Department of the Army

Economic Analysis Manual

U.S. Army Cost and Economic Analysis Center
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Chapter 1
Introduction

1-1. Purpose

The purpose of this manual is to provide guidance to analysts who prepare or review economic analyses (EA) in support of the decision making process. Increasing the quality of EA's should increase the likelihood of project approval. AR 11-18 establishes the basis for "The U.S. Army Cost and Economic Analysis Program." This manual provides a basic framework for implementing the policies of EA concepts, methods, and procedures.

1-2 Scope

All Department of the Army proponents should use this manual when preparing an EA.

1-3. References

Required and related publications are listed in Appendix A.

1-4. Explanation of abbreviations and terms

Abbreviations and special terms used in this manual are explained in the glossary.

1-5 Overview of manual

This manual provides detailed guidance for preparing an EA. It addresses EA terminology, the EA process, and overall policy.

a. Chapter 2 provides a basic definition of EA and the EA process. Each step in the process is explained in detail.

b. Chapter 3 discusses cost estimating methods, data collection and analysis, and estimating considerations.

c. Chapter 4 defines the types of benefits, and shows methods of identifying, quantifying, and evaluating benefits.

d. Chapter 5 identifies methods for comparing alternatives in an EA and developing economic indicators for a system or project.

e. Chapter 6 describes techniques and considerations for the handling of sensitivity, risk and uncertainty.

f. Chapter 7 discusses the proper methods of documenting an EA and provides a checklist for documentation.

g. Chapter 8 provides special guidance on preparation and approval of EAs for Major Command, Control, Communications and Computer/Information Technology (C4/IT) Systems.

h. Appendices provide additional details on special topics, including the required cost cell structure and cost element definitions for C4/IT System EA's, examples of EA quantitative methods, an EA example which illustrates common EA techniques and documentation methods, and a listing of economic analysis-related web sites.

Chapter 2
The Economic Analysis Process

2-1. EA process overview

a. The EA process is a systematic approach to identify, analyze, and compare costs and benefits of alternative courses of action that achieve a given set of objectives. This approach determines the most efficient and effective use of resources. The broad systematic approach called EA applies to new programs as well as to the analysis of ongoing programs. An EA is scientific and deliberate, leading to reasonable and valid recommendations for use by decision makers.

b. EAs address the basic problem of economic choice and can be applied to all decision processes dealing with at least two possible ways of meeting a requirement. An EA systematically identifies the costs and benefits of each suitable future course of action. An EA specifies the objectives and assumptions, addresses appropriate alternative courses of action, includes cost of the alternatives, and describes benefits and/or effectiveness of each alternative.

c. An EA is a rigorous and systematic analysis leading to better allocation of resources through improved management visibility. The EA process in this manual is a general approach, applicable to very simple as well as very complex problems. All organizations must consider EAs necessary for all resource allocation decisions. EAs can be applied to very small, as well as very large problems.

d. EAs facilitate the decision process by providing a strong analytical framework for evaluating alternatives, identifying costs and issues, highlighting implications of individual alternatives, identifying variables that drive results, assessing risks, uncertainties, and sensitivities of assumptions and costs, and suggesting recommendations. These elements comprise the EA process.

2-2. When economic analyses are required

a. An EA is required for all new or ongoing programs or activities forwarded to higher headquarters for approval when there is a choice or trade-off between two or more alternatives.

b. Ongoing programs must be assessed periodically for their cost-effectiveness. These assessments entail a comparison of actual performance with the approved program/project. In order to do this, an update to the program's economic analysis is often required. The update must reflect the current status of the program, and consider actual costs and benefits experienced to date. Actual data used in program evaluation will also form a sound basis for updated estimates of future costs and benefits.

c. Exceptions to the requirement for preparation of an EA are as follows:

(1) When Department of Defense (DoD) instructions or directives waive the requirement (e.g., equipment age or condition replacement criteria).

(2) When the requirement is an environmental, hazardous waste reduction, or Federal, state, or local regulatory agency mandate, including directed action by higher DoD or Army authority, which precludes choice or trade-off among alternatives.

d. In all cases, the efforts expended on an EA must be commensurate with the benefits to be gained from performing the EA. While there are no exemptions based on dollars alone, common sense must be used to determine the appropriate level of effort.

2-3. Components of an economic analysis

a. An EA is a systematic evaluation of the worth of alternative solutions to a specific mission requirement in terms of comparative costs and benefits. Figure 2-1 contains a pictorial display of the EA process.

b. As a minimum, each EA must contain the following components:

(1) Clear identification of the mission-related objective(s). This should be consistent with the existing Mission Need Statement (MNS), the Operational Requirements Document (ORD), or other approved requirements source, as applicable.

(2) Identification of assumptions with underlying rationale explained in the analysis.

(3) Identification and full explanation of constraints, assumed or imposed.

(4) Identification of the status quo and all feasible alternatives. If a candidate alternative is eliminated, specific reasons for dropping that alternative must be documented in the analysis.

(5) For each alternative, an estimate of all anticipated costs, both direct and indirect, over the economic life of the project. The methodologies of the cost estimates, and their sources, must be clearly identified in the analysis.

(6) Identification of mission-related benefits for all feasible alternatives. Benefits should be identified and analyzed in sufficient detail to indicate their contribution to mission accomplishment. Benefits should be quantified whenever possible. Nonquantifiable benefits, such as health or safety, should also be identified and explained in the analysis.

(7) Sensitivity, risk, and/or uncertainty analysis for those costs, cost factors, assumptions, and constraints that could affect a course of action.

(8) Results and recommendations that are fully supported.

2-4. Economic analysis limitations

Many external factors influence making economic decisions. They include such matters as safety, health, morale, pollution control, political constraints, and national priorities. Whenever possible, these factors should be considered either as quantifiable or non-quantifiable. Every factor has a value and it is up to the analyst to address as many of those influencing factors as possible. If properly prepared, the EA will provide the best answer as to whether or not a program is beneficial, or whether a program or project should be approved or disapproved. However, an EA will not:

a. Produce results that are more valid than the data used in the analysis.

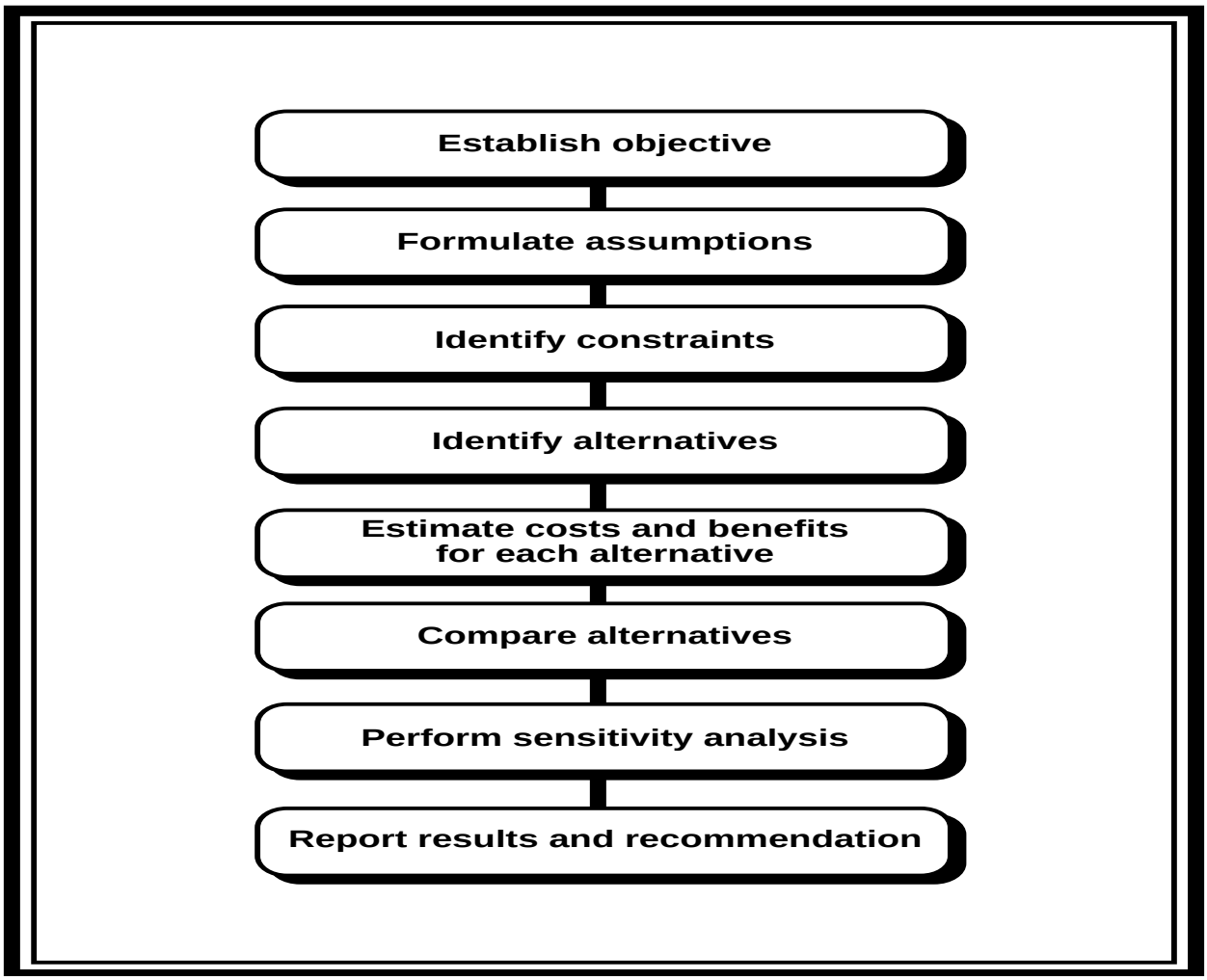


Figure 2-1. The Economic Analysis Process

b. Make final decisions.

c. Be applied with cookbook precision; instead it should be tailored to fit the problem.

d. Provide relevant solutions to irrelevant questions and problems.

e. Predict political and non-economic impacts.

f. Substitute for sound judgment, management, or control.

2-5. EA preparation

Prior to initiating an EA, an Economic Analysis Development Plan (EADP) should be developed. The EADP should include, at a minimum, the mission, background, purpose, constraints, assumptions, cost element structure, cost and benefit estimating methodology, system description, configuration, schedules, and issues. For a project of high dollar value or high visibility, the EADP should be relatively detailed and

should be provided to the decision-maker and other participants in the review/validation process before the analysis is performed.

The major steps in EA preparation are as follows:

a. **Establish the objectives for the project**. The single most important step in an analysis is the definition of the objective. Objectives should be measurable, realistic, achievable, and result-oriented. The more precisely the objective can be defined, the greater the likelihood that the analysis will meet the needs of the decision maker. The objective statement sets the tone for the whole analysis. The following are examples of objectives that may be appropriate:

(1) Reduce number of man-hours of effort required for a mission by a minimum of X%.

(2) Increase output produced by the organization by no less than X units per month.

(3) Improve product quality against a given standard of X or less errors per page.

(4) Provide a new, previously unavailable product or service at a reasonable cost.

b. **Formulate assumptions**

(1) Assumptions define and reasonably limit the scope of a study. Because an assumption is a hypothesis related to unknowns as opposed to a "fact" and relates to a future occurrence, it involves a degree of uncertainty. For this reason, regardless of the impact on the analysis, identify all pertinent assumptions.

(2) Do not confuse assumptions with facts or attempt to ease the work load by using assumptions that, with research, could be presented as factual data. For example, 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.” However, in this particular instance, there may have been no reason why this assumption could not be verified with research and presented as a fact.

c. **Identify constraints**

(1) All managers are faced with certain constraints within which they operate. Constraining organizational policies or procedures, funding considerations, physical limitations, and all time-related considerations need to be addressed in the EA. External constraints or barriers are normally beyond the control of the analyst and provide limitations within which analyses take place.

(2) Unreasonable, unrealistic, or undue constraints limit the number of alternatives considered, thus seriously slanting the analysis and forcing omission of feasible solutions. On the other hand, minimizing the attention given to constraints can lead to unrealistic recommendations.

d. **Identify feasible alternatives**

(1) After defining the objective and identifying the assumptions and constraints, develop all feasible alternative methods to accomplish the objective. Optimal allocation of resources depends largely on the considerations of suitable alternatives. The final decision is no better than the alternatives available to the decision maker. Rarely is there only one way to achieve a given objective.

(2) The analyst should guard against any bias for the continuation of a previous, traditional method of solving a particular problem. Likewise, simple conformity with the alternatives presented in a previous analysis should also be avoided.

(3) Do not regard as final the list of alternatives compiled in the beginning of the study. As the analysis proceeds, reduce the original list of alternatives by eliminating those that are not feasible and add those that are feasible within the constraints. In all cases, clearly document all alternatives that have been eliminated and include the reason for their deletion.

(4) Alternatives need not be functionally identical as long as they fulfill the objective. For example, an EA that determines the best solution to an installation's waste disposal problem should consider not only the installation of an incinerator, the possibility of a landfill, or a commercial contract, but also the possibility of cooperative disposal actions with other government activities located in the same general area. Another example of a feasible alternative is to consider leasing versus buying.

e. **Estimate costs for each feasible alternative**

(1) Cost considerations must enter every decision relating to the allocation of resources. The appropriate cost estimating method to be used in a particular situation depends upon the program being evaluated, and what data is available. (See section 3-2, Cost estimating methods.)

(2) The acceptance of the EA depends on the credibility of the cost estimates. Therefore, the analyst must document data sources, provide the derivation of all costs, and maintain a clear audit trail.

(3) The following guidelines must be observed in developing cost estimates in support of an EA.

(a) Support the comparative analysis process and/or benefit determination by fully documenting the status quo (existing system), and providing cost estimates for it.

(b) Include all anticipated costs directly or indirectly associated with each feasible alternative over the life of the project. Show all resources required to achieve the stated objective. Estimate all future costs from the start of the earliest alternative (other than the status quo) through implementation, operation, and disposal for a program or project.

(c) Ensure that cost estimates are consistent with the assumptions, constraints, and objectives of the project.

f. **Estimate benefits for each feasible alternative**

(1) Benefits are the results expected from alternatives. Benefits can be shown as measures of utility, effectiveness, performance or output. Benefit analysis must identify and analyze mission-related benefits for each feasible alternative.

(2) The principal task in formulating the benefit portion of the analysis is to identify the degree that objectives are met, and how this will be measured. There is not, however, a unique collection of measures of effectiveness applicable to every analysis.

(3) If the benefits of all alternatives accrue equally, an in-depth analysis of benefits is not required since the alternatives can be ranked solely on the basis of cost differences. If the benefits do not accrue equally, in-depth analysis is required since the benefits will be a factor in the ranking of alternatives.

(4) Chapter 4 provides additional information on identifying, estimating, and evaluating benefits.

g. **Compare costs and benefits of each alternative and rank the alternatives**

(1) The essence of the EA process is in comparing the costs and benefits of two or more alternatives. The period of comparison extends through the time during which an asset is productive, or a service is rendered. The alternative with the longest economic life may determine the end of the comparison period. However, the decision maker or analyst may shorten this period consistent with the objectives and assumptions of the analysis.

(2) When comparing a future system alternative to an existing system, the analysis must show the costs of extending the life of the existing system to meet that of the alternative. Also, the analysis must include the continued use of the existing system until replaced by the alternative as part of the cost of the alternative (phase out period).

(3) Chapter 5 contains more detail about comparison of alternatives.

h. **Perform sensitivity, risk and uncertainty analyses**

(1) It is not sufficient to present the decision maker with a set of alternatives whose costs and benefits are based on most likely factors and assumptions. The decision maker needs to be informed about how well the rankings hold up under reasonable changes to factors and assumptions. Describe how sensitive the costs and benefits are to changes, or how much risk (for example, 90 percent probability of success) exists in the data supporting the results.

(2) Chapter 6 describes some techniques for evaluating sensitivity, risk and uncertainty.

i. **Prepare conclusions and recommendations**

(1) The final step of the EA process summarizes the findings of the analysis and makes conclusive statements about the comparisons of alternatives.

(2) The conclusions should demonstrate the type of cost/benefit relationships that exist between alternatives. Also include how the alternatives were ranked using these criteria.

(3) Following a clear statement of the conclusions, the EA document should contain a firm recommendation regarding the preferred alternative.

(4) Figure 2-2 lists the key elements of an EA which should appear in the documentation.

2-6. Validation

a. All EAs must be validated prior to being presented to a decision-maker. A cost analysis activity within the major Army command (MACOM) of the preparing organization should prepare the validation.

EAs that are required by Headquarters, Department of Army (HQDA) must be MACOM validated prior to submission. When the preparer's organization is in the PEO/PM office, the estimate must be validated by the cost organization of the supporting command.

ECONOMIC ANALYSIS KEY ELEMENTS

Objectives

Assumptions
- Time considerations
- Project life
- Economic life
- Technological life

Constraints

Alternatives
- Status quo
- Other feasible alternatives

Data and Sources
- Benefits data
- Cost estimating relationships
- Cost estimating data

Costs
- Recurring
- Constant dollars
-Nonrecurring
-Current dollars

Benefits
- Quantifiable
- Nonquantifiable

Alternatives comparison:

Sensitivity, risk/uncertainty analysis
- Sensitivity analysis
- Risk/uncertainty

Economic indicators
- Savings/investment ratio
- Benefit/investment ratio
- Benefit/cost ratio
- Break-even point

Conclusions

Recommendations

Figure 2-2. Economic Analysis Key Elements

b. MACOMS and other organizations should establish validation procedures and assign appropriate responsibilities for validation of estimates prepared for proponents within the MACOM, or prepared by an element of the MACOM as matrix support.

c. In all cases, validators should insure that, at a minimum:

(1) Assumptions, constraints, and methodology are logical, reasonable, complete, and well documented.

(2) Documentation is sufficient to support the cost factors and unit prices used.

(3) Estimates of costs and benefits are realistic and consistent across alternatives.

(4) Proper inflation/discounting is applied.

(5) Alternatives are clearly described and appropriately ranked.

(6) Sensitivity, risk and uncertainty are properly addressed.

(7) Conclusions and recommendations are reasonably supported by the analysis.

d. EAs of high dollar value or high visibility (e.g., for projects which require approval by DOD, HQDA, or MACOM Commanders) should have a thorough validation consisting of a comprehensive review of all costs and benefits, with a formally documented report at the conclusion of the review. Lower dollar value EAs will require less comprehensive review, but key cost elements or cost drivers (those factors which significantly affect total cost) should always be reviewed in depth.

e. The checklist found in Appendix M of this document can serve as a general guide to assist in the review and validation process, and to avoid common pitfalls that keep EA's from being validated.

2-7. Relationship to Planning, Programming, Budgeting and Execution System (PPBES)

Considerable effort is usually associated with a good EA. A good EA should go beyond the decision-making process and become an integral part of developing requirements in the PPBES process. The preferred alternative should become the basis for developing inputs for the PPBES process. The EA must be updated as assumptions or any conditions change, to insure that PPBES estimates will reflect the current program. Additional detail on PPBES is provided at Appendix C.

2-8. Special categories of economic analyses

a. **Major Command, Control, Communications and Computer/Information Technology (C4/IT) Systems.** EAs for C4/IT systems being reviewed by the OSD IT OIPT and the Army IT OIPT require unique formats and cost cell structures. See Chapter 8 for more detail on the process; see Appendix D for the required cost element structure.

b. **Lease-purchase** Lease-purchase analysis is a type of EA which determines if it would cost less to lease or buy a given asset. See Appendix E for more information.

c. **Functional Economic Analysis (FEA)** (Business Case Analysis) is a type of EA which documents the review of an entire functional process, such as supply, maintenance, etc. It requires a risk assessment of each alternative solution, requesting a high and low estimate for each cost element and subsequent probability distribution of expected costs. DoD has issued a Functional Economic Analysis Guidebook which provides practical examples and illustrations consistent with DoD policy. See Appendix F for more information.

d. **Capital Budget Investment**. These Defense Working Capital Fund (DWCF) projects require either an EA or a Cost Comparison depending on dollar value of investment in support of requests for funding. The DoD Comptroller has approved policy, procedures, and formats for specific use in EA justification of Capital Budget projects. See Appendix G for this material.

e. **Analysis of Alternatives (AoA)**. An analysis of alternatives (AOA) is part of the acquisition process and is prepared at appropriate Milestone Decision Reviews by an independent agency (e.g., TRADOC) of the service component. Alternatives analysis shall broadly examine multiple elements of project or program alternatives including technical risk and maturity, and costs. Normally, the analysis is initially prepared to support a program initiation decision. The Milestone Decision Authority (MDA) may direct updates to the analysis for subsequent decision points, if conditions warrant. For example, an AoA may be useful in examining cost performance trades at the system demonstration interim progress review. AoAs are also prepared within the Army to determine appropriate mixes of weapon systems and allocate funding.

AoAs are intended to illuminate the risk, uncertainty, and the relative advantages and disadvantages of the alternatives being considered; show the sensitivity of each alternative to possible changes in key assumptions; and aid decision makers in judging whether or not any of the proposed alternatives offer sufficient military and/or economic benefit to be worth the cost. For most systems, the analysis shall consider total lifecycle costs and baseline against the system(s) that the acquisition program will replace. The analysis shall explicitly consider continued operations and support costs of the baseline. In some cases, there will not be an existing system to use as the baseline.

The role of CEAC is to validate the overall cost analytical effort, and ensure that the AoA cost analysis is consistent with the ACP, as well as the costs contained in the acquisition program baseline. For major program decisions the Cost IPT may review the AoA costs and assumptions in conjunction with the development of the ACP. CEAC shall review and validate costs for AoAs in support of funding allocation exercises performed for Headquarters DA. Ideally, CEAC should be involved early on in the AoA process to review assumptions and costing methodologies. The MACOM's cost analysis agency should review AoAs not passing through the Cost IPT before submittal to CEAC.

The AoA review is not limited to comparing the costs to an ACP. These reviews will also focus on the following related issues: Do the costed systems match the technical requirements in the CARD?; Does the cost estimate for a particular system reflect the same effectiveness used in the AoA for that system?; Are all viable alternatives considered or addressed?; Are all relevant personnel costs factored into the analysis?; Were potential cost avoidances addressed? (e.g., A proposed system may require fewer maintainers or operators thus freeing them up for other duties.)

f. **Military Construction (MilCON)**. The procedures and format required for MilCON EA’s are detailed in DA Pamphlet 415-3. The U.S. Army Corps of Engineers is the proponent for this program.

g. **Environmental Quality Economic Analyses (EQEA).** EQEAs support decision making associated with environmental quality costing alternatives. Environmental quality costs are those costs that are specifically related to activities within the Army environmental program including pollution prevention, compliance, restoration, and conservation. EQEAs can be conducted for both weapon system and non-weapon system environmental quality activities. See Appendix L for more information.

h. **Total Ownership Cost Reduction (TOCR) Initiatives**. The Army process to effect measurable improvements in our materiel solutions/systems, business processes, and infrastructure to reduce cycle time, increase support systems efficiencies, reduce ownership costs, and improve/maintain readiness.

i. **Supportability Analysis.** Required by the Army Acquisition Executive as part of the milestone decision package for MDAP's, these analyses focus on comparing the organic support of a weapon system to contractor support of the system.

j. **Competitive Sourcing Studies (A-76 Studies)**. Competitive sourcing is a process to determine the most cost effective method of obtaining services that are available in the commercial market. Agency missions may be accomplished through commercial facilities and resources, Government facilities and resources or mixes thereof, depending upon the product, service, type of mission and the equipment required. The prevailing regulations for the Competitive Sourcing studies are the OMB Circular No. 76 Supplemental Handbook, Performance of Commercial Activities, dated March 1996, AR 5-20, Commercial Activities Program, dated Oct 1, 1997 and DA PAM 5-20, Commercial Activities Program dated Jul 31, 1998. Further information and guidance may also be found at http://www.hqda.army.mil/acsimweb/ca/regs/htm.

2-9. Economic analysis training

a. The Defense Acquisition University (DAU) offers a 3-day course in Economic Analysis (BCF 207). Its purpose is to educate DoD personnel in the management of resources by proper analysis of economic decisions. Topics include multi-attribute decision analysis, cost analysis, present value analysis, and sensitivity analysis. Participants apply their skills in practical exercises and a case study. It is taught at the U.S. Army Logistics Management College (USALMC). For additional information, contact Commandant, USALMC, ATTN: ATSZ-MSR, Fort Lee, VA, 23801-6049, phone (804) 765-4733 or DSN 539-4733. For other possible courses involving EA visit the Defense Acquisition University (DAU) web site at http://www.sarda.army.mil/rdaisa/atrrs/aaedau.htm.

b. EA courses are also provided by the U.S. Army Corps of Engineers' PROSPECT training program. For additional information, contact HQUSACE (CECW-EI), Kingman Building, 7701 Telegraph Road, Alexandria, VA 22315, or call (703) 428-6073, DSN 328-6073.

2-10. EA guidance and assistance

a. The USACEAC, a Field Operating Agency of the Assistant Secretary of the Army for Financial Management and Comptroller (ASA(FM&C)), is the proponent for the Army EA program. USACEAC will provide guidance and assistance as requested. Questions may be addressed to Director, USACEAC, ATTN: SFFM-CA-CC, 1421 Jefferson Davis Hwy, Arlington, VA 22202-3259, phone (703) 601-4185 or DSN 329-4185.

b. USALMC provides consultation for EA questions and concerns. Additionally, the U.S. Army Corps of Engineers is the proponent for guidance specific to EAs for civil works projects and military construction.

c. For EA's required for Joint DOD programs, where the Army isn't the lead service, it may be helpful to have information on the other military services cost centers' EA guidance. The web site for Air Force guidance is http://www.saffm.hq.af.mil/, and the Navy's is http://www.ncca.navy.mil/.

Chapter 3
Cost Estimating

3-1. Cost estimating overview

a. Cost estimating is a means to translate resource requirements associated with programs, projects, and processes into estimated dollars. These dollars are estimates of what must be spent on the program, project, or process over its life cycle. The cost estimates are also used to translate the resource requirements into budget requirements. The EA cost estimating process is illustrated in figure 3-1.

b. Each EA must contain an estimate of all anticipated costs directly or indirectly associated with each alternative over the economic life of a project. All resources (personnel and dollars) required to achieve the stated objective must be identified.

c. When performing an EA, estimate all future costs from inception through implementation, operation, and disposal for the program or project. (Not all cost elements necessarily deserve the same attention. If a cost associated with a certain element is very small and not significant to the program, do not spend an inappropriate amount of time estimating this element. Devote the appropriate time to the more significant cost-driving elements.) The cost of an alternative includes the cost of operating the status quo programs until the chosen alternative is fully implemented, and the cost of inherited assets.

3-2. Cost estimating methods

The engineering approach, the parametric approach, the analogy approach, and the expert opinion approach are four cost estimating methods. The use of a specific approach varies with the amount and reliability of data available. Each approach may have limitations for a particular application.

a. Engineering approach. The engineering (bottom-up) approach can be broadly defined as an examination of separate segments of work at a low level of detail and a synthesis of the many detailed estimates into a total. Estimating by the engineering method requires the analyst to have an extensive knowledge of the system characteristics (the system, the production processes, and the production organization). Break the system, activity, or item of hardware into its lower level components and make estimates of each component. An analyst may use different estimating methods in estimating the costs of some components. Combine the costs of the components and the costs of integrating the components to get the total system cost. The detailed knowledge required for an engineering analysis is not always available, thus making this approach the most difficult to apply.

b. Parametric approach. In parametric cost estimating, the cost is based upon physical attributes or performance characteristics and their relationships to highly aggregated component costs. For example, the total estimated cost of an item will depend on such things as size, weight, speed, and so on. The lack of a significant number of data points can limit or preclude the use of parametric cost estimating. In the formal sense, the term "parameter" is a cost-related explanatory attribute, which may assume various values during a particular calculation. A parameter is a definable characteristic of one of the parts that can be added to give an expression of the value of the whole system, device, or item. The results of a parametric estimate depend upon the ability of the analyst to establish valid relationships between the attributes or elements that make up the alternative and its cost. Therefore, properly choose and describe the cost estimating

relationship (CER). When documenting results that have used a CER, present the statistical characteristics of the CER, the source database, and all assumptions surrounding the CER development.

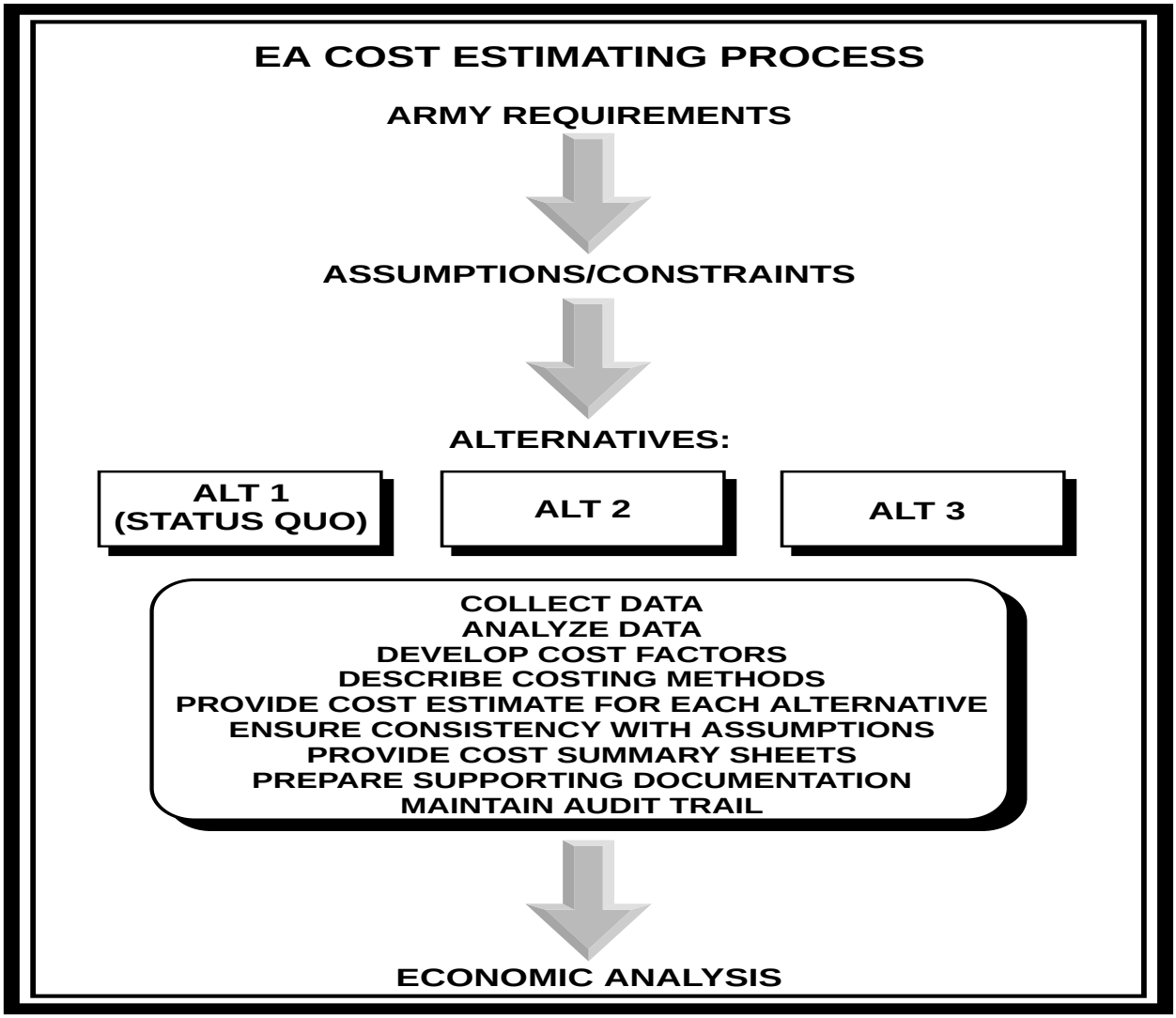


Figure 3-1. Economic Analysis Cost-Estimating Process

c. Analogy approach. The analogy approach is based on direct comparison with historical information of similar existing activities, systems, or components. The major disadvantage of this method is that it is a judgment process, requires considerable experience and expertise, and assumes that analogous systems are available. Use this method when the comparability of the analogous system and the product/process is well documented. The documentation should give a convincing argument that the product/process is similar enough to the source to make the methodology valid. A variation to this methodology is to make an adjustment to the source data to account for some variation in the estimate of the product/process. For example, if one used commercial vehicle data to estimate some aspect of a tactical vehicle, an adjustment could be made to the source data. Document the "adjustment technology" well so that there is no doubt about the methodology.

d. Expert opinion approach. The expert opinion approach uses the subjective 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. Don't use expert opinion when time permits the preparation of a more thorough analysis. Don't use expert opinion as a convenient substitute for more scientific methods when the preparation of more scientific methods are possible. If used, the documentation should contain the source(s) of the opinion and a list of the attributes of the source(s). One of the expert opinion methods used is the Delphi questionnaire. This method involves the query of expert opinion from a group. Seek information and supporting rationale from each expert independently. Summarize the results and send a report to each expert. Gather a second opinion after each individual reviews the report, then summarize the results. Continue this iteration process for several cycles until there is a consensus, or near-consensus.

3-3. Collecting and analyzing data

a. The analyst should identify, collect, classify, and analyze data before applying cost estimating within the analysis process. Below is a list of potential data sources. This list is not all-inclusive. Regardless of the nature of the data used, identify the source and date of the data in the documentation of any analysis.

(1) Financial reports and data.
(2) Budget and Program Objective Memorandum (POM) submission.
(3) Management Decision Package (MDEP).
(4) Contract performance data.
(5) Audit reports.
(6) Manpower utilization records/reports.
(7) Statistical reports.
(8) Surveys.
(9) Management studies.
(10) Modernization plans.
(11) Industry guides and standards.
(12) Professional journals and publications.
(13) State and local Government publications.
(14) Army regulations and publications.
(15) DoD instructions, directives, and publications.
(16) Technical manuals.
(17) Other Federal agencies, including the U.S. Air Force, Navy, Marine Corps, and Coast Guard.
(18) Data Bases of current and historical costs.
(19) Trade Studies
(20) Program Office Estimate (POE)
(21) Cost Analysis Requirements Document (CARD)
(22) Army Enterprise Architecture (AEA) relationships and associated costs
(23) Other sources.

b. 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 provides the analyst with indicators that can form the basis for assumptions, cost factors, and CERs.

c. Cost factors and CERs may be expressed in dollars, physical quantities, ratios, or percentages. Various methods may be used to develop them; whatever method is chosen should be relevant, valid, verifiable, and reasonable.

3-4. Cost estimating considerations

a. Economic life. A very important consideration in all economic analyses is the "economic life" of each alternative, which will ultimately govern the time period to be covered by the EA.

(1) The economic life of a project is the period of time over which the benefits to be gained from a project may reasonably be expected to accrue. Benefits from the project are limited ultimately by its physical life. This is the period a facility or piece of equipment can be used before it is exhausted in a physical sense, that is, unable to perform its stated mission. The economic life of a project is further limited by its technological life; that is, the period before improved technology makes the building, machine, etc. obsolete. Military or political considerations that may suggest benefit accrual for a much shorter period may further limit the economic life of a project. Ways in which economic life can be determined include policy, management judgment, Government or industry standards/experience, or vendor projection.

(2) In general, the economic life will be measured against a stipulated level of threat, or represent the period during which a given mission or function is required or can be supported. The life of a major Information Technology (IT) system, for example, is normally assumed to be 10 years after full fielding. If the economic life of a system is expected to be less than the specified maximum life, use the shorter life for the purpose of the analysis.

b. Status quo

(1) The status quo is the baseline program or systems against which the cost of all feasible alternatives are compared. The status quo alternative is the current existing operational capability as of the program start date. All expenditures required to maintain the existing capability will be included in the status quo estimates. The cost estimates for the status quo are an extrapolation of the current level of costs and effectiveness that would accrue without changes.

(2) Identify the status quo alternative and all resources required to meet the mission objective. Some sources of identification are historical, financial and budgetary data/reports, MDEP, 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. To establish the status quo the analyst should 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 or closely parallel those defined by the new mission need objective.

(3) If enhancement of the status quo to meet all or part of the mission objective is an alternative, estimate cost for the enhanced status quo alternative, in addition to the status quo.

(4) The alternative with the lowest nonrecurring investment cost will be used as the basis of comparison with other alternatives when programs/projects are totally new to the Army and no status quo exists. When programs/projects are totally new (new start) to the Army, there are no savings to consider.

(5) An EA that does not include the status quo (with applicable cost estimates) must be fully justified to the organizations reviewing the documentation. Usually, the status quo alternative is used to

compare costs with other alternatives and to determine the quantifiable benefits. Without the status quo costs, it is very difficult to display qualitatively or quantitatively the benefits associated with the new program. Where a status quo exists (even if it is not a feasible alternative), omitting it from the EA will reflect negatively upon the analysis and the credibility of realizing any proposed quantifiable benefits. When there is no status quo, the alternative comparison is done as discussed in paragraph (4) above.

(6) The cost of parallel operations (cost of operating the status quo until the new system or project is fully operational) will be a part of the cost of all other alternatives in the EA. These are Phase-out costs.

c. Common costs. Costs that are estimated to be equal regardless of the alternative selected are considered common costs. Ensure that the costs identified in this category are common and will not impact the results when considering all feasible alternatives. Costs that are common for two or more alternatives may not be common costs for all alternatives in meeting the same program objective. Identify and include common costs for all feasible alternatives in the EA. Fully document the rationale for costs identified as common costs.

d. Inherited assets. Inherited assets may result when systems or organizations phase out and release personnel, equipment, and facilities that are available for use by existing or new systems or organizations. When released resources fill requirements of new or existing systems or organizations, they become inherited assets. The availability of assets to be inherited may make a considerable difference in the cost of a new system. Inherited assets may be important in cost-effectiveness comparisons if one alternative being compared can utilize inherited assets while the other alternative cannot. A system utilizing inherited assets does not have to fund such one-time costs. However, there may be some one-time transitional costs, such as training, transportation, and travel, that would be incurred by the system using the inherited assets. Inherited assets represent an opportunity cost and must be included as a cost in the estimate that "inherits" the asset. The rationale for including this opportunity cost is that, if the asset in question is used in a particular project, it cannot be used in another project competing for its use. Therefore, the other project will have to purchase a new asset. The Government does not pay for the inherited asset (a second time) but the asset has a value; this value must be added as a cost to the project. Note that there is no opportunity cost to add to the project if other projects are without a need for the asset, and resale to other agencies or the public is not feasible. A practical approach to estimating the value of an inherited asset is to determine its value at the time it is "inherited" to the project.

e. Residual value. Residual value is the estimated future value of assets that will be available for alternative uses at a later date when the system will phase out of the force or out of use. The assets will have value because they can fill requirements of future organizations or because they can be sold. Residual value cannot be used to reduce investment costs since they are sunk by the time residual values come into play. Residual value is a benefit that is speculative at best. It does not represent savings but does represent a potential value. The estimation of residual value can be obtained by depreciation tables provided by the Internal Revenue Service for different types of assets, or from guidance in OMB Circular A-76 (equipment) and OMB Circular A-94.

f. Salvage value. Salvage or scrap value is the value of an asset at the end of its physical life. For most types of assets this value is negligible.

g. Inflation Considerations. Inflation is a consistent rise in the costs (prices) of goods and services over time. Consider inflation in cost estimating. Perform initial estimates in constant dollars, then convert to current dollars using inflation indices. Revised inflation indices are normally published in the December time frame to coincide with normal budget activity and annual Selected Acquisition Report (SAR) updates.

Compound and composite indices are provided for each appropriation account. If your organization is not on the distribution list for the annual inflation updates, visit USACEAC's web page for a copy of the current DoD-approved indices. For an inflation primer (current vs. constant dollars, etc.) visit ASA(FM&C's) web site.

(1) Constant dollars. Constant year dollars are the result of having the effects of inflation removed. Constant year dollars are always associated with a base year; for example, fiscal year (FY) 95 constant dollars. An estimate is in constant dollars if costs for all work are adjusted so that they reflect the base year level of prices. When prior or future costs are in constant dollars, the figures given are adjusted to presume that the "buying power" of the dollar was the same and will continue to remain the same as in the base year. The use of constant dollars assists in the evaluation of resource requirements over time because it removes distortions which are attributable only to price level changes. With the removal of inflation, the true cost growth of a system can be more readily determined.

(2) Current dollars. Current year dollars are expressed in the value of the year of in which a cost is expected to occur, and therefore reflect the effects of inflation. The term "current year" does not refer to the year in which the estimate is made or any other single year. It means that the amount is appropriate for the year in which the dollars are expected to be expended. When prior costs are stated in current year dollars, the values are the actual amounts paid out. When future costs are stated in current year dollars, the figures given are the actual amounts which will be obligated including any amount estimated for future price change. When making estimates for the future, assume a base buying power for each dollar (constant dollars) and then apply an inflation factor that converts the estimate into current year dollars. Composite indices should be used for the conversion because these indices take outlay rates into consideration and therefore provide greater accuracy.

h. Discounting and present value. Most cost comparison techniques take into consideration the time value of money, that is, a dollar today is worth some amount less in the future. For comparison purposes, future expenditures, occurring at different points in time, must be adjusted to a common point in time. This adjustment to a common point in time is called discounting or present value analysis. Discount factors can be calculated once an interest rate and period of analysis is determined. These discount factors indicate the present value (today's value) of a dollar expended at the end of each respective year (assuming end-of-year discounting is used). Therefore, discounting converts various cash flows occurring over time to equivalent amounts at a common point in time for purposes of comparison. This accounts for differing interest costs and the time value of money resulting from expenditures over varying time periods. For an illustration of this concept and a comparison between current, constant and discounted dollars, see figure 3-2.

(1) Office of Management and Budget (OMB) Circular A-94 and Department of Defense Instruction (DoDI) 7041.3 require the use of a discount rate based on the Treasury Department cost of borrowing funds. This discount rate should be used in evaluating the measurable costs and/or benefits of programs or projects when they are distributed over time. The prescribed rate will vary dependent on the length of the period of analysis and on whether the costs and benefits are measured in constant or current dollars. A discount rate that has already been adjusted to eliminate the effect of expected inflation should be used to discount costs and benefits expressed in constant dollars. Conversely, a discount rate that reflects expected inflation should be used to discount costs and benefits expressed in current dollars.

(2) Discount rates are prepared annually by the OMB, and reflect the expected cost of borrowing for 3, 5, 7, 10, and 30 years securities. DoD has bracketed the five basic rates, identifying the periods of analysis to which each rate applies. Appendix H shows these periods of analysis, the discount rates for each

period which are current from March 2000 through February 2001, and examples of how the applicable discount factors are calculated.

(3) Annual updates to discount rates are provided to agencies by OMB in the February/March time frame, and are disseminated throughout the Army by USACEAC upon receipt. Updated discount rates can be found on USACEAC's web page.

(4) EA documentation must specify whether end-of-year or mid-year values are used. Mid-year values should be used if it is expected that expenditures will be spread throughout the year. End-of-year values should only be used when all expenditures are expected to take place at, or very near to, the end of the year. If end-of-year is used, include justification in the documentation as to why end-of-year values were used.

(5) The present value (PV) of a stream of expenditures is the sum of discounted dollars over the life of a project. The following data is needed before beginning the PV process:

(a) Base year. The base year of an EA is the year to which all costs are discounted. This is usually the same year that costs begin to accrue for any alternative.

(b) Period of analysis. The period of analysis is normally the time from the start of a project to the end of the mission requirement. In most cases this will coincide with the economic life of a project as described in paragraph 3-4 (a).

(6) Once the base year and period of analysis is determined, the PV is calculated using the following procedure:

(a) Determine in what years the expenditures for the alternative will be made.

(b) Select a discount rate appropriate to the period of analysis and list the discount factor for each year, using either year-end or mid-year discount factors. Specify and document which one is being used.

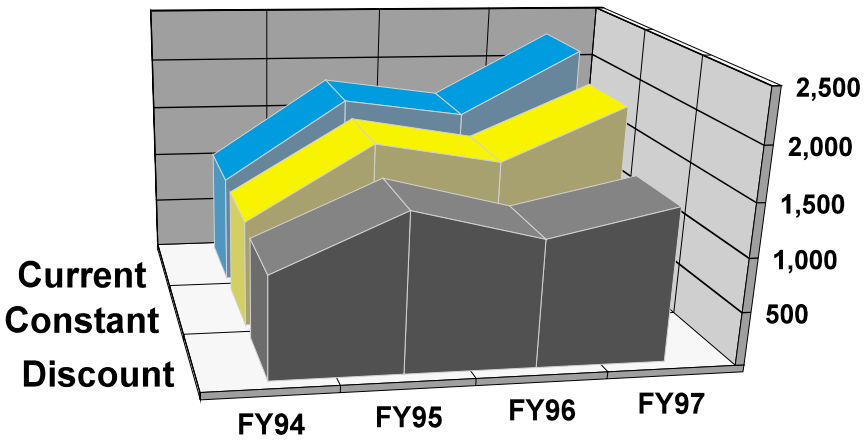
(c) Multiply each yearly cost by its discount factor to get discounted dollars for that year. Use the constant dollar rate if your cost basis is in constant dollars (as will normally be the case); otherwise, use the current dollar rate.

(d) Sum the annual discounted dollars to get a total PV of costs. Perform similar calculations for dollar quantifiable benefits. The difference between the totals of PV benefits and costs will be the net present value of the project. Appendix H contains examples of how discount factors are determined, and shows an example of how the factors apply in determining total PV costs and benefits for a project.

(e) If there is concern that the preferred alternative may change if a different discount rate is used, recalculate the results, varying the discount rate to see at what point (if ever) the preferred alternative changes. This will provide additional insight for the decision makers as they weigh the alternatives.

i. Foreign currency exchange rates. The use of foreign exchange rates is a problem unique to analyses performed on overseas projects where costs are stated in foreign currencies. It is usually difficult to obtain reliable forecasts of out year foreign exchange rates. One approach is to apply the concept of "purchasing

Time Value of Money



					Totals	
Current [1]	1,025	1,800	1,640	2,258	6,713	
Constant	1,000	1,700	1,500	2,000	6,200	
Discount [2]	954	1,474	1,182	1,434	5,044	Present Value

Notes:
1. Generally used for budgeting and payback analysis.
2. Used to develop benefit and savings to investment ratios.

Figure 3-2. Time Value of Money

power parity," which assumes that if local inflation is greater than U.S. inflation, the rise in local prices will be fully offset by local currency devaluation. Under this approach, it is possible to reflect the long-term dollar costs without resorting to a commercial forecast of the exchange rate and local inflation rate. This process is outlined below.

(1) If the foreign currency values are expressed in constant dollars, note the base year. If they are first expressed in current dollars, deflate by using the appropriate foreign compound index. The result of this step is costs expressed in constant dollars for a known base year.

(2) Multiply the result from step (1) above by the dollar/foreign currency exchange rate for the known base year. The result of this step is the constant dollar costs.

(3) With the costs now established, multiply these costs by the U.S. composite inflation values using the base year established at step (1). These will be the out year costs to be included in the estimate.

j. Personnel costs.

(1) When civilian personnel costs are part of the life cycle cost of a system or project, the entire cost of those personnel (i.e. salary and the Government's contribution to fringe benefits such as retirement,

life and health insurance, etc.) will be included in the estimate. (The portion of civilian benefits not required to be budgeted must be included to show the full cost. Appropriate adjustments will be required to determine funding requirements.) If the exact geographical locations of all civilians are known, the actual locality pay rates for the area(s) will be used; if civilians are scattered geographically, an average of locality pay rates may be used. The Army Military Civilian Cost System (AMCOS) maintained by CEAC has detailed information on civilian and military pay which, can be differentiated by locality pay areas. MACOM and installation budget offices are also a good source of locality pay rates as well as appropriate fringe benefit rates for specific organizations.

(2) Military personnel costs applied to a system or project will consist of Military Compensation (which includes Basic Pay, Basic Allowance for Quarters, Variable Housing Allowance, and Basic Allowance for Subsistence), Retirement Pay Accrual, Selective Reenlistment Bonus, Other Benefits, and Special Pays. These items will total to the Composite Standard Rate, which is published periodically.

(3) If only a portion of a person's time is chargeable to the system or project, then an appropriate percentage factor will be applied instead of costing a full work year.

(4) USACEAC can provide additional assistance in determining what types of personnel costs to include or exclude.

k. Force Costs. The Army force cost mission is to estimate the cost of the different configurations of people and equipment which make up force units. The Force and Organization Cost Estimating System (FORCES) is a suite of models and a database, which provides realistic, current, and supportable force cost estimates of Active and Reserve units. The model is sensitive to Operating Tempo (OPTEMPO), level of organization, geographic location, year and component. The model produces cost estimates for planning a Contingency Force or Training Operation through the predeployment, deployment, operations and sustainment, redeployment, reconstitution and demobilization phases. The model also estimates the costs and savings from reductions in military endstrength. The model can be accessed via the following web site: http://www.ceac.army.mil/.

l. Operating and Support Costs. The Operating and Support Management Information System (OSMIS) is the core of the Army Visibility and Management of Operating and Supports Costs (VAMOSC). OSMIS tracks operating and support information for over four hundred major Army weapon/material systems. OSMIS-tracked systems include combat vehicles, tactical vehicles, artillery systems, aircraft, electronic systems and miscellaneous engineering systems. OSMIS can be accessed via the following web site: http://www.ceac.army.mil/.

m. Service Based Costing (SBC). SBC was launched as a Base Operations Support (BASOPS) Tempo development initiative. This initiative supports the ACSIM and USACEAC efforts to evaluate the cost of Army services, and to institute a cost management system at the installation level in accordance with the Government Performance and Results Act (GPRA). The Army's SBC Program measures the historical costs incurred (resources consumed) to provide a given service and measures the actual output(s) or pacing measures of a service. Currently SBC collects data for a standard set of 95 services typically provided at Army installations worldwide. Department of the Army level personnel and other interested persons may gain access to Army SBC data by submitting name, duty position and location, email address, commercial telephone numbers, and the reasons for the request, to ArmySBC@CALIBREsys.com.

n. Investment costs. Those expenditures, regardless of appropriation, needed to initiate a new program or system. Includes all costs for research, development, military construction, production and

deployment of a system. Investment costs are the costs to the government (including initial purchases of replacement components, replenishment spares, supplies and consumables) required to achieve and fully sustain FOC. All costs in this category must be included when calculating economic indicators such as BIR and SIR.

3-5. Common problems in estimating

a. Three common problems in developing cost estimates are: double counting, omission of costs, and hidden costs.

(1) Double counting occurs when the same cost is included in two areas, or, simply stated, is counted twice.

(2) Omission of costs occurs when costs that are applicable to a project or program are overlooked.

(3) Hidden costs can occur in many ways such as; mislabeling cost elements, non-disclosure of certain costs, and improper allocation of overhead pools and rates.

b. The occurrence of any of the above problems may seriously distort the outcome of any cost analyses and can reflect unfavorably upon the credibility of the analyses.

3-6. Cost categories and structure

a. Costs are classified in two major categories for the Army's purpose. Those categories are: Investment and Operations and Support (O&S), also called Sustainment. For major systems, the Investment category is broken into Research and Development (R&D) and Production and Deployment (P&D).

b. While there is no required format or structure applicable to all EAs, documentation must clearly label the cost elements of a project. Investment costs are normally non-recurring (occurring one time or on an intermittent basis) and include such items as R&D, equipment purchases, software development, and facilities preparation. O&S costs are normally recurring (occur on a continuing annual basis) and include such items as operating personnel and hardware maintenance. Beyond the major categories, cost elements should be labeled in a manner clear enough for an independent reviewer to understand. Figure 7-4 illustrates some typical cost elements; Appendix D shows the CES for C4/IT systems. Appendix I contains a sample EA with an appropriate level of detail.

Chapter 4
Benefit Analysis

4-1. Overview of benefit analysis

a. Benefits are what the organization expects to receive for the resources expended. The purpose of benefit analysis is to identify, measure, and evaluate the benefits of proposed alternatives. Benefits can be defined by or measured in the following ways: effectiveness, physical yield, products, morale, quality of life, and timeliness. Benefits can be either quantifiable or non-quantifiable. Some, but not all, quantifiable benefits reduce required funding and are classified as savings.

b. It is important that all significant benefits, whether quantifiable or non-quantifiable, be included in the analysis. Where possible, benefits should be quantified in dollar values. Those benefits that can not be assigned a dollars value can sometimes be quantified in other terms. All benefits included in the EA must be relevant to the analysis. Each benefit must be clearly and distinctly identifiable from all other benefits; and should not duplicate or overlap any other measure.

4-2. Types of benefits

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

(1) Dollar quantifiable benefits are composed of three basic types.

(a) Cost savings. A savings results in the reduction of an approved Army program (the most current approved Army program) or MDEP, if the benefit occurs during the POM period. When the same type of benefits that would have led to an MDEP reduction occur beyond the POM period, these are also savings because they are assumed to be in an approved Army program.

(b) Cost avoidances. A cost avoidance is a reduction in some future resource requirement, which has not been included in an approved Army program, because investment in some needed program/project will not have to be made. For example, if the status quo requires the purchase of certain hardware which has not been included in an approved Army program, but implementation of the preferred alternative does not require its purchase and does not degrade current capability, there is a cost avoidance. Cost avoidances can accrue at any time during the life cycle.

(c) Productivity improvements. A productivity improvement is a reduction in future personnel time and effort requirements associated with a function or assigned task that has been included in an approved Army program. Under normal circumstances, productivity improvements do not represent an opportunity to reduce an approved program/budget or force structure. Unlike cost avoidances, productivity improvements have no direct impact on future requirements for funding, but enable the Army to accomplish more work with existing personnel. Productivity improvements can accrue at any time during the life cycle.

(2) Examples of other quantifiable benefits and methods of measurement include but are not limited to:

(a) Increase in number of commodities or items produced for each alternative (number of meals served, hours flown, or components manufactured).

(b) Increase in number of items produced per a given period of time (flight hours per month, number of items per man-hour, or number of trucks serviced per year).

(c) Improved system reliability in terms of reduction to its probable failure ratio (mean-time-between-failure, or number of repairs per item per year).

(d) Reduced number of errors per operating time period (number of errors per card punched, errors per hundred records, or errors per 100 items produced).

(e) Improved maintainability/supportability measures (such as increased mean-time-to-repair or reduced average downtime).

(f) Improved flexibility and adaptability to various modes of operations (number of operating modes).

(g) Improved environmental operating capabilities of the system (temperature operating range, day-night capability, or wind-speed range).

(h) Improved availability measures showing when a system will be delivered against when it is required (equipment delivery or initial spares delivery date).

(i) Improved accuracy, timeliness, and completeness of data produced by a system, resulting in efficient utilization of the Army's resources through more effective decisions made upon more accurate data.

b. Non-quantifiable benefits. Some benefits do not lend themselves to direct, quantitative measures. These benefits, though difficult to assess, should be addressed qualitatively in the EA. Though subjective in nature, qualitative statements can make a positive contribution to the analysis. Examples of non-quantifiable benefits are improved morale, compatibility, improved quality and security, increased customer satisfaction, and improved readiness.

4-3. Identifying, estimating and evaluating benefits

All significant benefits must be included in the benefit analysis portion of the EA, whether quantifiable or non-quantifiable. Benefits that cannot be quantified should be described in narrative form. The preparer of the EA should ensure that the benefits are validated by the functional proponent (or the organization responsible for the basic requirement) and coordinated with all appropriate activities. Extensive user involvement in identifying and documenting benefits is strongly recommended, beginning early in the EA process. The EA benefit analysis process is illustrated in figure 4-1.

a. Identifying benefits

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

(a) Identify all resources flowing into the system/project and the resulting benefits flowing out of the project.

(b) Anticipate what is important (both positively and negatively) from the viewpoint of each person affected by the system/project.

(c) Determine and list the benefits of each alternative, both quantifiable and non-quantifiable.

(d) Define each benefit in relation to the alternatives in the EA. 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.

(e) Develop a quantitative measure for each benefit where possible. This will allow direct comparison of alternatives for each benefit.

(f) Be consistent. Benefits should not be evaluated one way for one alternative, and a different way for another alternative.

(2) Following is a list of categories which may help to define benefits. The 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.

(a) Acceptability -- does the alternative contribute to the operation of parallel or higher level organizations? Does it improve the quality of the process?

(b) Accuracy -- does the alternative reduce error rates or improve the accuracy of information?

(c) Adaptability -- is the system/project adaptable to existing DoD, industry, national, or international standards?

(d) 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?

(e) Functionality -- how well does the system perform; how quickly can it process data or calculations, or other functions?

(f) Compatibility -- how will existing operations, facilities, equipment, data requirements be affected? How much initial training will be required? How will work methods and procedures be altered?

(g) Maintainability -- is the system difficult to repair? Are parts readily available? How much staff will be required to maintain the software/hardware? What is the anticipated down time for maintenance? Is the maintenance downtime longer for any alternative?

(h) Manageability -- will the system/project decrease the involvement/need for supervisors or quality inspections? Will a different type of personnel than currently assigned be required? Are trained personnel available?

(i) Morale - will the system/project contribute to a positive employee attitude towards work?

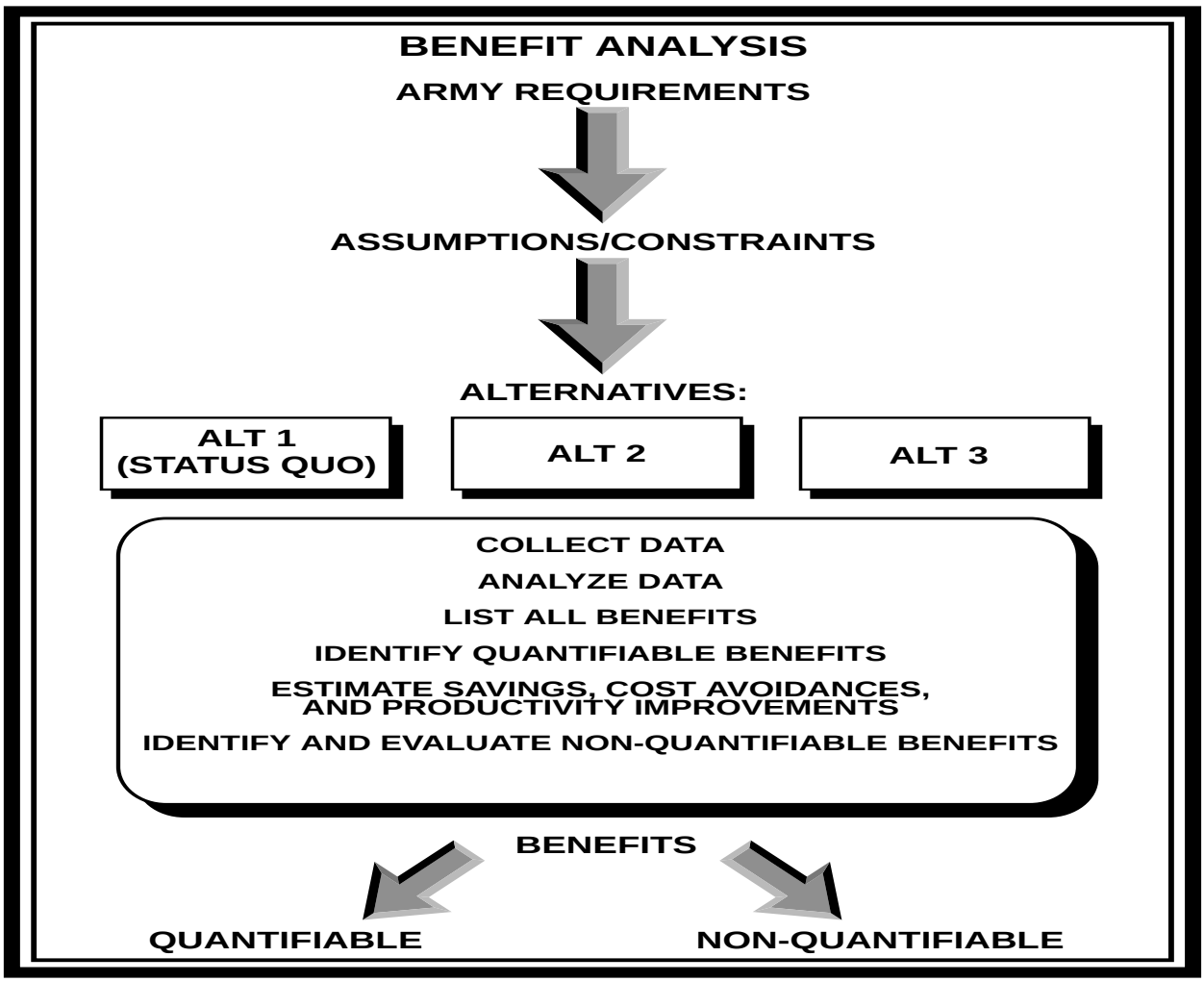


Figure 4-1. Benefit Analysis Process

(j) Production -- will the number of products produced be increased?

(k) Productivity -- will the rate of production increase? Will the system/project decrease the number of staff resources previously needed to produce the same product, or will the system/project allow more items to be produced with existing staff resources?

(l) Quality -- will a better product be produced? Will better service be provided? Will quality of products be more consistent? Is customer satisfaction improved?

(m) Reliability -- how many (how often) system failures will occur over time?

(n) Security -- will more or less precautions be needed?

(o) Service life -- how long will the equipment be able to support the operation? Will the equipment be obsolete before it reaches the end of its useful life?

(p) Upgradeability -- how compatible will additional equipment, such as memory, terminals, workstations, or other equipment, be with existing equipment or users of the system?

(q) Versatility -- will the equipment in any alternative provide additional capacity or capability beyond that required for the system?

b. Estimating quantifiable benefits

(1) Every effort should be made to quantify benefits to the maximum extent possible. Subdivide quantifiable benefits into those that are dollar quantifiable and those that are quantifiable in other terms. The methods of measurement for quantifiable benefits are as follows, in order of desirability:

(a) Dollar quantifiable.

(b) Physical count of tangible items (for example, units of output).

(c) Index or ratio (for example, 40 percent or greater).

(2) The benefit estimating process is similar to that for cost estimating discussed in Chapter 3. Data must be collected from appropriate sources and analyzed; relationships among data must be identified; inflation and discounting must be applied to annual dollar values via standard methods; the economic life of the alternatives and the fiscal years when benefits accrue must be carefully considered.

(3) Once benefits have been quantified, savings must be separated from cost avoidances and productivity improvements. Upon decision approval, cost savings dollars and/or personnel space savings appearing during the POM period will be withdrawn from the approved Army program for alternative use(s). Savings beyond the POM period, as well as cost avoidances and productivity improvements, do not have this impact. Identify all benefits by the appropriation and the FY in which they are expected to occur.

(4) Consider the limitations of benefit analysis carefully when using benefits in the decision making process. During the quantifying and analysis process, assumptions and judgments are made which influence the results. The analyst must make value judgments and trade-offs, and any uncertainty that exists about the information must be made clear to the decision maker.

c. Evaluating non-quantifiable benefits. The following are techniques for evaluating non-quantifiable benefits:

(1) Enumeration is a "simple listing" of the non-quantifiable benefits associated with each alternative for comparison purposes.

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

4-4. Treatment of certain benefits

This section provides guidance on the handling of some unique types of benefits.

a. Civilian whole personnel spaces can be reduced when a proposed alternative is estimated to significantly reduce personnel effort in a specific work center. In this case, a space reduction should be projected. This will be dollar quantified in the EA as a budgetary savings, which will begin to take effect when the new system or project is implemented. (Personnel space reductions will normally be verified through a study by the appropriate manpower element prior to actual TDA reductions. If there is an immediate, defensible need for additional manpower in the affected work center, a benefit quantified in terms of satisfying the need (and taking effect when the new system or project is implemented) should be reported instead of a space reduction.

b. Fractional civilian personnel time reductions occur when personnel effort reductions do not equate to whole space reductions. In this situation, the resulting benefit of time freed up for other duties is classified as a productivity improvement. An attempt should be made to quantify this in terms of the use of that available time (reduced backlog, performing tasks that would otherwise be undone, etc.). Fractional civilian man-years of effort cannot be applied as a budgetary savings because no salaries will be saved.

c. The same rules apply for both military and civilian personnel. However, whole military spaces do not represent a budgetary savings unless a reduction in the Army's end strength is mandated by Congress.

d. If the introduction of an alternative will result in a reduction in stockage requirements at any location, including the supply pipeline, the reduction is a dollar quantifiable savings. The savings will be time phased and identified, by appropriation and program, with the MACOM(s) expected to receive the savings.

e. Wartime benefits are not dollar quantified. Their net effect is increased combat, combat support, or combat service support capability.

f. Benefits which have already occurred (i.e., those associated with sunk costs) will not be included in the comparison of costs and benefits used in the decision making process. They should be discussed in the narrative only.

Chapter 5
Evaluation Methods for Comparing Alternatives

5-1. Overview

a. This chapter discusses the steps that lead to selection of a preferred alternative for a project. After completing the cost and benefit estimates for each alternative, the individual responsible for a program or project establishes priorities and identifies the preferred alternative by making comparisons of the costs and benefits of the feasible alternatives with respect to the status quo. The results of the comparison and recommendations are presented to the decision-makers.

b. As a general rule, the preferred alternative is the alternative that provides the greatest amount of benefits in relation to its cost. In situations where it is difficult to quantify benefits and measures of effectiveness, it is important to provide as much useful information as possible so that a decision can be made as to which alternative yields the most benefits.

5-2. Comparing costs and benefits

a. The following situations may result when comparing "raw costs and benefits" associated with two or more alternatives. Figure 5-1 is a graphical presentation of this information.

(1) When the results yield equal costs and unequal benefits, the recommendation should be the alternative that provides the greatest benefits for a given level of cost.

(2) When the results yield unequal costs and equal benefits, the recommendation would be simply the alternative that is the least costly.

(3) When the results yield unequal costs and unequal benefits, there is no single criterion for ranking alternatives. In this situation all alternatives, including the status quo, may be ranked in decreasing order of their benefit/cost ratios; if all benefits can be measured in dollars, the alternatives may also be ordered from the largest to the smallest net present value.

(4) When the results yield equal costs and equal benefits the recommendation for the preferred alternative may be based on other factors, such as a fortiori analysis (see paragraph 5-4b), subjective reasoning, and/or point systems.

b. Where alternatives have differing economic lives, the analyst must determine whether the longest or shortest life or some other time period should be used as a basis for comparison, and make an adjustment for unequal life. If the shortest life is used, recognize the residual values of the alternatives with the longer lives in the cost computation. If the longest life is used to establish the time period of the analysis, recognize the cost of extending the benefit-producing years of those alternatives with a shorter life. Ensure that the decision maker is presented the complete and valid costs for each alternative for the entire length of the analysis. In cases where adjusting the economic life is totally impractical, alternatives with unequal lives may be compared based on equivalent (uniform) annual cost. See Para 5-4a for more information on this technique.

Figure 5-1
Comparing Raw Costs and Benefits

Costs	Benefits	Selection Criteria
Equal	Unequal	Alternative that provides greatest benefits for given level of costs
	Equal	Based on other factors: subjective reasoning and a fortiori analysis
Unequal	Unequal	Alternatives ranked in order of benefit/costs ratios, or largest to smallest net present value
	Equal	Least costly alternative

5-3. Quantitative Methods (Economic indicators)

There are a variety of quantitative techniques (sometimes called economic indicators) available that provide a definitive basis for ranking alternatives. Quantitative methods and techniques establish the foundation of economic indicators for an EA. Quantitative analysis of costs and benefits and the resultant ranking of alternatives can be performed using discounted and undiscounted dollars. Some of these economic indicators are discussed below. **NOTE**: examples of these quantitative methods can be found in Appendix J.

a. **Benefit-Cost ratio (BCR)**. The BCR compares the present value of the total benefits associated with an alternative with the present value of its total costs. Alternatives that have a BCR greater than one are considered economically viable. Assuming insufficient resources resulting from budget constraints, projects with greater BCRs are usually given priority over those with smaller BCRs. A BCR provides the decision maker with the total benefit obtained per unit of cost, thus making it easier to compare different alternatives. The BCR indicates how efficiently funds will be used. The BCR is best used in situations when competing alternatives have unequal costs and unequal benefits. When this approach is used, comparison of the ratios indicates the relative desirability of alternatives. Calculating a general BCR for each alternative is accomplished as follows:

(1) Separately total the present values of annual costs and annual benefits. (Paragraph 3-4g lists the steps used to arrive at total costs and benefits in present value terms, and Appendix H provides an example.)

(2) Compute the BCR by dividing the present value of the benefits by the present value of the costs.

b**. Marginal analysis.** Marginal analysis, also referred to as incremental analysis, can be considered a specialized extension of benefit cost analysis. It examines the differences between alternatives and provides an indication of whether the differential costs of an alternative are justified by its differential benefits. This technique is different from most other techniques in that total costs and benefits are not evaluated, but rather various degrees (or increments) of investments and their resulting benefits. Since marginal analysis does not provide adequate awareness of the total costs and benefits of an alternative, it should not be used as the sole evaluation criteria.

c. **Break-even point (Payback period).** The break-even point, or payback, is the point (e.g., number of years or fractional years) at which the cumulative costs (investment plus sustainment) of two alternatives are equal. At this point the savings in current dollars from the comparison of alternatives will equal the investment in current dollars (Sunk costs are not considered in the computation.). The break-even point is computed using a comparison of costs between alternatives which identifies cumulative savings. Break-even analysis is normally performed using undiscounted current dollars. Break-even analysis is most commonly used in decision making when projects are high risk, and it is desirable to recover investment costs quickly, or when it is desirable for political reasons to quickly generate economic benefits. 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.

d. **Savings-to-investment ratio (SIR**), The SIR can be defined as the relationship between savings and the investment costs necessary to effect those savings. This implies that, if a proposed investment is not adopted, there will be expenditures associated with the status quo alternative required in the future. However, if the preferred alternative is implemented, those future expenditures will be reduced or perhaps even totally eliminated. This technique can be applied when feasible alternatives are to be compared to the status quo. The SIR takes on added importance in the comparative analysis process when a given requirement (objective) is already being met at the present time, but a potentially better way to meet the requirement is under consideration. The SIR only reflects costs and savings, the other benefits of the alternatives are not considered in any way. The SIR is calculated by dividing the present value of savings by the present value of the investment cost of the alternative. A SIR of 1.0 or greater indicates that the present value of savings is equal to or greater than the present value of the investment. For an investment to be considered economically sound, the SIR must normally be greater than 1.0.

e. **Benefit-to-investment ratio (BIR**) The BIR can be defined as the relationship between benefits and the investment costs necessary to produce those benefits. The BIR is determined by dividing the present value of the dollar quantifiable benefits (that is, savings, cost avoidances, and productivity improvements) by the present value of the investment cost of the alternative. A BIR of 1.0 or greater indicates that the present value of the benefits is equal to or greater than the present value of the investment.

f. **Net present value (NPV).** When the alternatives to satisfy an objective have the same economic life, a NPV comparison can be used to determine the optimum alternative based on costs and benefits. With the NPV technique, all future cash flows are converted to present equivalent values, then summed. Compute the present value of benefits as described previously, then subtract the present value of costs from the present value of benefits for each alternative. The alternative with the **greatest** NPV is the preferred alternative. In those situations where benefits do not exceed cost, follow the same procedures however, the preferred alternative is the one with the **lowest** NPV. The NPV approach is useful when the actual size of the returns from the alternative is the concern.

g. **Rate of return (ROR).** The ROR can be interpreted as a form of return on investment (ROI); however, it is considered more appropriate to use the term rate of return.

(1) The ROR is that discount rate at which the present value of the savings is equal to the present value of the investment cost through the remaining life cycle of the project being evaluated. The ROR technique for comparing alternatives is particularly useful when the total dollar value of potential investments exceeds the available funds. Thus, the ROR can act as a single value for each investment, permitting the ranking of projects with respect to their economic desirability. The ROR can also assist in determining whether or not proposed investments will provide at least a predetermined minimum return

specified by the decision makers. Essentially, the ROR method of analyzing and comparing potential projects is useful in that it answers the following two basic questions:

(a) Do the proposed expenditures meet the minimum ROR set by the requirement (decision-makers)?

(b) How does a particular project compare with other projects?

(2) The calculation of ROR is accomplished by iteration until one determines the discount rate at which the present value of the savings equals the present value of the investment. Spreadsheets which have automated this function are widely available.

h. Additional economic indicators are also available. For example, the "tooth to tail" ratio deals with comparing direct costs (i.e., fighting forces) with indirect costs (i.e., support personnel such as medical, logistics). Other ratios may be used in an EA when appropriate.

5-4. Other evaluation methods and techniques

a. Uniform annual cost. Use this technique to compare alternatives with different economic lives. The uniform annual cost is determined by dividing the total discounted alternative cost by the sum of the discount factors for the years which an alternative yields benefits. When computed in this manner, the uniform annual cost represents a constant amount which, if paid annually throughout the economic life of a proposed alternative, would yield a total discounted cost equal to the actual present value cost of the alternative.

b. Subjective factors approach. This approach attempts to rank alternatives on the basis of rough rules of thumb. Under this approach, it is assumed that alternatives are too widely different for rigid ranking and that informal political criteria are important. There are basically three methods used to evaluate nonquantifiable factors: a fortiori analysis, subjective reasoning, and the point system.

(1) A fortiori analysis involves the deliberate attempt to formulate assumptions that tend to uniformly favor or disfavor a particular alternative. The rationale is that if the assumptions uniformly favor an alternative and the alternative still does not rank above other alternatives, then any other set of assumptions would only tend to reduce the alternative's ranking. For example, a decision maker realizing personal bias to the status quo counteracts this bias by purposely formulating new assumptions that favor the competing alternatives. If the comparison of the alternatives still indicates the status quo is the most cost effective, the decision maker can be assured that the bias did not affect the decision process.

(2) The subjective reasoning method uses one or more of the following informal criteria for alternative ranking:

(a) Urgency in attaining the project objective.

(b) Whether or not the alternative fills a gap in existing mission requirements.

(c) Whether or not the alternative conserves or maintains existing mission objective levels.

(d) Whether or not the alternative meets emergency needs.

(3) The point system is another method used to rank alternatives based on evaluation of non-quantifiable factors. Under this method, an attempt is made to evaluate non-quantifiable benefits and intangible factors by subjectively developing point scores based on preferences for obtaining certain benefits. The first step is to establish the benefits, then each benefit is rated according to its contribution to the project objective. The sum of individual benefit attribute ratings establishes the overall ranking for the benefit. The benefit with the highest score is ranked first. Afterwards, total points are obtained for each alternative. Once project alternatives are ranked according to a total point score, a cutoff point can be established based on available dollars that are compared with each alternative's costs. Alternatives falling below the cutoff point are eliminated from further consideration by the decision makers; those alternatives that remain are evaluated on the basis of their total point scores. For suggestions on documenting the comparison of non-quantifiable benefits, see Chapter 7.

Chapter 6
Sensitivity, Risk, and Uncertainty Analysis

6-1. Sensitivity analysis

a. Sensitivity analysis is used to evaluate the effect of uncertainty or unknowns on the ranking of alternatives. Some uncertainty is always present in economic decision-making, therefore a sensitivity analysis should normally be done. Since much data used in calculating life-cycle costs are based on assumptions, evaluating a range of estimates for critical elements can test the sensitivity of an analysis. Sensitivity analysis measures the percentage change in one or more elements of the EA.

b. Sensitivity analysis is a tool for assessing the extent that costs and benefits are sensitive to changes in factors such as length of system life; volume, mix, or pattern of workload; requirements; and configuration of equipment, hardware, or software. Sensitivity analysis is a repetition of an analysis with different quantitative values for cost or operational assumptions in order to determine their effects on the results of the basic analysis. It tests whether the conclusion of an EA will change if some variable such as a cost, benefit, or other assumed variable value changes. If a small change in an assumption results in a significant change in the results, then the results are said to be sensitive to that assumption or parameter.

c. Sensitivity analyses can provide a range of costs and benefits that are likely to be a better guide than a single point estimate. Perform sensitivity analyses when:

(1) The results of the EA do not clearly favor any one alternative.

(2) There is significant uncertainty about a cost element, benefit, other parameter or assumption in the EA.

d. Sensitivity analyses can be performed within all analyses. First, describe the approach, assumptions, and the model used for conducting the sensitivity analysis. Second, describe the factors that are being tested for sensitivity. Third, vary the factors and obtain the resultant values. Following are examples of factors that may warrant sensitivity:

(1) The effects of a shorter or longer economic life.

(2) The effects of variation in the estimated volume, mix, or pattern of workload.

(3) The effects of potential changes in requirements resulting from either legislative/Congressional mandate or changes in functional responsibilities.

(4) The effects of potential changes in requirements resulting from changes in organizational responsibility at the site, installation, base, or MACOM levels.

(5) The effects of changes in configuration of hardware, software, data communications, prime support equipment, and other facilities.

(6) The effects of alternative assumptions concerning the project objective, requirements, operations, inflation rate, exchange rate, residual value of equipment, facilities and software, and length of development.

e. Within an EA, a sensitivity analysis can provide management with measures of effectiveness and efficiency at all feasible levels of production or operations. After sensitivity analysis is performed, estimates of marginal changes to effectiveness and efficiency as a function of costs will be available as decision criteria. Economic indicators such as the benefit cost ratio, savings investment ratio, and break-even point (as discussed in Chapter 5) can also be recomputed based on these changes, and in the process a different preferred alternative may appear. In any case the impact upon the economic indicators from the differing assumptions of the sensitivity analysis will be demonstrated.

6-2. Risk and uncertainty analysis

a. The terms risk and uncertainty are often used interchangeably, although a distinction can be drawn by noting that the concept of risk deals with measurable probabilities while the concept of uncertainty does not. An event contains an element of risk where a probability distribution can be defined. An event is uncertain when no probabilities can be developed concerning its occurrence.

b. Risk refers to probabilities of errors in the estimates or the probabilities of occurrence of events. Risk analysis deals with the likelihood and expectation of possible outcomes using probability concepts. If calculated in terms of the probability of success or failure, the risk is seen as an objective risk. It is an uncertainty when the probability cannot be mathematically indicated but there is enough knowledge to make a subjective judgment about it. The more explicitly the risk is defined, the greater the possibility for the decision maker to safely utilize the analysis.

c. Many statistical and other tools exist that can be used to make a quantifiable risk assessment. Some examples of these tools are expected value, break-even analysis, probability theory, gaming theory, Monte Carlo technique, Delphi technique, and decision trees. Cost models that can be used are ACE-IT, @RISK, and Crystal Ball. ACE-IT uses probability theory and the Monte Carlo technique in deriving a risk assessment.

d. Contingency analysis is a type of uncertainty analysis which is designed to cope with significant uncertainties of a qualitative nature. Contingency analysis addresses the effects of various broad conditions such as decreased (or increased) size of the Army, organizational changes, and technological breakthroughs. For example, if an installation has been given the mission to overhaul weapon systems A and B, the analyst may want to investigate the potential impact if the installation were also given the mission to overhaul weapon system C.

6-3. Expected value

a. The "expected value" technique minimizes the difference between the actual results and the expected results based upon the probability of occurrence. This is a key concept in probability theory, statistics, and decision theory. Multiply the output value associated with each possible outcome of the occurrence by the estimated probability of achieving that outcome. Then sum the products of these multiplications to calculate the expected value. A decision maker who is neither risk averse nor a risk taker might be expected to choose the strategy with the highest expected value.

Chapter 7
Economic Analysis Documentation and Presentation

7-1. Documentation overview

a. It is essential to adequately document the EA. 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. If the reviewer or the decision maker is unable to follow the assumptions, data and computations, the project may be delayed while clarification is obtained.

b. EAs are subject to many levels of review. These reviews are conducted by the cost analysis validating activities, MACOM, HQDA, Office of the Secretary of Defense (OSD), Congress, the General Accounting Office (GAO), Army Audit Agency (AAA), and DoD Inspector General. These reviewers may not be as familiar with the EA as the analyst that prepared it, and yet each will critically analyze and pass judgment on the EA's validity and adequacy. For this reason, it is of paramount importance to maintain an adequate audit trail to support your work. The documentation must provide an audit trail that permits validation of all costs and benefits. Consult the checklist provided at paragraph 7-6 for completeness of documentation.

c. Documentation should describe the functional process performed; define the requirement; present and explain workload projections; and identify significant assumptions, constraints, and key variables. It should also identify feasible alternatives; present total costs and differential savings expected in constant, discounted, and current dollars over the project life. It presents economic indicators; addresses estimating methods/relationships and data sources; treats sensitivity, risk, and uncertainty of key cost drivers and assumptions; and addresses all quantifiable benefits as well as any intangible benefits influencing the recommended course of action. The level of detail should be consistent with the dollar value, scope and complexity of the system or project, number of alternatives, data sources and methods, amount of risk/uncertainty, and the anticipated level of review. Table 7-1 contains a list of the decision criteria used most often for different types of EA's.

Table 7-1
Relevant Evaluation Criteria

Applicable Evaluation Criteria	C4/IT	AOA	FEA	OSCR	Capital Budgeting <$1M	Capital Budgeting >$1M	Lease Purchase
Least Cost – Cost Savings		Yes	Yes	Yes	Yes		Yes
Benefit-Cost Analysis	Yes	Yes	Yes			Yes	
BIR	Yes			Yes	Yes	Yes	Yes
SIR	Yes			Yes	Yes	Yes	Yes
Break-even Point	Yes			Yes	Yes	Yes	
NPV				Yes	Yes	Yes	

d. Figure 7-1 provides a suggested outline for performing an EA. While there is no prescribed format which applies to documenting all EAs, Figures 7-2 and 7-3 show one acceptable way of displaying costs for each alternative and a comparison of alternatives, and figure 7-4 illustrates a general cost element structure to further detail the annual cost displays. See Appendix I for an example of a complete EA which follows acceptable documentation procedures.

7-2. Documenting alternatives, assumptions and constraints

a. Alternatives must be defined in such a way that the differences between alternatives is clear and there is adequate rationale for their inclusion. In all cases, clearly document all alternatives that were eliminated and include the justification for their deletion.

b. Provide adequate rationale for all assumptions and constraints (assumed or imposed), identified in the analysis.

7-3. Documenting cost and benefits estimates

a. Documentation supporting the results of the analysis must include the computations and methodologies used to estimate the costs and benefits. For example, if 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 person to recreate the estimate and reach the same conclusions.

b. All costs must be presented in constant and current dollars, and displayed by fiscal year for the entire project life, beginning with the first fiscal year in which costs will be incurred.

c. Cost estimates must reflect the Army's true requirement for a system or project, not just available funding. If the system or project is not fully funded, the strategy for obtaining needed funding should be explained to the decision maker. Options for implementation within current funding levels must be addressed.

d. Specify clearly in the analysis the criteria by which benefits can be evaluated. Documentation supporting the results of the analysis will include all computations and a detailed description of the methodology used in developing these estimates. In addition, it is important to identify the sources of benefit data, methods used to collect the data, and quality of data.

e. The process of documenting the benefits of an EA should be no less rigorous and detailed than that of documenting the cost portion of the EA. Figure 7-5 provides a sample summary format for documenting dollar quantifiable benefits; Figure 7-6 shows a sample format for displaying and comparing non-quantifiable benefits.

7-4. Documenting the comparison of alternatives

a. The comparison of alternatives should show differences in costs and benefits by fiscal year. Comparison of alternatives should be shown in net present value terms; documentation should indicate the discount rate used and whether mid-year or end of year factors were used. Economic indicators appropriate

to the nature of the project must be included in the documentation. Some examples (further defined in chapter 5) are: Breakeven Point, Savings/Investment Ratio (SIR), and Benefit/Investment Ratio (BIR).

b. Other factors that may qualitatively or quantitatively affect the assessment of costs and benefits for one or more of the alternatives should also be identified for the decision maker. Examples include non-quantifiable benefits such as improved morale, better quality of life, customer satisfaction, etc.

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

GENERAL EA OUTLINE

PURPOSE

BACKGROUND

SCOPE OF THE ECONOMIC ANALYSIS

MAJOR ASSUMPTIONS AND CONSTRAINTS

DESCRIPTION OF ALTERNATIVES

- **STATUS QUO**
- **ALTERNATIVE**
- **ALTERNATIVE ...**

COST SUMMARY

BENEFITS SUMMARY

COMPARISON OF ALTERNATIVES

SENSITIVITY/RISK/UNCERTAINTY ANALYSIS

CONCLUSIONS AND RECOMMENDATIONS

SOURCE & DERIVATION OF COST ESTIMATES (DETAILED)

BENEFITS ANALYSIS (DETAILED)

Figure 7-1. General EA Outline

ECONOMIC ANALYSIS
TOTAL COSTS BY ALTERNATIVE

Submitting organization:

Date of submission:

Project title:

Description of project objective:

Description of this alternative:

Economic life for this alternative: years

Total project life: years **Discount Rate =** %

Project costs are in 20xx **Constant Dollars**

	Constant Dollars (Base Year FYXX)			Discounted Dollars (Present Value)		Current Dollars (Inflated)	
FY	Investment	O & S	Total Costs	Discount Factor	Annual Costs	Infl Index*	Annual Costs
	(1)	(2)	(3 = 1 + 2)	(4)	(5 = 3 x 4)	(6)	(7 = 3 x 6)
FYX1				0.XX		1.XX	
FYX2				0.XX		1.XX	
FYX3				0.XX		1.XX	
FYX4				0.XX		1.XX	
FYX5				0.XX		1.XX	
FYX6				0.XX		1.XX	
FYX7				0.XX		1.XX	
FYX8	(Prepare similar format for each alternative, including Status Quo)			0.XX		1.XX	
FYX9				0.XX		1.XX	
FYX10				0.XX		1.XX	
Sub-total							
Residual Value				0.XX		1.XX	
Total							

* Applies if all costs are in a single appropriation. If not, each appropriation must be inflated separately for each alternative, then a delta between alternatives for that appropriation is computed. Deltas for appropriations in each FY are summed to get Current Dollar figure.

Figure 7-2. Costs by Alternative

ECONOMIC ANALYSIS
COMPARISON OF ALTERNATIVES

Project title:

Comparison of: **Alternative 1 (Status Quo) and Alternative 2 (Title).**

	Constant Dollars (Base Year FYXX)			Discounted Dollars (Present Value)		Current Dollars (Inflated)	
	Operations Costs		Benefits (Differential Costs)		Benefits (Differential Costs)		Benefits (Differential Costs)
FY	Status Quo	Alternative 2		Discount Factor		Infl Index*	
	(1)	(2)	(3 = 1 - 2)	(4)	(5 = 3 x 4)	(6)	(7 = 3 x 6)
FYX1				0.XX		1.XX	
FYX2				0.XX		1.XX	
FYX3				0.XX		1.XX	
FYX4				0.XX		1.XX	
FYX5				0.XX		1.XX	
FYX6				0.XX		1.XX	
FYX7				0.XX		1.XX	
FYX8	(Prepare similar format comparing each alternative with the Status Quo)			0.XX		1.XX	
FYX9				0.XX		1.XX	
FYX10				0.XX		1.XX	
Sub - total							
Residual Value				0.XX		1.XX	
Total							
		Investment Cost: (Constant $)			Investment Cost: (PV Const $)		Investment Cost: (Current $)

Summary information	Alternative 2 (Title)
Total Benefits (Current $)	_____
Investment Cost (Current $)	_____
Break-Even Point (Years)	_____
BIR (Disc Constant $)	_____
Net Present Value (NPV)	_____
SIR	_____

*** Applies if all costs are in a single appropriation. If not, each appropriation must be inflated separately for each alternative, then a delta between alternatives for that appropriation is computed. Deltas for appropriations in each FY are summed to get Current Dollar benefits figure.**

NPV = PV(Benefits) – PV (Investment Cost)

NOTE: Some programs may have external benefits (i.e., benefits other than differences in operating costs) that should be added and included in all economic indicators.

Figure 7-3. Summary of Differential Costs

GENERAL COST ELEMENT STRUCTURE

The following general cost elements are illustrative of those considered in estimating the costs associated with an economic analysis for an equipment acquisition. These cost elements would be augmented as appropriate for other type projects. O&S cost elements apply to the status quo and all feasible alternatives while investment cost elements apply only to the alternatives. O & S costs should be estimated on a total cost basis including all direct and indirect labor, applicable overhead, and general and administrative costs.

INVESTMENT COSTS	O & S COSTS
* Acquisition (Purchase)	* Labor
* Transportation	- Civilian Personnel
* Installation	- Military Personnel
* Testing	*Material
* Training	* Maintenance and Repair
* Other	* Consumable Supplies
	* Lease/Rent
	* Utilities
	* Contracts
	* Other

Figure 7-4. General Cost Element Structure

7-5. Cost models

a. A specific model for developing cost and benefit estimates and documenting EAs is not prescribed. There are numerous acceptable ways to complete the process, with no single approach being best. Several Governmental organizations have developed automated means for conducting and documenting EAs, such as the Automated Cost Estimating Integrated Tools (ACE-IT) model which was adapted for Army use by USACEAC. ACE-IT is a powerful tool that is designed to be used in large EA's. It allows an analyst to perform cost and statistical analysis, cost estimating, risk analysis and sensitivity analysis. It also allows

one to build WBS/CES structures, specify cost methodologies, apply learning curve theory, time phase results, and document the estimate. Another model, Economic Analysis Package (ECONPACK), was developed by the Army Corps of Engineers. Information on ECONPACK can be found on their website at http://www.hq.usace.army.mil/cemp/e/ec/econ/econ.htm.

b. ECONOMIC ANALYSIS AUTOMATED MODEL (EATOOL). The EATOOL model was designed by HQ, OSC using EXCEL software. The model complies with EA policy requirements applicable to Army Working Capital Fund (AWCF) Capital Investment Program (CIP), Production Base Support (PBS) program and Automated Information Systems (AIS) projects (the policy that existed as of Jun 1998). This model provides the user with one single product that can be used to prepare the cost display formats applicable to each of these particular programs. After answering a few basic questions, and providing the cost input, the user is provided with the correct cost display format as well as the economic indicators applicable to the chosen program. Instead of spending time determining what the correct cost display should look like, or what particular economic indicators have to be calculated, the user is able to spend that time analyzing the results. In addition, since the model displays the cost formats on screen, as well as in hard copy, the user is able to run various "what if" or sensitivity analyses in a relatively short period of time. Users on a yearly basis must update the inflation factors, via file upload from AMC's web site, and the discount factors, from CEAC's web site. EATOOL97 version 1.04 includes the latest inflation indices (3 Jan 2000) and economic analysis discount factors (2 Mar 2000) It can be downloaded from the File Download Area directly from the following hyperlink http://www.osc.army.mil/cc/ccc/download.htm. Note, per the red narrative on the download page, the downloaded file is an executable compressed file. Double-click on it to obtain the Excel file. Users must include a separate narrative file, usually in WORD, to fulfill EA policy guidance requirements. The EATOOL model is used extensively throughout AMC installations as the standard for EA documentation. Several models available for different types of EA's are listed in Table 7-2.

Table 7-2
Economic Analysis Models

Models/Tools	C4/IT	MCA	Major EA	Minor EA	Capital Budgeting
ACE-IT	X		X		
ECONPACK		X			
EATOOL	X			X	X

c. The preparer's experience and complexity of the problem should determine the appropriate cost estimating and documentation process. There should be flexibility in any model used to allow the application of various techniques as a program progresses in its life cycle. Complexity is not necessarily desirable. One must consider the cost, labor hours, and schedule required to set up and provide data in the modeling effort. Another important aspect is that there must be continuity, so that the cost estimate is traceable over time.

7-6. Economic analysis checklist.

Guidelines of what should be included in an EA, in the form of a checklist of questions, is located in Appendix M.

QUANTIFIABLE BENEFITS SUMMARY
ALTERNATIVE: 2

CONSTANT $:

FY	SAVINGS	COST AVOIDANCES	PRODUCTIVITY IMPROVEMENTS	TOTAL
FYX1	(1)	(2)	(3)	(4 = 1 + 2 + 3)
FYX2				
FYX3				
FYX4				
FYX5				
FYX6				
FYX7				
FYX8				
FYX9				
FYX10				
FYX11*				
Total				

CURRENT $:

FY	SAVINGS	COST AVOIDANCES	PRODUCTIVITY IMPROVEMENTS	TOTAL
FYX1	(1 x Infl Rate)**	(2 x Infl Rate)**	(3 x Infl Rate)**	(Savings + CA + PI)
FYX2				
FYX3				
FYX4				
FYX5				
FYX6				
FYX7				
FYX8				
FYX9				
FYX10				
FYX11*				
Total				

Note: Specify what Cost Avoidances and Productivity Improvements include. Savings will be difference (plus or minus) in all other operations costs from Status Quo. Minus means the alternative will require more funding than the Status Quo in the indicated FY.

*** Residual value, if any, goes here (in the year following the last year of the program).**

**** Elements with different appropriations must be inflated separately, then the current dollar values are added together.**

(Prepare similar format for each alternative other than the Status Quo)

Figure 7-5. Summary of Dollar Quantifiable Benefits

Comparison of nonquantitative benefits							
Benefit Attribute	Weight	Alternative 1 (status quo)		Alternative 2		Alternative 3	
		Rank	Score	Rank	Score	Rank	Score
Total score							

Figure 7-6. Comparison of Nonquantitative Benefits

Chapter 8
Command, Control, Communications and Computers/Information Technology (C4/IT) Systems Economic Analysis

8-1. Overview of C4/IT

a. This chapter provides guidance for the EA preparation and documentation for major C4/IT systems that undergo an OSD IT Overarching Integrated Product Team (OIPT) review (and/or an Army IT OIPT). Figure 8-1 provides the categories of acquisition programs, milestone decision authorities and the required levels of review. Not all of the categories apply to IT systems.

b. The EA documentation describes the life-cycle cost and benefits of all viable alternatives and resources required to satisfy the mission requirement for C4/IT systems. Additionally, the EA can be used in program reviews to provide a basis for program/budget decisions. Chapter 7 provides guidance for the documentation of an EA.

c. EA development for the Army and OSD IT OIPT reviews is supported by a Cost IPT, made up of the Army and OSD (if applicable) staff organization including the functional proponent.

d. USACEAC will perform an Independent Cost Estimate (ICE) or Component Cost Analysis (CCA) for all systems undergoing an OSD IT OIPT. The Cost IPT will determine scope and focus.

8-2. General Information

a. All IT and National Security Systems (NSS), regardless of acquisition category, developed for use by U.S. forces are potentially for joint use. Interoperability and integration of IT and NSS requirements shall be determined during the requirements validation process by the Joint Staff and shall be updated as necessary throughout the acquisition period, deployment, and operational life of a system. The Chairman of the Joint Chiefs of Staff (JCS) establishes procedures for and ensures compliance with certification of joint interoperability of IT and NSS systems throughout their systems' life cycles and ensures that the Services are included in the review process.

For MAISs, the MDA will not grant approval for System Development and Demonstration until the Service Head or designee certifies to the DOD Chief Information Officer (CIO) that the system is being developed in accordance with the Clinger-Cohen Act. Additional information, to include a full discussion of the milestone decision points, is located in the DOD 5000.1 and 5000.2 and in the Chairman JCS Instruction 3170.01A. These documents can be accessed from the Defense Acquisition Deskbook available at http://www.deskbook.osd.mil/.

b. Process analysis and business/functional process improvements must be evaluated prior to making C4/IT investments as mandated in the Clinger-Cohen Act. C4/IT investments must provide measurable improvements in mission performance. Prior to making an investment and initiating any process analysis or improvement, the following questions must be addressed:

(1). Does the process support core/priority mission functions?

(2). Can the process be eliminated?

(3). Can the process be accomplished more effectively, efficiently, and at less cost by another source, e.g., another MACOM or Federal organization, or the private sector?

Additional information on process analysis and business/functional process improvements is located in AR 25-1, Army Information Management available at ftp://pubs.army.mil/pub/epubs/pdf/r25_1.pdf.

c. The Army Enterprise Architecture (AEA) is the Army's corporate framework and management process for developing and maintaining a comprehensive, integrated IT systems blueprint. The Army's IT systems blueprint translates operational patterns into discrete warfighter capabilities and is fundamental to achieving information dominance by linking military strategy and doctrine to the employment of information technology used in executing military operations. The AEA is composed of three architecture views: Operational Architecture, Technical Architecture, and Systems Architecture, which are defined in the Joint Technical Architecture-Army. Compliance with the AEA applies to all IT systems (or IT portions of broader systems) developed, operated, or maintained by the Army organization or unit that produces, uses or exchanges information electronically.

Additional information on the AEA is located in the Army Enterprise Architecture Guidance Document available at http://arch-odisc4.army.mil/aes/html/homepage.htm.

d. Information Assurance provides a measure of confidence that the security features, practices, procedures, and architecture of an information system accurately mediates and enforces the security policy. Information Assurance seeks to maintain effective C2 of friendly forces by protecting critical information infrastructures from unauthorized users, detecting attempts to obtain or alter the information, and reacting to unauthorized attempts to obtain access to or change information. These measures focus on the integrity, confidentiality, availability, authentication, verification, protection, non-repudiation of the infrastructures and the information contained within. Information Assurance components will be designed to protect information from the wide-ranging threats to the Army's critical information infrastructures to include the basic facilities, equipment and installations needed for the function of a system, network, or integrated network that will support the National Security of the United States and the continuity of Government.

Additional information on IA is located in AR 25-1, Army Information Management available at ftp://pubs.army.mil/pub/epubs/pdf/r25_1.pdf. and in AR 380-19, Information Systems Security.

8-3. The Army IT OIPT Process

a. All systems having a program cost (including sunk cost) in excess of $32M (FY00 constant dollars) in any single year, or in excess of $126M (FY00 constant dollars) total program, or total life-cycle costs in excess of $378M (FY00 constant dollars), or those systems of special interest to the Army, OSD, or Congress are reviewed by the Army IT OIPT .

b. All systems identified with costs below the levels identified for OSD/Army IT OIPT review will utilize an In-Process-Review process with the MDA designated by the AAE.

FIGURE 8-1
Categories of Acquisition Programs and Milestone Decision Authorities

Program Category	Program Management	Primary Criteria ($ = FY00 constant)	Milestone Review Forum	Milestone Decision Authority
ACAT I				
ACAT ID	PEO/PM	more than $365M RDTE more than $2.190B Proc	DAB	USA(A&T)
ACAT IC	PEO/PM	more than $365M RDTE more than $2.190B Proc	ASARC	AAE
ACAT IA				
ACAT IAM	PEO/PM	excess of $32M single year excess of $126M total program excess of $378M total life-cycle costs	DoD IT OIPT	ASD(C3I)
ACAT IAC	PEO/PM	excess of $32M single year excess of $126M total program excess of $378M total life-cycle costs	Army IT OIPT	Army CIO
ACAT II				
ACAT II	PEO/MAT CMD CDR[3]/PM	more than $140M RDTE more than $660M Proc	ASARC	AAE[1]
ACAT III				
ACAT III	Lowest appropriate level	Non-major (including C4/IT) systems	IPR	Designated by the office of the AAE

Notes:

1. The AAE may redelegate MDA authority at his discretion to a level no lower than PEO-equivalent.
2. The CIO may redelegate MDA authority at his discretion to a level no lower than PEO-equivalent.
3. *MAT CMD CDR* is PEO-equivalent-level commander of a materiel developing command.

c. The Army IT OIPT for C4/IT is chaired by the Army CIO and serves as the Milestone Decision Authority. Other current voting members include the ASA (Installations and Environment) (ASA(I&E)), ASA (Financial Management and Comptroller) (ASA(FM&C)), ASA (Manpower and Reserve Affairs) (ASA(MRA)), Deputy Chief of Staff for Logistics (DCSLOG), Deputy Chief of Staff for Operations and Plans (DCSOPS), Deputy Chief of Staff for Personnel (DCSPER), Director, Program Analysis and

Evaluation (PA&E), Deputy Under Secretary of the Army (Operations Research) (DUSA(OR)), Deputy Under Secretary of the Army (International Affairs)(DUSA(IA)), Commander, Army Materiel Command, Commander, Training and Doctrine Command, General Counsel, The Surgeon General, Deputy Chief of Staff for Intelligence (DCSINT), Chief, Army Reserves, Chief, National Guard Bureau, Assistant Chief of Staff for Installation Management (ACSIM), Chief, Legislative Liaison, Military Deputy to the ASA(ALT), and Commander, Army Test and Evaluation Command (ATEC). Non-voting members include the Army Inspector General and USACEAC.

d. An Analysis of Alternatives (AoA) is prepared for System Development and Demonstration decisions or Production and Deployment decisions and provides a major portion of the documentation required for program initiation. The EA is prepared for System Development and Demonstration when more information is available on the program. The EA provides a more detailed breakdown of the program costs than does the AoA. Both the AoA and the EA should incorporate Clinger-Cohen Act requirements. The EA is updated as changes in costs occur over the economic life of the program. The cost estimates associated with the preferred alternative need to be updated for an IPR when there are issues related to cost, schedule or performance; an update of the non-preferred alternatives is not required.

e. EAs must be prepared as early as possible in the acquisition cycle, generally for System Development and Demonstration decisions, to support program funds in the Army Planning, Programming, Budgeting and Execution System (PPBES). Program and budget requests are based on the costs presented for the preferred alternative in the Army Cost Position (ACP).

f. Cost data is provided for each year of the C4/IT life cycle. Costs are input and displayed by cost element, fiscal year, and appropriation. These costs are then converted from constant to then year dollars or discounted dollars to obtain a present value estimate. See Appendix D for the cost element structure and detailed definitions of cost elements.

g. The Life Cycle Cost Estimate (LCCE) for the preferred alternative is an estimate of total program costs from program initiation until the end of the system's lifetime, usually defined as Full Operating Capability plus 10 years. This estimate is based on the estimated costs in the EA for the preferred alternative and the sunk costs expended to date. In order to support the comparative analysis process and/or benefit determination, the status quo (existing current system/baseline) must be fully documented and presented with complete cost estimates.

h. Sunk costs are past expenditures from prior fiscal years. Sunk costs must be provided in the documentation at the cost element level. These costs, however, are excluded from EA computations.

i. For a C4/IT systems, the economic life is normally 10 years. If the economic life is expected to be less than 10 years, the shorter economic life is used for the purpose of the EA. The EA must provide documentation to support the shorter economic life.

j. To ensure timely completion of the EA documentation, the following guidelines are provided:

(1) At least 75 working days prior to the Army IT OIPT milestone review, the PM submits the project documents (e.g., CARD) that form the basis for the EA to USACEAC. This data will be used by USACEAC in the preparation of -the Component Cost Analysis (CCA).

(2) At least 45 working days prior to the Army IT OIPT, the PM submits a validated EA (including all supporting documentation) to the USACEAC through the responsible PEO, HQDA element, or Functional Proponent. USACEAC, in coordination with the PM, reconciles the CCA with the EA to

develop a proposed ACP. The proposed ACP is provided to the Army PA&E for preparation of the Affordability Assessment. The proposed ACP with the Affordability Assessment is presented to the Cost Review Board (CRB) for approval.

(3) At least 15 working days prior to the Army IT OIPT (30 working days following receipt of the EA), the CRB provides a recommended ACP to the ASA(FM&C) for approval. The approved ACP establishes the cost position for all subsequent planning, programming, and budgeting activities.

8-4. OSD IT OIPT Process

a. The Office of the Assistant Secretary of Defense for Command, Control, Communications and Intelligence (C3I) provides an annual listing of programs designated as Major Automated Information System Acquisition Programs and Special Interest Initiatives and Related Oversight Requirements.

b. The Clinger-Cohen Act of 1996 (Division E) requires the DOD CIO to oversee all the Department's IT investments. MAIS acquisition programs are subject to oversight by the IT OIPT. Special interest initiatives do not require IT OIPT oversight, but are subject to review by the DOD CIO and the Army CIO.

c. All DOD CIO reviews of MAIS acquisition programs and special interest initiatives address the requirements contained in the May 1, 1997, joint memorandum on "Requirements for Compliance with Reform Legislation for Information Technology Acquisition (including National Security Systems).

d. The OSD IT OIPT is composed of OSD staff principals, with the Assistant Secretary of Defense C3I serving as chairman and Milestone Decision Authority. The Army CIO is the Army's representative to the OSD IT OIPT.

e. USACEAC serves as the Army focal point for the PEO, HQDA staff elements, and functional proponents to provide program information and support documentation to the OSD analysts in support of OSD IT OIPT reviews.

f. The following suggested timelines for document preparation ensures completion prior to the scheduled review:

(1) Twelve Months. The PM and the USACEAC representatives meet with OSD (PA&E) analysts to establish guidelines for the validation of costs and benefits.

(2) Six Months. The final CARD is submitted to OSD(PA&E) and USACEAC.

(3) Two Months. The PM and USACEAC reconcile differences between the EA and the CCA. The final EA, including all support documentation, is provided to the OSD (PA&E) analysts.

(4) One Month. The PM and USACEAC representatives provide a presentation with support documentation to the OSD (PA&E) analysts prior to convening the OSD IT OIPT.

g. The following must be accomplished when developing documentation for the OSD IT OIPT review:

(1) Coordinate the process between USACEAC and the OSD(PA&E) analyst.

(2) Define the requirements.

(3) Define the structure.

(4) Ensure that the system architecture is compliant with the mandatory Joint Technical Architecture-Army and the Army Enterprise Architecture.

(5) Ensure that all components of the system are included in the EA (e.g., government furnished equipment (GFE), contractor furnished equipment (CFE), costs for infrastructure, etc).

(6) Ensure that the EA covers the entire life cycle for the system. This should include estimates for reprocurement and incremental improvements for both hardware and software.

(9) Ensure that all costs and benefits are attributable to the system being costed and reviewed.

(10) Provide clear, detailed documentation of the estimates and provide the methodology and sources for determining the estimate.

(11) Document the functional relationship between the life-cycle costs and the life-cycle benefits.

(12) Document how benefits are derived based on expenditures for specific functions.

(13) Estimate the cost of software lines of code (LOC), function points (FP), etc. from data using completed programs or from an approved cost estimating model.

(14) Reconcile all differences between the CCA and the PM's EA.

8-5. IT OIPT Cost Documentation Requirements.

This section provides types of documentation normally required in the preparation of an EA. The same information is required by USACEAC for the CCA preparation. Normally, this is summarized in the CARD. Where additional data is useful, the CARD will cross-reference documents where the data can be found.

a. Program Definition. This information is provided in the Mission Need Statement, the Operational Requirements Document, and the Capstone Requirements Document.

b. Software Requirements. Items to be considered are architecture, functionality, estimated lines of code (including software reuse opportunities), proposed development and fielding schedule, testing schedule; language for applications development; maintenance; requirements for Commercial Off-the-Shelf (COTS) software and the cost of modifications if required; and plans for software incremental improvements.

c. Hardware Requirements. Types of hardware to be procured, quantities, locations, fielding schedule, maintenance, warranties, infrastructure requirements, installation resources the system shares with other systems; percentage of usage or other charges to the system; power consumption; plans for hardware upgrades (e.g. replacement of major components/refreshment of system on a specific schedule).

d. Communications Requirements. Types of circuits to be used, basic network structure, estimated throughput for each site, and infrastructure.

e. Training Requirements. The overall training strategy, the total number of trainees and specific number of classes to be conducted, the expected duration of each class, the sponsor, the location of the training, TDY requirements, and the availability of continued training required as a result of personnel turnover (e.g., rotations, promotions and retirements).

f. Operations Requirements. The number of full time, part-time, and contractor personnel by type of labor position (engineer, program manager, etc.) and location (e.g., remote site, installation) required to conduct operations. Burdened labor rates should be identified. Additionally, identify supply support.

g. Security Requirements. The requirements necessary to accommodate classified processing capabilities/interface for information by location and security level.

h. Facilities Requirements. The requirements for facility modifications, construction or lease.

i. Interface Requirements. The requirements to interoperate with other IT systems and which portion of the cost each system will absorb.

j. Funding Requirements. Identify the funding requirements by fiscal year and appropriation.

k. Contract Documentation. Contract documentation is a good source of cost data.

8-6. IT OIPT Cost Review Board (CRB) Process

a. This section provides information on the review and approval process for life cycle cost and life cycle benefit estimates prior to the IT OIPT review.

b. All IT systems undergoing an IT OIPT milestone review will update the EA in accordance with this manual. USACEAC will concurrently prepare a CCA, where doing so will add value to the ACP development process. A Cost IPT will be formed. The Cost IPT will determine the focus of cost estimating and will develop a consensus as to whether a CCA, or a single best estimate is appropriate.

c. The PM will provide copies of the EA to the Cost IPT. USACEAC will prepare an Independent Assessment (IA) of the benefits analysis, and will also formally task the functional proponent for comments. Both the USACEAC IA and the functional proponent evaluation of the benefits will be provided to the CRB, along with the CCA when applicable.

d. CRB membership consists of the following:

(1) CRB Chairperson – Principal Deputy Assistant Secretary of the Army (FM&C).

(2) CRB Executive Secretary (Non-Voting) – Deputy for Cost Analysis.

(3) Vice Director of Information Systems for Command, Control, Communications and Computers.

(4) Deputy Director, Program Analysis and Evaluation, Army Staff.

(5) Assistant Deputy Chief of Staff for Operations and Plans, Army Staff.

(6) Chief, Cost, Training and Doctrine, U.S. Army Training and Doctrine Command.

(7) Director of Assessment and Evaluation, ASA(ALT).

(8) Assistant Deputy Assistant of the Army for Installation and Environment.

(9) Assistant Deputy Assistant Secretary for Army Budget.

(10) Deputy Chief of Staff for Resource Management, U.S. Army Materiel Command.

(11) Assistant Deputy Chief of Staff for Logistics.

e. A CRB working group, chaired by a representative appointed by the ASA(FM&C), will convene after the CCA is completed and the EA is validated. The working group normally includes representatives of all CRB members. The CRB working group will:

(1) Review the CCA and the final EA.

(2) Reconcile the CCA and the EA, document the cost estimate reconciliation and adjusted benefits estimate and develop an ACP.

(3) Brief the ACP to the CRB.

(4) Forward CRB recommended ACP to the ASA(FM&C) for approval.

8-7 In Process Review Cost Review Board Process

a. If an EA is required for an In Process Review (IPR) or other non-milestone review the EA will be provided to USACEAC, or to the Cost IPT if one is formed. The functional proponent will review the life cycle cost and benefits.

b. USACEAC will prepare an IA of the EA; this includes comments on the life cycle cost and benefits portions of the EA. USACEAC will provide this information to the CRB working group. The CRB working group reviews the EA and the information provided by USACEAC and the functional proponent and reconciles variances to develop a recommended ACP.

8-8. Software Life Cycle Cost Estimating

a. Software life cycle costs account for a significant portion of the cost associated with IT systems. The software life cycle phases are plans and requirements, product design, detailed design, code and unit test, integration, implementation, operation and maintenance, and phase out. The most critical of all the phases is the plans and requirements phase. A thorough analysis of the software development requirements during this phase is critical.

b. A software life cycle cost estimating methodology can be developed by collecting historical data on systems similar to the one being modeled (analogy). This data is used to develop an empirical relationship between the tasks to be performed and the resources required. Software life cycle cost models are available, however, no one model accommodates all applications. The use of software life cycle cost models requires a high degree of professional judgment and experience in using the applications. The accuracy with which a model predicts cost is directly related to the similarity of the historical data input to the system being costed. It is important to remember that a software life cycle cost estimate model cannot produce an estimate that is more valid than the information provided.

c. Software life cycle cost estimating models are based on the estimated LOC or FP to be developed. The sizing of the development effort is directly related to the program requirements. Sizing of the development effort by analogy and function point analysis models are among the more common techniques when developing software life cycle cost estimates.

d. LOC/FP is a significant cost factor for developing the LCCE for a system. LOC/FP impacts both cost and schedule and accuracy is critical for developing a reasonable EA. Additionally, software reuse opportunities should be considered when developing the software life cycle estimate. Software reuse, when applicable, reduces the cost for developing software.

e. An integral part of a software project is the consideration of the costs for software incremental improvements. Incremental improvements are systemic to software and these costs must be considered when developing a reasonable EA. Costs for incremental improvements to software are calculated by using the same cost estimating methods previously discussed.

8-9. Acquisition Program Baselines for C4/IT Systems

The Acquisition Program Baseline (APB) documents the cost, schedule and performance objectives and thresholds of the program beginning at program initiation. The system developer, in coordination with the user, prepares the APB at program initiation and at each subsequent major milestone decision, program restructure or program deviation. The APB contains only the most important cost, schedule, and performance parameters. The most important parameters are those that, if the thresholds are not met, the MDA would require a reevaluation of alternative concepts or design approaches. More detailed information can be found in DOD 5000.2-R. This document can be accessed from the Defense Acquisition Deskbook available at http://www.deskbook.osd.mil/.

8-10. Acquisition Program Baseline Document Preparation

a. All IT acquisition programs shall establish an APB at program initiation. The APB is developed based on the performance requirements, schedule requirements and the estimate of total program cost. The APB should represent the program as it is expected to be produced or deployed. The APB contains a clear statement of the program objectives and brief statement specifying that the program can be managed to satisfy the requirements within approved funding and established schedule. The format and structure of this document are found in the Consolidated Acquisition Reporting System (CARS) Mandatory Procedures and Formats (see DOD 5000.2-R) and is available at http://www.deskbook.osd.mil/.

b. The PM, in coordination with the user, prepares the APB. The APB will be concurred in by the PEO or MACOM Commander (as appropriate) and the AAE (if appropriate) and approved by the MDA.

c. A funding analysis is an integral part of the APB. This analysis represents a profile of the system's acquisition cost and a profile of the approved funding for the system. The life cycle cost profile is based on the ACP. The ACP is developed from the PM's LCCE (the EA) and the USACEAC's CCA and approved by the ASA(FM&C). The approved funding figures come from the Future Years Defense Plan (FYDP) or other appropriate official source (e.g. President's Budget, Budget Estimate Submission). Funding requirements based on the approved ACP are entered into the program/budget process by creating a MDEP or updating an existing MDEP. The approved funding level for the system in this MDEP becomes part of the FYDP.

d. Program changes and/or changes to program resources are evaluated against the established APB, within the framework of the PPBES. Changes to the APB must be approved by the MDA.

e. Revisions to the approved APB occur subsequent to milestone reviews, program restructurings or unrecoverable program deviations. A program deviation occurs when the PM has reason to believe that the current estimate of a performance, schedule, or cost parameter is not within the threshold value for that parameter.

f. When making changes to the APB between milestone reviews, the funding display must be updated with the current funding level in the FYDP for system acquisition. If the program change is a result of a funding decrement, the unfinanced dollars will be documented in the deferred program content attachment that is required for the APB document update.

Appendix A
References

Section I
Required Publications

AR 11-18
The Cost and Economic Analysis Program

Section II
Related Publications

A related publication is merely a source of additional information. The user does not have to read it to understand this manual.

AR 25-1
Army Information Management

Department of the Army Cost Analysis Manual

DISC4 (SAIS-IAA)
Letter of Instruction for Conduct of Major Automated Information System (AIS) Reviews

DoDD 5000.1
Defense Acquisition

DoDI 5000.2
Defense Acquisition Management Policies and Procedures

DoD 5000.2M
Defense Acquisition Management Documents and Reports

DoD 5000.2-R
Mandatory Procedures or Major Defense Acquisition Programs (MDAPs) and Major Automated Information System (MAIS) Acquisition Programs

DoD 7000.14-R
Financial Management Regulation

DoDI 7041.3
Economic Analysis for Decision Making

OMB Circular A-76
Performance of Commercial Activities

OMB Circular A-94
Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs

OMB Circular A-109
Major Systems Acquisition

OMB Circular A-130
Management of Federal Information Resources

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Appendix C
Planning, Programming, Budgeting, and Execution System (PPBES)

C-1. Introduction

The PPBES is the Army's primary financial management system. The Army's portion of the defense program and budget is developed and maintained through the PPBES. It supports program development and budget preparation at all levels of command. It supports execution of the approved program and budget by both headquarters and field organizations. During execution, it provides feedback to the planning, programming and budgeting processes.

C-2. Process

The PPBES ties together the Army's long and near term strategic and tactical planning goals, program management objectives, budgetary requirements and resource execution plans. It helps build a comprehensive plan in which budgets flow from programs, programs from requirements, requirements from missions, and missions from national security objectives. The patterned flow - from end purpose to resource cost - defines requirements in progressively greater detail.

a. Long-range planning establishes a vision of the Army 10 to 30 years into the future. Long-range macro estimates give way in the two to fifteen year mid-term to a specified size, composition, and quality of divisional and support forces. This base force, derived from joint strategic planning and intermediate objectives, provides the planning foundation for program requirements.

b. In the zero to two year near term, budgeting converts program requirements into requests for manpower and dollars, which, when enacted into appropriations and manpower authorizations, become available to carry out approved programs.

c. Formally adding the execution process to the traditional emphasis on planning, programming, and budgeting emphasizes the Army's concern for how well program performance and financial execution apply allocated resources to meet established requirements.

C-3. PPBES Objectives

The objectives of the PPBES are:

a. Provide essential focus on Departmental policy and priorities for Army functional activities.

b. Through planning, determine the size, structure, personnel, equipment, and training required for the Army force to support the national military strategy.

c. Through programming, allocate available manpower, dollars, and materiel among competing requirements according to Army resource allocation policy and priorities.

d. Through budgeting, convert program decisions on dollars and manpower into requests for congressional authorization and appropriations.

e. Through program execution, apply resources to achieve approved program objectives and adjust resource requirements based on execution feedback.

f. Through program and budget execution, manage and account for funds to carry out approved programs.

C-4. Management Decision Packages (MDEPs)

a. Early in the PPBES process, the resource management architecture allocates program and budget resources by appropriation, standard study number (SSN) and program element (PE) to MDEPs. MDEPs serve as a resource management tool. Taken collectively, MDEPs account for all Army resources. They describe the capability of the Total Army (Active, Guard, and Reserve). Individually, an MDEP describes a particular organization, program, or function, and records the resources associated with the intended output.

b. During programming, MDEPs provide useful visibility. They help Army managers, decision makers, and leaders assess program worth, confirm compliance, and rank resource claimants. During budgeting, MDEPs help convey approved programs and priorities into budget estimates. Providing the vehicle for data entry, MDEPs also help in tracking post program changes caused by budget decisions and approved funding. During execution, the adjusted MDEPs help HQDA principal officials, major command commanders, Program Executive Officers, and heads of other operating agencies track program and financial performance. The financial data they get as feedback help determine future requirements.

Appendix D
Major IT System cost cell structure and definitions

The life cycle cost elements, categories, and definitions applicable to Major IT systems are provided below. It should be noted that the cost elements are intended to be tailored and augmented to meet individual program requirements and the respective decision review. Regardless of the exact element structure finally developed to display the project cost, all the costs associated with the program itself must be disclosed. Care must be taken to avoid including the same cost in more than one cost element, and thereby double counting costs. All estimates do not necessarily include all cost elements. Include only the appropriate cost elements in each estimate. The investment cost category and elements below encompass program cost as discussed in Chapter 8.

1.0 INVESTMENT

This major cost element includes all costs to the government to implement, fully, at all required operational sites, the IT system required to achieve and initially sustain Full Operational Capability (FOC) and the operational and economic return on investment estimated in the IT system benefit analysis and Functional Economic Analysis (FEA). Costs are attributable to the IT system from the time of program initiation through the complete fielding, implementation and testing required to meet FOC requirements. Phase out of the Status Quo IT system (if any) and Operating costs after FOC are excluded from this cost element. This phase includes cost elements from the beginning of the program through purchases of operational IT systems, upgrades to the system in order to satisfy the approved requirements, and other initial items (e.g., initial training, spares, supplies, etc.). Also included are the elements to implement the IT system, such as implementation and acceptance team testing, facility construction costs, and site activation, upgrades and disposal costs or reuse credits. It includes the direct investments of the program, as well as, those investments made by a central facility or Mega Center to support the IT system being estimated.

1.1 Program Management

The program management cost element is defined as the business and administrative planning, organizing, directing, coordination, controlling, and approval actions designated to accomplish overall program objectives which are not associated with specific hardware elements and are not included in systems engineering. Examples of these activities are: 1) Cost, schedule, performance measurement management, warranty administration, contract management, data management, vendor liaison, subcontract management, etc., and 2) Initial Logistics Support (ILS) element management defined as the logistics tasks management effort and technical control, and the business management of the elements of ILS. The logistics management function encompasses the Integrated Support Plan, ILS Management Team (ILSMT) participation, ILS evaluation and supportability assurance required to produce an affordable and supportable defense materiel system. This element includes the planning and management of all the functions of logistics and logistic support analysis, e.g., maintenance support planning; support facilities planning; other ILS requirements determination; support equipment; supply support; Packaging, Handling, Storage, and Transportation (PHST); provisioning requirements determination and planning; training system requirements determination; computer resource determination; organizational, intermediate, and depot maintenance determination; and data management.

1.1.1 Personnel

This cost element includes the direct activities of persons performing program management functions such as Program Manager, Program Control Officer, and program manager's staff and staff support. Their costs will be accumulated in the following appropriate categories:

1.1.1.1 Military
1.1.1.2 Civilian
1.1.1.3 Contractor

1.1.2 TDY

This cost element includes the travel costs (i.e., transportation, per diem, etc.) of persons in the program management function as they conduct program related trips.

1.1.3 Other Government Support

This cost element covers any indirect government personnel or other support related to program management and will be accumulated in the categories below:

1.1.3.1 Military
1.1.3.2 Civilian
1.1.3.3 Other

1.1.4 Other

This cost element covers any program management costs not covered in the other categories and may include such things as supplies, equipment, facilities, leasing, studies, contract management support, etc.

1.2 Concept Exploration

The Concept Exploration cost element is defined as all costs associated with the study, analysis, design development, and test involved in investigating alternative methods of delivering prototype(s) or end item(s) to fulfill a requirement.

1.2.1 Engineering Analysis and Specifications

This cost element contains the technical and management efforts of directing and controlling a totally integrated engineering effort of a system or program. The element encompasses the systems engineering effort to define system alternatives and associated integrated planning and control of the technical program efforts of design engineering, specialty engineering, production engineering, and integrated test planning. This element includes but is not limited to : the systems engineering efforts to transform an operational need or statement of deficiency into a description of system requirements and a preferred system configuration; and the technical planning and control effort for planning, monitoring, measuring, evaluating, directing and replanning the management of the technical program. It specifically excludes the actual design engineering and the production engineering directly related to the cost element with which it is associated. For specific engineering efforts to include, consult MIL-STD-881B, Appendix H-3. The costs will be accumulated in the categories below:

1.2.1.1 Military
1.2.1.2 Civilian
1.2.1.3 Contractor

1.2.2 Concept Exploration Hardware

This cost element includes costs incurred to acquire, lease, or modify all hardware necessary to design, engineer and modify hardware components, including GFE, as required to support Concept Exploration.

All costs associated with determining possible prototype alternative hardware configurations are captured in this element, but not the costs of acquiring such hardware (See Cost Element Structure (CES) 1.3.2.1).

1.2.3 Concept Exploration Software

This cost element includes all costs incurred to acquire or lease all software necessary to design, engineer and modify software for a system in direct support of determining possible system (prototype) alternative concepts, including GFE. Costs for software which are acquired or modified for the development effort, including prototype efforts, should be included in element 1.3.2.2.

1.2.3.1 COTS

This cost element includes any expense required to purchase, lease or otherwise acquire any commercial-off-the-shelf (COTS) software necessary for Concept Exploration.

1.2.3.2 Other Software

This cost element includes any expense required to purchase, lease or otherwise acquire any non-commercial software necessary for Concept Exploration.

1.2.3.3 Software Exploration

This cost element includes any labor expense required to modify or further develop any software in the support of the exploration of software (prototype) alternatives concepts.

1.2.3.3.1 Military
1.2.3.3.2 Civilian
1.2.3.3.3 Contractor

1.2.4 Concept Exploration Data

This cost element includes the cost to purchase, lease or develop data in support of the concept exploration of all system alternatives.

1.2.4.1 Data Acquisition

This cost element includes the cost to purchase, lease or otherwise acquire data required to support concept exploration.

1.2.4.2 Data Exploration

This cost element includes the labor cost associated with collecting, analyzing, transitioning and distributing data required to support concept exploration. Accumulate costs in the following appropriate categories.

1.2.4.2.1 Military
1.2.4.2.2 Civilian
1.2.4.2.3 Contractor

1.2.5 Documentation

This cost element includes the cost of preparation, revision, and reproduction of drawings, test plans, testing procedures, manuals and other system documentation in support of the concept exploration.

1.2.5.1 Documentation Acquisition

This cost element includes the cost to purchase, lease or otherwise acquire documentation required to support concept exploration.

1.2.5.2 Documentation Exploration

This cost element includes the labor cost associated with collecting, analyzing, transitioning and distributing documentation required to support concept exploration. Accumulate costs in the appropriate categories below.

1.2.5.2.1 Military
1.2.5.2.2 Civilian
1.2.5.2.3 Contractor

1.2.6 Concept Exploration Testing

This cost element includes testing activities associated with the use of specially fabricated hardware to obtain or validate engineering data on the performance of the system during the investment/development phase of the program. This element includes the detailed planning, conduct, support, data reduction and reports from such testing, and all hardware/software items which are consumed, or planned to be consumed, in the conduct of such testing. It also includes all costs associated with the design and production of models, specimens, fixtures, and instrumentation in support of the test program. Test articles which are complete units (i.e. functionally configured as required by specifications) are excluded from this element and should be included in CES 1.4. All formal and informal testing up through the subsystem level which can be associated with the hardware/software element are excluded. Acceptance testing is also excluded. These efforts are to be included with the appropriate hardware software elements.

1.2.6.1 Testing Acquisition

This cost element includes the cost to purchase, lease or otherwise acquire testing required to support concept exploration.

1.2.6.2 Testing Development

This cost element includes the labor cost associated with conducting, collecting data and analyzing tests required to support concept exploration. Accumulate costs in the appropriate categories below.

1.2.6.2.1 Military
1.2.6.2.2 Civilian
1.2.6.2.3 Contractor

1.2.7 Facilities

This cost element includes all costs incurred in the construction, modification and/or leasing of facilities required to support concept exploration for the automated information management system and/or testing the prototype.

1.2.8 Other (Logistical Support, Environmental, etc., as required)

This cost element includes any costs and support required to support concept exploration.

1.3 Development

This cost element includes all resource expenditures required to develop and prototype the alternative.

1.3.1 System Design and Specification

This cost element reflects the activities of personnel involved in designing/improving the IT system as well as any supplies consumed during the development.

1.3.1.1 Personnel

This cost element reflects labor costs required for the design, development and improvement of the alternative system.

1.3.1.1.1 Military
1.3.1.1.2 Civilian
1.3.1.1.3 Contractor

1.3.1.2 Other

This cost element includes any administrative design/improvement engineering support costs not covered in the categories above and may include such things as facilities, equipment and supplies.

1.3.2 Development, Prototype and Test Site Investment

This cost element includes costs incurred to acquire, lease, or modify all hardware and software necessary to design, engineer, develop, test, and modify hardware components of the system in this phase, including GFE.

1.3.2.1 Development Hardware Investment

This cost element includes the lease, purchase or modification of NDI hardware to facilitate the development phase of the alternative.

1.3.2.1.1 Test Site
1.3.2.1.2 Development Support
1.3.2.1.3 Modification
1.3.2.1.4 Prototype

1.3.2.2 Development Software Investment

This cost element includes the lease, purchase, or modification of COTS products required to support the development effort. Costs will be accumulated in the appropriate categories which follow.

1.3.2.2.1 General Administration
1.3.2.2.2 Operating Systems
1.3.2.2.3 Communications
1.3.2.2.4 DBMS
1.3.2.2.5 Tools
1.3.2.2.6 Other (License)

1.3.3 Software Development

1.3.3.1 Commercial Off-the-Shelf (COTS) Modification

This cost element includes the cost of labor for developing software for a particular application and all of the lease, purchase, and modification costs associated with the different types of software. Categorize all software development personnel requirements into military, civilian or contractor.

1.3.3.1.1 Military
1.3.3.1.2 Civilian
1.3.3.1.3 Contractor

1.3.3.2 Application/Mission Software (Non COTS)

This cost element describes all costs required to develop deliverable lines of application software. This might include the lease, purchase, or modification of products which assist in the planning, designing, testing, de-bugging, validating, and documenting the application software necessary to automate a specific function or operation and integrate that function into the overall IT system. When converting an IT system from an old system to a new system, software development costs should reflect the amount of code to be transferred without modification, transferred with minor modification, bridged, redesigned, and eliminated. For contractor developed software include all program management, G&A, and other contractor related costs. For organic software development, fully burdened labor rates should be used and placed in the appropriate labor category.

1.3.3.2.1 Military
1.3.3.2.2 Civilian
1.3.3.2.3 Contractor

1.3.3.3 Communications Software Development/Modification

This cost element contains all costs for software to establish the connectivity required by the specific system.

1.3.3.3.1 Military
1.3.3.3.2 Civilian
1.3.3.3.3 Contractor

1.3.4 System Documentation

This cost element captures the costs associated with various system documentation requirements which follow. Accumulate the costs in the appropriate categories below.

1.3.4.1 Military
1.3.4.2 Civilian
1.3.4.3 Contractor

1.3.4.3.1 Technical Publications

This cost element includes data which provides instruction for the installation, operation, maintenance, training, and support of a system or equipment which is formatted into a technical manual. A technical manual normally includes operation and maintenance instructions, parts list or parts breakdown, and related technical information or procedures exclusive of administrative procedures. This data may be presented in any form, regardless of the form or method of recording.

1.3.4.3.2 Engineering Data

This cost element describes the cost of recorded information, regardless of the form or method of recording, of a scientific or technical nature, including computer software documentation. Engineering data does not include computer software or financial, administrative, cost or pricing, or management data or other information incidental to contract administration. Engineering data is required to define and document an engineering design or product configuration, sufficient to allow duplication of the original items, and is used to support production, engineering and logistics activities. This element includes, for example, all final plans, procedures, reports, and documentation pertaining to systems, subsystems, computer and computer resource availability and maintainability, and other engineering analysis, etc. A technical data package (re-procurement package) includes all engineering drawings, associated lists,

process descriptions, and other documents which define the physical geometry, material composition, and performance procedures.

1.3.4.3.3 Management Data

This cost element describes data items necessary for configuration management, cost, schedule, contractual data management, program management, etc., required by the government. This element includes contractor cost reports, cost performance reports, contractor fund status reports, schedules, milestone, networks, integrated support plans, etc.

1.3.4.3.4 Support Data

This cost element includes data items designed to document the support planning. This cost element includes, for example, LSA documentation and LSA record maintenance and delivery, supply, general maintenance plans and reports, training data, transportation, handling, packaging information, facilities data, data to support the provisioning process and all other support data and software supportability planning and software support transition planning documents.

1.3.5 Data Development and Transition

This cost element captures the costs for all labor associated with a variety of data types and includes all cost to design the logical data model to support the applications; DBMS requirements analysis; file design; data standardization and configuration management; data transiting, conversion and migration; and data validation. Include all costs associated with the requirements for conforming with DoD data standards or participation in activity for the DoD data element dictionary development. CES 1.3.5.4 includes COTS DBMS license costs to support the application development. Costs will be accumulated in the appropriate categories below.

1.3.5.1 Military
1.3.5.2 Civilian
1.3.5.3 Contractor
1.3.5.4 COTS DBMS

1.3.6 Data Base Standards and Dictionary

This cost element captures the costs for all labor associated with the development of data base definition standards and a single data base dictionary to support multiple applications, functional disciplines and operational (service) units, that will be supported, in an integrated fashion, by the alternative IT system.

1.3.6.1 Military
1.3.6.2 Civilian
1.3.6.3 Contractor
1.3.6.4 COTS DBMS

1.3.7 Training Development

This cost element aggregates the cost of training development/delivery personnel and the equipment and aids the personnel must use in their development/delivery efforts. Include all non-labor costs incurred in developing appropriate training services, devices, accessories, aids and equipment used to facilitate instruction through which personnel will acquire sufficient concepts, skills and aptitudes to operate and maintain the IT system in the other category.

1.3.7.1 Military
1.3.7.2 Civilian
1.3.7.3 Contractor

1.3.7.4 Other

1.3.8 Test and Evaluation

This cost element aggregates the costs for the various types of testing which occur in the development effort.

1.3.8.1 Development Test and Evaluation

This cost element describes the test and evaluation conducted to: (a) demonstrate that the engineering design and development process is complete; (b) demonstrate that the design risks have been minimized; (c) demonstrate that the system will meet specifications; (d) estimate the system's military utility when introduced; (e) determine whether the engineering design is supportable for operational use; (f) provide test data with which to examine and evaluate trade-offs against specification requirements, life-cycle cost, and schedule; and (g) perform the logistics testing efforts to evaluate the achievement of supportability goals, the adequacy of the support package for the system, (e.g., deliverable maintenance tools, test equipment, technical publications, maintenance instructions, and personnel skills and training requirements, etc.). development test and evaluation includes all contractor and in-house effort and is planned, conducted and monitored by the developing agency of the DoD Component. The Other category below is for costs representing supplies and hardware items consumed during the testing period.

1.3.8.1.1 Military
1.3.8.1.2 Civilian
1.3.8.1.3 Contractor
1.3.8.1.4 Other

1.3.8.2 Independent Verification and Validation

This cost element reflects those costs incurred for the independent testing of the alternative. The Other category is for supplies and hardware consumed during the testing period.

1.3.8.2.1 Military
1.3.8.2.2 Civilian
1.3.8.2.3 Contractor
1.3.8.2.4 Other

1.3.8.3 Operational Test and Evaluation

This cost element describes the test and evaluation conducted by agencies other than the developing command to assess the prospective systems military utility, operational effectiveness, operational suitability, logistics supportability, cost of ownership, and need for any modifications. Initial operation test and evaluation conducted during the development of an IT system will be included in this element. This element encompasses such tests as system demonstration, qualification operational test and evaluation, etc., and support thereto, required to prove the operational capability of the deliverable system. It includes contractor support consumed during this phase of the testing. It also includes performing the logistics testing efforts to evaluate the achievement of supportability goals and the adequacy of the support for the system. The other category is for costs of supplies and hardware items consumed during the test period.

1.3.8.3.1 Military
1.3.8.3.2 Civilian
1.3.8.3.3 Contractor
1.3.8.3.4 Other

1.3.9 Development Logistical Support

This cost element includes all logistics support costs required to support system development. In addition, it includes costs incurred in completing the development of logistics plans and services, through which logistical support will be available when necessary to support operation of the IT system. Includes all labor and non-labor costs associated with developing logistical support for this phase of the program.

1.3.9.1 Military
1.3.9.2 Civilian
1.3.9.3 Contractor
1.3.9.4 Other

1.3.10 Facilities

This cost element includes all costs incurred in the construction and modification of facilities required to support development of the IT management system and/or testing the prototype.

1.3.11 Environmental

This cost element includes all costs associated with environmental studies, protection and enhancements.

1.3.12 Other Development

This cost element includes all costs associated with development of the IT system which have not been captured in the above cost elements.

1.4 System Procurement

This cost element includes the costs for acquisition of all the elements (hardware, software, equipment, facilities and initial support) required to attain system FOC.

1.4.1 Deployment Hardware

This cost element includes all of the costs associated with deployment hardware. Hardware costs include vendor contracts, GFE, other Government contracts, and any organic effort used to acquire or purchase program hardware. Include costs for first destination transportation, warranties, and user's manuals. Include the depreciated value for government owned equipment that will be utilized by the system regardless of when it was purchased and the reason for which it was purchased. Include the lease for the entire life cycle or until terminated or the equipment is purchased. Although compliance with the hardware categories listed below is preferred, it is not conducive for systems which are acquired by specific configuration, i.e., specific configuration by site size or site functionality. In this case the acquisition community normally procures the hardware by configuration and the specific hardware cost categories listed below are not available. If this is the case, develop the hardware estimate based on configurations, however, attempt to maintain as much detail as possible for specific hardware components. The cost to the government to provide out-source, central or mega center are excluded from this element and should be included in cost element 1.5, “Outsource/Central/Mega Center Investment”.

1.4.1.1 Processing Units

This cost element aggregates the cost for various types of processing units and reflects the costs to lease, purchase or produce, or otherwise acquire system processing units regardless of source or funding.

1.4.1.1.1 Central Processing Units

This cost element includes all costs associated with the production and/or purchase or lease of the central processing units. Includes mainframes and associated hardware.

1.4.1.1.2 Intermediate Processing Units

All costs associated with the production and/or purchase or lease of the intermediate processing units. Includes mini computers and associated hardware.

1.4.1.1.3 Terminal Processing Units (PCs)

All costs associated with the production and/or purchase or lease of the terminal processing unit. Includes micro computer, PCs, laptops, workstations, terminals, etc., and associated hardware.

1.4.1.2 Peripheral Devices

All costs associated with the production and/or purchase or lease of peripheral devices used by the system. Peripheral devices shared by other systems will be prorated.

1.4.1.2.1 Printers

This cost element includes all costs associated with the production and/or purchase or lease of printers. List laser printers, high speed printers and common impact printers separately.

1.4.1.2.2 Storage Devices

This cost element includes all costs associated with the production and/or purchase or lease of storage devices. List disk drivers and optical storage separately only when they are not a functioning part of the mainframe.

1.4.1.2.3 Other Peripherals

This cost element includes all costs associated with the production and/or purchase or lease of other peripheral devices not accounted for in the categories above.

1.4.1.3 Communications Hardware

This cost element includes all costs for the hardware to establish the connectivity required by the specific system.

1.4.1.3.1 Wide Area Gateways

This cost element includes all costs associated with the production, purchase, installation and/or lease of wide-area gateways (broad band) necessary to establish the connectivity required by the IT system.

1.4.1.3.2 Wide Area Networks

This cost element includes all costs associated with the production, purchase, installation and/or lease of wide-area networks necessary to establish the connectivity required by the IT system.

1.4.1.3.3 Modems

This cost element includes all costs associated with the production, purchase and/or lease of modems necessary to establish the connectivity required by the IT system.

1.4.1.3.4 Local Area Networks (LAN)

This cost element includes all costs associated with the production, purchase, installation and/or lease of local area networks necessary to establish the connectivity required by the IT system. If the LAN is part of a geographic communications upgrade, establish a pro-rata share.

1.4.1.3.5 Crypto

This cost element includes all costs associated with the production, purchase, installation and/or lease of crypto devices necessary to establish the security in connectivity required by the IT system.

1.4.1.3.6 Communications Circuits

This cost element includes all costs associated with the production, installation purchase, and/or lease of other communication circuits necessary to establish the connectivity required by the IT system.

1.4.1.3.7 Other Communication Hardware

This cost element includes all costs associated with the production and/or purchase or lease of other communication hardware.

1.4.1.4 Other Hardware

This cost element includes all other hardware cost not previously detailed, such as satellite down links, radios, external power sources, dedicated trailers/vans, vehicles and mobile structures. Specify each hardware item in sub-elements of this cost element. Also, include any lease of hardware in lieu of investment.

1.4.2 System Deployment Software

This cost element includes all the cost to acquire software required to support full system deployment. This is normally software which is available in the commercial market. In a multi-tiered environment (Macro, Mini, Micro) each tier should be shown separately.
(Note: Application/Functional software development/procurement costs are included under cost element 1.3.3.2. The cost to develop or further modify non-developmental software is included under cost element 1.3.3.1.)

1.4.2.1 Operating System Software

This cost element includes cost of the basic operating system software.

1.4.2.2 General Administrative Software

This cost element includes cost for commercial application software, such as, spreadsheets, word processing, various statistical and mathematical packages, and general data base management packages needed to perform general tasks and improve the productivity of the users.

1.4.2.3 Tools Software

This element describes leases and/or purchases of CASE tools and compilers prescribed for the environment under which the application software will run.

1.4.2.4 Communication Software

This cost element includes all costs for the software to establish the connectivity required by the specific system.

1.4.3 Initial Documentation Requirements

This cost element includes all costs incurred in preparation, revision, and reproduction of drawings, test plans, testing procedures, manuals, and other documentation for the operation of the system. Includes the cost of contracts, to collect, analyze, and distribute data required to procure, operate and support the developed system.

1.4.4 Logistics Support Equipment

This element includes those costs incurred for the equipment required in support of this program or portions of this program, while not directly engaged in the performance of its mission. Includes GFE which may, or may not, be peculiar to the program but which is not considered a part of the total system.

1.4.5 Initial Spares

This cost element includes components, assemblies, and subassemblies required for initial stockage and related wholesale pipeline in support of the information management system being implemented, from the first to the last end item implemented. This element should contain all the costs incurred in the supplying of reserve spares, and repair parts to stock the initial pipeline in both peacetime and wartime. These costs include transportation and storage of these supplies and spares.

1.4.6 Warranties

This cost element includes costs for warranties and special warranties on both hardware and software (identified separately) purchased for this system. If these warranties are included in the hardware and/or software purchase price, so state in those respective elements.

1.5 Outsource/Central/Mega Center Investment

This element includes all investment, or lease in lieu of investment, required by any outsource support provider as required for the system to attain and maintain FOC.

1.5.1 Capital Investment

1.5.1.1 Hardware

This cost element includes all of the costs associated with deployment hardware. Hardware costs include vendor contracts, GFE, other Government contracts, and any organic effort used to acquire or purchase program hardware. Include costs for first destination transportation, warranties, and user's manuals. Include the depreciated value for government owned equipment that will be utilized by the system regardless of when it was purchased and the reason for which it was purchased. Equipment/Systems which are designed to support multiple users will be prorated and the costs will factored out of the surcharge reflected in CES 2.3.3 and 3.3.4.

1.5.1.2 Software (COTS)

This cost element includes all the cost to acquire software required to support the alternative system deployment. This is normally software which is available in the commercial market.

1.5.1.3 Leasing (In lieu of direct investment)

1.5.1.3.1 Hardware

Include the lease for the entire life cycle or until terminated or the equipment is purchased.

1.5.1.3.2 Software

This cost element includes the cost to lease software required to support the alternative system deployment. This is normally software which is available in the commercial market.

1.5.2 Central/Mega Center Software Development

This cost element describes all costs required to develop deliverable lines of application software. This might include the lease, purchase, or modification of products which assist in planning, designing, testing, de-bugging, validating, and documenting the application software necessary to automate a specific function or operation and integrate that function into the overall IT system. When converting an IT system from an old system to a new system or adding an IT system to the systems supported by the Center, software development costs should reflect the amount of code to be transferred without modification, transferred with minor modification, bridged, redesigned, and eliminated. For contractor developed software include all program management, G&A, and other contractor related costs. For organic software development, fully burdened labor rates should be used and placed in the appropriate labor category.

1.5.2.1 Military
1.5.2.2 Civilian
1.5.2.3 Contractor

1.5.3 System User Investment
This element includes costs incurred for system user interface with the outsource supplier.

1.6 System Initiation, Implementation and Fielding
This cost element aggregates the costs incurred in initiating the system for use by the functional user. It includes all costs required to transition the system to users, including training, testing, purchasing supplies, etc. Most elements contain personnel; include in other, the cost of supplies, etc.

1.6.1 Initial Training
This cost element includes all costs incurred in developing appropriate training services, devices, accessories, aids, and equipment used to facilitate instruction through which personnel will acquire sufficient concepts, skills, and aptitudes to operate and maintain the IT system. This includes all effort associated with design, and development, of training equipment as well as the execution of training services needed for the development of a system.

1.6.1.1 Military
1.6.1.2 Civilian
1.6.1.3 Contractor
1.6.1.4 Other

1.6.2 System Integration Site Test/Acceptance
This cost element includes all costs for system related production test activities which are identifiable with the integration and evaluation of the system. Included is the cost of test equipment, hardware, and/or software to obtain or validate data. Also included is the cost of planning, execution, support, data reduction, and reports from such testing and test items consumed in the conduct of such operations, and any contract costs, as well as the cost of design and production of models, specimens, fixtures, and instrumentation in support of the test program. The element also includes the costs of system operational test activities to ensure proper system installation and operation and the cost of all efforts associated with the design and production of models, fixtures, and the instrumentation in support of the test program.

1.6.2.1 Military
1.6.2.2 Civilian
1.6.2.3 Contractor
1.6.2.4 Other

1.6.3 Common Support Equipment
This cost element refers to those items required to support and maintain the system or portions of the system while not directly engaged in the performance of its mission, and which are presently in the DoD inventory for support of other systems. This element includes all efforts required to assure the availability of this equipment for support of the particular defense materiel item. It also includes the acquisition of additional quantities of this equipment if caused by the introduction of the defense materiel item into operational service.

1.6.4 Site Activation and Facilities Preparation

This element contains all costs incurred in the site survey, preparation, construction and activation of a site for the acceptance and operation of the system. This element includes all costs of construction and modification of facilities which are required for the successful fielding of the system and meets the following test: The information system cannot be fielded without the construction and the need for these facilities will terminate if the system to be fielded is canceled.

1.6.4.1 Military
1.6.4.2 Civilian
1.6.4.3 Contractor
1.6.4.4 Other

1.6.5 Initial Supplies

This cost element includes all costs for initial stocking of consumable supplies for the operation of the information management system, i.e. computer paper, disks, tapes, forms, ribbons, etc.

1.6.6 Engineering Changes

This cost element includes costs incurred in making engineering changes to the system hardware throughout the system life. Does not include hardware/software upgrades.

1.6.6.1 Military
1.6.6.2 Civilian
1.6.6.3 Contractor
1.6.6.4 Other

1.6.7 Initial Logistics Support

Includes the cost elements identified in 2.0 from IOC at **each** site until FOC at **all** sites. At FOC at all sites, the costs reflected in these cost elements will be shown under CES 2.0. These elements do not apply to the Status Quo alternative.

1.6.7.1 Annual Operations Investment
See CES 2.2

1.6.7.2 Hardware Maintenance
See CES 2.3

1.6.7.3 Software Maintenance
See CES 2.4

1.6.7.4 Mega Center Ops & Maintenance Support
See CES 2.5

1.6.7.5 Data Management
See CES 2.6

1.6.7.6 Unit Site Operations
See CES 2.7

1.6.8 Office Furniture and General Support Furniture

Includes costs for office and general support furniture required to support the IT system if it is intended for the sole use of the IT system. Office furniture to support management functions is included in CES 1.1.4.

1.6.9 Data Upload & Transition

Includes site/function specific initial loading and checkout of data for the system if accomplished separately from software installation and test. Also include any expense associated with the transition of data from the current system. Accumulate costs in the appropriate categories below.

1.6.9.1 Military
1.6.9.2 Civilian
1.6.9.3 Contractor

1.6.10 Base/Installation Communications

Includes all costs, not already included in cost element 1.6.4, associated with installation communications required for the IT system to meet its operational requirements. Note: Reference cost element 1.4.1.3, do not double count costs.

1.6.10.1 Military
1.6.10.2 Civilian
1.6.10.3 Contractor
1.6.10.4 Other

1.6.11 Other

This cost element covers any System Initiation, Implementation and Fielding cost not included in the elements above, including second destination transportation.

1.7 Upgrade/Preplanned Product Improvement

This cost element includes the cost of enhancements to the alternative throughout the life cycle. In planning life cycle requirements and calculating economic benefits of IT systems, five years from the initial date of installation will be used as the metric for obsolescence. Serviceability, maintainability, and utility will also be used as factors to consider in specific life cycle replacement decisions. This metric may vary according to mission requirements. (Reference is final draft AR 25-1, Army Information Management, 6.2 (j). In many cases when hardware changes are made, software is also upgraded to take maximum advantage of the increased hardware capability.

1.7.1 Upgrade Development

This cost element includes the <u>development</u> costs of all pre-planned product improvements throughout the alternative system life for hardware and software. System planning should include provisions for product upgrades during the projected life span to cover potential obsolescence, lack of support, or incorporation of alternative products or technologies when such changes are justifiable and cost effective. (Reference is final draft AR 21-1, Army Information Management, 6.2 (j This is in addition to the annual software maintenance costs reflected in CES 2.4.

1.7.1.1 Hardware

1.7.1.2 Software

1.7.1.2.1 Military
1.7.1.2.2 Civilian

1.7.1.2.3 Contractor

1.7.2 Life Cycle Upgrades Procurement

This cost element includes all product improvement upgrade costs throughout the system life cycle. Specifics of hardware and software upgrades should be well documented.

1.7.2.1 Hardware Upgrades

1.7.2.2 Software Upgrades

This cost element includes all the cost to acquire software required to accommodate the hardware upgrade. This is normally software which is available in the commercial market.

1.7.2.3 Other

1.7.3 Central Mega Center Upgrades

1.8 Disposal/Reuse

1.8.1 Capital Recoupment

This cost element captures the value of any assets turned in to a repository for redistribution or any assets which may have recyclable value.

1.8.2 Retirement

This cost element captures the cost of the effort required to dispose of equipment and may include charges for destroying the equipment.

1.8.3 Environmental/Hazardous Disposal

This cost element captures the cost of the effort required to dispose of environmental hazardous equipment and may include charges for destroying the equipment

2.0 SYSTEM OPERATIONS AND SUPPORT

This major element includes all costs to sustain the IT systems alternative after FOC at all sites. It includes the cost to manage and maintain the hardware and software, whether centrally or at each unit, to sustain operations throughout the life cycle, and to provide the basis for the benefits identified in the FEA. This major cost element will be used to show <u>all</u> costs associated with the operations of the Status Quo alternative. When providing the cost estimate for the Status Quo alternative, this element will be used to identify the costs from program inception through FOC plus ten years.

2.1 System/Material/Item Management

This cost element covers the resource requirements for system management. Management includes the costs incurred in the process of acquiring, employing, and retraining needed personnel, i.e. fully burdened salaries, benefits, relocation expenses, retirement accrual, required TDY, and all costs associated with the personnel of the deployed IT systems. It also includes the services, studies and support resources needed to manage the program after deployment.

2.1.1 Personnel

This cost element contains all labor cost associated with O&S costs for configuration, material, and systems management associated with the distribution, warehousing, cataloging, technical support, personnel, and facilities for system specific activities. It includes the program management function after FOC, and the centralized control, management, and design of the IT systems throughout its life cycle. It

also includes the centralized system administrators and system operators. The personnel necessary to operate the IT system at each unit location are included in cost element 2.7.1. Accumulate costs in the appropriate categories below.

2.1.1.1 Military
2.1.1.2 Civilian
2.1.1.3 Contractor
2.1.1.4 Other

2.1.2 TDY

This cost element includes the travel costs of persons in the system/material/item management function as they conduct program related trips.

2.1.3 Other Government Support

This cost element covers any indirect government support costs related to system/material/item management not covered in the categories above.

2.1.3.1 Military
2.1.3.2 Civilian
2.1.3.3 Other

2.1.4 Other

This cost element covers any system/material/item management costs not covered in the categories above and may include such things as facilities, leasing, studies, contract management support, supplies, etc.

2.2 Annual Operations Investment

This element contains all costs associated with the acquisition and first destination transportation of replacement components, replenishment spares, supplies and consumables required over the life cycle of the specific system. Included are costs incurred in the acquisition of replacement parts, supplies and consumables to re-supply the initial pipeline. The replacement of major system components that cost in excess of $25K each must be included under cost element 1.0, “Investment”. Accumulate costs in the appropriate categories below.

2.2.1 Annual Systems Maintenance Investment
2.2.2 Replenishment Spares
2.2.3 Replenishment Supplies and Consumables

2.3 Hardware Maintenance

This cost element includes cost incurred in providing maintenance and repair for the system hardware regardless of who has "ownership" of the equipment or responsibility for repair. These costs include, but are not limited to: overhaul expenses, programmed maintenance expense (periodic inspection of war reserve material), component repair, minor facilities modifications and upkeep, support equipment repair (test equipment, trucks, generators, etc.), lab calibration, depot support data, second destination transportation, and administrative support required for maintenance operations. All equipment covered in CES 1.4.1 and 1.5.1 should be included. Note: When maintenance support is not accomplished by a local facility, organic or contract, such as overseas, remote locations, mobile operations, and due to contract considerations, cost for additional components and spares that must be provided at the deployed locations are included in CES 1.4.5.

2.3.1 Organic Hardware Maintenance

This cost element captures the fully burdened labor costs associated with government hardware maintenance for the fielded system. Accumulate the costs in the appropriate categories below.

2.3.1.1 Military

2.3.1.2 Civilian

2.3.2 Contract Maintenance Support

This cost element aggregates all costs for maintenance performed by contract or covered by an Interservice Support Agreement (ISSA).

2.3.2.1 Processing Units

This cost element covers the maintenance for CES 1.4.1.1. Provide details in the documentation.

2.3.2.2 Peripheral Devices

This cost element covers the maintenance for CES 1.4.1.2. Provide details in the documentation.

2.3.2.3 Communications Hardware

This cost element covers the maintenance for CES 1.4.1.3. Provide details in the documentation.

2.3.2.4 Other Hardware

This cost element describes all other contractor hardware maintenance costs which have not been captured in the hardware maintenance categories above. List each sub-element under this cost element and describe fully.

2.3.3 Other Hardware Maintenance

This cost element includes all hardware maintenance costs which are incurred by a centralized support facility.

2.3.3.1 Outsource /Mega Center Support

2.3.3.2 Other Government Agency Support

2.4 Software Maintenance

This element includes all costs for software maintenance for the new system. When identifying software and data maintenance costs in these categories include vendor contracts, GFE, other Government contracts, facilities upkeep, and ISSAs. It does not includes system management activities such as system redesign or programmers/operators which are covered under CES 2.1. All software maintenance costs including related local contract services for research and studies that contribute to software and data maintenance planning, and development must be included.

2.4.1 Commercial-off -the Shelf (COTS)

This cost element aggregates the software maintenance costs for the four different software types listed below.

2.4.1.1 Operating System Software

This cost element reflects licensing and update costs of the operating system software. See CES 1.4.2.1.

2.4.1.2 General Administrative Software

This cost element reflects maintenance of software identified in CES 1.4.2.2 and that software which was transferred from the old system to the new system without development.

2.4.1.3 Tools
This cost element reflects maintenance of software identified in CES 1.4.2.3.

2.4.1.4 Communications Software
This cost element reflects maintenance of software identified in CES 1.4.2.4.

2.4.2 Application/Mission Software (Non-COTS)
This cost element describes the maintenance of software identified in CES 1.3.3.2. Accumulate the costs in the appropriate categories below.

2.4.2.1 Military
2.4.2.2 Civilian
2.4.2.3 Contractor

2.4.3 Communications Software (Non-COTS)
This cost element describes the maintenance of the Communications Software developed in CES 1.3.3.3.

2.4.3.1 Military
2.4.3.2 Civilian
2.4.3.3 Contractor

2.4.4 Data Center Software
This cost element describes the maintenance of the Data Center Software developed in CES 1.5.2.

2.4.4.1 Military
2.4.4.2 Civilian
2.4.4.3 Contractor

2.4.5 Other Software Maintenance
This cost element includes all other software maintenance costs not captured in the categories above. List each sub-element and fully describe.

2.4.5.1 Military
2.4.5.2 Civilian
2.4.5.3 Contractor

2.5 Mega-centers Operating Support
This cost element contains the costs associated with services received by the IT systems from a Mega-center in support of systems operations. When investment and operating support costs are included in an annual surcharge or fee, this fee will be separated into the various components which generated that fee and added to the appropriate elements of this CES.

2.6 Data Maintenance
This cost element reflects the maintenance costs to keep the new system data current. It includes labor expense to accomplish data maintenance as well as specific supplies consumed during the maintenance of the data in the two categories listed below.

2.6.1 Mission Application Data
This cost element reflects the maintenance cost for mission specific data developed in CES 1.3.5.

2.6.1.1 Military
2.6.1.2 Civilian
2.6.1.3 Contractor
2.6.1.4 Other

2.6.2 Standard Administrative Data
This cost element reflects the maintenance cost for standard administrative data developed in CES 1.3.5.

2.6.2.1 Military
2.6.2.2 Civilian
2.6.2.3 Contractor

2.7 Unit/Site Operations
This cost element includes personnel costs, as well as fuel and power requirements, training, communications, facilities maintenance, etc.

2.7.1 System Operation Personnel
This element includes the decentralized system administrators and system operators. It includes the personnel necessary to operate the hardware/software. It does not include functional personnel who interface with the system. Accumulate costs in the appropriate categories below.

2.7.1.1 Military
2.7.1.2 Civilian
2.7.1.3 Contractor

2.7.2 Utility Requirements
This cost element includes the costs of commercial utilities (power, water, etc.) required for the operation and cooling of the system hardware including all peripheral devices.

2.7.3 Fuel and POL
This element includes the costs for fuel, oil, and lubricants to operate the system and support equipment. Examples are fuels for generators and vehicles and coolants for environmental control systems.

2.7.4 Facilities Lease and Maintenance
This element contains all costs associated with support facilities operations which can be directly attributed to the system being fielded or in support of its personnel. These costs include, but are not limited to: facilities, power requirements, special material and supplies, leased or owned facilities, and construction, operations, maintenance of facilities.

2.7.5 Communications
This cost element aggregates the cost of leasing and maintenance for the system communications.

2.7.5.1 Long Haul
This cost element includes costs for all required communications from the local (base) level through the DoD level, such as leased long lines, long distance networks for data and voice, and other costs to interconnect components of the IT systems and interface with other systems (including input and output).

2.7.5.2 Intra-Base

The cost of leasing or maintenance of local area networks and intra base communications. When communications are shared, costs will be prorated, and the proration methodology will be reflected in the documentation.

2.7.6 Base Operating Support

The allocated cost of providing personnel support to the system's dedicated personnel. This includes medical, personnel, MWR, financial and subsistence support to people. It is normally based on the population of system personnel being supported.

2.7.7 Recurring Training

This element contains all costs associated with training services, devices, accessories, aids, equipment, facilities, and parts used to facilitate instruction through which personnel will acquire sufficient concepts, skill, and aptitudes to operate and maintain the information management system. This element includes the effort associated with the maintenance of training equipment, as well as the execution of training services. It includes the basic, burdened wage of the trainers, but not the wage of the trainees covered in CES 2.7.1. It also includes TDY of Government personnel for training, and the cost of any contracts to train personnel. Costs will be accumulated in the appropriate categories below.

2.7.7.1 Military
2.7.7.2 Civilian
2.7.7.3 Contractor
2.7.7.4 Other

2.7.8 Miscellaneous Support

This cost element describes all other resources necessary to support the IT systems in the local areas. Accumulate the costs in the appropriate categories below. Include second destination transportation in the other category.

2.7.8.1 Military
2.7.8.2 Civilian
2.7.8.3 Contractor
2.7.8.4 Other

2.8 Environmental and Hazardous Material Storage and Handling

This cost element includes all support and maintenance costs associated with environmental studies, protection, and enhancements, including costs associated with the handling and storage of environmental and hazardous materials associated with the specific IT systems.

2.9 Contract Leasing

This cost element includes all costs associated with leasing, maintenance and support of hardware ADP equipment for the life cycle of the system when not covered under Cell 1.4. Use the same sub-elements as contained in Cell 1.4 in supplemental documentation. All outsource leasing or lease in lieu of investment are covered under cost element 1.0, “Investment”.

3.0 ALTERNATIVE PHASE OUT (STATUS QUO) PROFILE

This cost element includes the costs incurred in managing, supporting and maintaining the day-to-day operations of the status quo system as it runs parallel to the phasing in of the new system. Personnel costs are reflected, as well as any projected hardware replacements and all maintenance for hardware and

software. It begins prior to IOC and continues until after FOC of the last unit. When providing an estimate of the Status Quo alternative this major element will not be used except for Sunk Costs.

3.1 System Management

This cost element includes the costs of managing the status quo system.

3.1.1 Personnel

This cost element includes the fully burdened labor costs for the business and administrative planning, organizing, directing, coordinating, controlling, and approval actions designated to accomplish overall program objectives associated with the status quo system until it is finally phased out. Accumulate costs in the appropriate categories below.

3.1.1.1 Military
3.1.1.2 Civilian
3.1.1.3 Contractor

3.1.2 TDY

This cost element includes the travel costs (i.e., transportation, per diem, etc.) of persons in the system management function as they conduct program related trips.

3.1.3 Other Government Support

This cost element covers any indirect government support related to system management in the status quo phase out period.

3.1.3.1 Military
3.1.3.2 Civilian
3.1.3.3 Other

3.1.4 Other

This element covers any system management cost not covered in the other categories above and may include such things as supplies, equipment, facilities, leasing, studies, contract management support, etc.

3.2 Phase Out Investment

This cost element reflects the costs of replacing any hardware which is inoperable and is not capable of supporting the mission in the status quo system only as it transitions to the new system. Document the specific hardware replacements.

3.2.1 Deployment Hardware

This cost element describes all of the elements associated with replacement hardware. When identifying hardware costs, look into your program's vendor contracts, GFE, other Government contracts, and any organic effort used to procure the Status Quo hardware. Includes costs for first destination transportation, warranties, and user's manuals, if applicable.

3.2.1.1 Processing Units

This cost element aggregates the cost for various types of processing units and reflects the costs to lease, purchase or produce, consistent with the definition in 1.4.1.1.

3.2.1.1.1 Central Processing Units

This cost element includes all costs associated with the production and/or purchase or lease of the central processing units. Includes mainframes and associated hardware.

3.2.1.1.2 Intermediate Processing Units

All costs associated with the production and/or purchase or lease of the intermediate processing units. Includes mini computers and associated hardware.

3.2.1.1.3 Terminal Processing Units (PCs)

All costs associated with the production and/or purchase or lease of the terminal processing unit. Includes micro computer, PCs, laptops, workstations, terminals, etc., and associated hardware.

3.2.1.2 Peripheral Devices

3.2.1.2.1 Printers

This cost element includes all costs associated with the production and/or purchase or lease of printers. List laser printers, high speed printers and common impact printers separately.

3.2.1.2.2 Storage Devices

This cost element includes all costs associated with the production and/or purchase or lease of storage devices. List disk drivers and optical storage separately only when they are not a functioning part of the mainframe.

3.2.1.2.3 Other Peripherals

This cost element includes all costs associated with the production and/or purchase or lease of other peripheral devices not accounted for in the categories above.

3.2.1.3 Communications Hardware

This cost element includes all costs for the hardware to establish the connectivity required by the specific system.

3.2.1.3.1 Wide Area Gateways

This cost element includes all costs associated with the production, purchase, installation and/or lease of wide-area gateways (broad band) necessary to establish the connectivity required by the automated information system.

3.2.1.3.2 Wide Area Networks

This cost element includes all costs associated with the production, purchase, installation and/or lease of wide-area networks necessary to establish the connectivity required by the automated information system.

3.2.1.3.3 Modems

This cost element includes all costs associated with the production, purchase and/or lease of modems necessary to establish the connectivity required by the automated information system.

3.2.1.3.4 Local Area Networks (LAN)

This cost element includes all costs associated with the production, purchase, installation and/or lease of local area networks necessary to establish the connectivity required by the automated information system. If the LAN is part of a geographic communications upgrade, establish a pro-rata share.

3.2.1.3.5 Crypto

This cost element includes all costs associated with the production, purchase, installation and/or lease of crypto devices necessary to establish the security in connectivity required by the IT system.

3.2.1.3.6 Communications Circuits

This cost element includes all costs associated with the production, installation purchase, and/or lease of other communication circuits necessary to establish the connectivity required by the IT system.

3.2.1.3.7 Other Communication Hardware

This cost element includes all costs associated with the production and/or purchase or lease of other communication hardware.

3.2.1.4 Other Hardware

This cost element includes all other hardware cost not detailed, such as vehicles and mobile structures. Specify each hardware item in sub-elements of this cost element.

3.2.2 Software

This cost element includes all software which is available in the commercial market and which requires little or no modification to utilize. In a multi-tiered environment (Macro, Mini, Micro) each tier should be shown separately.

3.2.2.1 Operating System Software

This cost element includes cost of the basic operating system software if replacement is needed prior to the phase out of the Status Quo.

3.2.2.2 Applications (Mission) Software

This cost element includes cost of the application (mission) software if replacement is needed prior to the phase out of the Status Quo.

3.2.2.3 Interface Software

This cost element includes cost of any interface software if necessary for partial implementation of the new software, or if replacement is needed prior to the phase out of the Status Quo.

3.2.2.4 Communication Software

This cost element includes all costs for the software to establish the connectivity required by the specific system.

3.2.3 Environmental and Hazardous Material Storage and Handling

This cost element includes all costs associated with environmental studies, protection, and enhancements, including costs associated with the handling and storage of environmental and hazardous materials of the Status Quo.

3.3 Status Quo Phase Out Operations & Support

3.3.1 Hardware Maintenance

This cost element includes cost incurred in providing maintenance and repair for the system hardware for the status quo regardless of who has "ownership" of the equipment or responsibility for repair. These costs include, but are not limited to: overhaul expenses, programmed maintenance expense (periodic inspection of war reserve material), component repair, minor facilities modifications and upkeep, support equipment repair (test equipment, trucks, generators, etc.), lab calibration, depot support data, second destination transportation, and administrative support required for maintenance operations.

3.3.1.1 Military
3.3.1.2 Civilian
3.3.1.3 Contractor
3.3.1.4 Other

3.3.2 Software Maintenance

This cost element reflects the costs incurred in providing maintenance and repair for the system software for the status quo only, regardless of who has ownership of the software or responsibility for repair**.** When identifying software and data maintenance costs in these categories include vendor contracts, GFE, other Government contracts, facilities upkeep, and ISSAs. All software maintenance costs, including related local contract services for research and studies that contribute to software and data maintenance planning, development and maintenance, must be included.

3.3.2.1 Military
3.3.2.2 Civilian
3.3.2.3 Contractor

3.3.3 Unit/Site Operations

This cost element includes all costs associated with support facilitates operations which can be directly attributed to the status quo system during phase out, or in support of its personnel. These costs include but are not limited to: power requirements, special material and supplies, facilities and construction, operations, maintenance of facilities, administrative personnel, medical, contract service/support, equipment leasing, retraining, base operations data, base communications, base transportation, installation support and miscellaneous support functions.

3.3.3.1 System Operation Personnel

This cost element describes the fully burdened labor costs for status quo system operators, with costs accumulated in the categories below.

3.3.3.1.1 Military
3.3.3.1.2 Civilian
3.3.3.1.3 Contractor

3.3.3.2 Utility Requirements

This cost element describes the costs of commercial utilities required for the operation and cooling of the status quo system hardware, including all peripheral devices. If the new system is partially fielded, an apportionment of power requirements can be accomplished for each system. Provide apportionment rationale in the documentation.

3.3.3.3 Fuel and POL

This element includes the costs for fuel, oil, and lubricants to operate the system and support equipment. Examples are fuels for generators and vehicles and coolants for environmental systems.

3.3.3.4 Facilities Maintenance

This element contains all costs of real property upkeep or rental fee paid for occupancy of facilities for the status quo system. It does not include facilities occupied by users in a distributed system unless the space is dedicated to the system operations. Included are minor construction and maintenance of real property and upgrade of facilities necessary to sustain the system during the phase out period.

3.3.3.5 Communications

This cost element aggregates the cost of leasing and maintenance for status quo communication costs.

3.3.3.5.1 Long Haul

This cost element captures the costs of DDN monthly charges, leased long lines, communications usage fees, and other charges generated to interconnect components of the status quo system with other systems. This includes all required communications from the local level through the DoD level.

3.3.3.5.2 Intra Base

This cost element includes the cost of leasing or maintenance of local area networks and intra-base communications in support of the status quo system. When communications are shared, cost will be prorated, and the proration methodology described in the documentation.

3.3.3.6 Base Operating Support

This cost element reflects the cost of providing personnel support to the status quo's dedicated personnel. This includes medical, personnel, MWR, financial and subsistence support to people. It is normally based on the population of system personnel being supported.

3.3.3.7 Annual Operations Investment

3.3.3.7.1 Annual System Maintenance Investment
3.3.3.7.2 Replenishment Spares
3.3.3.7.3 Replenishment Supplies and Consumables

3.3.3.8 Recurring Training

This cost element contains all costs associated with training services, devices, accessories, aids, equipment, facilities, and parts used to facilitate instruction through which personnel will sustain sufficient concepts, skill, and aptitudes to operate and maintain the information management system. This element includes the effort associated with the maintenance of training equipment, as well as the execution of training services. It also includes TDY of Government personnel for training, and the cost of any contracts to train personnel. Accumulate the costs in the appropriate categories below.

3.3.3.8.1 Military
3.3.3.8.2 Civilian
3.3.3.8.3 Contractor
3.3.3.8.4 TDY

3.3.3.9 Miscellaneous Support

This cost element describes all other resources necessary to support the status quo system in the local areas, including second destination transportation. Costs will be accumulated in the appropriate categories below.

3.3.3.9.1 Military
3.3.3.9.2 Civilian
3.3.3.9.3 Contractor
3.3.3.9.4 Other

3.3.4 Mega-centers Operating and Maintenance Support

This cost element contains all costs associated with services received by the Status Quo IT system from a Mega-center in support of the systems operations in the Status Quo.

3.3.5 Phase Out Contracts

This cost element includes all costs associated with leasing hardware IT equipment and contract termination for the status quo.

3.3.5.1 Leasing

3.3.5.2 Termination

ANNEX A

PERSONNEL COSTING GUIDANCE FOR MAJOR IT SYSTEMS

1. The purpose of this annex is to clarify the policy for estimating the cost of personnel involved in the operations phase of major IT system and the treatment of these costs in EA/LCCE and ACP development. For this discussion, the following definitions apply:

a. Operating personnel. System specific personnel whose involvement with the major IT systems is as maintainers, administrators, or operators, either full or part time.

b. Functional personnel. Non-system specific personnel who use the system either full or part time to accomplish their mission, but in no way administer, maintain, or provide support for the system.

2. The personnel defined in paragraph 1a. will go in Cost Cell 2.1.1, 2.5, or 2.7.1, depending on whether they are serving as administrators or operators, and for operators, whether the operation is centralized or decentralized. In cases where personnel in a functional specialty are performing these same functions, the definition in paragraph 1a. also applies. For example, if a transportation system has system administrators whose functional specialty is transportation, these are operating personnel for the system and their cost must be included in one of the cells listed above. These costs will be included in the EA/LCCE and the ACP.

3. The personnel defined in paragraph 1b. will not be included in the cost portion of the EA, because they are not a part of the system LCCE or the EA alternative cost. However, the cost of these personnel, who are directly interfacing with the major IT system to input data and/or to extract reports, must be identified because they often are the basis for benefits (primarily productivity improvements) which the new system will provide. Their costs, either total or incremental between an alternative and the Status Quo, will normally be displayed in the supporting documentation for the benefits analysis.

4. The above costs will be computed based on the amount of time each person spends in direct support (operating personnel) or use (functional personnel) of the major IT system. If full time, then the total cost of the person is included. If part time, then the cost must be prorated based on hours per day of system usage or some other appropriate factor. If the person is a functional who also provides part time direct support, allocate the cost between operational cost in the EA and functional cost in the backup for the benefits analysis.

Appendix E
Lease-purchase analysis

E-1. Introduction

Lease-purchase analysis is a comparative tool. OMB Circular A-94 is the regulation that governs when leasing is an option. This document applies when the assets to be leased have a total fair market value exceeding $1 million (current dollars). It is optional for use when lesser dollar values are involved. OMB Circular A-94 does not apply to service contracts that involve the use of capital assets by a contractor incidental to the provision of services to the Government. OMB Circular A-76 analyzes these applications.

E-2. Special guidance for lease-purchase analysis

a. The analysis required by OMB Circular A-94 determines if it would cost less to lease or to buy a given asset. It is not to be used to determine what kind of asset should be acquired, in what amount, or on what acquisition schedule. For example, when there is a choice between leasing an asset this year and purchasing it next year, perform a cost-benefit analysis to determine when to acquire the asset. Then perform the lease-versus-buy analysis to determine whether to lease or buy.

b. OMB Circular A-94 departs from the traditional (non-lease) methods discussed previously in this document.

(1) In estimates with lease alternatives, the cost is considered as the cost to the Government as a whole. This means that besides lease or acquisition cost, costs to the Government in areas such as special tax and accelerated depreciation plans must be included.

(2) The basis for comparing lease versus buy is the net present value method. Other methods such as savings investment ratio (SIR) and Discounted Payback Period (DPP) are not to be used in a lease-versus-buy analysis.

(3) Determine the costs and benefits for all alternatives, then one alternative can be compared with another. The main benefit to be derived from a project of this nature is fulfillment of the stated objective. This is a benefit common to all feasible alternatives, and its inclusion in the EA calculations would not affect the ranking of the alternatives. Thus, dollar quantifying the major benefit is unnecessary. Emphasis, therefore, is placed on the costs of the alternatives. Dollar quantifiable benefits, beyond the stated objective, of each alternative are treated as cost offsets for that alternative.

(4) The discount rate in lease-purchase analysis is based on the Treasury Department cost of borrowing funds, as explained in Section 3-4h. If there is concern that the actual discount rate may affect the choice of alternatives, perform a sensitivity analysis with the discount rate varied significantly in both directions. The sensitivity analyses do not invalidate the analysis results, but simply show how results may change if the discount rate changes.

(5) The normal payment of taxes refers to the income tax effects on the U.S. Treasury, produced by a given expenditure. Every dollar spent by the Government becomes the income of some taxable party. The assumption is that rates of taxation for the various types of income tax are roughly equal. It should be noted that typical Government EAs use pre-tax values of expenditures. The normal payment of taxes on

income and profits by the lessor (or by other parties to the transaction) should not enter in the lease-versus-buy analysis. Normal income taxes are already taken into account when the cost of obtaining assets is measured by their market prices. Including them explicitly in the analysis would represent double counting.

(6) In an EA governed by OMB Circular A-94, insurance premiums, land costs, and real estate taxes must be considered. These are not absolute values like operations or lease payments, but must be estimated and imputed. Since a private developer pays insurance, real estate taxes, and land purchase costs, these costs are in the lease charge to the government and must be imputed for the Government so the alternatives are comparable. Imputed cost of land is the Government's lost revenue in retaining property that might otherwise be sold on the private market or used for another purpose. This cost represents an "opportunity cost" to the Government that deals with holding the property. This value would be realized if the land were sold. To estimate the imputed cost and include it in the purchase alternative, an equivalent cost must be found in the private market. To obtain a reasonable equivalent cost, the analyst must find the most recent transaction for a similar piece of property. This figure should be for a recent sale in the same general area for land with similar attributes, such as nearness to services and population centers. In addition, some consideration should be given to any zoning that would apply if the land were a private holding. This represents the best estimate of the land's market value and should be imputed to the Government alternative of the EA. It may be possible to obtain this information from local real estate dealers or from records of recent transactions. However, the agency that handles the installation real estate transactions is normally the best source. This could be the real estate office on the installation or one at the Corps of Engineers district office. An imputed insurance premium against loss of property for the Government alternative is required. To determine the value of the insured property, the analyst must establish some equivalent commercial value for the building. The approach should be the same as that for the imputed cost of land. Compute the imputed cost of insurance as a fixed fractional share of property value. The fractional share can be derived from rate schedules of commercial insurers. Local estimates of standard commercial coverage for similar property may also be obtained from the Building Owners and Managers Association (BOMA) Regional Exchange reports. Imputed real estate taxes must be added to the Government's alternative. The analyst should consult the city or county office of assessments to obtain the method of assessment (e.g. % of market value) and the tax rate to be applied. Then the yearly tax would be calculated and used as the Government's expense for providing community-type services. Normally the cost of real estate taxes is included in the lease charges to the Government. However, the lease contract may specify that the Government will pay any increase in property taxes charged to the private developer. The EA must reflect any such special provision in the lease contract.

c. The Corps of Engineers publishes DA Pamphlet 415-3, which provides more detail on the application of OMB Circular A-94. For assistance, their address is: U.S. Army Corps of Engineers, ATTN: CECW-EI, Kingman Building, 7701 Telegraph Road, Alexandria, VA 22315.

Appendix F
Functional economic analysis

F-1. Introduction

Functional Economic Analysis (FEA) (Business case analysis) is a type of EA which documents the review of an entire functional process, such as supply, maintenance, etc. It has been developed in support of the DoD corporate information management (CIM) initiatives, whose goal is to adopt cost-effective improvements in the way DoD manages its functions.

F-2. FEA process

a. The current guidance for preparing a FEA requires a risk assessment of each alternative solution, requesting a high and low estimate for each cost element and subsequent probability distribution of expected costs. Mission impact and quantifiable cash savings are the primary measures of merit. Savings are derived by computing the difference between the alternative and the current situation. Cost avoidances (or productivity improvements) are not acceptable as contributors to the relative merit of the alternative solution. Another significant aspect of the current DoD guidance is that there must be an audit trail established which can track projected versus actual financial results from project inception throughout the life cycle. Additionally, the FEA must include an estimate of the management support and overhead costs associated with each alternative.

b. DoD has issued a Functional Economic Analysis Guidebook which provides practical examples and illustrations consistent with DoD policy. In addition, a software model has been developed for DoD by the Institute for Defense Analysis (IDA) which will produce FEA documentation.

c. Army activities that are required to provide FEA to HQDA or DoD should obtain an independent validation at the MACOM level, and coordinate the document with USACEAC (Command, Control, Communications and Computers Cost and Economic Analysis Division) prior to final submission. USACEAC can also assist FEA preparers in obtaining copies of guidance documents, and can provide additional information concerning available software productivity tools, such as the IDA model, which will assist in preparing and documenting FEAs.

Appendix G
Capital Budget investment projects

G-1. Purpose

This Appendix restates the DoD Policy Statement, August 1994, entitled **Economic Analysis of Army Working Capital Fund (AWCF) Projects**. It provides DoD policy and guidance regarding the application of economic analysis in Capital Budget investment projects.

G-2. Applicability

This policy and guidance applies to DoD Components responsible for preparation, review, approval and processing of AWCF capital projects.

G- 3. Scope

This policy statement implements Action C7 of the AWCF Improvement Plan of September 1993 through:

a. Clarifying techniques and procedures for analysis and documentation of capital projects with investment costs less than $1,000,000 as well as those over $1,000,000. Capital projects begin at $100,000 investment cost with an estimated useful life of two years or more.

b. Outlining the process for capital project economic analysis and cost comparison justifications in support of the Planning, Programming, Budgeting, and Execution System.

G-4. General policy

a. Capital Budget projects within the DoD are essential in maintaining efficient and effective business operations. It is imperative that expenditure of funds for these projects be justified based on sound analytical evaluation to ensure competitive operations reflected in a structure supporting the lowest price to the customer.

b. Funding requests for projects in the four Capital Budget investment categories below shall be justified and supported by a formal, pre-investment analysis. Either an economic analysis or cost comparison as discussed in this document is required to justify investment projects for Capital Budget submissions, reprogramming requests, or substitution of projects. The scope of analysis shall be tailored depending on dollar value of the project as outlined in paragraphs G-7 and G-8 and Annex A. These analyses shall be maintained by the originating office of the DoD Component as project documentation support for the Capital Budget submission as well as program execution.

(1) Equipment (non-combat)

(2) Minor Construction (less than $500,000)

(3) ADPE and Telecommunications Equipment

(4) Software Development

c. Capital Budget projects in the four investment categories above shall also be identified according to one of the following primary reasons for justifying the investment:

(1) Replacement. Unsafe, beyond economical repair, or inoperative/unusable assets.

(2) Productivity. Improved efficiency (savings) or effectiveness.

(3) New Mission. Required new capability or capacity that cannot be met with current equipment or facilities.

(4) Environmental. Investment for environmental or hazardous waste reduction including regulatory agency mandated requirements.

G-5. Exemptions

There are two exemptions that may apply in lieu of performing a pre-investment analysis. In both instances, an exception justification statement shall be prepared documenting the requirement or authority for the exemption claimed. Exemption statements shall be validated as would a pre-investment analysis and approved through DoD Component review channels.

a. Environmental, hazardous waste reduction, or regulatory agency (state, local, or Federal) mandated requirements; also includes directed action by higher DoD or Component authority which precludes choice among alternatives.

b. DoD instruction or directive waive the requirement (e.g., equipment age or condition replacement criteria).

G-6. Investment projects under $1,000,000

a. These projects shall be justified using an abbreviated approach which compares the costs of feasible alternatives to the status quo. The cost comparison initially shall be prepared in constant base year dollars and shall present a differential cost display by year for up to a six year evaluation period beginning with the budget year for which investment funds are requested.

b. Documentation for a cost comparison shall describe the functional process performed; define the need/requirement/objective; identify workload projections; address feasible alternatives; present total costs attributed to each alternative and the differential costs/monetary benefits expected in constant and current dollars over the six year evaluation period; provide significant assumptions, constraints, estimating methods, rationale and data sources.

c. The following economic indicators (defined in paragraph G-8) shall be developed and summarized in the cost comparison: Payback, SIR and BIR. These values shall be used in conjunction with the above documentation elements in determining the recommended project alternative when there is more than one

under evaluation. Payback shall be the primary indicator from cost comparisons to rank order projects up to $1,000,000 within the investment categories of each business area.

d. Annex A presents a recommended outline and format for the cost comparison reflecting the above documentation elements. Complete documentation for a cost comparison may be 3-5 pages although this may vary depending on the number of alternatives considered and complexity of the project.

G-7. Investment projects over $1,000,000

a. These projects shall be justified using conventional, analytical techniques pertaining to economic analysis for evaluation of alternatives relative to the current situation or status quo. The economic analysis shall be prepared on a net present value (NPV) basis and shall comply with applicable DoD or Component guidance as well as functional program guidance. The economic analysis initially shall be prepared in constant base year dollars and shall present a differential cost display by year over the project's expected economic life beginning with the budget year for which investment funds are requested.

b. Documentation shall describe the functional process performed; define the need/requirement/objective; present and explain workload projections; identify feasible alternatives; present total costs and the differential costs/monetary benefits in constant, discounted, and current dollars over the expected economic life of the project; highlight NPV of the alternatives; present estimating methods/relationships, and data sources; identify significant constraints, assumptions and variables; treat sensitivity and uncertainty of key parameters; and address all other quantifiable benefits as well as any intangible benefits influencing the recommended course of action. Quantifiable benefits are all outputs/results achieved in return for investment dollars associated with an alternative. Numerical values such as dollars saved or physical/performance attributes are measures of quantifiable benefits. Intangible benefits are qualitative in nature such as improved morale or quality of life considerations.

c. The standard criterion used in evaluating investment alternatives based on economic principles is NPV, which is the difference between the discounted present value of monetary benefits and the discounted present value of investment costs. In addition to NPV, the following economic indicators (defined in paragraph G-8) shall be developed and summarized in the economic analysis: Payback, SIR and BIR. These values shall be used in conjunction with the above documentation elements in determining the recommended project alternative when there is more than one under evaluation. NPV and BIR shall be the primary financial measures from economic analyses used to rank order projects of over $1,000,000 within the investment categories of each business area.

d. Annex A contains a recommended outline and format for the economic analysis reflecting the above documentation elements. Automated economic programs and reports may be used if the programs provide reports comparable to the requirements of Annex A.

e. With regard to IT systems investments and functional program evaluations within the DoD, the pre-investment analysis process shall comply with existing requirements identified below. Care shall be exercised in consideration of the type and program responsibility for the respective economic analyses to assure efficient preparation and submission to the appropriate Capital Budget business area and category.

(1) IT OIPT Review Systems. Shall comply with economic analysis preparation, display, milestone, and dollar threshold requirements for automated information systems governed by DoDD 5000.1, DoDI 5000.2, and DoD 5000.2-M.

(2) Functional Economic Analyses (FEAs). Shall comply with DoD economic analysis requirements in support of functional program business.

f. All IT systems investments shall be supported by an economic analysis for each phase of the acquisition review and approval process prescribed by DoD and Component regulatory authority.

G-8. Economic indicators

a. Economic indicators, as defined and discussed below, shall be used in both cost comparisons and economic analyses for Capital Budget projects.

(1) Payback. Used to compare the period of time, in years, necessary for an alternative to repay its investment cost from monetary benefits expected; also used as a value to compare and rank order competing projects; computed using current dollars. Calculated and presented as whole and fractional part of a year (i.e., 2.73 years).

(2) Benefit to Investment Ratio (BIR). Used to compare project alternatives in terms of all expected monetary benefits inclusive of whole and partial manpower productivity savings resulting from increased efficiency and other cost avoidances achieved over the total project life under evaluation; also used as a value to compare other projects. Calculated, using discounted constant dollars, as an index value and rounded to the second decimal place (e.g., 3.74). The value must be greater than one to be cost beneficial; the larger the ratio the greater the advantage.

b. The computation of BIR shall be limited for Capital Budget projects to a six year evaluation period for cost comparisons and a project's expected economic life for economic analyses. If the expected economic life of a proposed capital asset/alternative is less than the six year period for a cost comparison, the evaluation period shall be shortened to match. Additionally, the cost comparison BIR shall be computed using constant dollars only since discounting does not apply to the cost comparison analysis.

c. Some projects may not generate sufficient expected monetary benefits to payback within the specified evaluation period for cost comparisons. In these instances, annual benefits shall be extrapolated beyond the evaluation period for purposes of determining the Payback.

d. IT systems economic analyses should also include the Savings to Investment Ratio (SIR). The SIR is used to compare project alternatives in terms of hard savings expected (i.e., funds no longer required in the budget and program out years) relative to the investment cost of each alternative over the total project life under evaluation. Also used as a value to compare other projects (computed using discounted constant dollars).

G-9. Budget formulation and execution

a. Capital Budget project justifications shall be used in support of program planning as well the budget formulation process. Initial supporting, pre-investment analyses shall be completed approximately eighteen months prior to the year of execution and then reassessed approximately six months before year of execution. In addition to budget formulation, either an economic analysis or cost comparison shall be used to support a project substitution or to accomplish a reprogramming request.

b. DoD Components are encouraged to rank order all projects by investment category (as shown in paragraph G-5b) within each business area based on NPV and the economic indicators discussed above as well as other essential criteria (e.g., exemptions) deemed appropriate by Component activities. The prioritization process shall facilitate timely substitution of worthy projects for those no longer justified and subsequently drop out. The priority sequencing process shall result in a listing that is periodically updated as Component or business area priorities change.

c. Capital Budget projects shall be submitted in accordance with DoD 7000.14-R, Financial Management Regulation, Volume 2B, Chapter 9:

(1) Investment projects of $500,000 or more shall be supported by a summary of the results of the economic analysis including: explanatory narrative of the need/requirement, workload projections, feasible alternatives, significant assumptions, estimating methods, data sources, NPV, Payback, BIR, dollar benefits expected, and other support of the recommended project. An appropriate exemption justification statement shall be included as applicable in lieu of economic analysis summary results.

(2) Investment projects of $1.0 million or more shall have a copy of their supporting economic analysis submitted to the DoD Component for review and retention.

G-10. Post-Investment Analyses

Annually, each military activity within the AWCF shall prepare post-investment analyses for ten percent of the number of capital investment projects, but not less than five projects, that were completed during the previous fiscal year and had been justified wholly or partially on the basis of economic considerations (e.g., productivity improvements). The projects selected for post-investment analysis shall be a representative sample of the completed investment projects. The format and technique for each post-investment analysis shall be similar to the cost comparison or economic analysis used for the project justification. The post-investment analyses shall be retained for ready review for five years.

G-11. References

a. OMB Circular A-94, Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs, October 1992.

b. DoDI 7041.3, Economic Analysis for Decision Making, November 1995.

c. DoD 7000.14-R, Department of Defense Financial Management Regulation, Volume 2B, Chapter 9, June 2000, and Volume 11B, Chapter 58, December 1994.

d. OSD(C) Inflation Indices issued annually to DoD Components for use in preparation of PPBES submissions and cost estimates.

ANNEX A

AWCF CAPITAL BUDGET INVESTMENT PROJECTS

RECOMMENDED OUTLINE AND FORMATS

for

COST COMPARISON

(Investment Cost Under $1,000,000)

or

ECONOMIC ANALYSIS

(Investment Cost over $1,000,000)

Remarks:

1. The enclosed outline and formats provide the basic framework for presentation and documentation of either a cost comparison or an economic analysis of a Capital Budget project. This material is to be used in conjunction with descriptive information provided in paragraphs G-7 and G-8 of the basic DoD policy statement. The formats provided as figures G-2 and G-3 are specifically tailored for use in a cost comparison or an economic analysis respectively. The length of a cost comparison typically may range 3-5 pages while an economic analysis may range from the same length to considerably longer depending on the dollar value of investment, scope and complexity of the project, number of alternatives, data sources and estimating methods, and treatment of risk/uncertainty.

2. The following time periods correspond to the AWCF depreciation/amortization schedule for capital assets. This schedule may serve as a basis for the expected economic life used in estimating the costs and benefits of an alternative shown on the Economic Analysis Format (figure G-3).

-- Facilities Construction Projects (including minor construction)	20 Yrs
-- Equipment (non-ADP/Telecommunications)	10 Yrs
-- General Purpose Vehicles	5 Yrs
-- ADP Hardware and Telecommunications Equipment	5 Yrs
-- Software Development	5 Yrs

AWCF CAPITAL BUDGET INVESTMENT PROJECT

☐ **COST COMPARISON (Investment < $1,000,000)**

☐ **ECONOMIC ANALYSIS (Investment >$1,000,000)**

1. Project Title:

2. Functional Process/Project Description:

3. Need/Requirement/Objective Statement:

4. Workload Projections:

5. Alternative(s):

*** Status Quo**

*** Feasible Alternative(s)**

- Alternative A

- Alternative B (if applicable)

6. Costs and Benefits Display: (See Figure G-2 for Cost Comparison, or Figure G-3 for Economic Analysis)

7. Summary Information for All Alternatives: (See Figure G-2 for Cost Comparison, or Figure G-3 for Economic Analysis)

Figure G-1. Capital Budget Cost Comparison/EA Outline

8. Source and Derivation of Costs: Provide complete explanation, rationale, and backup to support the project and ensure validation.

9. Assumptions and Constraints: Identify significant assumptions and constraints.

Continue with the following for Economic Analysis:

10. Sensitivity/Uncertainty: Analyze the implications of potential changes to key parameters on the costs and monetary benefits for each alternative.

11. Other Quantifiable Benefits (non-monetary) and Intangible Benefits: Identify and discuss other quantifiable and intangible benefits that may help distinguish between alternatives with similar economic indicator values.

12. Conclusions and Recommendations:

Figure G-1. Capital Budget Cost Comparison/EA Outline (Continued)

6. Costs and Benefits Display:

COST COMPARISON FORMAT

	Constant Dollars (Base Year FY95)			Current Dollars (Inflated)
	Operations Costs		Benefits	Benefits
Evaluation Period*	Status Quo	Alternative A	(Differential Costs)	(Differential Costs)
(1)	(2)	(3)	(4 = 2 - 3)	(5 = 4 x Infl. Fac.)
FY95				
FY96				
FY97				
FY98				
FY99				
FY00				
FY01				
FY02				
FY03				
FY04				
Residual Value	$ - xxx	$ -xxx	$ xxx	$ xxx**
Total	$ xxx	$ xxx	$ xxx (8)	$ xxx (6)
		Investment Cost	Investment Cost	Investment Cost***
		$ + xxx (9)	$ -xxx (10)	$ xxx (7)
		Project Total Cost	Net Benefits	
		$ xxx	$ xxx (11)	

- * Number of years based on project economic life
- ** Discount and inflate with factors for the year following economic life
  *** Inflate with factors for year(s) in which investment occurs

Repeat Cost Comparison Format for each alternative

7. Summary information for All Alternatives:

	Alt A	Alt B
o Total Benefits (Current Dollars) (6)	_____	_____
o Investment Cost (Current Dollars) (7)	_____	_____
o Net Benefits (11)	_____	_____
o Payback (Years)	_____	_____
o BIR (8/9)	_____	_____
o Productivity Benefits: (Work years)	_____	_____

Figure G-2. Capital Budget Cost Comparison Format

6. Costs and Benefits Display:

ECONOMIC ANALYSIS FORMAT

	Constant Dollars (Base Year FY95)			Discounted Dollars (Present Value)	Current Dollars (Inflated)
	Operations Costs		Benefits	Benefits	Benefits
Evaluation Period*	Status Quo	Alternative A	(Differential Costs)	(Differential Costs)	(Differential Costs)
(1)	(2)	(3)	(4 = 2-3)	(5 = 4 x Disc Fac)	(6 = 4 x Infl. Fac.)
FY95					
FY96					
FY97					
FY98					
FY99					
FY00					
FY01					
FY02					
FY03					
FY04					
Residual Value	$ - xxx	$ -xxx	$ xxx	$ xxx **	$ xxx**
Total	$ xxx	$ xxx	$ xxx (9)	$ xxx (11)	$ xxx (7)
		Investment Cost		Investment Cost***	Investment Cost***
		$ + xxx (10)		$ -xxx (12)	$ xxx (8)
		Project Total Cost		Net Present Value	
		$ xxx		$ xxx (13)	

* Number of years based on project economic life
** Discount and inflate with factors for the year following economic life
*** Discount and inflate with factors for year(s) in which investment occurs

Repeat Economic Analysis Format for each alternative

7. Summary information for All Alternatives:

	Alt A	Alt B
o Total Benefits (Current Dollars) (7)	_____	_____
o Investment Cost (Current Dollars) (8)	_____	_____
o Net Present Value (13)	_____	_____
o Payback (Years)	_____	_____
o BIR (11/12)	_____	_____
o Productivity Benefits: (Work years)	_____	_____

Figure G-3. Capital Budget Economic Analysis Format

ANNEX B

AWCF CAPITAL BUDGET INVESTMENT PROJECTS

COST ELEMENT STRUCTURE

The following elements are illustrative of those considered in estimating the costs associated with an a Capital Budget equipment category project for either a cost comparison or economic analysis. These elements would be augmented as appropriate for the other Capital Budget categories (e.g., software development). Operations cost elements apply to the status quo and all feasible alternatives while investment cost elements apply only to the alternatives. Operations costs should be estimated on a total cost basis including all direct and indirect labor, applicable overhead, and general and administrative costs. Operations costs may include non-recurring (one time) as well as recurring costs.

OPERATIONS COSTS

- o Labor
  - Civilian Personnel
  - Military Personnel
- o Material
- o Maintenance and Repair
- o Consumable Supplies
- o Lease/Rent
- o Utilities
- o Other

INVESTMENT COSTS

- o Acquisition
- o Transportation*
- o Installation*
- o Testing*
- o Training
- o Other

* May be applicable if not included in acquisition cost.

Appendix H
Discounting and present value

H-1. Discount rates and sample discount factors

a. Following are the current discount rates to be used in all analyses through January 2001. Annual updates to discount rates are disseminated throughout the Army by USACEAC upon receipt.

Period of Analysis (in years) At Least	But Less Than	Constant Dollar Rate (Real)	Current Dollar Rate (Nominal)
	4	3.8%	5.9%
4	6	3.9%	6.0%
6	9	4.0%	6.0%
9	20	4.0%	6.1%
20		4.2%	6.3%

b. The methodology for calculating the discount factors associated with the various discount rates is based on the following formula:

$PVF_n = 1/(1+i)^n$
where PVF = the present value factor for year n
i = the discount rate
n = the project year

For example, the calculation of the end-of year discount factors for the three years of a three year project for constant dollars is:

$PVF_1 = 1/(1+.038)^1 = 0.9634$
$PVF_2 = 1/(1+.038)^2 = 0.9281$
$PVF_3 = 1/(1+.038)^3 = 0.8941$

When costs and benefits occur in a steady stream, applying mid-year factors would be more appropriate for the analysis. The formula for the calculation of the mid-year discount factors becomes:

$$PVF_n = 1/(1+i)^{(n-.5)}$$

For example, the calculation of the mid-year discount factors for the six years of a six year project using constant dollars is:

$PVF_1 = 1/(1+.040)^{.5} = 0.9806$
$PVF_2 = 1/(1+.040)^{1.5} = 0.9429$
$PVF_3 = 1/(1+.040)^{2.5} = 0.9066$
$PVF_4 = 1/(1+.040)^{3.5} = 0.8717$
$PVF_5 = 1/(1+.040)^{4.5} = 0.8382$
$PVF_6 = 1/(1+.040)^{5.5} = 0.8060$

H-2. Sample format for discounting deferred costs and benefits

Assume a 5-year program which will commit the Government to the stream of constant-dollar expenditures appearing in column (2) of the table below and which will result in a series of constant-dollar benefits appearing in column (3). The mid-year discount factor for a 3.9 percent discount rate is shown in column (4). The present value cost for each of the 5 years is calculated by multiplying column (2) by column (4); the present value benefit for each of the 5 years is calculated by multiplying column (3) by column (4). The present values of costs and benefits are presented in columns (5) and (6) respectively.

Year since initiation, renewal or expansion (1)	Expected yearly cost (2)	Expected yearly benefit (3)	Discount factors for 4.5% (4)	Present value of costs Col. 2 x Col. 4 (5)	Present value of benefits Col. 3 x Col. 4 (6)
1	$10.00	$ 0.00	0.9811	$ 9.81	$ 0.00
2	20.00	0.00	0.9442	18.88	0.00
3	30.00	35.00	0.9088	27.26	31.81
4	30.00	50.00	0.8747	26.24	43.74
5	10.00	75.00	0.8418	8.42	63.14
				---	---
Total				$90.61	$138.69
					-90.61
NPV					48.08

The sum of column (5) is the total present value of costs and the sum of column (6) is the total present value of benefits. The net present value of $48.08 is the difference between the sum of discounted benefits and the sum of discounted costs.

The discount factors presented in the table above are calculated using mid-year factors on the implicit assumption that costs and benefits occur in a steady stream. For instance, the first cost in the table may be estimated to occur after six months, rather than at the end of one year to better approximate a steady stream of costs and benefits occurring during the first year. Similarly, it may be assumed that all other costs and benefits are advanced six months to approximate better a continuing steady flow.

The present value of costs and benefits computed from the table above (mid-year discounting basis) can be converted to a year-end discounting basis by dividing them by 1.0193 (the square root of 1.039 or 1 plus the discount rate). Thus, if the above example were converted to a year-end basis, the present value of costs would be $88.89, the present value of benefits $136.06, and the net present value would be $47.17.

Appendix I
Economic analysis example

I-1. Overview

This appendix gives an example of a completed EA. The presentation of this example is not intended to be a precise template for every EA. Rather, it is provided as general guidance for the important aspects which should be evident in every EA. As stated earlier, there is not a prescribed format. The documentation for each EA should be developed to reflect the program which is being evaluated.

I-2. Example

The following pages constitute a stand-alone example. The example includes all necessary narrative information and shows one acceptable way of displaying cost data.

ECONOMIC ANALYSIS OF PAINT REMOVAL FOR M999 HOUSINGS

1. Purpose

This EA was conducted to compare and determine the least costly alternative for paint removal from M999 housings, a component of the M888 armament system.

2. Background

a. The Harryville Army Depot (HVAD) has the mission of repair and modification of vehicles. The Future Year Defense Plan (FYDP) assigns to HVAD the modification program for the M888 armament system. This program began two years ago and is expected to continue for the next ten years.

b. One portion of the M888 modification program consists of disassembling M999 housings (four per vehicle), removal of paint, modification of new armor kits, and reassembly to the vehicle.

3. Scope of the Economic Analysis

a. This EA will address the costs, benefits, and funding requirements of each feasible alternative for removing paint from the housings. The current manual operation will serve as the status quo and is included in the EA as a feasible alternative (Alternative 1). The status quo is compared with all other feasible alternatives.

b. The objective is to determine the least cost alternative for providing paint removal from the M999 housing in accordance with specifications at the prescribed schedule rate.

4. Major assumptions

a. Regarding any potential equipment purchase, it is assumed that funding for capital investment will be available as required.

b. Anticipated workload has been derived from the FYDP modified as per information provided by Assistant Secretary of the Army for Installations and Environment (ASA (I&E)). The workload forecast shows the requirement increasing to a maximum of 4,000 housings per year as shown in table I-1.

c. In view of the lack of data for subsequent years, it is assumed that the workload will remain constant for the remainder of the modification program.

d. The economic life for each alternative, including the status quo, is ten years. A discount rate of 2.7% is used for present value calculations. [The discount factors appearing in the cost documentation have been simplified for illustrative purposes.]

Table I-1
Workload forecast

FY 95:	2600 housings
FY 96:	2600 housings
FY 97:	2600 housings
FY 98:	3300 housings
FY 99:	4000 housings
FY 00 - 04:	4000 housings

e. The inflation indices used to convert constant dollars to current dollars are as follows: FY95 = 1.03, FY96 = 1.06, FY97 = 1.09, FY98 = 1.12, FY99 = 1.15, FY00 = 1.18, FY01 = 1.21, FY02 = 1.24, FY03 = 1.27, FY04 = 1.30, FY05 (for Salvage Value) = 1.33. [The inflation indices used in this example were arbitrarily determined, and applied regardless of appropriation. Preparers of an actual EA should use the most current DoD-approved inflation indices for each appropriation.]

5. Major constraints

a. In view of the current stringent limitations on funding for military construction, paint removal must be accomplished within existing facilities if performed in-house.

b. Due to additional modification programs scheduled for HVAD operating space is to be conserved as much as possible.

6. Alternatives

a. Alternative 1 (status quo) is the current method of manually brushing the painted surfaces with solvent, followed by manually scraping with tools to remove the paint.

b. Alternative 2 is the mechanized paint removal process, using automatic dip tanks fed by overhead conveyors, followed by solvent draining and partial drying in a forced-air environment. Spot cleaning, if necessary, will be accomplished by hand scraping.

c. Alternative 3 is a commercial contract for paint removal by a paint removal specialty firm.

d. Alternative 4 is sandblasting and subsequent clean surface refinishing. Alternative 4 was eliminated after preliminary analysis. Paint removal with current sandblasting technology results in surface cleanliness that is insufficient per specifications.

7. Cost summary

Annual costs by alternative are provided in figure I-1, and summarized in table I-2.

ECONOMIC ANALYSIS
TOTAL COSTS BY ALTERNATIVE

Submitting organization:

Harryville Army Depot

Date of submission: **15 Jun 99**

Project title:
Paint Removal for M999 Housings

Description of project objective:
To determine the least cost alternative for providing paint removal from the M999 housing in accordance with specifications at the prescribed schedule rate.

Description of this alternative:
Alternative 1 (Status Quo): Current method of manual brushing and scraping.

Economic life for this alternative: **10** **years**

Total project life: **10** **years** **Discount Rate =** **2.70%**

Project costs are in **2000** **Constant Dollars**

	Constant Dollars (Base Year FY00)			Discounted Dollars (Present Value)		Current Dollars (Inflated)	
FY	Investment	O & S	Total Costs	Discount Factor	Annual Costs	Infl Index	Annual Costs
FY00	$0	$265,000	$265,000	0.98	$259,700	1.03	$272,950
FY01	$0	$265,000	$265,000	0.96	$254,400	1.06	$280,900
FY02	$0	$265,000	$265,000	0.94	$249,100	1.09	$288,850
FY03	$0	$265,000	$265,000	0.92	$243,800	1.12	$296,800
FY04	$0	$265,000	$265,000	0.90	$238,500	1.15	$304,750
FY05	$0	$285,000	$285,000	0.88	$250,800	1.18	$336,300
FY06	$0	$285,000	$285,000	0.86	$245,100	1.21	$344,850
FY07	$0	$285,000	$285,000	0.84	$239,400	1.24	$353,400
FY08	$0	$285,000	$285,000	0.82	$233,700	1.27	$361,950
FY09	$0	$285,000	$285,000	0.80	$228,000	1.30	$370,500
Sub-total	$0	$2,750,000	$2,750,000		$2,442,500		$3,211,250
Residual Value	$0	$0	$0	0.78	$0	1.33	$0
Total	$0	$2,750,000	$2,750,000		$2,442,500		$3,211,250

Figure I-1. Costs by Alternative

ECONOMIC ANALYSIS
TOTAL COSTS BY ALTERNATIVE

Submitting organization:

Harryville Army Depot

Date of submission: **15 Jun 99**

Project title:
Paint Removal for M999 Housings

Description of project objective:
To determine the least cost alternative for providing paint removal from the M999 housing in accordance with specifications at the prescribed schedule rate.

Description of this alternative:
Alternative 2: Mechanized paint removal process using automatic dip tanks.

Economic life for this alternative: **10** **years**

Total project life: **10** **years** **Discount Rate =** **2.70%**

Project costs are in **2000** **Constant Dollars**

	Constant Dollars (Base Year FY00)			Discounted Dollars (Present Value)		Current Dollars (Inflated)	
FY	Investment	O & S	Total Costs	Discount Factor	Annual Costs	Infl Index	Annual Costs
FY00	$200,000	$162,000	$362,000	0.98	$354,760	1.03	$372,860
FY01	$100,000	$96,000	$196,000	0.96	$188,160	1.06	$207,760
FY02	$0	$102,000	$102,000	0.94	$95,880	1.09	$111,180
FY03	$0	$102,000	$102,000	0.92	$93,840	1.12	$114,240
FY04	$0	$102,000	$102,000	0.90	$91,800	1.15	$117,300
FY05	$0	$102,000	$102,000	0.88	$89,760	1.18	$120,360
FY06	$0	$106,000	$106,000	0.86	$91,160	1.21	$128,260
FY07	$0	$108,000	$108,000	0.84	$90,720	1.24	$133,920
FY08	$0	$108,000	$108,000	0.82	$88,560	1.27	$137,160
FY09	$0	$108,000	$108,000	0.80	$86,400	1.30	$140,400
Sub-total	$300,000	$1,096,000	$1,396,000		$1,271,040		$1,583,440
Residual Value	$0	($19,500)	($19,500)	0.78	($15,210)	1.33	($25,935)
Total	$300,000	$1,076,500	$1,376,500		$1,255,830		$1,557,505

Figure I-1. Costs by Alternative (Continued)

ECONOMIC ANALYSIS
TOTAL COSTS BY ALTERNATIVE

Submitting organization:

Harryville Army Depot

Date of submission: **15 Jun 99**

Project title:
Paint Removal for M999 Housings

Description of project objective:
To determine the least cost alternative for providing paint removal from the M999 housing in accordance with specifications at the prescribed schedule rate.

Description of this alternative:
Alternative 3: Commercial contract with paint removal specialty firm.

Economic life for this alternative: **10** **years**

Total project life: **10** **years** **Discount Rate =** **2.70%**

Project costs are in **2000** **Constant Dollars**

	Constant Dollars (Base Year FY00)			Discounted Dollars (Present Value)		Current Dollars (Inflated)	
FY	Investment	O & S	Total Costs	Discount Factor	Annual Costs	Infl Index	Annual Costs
FY00	$20,000	$262,000	$282,000	0.98	$276,360	1.03	$290,460
FY01	$0	$262,000	$262,000	0.96	$251,520	1.06	$277,720
FY02	$0	$262,000	$262,000	0.94	$246,280	1.09	$285,580
FY03	$0	$262,000	$262,000	0.92	$241,040	1.12	$293,440
FY04	$0	$262,000	$262,000	0.90	$235,800	1.15	$301,300
FY05	$0	$272,000	$272,000	0.88	$239,360	1.18	$320,960
FY06	$0	$272,000	$272,000	0.86	$233,920	1.21	$329,120
FY07	$0	$272,000	$272,000	0.84	$228,480	1.24	$337,280
FY08	$0	$272,000	$272,000	0.82	$223,040	1.27	$345,440
FY09	$0	$272,000	$272,000	0.80	$217,600	1.30	$353,600
Sub-total	$20,000	$2,670,000	$2,690,000		$2,393,400		$3,134,900
Residual Value	$0	($1,000)	($1,000)	0.78	($780)	1.33	($1,330)
Total	$20,000	$2,669,000	$2,689,000		$2,392,620		$3,133,570

Figure I-1. Costs by Alternative (Continued)

Table I-2
Total cost by alternative

Alternative:	1	2	3
Constant $	$2.75M	$1.38M	$2.69M
Current $	3.21M	1.56M	3.13M
Present Value	2.44M	1.26M	2.39M

8. Dollar benefit summary

The annual dollar quantifiable benefits by alternative are provided in figure I-2 and figure I-3. They are summarized in Table I-3.

Table I-3
Dollar quantifiable benefits
(Constant $)

Alternative:	2	3
Savings	$1.14M	-$1.32M
Cost Avoidances	0.00M	0.00M
Productivity Improvements	0.53M	1.40M
Total	$1.67M	$0.08M

9. Comparison of alternatives

A comparison of Alternatives 2 and 3 with the Status Quo is shown in figures I-4 and I-5 respectively. Table I-4 summarizes the results of this comparison.

Table I-4
Comparative analysis results

Alternative:	2	3
Net Present Value	1.19M	0.05M
Break-even point (yrs):	2.1	5.3
Benefit/Inv Ratio:	5.064	3.545

QUANTIFIABLE BENEFITS SUMMARY
ALTERNATIVE: 2

CONSTANT $:

FY	SAVINGS	COST AVOIDANCES	PRODUCTIVITY IMPROVEMENTS	TOTAL
FY00	$75,000	$0	$28,000	$103,000
FY01	$113,000	$0	$56,000	$169,000
FY02	$107,000	$0	$56,000	$163,000
FY03	$107,000	$0	$56,000	$163,000
FY04	$107,000	$0	$56,000	$163,000
FY05	$127,000	$0	$56,000	$183,000
FY06	$123,000	$0	$56,000	$179,000
FY07	$121,000	$0	$56,000	$177,000
FY08	$121,000	$0	$56,000	$177,000
FY09	$121,000	$0	$56,000	$177,000
FY10*	$19,500	$0	$0	$19,500
Total	$1,141,500	$0	$532,000	$1,673,500

CURRENT $:

FY	SAVINGS	COST AVOIDANCES	PRODUCTIVITY IMPROVEMENTS	TOTAL
FY00	$77,250	$0	$28,840	$106,090
FY01	$119,780	$0	$59,360	$73,140
FY02	$116,630	$0	$61,040	$177,670
FY03	$119,840	$0	$62,720	$182,560
FY04	$123,050	$0	$64,400	$187,450
FY05	$149,860	$0	$66,080	$215,940
FY06	$148,830	$0	$67,760	$216,590
FY07	$150,040	$0	$69,440	$219,480
FY08	$153,670	$0	$71,120	$224,790
FY09	$157,300	$0	$72,800	$230,100
FY10*	$25,935	$0	$0	$25,935
Total	$1,342,185	$0	$623,560	$1,965,745

Note: Change in personnel costs is a Productivity Improvement because no spaces will be saved. Savings here is difference (plus or minus) in all other operations costs from Status Quo. Minus means the alternative will require more funding than the Status Quo in the indicated FY.

*** Residual value.**

Figure I-2. Dollar Quantifiable Benefits, Alternative 2

QUANTIFIABLE BENEFITS SUMMARY
ALTERNATIVE: 3

CONSTANT $:

FY	SAVINGS	COST AVOIDANCES	PRODUCTIVITY IMPROVEMENTS	TOTAL
FY00	($137,000)	$0	$140,000	$3,000
FY01	($137,000)	$0	$140,000	$3,000
FY02	($137,000)	$0	$140,000	$3,000
FY03	($137,000)	$0	$140,000	$3,000
FY04	($137,000)	$0	$140,000	$3,000
FY05	($127,000)	$0	$140,000	$13,000
FY06	($127,000)	$0	$140,000	$13,000
FY07	($127,000)	$0	$140,000	$13,000
FY08	($127,000)	$0	$140,000	$13,000
FY09	($127,000)	$0	$140,000	$13,000
FY10*	$1,000	$0	$0	$1,000
Total	($1,319,000)	$0	$1,400,000	$81,000

CURRENT $:

FY	SAVINGS	COST AVOIDANCES	PRODUCTIVITY IMPROVEMENTS	TOTAL
FY00	($141,110)	$0	$144,200	$3,090
FY01	($145,220)	$0	$148,400	$3,180
FY02	($149,330)	$0	$152,600	$3,270
FY03	($153,440)	$0	$156,800	$3,360
FY04	($157,550)	$0	$161,000	$3,450
FY05	($149,860)	$0	$165,200	$15,340
FY06	($153,670)	$0	$169,400	$15,730
FY07	($157,480)	$0	$173,600	$16,120
FY08	($161,290)	$0	$177,800	$16,510
FY09	($165,100)	$0	$182,000	$16,900
FY10*	$1,330	$0	$0	$1,330
Total	($1,532,720)	$0	$1,631,000	$98,280

Note: Change in personnel costs is a Productivity Improvement because no spaces will be saved. Savings here is difference (plus or minus) in all other operations costs from Status Quo. Minus means the alternative will require more funding than the Status Quo in the indicated FY.

*** Residual value.**

Figure I-3. Dollar Quantifiable Benefits, Alternative 3

ECONOMIC ANALYSIS
COMPARISON OF ALTERNATIVES

Project title:
Paint Removal for M999 Housings

Comparison of: **Alternative 1 (Status Quo) and Alternative 2 (Mechanized process).**

	Constant Dollars (Base Year FYXX)			Discounted Dollars (Present Value)		Current Dollars (Inflated)	
	Operations Costs						
FY	Status Quo	Alternative 2	Benefits (Differential Costs)	Discount Factor	Benefits (Differential Costs)	Infl Index*	Benefits (Differential Costs)
FY00	$265,000	$162,000	$103,000	0.98	$100,940	1.03	$106,090
FY01	$265,000	$96,000	$169,000	0.96	$162,,240	1.06	$179,140
FY02	$265,000	$102,000	$163,000	0.94	$153,220	1.09	$177,670
FY03	$265,000	$102,000	$163,000	0.92	$149,960	1.12	$182,560
FY04	$265,000	$102,000	$163,000	0.90	$146,700	1.15	$187,450
FY05	$285,000	$102,000	$183,000	0.88	$161,040	1.18	$215,940
FY06	$285,000	$106,000	$179,000	0.86	$153,940	1.21	$216,590
FY07	$285,000	$108,000	$177,000	0.84	$148,680	1.24	$219,480
FY08	$285,000	$108,000	$177,000	0.82	$145,140	1.27	$224,790
FY09	$285,000	$108,000	$177,000	0.80	$141,600	1.30	$230,100
Sub-total	$2,750,000	$1,096,000	$1,654,000		$1,463,460		$1,939,810
Residual Value	$0	($19,500)	$19,500	0.78	$15,210	1.33	$25,935
Total	$2,750,000	$1,076,550	$1,673,500		$1,478,670		$1,965,745
		Investment Cost: $300,000			Investment Cost: $292,000		Investment Cost: $312,000

Summary information	Alternative 2 (Mechanized process
Total Benefits (Current $)	$1,965,745
Investment Cost (Current $)	$312,000
Break-Even Point (Years)	2.1
BIR (Disc Constant $)	5.064
Net Present Value (NPV)	$1,186,670

*** Assumes all costs are in a single appropriation for simplicity. Values in differing appropriations must be inflated separately, then sums for each alternative and differences between alternatives can be computed in current dollars. In that case , inflation indices would be shown in backup only.**

Figure I-4. Comparison of Alternatives 1 & 2

ECONOMIC ANALYSIS
COMPARISON OF ALTERNATIVES

Project title:
Paint Removal for M999 Housings

Comparison of: **Alternative 1 (Status Quo) and Alternative 3 (Commercial contract).**

	Constant Dollars (Base Year FYXX)			Discounted Dollars (Present Value)		Current Dollars (Inflated)	
	Alternative Costs						
FY	Status Quo	Alternative 3	Benefits (Differential Costs)	Discount Factor	Benefits (Differential Costs)	Infl Index*	Benefits (Differential Costs)
FY00	$265,000	$262,000	$3,000	0.98	$2,940	1.03	$3,190
FY01	$265,000	$262,000	$3,000	0.96	$2,880	1.06	$3,180
FY02	$265,000	$262,000	$3,000	0.94	$2,820	1.09	$3,270
FY03	$265,000	$262,000	$3,000	0.92	$2,760	1.12	$3,360
FY04	$265,000	$262,000	$3,000	0.90	$2,700	1.15	$3,450
FY05	$285,000	$272,000	$13,000	0.88	$11,440	1.18	$15,340
FY06	$285,000	$272,000	$13,000	0.86	$11,180	1.21	$15,730
FY07	$285,000	$272,000	$13,000	0.84	$10,920	1.24	$16,120
FY08	$285,000	$272,000	$13,000	0.82	$10,660	1.27	$16,510
FY09	$285,000	$272,000	$13,000	0.80	$10,400	1.30	$16,900
Sub-total	$2,750,000	$2,670,000	$80,000		$68,700		$96,950
Residual Value	$0	($1,000)	$1,000	0.78	$780	1.33	$1,330
Total	$2,750,000	$2,669,000	$81,000		$69,480		$98,280
		Investment Cost: $20,000			Investment Cost: $19,600		Investment Cost: $20,600

Summary information	Alternative 3 (Commercial contract)
Total Benefits (Current $)	$98,280
Investment Cost (Current $)	$20,600
Break-Even Point (Years)	5.3
BIR (Disc Constant $)	3.545
Net Present Value (NPV)	$49,880

*** Assumes all costs are in a single appropriation for simplicity. Values in differing appropriations must be inflated separately, then sums for each alternative and differences between alternatives can be computed in current dollars. In that case , inflation indices would be shown in backup only.**

Figure I-5. Comparison of Alternatives 1 & 3

10. Other benefits

The following analysis identified and measured benefits which are not quantifiable in dollars.

a. Process capability

(1) Alternative 1 depends entirely upon manpower and includes a manpower level to process the maximum forecast of 80 units per week. Due to space limitations, maximum capacity would be 100 units per week.

(2) Alternative 2 is an equipment-controlled process, and as such, has a maximum capability of 130 housings per week. This capability would be possible, however, only with additional manpower. The manpower level specified in the analysis (FY 00-09) would provide no more than 80 units per week, the maximum forecasted rate.

(3) Processing capability of the contractor facility (Alternative 3) is based entirely upon the facilities that the contractor would be willing to construct. The contractor's plan is to construct a facility that will provide only maximum contract capability. This would be for a quantity of 80 units per week. It is felt, however, that additional capability could be provided by the contractor on a reimbursable arrangement.

b. Product quality

(1) While product assurance and inspection efforts in each of the three alternatives would ensure the acceptability of the paint removal, as required by specification, it is felt that higher quality and increased uniformity would be possible with Alternatives 2 and 3, but especially with Alternative 2. While the initial development of the process might require numerous equipment adjustments, the ultimate process would not be subject to the variations of manual effort.

(2) Inasmuch as the processes used in Alternatives 2 and 3 are currently in use in a wide number of both Government and private industry applications, the capabilities of automated paint removal are not in question.

c. Process flexibility. Although the FYDP, the ASA (I&E), and the actual quantity of M999 systems in the field all indicate a multi-year modification program, the degree of flexibility of the process line is rather important. Response to increased priority of another program, continued usage of the facilities after program completion, and so on, depend on the capability of the process to be adapted to a variety of items.

(1) Inasmuch as Alternative 1 (status quo) is strictly a manual operation, there is no limitation on size of housings.

(2) Alternative 2 is restricted to items only slightly larger than the planned M999 housings. This limitation is determined by the size of the dip tank. Maximum size is thus 2 feet by 2 feet by 3 feet.

(3) The contract alternative (per tentative plans submitted by the contractor) would be constrained by dip tank to items no larger than 3 feet by 3 feet by 6 feet.

d. Space requirements. Because the space for vehicle modification programs is extremely limited, economy of usage is a significant factor. Requirements per alternative are shown in table I-5.

Table I-5
Space requirements

Alternative:	1	2	3
No. of square feet required:	100,000	60,000	30,000

e. Workforce level.

(1) In view of the high unemployment rate in the geographical locale of Harryville Army Depot, the level of workforce at HVAD has a great impact upon the local community. While the relationship between this program, local total employment, and welfare costs of local, State, and Federal Government is not certain, there is no question that the actual number of employees depend upon the process selected.

(2) Table I-6 indicates the level of HVAD paint removal workforce at level-off process rates for each alternative.

Table I-6
Paint removal workforce

Alternative:	1	2	3
No. of people:	5	3	0

f. Safety. There are both commercial and Government agencies that publish statistics regarding industrial accidents and injuries related to various types of equipment and processes. In paint removal operations such as those under consideration here, accidents and injuries are caused by solvent inhalation, flash fires, and fume explosion. Equipment and control technology, along with continually improved safety procedures, has reduced the fire and explosion incident rate to a negligible factor. Fume inhalation, while causing no deaths since 1953, does result in increase in workforce loss due to time absent from the work area for recuperation from very temporary discomfort. Total absenteeism from the job due to dissatisfaction with overall working conditions also occurs. This lost time will vary based upon the work environment. Historically such lost time has been 20 percent for the current operation. Estimate for Alternative 2 is 10 percent, and for Alternative 3 it is zero (no effect).

g. Other conditions. The major impacts on the alternatives due to working conditions (other than that discussed above) are results of automation versus manual work and cleanliness of the work area.

(1) Alternative 1, involving manual brush and scrape, requires extensive physical effort, which results in personal fatigue. In addition, the manual application of the solvent and removal of the paint causes excessive solvent and paint scrapings to cover the floor.

(2) Alternative 2 represents the automation type of process. Limited physical effort is required due to the use of equipment for the major part of paint removal. Cleanliness of the work area is at a high level due to containment of the solvent in dip tanks, drench compartments, and drain booths.

(3) Alternative 3, the contracting alternative, obviously has no adverse impacts upon the work environment at HVAD.

h. Comparison of benefits

(1) Using the quantification and narrative assessments of benefits described above, the alternatives were ranked from 1 to 3 (3 being most desirable) for each of the benefits. Benefits were then weighted from 1 to 5 (5 being most desirable). For each benefit, the alternative ranking was multiplied times the weight to obtain a score. The results of this weighted relative ranking are summarized in figure I-6.

(2) Using the aggregate scores representing weighted benefits from figure I-6, it was determined that Alternative 2 has the largest aggregate score for benefits not quantifiable in dollars, as well as the highest dollar benefits. [If Alternative 3 had scored higher in this analysis, the decision maker would have to determine whether these benefits outweigh the impact of the higher dollar benefits of Alternative 2.]

11. Sensitivity/risk/uncertainty

[Not addressed in this example. Where applicable, pertinent issues and alternate dollar values for costs and benefits would be discussed here.]

12. Conclusions/recommendations

Alternative 2 has the highest net present value, highest Benefit/Investment ratio, a much earlier break-even point, and a higher value for non dollar-quantifiable benefits. It is therefore recommended that approval be given to initiate action to implement Alternative 2.

13. Source and derivation of cost estimates

Figure I-7 shows the source and derivation of costs for each alternative.

Comparison of benefits							
Benefit Attribute	Weight	Alternative 1 (status quo)		Alternative 2 (mechanize)		Alternative 3 (contract)	
		Rank	Score	Rank	Score	Rank	Score
Process capability, units per week (80 minimum)	5	2 (100)	10	3 (130)	15	1 (80)	5
Product quality/ uniformity	5	1 fair	5	3 best	15	2 better	10
Process flexibility, max part size, feet (2x1x2 min)	4	3 no limit	12	1 (2x2x3)	4	2 (3x3x6)	8
Space requirements, square feet (thousands)	3	1 (100)	3	2 (60)	6	3 (30)	9
Workforce level at peak workload	1	3 (5)	3	2 (3)	2	1 (0)	1
Lost time due to exposure to solvent	4	1 (20%)	4	2 (10%)	8	3 (0)	12
Working conditions for Harryville Army Depot employees	2	1 (poor)	2	2 (fair)	4	3 (good)	6
Total score			39		54		51

Figure I-6. Comparison of Benefits

SOURCE AND DERIVATION OF COSTS

I. ALTERNATIVE I (Status Quo) Use 5 existing machines and 5 personnel.

A. Investment. None.

B. O & S

1. Hardware Maintenance. Cost per machine * no of machines

Estimated annual cost, FY 00-04:	$25,000	Source: existing maint
FY 2005-2009:	$29,000	contract #DAAB07-98-GHIJ dated 3 Apr 99
No of machines:	5	

2. Personnel. Estimated annual salary, FY 2000-2009: $22,950 Source: Depot TDA, 1 Oct 98

5 Operators	@ $22,950	=	$114,750	
Plus fringe benefits	22%	=	$25,250	Source: Depot Budget Officer

Totals	HW Maint	Personnel	Total O & S
FY00	$125,000	$140,000	$265,000
FY01	$125,000	$140,000	$265,000
FY02	$125,000	$140,000	$265,000
FY03	$125,000	$140,000	$265,000
FY04	$125,000	$140,000	$265,000
FY05	$145,000	$140,000	$285,000
FY06	$145,000	$140,000	$285,000
FY07	$145,000	$140,000	$285,000
FY08	$145,000	$140,000	$285,000
FY09	$145,000	$140,000	$285,000

3. Residual value per machine: $0.00 Source: Depot engineer ("expert opinion")
Total residual value: $0.00

II. ALTERNATIVE 2 Purchase 3 new machines for automated process. Reduces personnel requirement to 3.

A. Investment: HW Purchase

Cost per machine:	$100,000	Source: manufacturer quote
No. of machines bought (FY 99):	2	(Scott Mfg. Co.), 13 May 98
(FY 00):	1	

Totals	Total Investment	Discounted $	Current $
FY00	$200,000	$196,000	$206,000
FY01	$100,000	$96,000	$106,000

Figure I-7. Source and Derivation of Costs

B. O & S

1. Hardware Maintenance. Cost per machine * no of machines

No of new machines (FY 00 = Year 1)	2	
(FY 01 = Year 1)	1	
Estimated annual cost, Year 2-6:	$6,000	
Year 7-10:	$8,000	Source: Vendor quote (Robertson Industries), 13 May 99

Note: First year maintenance is free. Year 2-6 will be FY 2001-2005 or 2002-2006 depending on year of purchase. Source: Manufacturer

No of old machines FY 00	2	
FY 01 and on	0	
Annual cost, old machine	$25,000	Source: existing maint contract # DAAB07-98-GHIJ dated 3 Apr 98

2. Personnel. Estimated annual salary, FY 2000-2009: $22,950 Source: Depot TDA, 1 Oct 98

No of personnel, FY 00: 4 (2 for 2 new machines, 2 for 2 old that remain)

4 Operators @	$22,950 =	$91,800	
Plus fringe benefits	22% =	$20,200	Source: Depot Budget Officer

No of personnel, FY 01-09: 3

3 Operators @	$22,950 =	$68,950	
Plus fringe benefits	22% =	$15,150	Source: Depot Budget Officer

Totals	HW Maint	Personnel	Total O & S
FY00	$50,000	$112,000	$162,000
FY01	$12,000	$84,000	$96,000
FY02	$18,000	$84,000	$102,000
FY03	$18,000	$84,000	$102,000
FY04	$18,000	$84,000	$102,000
FY05	$18,000	$84,000	$102,000
FY06	$22,000	$84,000	$106,000
FY07	$24,000	$84,000	$108,000
FY08	$24,000	$84,000	$108,000
FY09	$24,000	$84,000	$108,000

3. Residual value per machine: $6,500 Source: Manufacturer
Total residual value: $19,500

Figure I-7. Source and Derivation of Costs (Continued)

III. ALTERNATIVE 3 **Contract out entire process.**
No in-house personnel required after contract is in place (Beginning of FY 00)

+

A. Investment: One truck (beginning of FY 00) to deliver material to and from contractor.
Purchase price = $20,000 **Source: Vendor quote (Harryville Chevrolet, Inc), 28 Apr 99**

B. O & S

1. Contract. FY 00-04: Will cost $260,000 annually in constant $.
FY 05-09: Will cost $270,000 annually in constant $. **Source: Contractor Proposal (Duval Paint Removal Inc, 21 Apr 99)**

2. Ops & Maintenance for truck. $2,000 annually beginning in FY 00. **Source: Depot engineer ("expert opinion")**

Totals	Contract $	Truck O & M	Total O & S
FY00	$260,000	$2,000	$262,000
FY01	$260,000	$2,000	$262,000
FY02	$260,000	$2,000	$262,000
FY03	$260,000	$2,000	$262,000
FY04	$260,000	$2,000	$262,000
FY05	$270,000	$2,000	$272,000
FY06	$270,000	$2,000	$272,000
FY07	$270,000	$2,000	$272,000
FY08	$270,000	$2,000	$272,000
FY09	$270,000	$2,000	$272,000

3. Residual value on truck = $1,000 **Source: Depot engineer ("expert opinion")**

Figure I-7. Source and Derivation of Costs (Continued)

Appendix J
Examples of Quantitative Methods

J-1. Benefit Cost Analysis. When all the costs and benefits for each alternative have been converted to dollar values and discounted, alternatives should be compared and ranked. Two methods of comparison are net present value (NPV) and the benefit cost ratio. NPV (discounted net benefits) are determined by subtracting discounted costs from discounted benefits. The benefit cost (B/C) ratio is calculated by dividing discounted benefits by discounted costs. In Table J-1, Alternatives 1 and 3 both have B/C ratios greater than one, therefore both alternatives are cost effective. Since Alternative 1 has the greatest net benefits, the highest B/C ratio and is also the cheapest alternative, it would be the recommended alternative.

Table J-1
Example of Benefit Cost Ratio

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

There will probably be very few cases when the lowest cost alternative also has the highest net benefits. In those cases, the alternative with the highest discounted net benefits could be considered the best alternative; however, it is usually advisable to look at other factors as well. Two examples will help clarify these situations. First, in Table J-2, although alternative 4 isn't the cheapest alternative it has the highest net benefits (and B/C ratio) at $300,000. Therefore it would be the best alternative assuming there is enough money budgeted to afford the $2.5M costs.

Table J-2
Example of Benefit Cost Ratio (Continued)

Alternative	Discounted Costs (C)	Discounted Benefits (B)	Discounted Net (B-C)	Benefit Cost Ratio (B/C)
1	$1,500,000	$1,600,000	$100,000	1.07
2	$1,600,000	$1,750,000	$150,000	1.09
3	$2,250,000	$2,500,000	$250,000	1.11
4	$2,500,000	$2,800,000	$300,000	1.12

The second situation is shown in Table J-3. In this situation, alternatives 3 and 4 both have the highest net benefits at $450,000. However, since alternative 3 has a higher B/C ratio (and is also cheaper) it would be the preferred alternative. (See paragraph J-2 on marginal analysis for additional guidance). In situations where a **cost benefit ratio** is used rather than a benefit cost ratio, the alternative with the **lowest** cost benefit ratio is the preferred alternative.

Table J-3
Example of Benefit Cost Ratio (Continued)

Alternative	Discounted Costs (C)	Discounted Benefits (B)	Discounted Net (B-C)	Benefit Cost Ratio (B/C)
1	$1,500,000	$1,600,000	$100,000	1.07
2	$1,600,000	$1,750,000	$150,000	1.09
3	$2,000,000	$2,450,000	$450,000	1.23
4	$3,000,000	$3,450,000	$450,000	1.15

J-2 Marginal (Incremental) Analysis. Another method of differentiating between alternatives is through the use of marginal, or incremental, analysis. This technique looks at the incremental costs and benefits between alternatives. This comparison can be between the status quo and each alternative, assuming the status quo is the least costly option, or between the least costly alternative and the next cheapest alternative. For example, if the Army wanted to replace a facility, it might consider the following options ranked from least costly to most costly: status quo, renovate, lease, and build new. In this example, the marginal comparisons would either be between the status quo and all other alternatives, or between the status quo and renovate, renovate and lease, and lease and build new.

The following example illustrates the use of marginal analysis. Suppose the Army is considering replacing an information management system. Due to budget constraints, the decision-maker has four alternatives to compare with the status quo for this particular project. Those alternatives may include upgrading the current system, partial or full replacement, etc. The first step is to order the alternatives by discounted cost, lowest to highest. Next calculate discounted net benefits and the benefit cost ratio as explained in section J-1, benefit cost analysis. Table J-4 provides this information for this sample project.

Table J-4
Example of Marginal Analysis

Alternative	Discounted Costs (C)	Discounted Benefits (B)	Discounted Net (B-C)	Benefit Cost Ratio (B/C)
Status Quo	$1,500,000	$1,600,000	$100,000	1.07
1	$1,600,000	$1,750,000	$150,000	1.09
2	$2,000,000	$2,000,000	0	1.0
3	$2,255,000	$2,805,000	$550,000	1.24
4	$2,500,000	$3,050,000	$550,000	1.22

A decision-maker, given just this project and unlimited resources might have difficulty selecting between alternatives 3 and 4, since both have the greatest net benefits, and the B/C ratios are almost identical. So, how does a decision-maker select from among these alternatives with a limited budget? Marginal analysis is one method to assist in the decision process. One can compare the differences among alternatives and reformat the data to calculate marginal cost-benefit ratios. In this example, the costs and benefits of each alternative are compared with the costs and benefits of the status quo (to determine incremental costs and benefits) as shown in Table J-5. The decision-maker can now ask himself or herself whether the additional cost of each alternative is worth expending their limited resources.

Based on this incremental analysis, spending an additional discounted $755,000 for Alternative 3 increases discounted benefits by $1.2 M and results in a gain in discounted net benefits of $450,000, and an incremental B/C ratio of 1.6. By comparison, Alternative 4 has an incremental B/C ratio of 1.45, making

Table J-5
Example of Marginal Analysis (Continued)

Alternatives Compared	Discounted Incremental Costs (IC)	Discounted Incremental Benefits (IB)	Discounted Incremental Net (IB-IC)	Marginal Benefit Cost Ratio (IB/IC)
Alternative 1 to Status Quo	$100,000	$150,000	$50,000	1.5
Alternative 2 to Status Quo	$500,000	$400,000	($100,000)	0.8
Alternative 3 to Status Quo	$755,000	$1,205,000	$450,000	1.6
Alternative 4 to Status Quo	$1,000,000	$1,450,000	$450,000	1.45

Alternative 3 the best alternative. Although the marginal B/C ratio for Alternative 1 is higher than Alternative 4 (1.5 vs. 1.45), Alternative 4 is a better alternative because its discounted incremental benefits are much greater than the incremental net benefits for Alternative 1. Budget considerations may override marginal analysis results. For example, although Alternative 3 and 4 have greater incremental net benefits, if the amount budgeted for the project is $1.6 M, then Alternative 1 is the best option. The decision-maker could use the marginal analysis as justification to try to get an increase in funding by showing the additional benefits provided by Alternatives 3 or 4.

J-3 Savings Investment Ratio (SIR). The SIR is used to compare investment costs to savings to determine if the investment costs can be recovered through savings. The SIR is determined by comparing the present value (PV) of cost savings over the lifetime of a project to the PV of investments minus the PV of investment terminal value (if any) necessary to generate those savings. An SIR greater than 1.0 indicates that the investment is cost effective. The formula for SIR is shown below. The example in Table J-6 illustrates the process.

$$SIR = \frac{PV(S)}{PV(I) - PV(T)}$$

Where S = Savings, I = Investment, and T = Terminal Value

Table J-6
Example of SIR

Project Year	Investment	Savings	Discount Factor	PV Investment	PV Savings
1	$300,000	$75,000	.926	$277,800	$69,450
2		$140,000	.857		$119,980
3		$140,000	.794		$111,160
4		$140,000	.735		$102,900
5		$140,000	.681		$95,340
Total	$300,000	$635,000	-	$277,800	$498,830

Where discount rate = 8%, and terminal value = 0.

SIR = $498,830 ÷ $277,800 = 1.8

J-4 Benefit Investment Ratio (BIR). As explained in section 5, the BIR is defined as the relationship between benefits and the investment costs necessary to produce those benefits. It is calculated exactly as the SIR shown above, except any productivity improvements achieved in addition to the cost savings and cost avoidances are included in the numerator of the equation.

$$BIR = \frac{PV(SA) + PV(P)}{PV(I) - PV(T)}$$

Where SA = Savings and cost avoidance, P = Productivity Improvements, I = Investment, and T = Terminal Value

J-5 Net Present Value (NPV). This method is used when all alternatives meet the mission requirement over the same period of analysis. The equivalent PV is calculated for each alternative using the procedures described in section 3-4 h (5). The word "net" in NPV indicates that the amounts in the cost stream are net cost i.e., the PV of cost minus the PV of benefits. The equivalent PV amounts are summed giving a NPV equivalent for all future costs. The alternative with the lowest NPV is the preferred alternative. Table J-7 shows an example of NPV for a project with two alternatives. Alternative 1 has investment cost of $100,000 and operating costs of $5,000 per year, while alternative 2 has investment costs of $150,000 and operating costs of $8,000 per year. For this example, assume there is no status quo and all costs shown are net of benefits. Alternative 1 is the preferred alternative since it has the lowest NPV,

Table J-7
Example of NPV

Year	Alternative 1 Expenditures	Alternative 2 Expenditures	Discount Factor	Alternative 1 Discounted Costs	Alternative 2 Discounted Costs
1	$100,000	$150,000	.926	$92,600	$138,900
2	$5,000	$8,000	.857	$4,285	$6,856
3	$5,000	$8,000	.794	$3,970	$6,352
4	$5,000	$8,000	.735	$3,675	$5,880
5	$5,000	$8,000	.681	$3,405	$5,448
6	$5,000	$8,000	.630	$3,150	$5,040
Total NPV	-	-	-	$111,085	$168,476

J-6 Break Even Point. Figure J- 8 is an example of how the break-even point for a project is calculated. Project-Redesign has a status quo that requires $30,000 nonrecurring cost (constant dollars) in the second year and $10,000 of recurring cost (constant dollars) per year for year 1 through year 12. Alternative 1 of Project-Redesign has $10,000 nonrecurring cost (constant dollars) in year 1 and $40,000 nonrecurring cost (constant dollars) in year 2. Alternative 1 also has $10,000 recurring cost (constant dollars) in years 1 and 2, and $5,000 recurring cost (constant dollars) in year 3 through year 12. To arrive at the current dollar break-even point, these constant dollar costs are converted to current dollars using the appropriate inflation indices. (In this example, the constant dollar costs have been converted to current dollars by using arbitrary inflation indices.) Next, the savings are determined by calculating the difference between the cumulative costs of the status quo and alternative 1 cumulative costs. The break-even point is identified as that point in time where the savings become positive. As shown in Table J-8, the break-even point for Project-Redesign occurs in year 6.

Table J-8
Breakeven Analysis
(In Thousands of Current Dollars)

	Status Quo		Alternative One				
Year	Recurring	Non-recurring	Recurring	Non-recurring	Status Quo Costs	Alternative One Costs	Savings
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: Breakeven point occurs in the 6th year.

J-7 (Internal) Rate of Return. To determine ROR for a project with investment cost of $200 in year 1 and annual savings of $50 in years 2-9, perform an iterative computation, varying the discount rate until the

total present value of the investment is approximately equal to the total present value of the savings. Begin with the basic present value formula;

$$PV = F_n*1/(1+i)^n$$

Where PV = Present Value, F_n = dollar amount of investment or savings in year n, n = number of periods (in years), and i = interest rate. For this scenario, the ROR is determined when $PV_{inv} = PV_{sav}$, where PV_{inv} is the present value of investment and PV_{sav} is the present value of savings. Thus, $200*1/(1+i) = 50*1/(1+i)^2+...+50*1/(1+i)^9$. At i = .186, $PV_{inv} = PV_{sav} = 168.6$. Hence, the ROR for this example is .186, or 18.6%. Table J-9 shows the annual dollar values and present value equivalents based on the 18.6% ROR.

Table J-9
Annual investments and savings with 18.6% ROR

Project	FYXX Constant $		Present Value $	
Year	Investment	Savings	Investment	Savings
1	200	0	168.6	0.0
2	0	50	0.0	35.5
3	0	50	0.0	29.9
4	0	50	0.0	25.2
5	0	50	0.0	21.3
6	0	50	0.0	17.9
7	0	50	0.0	15.1
8	0	50	0.0	12.7
9	0	50	0.0	10.7
Total	200	450	168.6	168.6

Appendix K
Economics Links

NOTE: The links listed in this Appendix are in no way an endorsement by the U.S. Army of the information contained on those links.

K-1 The Legislative Branch

The United States Senate

Joint Economic Committee Committee Overview, Economic News, Tax Reform, Your Economic Future, Government and Spending, JEC Reports, and Clintonomics.

Economic News Page

Weekly Economic News

Economic Links

K-2 The Executive Branch

The White House

Economic Statistics Briefing Room "To provide easy access to current Federal economic indicators."

Council of Economic Advisers

Working Papers

Economic Indicators

OMB Library - List of all files available from the OMB Library to include OMB Bulletins and Circulars

K-3 Cabinet Level Agencies

Department of Agriculture

Economic Research Service

Department of Commerce

Economics and Statistics Administration

Bureau of Economic Analysis (BEA)

Bureau of the Census - *"The Official Statistics"*

Economic Data and Current Economic Indicators

Statistical Abstract of the United States

Statistical Abstract of the United States - Monthly Economic Indicators

STAT-USA Consolidates economic and business information from more than 50 Federal government agencies. SUBSCRIPTION REQUIRED!

Frequently Requested Statistical Releases

Database Products

Economic Bulletin Board

Economic Publications of Interest

Survey of Current Business (SUBSCRIPTION REQUIRED)

FY 1999 Budget of the United States Government

Economic Development Administration

Office of Economic Conversion Information This clearinghouse is designed to serve the information needs of communities, businesses, and individuals in adjusting to the effects of defense downsizing and other changing economic conditions.

Department of Defense (DefenseLINK)

Defense Finance and Accounting Service (DFAS)

DoD Costing References Policy and procedures, standard cost factors, supporting tools and models abstracts, highlights, events, and other links. Go to DTIC site and search.

Department of the Air Force (Air Force LINK)

Deputy Assistant Secretary of the Air Force, Cost and Economics (SAF/FMC)

Economic Analysis (EA) Home Page

Air Force Instruction (AFI) 65-501, Economic Analysis (Word Document)

Air Force Manual (AFM) 65-506, Economic Analysis (Word Document)

Air Force Instruction (AFI) 65-502, Inflation (Word Document)

Activity-Based Costing (ABC) / Activity-Based Management (ABM)
Discount Rates for Economic Analyses

USAF Statistical Digest

Department of the Army

Assistant Secretary of the Army, Financial Management and Comptroller

U.S. Army Cost and Economic Analysis Center (CEAC)

The Cost and Economic Analysis Program

Department of the Navy

Naval Center for Cost Analysis

Cost Inflation Indices

Department of Labor

Bureau of Labor Statistics (BLS)

Economy at a Glance

Data

Consumer Price Indices (CPI) / Producer Price Indices (PPI) (under Prices and Living Conditions)

CPI - All Urban Consumers

K-4 Independent Agencies

Statistical Releases

FEDSTATS Link to statistical data from over 70 agencies. Site maintained by The Federal Interagency Council on Statistical Policy

GSA's Finance WebSite

BudgetNet

FinanceNet - Financial Management in Government

K-5 International Economics

Centre for Economic Performance - London School of Economics Based at the London School of Economics, the Centre for Economic Performance is one of the leading academic research centres in Europe. The goal of the CEP is "to identify and understand the factors that affect the economic performance of nations and firms."

Currencies of the World

Current Exchange Rates

Finance Watch

Financial Times Group

Institute for International Economics

London School of Economics and Political Science

The World Bank

K-6 THINK TANKS

The Brookings Economic Studies Program The Brookings Economic Studies Program analyzes current emerging economic policy issues facing the United States and the industrialized and developing world. Brookings economic research aims to increase understanding of how the economy works and what can be done to make it work better.

Center for Applied Economic Analysis (CAEA) (Marquette University) The CAEA specializes in quantitative applied economic analysis that is of use to business and public policy decision makers.

Center on Budget and Policy Priorities

Economic Policy Institute

K-7 General Economic Links

Standard & Poor's Index Statistics

Economics Journals on the Internet This site is maintained by the Department of Economics, Helsinki School of Economics and Business Administration.

The RAND Journal of Economics The purpose of The RAND Journal of Economics is to support and encourage research in the behavior of regulated industries, the economic analysis of organizations, and more generally, applied microeconomics

BibEc - Printed Working Papers in Economics

Economic Resources (Eastern Illinois University) *"Links to Resources for Economists on the Net"*

Federal Reserve Board Statistical Releases Federal Reserve Board statistical releases include industrial production and capacity utilization, aggregate reserves and the monetary base, interest rates and bond yields, money stock components, and a weekly series about the assets and liabilities of large commercial banks.

Internet Economic and Statistics Resources LSU Libraries Webliography

Statistical Resources on the Web - Comprehensive Economics (University of Michigan)

Resources for Economists (University of Mainz, Germany)

WebEc - World Wide Web Resources in Economics WebEc, maintained by the Department of Economics, Faculty of Social Sciences, University of Helsinki, Finland, is a classification effort to improve the availability of free information in economics on the WWW. WebEc in Finland is mirrored in Italy, UK, and US.

Society of Computational Economics

Society of Cost Estimating and Analysis (SCEA)

Inflation Calculator Calculator of the change in CPI from 1800 to the present.

Appendix L
Environmental Quality Economic Analyses (EQEA)

L-1. Introduction

This Appendix provides basic guidance for conducting EQEAs. EQEAs can be conducted for all types of environmental quality technology comparison studies but will mainly be utilized for pollution prevention type projects when comparing proposed technologies to ones currently utilized at an installation.

L-2. EQEA Process

a. The Army environmental program places a high emphasis on implementing environmental quality technologies that are not only environmentally friendly but also cost effective. Many Army and DoD funding programs now require that proposed pollution prevention projects must show favorable benefit-to-investment ratios and future cost avoidances when the technology is finally implemented at an installation.

b. There are a number of economic analysis models that can be used for conducting environmental quality economic analyses.

(1) The TurboBPR model was developed for the Office of the Secretary of Defense C3I by the SRA Corporation. The TurboBPR model consists of five modules to produce an economic estimate: strategic planning; operational analysis; initiatives; alternatives and actuals. The TurboBPR cost model can be found at the following web site: http://www.c3i.osd.mil/bpr/bprcd/3007.htm.

(2) The P2/FINANCE spreadsheet tool was developed for the Environmental Protection Agency by the Tellus Institute. The software was developed for conducting financial evaluations of current and potential investments, mainly for pollution prevention projects. The P2/FINANCE tool can be found at the following web site: http://www.epa.gov/opptintr/acctg/download/download.htm.

(3) The I-PAPA (Implementing Pollution Abatement and Prevention Analysis) model was developed by the U.S. Army Concepts Analysis Agency (CAA) and applies CAA's PAPA methodology. PAPA was designed for user-friendly development and evaluation of prioritized pollution investment strategies at the Army Major Command and Headquarters Department of the Army level. The I-PAPA model can be found at the following web site: http://www.aec.army.mil/prod/usaec/et/p2/p2ifpapa01.htm.

(4) The Army Acquisition Pollution Prevention Support Office developed an economic analysis model that can be used to determine the project's total benefit, investment costs, break-even point, benefit-to-investment ratio, and net present value. This model, called the P2 Project Economic Analysis Tool Version 1.0 accounts for all costs associated with a project including previous research and development funding prior to implementation. This model can be found at the following web site: http://www.aappso.com and then click on "P2 Economic Analysis Tool."

Appendix M
Economic analysis checklist

M-1. Introduction

Because each project requiring an EA is different, the evaluator will have questions and concerns which impact specific aspects of that particular project. The following list of questions (guidelines) was developed as a tool to assist in the preparation, review, and validation of EAs. The list is not all-inclusive.

(1) **Objective/problem review checklist**

(a) Is the objective clear and specific?

(b) Is the objective realistic and attainable?

(c) Is the objective statement in terms of output or accomplishment?

(d) Is the objective, as stated, unbiased as to the means of meeting the objective?

(e) Are the expected outputs/accomplishments defined in quantifiable, measurable terms?

(f) Are criteria specified for selection of a preferred course of action?

(g) Can progress toward attainment of the objective be measured?

(h) Is the objective statement phrased so that the type and variety of potential alternatives are not unnecessarily limited?

(i) If a completion or implementation date is required, has it been specified?

(j) Is the statement of the objective/problem well documented?

(2) **Assumptions/constraints**

(a) Are all assumptions realistic and justified?

(b) Are all assumptions pertinent to the analysis identified and rationale provided?

(c) Are all assumptions identified as such?

(d) Are assumptions used only when facts cannot be obtained?

(e) Do the assumptions preclude potential alternative solutions?

(f) Is an assumed future "state of nature" identified?

(g) Do assumptions include economic life and future workload?

(h) Is a project time frame established?

(i) Are funding/budget constraints considered and identified?

(j) Are space, construction, furniture and lab equipment needs included?

(k) Are necessary geographical constraints included?

(l) Are assumptions too restrictive or too broad?

(m) Are facts presented as assumptions? Can the facts be verified? Are uncertainties treated as facts?

(n) Are all assumptions/constraints well documented?

(3) **Alternatives**

(a) Have all feasible alternatives been considered?

(b) Is the status quo presented as an alternative? If not, this needs to be explained in the documentation.

(c) Are all alternatives presented feasible?

(d) Is the status quo used as a basis for comparison?

(e) If appropriate, is lease versus buy evaluated as an alternative?

(f) Are the alternatives distinctly different, rather than a mere restructuring of a single course of action?

(g) Are options applicable to each alternative presented?

(h) Has the rationale for immediate rejection of alternatives, prior to full analysis, been provided?

(i) Have alternatives omitted from the analysis been identified and rationale provided for their omission?

(j) If other Government organizations can provide the desired product or service, have they been identified as alternatives?

(k) If the project increases productive capacity, has a contracting alternative been examined?

(l) Are the alternatives well defined?

(m) Do alternatives overlap one another? Why?

(4) **Cost estimating**

(a) Have all costs, including common costs, been provided for each alternative?

(b) Have cost estimates been provided for the status quo? Are they reasonable? Can they be verified?

(c) Do labor costs consider specific skill levels, fringe benefits, overtime, and shift differential?

(d) Is future equipment replacement properly included as an investment cost (production and deployment)?

(e) Are current asset values, residual values, and inherited assets considered? Is the method of determining these values adequate? Has it been identified and explained?

(f) Is space or operating area included as a capital asset and not as an operating cost?

(g) Are cost collection methods correct?

(h) Are CERs and methodologies identified? Are CERs adequate and structurally valid?

(i) Are the sources of estimates identified? Are these sources accurate and appropriate?

(j) Are future costs evaluated in terms of constant dollars?

(k) Have cash flows been discounted at an appropriate discount rate?

(l) If inflation or cost escalation is included, have the rate and the source of the rate been identified?

(m) Are cost savings or avoidance determined only by comparing with the "status quo?"

(n) Are cost factors current and supportable?

(o) Is appropriate backup documentation, e.g. cost data sheets and variable explanation sheets, provided to support cost estimates?

(p) Are cost estimates consistent with assumptions and constraints?

(q) Has the life cycle cost estimate been provided for all feasible alternatives?

(5) **Benefit analysis**

(a) Have all project benefits, been included and adequately explained?

(b) Are the benefits identified in quantifiable, measurable terms as much as possible?

(c) Do the benefits relate to the project objective?

(d) Are secondary, side benefits identified as such?

(e) Has a ranking or priority system been developed for evaluating importance of non-quantifiable benefits?

(f) Are negative benefits identified and quantified?

(g) Is the list of benefits free of double counting?

(h) Are the assumptions identified and rationale explained? Are they too restrictive or too broad?

(i) Are estimating techniques defined? Are they appropriate?

(j) Are information/estimation sources clearly identified?

(k) Is all the benefit information tabulated for ease of examination?

(l) Are data collection methods valid and adequate?

(m) Are benefits estimating techniques valid?

(n) If savings have been claimed, will a budget actually be reduced? Have the identified savings been fully coordinated with the impacted activity?

(o) Have all advantages and disadvantages of the alternatives been identified?

(p) Were the criteria used to measure the benefits justified by the context of the EA?

(q) Is expert opinion used? Were these experts properly qualified?

(r) Has there been a rational assessment of nonquantifiable factors?

(6) **Comparative analysis of costs and benefits**

(a) Do the comparison and selection criteria agree with those in the project or mission objective statement?

(b) Do the alternatives permit attainment of the project objective?

(c) Have costs and benefits information for each alternative been combined to show relationships such as cost benefit ratios, and so on?

(d) Are the alternatives compared to the status quo?

(e) Were alternatives compared using the proper quantitative technique(s); such as benefit cost ratio, savings-to-investment ratio, etc? Does the benefit-cost ratio reflect worthwhile alternatives for completeness?

(f) Was an incremental analysis performed?

(g) Have trade-offs between benefits been considered?

(h) Does the analysis seem free of bias in favor of a particular alternative (for example, no benefits indicated for one or more of the alternatives, biased assumptions, and so on)?

(i) Was the cost impact of parallel operations included?

(j) Are the economic lives reasonable?

(7) **Sensitivity/risk/uncertainty analysis**

(a) If a risk analysis has been performed, how were the probability estimates derived?

(b) Has an uncertainty analysis been performed? What technique was used (for example, a fortiori or contingency analysis)?

(c) Were ranges of values used for unknown quantities?

(d) Were point values varied to illustrate impact?

(e) Have all relevant "what if" questions been answered? Are they documented in the EA?

(f) Has a sensitivity analysis been performed to show the impact of changes in dominant cost elements? Examples are length of economic life; volume, mix or pattern of workload; requirements; organizational structure; equipment, hardware, or software configuration; or, impact on the length of time for project completion. If no sensitivity analysis has been performed, why not?

(g) What do the sensitivity analysis results imply about the relative ranking of alternatives?

(h) Would the recommendation stay the same if an unknown characteristic varied within a feasible range?

(8) **Recommendation checklist**

(a) Are the recommendations logically derived from the material?

(b) Are the recommendations feasible in the real world of political or policy considerations?

(c) Are the recommendations based on significant differences between the alternatives?

(d) Do benefits exceed costs for the preferred alternative?

(e) Does the analysis data support the recommendation?

(f) Is the recommended alternative supported with proper rationale? Are the reasons clearly identified and documented?

(g) Have all significant differences between the recommended alternative and others been emphasized?

(9) **Documentation checklist**

(a) Is the EA documentation consistent with other program documentation?

(b) Will the EA "stand on its own?"

(c) Will an independent reviewer be able to reach the same conclusion?

(d) Is the EA documentation adequate for the reviewer to duplicate cost and benefits estimates?

Glossary

Section I
Abbreviations

AAA - Army Audit Agency

ACAT - Acquisition category

ACE-IT – Automated Cost Estimating – Integrated Tools

ACP - Army Cost Position

ACWF – Army Working Capital Fund

AE - Acquisition Executive

AEA – Army Enterprise Architecture

AMEC - Army Management Engineering College

AOA – Analysis of Alternatives

ASA(FM&C) - Assistant Secretary of the Army (Financial Management and Comptroller)

ASA(I&E) - Assistant Secretary of the Army (Installations and Environment)

ASA(MRA) - Assistant Secretary of the Army (Manpower and Reserve Affairs)

ASA(ALT) - Assistant Secretary of the Army (Acquisition, Logistics and Technology)

ASD - Assistant Secretary of Defense

ATEC– Army Test and Evaluation Command

BCR - Benefit cost ratio

BIR - Benefit investment ratio

BOMA - Building Owners and Managers Association

C4IT – Command, Control, Communications and Computers/Information Technology

CAB - Cost Analysis Brief

CAIG - Cost Analysis Improvement Group

CARD – Cost Analysis Requirements Document

CCA - Component Cost Analysis

CER - Cost estimating relationship

CFE - Contractor furnished equipment

CIM - Corporate information management

CIPT – Cost Integrated Product Team

CONUS - Continental United States

COTS - Commercial-off-the-shelf

CRB - Cost Review Board

DAU - Defense Acquisition University

DCSLOG - Deputy Chief of Staff for Logistics

DCSOPS - Deputy Chief of Staff for Operations and Plans

DCSPER - Deputy Chief of Staff for Personnel

DISC4 - Director of Information Systems for Command, Control, Communications, and Computers

DoD - Department of Defense

DoDD - Department of Defense Directive

DoDI - Department of Defense Instruction

DPP - Discounted payback period

DUSA(OR) - Deputy Under Secretary of the Army (Operations Research)

EA - Economic analysis

EADP – Economic Analysis Development Plan

EATOOL –Economic Analysis Automated Model

ECONPACK - Economic Analysis Package

ECP - Engineering change proposal

FEA - Functional Economic Analysis

FP - Functional Proponent

FY - Fiscal year

FYDP - Future Years Defense Plan

GAO - General Accounting Office

G&A - General and administrative

GFE - Government furnished equipment

HQDA - Headquarters, Department of Army

HVAD - Harryville Army Depot

IA - Independent Assessment

ICE – Independent Cost Estimate

IIPT – Integrating Integrated Product Team

IPF - Initial production facilities

IPR - In process review

IPT – Integrated Product Team

IT – Information technology

LAN - Local area network

LCCE - Life cycle cost estimate

LOC - Lines of code

LRIP - Low rate initial production

MACOM - Major Army Command

MAIS - Major Automated Information System

MANPRINT - Manpower and personnel integration

MCA - Military Construction, Army

MDEP - Management Decision Package

MNS - Mission need statement

O&S - Operations and support

OIPT – Overarching Integrated Product Team

OMB - Office of Management and Budget

OSD - Office of the Secretary of Defense

P&D - Production and deployment

PAT - Production Acceptance Test

PA&E - Program Analysis and Evaluation

PBS - Production base support

PCS - Permanent change of station

PEO - Program Executive Officer

PEP - Producibility engineering and planning

PM - Program manager

POE - Program Office Estimate

POL - Petroleum, Oil and Lubricants

POM - Program Objective Memorandum

PPBES - Planning, Programming, Budgeting, and Execution System

PV - Present value

P3I - Preplanned product improvement

QA - Quality assurance

R&D - Research and development

RDTE - Research, Development, Test and Evaluation

ROR - Rate of return

SAR - Selected Acquisition Report

SCP - System change package

SDP - System decision package

SIR - Savings investment ratio

SSN - Standard study number

TDA - Table of Distributions and Allowances

TDP - Technical data package

TDY - Temporary duty

TOE - Table of Organization and Equipment

USACEAC - United States Army Cost and Economic Analysis Center

USALMC - United States Army Logistics Management College

USD(A) - Undersecretary of Defense (Acquisition)

Section II

Terms

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

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, deploying (including Military Construction) and sustaining the alternative system or program. The alternative cost also includes the phase-out cost of the status quo. 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 Appropriation Committee annually establish funding levels through an appropriations bill, which ultimately is enacted into law upon signing by the President.

Army Cost Position
The results of comparative analysis of the Program Office Estimate/Economic Analysis and the Component Cost Analysis/Independent Cost Estimate that is documented in the cost analysis brief and approved by the Cost Review Board. It is the approved cost position for all subsequent programming, budgeting, and cost analysis activities.

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 (Acquisition, Logistics and Technology) is currently designated as the Army Acquisition Executive responsible for overall management of Army acquisition programs.

Assumption
A statement or hypothesis made concerning unknown factors and data which are required to accomplish the analysis. Assumptions should never be confused with facts.

Benefit
Results expected in return for costs incurred for a chosen alternative. It includes measures of utility, effectiveness, and performance. Benefits focus on the purpose and the objectives of a project.

Benefit/cost ratio
The ratio of the present value of the total dollar quantifiable benefits divided by the present value of the total costs (life cycle less sunk cost). A BCR of 1.0 indicates that the present value of the benefits is equal to the present value of the total costs. The calculation for BCR begins by applying the discount factor to the constant dollar benefits and the constant dollar costs to arrive at the present value of the total benefits and the present value of the total costs.

Benefit /investment ratio
The ratio of the present value of the total dollar quantifiable benefits divided by the present value of the investment (development, production, and deployment) cost of the alternative. It does not consider benefits which are associated with sunk cost. A BIR of 1.0 indicates that the present value of the benefits is equal to the present value of the investment.

Break-even point/payback
The point, for example, number of years or fractional years, at which the cost of two alternatives are equal. At this point the savings in current dollars from the comparison of alternatives will equal the investment in current dollars. Sunk costs are not considered in the computation.

Common costs
Common costs are costs that will be the same regardless of the alternative selected. In instances where this occurs, common costs must be identified and included in the life cycle cost estimate of all feasible alternatives.

Component Cost Analysis
Current OSD terminology for the independent cost estimates prepared by the Services.

Constant dollars
All prior year, current, and future costs that reflect the level of prices of a base year, regardless of when the costs are incurred. 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 analysis brief
A CRB-originated document that presents a comparative analysis between the POE/EA and the CCA/ICE. It documents the contrasting methodologies between the two estimates, explains major cost differences, and is used to document the ACP.

Cost avoidances
All reductions in future resource requirements, not in an approved Army program, because investment in some needed program/project will not have to be made. For example, if the status quo has a plan that requires the purchase of certain hardware which has not been included in an approved Army program, but the implementation of the preferred alternative does not require the purchase of the hardware and does not degrade current capability, there is a cost avoidance. Cost avoidances are a quantifiable benefit.

Cost driving variable
A parameter, such as speed, range, peak power levels, which has a major or significant effect on the cost.

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.

Cost reduction
A decrease in elements of cost between the status quo and one of the feasible alternatives that result from a variation in operations. For example, the requirement for supplies may decrease as a result of a change in operations.

Cost Review Board
A senior level HQDA body which is the approval authority for the recommended Army Cost Position for major weapon systems and major automated information systems.

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 these years. Future costs or savings stated in current year dollars are the projected values which will be paid out in the future years.

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. The discount rate used by the Federal Government is based on the Treasury Department cost of borrowing funds, and will vary depending on the period of analysis (as stated in OMB Circular A-94).

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. (Alternative definition of present value.)

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 EA 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 utilization 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.

Functional Economic Analysis
A type of economic analysis which documents the review of an entire functional process, developed in support of DoD's corporate information management initiatives.

Functional proponent
The Army staff element, MACOM, or agency designated by the HQDA DISC4 that serves as the proponent for the functional requirements of an information system, upon approval of the Information Management Master Plan.

Independent assessment
An evaluation of the PM's estimate, short of performing a full CCA/ICE, for a program scheduled to be reviewed by the Army System Acquisition Review Council or Army MAISRC. This review includes a thorough analysis of the problem definition, alternatives, assumptions, cost estimate, benefit analysis, risks, conclusions, and recommendations.

Independent cost estimate
A complete and fully documented life cycle cost estimate for a system developed independently of the acquisition proponent. The ICE is used to test the soundness of the program manager's estimate and provide a second opinion of the system's cost. In OSD terminology, the Service's independent estimate is designated the Component Cost Analysis (CCA) and the cost estimate generated by OSD is designated the ICE.

Information system
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. Information system equipment consists of components to create, collect, process, store, retrieve, transmit, communicate, present, dispose, and/or display information.

Information Technology
Any equipment or interconnected system or subsystem of equipment, that is used in the automatic acquisition, storage, manipulation, management, movement, control, display, switching, interchange, transmission, or reception of data or information. The term “equipment” means any equipment used by the DOD directly or used by a contractor under a contract with the DOD that requires the use of such equipment, or the use, or a significant extent, of such equipment in the performance of a service or the furnishing of a product. The term “IT” includes computers, ancillary equipment, software, firmware, and similar procedures, services (including support services), and related resources. The term “IT” also includes National Security Systems. It does not include any equipment that is acquired by a Federal contractor incidental to a Federal contract.

Infrastructure (Information Technology)
The term most generally relates to hardware, but it is frequently more comprehensive and includes software and communications. Collectively, the structure must meet the performance requirements of and capacity for data and application requirements. It includes processors, operating system, service software, and standards profiles that include network diagrams showing communication links with bandwidth, processor locations, and capacities to include hardware builds.

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

In process review
Review of a project or program at critical points to provide current status information to the leadership.

Investment cost
The research and development and production and deployment costs of a system, including military construction.

Life cycle cost estimate
Estimate of all costs incurred during the total life from project initiation through termination of a system. The LCCE includes the costs for research and development, production and deployment (including military construction), and operating and support.

Major Automated Information System
An AIS that is designated by ASD(C3I) as a MAIS, or estimated to require program costs in any single year in excess of $32 million in fiscal year (FY) 2000 constant dollars, total program costs in excess of $126 million in FY2000 constant dollars, or total life-cycle costs in excess of $378 million in FY 2000 constant dollars. MAISs do not include highly sensitive classified programs (as determined by the Secretary of Defense) or tactical communication systems. For purposes of determining whether an AIS is a MAIS, the following shall be aggregated and considered a single AIS: (1) the separate AISs that constitute a multi-element program; (2) the separate AISs that make up an evolutionary or incrementally developed program; and (3) the separate AISs that make up a multi-DOD component AIS program.

Management Decision Package
Documentation which represents the most current approved funding position developed through the PPBES. A Major AIS will normally have a separate MDEP. Each MDEP covers a 9-year period.

Manpower released (not included elsewhere)
Work years of effort that have been funded, released, or retained for other functions. This is a quantifiable benefit.

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

Nonquantifiable benefit
A benefit that does not lend itself to numeric valuation, such as better quality of services or improved readiness. Nonquantifiable benefits are to be addressed in EA documentation.

Nonrecurring costs
Costs incurred on a one-time basis. Normally these are development, production, and deployment expenditures; and include all costs associated with the acquisition and installation of equipment, real property, and start-up costs. All nonrecurring costs need not occur in a single year.

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 discount rate will vary depending on the period of analysis, as prescribed by OMB.

Productivity improvement
Reduction in partial future personnel resource requirements associated with a function or assigned task that has been included in an approved Army program. Under normal circumstances, productivity improvements do not represent an opportunity to reduce an approved program/budget or force structure.

Program acquisition cost
The estimated cost of development, production (including system-specific military construction), and acquisition-related operation and maintenance necessary to acquire the system.

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

Program Executive Officer
A senior service acquisition official who has primary responsibility for directing several MDAPS and for assigned major system and non-major system acquisition programs. A PEO has no other command or staff responsibilities within the Army, and only reports to and receives guidance and direction from the Army Acquisition Executive.

Program/project/product manager
The individual designated, in accordance with criteria established by the Army Acquisition Executive, to manage an acquisition program and appropriately certified under the provisions of the Defense Acquisition Workforce Improvement Act. A PM has no other command or staff responsibilities within the Army.

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

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

Recurring costs
Expenditures required on a repetitive basis for personnel, operations and support costs, overhead, and other services.

Savings
A cost reduction (to include civilian whole spaces) which will be made in a specific MDEP resulting from implementing a specific alternative that does not degrade current capability, in lieu of continuing the present system. The savings will be specifically identified in the EA. Savings are a quantifiable benefit. For example, if the implementation of an alternative way of doing business does not consume as much paper as the previous way of doing business, there is a savings, because a MDEP can be reduced by the amount of paper that does not have to be purchased. Likewise, if the new alternative reduces the number of civilians required to perform the mission and those civilian spaces are terminated, there is a savings because a MDEP can be reduced by the amount required to employ that manpower. If military manpower can be specifically identified to a force reduction, there is a savings. If the military manpower cannot be identified to a specific

force reduction, there is a cost avoidance. When the same type of benefits that would have led to an MDEP reduction occur beyond the POM period, these are also savings because they are assumed to be in an approved Army program.

Savings/investment ratio
The ratio of the present value of the savings to the present value of the investment required to produce the savings. It does not include sunk costs. A SIR of 1.0 indicates that the present value of the savings is equal to the present value of the investment.

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

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

System specific cost
Hardware, software, and related costs that can be directly attributed to a particular information system.

Uniform annual cost
A constant amount which, if paid annually throughout the economic life of a proposed alternative, would yield a total discounted cost equal to the actual present value cost of the alternative. It is calculated by dividing the total discounted cost of the alternative by the sum of the discount factors for the years in which the system provides benefits.

Validation
A review of all elements in a cost estimate to confirm that they are sound, developed using acceptable cost estimating methods, adequately documented, and capable of being justified, supported, and defended.

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