0.621	\$23,288
Total (Discounted)			\$23,288
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
Total (Discounted)			\$29,454

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

- **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 6th year.

Summary: Break-even Point

- Break-even point is the year where the savings become positive.
- Savings are determined by calculating the difference between cumulative costs.

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 alternative assumptions on areas such as project operations, relative differences, inflation rate, residual value of equipment, and length of development.
- The effects of changing grade plate assumptions

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. Organizations rarely find themselves with excess funds. Moreover, the Army operates in a constrained resource environment and does not have sufficient resources, financial and otherwise, to satisfy each and every requirement. As a consequence, 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. 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 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. The analysis must support the decision between thirty trucks or ten tanks. It is important that leadership be willing to make such sacrifices if it means implementing a specific COA.

Quick Review

- Comparing the costs and benefits of each alternative is a fundamental part of the CBA methodology.
- 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.
- Sensitivity analysis is a technique for analyzing whether changes in assumptions, quantitative values, or priorities will affect the recommendation.

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 preferably using a word processing application such as Microsoft Word. An example has been posted to the CBA portal located at: <https://acm.army.mil>.

A CBA presented in 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 PowerPoint to facilitate a briefing for the decision maker. A suggested format for a set of briefing slides can be found on the CBA portal. 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.

CBA documentation should describe the functional process performed, define the requirement, and 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.

Note: For CBAs requiring a HQDA review by FM&C (DASA-CE), the CBA preparer must submit all documentation, including all supporting spreadsheets and calculations attached separately must accompany the CBA document and charts.

Present all costs 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.

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: Cost-Benefit Index (CBI) and Break-even Point (Payback Period). Also, identify other factors that may quantitatively or non-quantitatively affect the assessment of costs and benefits for one or more of the alternatives.

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

In addition to a recommendation, an Executive Summary should be prepared and inserted at the front of the CBA. The Executive Summary provides an overview of the CBA to include the outcome of the CBA in terms of a recommended alternative. The Executive Summary should also present the value proposition. In short, they are concise statements presenting tangible results and services of the recommended COA.

Supplementary Content

Before submission of the CBA, consider the following additional elements to 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.

Briefing the Results of the CBA

The purpose of the suggested briefing formats (located on the CBA Portal) is to provide a tool to summarize a CBA, as well as to present the results and recommendations to senior leadership. The formats are 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 approval of a recommended course of action by a 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 format to fit the unique requirements of their CBA and/or the decision maker.

Note: The briefing format is not a substitute for a complete and well documented CBA.

Users may adopt the format exactly as is 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 the briefing adheres to the eight step process and that it flows logically. 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.

Quick Review

- Layout the CBA 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 format is flexible for a wide variety of CBA topics, it should be tailored to the particular needs of the CBA by following the 8-Steps and the briefing outline described in this Appendix. Leaving out steps may weaken the case for the recommended alternative/COA.
- The DECMAT is a recommended slide for most briefings.
- CBA preparers should seek 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.
- Assume the reader of the CBA has no background in the subject matter.
- 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

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/Investment Ratio (BIR)

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-Benefit Index

A ratio that is used to compare alternative COAs. For a given COA, the index equals the total life-cycle cost of the COA in constant dollars, divided by the benefit score for that COA's non-financial benefits.

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 Department of Defense (DoD) corporate body for systems acquisition that provides advice and assistance to the Defense Acquisition Executive (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, analyze, 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 PEOs and PMs 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). 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.
- c. To support Army-sponsored CDDs and CPDs, life-cycle costs in the CBA must be expressed in threshold and objective values and include the base year and dollar-level (thousands (\$K) and millions (\$M)). For all ACAT programs, the default threshold value for

cost is the objective value plus 10% as defined in DA Pamphlet 70-3, Army Acquisition Procedures (28 January 2008).

Major System

a. Systems estimated by the Secretary of Defense to require a total expenditure for RDT&E of more than \$365 million (FY2000 constant dollars) or an eventual total expenditure for procurement of more than \$2.190 billion (FY2000 constant dollars) (DoD Instruction 5000.02, Enclosure 3, Table 1).

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 offsetting 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 quantify 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.

Appendix B

Acronyms

AAE	Army Acquisition Executive
AC	Active Component
ACP	Army Cost Position or Army Campaign Plan
AIS	Automated Information System
AKO	Army Knowledge On-line
AMCOS	Army Military-Civilian Cost System
APB	Acquisition Program Baseline
APGM	Army Programming Guidance Memorandum
AR2B	Army Requirements and Resourcing Board
ARFORGEN	Army Force Generation
AS	Acquisition Strategy
ASARC	Army Systems Acquisition Review Council
BIR	Benefit Investment Ratio
BRP	Budget Requirements and Programs
BY	Base Year
BY	Budget Year
CAC	Common Access Card
CAPE	Cost Assessment and Program Evaluation
CARD	Cost Analysis Requirements Description
CBA	Cost Benefit Analysis
CBI	Cost-Benefit Index

CCIR	Commander’s Critical Information Requirement
CDD	Capability Development Document
CER	Cost Estimating Relationship
CES	Cost Element Structure
CIVPAY	Civilian Pay
CJCSI	Chairman of the Joint Chiefs of Staff Instruction
COA	Course of Action
CPD	Capability Production Document
CPP	Cost and Performance Portal
DAB	Defense Acquisition Board
DAE	Defense Acquisition Executive
DAP	Defense Acquisition Program
DECMAT	Decision Matrix
DOD	Department of Defense
DODI	Department of Defense Instruction
DOTMLPF	Doctrine, Organization, Training, Materiel, Leader and Training, Personnel, and Facilities
EEFI	Essential Element of Friendly Information
EMD	Engineering and Manufacturing Development
FOC	Full operational capability
FOM	Facilities Operation Model
FSM	Facilities Sustainment Model
FMM	Facilities Modernization Model
FORCES	Force and Organization Cost Estimating System
FPS	Facility Planning System
FY	Fiscal Year

GAO	Government Accountability Office
GR&A	Ground rules and Assumptions
HMMWV	High Mobility Multipurpose Wheeled Vehicle
HQ	Headquarters
HQRPLANS	Headquarter Real Property Planning and Analysis System
ICE	Independent Cost Estimate
INSTRPLANS	Installation Real Property Planning and Analysis System
IOC	Initial Operational Capability
IPB	Intelligence Preparation of the Battlefield
JCIDS	Joint Capabilities Integration and Development System
JIAT	Joint Integrated Analysis Tool
LCC	Life-cycle Cost
LCCE	Life-cycle Cost Estimate
LIN	Line Item Number
MDEP	Management Decision Package
MDMP	Military Decision Making Process
MILCON	Military Construction
MOS	Military Occupational Skill
MP	Military Personnel
MSC	Major Subordinate Commands
NPV	Net Present Value
O&M	Operations and Maintenance
O&S	Operations and Support

OASA(FM&C)	Office of the Assistant Secretary of the Army (Financial Management & Comptroller)
OMB	Office of Management and Budget
OPORD	Operation Order
OPLANS	Operation Plans
OPTEMPO	Operating Tempo
OSMIS	Operating and Support Management Information System
P&E	Personnel and Equipment
PEO	Program Executive Office
PME	Prime Mission Equipment
PMO	Program Management Office
POE	Program Office Estimate
POM	Program Objective Memorandum
POV	Privately Owned Vehicle
PPBE	Planning, Programming, Budget and Execution
PV	Present Value
RDT&E	Research, Development, Test and Evaluation
RGNRPLANS	Region Real Property Planning and Analysis System
RPLANS	Real Property Planning and Analysis System
SDE	System Development Effort
SEER-SEM	Software Estimate, Planning and Project Control
SEPM	Systems Engineering and Program Management
SLIM	Software Life-cycle Management
TDA	Table of Distribution and Allowances
TOE	Table of Organization and Equipment

TRADOC	Training and Doctrine Command
VOS	Voice of the Stakeholder
WBS	Work Breakdown Structure

Appendix C

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.

- a. **Engineering Method.** The engineering method can be broadly defined as an examination of separate segments of work at a high level of detail and a synthesis of the many detailed estimates into a total. The engineering method builds an estimate from the "bottom up" by analyzing the individual elements of the work breakdown structure (WBS) for the direct costs of accomplishing the work then adding appropriate amounts for indirect costs (for example, plant overhead, company overhead, etc.). 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). 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. One advantage of the engineering method is that engineering cost estimates can be quite accurate since they are usually exhaustive in covering the work to be performed by virtue of using the WBS. These estimates also make use of insight into the specific resources and processes used in performing the work. One disadvantage of the engineering method is that the detailed knowledge required for an engineering analysis is not always available, thus making this approach the most difficult to apply.

- b. Parametric Method.** The parametric method uses regression analysis of a database of several similar systems to develop a mathematical equation describing a line or curve that fits as closely as possible to the data. The resulting equation, known as a cost estimating relationship (CER), estimates cost based on the value(s) of one or more system performance or design parameters (for example, speed, weight, number of parts, etc.). 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. Key advantages of the parametric method are its objectivity and the fact that CERs can easily be used to evaluate the cost effects of changes in design, performance, and program characteristics. The major disadvantages of the parametric method are the requirement for a robust set of data on similar programs and the inability to extrapolate estimates beyond the range of available data. The lack of a significant number of data points can limit or preclude the use of parametric cost estimating. One rule of thumb for a valid statistical analysis calls for at least four data points containing the latest available data reflecting technology similar to that of the system of interest. A CER based on the latest quality data may still be unsuitable for use in a particular system's cost estimate if the value of the new system's parameters falls outside the database range. 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.
- c. Analogy Method.** The analogy method is based on direct comparison with historical information of similar existing activities, systems, or components. The cost of a new item is estimated by starting with the cost of one or more similar existing items, then adjusting this cost to take into account the differences between the existing item and the new item. After obtaining a technical evaluation of the differences between the systems (for example, increased speed and stealth characteristics for the new aircraft) from engineers or other experts, we would assess the cost impact of these technical differences as well as any other factors that may have changed since the existing model was designed and produced (for example, increased use of computer aided design and manufacturing). The main advantage of the analogy method is that it tends to be a relatively fast and inexpensive way of estimating program costs and can be done at a high level of the WBS with relatively little technical detail about the new system. 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 well the "adjustment technology" so that there is no doubt about the methodology.

- d. Expert Opinion Method.** The expert opinion method 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 qualifications 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 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/offices/office.aspx?officecode=1400> 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://asafm.army.mil/offices/linksdocuments.aspx?OfficeCode=1400> and <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 <https://www.osmisweb2.army.mil/AMCOS/login.aspx>.

The Army Cost Management (ACM) Portal

The Army Cost Management (ACM) Portal website:

<https://acm.army.mil> 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 Support (BOS) 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 BRM Model. <http://www.acsim.army.mil/rd/why.html>

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.

<https://www.osmisweb.army.mil/forces/login.aspx> 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. The URL is for the commercial site of the company that manages these tools: <http://www.rubiconplanning.com/rplans-systems.html>

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: The URL for the JIAT website is: <https://www.awps.army.mil/>

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 <https://www.osmisweb.army.mil/forces/login.aspx>.

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.pricystems.com/products/price_trueplanning.asp 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

1. 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.

The URL is for the commercial site of the company that manages these tools:

<http://www.rubiconplanning.com/rplans-systems.html>

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. The URL is for the commercial site of the company that manages these tools: <http://www.rubiconplanning.com/rplans-systems.html>

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). 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

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
- DoD Financial Management Regulation, Volume 4, Chapter 19, Managerial Cost Accounting”.

U.S. Army References

- AR 11-18, The Cost and Economic Analysis Program, 31 January 1995
- AR 70-1 Army Acquisition Policy, 22 July 2011
- AR 700-127 Integrated Logistics Support, 26 March 2012
- 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://acm.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, 111th Congress, May 2009
- ❑ CJCSI 3170.011H, Joint Capabilities Integration and Development System, 10 January 2012, 1 March 2009
- ❑ FM 5-19, Composite Risk Management, HQDA, August 2006
- ❑ FM 5-0, The Operations Process, HQDA, March 2010
- ❑ Statement#4, Managerial Cost Accounting Concepts and Standards for the Federal Government, July 31 1995