Department of the Army
Pamphlet 210–6

Installations

Economic Analysis of Army Housing Alternatives -- Concepts, Guidelines and Formats

Headquarters
Department of the Army
Washington, DC
8 October 1990

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SUMMARY of CHANGE

DA PAM 210–6
Economic Analysis of Army Housing Alternatives -- Concepts, Guidelines and Formats

This change--

- Incorporates information about ECONPACK, a computer program that is available to perform economic analysis calculations. ECONPACK is available on PAX, and floppy disk for IBM-compatible microcomputers.

- Presents current implementation of new requirements of OBM Circular A-104, which requires use of current discount rates.

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Economic Analysis of Army Housing Alternatives -- Concepts, Guidelines and Formats

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History. This publication was last revised on 27 August 1986. This UPDATE printing publishes a change 1. This publication has been reorganized to make it compatible with the Army electronic publishing database. An appendix of references was inserted as appendix A. No content has been changed.

Summary. This pamphlet provides guidance for the preparation of economic analyses in support of housing construction or leasing requests. It also presents the concepts, guidelines, and formats necessary for identifying sources and developing cost data, organizing the economic analysis report, and carrying out communications with reviewers and decisionmakers.

Applicability. This pamphlet applies to the Active Army. It does not apply to the Army National Guard or the U.S. Army Reserve.

Proponent and exception authority. Not applicable

Impact on New Manning System. This pamphlet does not contain information that affects the New Manning System.

Interim changes. Interim changes to this regulation are not official unless they are authenticated by The Adjutant General. Users will destroy interim changes on their expiration dates unless sooner superseded or rescinded.

Suggested Improvements. The proponent agency of this pamphlet is the Office of the Chief of Engineers. Users are invited to send comments and suggested improvements on DA Form 2028 (Recommended Changes to Publications and Blank Forms) directly to HQDA (CEHSC–HS), WASH DC 20314–1000.

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Chapter 1
Introduction

1–1. Purpose

a. This pamphlet will help housing managers understand (see chaps 2, 3, 4, and 5) and conduct (see chaps 4 and 5) economic analyses. It explains rather than describes policy.

b. This pamphlet gives information that applies directly to analysis of housing alternatives. It includes descriptions of economic analyses and related benefit and cost concepts. Each of these descriptions is tailored to the needs, circumstances, and situation of the housing manager who is faced with proving a request for family and unaccompanied personnel housing at an installation. This pamphlet also describes the analytical process in terms related to housing alternatives. It covers analytical and quantity measuring methods that will aid by providing data to show when one alternative is preferred or less costly. Reporting ideas and requirements are explained, stressing the reason for the recommended action. The appendixes present material that may be needed or used during the economic analysis process. Included are references, definition of terms, suggested data and analytical formats, and present value tables.

c. This pamphlet is to be used by persons who are doing an economic analysis or who are supervising the work of an economic analysis. Persons doing data collection will find it helpful to use in understanding ideas and terms. They may also need to consult this pamphlet on data collection. Persons that have not reached the midlevel may find this material somewhat difficult. They may require either close supervision or need a training course before proceeding beyond the data collection phase. Supervisory personnel will need to study this material carefully to ensure proper design and conduct of the economic analysis. Some may need to attend a training course to assist them in understanding the idea of economic analysis. Midlevel supervisors should find this pamphlet helpful as a reference.

d. The formats, processes, and descriptive material of this pamphlet are designed to cover most circumstances commonly met during preparation of an economic analysis. The analyst may find it necessary to modify procedures or formats to show any unusual features of the situation. (Background and detail is included in the definitions of terms and descriptions of techniques and processes.) If an unfamiliar idea or method is met, the analyst should consult a source document that explains it in detail. Although much of the material may be known to the analyst, it is important to review this treatment of the subjects to ensure a housing analysis orientation. The formats in appendix B include a step–by–step gathering of data and analyses to prove the validity of the recommendation. Use substitute formats if clarity and communication are improved. The purpose of the format design is to ensure a thorough analysis and to communicate the recommendations to decision authorities in a clear and convincing manner.

1–2. References

Related publications are listed in appendix A. Guidance provided herein is consistent with the current version of AR 11–28, and its source documents. Occasionally, these documents will be revised. It is imperative that each housing manager is aware of any revisions, and complies with guidance and requirements of documents that are current as of the date of the analysis. Do not rely on this pamphlet for analysis factor values, such as GSA or DLA overhead rates, employee benefit rates, expense rates, etc.

1–3. Explanations of abbreviations and terms

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

1–4. Economic analysis vs. budgeting

Economic analysis and budgeting are two separate processes. Each has separate objectives and techniques. The objective of economic analysis is to select the least life cycle cost alternative. The objective of budgeting is to establish the amount of funding required to support operations during a specific future period. The total cost resulting from an economic analysis typically is not acceptable for budgeting purposes. For example, wash costs are not included in an economic analysis, but must be included in the budget. An economic analysis includes costs of many organizations and often some imputed costs. Therefore, the total cost specified by an economic analysis is not relevant to the budget of either an organization or a project. Timing of the economic analysis and budget preparation also differ. By the time budget preparation begins, estimates in the economic analysis may be outdated; often, there are more precise cost estimates available. Also, the content of the economic analysis for a project and the budget to implement the selected alternative may differ because the project was approved in a different form than it was proposed. In addition, economic analysis estimates the net present value of each cost to equate the value of the alternatives, while budgets specify only current dollar amounts to be expended in the future.

1–5. Economic analysis of housing alternatives

a. Each economic analysis of housing alternatives should be conducted as follows:

(1) Identify the need for housing resources by referring to the most recent housing requirements survey. This survey should not be more than 1 year old. It must be based on the projected post strength and it must be supported by a Segmented Housing Market Analysis (SHMA) which demonstrates that the private rental market cannot provide the dwelling units that are the subject of the economic analysis.

(2) ***(Rescinded.)***

(3) Design housing alternatives in response to housing needs, housing market features, command choices, and special rights (prerogatives).

(4) Identify all reasonable alternatives excluding those that cannot solve the housing problem. Several alternatives are shown in figure 2–12. The list in this display contains only the most frequently encountered alternatives; it is not an exhaustive list of all alternatives. It is important to include only the alternatives that will solve the housing problem. With fewer alternatives, more expense item (cost elements) will be identical for all alternatives. This results in reduced effort needed for economic analysis design, data collection calculations, and documentation. The reason an obvious alternative cannot solve the housing problem must be thoroughly documented. If this is not done, it will lead the Department of the Army (DA) and the Office of the Secretary of Defense (OSD) to conclude that the economic analysis is incomplete or that it tends to support only the alternative preferred by the commander. Either of these implications may cause rejection of the project. Several alternatives are discussed in chapter 2.

(5) Identify all cost kinds that are relevant to each alternative to be analyzed.

(6) Identify all cost elements that are relevant to each cost kind for each alternative.

(7) Prepare a matrix. (See chap 5 for format.) Mark each line only for those alternatives that contain exactly the same types of operating characteristics and costs.

(8) Identify wash costs. These costs should be specified in the economic analysis documentation.

(9) Collect cost, inflation, and other data needed to complete the economic analysis.

(10) Compute total cost and other needed statistics. HQDA (CEHSC–HS) has developed a computer program (ECONPACK) for this process and will make it available upon request to HQDA (CEHSC–HS), WASH DC 20314–1000.

(a) Analysts should use the computer if it is available .

(b) If a computer is not available, the analyst should use the formats in appendix B or some reasonable change to them.

(11) Prepare documentation per chapter 5 and appendix B. Sources of cost and other estimates must be thoroughly documented. All calculations must also be documented to inform reviewers that

analyses were performed appropriately, and that the calculations were structured correctly.

b. Where qualified or sufficient staff is not available, it may be necessary to do economic analysis via contract. A sample statement of work is in appendix C.

1–6. Conditions requiring or precluding economic analysis

An economic analysis of alternative means of providing housing required for realignment actions must be made when any of the following occurs:

a. A current community Segmented Housing Market Analysis and housing survey show there are not enough housing assets at the installation or its private rental economy to cover realignment needs.

b. After a base closure, a current housing justification survey identifies a residual Department of Defense (DOD) family or unaccompanied personnel housing need.

c. An installation finds that its family housing or unaccompanied personnel housing shortage is severe enough to require expansion beyond the thresholds shown in table 1–1.

Table 1–1
Economic analysis thresholds by type of housing construction or project (installation, real estate, construction and facilities engineering)

Type of construction: Installation alternatives **Governing regulation:** AR 210–20 **Threshold:** Economic analysis is required for total life–cycle cost increment greater than $1 million or initial implementation cost greater than $500,000 or change in annual operating cost greater than $200, 000. (These thresholds include construction or facilities engineering changes, but where only construction or facilities engineering is applicable, thresholds established in the appropriate regulations will apply.)
Type of construction: Family housing operation alternative **Governing regulation:** AR 210–50 **Threshold:** Changes in operation and maintenance concepts as needed.
Type of construction: Family housing maintenance or repair alternative—multiyear project **Governing regulation:** AR 210–50 **Threshold:** Maintenance or repair project estimated to cost $30,000 or more per dwelling unit.
Type of construction: Family housing maintenance or repair alternative to be completed in 1 fiscal year **Governing regulation:** AR 210–50 **Threshold:** Maintenance or repair project estimated to cost $15,000 or more per dwelling unit.
Type of construction: Family housing lease alternative **Governing regulation:** AR 210–50 **Threshold:** Include build–to–lease in all new foreign acquisitions and evaluation of housing alternatives. Evaluate renewal actions as needed.
Type of construction: Construction **Governing regulation:** AR 415–15 **Threshold:** All construction projects with total life–cycle cost exceeding $500,000 NPV.
Type of construction: Construction **Governing regulation:** AR 415–35 **Threshold:** All construction projects with total life–cycle cost exceeding $500,000 NPV.
Type of construction: In–house vs. contract alternatives **Governing regulation:** AR 5–20 **Threshold:** Conduct an evaluation of performance alternatives of commercial activities.

1–7. General guidelines for performing economic analysis studies

It will not always be feasible to conduct a complete economic analysis on the basis outlined in this pamphlet. Therefore, it will be necessary to determine the following locally:

a. Implementation plans. These plans should show discrete areas and priorities for doing economic analyses or program evaluations to ensure that all areas for possible application are systematically covered except as noted in *c*(3) below.

b. Analytical approach. This includes level of detail and sophistication, format for documentation, and amount of resources to be devoted to the analyses or program evaluations.

c. Processing thresholds. A complete and definitive analysis of nearly any situation will consume excessive resources such as staff time, calendar time, money, and computer time. Therefore, it is necessary to follow guidelines that will shorten the search, validation, and analytical processes. The following guidelines apply to this analysis:

(1) After a cursory examination, a cost kind composed of a single item or a cost element may appear to contribute less than $5,000 per year to recurring costs. In this case, proceed as in (3) below.

(2) After a cursory examination, a cost kind composed of a single item or a cost element may appear to contribute less than $5,000 to a one–time cost. In this case, proceed as in (3) below.

(3) For conditions in (1) or (2) above, perform a cursory analysis to estimate the level of annual cost to an approximate level rounded to an even $100. Add this estimate to the expense item titled "other cost" in the proper cost kind. Provide in the written economic analysis report a listing of the items and the amounts of the estimates.

d. Conditions that make it unnecessary to do an economic analysis. (See AR 11–28 for additional guidance.) Under the following conditions, an economic analysis is not necessary:

(1) When it can be shown that the minimum level of effort needed to do the analysis would be greater than the benefits to be gained.

(2) When a waiver has been granted by HQDA (CEHSC–HS).

(3) When the cost of the expansion of housing supply does not exceed the thresholds stated in *c* above. However, managers responsible for recommending or approving a project may require an economic analysis even if the cost is less than the threshold.

(4) When DOD instructions or directives prescribe equipment age or condition replacement criteria, labor and equipment trade–off standards, or requirements computations. (Examples are time between overhauls and shelf life of supplies.)

(5) When proposed action is directed by a statute or directive of authority higher than DOD that precludes any choice or tradeoff among alternatives to accomplish the objective. (Examples are the National Environmental Policy Act, civil work requirements, and pollution controls.)

(6) When another regulation requires an analysis of the cost and effectiveness of weapons systems, support systems, or force levels. Cost and operational effectiveness analysis (COEA) is an example of such an analysis.

(7) When an economic analysis has been completed within the past year with a scope that includes alternatives and thresholds covering the project in question, if private rental and post conditions have not changed. However, the existing economic analysis must be validated to demonstrate that it represents current conditions.

1–8. Guidelines for ranking alternatives

The following guidelines shall be used to determine which alternative is to be recommended. Deviations from these guidelines must be thoroughly supported and must be thoroughly documented. There are typically four possible patterns into which an alternative may fall:

a. Equal benefits with unequal costs. The least costly alternative is preferred. Equal benefits justify the minimum expense. This pattern rarely occurs in pure form since the benefits of different alternatives are seldom truly equal. However, when the benefits are nearly equal, this guideline should be used. Most housing alternatives are designed to be equal, because each alternative provides adequate housing within DOD guidelines for the same number of families and/or UPH.

b. Unequal benefits with equal costs. This may occur when housing alternatives are analyzed. Benefits that can be quantified in dollar terms should be treated as cost recoveries (income, negative cost) and subtracted from the cost stream. Costs must be shown to be equal, and one set of benefits must yield an outcome that is more supportive of Government policy than the benefits from the other alternatives.

c. Unequal benefits with unequal costs. The least costly alternative is preferred unless strong evidence supports the existence and value of the benefits. Often, this is the only valid interpretation because benefits and costs are seldom equal among alternatives. In this case, the analyst must identify the important differences between alternatives and justify any deviation from the low cost preference.

d. Equal benefits with equal costs. This condition shows that the decisionmaker may select any of the alternatives. Make the selection on the basis of the lowest. Do this by selecting the alternative that includes the lowest amount of high–risk expenditures such as energy costs, or the smallest dollar value of expense items involving significant risk.

1–9. Determining the scope of economic analysis

a. In the past, each new lease and lease renewal triggered a requirement for analysis. However, current guidance requires these analyses to be prepared only at the installation or community level. Analyses for smaller areas may be required locally, by major Army command (MACOMs) or by HQDA (CEHSC–HS) when special circumstances are present.

b. Development of standard factors for elements such as cost, floor area, and inflation is encouraged for major Army commands (MACOMs) and other areas larger than communities. However, care must be taken to ensure that the standards truly show actual costs and structures. Do not use standards just to reduce the effort required to perform an economic analysis. Economic analyses for areas larger than a community will rarely, if ever, be accepted.

c. Each economic analysis for each community should cover the entire housing deficit. This will reduce the number of analyses that must be prepared. It also will maximize the number of units authorized.

1–10. Applicability of economic analysis techniques and processes

a. The techniques and processes of economic analysis apply to many of the management problems that a housing manager faces daily.

(1) Some applications are small. Examples are determination of maintenance cycle periods, staffing patterns, and use of physical facilities.

(2) Other applications involve longer terms and larger funding. Examples are refurbishment, renovation of structures, rehabilitation of damaged structures, modernization, replacement of major systems such as roofs and heating plants and location of service facilities.

b. Management efficiency can be improved through application of the techniques of economic analysis. One major function of a manager is to plan for the future. These techniques can aid greatly in this effort.

1–11. Guidance for overseas commands and installations

Overseas commands and installations encounter several sets of unique problems. The following guidance will assist in preparation of an economic analysis for overseas operations:

a. Future exchange rates for foreign currencies are difficult to estimate accurately. The most credible source of future exchange rates is the installation or MACOM comptroller. Assume that the exchange rate will remain constant over the life of the project, unless other instructions are received from the comptroller. Two additional levels of exchange rates (+25% and −25% of the expected level) must be included in the sensitivity analysis. This information is applied to all costs that will be paid in foreign currency, including both and recurring and nonrecurring expenses.

b. Future inflation rates for various expense items in foreign countries should be estimated carefully. They are not the same as United States inflation rates. An estimate should be available from local or host government sources. The installation or MACOM comptroller may provide some guidance. Apply the estimated rates to expense items and cost kinds as indicated in chapter 3. Two additional levels of foreign inflation rates (+25% and −25% of the expected level) must be included for sensitivity analysis if the total of all costs paid in foreign currency exceeds 15% of the total project cost. This information is applied to all costs that will be paid in foreign currency, including both recurring and nonrecurring costs.

c. Discounting calculations for projects in foreign countries are identical to those for CONUS projects. The payment of costs in foreign currency has no affect on the discounting calculation. The investment and the sources of investment funds (U.S. taxpayers) both relate to the United States. The U.S. discount rate is used for all costs of all projects in all countries.

1–12. Computer availability

a. Preparing a credible economic analysis requires large amounts of time and technical knowledge. Use of a computer will reduce errors and the requirement for staff time, calendar time, and technical knowledge. Another way to reduce time and knowledge requirements is to contract for preparation of the economic analysis. Sample statements of work and sample scopes of work are in appendix C.

(1) The computer program that calculates economic analyses is named ECONPACK. Two versions are provided to maximize its usefulness. One version is on PAX, the world–wide computer network which services the Corps of Engineers. PAX is used for several other purposes, including message services. Each organization that subscribes to PAX (Housing, Engineering, Master Planning, District Offices and others) can use ECONPACK by merely adding it to the organization's PAX menu, or by executing the 1391 processor and entering "ECONPACK" at the time–of–day prompt. Documentation for this version is contained in the PAX ECONPACK Economic Analysis Package User's Manual (HNDSP 86–117–ED–ES).

(2) The microcomputer version of ECONPACK is available from Huntsville Division (HNDSP). It requires and IBM–compatible microcomputer with 640K memory and at least 10 megabytes of hard disk storage.

b. It is recommended that the computer be used for all economic analyses. The result will be reduced time consumed during preparation, reduced frustration of the analyst, and increased accuracy of calculation . The program is also available on the Military Construction, Army (MCA) Programming, Administration, and Execution System (PAX) under the name "ECONPACK." HQDA (CEHSC–HS) can provide details on its availability and use.

Chapter 2
Nature of Economic Analysis and Costs

2–1. Description of economic analysis

a. Economic considerations are essential when making decisions on the use of limited resources. Therefore, analysis of the economic results of keeping existing or starting new courses of action to accomplish an Army mission is needed. The degree and depth of analysis should be suitable to the complexity of the situation and the issues and resources involved.

b. Economic analysis involves determining financial and nonfinancial costs and benefits of various methods to solve a problem or achieve a goal. The quantifiable costs and benefits for each alternative are subjected to a variety of summarization and statistical techniques in an attempt to determine their relative efficiencies and effectiveness. Nonquantifiable costs and benefits are included in the analysis to aid in selecting the alternative that fulfills the need at the lowest cost.

c. Economic analysis is a detailed common sense approach to the

very real problem of efficient allocation of scarce resources. All people make such analyses in a simple manner when they buy a car, rent an apartment, buy a house, or evaluate personal investment alternatives. The DOD economic analysis policy is merely a formalization of these processes. This orderly, thorough analysis and presentation of investment alternatives allows the decisionmaker to select the most cost–effective alternative available by—

(1) Focusing informal thinking and amplifying its effectiveness.

(2) Surfacing hidden assumptions, prescribed conditions or notions, and clarifying their logical implications.

(3) Providing an effective vehicle to communicate the opinions that support a recommendation and its justification.

2–2. Objectives of economic analysis

The basic objectives of economic analysis are simple concepts that are used for a wide variety of decisions. The housing manager must seek the most efficient and effective allocation of resources. This can be done by following the guidance below.

a. The housing manager must identify and evaluate the most efficient and effective allocation of resources by using all reasonable alternative methods of satisfying a given housing shortage.

b. Each alternative under consideration must be considered for its full life–cycle funding implications and its full life–cycle benefits.

c. The value of money changes on the basis of the time that it is needed or is available. Therefore, money has a cost that is commonly known as interest rate. This fact must be formally included in the analysis by expressing the life–cycle costs and benefits of each alternative in terms of their present value.

d. The U.S. economy is in an extended period of inflation. All housing alternatives are implemented and operated over long periods of time. Therefore, current costs cannot be expected to apply to future construction or other costs. This fact must be formally included in the analysis by adjusting the life–cycle costs of each expense item or cost kind for estimated levels of inflation.

e. Each economic analysis includes many estimates of operating characteristics and costs. Since estimates seldom identify the exact outcome, it is necessary to identify expense items and cost kinds that may be significantly different from the estimate. Include the impact of these potential differences and their likelihood of occurrence in the analysis. The process that evaluates the impacts and likelihood of cost changes is known as sensitivity analysis.

2–3. Techniques of economic analysis

a. The techniques addressed relate to the systematic comparison of costs and benefits which typically occur in the construction and operation of housing. The concepts described in this pamphlet are expressed in dollars, because an economic analysis treats only monetary costs and benefits. These techniques also apply to benefits that are expressed in dollars. (For a discussion of benefit measurement and comparison, see chaps 3 and 4.)

b. Many techniques, both quantitative and qualitative, aid in developing and displaying the value of an alternative. The most common techniques and examples to explain many of the concepts are in *c* below.

c. Throughout this pamphlet, the process of economic analysis is described in various ways. Central to these definitions is the notion that economic analysis is a system that operates on certain input data and provides an output to aid the decisionmaker. The best and most complete systems can yield output only as good as the input data supplied. Economic analysis is no exception to this rule. Solid, well–documented cost input data provide the foundation for the analysis and are absolutely essential to it.

(1) Cost refers to the value of input such as materials, operating labor, maintenance, supplies, and capital expended in producing goods or services. To be realistic, cost estimates must refer to all ramifications of alternatives being analyzed. A well–done cost analysis of an operation requires detailed analysis of where money comes from, where it goes, and what it buys.

(1.1) Cost of ownership is the total cost required to maintain and operate a dwelling unit. The full cost of ownership is greater than annual maintenance. It includes periodic replacements of mechanical equipment, appliances, roofs, painting, yard replanting, and all other repairs that are necessary to maintain the unit in adequate condition.

(2) Both tangible and intangible costs are associated with most housing alternatives. Define, summarize, and present each of these costs in the report. This will help support the recommendation. Tangible costs are those elements that require measurable amounts of financial resources. They include expenses that must be incurred and paid for contracted or purchased items. They also include the portion of onpost resources consumed to create, design, manage, and evaluate the project or alternative. Intangible costs are all other elements of the alternative that tend to degrade effectiveness of the alternative or mission capability. Tangible costs are quantitative in nature. Intangible costs are either nonquantitative or cannot be interpreted into dollar costs. Tangible costs are discussed in *d* below. Intangible costs are discussed in chapters 3 and 4.

d. The economic analysis summary will present a matrix of cost data for each alternative . Each alternative in the summary matrix must be supported by a summary of significant costs. For guidance in presenting this data, see ECONPACK and appendix B. For an economic analysis, only expense items and cost kinds that are expected to affect the total cost by more than $5,000 are to be included in "other costs." Buildup of costs should begin with identifying expense items that are relevant to the various cost kinds in chapter 3. This concept is in figure 2–1. For guidance in presenting this data, see appendix B. For an economic analysis, only expense items and cost kinds that are expected to affect the total cost by more than $5,000 are to be included in "other costs." Discussion of this analysis structure begins with the definition of expense items, and proceeds to cost kinds and alternatives.

e. A cost that is expected to be identical for all alternatives is called a "wash cost." Wash costs are not included in the cost accumulation because they do not change the ranking of alternatives. (See para 3–12 for a discussion of wash costs.)

2–4. Cost elements

a. General information. Expense items to be considered for each alternative in an economic analysis are discussed below. The listing is intentionally broad, and it is unlikely that any one analysis will include all of the cost elements. The analyst should consider it a checklist against which each cost kind should be measured. If the expense items listed are not broad enough to meet the needs of certain analyses, the analyst should add expense items as needed. When applying this checklist, the analyst must take the vantage point of the U.S. Government to ensure that all relevant costs are included. This will ensure maximum effectiveness of national defense resource allocation. A cost need not be directly billable to the unit, but estimates must be carefully developed and thoroughly documented. While evaluating these expense items, be certain to implement the processing thresholds discussed in chapter 1.

(1) The expense items to be discussed are listed below:

(a) Land.
(b) Equipment procurement.
(c) Inherited assets.
(d) Construction costs.
(e) Depreciation.
(f) Terminal or residual value.
(g) Equipment rental or lease.
(h) Personnel costs.
(i) Materials and supplies.
(j) Contracted services.
(k) Telephone and communications.
(l) Electricity.
(m) Heating.
(n) Water and sewer.
(o) Snow removal and entomological services.
(p) Household goods shipment.
(q) Travel.
(r) Transportation.
(s) Taxes.
(t) Imputed insurance premiums.

(u) Other costs.

(1.1) *Land.* The value of land that is committed to a project must be included as an inherited asset unless the land is purchased specifically for the project. The estimated residual value of the land must also be treated as an inflow to the project at then end of the period of analysis (typically 25 years). This is necessary because any land committed to the project is not available for other purposes. The estimate must be based on the projected use of the land, not the existing use. The Master Planning Section on the installation, the Real Estate Section on your installation, and the district office of the Corps of Engineers are the best sources for the cost estimates.

(1.2) *Equipment procurement costs.* These are nonrecurring costs that may be required to support a variety of cost kinds. This expense item covers the purchase price, transportation, and installation costs. It includes such items as housing equipment replacements, office furniture, office equipment, maintenance equipment, vehicles, and communications equipment, when the equipment is purchased to support a specific housing alternative or housing management operation.

(2) *Treatment of inherited assets.* Investment for the project under study may consist of assets to be acquired, plus assets already on hand; (inherited assets). When an inherited asset is being used or is intended for use on a housing alternative, the residual value at the base year (measured by market price, salvage value, alternative use value, or amortized value) will be included in the investment cost. Appendix E provides amortization tables for estimating residual value. Use these factors if credible estimates of residual value are not available. The value of an inherited asset intended for sale will be included in the investment cost, since it deprives the Government of the expected income from the sale. An inherited asset released for sale by the proposed alternative will have its expected sale value deducted from the investment cost. The value of an idle inherited asset that has no other use, and is not intended to be sold, will not be included in the analysis. Each inherited asset must be evaluated on its own merits and in terms of whether its use in connection with the alternative being considered will cause future expense to the Government. Documentation of alternative use is necessary for each existing asset employed or replaced. When no documentation is possible, the analyst and the reviewer must estimate the commercial value of the assets to be inherited. Housing operations typically inherit assets such as land, existing dwelling units and office facilities, household furnishings and office furniture and equipment, although other articles occasionally are inherited. Dwelling units that are part of a renovation alternative should be included with a physical life span of 25 years, and the cost of an additional renovation at the 15 year point should be included.

(3) *Construction contract costs.* These are nonrecurring costs that are incurred to construct new housing facilities. Prices or costs of construction contracts are included. Other costs, such as administration, inspection, supervision, Government–furnished property, nonconstruction contracts, and indirect costs, are also included. Typical sources of data are the housing office, facility engineer, district or division engineer, and the procurement office. (See the example in fig 2–2 for the level of detail to be included in the economic analysis documentation to identify the operational basis for the estimate.)

Assumptions:

No unusual site conditions. Utilities are available, and land is available.

1st Year

Units	Description
96	2BR JNCO, SNCO & CGO
56	3BR SNCO & CGO
20	3BR FGO
40	4BR FGO
212	Total

Figure 2-2. Example of documentation computation for constructions costs

(4) *Depreciation.*

(a) Depreciation has no effect on Government cash flow, but it does represent a consumption of asset value, and has an affect on residual value. Depreciation cannot be included in most Government accounting processes, but it is relevant to all portions of economic analysis where the value of an asset is consumed by use or the passage of time. Related operating costs to be charged annually are also included in economic analysis. This user cost is composed of expense items such as materials, supplies, maintenance labor, utilities. Use the amortization table of appendix E to estimate residual value unless some other estimate is more valid. Estimates of residual value are necessary for assets that are inherited at the beginning of the project, and for the value of all assets that have a remaining useful life at the end of the project. Do not include depreciation in any other parts of the analysis.

(b) In the private sector, the depreciation write-off of a long–term asset is an accounting expense that neither requires nor generates cash. It therefore has no effect on the firm's cash balance. However, due to the nature of U.S. tax laws, a firm can deduct its depreciation allowance from net income before paying taxes to recognize consumption of the asset. When the tax provisions for depreciable life are different from the useful life of the asset, economic analysis must include the impact on Federal, State, and local taxes. (See para 2–5*d*(11).) The concept of depreciation (amortization) is also used by the analyst when attempting to estimate the terminal or residual value of an asset.

(c) ***(Rescinded.)***

(5) *Estimating terminal or residual value.*

(a) A resulting residual value, if large enough to be important, must be deducted to arrive at the total cost for an alternative. This value is estimated on the basis of the expected term of use, type of use, cost of maintenance, obsolescence, residual reliability of the remaining structure and infrastructure, and market value. Disposal costs must then be subtracted from market value at the time of disposal.

(b) Direct estimates or amortization computations may be appropriate to estimate residual value of unique assets. Otherwise use the tables of appendix E. Residual value depends on quality of construction, construction standards, economic life, and relative inflation. Some techniques in chapter 3 are helpful. Also, building decay–obsolescence, and site appreciation factors are in table E–1. Use the 60 year table for new construction, and the 25 year table for rehabilitation. Where an amortization method is used, its applicability should be documented with the reason for its selection, and the cost of land should be excluded from amortization calculations. Land does not depreciate, but the value of land must be included as an inherited or purchased cost, and as residual value.

(c) Regression analysis may help identify the trend of construction costs or residual value experienced in the past, and population trends and their effect on housing supply and residual value.

(d) Continental United States (CONUS) projects must always include an estimate of residual value in the economic analysis. Outside continental United States (OCONUS) projects must include both an estimate of residual value and an estimate of the probability that the Status of Forces Agreement (SOFA) will result in a residual value of zero. When clear indicators specify that residual value will be zero, the documentation of the economic analysis will omit the residual value from the calculations.

(e) The rationale used to develop the estimate must be documented. This is particularly true for assumptions of probable need for the facility beyond the end of the assumed economic life of the alternative.

(f) After adjusting the residual value for inflation, the adjustment

must be included in the formats showing constant dollar costs discounted back to the base year.

(6) *Equipment rental or lease.* These costs can be part of recurring or nonrecurring costs, depending on the use of the equipment. When the equipment is used as part of a construction or remodeling project or other investment effort, the costs should be included in nonrecurring costs. This expense item includes monthly rental or lease fees on such items as office equipment, construction equipment, and vehicles.

(7) *Personnel costs.* This includes personnel costs (civilian and military) and employee benefits for all employees who can be identified with the work to be done.

(a) Civilian personnel services.

1. The cost of civilian personnel paid at annual rates will be gross pay in current pay tables (use Step 5 of the pay grade if otherwise unknown) plus the Government's contribution for civilian retirement, location differential, disability, health, life insurance, and, where applicable, social security programs. These contributions are determined by multiplying percents by gross pay as indicated in figure 2–3.

Retirement and disability (for employees under Civil Service retirement)	20.4 percent
Health and life insurance	3.7 percent
Compensation, unemployment, bonus, and awards	1.9 percent
Total	26.0 percent

Figure 2-3. Government contribution for civilian personnel services (based on percentage of annual pay rates)

2. If labor costs are calculated on the basis of direct labor hours applied, the civilian pay rate increases to 49 percent to include leave and other benefits. This percent increase over basic pay is the compound increase due to the average cost of leave (sick leave taken and for annual, holiday, and other accruals—23 percent, and the average Government contribution for benefits—26 percent).

(b) Military personnel services.

1. The cost of military personnel will be computed using standard rates set up by DOD for expensing military personnel services. These standard by–grade rates are a composite of military basic pay, incentive pay, special pay, and certain other expenses and allowances paid from the Military Personnel, Army (MPA) appropriations. (See AR 37–100 for additional information.) Adjustments to show the Government's contribution for retirement and certain other personnel costs will be made by multiplying gross pay by the percentages shown in figure 2–4.

2. If labor costs are calculated on the basis of direct labor hours applied, the military pay rate for officers should be increased to 61 percent and for enlisted personnel to 79 percent. This percentage increase over the basic pay is the compound increase due to the average cost of leave (20 percent for leave and holiday periods) and the average Government contribution for benefits (the sum of the percents in the above table).

(b.1) Host country national personnel services This expense item includes pay and employee benefits for any host country national or third country national employees. Pay, benefits, holidays, severance pay, bonus pay, and other employment costs are typically quite different from the U.S. Civil Service.

(c) Other personnel costs. The sum of personnel costs that pertain to performance of the function under consideration, and that are not included under *(a)* and *(b)* above. Some examples are travel, per diem, moving expenses, cost of personnel training chargeable to the operation, home leave, Government household furnishings, environmental and morale leave, and health costs in some overseas locations.

(8) *Basic allowance for quarters (BAQ).* This expense item includes the BAQ allowance that is provided to military members and key civilian personnel who live on the economy. It should be included for each year that it will be required, except for years when this cost is identical for all alternatives. (See "wash costs" in chap 3 if the cost is the same for all alternatives.)

(9) *Other allowances for quarters.* This is the cost of all other allowances for quarters. Examples are Variable Housing Allowance, Overseas Housing Allowance, living quarters allowance for certain civilians on overseas assignment, Family Separation Allowances I and II, Temporary Living Allowance (TLA) after permanent change of station (PCS) moves, and any others that may apply to military or civil service personnel or host country national employees.

(10) *Materials and supplies.* This is the cost to the Government of supplies and materials used in providing a function. Included are costs of base transportation that can be directly identified with the function, costs for handling, storage, custody, and protection of property. The cost of material and supplies should include reasonable overruns, spoilage, or defective work.

(11) *Contracted services.* This expense item includes all contracted services, except those for major construction. Examples of contracted services are repairs, maintenance, painting, large component repairs, rehabilitation, and grounds maintenance. These costs are typically recurring in nature, but should be included in nonrecurring costs if they relate directly to a major project that is a nonrecurring item. Prepare a detailed listing of the required services and estimated costs for each.

(12) *Telephone and communication services.* This cost includes regular monthly charges for telephone, long distance, and other special service charges for a telephone. It also includes other communication services such as cable, mail, and facsimile transmittal.

(13) *Electricity.* Prepare a detailed estimate of electricity consumption. An example at figure 2–5 shows the level of detail to be included in the documentation. The typical source of data is the facility engineer.

	Officer	Enlisted
Retirement	26.5 percent	26.5 percent
Other employee benefits (provides for portion of quarters, medical, and other costs not included in standard rates. The reason for the large difference of percentages is the difference in pay levels).	8.0 percent	23.0 percent
Total for military personnel	34.5 percent	49.5 percent

Figure 2-4. Government contributions for military personnel services (based on percentage of gross pay)

(14) *Heating.* Prepare a detailed estimate of heating costs. The type of fuel may differ from the example presented in figure 2–6. This will alter portions of the calculation. A level of detail similar to figure 2–6 should be in the documentation. The typical source of data is the facility engineer.

Calculated heat loss* =	1,378,000 BTU
Bathroom make–up exhaust =	1,328,000 BTU
Ventilation load at 1,170,080 on 12/ 24 cycle =	585,040 BTU
Combustion air =	320,000 BTU
Total BTU/HR	3,611,040 BTU

Notes:

*Heat loss computations. (Heat load computations are found in a Hackner, Schroeder, Roslansky & Associates, Inc., publication, "Concept Phase Design Analysis.")

Figure 2-6. Example of documentation computation for heating costs for alternative A

(15) *Water and sewer.* Prepare a detailed estimate of water costs. The source of water may differ from the example in figure 2–7. This may alter portions of the calculations. A level of detail similar to figure 2–7 should be in the documentation. The typical source for data is the facility engineer.

(16) *Snow removal and entomological services.* Prepare a detailed estimate of these costs if they are needed. The estimate can be built on estimated hours of equipment use, or any other base that is suitable to measure the effort and expense. The typical source of data is the facility engineer.

(17) *Household goods shipment.* This expense item includes shipment of personal effects of military personnel on unaccompanied assignment status, shipment of household goods for family members, and claims for damaged goods. The effect of various housing alternatives on decisions of individuals to opt for accompanied or unaccompanied tours of duty should be evaluated. This expense item is a recurring cost. The typical source of data is Military Traffic Management Command (MTMC) cost data. A level of detail similar to figure 2–8 should be included in the documentation.

(18) *Travel.* This is a recurring cost unless closely associated with a nonrecurring project. It includes such items as travel fares, related ground transportation, per diem, and professional meeting registration fees. The traveler can be either civilian or military on official duty or in transit. Family members traveling on orders are also included. A level of detail similar to figure 2–9 should be included in the documentation.

(19) *Transportation.* This expense item is included in both recurring and nonrecurring costs as appropriate to the purpose of the transportation. It includes the following:

(a) Motor pool billings, short term vehicle rental (less than 1 month), vehicle maintenance and operating costs, short term contracted services (moving vans, and so forth), and rail and truck freight billings.

(b) Costs of transporting such items as furniture, action officers, materials, supplies, and administrators, for official housing operations and management purposes.

(c) Freight on items that the Government supplies to a major construction or modernization project if the freight is billed separately.

(d) Taxes paid to foreign governments. The general rule is that the U.S. does not pay taxes to foreign governments. However, some exceptions exist, and should be included in this cost. In addition, some governments have established "user fees" that are a substitute for taxes. In cases where these user fees must be paid, they must also be included in the EA.

(e) State and local taxes. The Federal Government is exempt from paying most State and local taxes. To determine whether a State or local tax is an expense item of a particular housing alternative, the legal office of the activity where the economic analysis is performed should review all applicable State and local tax provisions. Contact the installation legal office for guidance and direction.

(f) Federal income taxes. When comparing the cost to the Government of a product or service obtained by contract with the cost of in–house performance, consider the potential Federal income tax revenues that are generated by tax preference provisions. Regular taxes are not relevant, because the basic assumption envisions all entities to be regularly engaged at most times. Therefore, they would be paying Federal income tax, even if not involved in a Federal project. Most tax preferences (such as long term capital gains and ACRS) are no longer in effect, and can be ignored. However, a difference continues to exist in the area of depreciable life. The physical life of most assets is greater than the tax life, which results in a tax preference for the private owner. Current policy is to assume a 60 year physical life of dwelling units, while the tax life is 27.5 years. The result is an understatement of cost (tax) during the first 27.5 years of a building (if the same entity owns it for the full period), and an equal overstatement of cost (tax) during the remainder of the time the dwelling unit is owned by the same entity. Each time ownership of a dwelling unit changes, the same concept applies. Since few dwelling units are owned by the same entity during the entire physical life, the most frequent result is less tax than would otherwise have occurred. An additional problem is estimation of the average Federal income tax rate that will be paid. Individuals will pay from as high as 30 percent to as low as zero percent. the range for corporations will be similar. For Army Housing purposes, assume that the tax preference will always be in effect at the rate of 20 percent. The result is an annual cost to alternatives containing private ownership at a level of 0.33 percent of construction cost (1/60 of cost × .0033). This does not apply if the prospective owner is a tax–exempt organization.

(g) Imputed insurance premiums. The Government does not buy insurance policies, but the Government does incur casualty losses. The reduced value of assets which suffer casualties should be included in the economic analysis as a cost of using the asset. In most cases the cost or restoring damaged items to useful condition is included in normal historical cost records, so it will be included in the estimates for other expense items. When this is true, the economic analysis should specify separately an estimate of value losses related to casualties. Local estimates of standard, commercial coverage for like property from the Building Owners and Managers Association's Regional Exchange Reports must be determined.

(h) Other costs.

1. This expense item is available for any costs that do not fit any of the expense items in *a,* above. Special care must be exercised to ensure that a cost cannot be included in any of the specific expense items in *a,* above. These costs should seldom, if ever, exceed 10 percent of the total dollars identified with one kind of cost. A need to classify more than 10 percent as "other" usually indicates the existence of an expense item that is not listed in *a,* above. If more expense items are needed, it is better to specify them precisely than to overload the "other costs" expense item.

2. This expense item also contains all small costs that have not been evaluated in detail. Chapter 1 sets the criteria for placing small costs in this cost element rather than where they would normally belong. Other costs includes all items with an annual cost less than $5,000 or a one– time cost less than $5,000. The economic analysis documentation must include a list of each of these small items and the level of cost estimated to a rounded $100 level. (See chap 1.)

b. ***(Rescinded.)***

c. ***(Rescinded.)***
d. ***(Rescinded.)***

2–5. Cost kinds

a. General information. Costs are grouped into 13 kinds. Many of these are composed of several expense items. The expense items most likely to appear in each cost kind are in table 2–1. This display is provided as a checklist to ensure consideration of each potentially relevant expense item during the economic analysis process. Table 2–1 must be flexibly interpreted to see how it relates to the operation currently being analyzed. For example, an operation may not involve any equipment procurement to support furnishings operations, even though table 2–1 warns to be alert for this expense item. Or, the operation may require that water and sewer are included in housing area maintenance and repair, even though table 2–1 does not indicate the relationship. Table 2–1 does not predict every possible combination. It merely displays the most likely ones. The material that follows defines each cost kind and provides examples that may be useful. The cost kinds examined in this pamphlet are—

(1) Planning and programming.
(2) One–time costs.
(3) Operations costs.
(a) Furnishings operations.
(b) Housing referral.
(c) Housing allowances.
(d) PCS travel and household goods shipment.
(e) Housing area utilities.
(f) Housing area maintenance and repair (M & R).
(g) Government–furnished materials and supplies.
(h) Contract administration.
(i) Overhead.
(j) Other engineer services.
(k) Taxes.

b. Planning and programming costs. These costs are connected with the determination of the scope and feasibility of a specific alternative. They include such costs as research required to define the project, develop initial configurations, perform preliminary zoning or master planning functions, prepare environmental impact assessments and prepare economic impact statements. They are not costs incurred to do the economic analysis. They are incurred after selection of the course of action to be pursued to develop the selected course of action into a workable, implementable project.

c. One–time costs. These are costs connected with acquisition of equipment and real property, demolition of existing units, cash to be received upon disposal of an asset, personnel training, nonrecurring services, site survey, housing and furnishings rehabilitation or modernization, periodic maintenance that occurs at intervals exceeding 5 years, and construction contracts. One–time costs need not all occur in a single year.

d. Operations costs. A variety of functions contributes to a selected course of action. The costs incurred during performance of these functions are called operations costs. This economic analysis procedure classifies operations costs into 13 kinds. These are defined in (1) through (13) below. The typical relevant housing alternatives for each cost kind are in table 2–2.

(1) *Furnishings operations.* This is the cost of performing all operations needed to provide enough furnishings for all eligible Government and economy quarters. This cost should include replacement, maintenance, repair, storage, distribution, security, and all other property management functions. Various levels of housing will produce a need for different levels of furnishings.

(2) *Housing referral.* This cost is for performing all operations needed to identify community–owned housing that is vacant and to give this information to post personnel. This cost includes on–site inspections and extensive personal interactions with community organizations , such as the board of realty, chamber of commerce, and the apartment owners' association. Funding for memberships should be included in the organization budget, and often may be obtained from the public affairs budget. HRS will be required at all levels of onpost operations.

(3) *Housing allowances.* This cost is relevant to the extent that Government–furnished housing is not available to satisfy permanent party needs and desires. Include BAQ and other housing allowances at the amount that will be paid separately from base pay. When the economic analysis is for a foreign station, these payments may be needed for permanent party U.S. civilian personnel.

(4) *PCS travel and household goods shipment.* This includes all costs of family member transfer. The category also includes the costs of hold baggage for unaccompanied personnel and claims for damaged household goods. When family housing is available, reduce hold baggage costs and increase family transfer costs. Include in this cost kind all relevant family member travel, household goods transportation costs, and hold baggage transportation costs.

(5) *Housing area utilities.* This includes all utility costs that will be incurred during regular operations. It includes such items as electricity, water, natural gas, fuel oil, and sewer charges. It also includes contracted services when a expense item is purchased from a non–Government source. This cost kind does not include construction or modification of utility service facilities since these are one–time costs. It also does not include maintenance of utility service facilities because these are housing area maintenance and repair costs. Utilities costs include only the direct service costs.

(6) *Housing area maintenance and repair.*

(a) This includes the cost of all operations that support maintenance and repair of the housing area. Examples are structure maintenance, grounds maintenance, utility system maintenance, rehabilitation of structures, electrical and plumbing repairs, interior and exterior painting, operation of equipment, inventories, and facilities to perform these tasks. It also includes such items as the operation of vehicles to perform maintenance and repair, emergency operations, self–help program costs, materials, and equipment procurement costs. Capital improvements (projects that lengthen asset life or improve function) are not included with household area maintenance and repair costs, but should be included with one–time costs. Only those M & R costs that apply to the project under analysis are included. Maintenance of rented equipment is included where the Government must pay the cost separately from the lease or rental payment.

(a.1) Include the concept that M & R cost levels are not constant over the physical life of most assets. As they age, more effort and materials are required to maintain adequate operating condition. Inflation also increases the cost level. The analyst may estimate M & R costs at the beginning and end of the period of analysis, and calculate the compound rate of increase. Beginning in year 5, add the rate of increasing effort and materials to the inflation rate which is appropriate for the expense item being estimated. The total of the two rates of increase is then applied to the cost stream in the same manner as inflation would be, if inflation were stated separately.

(b) The documentation supporting estimates of maintenance and repair may be the total of estimates for the cost elements in figure 2–11, or it may be a rate computed in a manner similar to the process of developing overhead rates. (See chap 3 for more information on computing overhead rates and fig 2–11 for an example of documentation using such rates.) The typical source of data is the facility engineer.

1st Year	$838.95/1000 SF		
96 units ×	950 SF	=	91,200 SF
56 units ×	1350 SF	=	75,600
20 units ×	1400 SF	=	28,000
40 units ×	1550 SF	=	62,000
		Total =	256,800 SF

256,800 × $838.95/1000 SF = $215,442

Figure 2-11. Example of documentation of M & R using calculated rate for alternative A

(7) *Government–furnished facilities, materials and supplies.* Often the Government furnishes facilities, equipment, materials, supplies, utilities, transportation, and other items to construction and nonconstruction contractors. The cost of such items is included in this cost kind.

(a) Government–furnished property includes that which is in the possession of or acquired directly by the Government, and is later delivered or made available to the contractor. It also includes property, acquired by a contractor under the terms of the contract, that does not become a part of the end item and is not consumed during contract performance, if the Government retains title at the end of the project. Examples of Government–furnished property are facilities, equipment, special tooling, materials, and supplies.

(b) The methods for determining the costs related to furnishing Government property will vary with the use of the property. Sometimes Government property becomes a part of the end product (material) or is consumed in providing a product or service (supplies). In these cases, the full cost to the Government of acquiring and furnishing these materials and supplies includes Defense Logistics Agency (DLA) or General Services Administration (GSA) overhead. These overhead costs must be added to the cost of the project. At other times, such property as land, buildings, facilities, equipment, and special tooling are provided for the contractor's use during the performance of the contract but will be returned to the Government on contract completion. The costs of Government ownership of these assets during the period of contract performance, plus any other costs incurred in furnishing the property to the contractor, must be added to the cost of contracting. For economic analysis, indirect costs applicable to material obtained from other agencies will be added to the cost estimate. Within DOD, most Government–furnished materials are procured through the DLA or GSA. These cost estimates are treated as described in (c) and (d) below.

(c) Supply services under the wholesale stock fund and direct delivery are provided by DLA to DOD. Under chapter III, B.2.E. of the Cost Comparison Handbook, the proper markup rates applied to DLA prices to show full costs are as follows:

1. Wholesale stock fund. For material for which the Defense Stock Fund has procuring, receiving, storing, and shipping responsibility, add 19.1 percent.

2. Direct delivery. This includes material for which the Defense Stock Fund has procurement responsibility only, and which is delivered directly to the customer from the vendor. For direct delivery services, add 13.6 percent.

(d) In most cases, the prices charged by GSA for material do not include all costs of acquisition and storage functions made by GSA. Since inclusion of some of these costs in GSA prices is not authorized by law, GSA prices must be adjusted for cost estimates. The following material supply services are provided by GSA with the markup rates to be applied to GSA prices to show full costs:

1. Wholesale and stores direct delivery. This involves the distribution of common–use, commercially available items to agency requisitioners worldwide. Such distribution is through a network of supply distribution facilities located throughout the United States. Also included is the Stores Direct Delivery Program. This program is designed to provide customers with the same type of items carried in stock that, because of volume orders, are procured from the vendor for direct delivery to the requisitioner when delivery time is not critical. Add 11 percent for this service.

2. Retail source delivery. This service provides the agency requisitioner with high demand, common–use office and janitorial needs from retail outlets located in areas of concentrated Federal activity. Add 23 percent for this service.

3. Nonstores direct delivery and competitive federal supply schedules. This program is concerned with obtaining customer nonstock requirements through direct shipment from the vendor. Agencies can order directly from vendors. They must use price schedules set up by the GSA Federal supply service. Agencies pay the vendors directly for goods and services obtained. Add 5 percent for this service.

(8) *Contract administration.* This includes costs incurred by the Government to assure that the contract is faithfully executed by both the Government and the contractor. In addition to reviewing contractor performance and compliance with the terms of the contract, contract administration consists of processing payments, negotiating change orders, and monitoring close–out of contract operations. Centralized agency–wide contracting costs are also included. The costs of contract administration will be a percentage of the contract price (currently 5.5% for construction, 7.5% for M & R, and 2% for commercial activities) as required by chapter IV of the Cost Comparison Handbook, or DD Form 1391 processor.

(9) *Overhead.*

(a) Include estimates of overhead costs attributable to the alternative being analyzed, particularly costs that represent a change in the overhead as a result of the proposal. These may be costs for accounting, personnel, legal, administration, local procurement, medical services, receipt, storage, issue of supplies, and other services. Also include the costs of terminating or canceling existing arrangements that will become due as a result of undertaking the alternative. For example, services contracted for overhead operations may be greatly increased if housing is constructed onpost. On the other hand, these costs may be reduced if current onpost housing is demolished or converted to nonhousing uses. For practical reasons, some minor costs are treated as overhead even though they may be directly related to the effort described in a specific cost kind. Short–term work efforts and small, inexpensive items of material are generally in this group. Another example is a cost that supports several cost kinds in a manner that is difficult to identify with any single cost kind. Estimates may be the total of various relevant expense items shown in table 2–1. They may also be based on a rate computed in the manner shown in figure 2–12. The typical source of data is the installation resource management office.

(b) Figure 2–12 shows computation of the actual overhead rate based on historical costs. The same concept can be used when estimating costs for future years. If functional operations will be different from past experience, historical costs may not be available or they may be less accurate than an estimate of future costs.

(10) *Other engineer services.* This cost kind includes all engineer services that are not included elsewhere in the cost kinds. Examples include such items as blueprint services, grounds maintenance, grass cutting, street sweeping, snow removal, entomological services, and emergency services. Documentation must show the service to be rendered. It must also give a cost estimate with a level of detail similar to that of the examples in this pamphlet.

(11) *Taxes.* This cost kind includes all tax considerations, such as state and local taxes that must be paid, taxes and user fees that must be paid to a foreign government, and Federal income tax preferences that are expected to apply.

(a) When comparing the cost to the Government of a product or service obtained by contract with the cost of in–house performance, the potential impact on Federal income tax revenues resulting from tax preferences must be considered. Since contract performance may result in tax preferences which reduce Federal income tax, an estimated amount of such tax preference is a proper addition to the cost of the project. This does not apply if the prospective contractor is a

tax–exempt organization. A tax adjustment to the cost of an alternative applies only in situations where the contractor is subject to U.S. Federal income taxes.

(b) ***(Rescinded.)***

e. Other Costs. This cost kind is available for any operating costs that do not fit any of the cost kinds in *d* above. Care must be taken to ensure that a cost cannot be included in any of the specific kinds defined in *d*. These costs should seldom, if ever, exceed 10 percent of the total dollars identified with one alternative. A need to classify more than 10 percent as "other" usually indicates the existence of a cost kind not listed in *d* above. If more cost kinds are needed, it is better to specify them than to overload the other cost kind. The operating costs of the current operations should be included to the extent needed to continue while the proposed alternative is being phased in.

2–6. Cost elements applicable to cost kinds

Figure 2–1 shows the flow of costs as they are built up to obtain total cost for a housing alternative. It shows a cost kind to be composed of several cost elements. The most frequent combinations of cost elements and cost kinds are in table 2–1. This display should guide accumulation of cost estimates unless the circumstances and data require a different combination. Maintaining as much standardization as possible will aid reviewers of economic analyses. This methodology will also help to communicate more effectively to higher levels of command and to Congress.

2–7. Cost kinds applicable to housing alternatives

a. Most economic analyses of housing alternatives focus on two or more alternatives. The nine alternatives found most frequently are as follows:

(1) Use of private rental housing assets.

(2) Use of private rental housing assets, combined with Government rental guarantee.

(3) Government lease and Government operation of a housing complex, such as an apartment complex or housing development.

(4) Government–leased housing operated by a contractor.

(5) Government–owned and Government–operated housing facilities onpost.

(6) Government–owned and contractor–operated housing facilities onpost.

(7) Renovation of existing dwelling units to return them to their original condition.

(8) Upgrading of existing dwelling units to make them conform to current size, equipment, and architectural standards.

(9) Purchase of existing private rental assets, combined with Government or contractor operation.

(10) The most frequent combinations of cost kinds and alternatives are displayed in figure 2–12. To prepare and EA the analyst should follow the sequence shown below:

(a) Determine the appropriate alternatives.

(b) Identify the cost kinds that will be involved for each alternative.

(c) Identify the expense items that will be involved for each cost kind.

(d) Collect cost data for each expense item.

(e) Enter the data in ECONPACK and run it.

(f) Prepare the documentation as indicated in chapter 2 and 5.

b. For discussions with architects and engineers and for formal paper submittals, the terms "renovation" and "upgrading" are included in the term "renovation." Recognition of this by housing personnel may promote effective communication.

Chapter 3
Analytical Techniques of Economic Analysis

3–1. Measurement of tangible costs

a. Cost estimates suffer from several sources of potential estimating inaccuracies. Estimates relate to work that has not yet been done. Since problems and processes cannot be precisely identified in advance, estimates never predict all actual costs. Estimates relate to future periods of time. This involves prediction of inflation rates, foreign monetary exchange rates, and discount rates. Such rates are not stable. They vary from time to time, project to project, and country to country. Several guidelines specify inflation rates to be used for various cost estimates. However, the analyst must carefully evaluate each major component of the estimate to ensure use of appropriate rates. Estimates for future periods of time also become obsolete because of policy shifts and changing funding constraints. Estimates must be as precise as possible. Precision is obtained by detailed analysis and application of analytical techniques, based on obtaining as much data as economically possible.

b. The analyst must choose the proper level of detail and accuracy in cost estimating. Detail and accuracy are generally classified into the following levels:

(1) Detailed estimates.

(2) Semidetailed estimates.

(3) Order–of–magnitude estimates.

c. The analyst is often confronted with a tradeoff between the accuracy of an estimate and the ease with which it may be made. Order–of–magnitude estimates, the easiest to obtain, have a very low level of accuracy. The actual cost may easily differ from an order–of–magnitude estimate by 35 percent or more.

d. Semidetailed estimates are considered accurate to within about 10 percent of the actual cost. This level of accuracy is often adequate for some of the estimates in an economic analysis.

e. Detailed estimates are used in making bids. These estimates should be within about 5 percent of the actual costs since they are prepared from complete plans and specifications or from historical records. Detailed cost estimates are time–consuming to prepare. Also, all needed details may not be known when the economic analysis is made. However, detailed estimates should be used whenever possible.

f. All cost estimates should be made with care, with full knowledge of their limitations. The level of accuracy should be verified through sensitivity analysis. The primary methods of cost estimating are as follows:

(1) *Budgeting or industrial engineering costing method.* This approach is a consolidation of estimates from various separate work segments into a total project estimate. For example, the estimated cost of production of a new model widget, consisting of work from 10 separate work divisions in a plant, could well be a consolidation of 10 separate and detailed estimates from subcontractors, each of which may be composed of several estimates.

(a) Estimating by engineering methods is based on extensive knowledge of the system's characteristics. The analyst should have a detailed knowledge of the system, operating processes, and organization. In using the engineering method, the system is broken down into its lower–level components and estimates of each component are made. Parametric methods are often used to estimate costs of these components. These results are then combined with estimates of costs of integrating the components to arrive at a total system cost. An advantage of this method is that it separates the parts of the system on which little data is available and require special treatment.

(b) Because detail required for an engineering analysis is not always available to a Government cost analyst, this approach is difficult to apply. Each person making an estimate often does not have enough available data to make a reliable estimate; also, there are few means to evaluate inherent errors. Therefore, a cost estimate combined from as few as 10 separate estimates also combines the errors in each of those estimates. In aggregate form, there is no way to evaluate the errors involved or the level of uncertainty in the

estimate. Where detailed cost data exists, the industrial engineering method is the most reliable method to estimate costs.

(2) *Parametric cost estimating* In parametic cost estimating, the total cost of an alternative is based on physical and performance characteristics and their relationships to component costs. In other words, a functional relationship must be set up between the total cost of the alternative and the various characteristics or parameters of the alternative. In the formal sense, parameter is defined as a cost–related explanatory attribute that may assume various values during a specific calculation. For purposes here, it is best to consider a parameter of an alternative as a definable characteristic of that alternative. It is one of the parts that can be added to express the value of the whole system.

(a) The result of a parametric estimate depends directly on the ability of the analyst to set up relationships between the attributes or elements that make up the alternative. That is, the first job must be to choose and then describe the factors that influence the cost of the alternative. For example, the construction of a new house might involve the following parameters (among others): number of bedrooms, baths, dens, and finished recreation rooms; floor area of the various rooms; capacity of the garage; size of the property lot; and location. If a house price for any combination of these parameters is known, prices for other parameter mixes may be estimated relative to this baseline.

(b) The greater the number of actual combinations for which the prices are known, the easier it is to estimate the effects of a specific parameter on the total cost. The aim of the analyst is to develop a valid cost estimating relationship.

(3) *Analogy method.* If more formal techniques cannot be applied, a specialized method of judgment must be used. This technique, called the analogy method, may be used to estimate costs by making direct comparisons with historical data on similar existing alternatives or their components. This is basically a judgment process requiring considerable experience and expertise to be done successfully.

(a) Estimation of housing acquisition costs may place heavy reliance on the analogy method. At the installation level, the process will obviously be influenced by the recent data on construction costs for that region. At times, cost estimates are available from an expert source such as a local architect and engineering firm. However, these estimates will essentially be based on the firm's most recent experience in labor, materials, and overhead costs.

(b) Estimates of housing–related recurring annual costs also lend themselves to the analogy method. Such estimates will depend heavily on expert judgment based on experience.

g. Providing valid cost data is often the most demanding and time–consuming task for preparing an economic analysis. Even with the application of one or more of the techniques in *f* above, the results are by no means certain.

h. Some sources for linking the parameters of an alternative to costs are listed below.

(1) DA policy.
(2) Expert opinion.
(3) Catalog prices by item.
(4) Industrial engineering standards.
(5) Specific cost estimating relationships.
(6) Cost estimating relationships for analogous programs.

i. The data from the sources in *h* above are both historical and statistical. Relationships have been set by using statistics from the cost data of prior programs.

3–2. Quantitative techniques applicable to economic analysis

Many statistical and summarizing techniques are available to help develop cost estimates and economic analyses. Each technique is designed for a specific purpose and must be used carefully to avoid inserting bias into the analysis. Each technique is based on a set of assumptions about the character of the data and the objectives of the analysis. The technique must be selected carefully and used wisely to ensure thorough analysis, improved communication, and better response from the decisionmakers at higher levels. The analytical techniques explored in this pamphlet are as follows:

a. Regression (trend) analysis.
b. Life–cycle costing.
c. Cash flow diagrams.
d. Designing alternatives to be equal.
e. Discounting and present value analysis.
f. Estimating the impact of inflation.
g. Risk and sensitivity analysis.
h. Sunk costs.
i. Incremental cost.
j. Wash costs.

3–3. Regression analysis

a. This technique expresses a set of quantitative data in terms of a straight–line function. The major objective is to find the trend of the data and extend it into future periods. This technique relates cost as a dependent variable to physical or performance characteristics (independent variables). Simple regression analysis calculates the relationship between two variables. Multiple regression analysis calculates the interrelationships among several variables. A program for each of these techniques is available on most computers as a part of the statistical library. With a small amount of help from an analyst in the computer center, any employee can apply this technique. Figures 3–1 and 3–2 display these concepts.

b. If a computer is not available, reasonable estimates of trend lines and future costs can be obtained by carefully drawing a graph. All costs should be plotted in constant dollars. Several simplifying assumptions and procedures can be used if the analyst is not familiar with the regression analysis technique. These procedures do not result in a precise trend line, but estimating inaccuracies are typically less than those resulting from any assumptions underlying most cost estimates. The simplifying processes are as follows:

(1) Convert all costs to constant dollars.

(2) Select scales for both the vertical and horizontal axes of the graph to allow about 25 percent of the distance to be beyond the highest number to be plotted.

(3) Plot all data points. If no trend is evident in the data, the variables are not related. Do not draw a trend line. Select relevant variables and replot.

(4) Cross out unusual data points. They represent unusual circumstances that cannot be predicted.

(5) Draw the straight line that most nearly shows the trend of the data, using the following guidelines. Do not attempt to draw curved trend lines unless you are familiar with regression analysis. Conditions in (6) through (10) below must all be satisfied at the same time.

(6) Place a ruler across the graph. Turn it on edge so the data points can be seen on both sides.

(7) Place the ruler on the graph so about half of the data points are on each side of the ruler.

(7.1) The trend line to be drawn beside the ruler does not start where the axes meet (the zero point). It may start at any point on either axis.

(7.2) The trend line does not necessarily go through any data point. It is a type of average trend of the data points.

(8) Change the slope of the trend line (ruler) and raise it or lower it on the graph until the total distance between the ruler and all data points on one side of the ruler is about equal to the total distance on the other side.

(9) Change the slope of the trend line (ruler) and raise it or lower it on the graph until the smallest total distance appears on each side of the ruler.

(9.1) All of these conditions specified in items 6 through 11 must be satisfied at the same time.

(10) Draw a line down the side of the ruler. Extend the trend line beyond the last data point to estimate future costs.

c. Note that regression analysis can aid in estimating the total cost of a project. It provides an evaluation of an estimate that was developed by a different analysis or estimates the level of detail cost elements. In figure 3–2, M & R costs should be increased for

dwelling age during future years. Also, it is necessary to adjust these costs for inflation.

d. One difficulty often met during the beginning of a regression analysis is an appearance of three variables, when only two variables are relevant. For example, in figures 3–1 and 3–2, each project was completed during a certain year. Adjusting construction costs to 1980 dollars (constant dollars) makes the year of construction irrelevant, and the dates do not enter the regression analysis.

e. Figure 3–1 shows the use of regression analysis to develop a housing project construction cost. Historical costs per square foot of living area were escalated to 1980 constant dollars. The scattered points in figure 3–1 show the combinations of square feet of area and construction cost in 1980 dollars. The line shown is the "best fit" of a linear (straight line) relationship between area (the independent variable) and construction cost (the dependent variable). It allows the analyst to estimate the construction cost for a new housing project if the living area to be constructed is known. The distances between the line and the points give a visual impression of the statistical confidence of the estimate. The analyst might wish to analyze the impact of other independent variables such as number of buildings, number of stories, and capacity of the air conditioning system. Multiple regression analyses could be applied for this purpose.

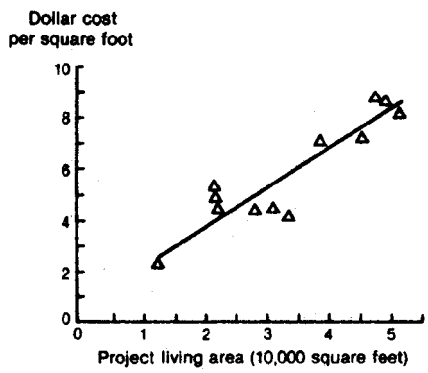


Figure 3-1. Use of regression analysis to develop a housing project construction cost (1980 dollars)

f. Figure 3–2 shows the use of regression analysis to evaluate the impact of dwelling age on M & R costs. All M & R costs are escalated to 1980 dollars, then plotted on the graph and entered into the regression calculations. Escalating all costs to constant dollars allows comparisons by age of a single dwelling and allows a wide variety of dwellings to enter the analysis. Sometimes distortions entering the analysis can be reduced by applying local or regional inflation indexes when adjusting to 1980 dollars and by entering data in the regression analyses only for the type of dwelling to be constructed, such as single unit, multiple unit, masonry, or frame.

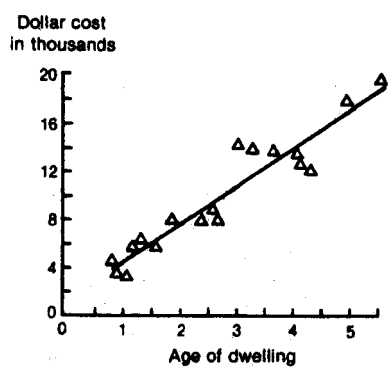


Figure 3-2. Use of regression analysis to evaluate the impact of dwelling age on maintenance and repair costs (1980 dollars)

3–4. Life–cycle costing

a. Life–cycle cost in an economic analysis is the total cost to the Government of acquisition and ownership of an alternative over its full life. It includes the costs of development, production, operation, support, and disposal. The timing of these costs is important to the application of present value techniques and budgetary considerations.

b. A decision to make an investment involves allocation of many resources and tapping of several sources of money. The construction of a housing project, for example, involves the construction investment cost, allocation of land, commitment of funds for personnel, operations, routine maintenance, and other recurring expenses throughout the facility's economic life. It also involves other resource allocations. Any attempt to evaluate an investment alternative without considering all the resource implications is incomplete.

c. The prime purpose of an economic analysis is to provide data for the decisionmaker to use in the resource allocation process. The economic analysis should present an unbiased picture of the full life–cycle resource and benefit implications of each alternative considered. The decisionmaker must have an unbiased presentation to achieve the highest level of national defense possible within the constraints of the budget.

d. When compiling life–cycle costs, the analyst must take the proper vantage point to ensure that all relevant costs are included. The correct vantage point is that of the U.S. Government. This

posture not only provides for the maximum effectiveness of national defense resource allocation, but is also fitting because the highest level of approval sought for a resource allocation decision is that of Congress and the President. Also, Congress is interested when a program or project of one Federal agency affects costs incurred by another Federal agency. Also, the analyst must consider the impact on the local community, and include imputed costs for local services that are used, if no compensation is paid to the provider of the service.

(1) An example of a case in which costs to an Army activity may differ from costs to the Federal Government as a whole is that in which the Army activity occupies a building leased from a private owner through the GSA. GSA levies a charge on the Army activity called standard level user charge (SLUC). The SLUC, however, does not necessarily represent the cost to GSA for providing the building. Thus, if an alternative is considered in which there will no longer be a requirement for the leased building, the savings to the Government are not the amount of the SLUC payments that the Army activity no longer has to pay, but rather the actual costs that GSA had been paying for such items as rent, utilities, and maintenance. In some cases, the analyst may wish to prepare a second comparison of alternatives to show only the costs to the Army. Such a comparison, however, is to be considered supplemental information to an economic analysis and not a substitute for an economic analysis.

(2) Implicit in life–cycle costing is the determination of economic life. The economic life of an asset is the period during which it provides a positive benefit to the Government. The specific factors limiting the duration of economic life are as follows:

(a) The mission life, or period over which a need for the assets is expected.

(b) The physical life, or period over which the assets may be expected to function.

(c) The technological life, or period before obsolescence would dictate replacement of existing or prospective assets.

(d) The expected useful or reasonable life of the decision.

(3) Generally, the economic life of an alternative should be taken as the shortest of the time parameters in (2) above. Explicit guidelines are supplied in table 3–1 for several general investment classifications.

(4) There may be a significant lead time between the first investment expenditure and the beginning of the economic life. Economic life starts only when the asset begins to yield tangible benefits. In the case of buildings, for example, the beginning of economic life coincides with the date of beneficial occupancy. It ends when the alternative falls below some minimum performance standard to achieve the primary objectives of the project. Economic life may also end when the operating and maintenance cost of the alternative exceeds the value of the benefit derived from it on a continuing basis.

(5) The economic lives of the possible project alternatives will govern the time period to be covered by the economic analysis. In general, the economic lives of all alternatives should be set so that they start in the same year and, where possible, should extend over the same period of time.

e. To provide a basis for comparison between competing projects, economic lives for several general investment classifications are displayed in table 3–1. These should be used as guidelines in the absence of better information. Constraints of mission and technological life may make the economic life shorter than the guideline, but the economic life chosen should not exceed the level in figure 3–3. If a shorter life is selected, document the reasons for the choice. (Guidelines for facility groups are based on DODI 4270.1–M, DOD Construction Criteria Manual (CCM).) Table 3–1 shows the current life–cycle guidelines.

3–5. Cash flow diagrams

a. The best tool to define the exact pattern of cash flows is a cash flow diagram. It is worthwhile to prepare a cash flow diagram even for a simple alternative. The cash flow diagram is a visual technique to show the magnitudes and timing of all cash flows for a given economic alternative. It is important to draw a cash flow diagram for each alternative considered in an economic analysis.

(1) Figure 3–3 shows a generalized cash flow diagram with a typical pattern of life–cycle costs. The horizontal line represents a time axis. The choice of time unit is arbitrary, but the scale is usually graduated in years. Costs are represented by vertical arrows. The lengths of these arrows are sized to the cost extents. Their locations on the time line indicate when they occur.

(2) The long arrow on the left (time zero) stands for the acquisition or start–up cost; the shorter downward arrows (years 1–7) stand for costs incurred from year to year (e.g., operating costs, maintenance costs, and isolated one–time costs).

(3) The upward arrow at the right (year 7) stands for the terminal or residual value of assets on hand at that time. Because terminal value is to be netted against the total life cycle cost, it acts to offset other costs, and is drawn upward. In some cases terminal dismantling or demolition costs exceed scrap or salvage value, which would be a net cost represented by a downward arrow.

b. Another common complexity introduced into analysis is the delay of receiving benefits. When operating costs for an alternative are not incurred until several years after project year 1, care should be taken to ensure that the costs are placed in the correct year and discounted. Project year 1 must be the same fiscal year for each alternative. The formats shown in appendix C allow for alternatives to start in different years. The year–by–year accumulation of costs automatically integrates delays by tying costs to a specific fiscal year.

3–6. Designing alternatives to be equal

a. Most economic analyses address new or changed needs. The alternative methods of providing housing differ in concept, content, investment, operating cost, timing, and economic life. Valid comparisons of such diverse alternatives can be prepared only if the alternatives are designed to be equal in as many ways as possible. Calculate the net present value (NPV) of each alternative as of the same base year, even if all the alternatives do not all start in the same year.

b. The comparison period differs from the economic life of an asset because it may begin several years before the start of benefits to allow for project setup, contracting processes, development, and other procurement lead times. This comparison period may end with the longest or shortest economic life among the assets needed for the various alternatives. It also may end at some reasonable time for project completion, consistent with the objective and assumptions of the mission or the study. Set the comparison period of the alternatives so alternatives yield net benefits for the same period of time. Often, adjustment for unequal economic asset lives is required to enable comparison of alternatives. If the shortest economic life among the alternatives is used to find the end of the comparison period, residual values of alternatives with longer economic lives must be considered in the analysis. If the longest economic life among the alternatives is used, include the costs of extending the benefit–producing years for all other alternatives. Another method is to compute the uniform annual cost. Obtain this by dividing the NPV of an alternative (including investment and terminal values) by the sum of the discount factors of the years of operating economic life. The result is an average cost per year of operation.

c. A Government lease versus on–post construction is an example. The alternatives should include equal numbers of various types and sizes of quarters to be provided. If fewer quarters can be constructed than can be leased, prepare one alternative for the total need using the lease and the other alternative with a combination of construction and lease, as in the construction example at figure 3–4.

(1) This example shows only total project cost. Apply the same concept to detail costs if their timing is not coincident. Where the timing is not coincident, apply factors of inflation and cost of capital (discount rate) to the detail.

(2) Equate alternatives that differ in length of economic life.

(3) Compare alternatives on the basis of the time period of stable program use or operation. In the case of lease purchase or purchase

contract, if the period is greater than the contract term permitted under authority for long–term leasing, the analysis should assume renewal of the lease at the level of the last constant dollar payment.

d. To show the extension of one alternative at an increased rate, the cash flow diagrams and assumptions in figures 3–4 and 3–5 should be considered. Cash flow diagrams are explained in paragraph 3–5.

```
     0   1   2   3   4   5   6   7   8   9   10   11   12   Year
A    ! ——! ——! ——! ——! ——! ——! ——!
      $6  6   6   6   6   6   6   6   6   6   6   6   Cost

   0   1   2   3   4   5   6   7   8   1   2   3   4   Year
B  !   —— !   —— !   —— !   —— !   —— !   —— !   —— !   —— !   —— !   —— !   —— !   ——
      $5   5   5   5   5   5   5   5   9   9   9   9   Cost
```

Figure 3-5. Example of extending economic life to equalize alternatives A and B

(1) The cash flow diagrams at figure 3–5 stands for alternatives A and B at the costs indicated. Alternative B includes renegotiation for a lease in year 9.

(2) The only costs considered by the example in figure 3–5 are the uniform recurring costs. Include one–time costs and residual values in the inflation and present value calculations of a comprehensive analysis.

(3) This strategy extends both alternatives to a common point in time (the 12th year). The extended alternative meets at least the minimum level of benefits over the full 12–year period. Thus, it equalizes the economic lives of the assets or leases. Each alternative provides a benefit at least equal to the minimum requirement.

e. Another technique used to equate alternatives is to compute the payback period. Payback, or return, of invested assets is achieved when the total present value savings are enough to offset the discounted investment cost of a proposed alternative to the current situation.

(1) The payback period is the total elapsed time between the point of first investment and the point at which the cumulative value of savings equals the value of the investment. Also, the economic connotation of a payback period is not affected by the duration of the project's economic life. (For example, a 4.5 year payback period means the same thing whether the economic life is 10 years or 25 years.) This concept is shown graphically in figure 3–6, which shows the cumulative present values of investment and savings over the economic life. Payback occurs at the intersection of the two curves.

(2) The weakness of the payback period is in its failure to address cash flows beyond the period needed to recover investment costs. If significant one–time costs are to occur after the estimated point of payback (for example, major repair or renovation costs), the payback period may overstate the economic effectiveness of the proposed project. If significant residual value occurs after the estimated point of payback, the payback period will tend to understate the economic attractiveness of the alternative. Payback period analysis should not be used when—

(a) There are major one–time costs or residual values in the out–years of either alternative.

(b) An appreciable lead-time intervenes between the first investment and the beginning of benefits.

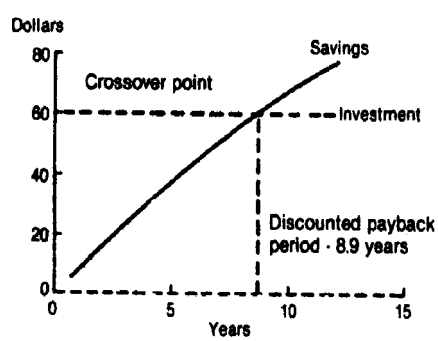


Figure 3-6. Illustration of payback period concept

f. Uniform annual cost is another technique to compensate for unequal lives. To show the uniform annual cost technique, consider the cash flow diagrams and assumptions in figure 3–7.

(1) The cash flow diagrams stand for alternatives A and B at the costs indicated in figure 3–7.

(2) No end of the requirement is foreseen, nor do technological considerations play any major role. The limitation of physical life constrains the economic lives of alternatives A and B to 12 and 8 years, respectively.

(3) Each alternative provides at least the minimum level of benefits required, except for the unequal economic lives.

(4) Each alternative may be repeated, with proper cash flow patterns. This concept is highlighted in figure 3–5.

(5) This strategy uses a computation to average all present value

over the economic life of the assets employed in the alternative. The present values of alternatives A & B are calculated in figure 3–8.

(6) Uniform annual cost is calculated by dividing the project net present value by the sum of the end–of–year discount factors.

(7) If the uniform annual costs were spent each year for the number of operating years, the total net present value of the payments would equal the net present value for the total alternative. In this example, only the cost of capital (discount) is entered into the computation. An inflation factor is not needed, because the discount factor used includes no inflation.

(8) ***(Rescinded.)***

(9) Compute uniform annual cost only for the operating period, excluding any lead time. This average cost is related only to the period of benefit, not to the period of investment. If costs are incurred before the term of benefit, include these investment costs in the net present value and uniform annual cost. Do not include the prebenefit period when selecting the discount factor to divide into the net present value.

3–7. Discounting and present value analysis

a. Discounting is a technique to translate the value of value flows incurred at different times to equivalent amounts as if they were incurred at a common time. Once cost or monetary benefit estimates have been made, they must be recorded by year of estimated expenditure or accrual. Include an allowance for inflation. Obtain the present value by applying the discount factor to each year's cost or benefit. This value represents the value of all dollars in terms of the base year or present dollar considering private sector investment opportunities foregone because the money was spent on a public project.

b. All cost and monetary benefit streams will be treated for inflation (para 3–9) and discounted to present value unless specifically exempted from this requirement. Exempted situations are as follows:

(1) Decisions concerning water resource projects under the jurisdiction of the Corps of Engineers.

(2) Comparative cost analysis conducted per AR 5–20.

(3) Proposed programs or projects, which if adopted, would commit DOD to a series of measurable costs, the total of which would not extend over 3 years, or that would result in a series of cash benefits that do not extend over 3 years from the starting date.

(4) Program evaluation studies that deal only with historical costs or contain no cost comparisons.

c. Treat interest as a related cost to all Government expenditures, whether or not revenues or income from special taxes could make a project self–supporting. This policy is based on the premise that no public investment should be undertaken without considering the alternative use of funds that it absorbs or displaces.

d. The Government can ensure compliance with the philosophy in *c* above by adopting a discount rate policy that reflects the private sector estimate of future economic conditions. The discount rate shows the preference for current and future money sacrifices that the public exhibits in non–Government transactions. The discount rate for a project EA is to be the Government securities interest rate plus one–eighth of one percent. The one–eighth of one percent is to cover transaction costs. These rates are provided by DA Headquarters, and are transmitted to installations on the PAX computer system. This information can be obtained by entering PAX and selecting the following menu items—

(1) ECONPACK.

(2) Help Facility.

(3) OCE Economic Briefs.

(4) If the installation housing office does not have a computer with access to PAX, the information can be obtained from the installation facility engineer office, or the Corps of Engineers District office. Both have computer access to PAX, and can retrieve the OCE Economic Briefs. The Briefs contain a discount rate for each maturity period (such as 1 year, 5 years, 10 years, 30 years), and current instructions for use of the information. Use the rate for the maturity period that is approximately the same as the period of analysis in the EA. In the absence of PAX information, the proper source of discount rates is the most recent issue of Federal Reserve Statistical Summary Publication H–15 (Use the "THIS WEEK" column plus one–eighth of one percent, rounded to the nearest hundredth of one percent), the Wall Street Journal, or the New York Times in that order of preference (Use the rates specified for U.S Government treasury bonds for each year of the duration that is nearest the period of analysis in the EA.) Example: 6.5 plus 0.125 = 6.625 is rounded to 6.63 percent.

e. The period of comparison of alternatives should commence with the year in which the first investment expenditure of the alternatives under consideration will take place. That year is considered as project year 1 for determining the present value of the benefits and costs of all alternatives. Because of the discounting process, this will impose an opportunity cost for the capital needed to finance an alternative that requires earlier funding. This sets the time reference point for present–value calculations; the discounting of all other costs in both alternatives brings them back to this same baseline. Year 1 may be a future point in time; it need not be the present. This does not violate the consistency of the cost comparison, however, because the discounting still translates all cost to the same point in time.

f. Two basic patterns of cash flows will be involved. At least one of these will be part of every housing economic analysis; typically, both will be represented. Also, both will be represented in the form of inflation and multiple cash flows over time. The basic patterns are as follows:

(1) *A single cash flow at a specific time.* This flow can be a cost (outflow) or a monetary benefit (inflow). This cash flow can occur at any time during the project. It may occur as an initial investment for purchase of equipment, construction of housing, planning and programming expenses, or other one–time costs. It may occur during execution of the project in the form of a lease renewal fee, major repair, or replacement of major appliances. Or, it may occur at the end of the project as residual value of structures or equipment.

(2) *A uniform series of cash flows at regular intervals.* Examples are BAQ allowances, monthly or annual lease payments, utilities, and normal repair and maintenance costs.

g. Each case will be one or a combination of the two patterns of *f* above. The difficult aspect of computing present value of an alternative is defining the exact pattern of value flows. After defining the flows, mathematical process will convert them to present value as of the reference date chosen by the analyst. This reference date is sometimes called the base year or project year 1. It is critical for all value flows to be converted to present value as of this specific date.

h. The formats recommended in appendix B are designed to take care of all combinations of cash flow patterns. They are designed to assist in gathering data and applying present value concepts. The emphasis in these formats is on identifying all costs for each year and totaling them. Each year's total is then multiplied by the proper discount factor. (See app D for discount factors.) The discounted values are then added to get the present value of total cost for the alternative. Near–term costs must be estimated carefully. Less precise estimates are necessary for distant time periods, because discounting reduces the impact of estimating inaccuracies.

i. This process requires that each cost subject to inflation enter the format in agreement with paragraph 3–8.

(1) The NPV of alternatives A and B are calculated in figure 3–8. The analyst must first determine the appropriate Government interest rate, and add one–eighth of one percent to it. The example in figure 3–8 shows this calculation. The next step is to estimate value and cash flows. Then, select the appropriate factor from statistical tables, and multiply it by the adjusted interest rate. In figure 3–8 the example shows a factor calculations of .100 × 10 = 1.000, 0.7149 × 10 = 7.149, and .0319 × 10 = 0.319 for alternative A; and similar calculations for alternative B. The value and cash flows are then multiplied by their respective discount factors, and added (or subtracted) to obtain NPV.

(2) Uniform Annual Cost (UAC) is calculated from the NPV by dividing it by the sum of the end–of–year discount factor for the number of years in the period of analysis. This is the most accurate

measure of the average value of a project. If the UAC were spent each year for the period of analysis, the total net present value of the payments would equal the net present value for the total alternative. To simplify this example, only the cost of capital (discount) was entered into the computation. Inflation was not considered. EA's must present current dollar costs, as indicated in paragraph 3–8. The computer program ECONPACK handles these features (inflation and discounting) thoroughly without complex interaction by the analyst. Use ECONPACK wherever possible. Calculating by hand is extremely time consuming, repetitious, and very subject to calculation error.

(3) Since alternative B has the lower UAC, it is preferred. However, the cost preference can be overridden by critical mission or political preferences.

(4) Computer UAC only for the operating period of the analysis, excluding lead time. This average cost is related only to the period of benefit, not to the period of investment. If costs are incurred prior to the term of benefit, include these investment costs in the NPV and UAC, but do not include prebenefit periods when calculating the discount factor.

(5) Mean (average) net present value and mean cash flow are shown in figure 3–8 to highlight the impact of the time value of money which is implicit in calculating the Uniform Annual Cost.

3–8. Estimating the impact of inflation

a. Because of differences in the timing and nature of costs, the effects of inflation during the planning period covered by an economic analysis may impact the decision. All costs are stated in current dollars. The constant dollar costs are inflated; then, each year's costs are discounted with a rate that includes the impact of inflation. This results in a current dollar cost matrix, which must be presented with each EA to satisfy the requirements of OMB Circular A–104 if a lease alternative is presented. In the interest of consistency, a current dollar cost matrix is also required by the Army when a lease alternative is not presented.

(1) Inflation differences between expense items represent relative changes in value. These changes in value must be included in the economic analysis. Each cost that is expected to inflate unusually fast or slow must be inflated, or deflated, for the amount of the estimated inflation. This is true for both domestic and foreign expense items.

(2) Current inflation indices must be the basis for each EA, including annual updates while in the approval process. The proper source for inflation rates is the installation comptroller office. The Comptroller of the Army issues a letter quarterly, which specifies actual inflation rates for several past years and estimated inflation rates for the next five years. It also specifies an estimated rate for years six and on, but the most accurate estimate is obtained by calculating the average inflation rate over the past 30 years. The actual annual rates for that period are in the Statistical Abstract of the United States and Federal Reserve publications.

b. ***(Rescinded.)***

c. It is important to understand the definition of constant dollars and current dollars, in order to calculate inflation adjustments.

(1) Constant dollars indicate constant purchasing power. They are always associated with a base year. (An example is fiscal year 1984 constant dollars.) An estimate is said to be in constant dollars if all costs are adjusted to show the level of prices for the base year.

(2) Current dollars are stated at the levels of the year of their expenditure. When past costs are stated in current dollars, the figures given are the actual amounts paid out. When future costs are stated in current dollars, the figures given are the amounts that will be paid. This includes any amount due to projected future price changes at a level different from the general inflation rate.

d. Economic analysis requires measuring the value of costs and benefits. The unit of measure used is the dollar. To avoid errors due to changes in the value of the unit of measure when the general price level changes, all estimates of costs and financial benefits are made first in terms of constant dollars; that is, in terms of the general purchasing power of the dollar as of the analysis base year (project year 1). In this baseline analysis, projected annual costs should vary only to the extent that the required level of procured goods and services is expected to vary during the project life. For example, it would be legitimate for annual costs to show an increase in the expected amount of repairs needed, as measured by prices in effect at the beginning of the project life. This represents a real cost increase, not an inflationary cost.

e. To ensure consistency, first make all estimates of costs and monetary benefits for each year of the planning period in constant dollars as of the time of the analysis or decision. These estimates will include any forecasted change in price economies or diseconomies of scale in changing the quantity of goods and services.

f. Current inflation rates or indexes are available in MACOM comptroller offices, at the Office of the Comptroller of the Army, or at the Office of the Secretary of Defense (Comptroller) (OSD(C)). Inflation rates for foreign installations may differ from CONUS rates. The OSD(C) Letter, subject: Price Escalation Indices, that is published quarterly, or the local comptroller's office will give guidance. The OSD letter estimates inflation by fiscal year. Care must be taken when inflation is included in cost estimates for more than 4 years beyond the budget year. The reasons are that forecasts of future national economic conditions are uncertain and imputed values for inflation are subject to frequent change.

g. The period between the present and project year 1 is of major concern. Normally, costs will be estimated first on the basis of today's known prices. The problem is that the cost is not incurred today; it is incurred only after the project or program has been approved and funding is authorized and appropriated. For proposed military housing projects, the lag between preparation of the economic analysis and obligation of initial funding can be 3 or more years. The analyst must determine the fiscal year to be designated project year 1; then must inflate current dollar cost estimates to the level appropriate to project year 1. This process is explained in the instructions to the inflation adjustment format in appendix B.

h. The pattern of annual costs can be nonuniform for reasons other than inflation. Maintenance costs may increase with age. Also, periodic future investment outlays may be needed for repair or replacement of physical assets. To the extent that these circumstances can be foreseen and justified, they should be stated in basic narrative documentation, annual cost estimates, and cash–flow diagrams.

i. If a expense item is expected to undergo abnormal inflation of major proportions during the term of the alternative, it should be stated in the narrative documentation and cost analysis. The computer program (ECONPACK) handles this calculation easily. If the economic analysis must be computed by hand, the preferred treatment is the use of the inflation adjustment format in appendix B. The process computes the difference between the abnormal inflation and general inflation rates, and applies this difference to the cost estimates.

j. Inflation rates for foreign installations may differ from CONUS rates. Use the host country inflation rate for all costs that will be paid in host country currency. Estimates of host country inflation are usually available from the host government.

3–9. Risk and sensitivity analysis

a. Economic analyses are built from data just as a house is built of bricks; but an accumulation of data is no more an analysis than a pile of bricks is a house. Regardless of the care devoted to data collection, there is always a possibility that the data will be misleading. Estimates and forecasts may be inaccurate. Data may be accurate but may describe a different situation. When validity of the data is in doubt, the analyst must consider the consequences of using the data.

b. Data analysis and forecasts represent the analyst's best judgment on the way future events will occur. There are always uncertainties about the future. However, the analyst must base conclusions on the best possible estimates. A decision among alternatives often can be made more confidently if the decisionmaker can see whether the conclusion is sensitive to moderate changes in

data forecasts. Sensitivity analysis provides this extra dimension to an economic analysis.

c. For housing economic analyses, it is not useful to make the technical statistical distinction between risk and uncertainty. Therefore, these two terms are used interchangeably in this pamphlet.

(1) Housing managers are faced with the difficulty of evaluating assumptions with a degree of uncertainty. These uncertainties must be analyzed in two broad areas.

(a) What is the risk of an assumption not holding true?

(b) Given that the future may be different from the assumptions, what is the range of possibilities that could occur? How will these possibilities affect the program objectives?

(2) To estimate the risk of an assumption, one must consider reasons for the uncertainty. These reasons may be either internal or external.

(3) The internal risks of a project are produced by the project itself. An increase in the size or the complexity an increase in the risk factor. Also, uncertainty is proportional to the number of future years involved.

(4) External risks are those that could occur independently of the project itself. For example, the effectiveness of a well–run leasing project in a foreign country may be reduced by sharp currency fluctuations, or a new construction project may be halted by a strike. Therefore, to find the uncertainty level of an assumption, one must recognize the possibility of both internal and external risks.

(5) For the housing manager, the effects of these risks on assumptions will be shown by cost changes. In cost analysis, a distinction should be made between requirements uncertainty and cost estimating uncertainty. Requirements uncertainty represents variations in the physical elements of the alternative, while cost estimating uncertainty relates to changes in the final cost of the alternatives. Examples of requirements uncertainty are future post staffing level, community housing availability, cost of community housing that influences the number of families and unaccompanied personnel voluntarily living offpost, and the quantity of utilities required. Examples of cost estimating uncertainty are the unforeseeable shifting of the cost of utilities, construction, transportation, equipment rental or lease, and foreign exchange rates. (See fig 3–9 for presenting the principles of risk and uncertainty.)

d. Since assumptions are necessary when doing an economic analysis and since the levels of many inputs are seldom known with certainty, areas of uncertainty could effect the study results. Thus, the study should address uncertainty and treat it explicitly to expose and reduce, if possible, the unknowns that could affect the decision. Sensitivity analysis deals with uncertainty by changing the values of key variables over feasible ranges to identify the variables that drive the results and to examine the stability of the ranking of alternatives. Other statistical and mathematical techniques may also be used to show or reduce the possibility of altering the ranking of alternatives. The sensitivity analysis also aids in identifying the most cost–effective alternative under conditions of uncertainty.

e. The housing manager's estimate will be an assessment of the end cost expected for a project. As such, the estimate should be relatively stable over long periods of time and not change with small increases to the approved program, funding changes, or financial fluctuations. To the extent possible, schedules and funding should be structured to handle program uncertainties and unforeseen problems. Special degrees of risk or uncertainty related with a project may be pointed out quantitatively in an analysis. This data may be used for program review purposes. Sometimes, probability estimates can be developed by testing the sensitivity of key variables on estimated costs and performance. The narrative must show the probability that each of the possible cost or output estimates may be realized.

f. Estimates must be stated in terms of performance thresholds, goals, or ranges. Project estimates will include the limits within which program cost and technical performance are expected to fall.

g. A sensitivity analysis of decision will identify critical elements. A sensitivity analysis measures the degree of change in one or more elements that will reorder a ranking of alternatives.

h. When conducting an economic analysis, the stated cost estimates depict the analyst's best judgment of the way in which expected future cash flows will occur. Future costs, salvage value, economic life, and other data are estimated based on reasonable expectations. They are rarely known with certainty. The degree of uncertainty generally increases with the time interval between the estimate and the occurrence. In addition to recognizing uncertainty during the estimating process, it is prudent to examine the degree to which each of the variables may be higher or lower than the best estimate.

i. If some cost elements were sufficiently different, the ranking of alternatives would be different. On the other hand, radical changes could be made to other elements without changing the decision. For example, if one element can be varied over a wide range of values without affecting the decision, the decision is said to be insensitive to uncertainties regarding that element. However, if a small change in the estimate of one element will alter the decision, the decision is said to be very sensitive to changes in the estimate of the element.

j. As with economic analysis, the watchword in sensitivity analysis is common sense. If the preference ranking of alternatives sets up one option as markedly superior to the rest, the analyst should not be overly concerned about the sensitivity of this choice to nominal variations in the values of input parameters. When an economic choice is not clear–cut, further investigation is needed. Sensitivity analysis should be applied as an iterative process to refine the analysis. Rather than developing a formal theory, the remainder of this section describes basic techniques most commonly applied in sensitivity analysis. A detailed explanation of sensitivity analysis is in NAVFAC P–442.

j.1. Each housing EA must test for sensitivity to inflation, exchange rates (where some costs will be paid in foreign currency), rent, discount rates, and construction costs. Each of these factors must be tested for increases and decreases.

k. Sensitivity analysis of housing economic cost estimates may be done in detail, specifying levels of change required to alter the ranking of alternatives. This process is performed explicitly and completely by the computer program (ECONPACK) developed by the Pacific Ocean Division of the Corps of Engineers. This program is easy to use and provides the quantitative information to enter the sensitivity analysis portion of the economic analysis report. When the computer is not available, it is acceptable to use one of the processes in (1) or (2) below. These are designed to be performed without the use of complicated mathematics or machines. These two processes use validated or estimated probability distributions, or generalized estimates of risk. An example of each of these procedures is given below:

(1) *Sensitivity analysis via generalized estimates of risk.*

(a) This method selects dominant cost kinds in each alternative. For each cost kind, the analyst estimates the degree of risk inherent in the cost estimate. In some cases, the need for the material is fixed (no risk). In other cases, requirements cannot be definitely calculated, and risk level should be estimated. With the material example, the price of the material may be firm (no risk), or it may be subject to severe fluctuation because of changes in supply and demand (high risk). The result of the analyst's risk estimate should identify the potential for fluctuation of cost. This estimate of risk is an expression of the analyst's confidence level in the accuracy and predictability of the cost estimating process.

(b) Both conditions identified in (a) above are demonstrated in table 3–2 which is an example of the dominance of the cost kind (column 2) and confidence in the estimate (column 3). These conditions are then expressed as percentages. They are multiplied to find the importance of their combination with relation to the total cost of the alternative. The cost kind with a dominance level greater than 5 percent is then analyzed to identify its impact on total cost of the alternative. A definitive analysis would use net present value at this point for columns (6) and (7). However, the net present value amounts will not be available to the analyst in this type of analysis. To calculate net present value by hand consumes too much time and introduces too much opportunity for calculating error.

(2) *Sensitivity analysis via estimate of probability distributions.*

(a) In some cases, the analyst has quantitative data about the probabilities of various possible outcomes of an alternative; that is, there is enough data to make an estimate of the relative frequency of an outcome if numerous trials were made. One useful technique is "expected value." The expected value is a weighted average that represents the average outcome that would be realized if the alternative were implemented many times. For a set of n possible outcomes, where P(i) is the probability of outcome i, and W(i) is the worth or value of outcome i, the expected value E is given by the summation of the products of the probabilities and their corresponding values. The equation for this concept is as follows: $E = P(1)W(1) + P(2)W(2) + P(3)W(3) + \ldots + P(n)W(n)$.

(b) The expected value method provides a relatively simple means of implementing sensitivity analysis. Tables 3–3 and 3–4 show cost estimates resulting from the processes of chapters 2 and 3.

(c) Table 3–4 is divided into four horizontal sets of information—one set for each housing alternative. Three housing alternatives are specified in the format because they will be needed in nearly every analysis. The fourth set of information does not specify an alternative title.

(d) The column titled "Probability" contains five levels of probability for each alternative. These specific levels are not required; however, they provide reasonable benchmarks on which to base estimated cost distributions. It is not necessary to use the same levels for each alternative or for each kind of cost. The format could be altered in the field to specify other levels when needed.

(e) The next three sets of columns are for analysis of specific kinds of costs. The process is based on the premise that kinds of costs that total 20 percent or less of total cost are not large enough to need special sensitivity analysis. Only those kinds of costs that total more than 20 percent are listed separately. Each alternative is analyzed separately. The set of columns for each kind of cost is composed of two columns.

(f) The first column (Estimated cost) contains the level of cost to relate to each probability level. To be definitive, these amounts should be net present values, but calculation of present values consumes too much effort without a computer. The estimated constant dollar costs should be used. The entry on the .40 probability line is the estimated cost shown in the Economic analysis summary. (See fig. B–9 for format.)

(g) From this base, entries are to be estimated for each of the other lines. If verifiable distribution statistics are available, they are used in preference to this simplified method. A computer will be an important tool if the analyst decides to pursue the rigid statistical routine. Estimates based on the method implicit in the format require only a calculator. Line 1 (Probability = .10) alternative has the highest estimate, and line 5 (Probability = .10) has the lowest estimate. Also, the distribution of estimates is not required to be symmetrical. The distribution should be based on a realistic assessment of anticipated possible situations. For example, Onpost construction may show the lowest three estimates to be identical. Seldom, if ever, is cost less than the estimated level. Another example may be Government lease utilities. The lowest three estimates are likely to be identical. Although the lease agreement will include a provision that allows reduction of the rent, economic circumstances almost never result in reduction. The high estimate is higher than the .40 probability level because the lease agreement will contain a provision that allows the rent to increase. Economic circumstances are also expected to allow an increase.

(h) The second column of each set contains the expected cost for each level of probability. This is obtained by multiplying the Estimated cost by its associated probability. In the example in table 3–4, Community Assets, BAQ, probability of .10, Estimated cost of $3, 400 = Expected cost of $340; Onpost construction, Utilities, probability of .40, Estimated cost of $2,129 = Expected Cost of $852; and Government lease, M & R, probability of .40, Estimated cost of $1, 563 = Expected cost of $626.

(i) After estimating each element of the probability distribution, the analyst must add the five estimates of a cost kind to obtain the total expected cost for that cost kind. Note in table 3–4 that six totals have been calculated, as an example.

(j) The next column displays the total of estimated costs that have not been included in cost kind listed in the sensitivity analysis. For example, in the Community assets alternative, only BAQ payments may consume more than 20 percent of total estimated cost. Therefore, in table 3–3 the costs not listed ($4,212) include all costs shown in the Economic analysis cost summary other than BAQ. (See fig B–9 for format.) The total estimated cost of this alternative as presented in the Economic analysis cost summary is $7,235 composed of the .40 probability level, estimated cost, and costs not listed ($3,023 + $4,212 = $7,235).

(k) The next column in table 3–4 displays the sensitivity adjusted expected total cost (hereafter called expected total cost). This is the total of the expected cost kind for each cost kind listed and the costs not listed for community assets, ($3,059 + $4,212 = $7,271).

(l) The Community assets alternative is an example of simple and straightforward estimation. The estimated cost on the .40 probability line ($3,023) is the cost of all BAQ payments. It must be computed by using the constant dollar costs of appendix B. The economic analysis summary format computes net present value, but only for total cost. It does not compute net present value for individual cost kinds. Therefore, the analyst will have only constant dollar costs available to use.

(1) After entering the $3,023 in table 3–3 format, the analyst must estimate the level of cost likely to be encountered at each of the other levels of probability (.10 high estimate, .20 next to highest, .20 next to lowest, and .10 low estimate). An effective process estimates the extremes first, then the others. This should be a comprehensive process, including a look at all major variables that affect the kind of cost and the cost elements of which it is composed. On some occasions, the analyst will receive explicit guidance from higher headquarters or from published sources, but this will be the exception. Typically, the analyst will need to do this portion of the process personally. Validation of estimates should be obtained by talking with informed peers, subordinates, and supervisors in housing and directly related organizations.

(2) The onpost construction alternative is more complex. There are two kinds of costs qualified for specific treatment in the analysis. The estimate approaches $5 million but the variance between the lowest expected cost and the highest is only about $200,000 ($4, 900,000 estimated maximum, less $4,715,000 estimated minimum). This is a small difference that recognizes the stability and predictability of these costs, due in part to their near–term timing. The lowest three estimates of one–time costs are identical. Detailed estimates are used to calculated this amount, and its content is known. Therefore, actual cost will seldom, if ever, be less. On the contrary, it is possible that the analysis did not include all costs or underestimate the need for some elements. Therefore, the highest two estimates exceed that of the .40 probability level.

(3) The onpost construction utilities distribution shows dispersion. Although the lowest three estimates are identical, the dispersion from the .40 probability level to the highest estimate is a 88 percent ($2,129 to 4,000) increase. This recognizes the instability and unpredictability of utilities costs in the current and projected economies of the world.

(4) The Government Lease alternative appears to be less costly than the on–post construction alternative. Estimated lease cost is lower, as are utilities costs. The lease cost may be lower because the lessor selected a longer period of amortization than Army policy allows. The utilities may be lower because of differences in construction patterns. However, M & R costs consume a large proportion of the lease alternative costs. The M & R costs were less than 20 percent of the onpost alternative, but greater than 20 percent of the lease alternative. This may be caused by differences in construction patterns and materials.

(5) The results of sensitivity analysis in table 3–4 must be displayed to assist in the interpretation and decision process. A logical display of results would be like those in table 3–5.

(6) The variables selected for specific treatment in the sensitivity

analysis were sensitive enough to change the rank of each alternative. Estimated cost would result in selection of the onpost alternative because its estimated cost is considerably below the others. However, when the sensitivity of alternatives is considered, Government lease cost is lowest. Both methods are based on many estimates. The use of probability distributions is the more complete estimate and is likely to be more accurate.

m. The following should be considered when preparing a housing economic analysis:

(1) A sensitivity analysis is required.

(2) The ECONPACK computer should be used, if possible. Only when the computer is not available should the cost dominance and probability procedures discussed in this chapter be used.

(3) A sensitivity analysis should be computed for each expense item that contributes more than 15 percent of total cost (20 percent if the computer is not used). ECONPACK will perform these tests without separate basic runs.

(4) Inflation: Use the best estimate of inflation for the basic EA, and test for sensitivity at 25 percent higher and 25 percent lower. Example: If estimated inflation rate = 5 percent, test for sensitivity at 3.75 percent and 6.25 percent to identify any change in ranking of alternatives. This requires a separate run for each inflation level.

(5) Exchange rates: Use the best estimate of exchange rates for the basic EA, and test for sensitivity at 25 percent higher and 25 percent lower. Example: If estimated exchange rate = 1.85 per dollar, test for sensitivity at 1.388 and 2.312 to identify any change in ranking of alternatives. This requires a separate run for each level.

(6) Rent: Use the best estimate of rent for the basic EA, and test for sensitivity at 25 percent higher and 25 percent lower. Example: If estimated rent is $120,000 per year, test for sensitivity at $90,000 and $150,000 to identify any change in ranking of alternatives. ECONPACK sensitivity analysis will perform these tests without separate basic runs.

(7) Discount Rate: Use the best estimate of discount rate for the basic EA, and test for sensitivity at 25 percent higher and 25 percent lower. Example: If estimated discount rate = 8 percent. Test for sensitivity at 6.00 percent and 10.00 percent to identify any change in ranking of alternatives. This requires a separate run for each level.

(8) Construction Cost: Use the best estimate of construction cost for the basic EA, and test for sensitivity at 25 percent higher and 25 percent lower. Example: If estimated construction cost = $25,500, 000, test for sensitivity at $19,125,000 and $31,875,000 to identify any change in ranking of alternatives. ECONPACK will perform these tests without separate basic runs.

(9) The sensitivity analysis must estimate the out–year point (or points) where the two least costly alternatives are expected to be equal.

(10) The sensitivity analysis must estimate the degree of divergence or convergence as the two least costly alternatives approach the point at which they are expected to be equal.

(11) The sensitivity analysis must identify the cost kinds that are expected to be subject to excessively high inflation, and calculate the impact of estimating inaccuracies.

(12) The sensitivity analysis must identify the cost kinds that are expected to be subject to excessively low inflation, and calculate the impact of estimating inaccuracies.

(13) The sensitivity analysis must estimate the impact of estimating inaccuracies for all cost kinds which exceed twenty percent of total cost.

(14) The sensitivity analysis must identify the estimated impact of estimating inaccuracies for related combinations of cost kinds which exceed twenty percent of total cost. For example, a change in oil price affects transportation costs, occupancy costs, construction costs, and utilities. Include such combinations as a group, and test for sensitivity.

(15) The sensitivity analysis must state an opinion about the likelihood of cost shifts of the size required to alter the ranking of alternatives.

(16) The sensitivity analysis conclusion must be reasonable and appropriate.

(17) The results of the sensitivity analysis should be documented, including an estimate of how likely it is that the rankings will change.

3–10. Sunk costs

The principle of full life–cycle analysis applies to all costs and benefits that occur after the decision point.

a. The economic analysis will include only those cash flows that the decision can affect. Many costs that occur before the decision are "sunk" and cannot be altered or recaptured. For example, if an alternative is linked to a renovation effort undertaken before the decision point involving past expenditures of $300,000, to the extent that they are not recoverable, the renovation cost must be disregarded when estimating the cost of the alternative. The unrecoverable amount is a sunk cost and cannot be affected in any way by the choice among alternatives.

b. Sunk costs are never included in the economic analysis. This is true regardless of the timing involved. Even if the unrecoverable amount was spent yesterday, it is a sunk cost and it is not relevant to today's decision. However, the asset purchased may still have residual value. The renovation may have included kitchen, bathroom, heating, or laundry appliances that possess major residual value. Other items such as paint, plasterboard, and concrete do not possess residual value, and the cost of purchasing and installing them is a sunk cost. The cost is not recoverable and is not relevant to today's decision. It may be relevant to the extent that its existence makes it unnecessary to paint or plaster as part of one of the alternatives considered.

3–11. Incremental costs

a. Incremental costs are cost increases or decreases that result from a change in operations. These costs are often stated in terms of cost change per unit of change. They are also sometimes stated in terms of total cost of a change in operations. Changes in costs can result from such items as the addition of dwelling units, personnel, consumption of more water, or added cost to mow the lawn more often than under prior methods. If the cost of coal is $100, and incremental cost per ton of coal for heating is $20 for a decrease in consumption from 150 to 100 tons per month, but only $15 per ton for a decrease of 20 tons per month, the cost saving in total operations would be $3,000 for reducing 50 tons of consumption, and only $50 for reducing 20 tons per month. Each alternative nearly always alters the level of portions of the operation. These cost changes are incremental costs or savings.

b. Economic analyses should be computed on the basis of cost differences between current operations and those proposed by an alternative. Economic analysis is not a budgeting process, but an analytical process. A budget estimates total cost of operating an organization and considers only the selected alternative. An economic analysis is a decision point tool. It includes only those costs that change, and it considers the cost of several alternatives. It includes the costs of all organizations that are to contribute to the changed process. (See para 3–12.)

c. The objective of an economic analysis is to identify the best course of action. Usually this can be done effectively without calculating the total cost of any alternative. Financial aspects of the decision rest entirely on the need for additional funding and the obligation of more resources. Nonfinancial considerations affect the decision, but only added costs to be incurred and cost reductions to be gained are relevant.

d. Economic analyses are often reviewed by persons who are not familiar with the concept of incremental cost. These persons know of many costs that must be incurred to support a wide variety of activities; they expect identification of these costs in the economic analysis report. The report must be complete; it should attempt to forestall as many questions as possible. One way to reduce questions and to show competence and quality analysis is to include comments in the report. Typical expense items that would not incur increases should be identified. This informs the reviewer that the

preparer knows the expense item exists. It also shows that the impact of the alternative on the expense item was considered, and that the impact was negligible.

3–12. Wash costs

a. Wash costs are cost elements that are the same for all alternatives and should not be included in the economic analysis. Computing the detail for such cost elements is a waste of staff time because it does not aid in distinguishing between them. It also adds to the complexity of the report and the analytical burden of reviewers.

b. Costs that are the same for all alternatives should be included only when the cost item would consume more than 15 percent of the total cost of one alternative, and the decision would be greatly influenced by some proportional statistics.

c. A statement that the omitted expense item is the same for all alternatives should be included. This will reduce questions from reviewers.

d. Include ALL cost, even wash costs for purposes of computing averages, ratios, percentages, savings investment ratios, and any other statistics that depend on total cost. Ignoring wash costs in such calculations will distort the statistic, and mislead decision makers.

3–13. Nonmonetary benefits and costs

a. Even though the analyst tries to develop quantitative monetary measures of costs and benefits, sometimes the situation does not allow monetary expression of all major variables.

(1) These costs and benefits include all nonmonetary elements of an alternative that tend to degrade or improve the performance of the alternative or organization. Some of these can be measured and quantified, but direct translation into monetary terms often is not possible. Many other intangible benefits and costs cannot be quantified. They are known to exist, and they are known to affect operations, but data and exact relationships are not available.

(2) Some examples of quantifiable elements are as follows:

(a) Commuting distances and times.

(b) Vacancy rates.

(c) Frequency of maintenance.

(d) Delay between reported need for repair and completion of the repair.

(e) Number of families served by the housing referral office.

(f) Percent of sponsors who are adequately housed.

(g) Percent of sponsors that requested housing through the housing office.

(h) Amount of downtime for unscheduled maintenance.

(i) Specific reporting time requirements to support the mission.

(j) Special security requirements that demand protection for the sponsors.

(3) Examples of nonquantifiable elements are as follows:

(a) Impact on combat readiness.

(b) Effectiveness of communication links.

(c) Interpersonal relationships developed by onpost housing.

(d) Future decisions of the U.S. Government and foreign governments.

(e) ***(Rescinded.)***

(f) Impact on retention rates.

(g) Better troop habitability.

(h) Increased mission capability.

(i) Other similar qualitative advantages and disadvantages.

b. It is widely known and accepted that these quantifiable and nonquantifiable elements can seriously impact mission effectiveness and combat readiness. However, the following factors tend to minimize the impact on decisions:

(1) Demonstration of the relationship and seriousness of the impacts are difficult.

(2) Severe congressional pressure often forces decisions to be made primarily on the basis of lowest cost.

c. To justify an alternative with greater than lowest cost, a very strong, detailed, and directly related position must be included in the economic analysis report.

d. Although nonmonetary benefits and costs are the most difficult to assess, they should be documented and described in a section of the economic analysis.

Chapter 4
The Analytical Process

4–1. General

a. Economic analysis is a framework of techniques for systematic investigation of problems of choice. An economic analysis identifies alternative means to satisfy a set of objectives, and investigates the costs and benefits of each of these alternatives. This orderly, comprehensive presentation of the important considerations of each alternative helps the manager to make and review decisions. It does this in the following manner:

(1) Develops informal thinking into a complete, quantified, and qualified basic plan of action.

(2) Surfaces hidden assumptions and makes their logical implications clear.

(3) Provides an effective vehicle to communicate the considerations that support a recommendation.

b. An acceptable analytical process closely follows the scientific method of research, except when the—

(1) Researcher starts with a hypothesis and attempts to prove that it is true or false.

(2) Army housing manager starts with a frustration or a change in conditions, and must obtain a solution.

c. The process of economic analysis must be tailored to the specific situation facing the installation. One analytical structure does not fit every economic analysis; therefore, this chapter will describe the concept of each step of the analytical process. The housing manager must adapt the analysis and the formats in appendix B to fit the specific analysis being done. To provide as much guidance as possible, the formats have been designed to be comprehensive and flexible; however, they may need adaptation to the installation's needs.

d. The general structure of an economic analysis involves determining costs and benefits of several possible future courses of action. These are called alternatives. Through a cost benefit or cost effectiveness analysis, the decisionmaker can use a set of facts and quantitative information to select a preferred means to achieve goals. The facts and quantitative information help in selecting the preference, not vice versa. Too often a commander selects a preference and proceeds to construct a justification. This process frequently yields an acceptable solution. However, it seldom selects the best solution—the solution which most nearly satisfies the objectives of Congress. Only by designing and testing viable solutions can the best decision be insured.

4–2. Elements of the analytical process

a. The key elements of an economic analysis of housing alternatives are as follows:

(1) Identifying and defining the problem.

(2) Developing a set of objectives or selection criteria.

(3) Identifying constraints and assumptions under which the alternatives must operate.

(4) Defining and developing alternatives for accomplishing the objectives.

(5) Determining the costs and benefits of each alternative.

(6) Testing the sensitivity of the decision to major uncertainties.

(7) Selecting the best alternative.

b. Figure 4–1 shows the elements in *a* above in a flow chart that depicts both sequence and continuity of process. Paragraphs 4–3 through 4–9 describe each of these processes and the difficulties that may be encountered.

4–3. Identifying and defining the problem

a. In many cases, this process is one of the most difficult; however, identification of the housing problem is quite simple. A housing requirements survey supported by a Segmented Housing Market

Analysis states the level of deficiency in housing assets by grade groups under expected conditions and future staffing levels. Also, housing shortages will be evident in the assignment of billets, whether the problem exists in family or unaccompanied personnel housing. Similarly, problems faced by service families as they attempt to enter the economy housing market will be known to the housing manager through the amount and type of assistance that the housing offices must provide.

b. Substandard housing, inadequate housing assets, or inadequate allowances for housing may stimulate low levels of extended tours, low levels of accompanied tours, or high levels of short tours. Each of these conditions includes implications for efficiency and effectiveness of the organizations to which the soldiers are assigned. This type of problem is more difficult to label and define, and will need greater justification than the conventionally identified deficiencies of housing.

4–4. Developing objectives and selection criteria

a. Development of objectives and selection criteria is a relatively easy process. The objectives should be stated in terms of output measures—the end results of implementing a perfect alternative. These are the criteria by which each alternative is to be judged, and they form the basis for selecting the alternative that will best accomplish the objectives.

b. Selection criteria must be developed before identifying alternatives. Until the objectives have been defined, it is impossible to select a course of action (alternative) that may satisfy the nonexistent objectives. People often transpose these two steps. They identify a problem, then think of an alternative and test it to see if it is acceptable. This process usually ends in solving portions of the problem in a manner less effective or less efficient than other available solutions. The economic analyst must carefully select in advance the best solution to a housing problem. The solution must then be developed in detail. The analyst must define the problem, develop objectives, then identify possible alternatives. During development of the objectives and selection criteria, it is likely that the analysis will discover needed and important additions to the definition of the problem. When (not if) this happens, the objectives should be modified and their development refined.

c. Examples of selection criteria are as follows:

(1) Minimizing costs.

(2) Providing housing for a specific number of families.

(3) Keeping commuting time within 1 hour and the commuting distance within 30 miles.

(4) Providing a distribution of units with 0 (studio), 1, 2, 3, 4, and 5 or more bedrooms.

(5) Meeting Army standards for housing soldiers and their families in various grades.

(6) Operating under control of the Army (or not).

(7) Freeing tenants from dealing with host country landlords.

(8) Reducing the amount of money service personnel must pay for quarters.

(9) Increasing the number of accompanied (longer) tours.

d. Only quantitative objectives and criteria are cited in the body of the economic analysis. All judgmental, nonquantifiable, and social objectives should be identified and explored in a section of the report that is reserved for that purpose.

4–5. Identifying constraints and assumptions

a. Every analysis will include some conditions that cannot be changed as predicted. The analysis must conform to those conditions that cannot be changed. These constraints are normally imposed by Army policy, local conditions, weather, host country custom, or mission.

b. Some other conditions cannot be predicted accurately. Political decisions in the host country or in the United States are seldom predictable, although they often affect the cost and character of housing provisions. Economic conditions, availability of economy housing, and levels of BAQ and overseas housing allowance (OHA) are predictable only with high chance of error. Monetary exchange rates change erratically. Mission and organizational objectives and staffing levels change. Assumptions are required concerning the time needed to obtain authority and funding to proceed, and the time needed for construction or lease execution.

c. Each of the conditions in *a* and *b* above affect the timing, cost, composition, or operations of at least one alternative. It is necessary to evaluate the total situation carefully to make the analysis accurate and appropriate. Since some of these constraints and assumptions apply to all alternatives and others apply to only one, it may be helpful to separate them. Those that apply to all alternatives should be listed in one section, and a separate section should be included for each alternative, specifying appropriate constraints and assumptions. Assumptions must not be used in lieu of factual data. If factual data is available or can be produced with reasonable expenditure of resources, the effort is well invested. A little searching for more information leading to factual inputs increases the validity and acceptability of the analysis.

d. As alternatives are identified and defined, additional objectives, selection criteria, and characteristics of the problem will also be identified. It is essential that the analyst return to the section of the analysis that is affected by this new information. This new information must be included if the analysis is to be accurate, effective, and communicate with the greatest possible power.

4–6. Developing alternatives

a. The following alternatives are typically available as methods of housing military personnel and families (other alternatives may be available in specific situations):

(1) Individuals rent housing on the economy. This alternative is required for each economic analysis where private rental housing is available, as demonstrated by a SHMA. This alternative must include addition of sufficient HRS resources to increase penetration of the market enough to cover all housing deficits.

(2) Individuals rent housing on the economy with the Army guaranteeing payment of the rent. This alternative must include addition of sufficient HRS resources to increase penetration of the market enough to cover all housing deficits.

(3) Army Family Housing Construction.

(4) Military Construction Army (for UPH).

(5) Government lease, or build to lease.

(6) Renovate existing housing assets.

(7) Purchase existing housing assets.

b. The analyst must study all feasible alternatives and present to the decisionmaker those that are most cost effective. This requires a great deal of skill and extensive interaction with the decisionmaker. It is important to consider all reasonable and viable alternatives or the value of the analysis may be seriously undermined. Good decisions are extremely difficult unless they are made with an understanding of all relevant options.

c. As alternatives are developed, other objectives, selection criteria, characteristics of the problem, constraints, and assumptions will also be identified. It is essential that the analyst return to the section of the analysis that is affected by this new information. The new information must be included if the analysis is to be accurate, effective, and communicate with the greatest possible power. If this circular process does not occur, the analysis most likely is not being performed in sufficient detail to be credible..

4–7. Determining costs and benefits

a. The preceding chapters have explored the areas of costs and benefits in detail. The analyst must know that material well and do a comprehensive analysis; otherwise, a wrong decision may be made. The most common errors are incomplete analyses and careless mistakes. This portion of the analysis is very quantitative and demands exacting attention to detail. Even small errors accumulate to large amounts of money when totaled over 25 years. For example, if the inflation or discount factors are not handled properly, costs may be inflated when they should be deflated. The procedures in this pamphlet should be studied thoroughly. They should be applied carefully, and every part of the analysis should be checked. Discovery of two or more errors (typographical or calculation) may destroy the

credibility of the entire analysis. This is particularly true if the decisionmaker or reviewer questions the validity of the recommendation or prefers a different solution.

b. The circular nature of the analytical process may appear. As costs and benefits are identified, collected, and calculated, important additions or changes to the problem definition, objectives, criteria, constraints, assumptions, or alternatives may become known. They should be treated definitively, even though parts of the economic analysis must be reworked. The new information must be included if the analysis is to be accurate, effective, and communicate with the greatest possible power. If this circular process does not occur, the analysis most likely is not being performed in sufficient detail to be credible.

4–8. Testing sensitivity

To test sensitivity of the various variables, the concepts and processes described in chapter 3 should be used. For each variable and combination of variables that is likely to be volatile enough to change the ranking of alternatives, the degree to which the solution is sensitive to changes must be calculated. It is essential to estimate the likelihood that such a shift in the variable will occur. Also, the sensitivity analysis must test the impact of high and low levels of inflation, exchange rates, and discount rates. (See chap 3.).

4–9. Comparing alternatives

a. Now that the costs and benefits of each of the proposed alternatives have been quantified, it is possible to analyze them side by side, and select the preferred alternative. This step is the essence of economic analysis because it provides the tool for better management decisionmaking. The purpose of comparing alternatives is to identify the key issues and focus on the trade–offs that are necessary or available. The relative strengths and weaknesses of competing alternatives can be brought into clearer focus when their costs and benefits are compared directly. This process identifies the most feasible cost–effective alternative among those considered in the analysis. In general, the primary patterns into which the alternatives may fall are as follows:

(1) Equal benefits with unequal costs.

(2) Unequal benefits with equal costs.

(3) Unequal benefits with unequal costs.

(4) Equal benefits with equal costs.

b. Brief explanations of the concepts in *a* above and their impact on decisions are in chapter 1.

c. At this point, the analyst must consider both quantitative and nonquantitative information. OSD requires, however, that specific results of the quantitative analysis be presented in full, after which qualitative factors may be considered.

Chapter 5
Reporting the Results of the Economic Analysis

5–1. General character of the report

a. The report that transmits the results of an economic analysis should be concise in summary. Yet, it should have enough detailed sections to document the credibility of the analytical techniques and processes. It must also document sources of information and estimates thoroughly. This will enable the reviewers at the Army Corps of Engineers, Army Housing Management Division, and OSD to determine the suitability of the source and the credibility of the information. Also, the report must present all of this information and the conclusions indicated by the analysis in a clear, effective manner. The report must be organized to reduce the time a reviewer needs to understand the report. It must also lessen the time an informed reviewer needs to evaluate the merit of the proposed solution. This chapter is directed toward accomplishing these ends.

b. On the basis of previous documentation validating similar projects, an economic analysis report may combine the data for several communities. This is acceptable only where an economic analysis has been prepared for each community separately within the last 5 years. Such a report must name each community, describe areas of similarity, describe areas of individual differences, and identify previous documentation that validated the similarity of the communities. It is acceptable to group the data for several similar communities. It is not acceptable to group communities where the cost characteristics are dissimilar. It is not acceptable to group communities before demonstrating their similarity.

5–2. Outline of the report

a. The preferred sequence and content of the economic analysis report is in *b* and *c* below. Summary and detail are the keys to effective preparation and presentation of the results of an economic analysis.

b. Documenting the economic analysis is important because much of the effort that goes into collecting and compiling data will be lost if it is not presented clearly and effectively. Tables, charts, graphs, mathematical models, and other visual aids can often be designed to replace a lengthy narrative explanation. They can also stress the most important facts and relationships. This material should be included when it will help the presentation or the result of the analysis. The sequence of material in the report is not the same as the sequence of performance or preparation of the data. Better communication with reviewers and decisionmakers is achieved by the sequence presented in *c* below.

c. If possible, each economic analysis should include the following essential elements in the sequence indicated:

(1) *Letter of transmittal.* This letter should include only a statement of the decision requested and notice of transmittal of the justification. More information would be counterproductive.

(2) *Executive summary.* This summary is the capstone of the economic analysis. Its careful preparation and presentation can determine whether the end result of the economic analysis will be understood and accepted by those making the decision. The purpose of doing an economic analysis is to find the most efficient and effective alternative for achieving the objective involving the allocation of scarce resources. The objective of the executive summary is to communicate the results determined by the economic analysis to those with decision authority. Therefore, the executive summary should include only the end result information that identifies the following elements in sequence:

(a) The decision objective. The objective of the economic analysis should clearly state the decision to be made. Include directly related mission objectives and requirements. Those with decision authority must be able to understand immediately and clearly the dimensions of the problem that required the economic analysis. The actual wording of the objective is critical, as it should reflect a totally unbiased point of view on methods to meet the objective.

(b) Recommended course of action. State the preferred alternative clearly and the reasons for its selection. If the recommended course of action is not the lowest present value cost, as determined by the economic analysis, this section of the executive summary should explain in detail the justification for not selecting the least–cost alternative. Qualitative and quantitative data showing such information as the availability of community housing, effect on mission, combat readiness, morale, turnover, and family stability should be cited to support an alternative other than the least–cost alternative. In short, when recommending any course of action other than the least cost, extensive, clear, and compelling justification should be developed and presented if a favorable decision is to be obtained.

(c) Major assumptions. The process of economic analysis deals with future expenditures and involves elements of uncertainty. A complete factual picture of an alternative under consideration may be impossible to construct. Also, certain assumptions may be necessary to proceed with the analysis. When this is the case, all assumptions used in the analysis should be briefly summarized. A more elaborate discussion of the constraints, assumed or imposed, along with the underlying rationale should be presented in the detailed statement of assumptions. (See (7) below.)

(d) Alternative courses of action. This section of the executive

summary should state and briefly describe each alternative considered and not considered in the economic analysis. Extensive justification of the alternatives considered and not considered should be presented in the detailed identification of alternatives. (See (8) below.)

(e) Economic analysis results. The results of the economic analysis should be concisely outlined. The presentation should include a present value summary comparison of the alternatives analyzed. It should also include a brief summary discussion of benefits and costs of each of the considered alternatives.

(f) Sensitivity factors. The impact that sensitivity analysis had on the economic analysis results should be briefly summarized. The discussion of sensitivity factors should identify which cost elements and kinds for each alternative affected the results of the economic analysis. Extensive discussion of the sensitivity analysis should be included in the detailed statement of sensitivity analysis. (See (6) below.)

(3) *Preparers of the economic analysis.* The names and phone numbers of the individuals preparing the analysis should be listed. This helps a reviewer or decisionmaker to have a point of contact if a question arises. If the analysis was prepared by a contractor, the name of the company, its address, and phone number should also be listed.

(4) *Approval authority for the economic analysis.* The name, rank, title, and organization of the installation approval authority should be given.

(5) *Detailed summary of economic analysis including detailed cost buildup and discounting analysis.* The detailed results of the economic analysis should be specified. This section should begin with a matrix for each alternative, listing fiscal years down the left column. For each of these years, each major cost kind is entered in its own column; they should be totaled and discounted. This section should also present net present value of the alternative, present value of any residual values, and average annual discounted cost. Appendix C includes this format and other formats that may be needed to display and total the cost data. Congress and OSD have expressed a strong preference to having data presented in these formats. Also, these formats should be used whenever possible to present such items as the cost buildup, discounting analysis requirements, and comparison of alternatives based on different inflation, use, or other characteristics.

(6) *Detailed statement of sensitivity analysis.*

(a) The sensitivity of the economic analysis to variations of the cost kinds and cost elements that contribute the most to the total cost must be evaluated. Also, assumptions and characteristics that contain significant risks are identified and the sensitivity of the economic analysis evaluated. How likely it is that the estimating inaccuracies will cause a shift of the rankings should be indicated. (See fig 3–9 for calculating sensitivity.)

(b) An economic analysis may combine data for two or more communities that are relatively similar. Such a combined analysis must include special consideration of the sensitivity factors. It must state the degree to which the data for each community may be sensitive. It should also identify the unique characteristics of each community, and fully discuss the extent to which these characteristics affect the decision.

(7) *Detailed statement of assumptions.* A comprehensive statement of the assumptions on which the economic analysis is based must be included. These assumptions relate to many portions of the analysis and impact on various calculations throughout the analysis. They must be stated concisely, clearly, and in a manner that relates them to the cost elements, cost kinds, or other elements of the analysis. A list of assumptions may be needed for each alternative.

(8) *Detailed identification of alternatives.* All feasible alternatives of meeting Army housing objectives must be specified and defined in detail. All reasonable and viable alternatives should be considered, or the value of the analysis will be seriously undermined. Considering all alternatives provides useful information about impossible alternatives. Each alternative should be described in enough detail to inform reviewers and decisionmakers of its characteristics. Descriptions that involve quality evaluations on the desirability of one or more housing alternatives are explained in (11) below.

(9) *Identification of cost elements, cost kinds, and basic parametric information required for cost calculations.* A display that appears early in this section would contain a list of all cost elements and kinds related to the alternatives. This matrix should list the costs that apply to each alternative. (See table 5–1 for matrix examples.) It should include identical costs for each alternative, and then highlight them as wash costs that will not be included in the rest of the analysis because they do not affect the decision. Identification of the source should be included for each element of cost data. Also, a calculation of annual constant dollar costs and construction costs to be included in the buildup should be made. Nonmonetary factors must be excluded from this section; they belong with nonmonetary factors. (See (11) below.)

(10) *Source documents.* A copy of the latest DD Form 1377 (Tabulation of Family Housing Survey (LRA)) and DD Form 1378 (Determination of Housing Requirements and Project Composition (LRA)) should be included, showing the date these documents were prepared. Also, a segmented housing market analysis and other documents that are believed to be relevant should be included. These documents should include DD Form 1379 (Narrative on Family Housing (LRA)), DD Form 1410 (Inventory and Occupancy of Military–Owned and Controlled Family Housing Units (LRA)), DD Form 1411 (Statement of Facilities and Assignment (LRA)), and DD Form 1657 (Determination of Bachelor Housing Requirements). (See AR 210–50 and AR 210–11 for additional information.)

(11) *Nonmonetary factors.* All of the nonmonetary discussion, documentation, and declarations of preferences and conditions that should influence the decision are included here. These should be specific, quantitative, and comprehensive in this area. General statements will be of little help, and preferences should not be shown. The primary objective of an economic analysis is to determine the best and least costly course of action, not to justify the preferred course of action. Each element of this section should be related to the objectives of the analysis and to the alternatives being evaluated.

Cost elements typically applicable of cost kinds

Cost elements	Cost kinds												
	Planning and programming	Onetime costs	Furnishings operation	Housing referral	Housing quarters allowances	PCS travel and HHG shipment	Housing area utilities	Housing area maintenance and repair	Government furnished materials and supplies	Contract administration	Overhead	Other engineer services	Federal income tax generated
Equipment procurement		X	X	X				X	X		X		
Inherited assets		X	X					X	X		X		
Construction contracts		X							X				
Terminal or residual value		X	X										
Equipment rental or lease			X	X				X		X	X		
Personnel costs	X	X	X	X				X		X	X		
Materials and supplies	X	X	X	X				X	X	X	X		
BAO					X								
Other quarters allowances					X								
Contracted services	X	X	X	X			X	X		X	X		
Telephone				X				X		X			
Electricity							X	X	X				
Heating							X	X	X				
Water and sewer							X	X	X				
Snow removal, entomological								X	X				
Household goods shipment						X							
Travel	X	X	X	X		X					X		
Transportation	X	X	X	X		X		X	X		X		
Imputed insurance	X	X											

Figure TABLE 2-1. Cost elements typically applicable of cost kinds

Costs typically applicable to housing alternatives

Cost kinds	Housing alternatives								
	Community owned	Government rental guarantee	Government lease	New construction	Government owned contractor operated	Government leased contractor operated	Renovation	Upgrading	Purchase existing assets
Planning and programming costs	X	X	X	X	X	X	X	X	
Onetime costs	X	X	X	X	X		X	X	X
Furnishings operations			X	X	X	X	X	X	X
Housing referral operations	X	X	X	X	X	X	X	X	X
Housing quarters allowances	X	X	X	X	X	X	X	X	X
PCS travel and household goods shipment	X	X	X	X	X	X			
Housing area utilities		X	X	X	X	X	X	X	X
Housing area maintenance and repair		X	X	X	X	X	X	X	X
Contract price (except construction)			X		X	X			
Government furnished materials and supplies		X	X		X	X	X	X	X
Contract administration cost		X	X	X	X	X	X	X	X
Overhead costs	X	X	X	X	X	X	X	X	X
Other engineer services			X	X	X	X	X	X	X
Federal income taxes generated			X	X	X	X	X	X	X
Incremental personnel requirements	X	X	X	X	X	X			X

Figure TABLE 2-2. Costs typically applicable to housing alternatives

Life cycle guidelines

ADP equipment	8 years
Buildings	
Permanent	25 years
Semipermanent, non-wood	25 years
Semipermanent, wood	20 years
Temporary or rehabilitated (with extra maintenance at 15 years)	25 years
Operating equipment	10 years
Utilities, plants and utility distribution systems (This category includes investment projects for electricity, water, gas, telephone, and similar utilities.)	25 years
Energy conserving assets	
Insulation, solar screens, heat recovery systems, and solar energy installations	25 years
Energy Monitoring and control systems	15 years
Controls (e.g., thermostats, limit switches, automatic ignition devices, clocks, controls, photocells, flow controls, temperature sensors, etc.)	15 years
Refrigeration compressors	15 years

Figure TABLE 3-1. Life cycle guidelines

Cost kind dominance calculation

(1) Cost kinds	(2) Estimated cost (percent)	(3) Cost kind risk level (percent)	(4) Projected risk (percent) Col (2) X Col (3)	(5) Estimated cost $(000)	(6) Estimated risk Col (4) > 5 percent Col (3) × (5) $(000)	(7) Adjusted cost $(000)
Planning and Programming	5	50	2.5	779	n/a	779
Onetime costs	25	20	5.0	3,932	n/a	3,932
Housing referral	20	10	2.0	3,082	n/a	3,082
BAQ payments	5	0	0	772	n/a	772
Utilities	30	40	12.0	4,678	1,871	6,549
Maintenance and repair	5	10	.5	787	n/a	787
Overhead	10	20	2.0	1,563	n/a	1,563
Total	100	n/a	n/a	$15,593	$1,871	
Adjusted total cost.						$17,464

Notes:

1. Note the operating rules in the column headings. In Table 3-2, planning and programming costs consume 5 percent of the total cost. But the specification of column (6) requires entry of those costs that consume more than 20 percent of the total estimated cost and also have project risk greater than 5 percent. Therefore, n/a is entered in column (6). This example shows an entry for each kind of cost included in alternative A, so the total of column (2) is 100 percent. Columns (3) and (4) have not been totaled because the total is not relevant. If the totals were printed in the table, the reader might be confused by the belief that they are relevant.
2. After calculating the relevant potential change of estimated costs, the amount of change showed be entered in column (7). These values are then totaled and added to the total cost to obtain adjusted total cost for the alternative. The adjusted total cost identifies the expected level of total cost for the alternative under adverse conditions. After computing adjusted total cost for each alternative, they are compared to find the lowest cost alternative, and this should be presented in the narrative documents.

Figure TABLE 3-2. Cost kind dominance calculation

Cost estimates for listed cost kinds and total cost

Alternative	Cost kind	Constant dollars $(000)	Costs not listed $(000)	Estimated total $(000)
Community assets	BAQ	3,023	4,212	7,235
Onpost construction	Onetime costs	4,715		
Onpost construction	Utilities	2,129	64	6,908
Government lease	Rent	3,459		
Government lease	Utilities	1,892		
Government lease	Maintenance and repair	1,563	132	7,046

Figure TABLE 3-3. Cost estimates for listed cost kinds and total cost

Sensitivity analysis via probability distributions

Alternative		Probability	Cost kind: If >20 percent of estimated total cost $(000)		If >20 percent of estimated total cost $(000)		If >20 percent of estimated total cost $(000)		Total estimated cost not listed $(000)	Expected total cost $(000)
			Estimated cost	Expected cost	Estimated cost	Expected cost	Estimated cost	Expected cost		
Community assets	Cost kind		BAQ							
	High estimate	.10	3400	340						
		.20	3100	620						
		.40	3023	1209						
		.20	3000	600						
	Low estimate	.10	2400	290						
	Total			3059		—		—	4212	7271
On-post construction	Cost kind		ONE TIME COSTS		Utilities					
	High estimate	.10	4900	490	4000	400				
		.20	4750	950	2800	560				
		.40	4715	1886	2129	852				
		.20	4715	943	2129	426				
	Low estimate	.10	4715	472	2129	213				
	Total			4741		2451		—	64	7256
Government lease	Cost kind		LEASE COST		Utilities		M&R			
	High estimate	.10	4920	440	3110	311	1580	155		
		.20	3680	736	2222	444	1530	314		
		.40	3459	1384	1892	757	1563	626		
		.20	3469	692	1892	375	1541	308		
	Low estimate	.10	3469	346	1392	189	1500	150		
	Total			3598		2079		1583	132	7230
Others	Cost kind									
	High estimate	.10								
		.20								
		.40								
		.20								
	Low estimate	.10								
	Total									

Figure TABLE 3-4. Sensitivity analysis via probability distributions

Comparison of estimated costs and expected costs

Alternative	Estimated cost*		Expected cost**	
	$(000)	Rank	$(000)	Rank
Community assets	7235	3	7271	3
Onpost construction	6908	1	7256	2
Government lease	7046	2	7230	1

Footnotes:
*Estimated cost is the level resulting from a detailed estimate of each cost element.
**Expected cost is the result of applying a probability distribution to a set of cost estimates.

Figure TABLE 3-5. Comparison of estimated costs and expected costs

Cost element matrix

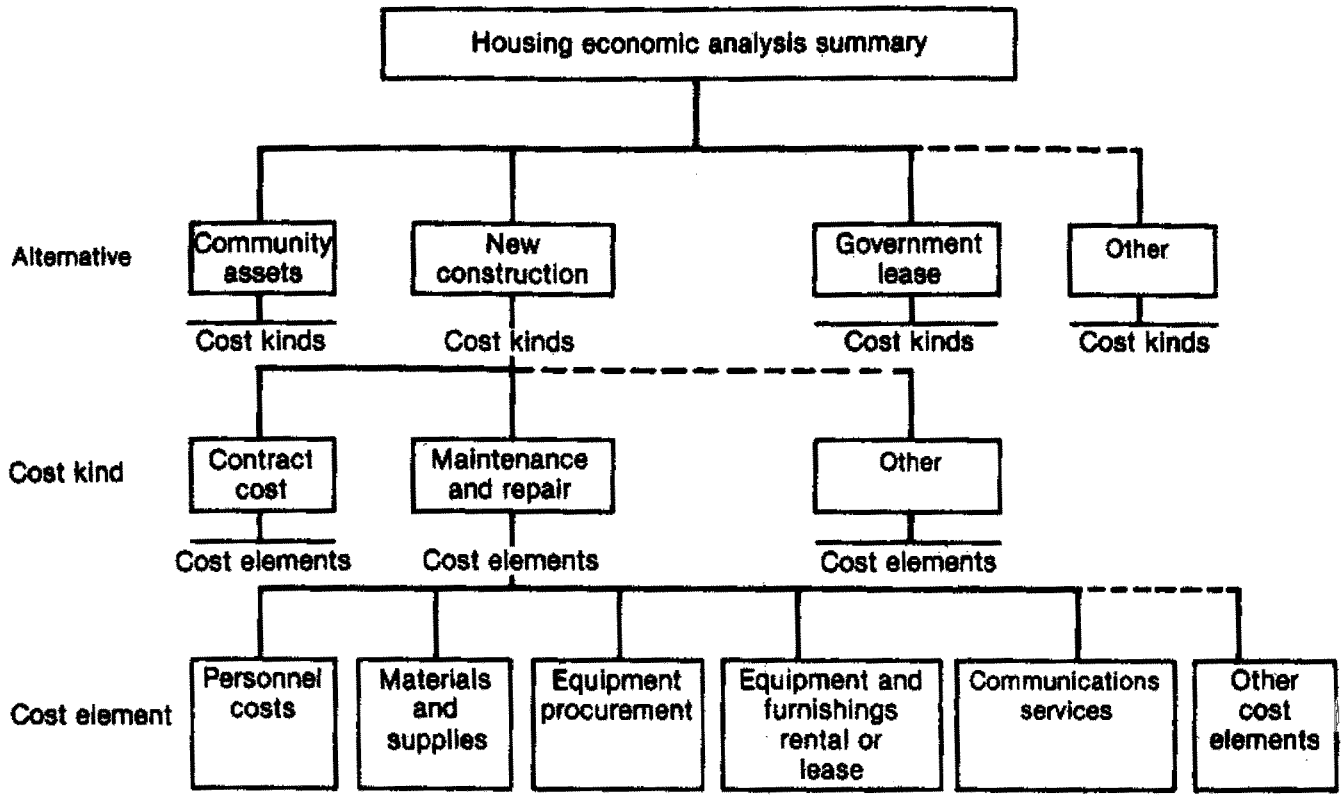
Variable number	Cost element	Economy housing	BTL	MCA
1	Construction costs			X
2	Land			X
3,4	Maintenance		X	X
5,6	Water and sewer		X	X
7,8	Electricity and gas		X	X
9,10	Heating fuels		X	X
11	Rent		X	
12	Administration		X	X
13,14	Entomology and refuse		X	X
15	Contract administration		X	
16	F&E moving and handling		X	X
17-19	Allowances	X	X	X
	Travel and HHG shipment	W	W	W*
20	Restoration		X	
21,22	Contract appliance maintenance		X	X
23,24	Post overhead not included above		X	X
25,26	Federal income taxes generated		X	X
27	BTL buyout		X	
28	Residual value		X	X
	Housing referral operations	W	W	W*
	Billeting operations	W	W	W*

Footnote:
*For this economic analysis this cost element will contribute to total cost for each of the alternatives in identical amounts, and on the same time schedule. Therefore, they do not drive the decision.

Note:
All items shown above are examples. In an economic analysis any one of them may be relevant, or be a wash item.

W = Wash cost*, X = Relevant cost.

Figure TABLE 5-1. Cost element matrix



Discussion of this analysis structure begins with definition of cost elements, and proceeds to cost kinds and alternatives.

Figure 2-1. Housing alternative cost analysis structure

Application Type	Connected load	Demand factor	Est. hr/dy	Demand dy/yr	Estimated consumption
Lighting 365,467KWH/Yr	178.8KVA	70%	8	365	
Recep & misc	467.0	25	16	365	681,820
HVAC motors	81.0	50	24	365	354,780
Estimated total annual consumption 1,402,067KWH/Yr					
Rate per KWH					$0.02
Estimated total cost-electricity					$28,041/Yr

Figure 2-5. Example of documentation for electrical energy consumption

150 gal/person/day

	No. people	Units		Usage	
1st Year:	3 X	96 × 150	=	43,200	gal/day
	4 X	76 × 150	=	45,600	gal/day
	5 X	40 × 150	=	30,000	gal/day
		Total	=	118,800	gal/day

$$\frac{118{,}800 \text{ gal}}{264.2 \text{ gal/M3}} = 449.66 \text{ M3/day}$$

Year 1 Cost: 449.66 M3/day × $.30/M3 × 365 = $49,237

2nd Year:	3 X	103 × 150	=	46,350	gal/day
	4 X	106 × 150	=	63,600	gal/day
	5 X	27 × 150	=	20,250	gal/day
		Total	=	130,200	gal/day

$$\frac{130{,}200}{264.2} = 492.81 \text{ M3/day}$$

Years 1 & 2 Cost: (492.81 + 449.66) × $.30/M3 × 365 = $103,200

*Data for 2 years are presented in this example because of the increase in number of units available during the second year. Note also that this example does not include inflation, because the rate is similar to the general inflation rate.

Figure 2-7. Example of documentation computation for water costs for alternative A

1st year: 1st phase 212 families is a wash out cost for total project life for household goods and travel because they are already in place and will remain.

2nd year:

Number of families
New families—inbound 236 × 2000 lbs × $1.03 = $486,160
Bachelor—in & outbound 314 × 500 lbs × 1.70 × 2 = 533,800

Total household goods transportation, Year 2 = $1,019,960

Figure 2-8. Example of documentation computation for household goods costs for alternative A

1st Year—PCS travel—1st phase 212 families is a wash out cost for total project life for travel because they are already in place, and will remain.

Administrative travel (overhead)
8 trips * $390 = $3,120

2nd Year—New families

Family members		Families	Persons
3	×	103	= 309
4	×	106	= 424
5	×	27	= 135

Family travel cost: = 868 × $262.34 = $227,711
Bachelor travel cost: 314 × $252.34 × 2 = 164,750
Total PCS travel for Year 2 = $392,461
Administrative travel (overhead) 5 × $430 = 2,150
Total travel costs for Year 2 = $394,611

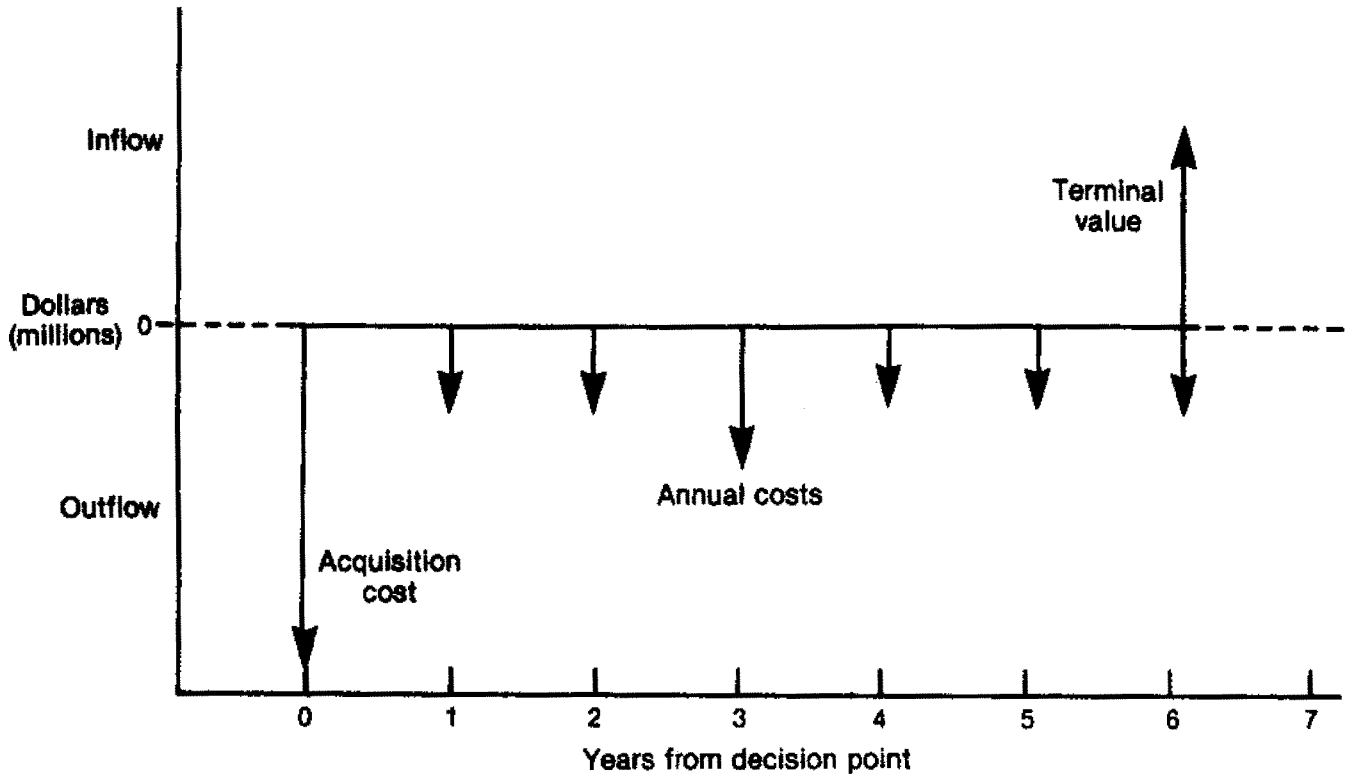
Figure 2-9. Example of documentation computation for travel costs for alternative A

Overhead application base: Total direct cost, excluding construction contracts.

Cost Element	Years X, Y, & Z Actual direct cost	Years X, Y, & Z Actual overhead cost
Equipment procurement	$ 262,842	$ 48,478
Equipment rental or lease	656,630	434,555
Personnel costs	3,426,843	1,654,321
Materials and supplies	2,456,789	814,580
Contracted services	555,666	137,543
Telephone	17,444	—0—
Electricity	1,593,210	—0—
Heating	2,165,555	—0—
Water and sewer	234,567	—0—
Snow removal and entomological Services	88,452	57,644
Travel	1,003,456	312,769
Transportation	256,543	151,400
Post Overhead	2,445,445	1,496,817
Total	$15,163,442	$5,108,107

Mean actual overhead rate, years X, Y, & Z 33.7%

Figure 2-12. Example of documentation of overhead rate calculation for alternative A



Notes:

1. Figure 3-3 shows a generalized cash flow diagram with a typical pattern of life-cycle costs. The horizontal line represents a time axis. The choice of time unit is arbitrary, but the scale is usually graduated in years. Costs are represented by vertical arrows. The lengths of these arrows are sized to the cost extents. Their locations on the time line indicate when they occur.
2. The long arrow on the left (time zero) stands for the acquisition or start-up cost; the shorter downward arrows (years 1 to 7) stand for costs incurred from year to year (e.g., operating costs, maintenance costs, and isolated one-time costs).
3. The upward arrow at the right (year 7) stands for the terminal or residual value of assets on hand at that time. Because terminal value is to be netted against the total life cycle cost, it acts to offset other costs and is drawn upward. In some cases terminal dismantling or demolition costs exceed scrap or salvage value, which would be a net cost represented by a downward arrow.

Figure 3-3. Cash flow diagram

Alternative		No of Units	Total Cost	Cost	Total project cost (equated)
Construction Alternative:	Construction	400	$68Mil	$115K	$46,000,000
	Lease	100	17Mil	170K	46,000,000
	Total	500	63Mil	126K	63,000,000
Government Lease Alternative:	Lease	500	70Mil	140K	70,000,000

Figure 3-4. A method of equating alternatives

A	0	1	2	3	4	5	6	7	8	9	10	11	12	Year
	$90													Investment
		$6	6	6	6	6	6	6	6	6	6	6	6	Annual cost
													$9	Terminal value
B	0	1	2	3	4	5	6	7	8	9	10	11	12	Year
	$60													Investment
		$5	5	5	5	5	5	5	5					Annual cost
									$0					terminal value

Figure 3-7. Example of unequal lives—alternatives A & B

Interest rate on 10 year Government Bonds 9.875%
Plus one-eighth of one percent for trans. costs .125%
Discount rate for this project as of _____ 10.000%

	Project year	Expense item	One-Time cost	Annual Recurring cost	10% Discount factor*	Present value
Alternative A:						
	0	Invest.	90K		1.000	$90.0K
	1–12	Opn Cst		6K	7.149	42.9K
	12	Residual	(9)K		0.319	(2.9)K
Years 1–12 NET PRESENT VALUE		$130K				
Divide by sum of end-of-year disc factor for 12 years		6.812				
Uniform annual cost—Alt A		$19.1K/Yr				
Mean present value (130/12)		10.8K/Yr				
Mean cash flow ((90 + (6 × 12) − 9)/12)		12.8K/Yr				
Alternative B:						
	0	Invest.	60K		1.000	$60.0K
	1–8	Opn Cst		5K	5.597	28.0K
	8	Residual	0			0.0
Years 1–8 Net present value						$88K
Divide by sum of end-of-year disc factor for 8 years.		5.333				
Uniform annual cost—Alt A		$16.5K/Yr				
Mean present value (88/8)		11.0K/Yr				
Mean cash flow (60 + (5 × 8) − 0)/8)		12.5K/Yr				

Note that the means for the alternatives are very close, but the uniform annual cost of alternative A is 16% higher than the cost of alternative B. Uniform annual cost is the most comprehensive and meaningful statistic.

*Obtain the discount factors from appendix D.

Figure 3-8. Calculation of present value of alternatives A & B

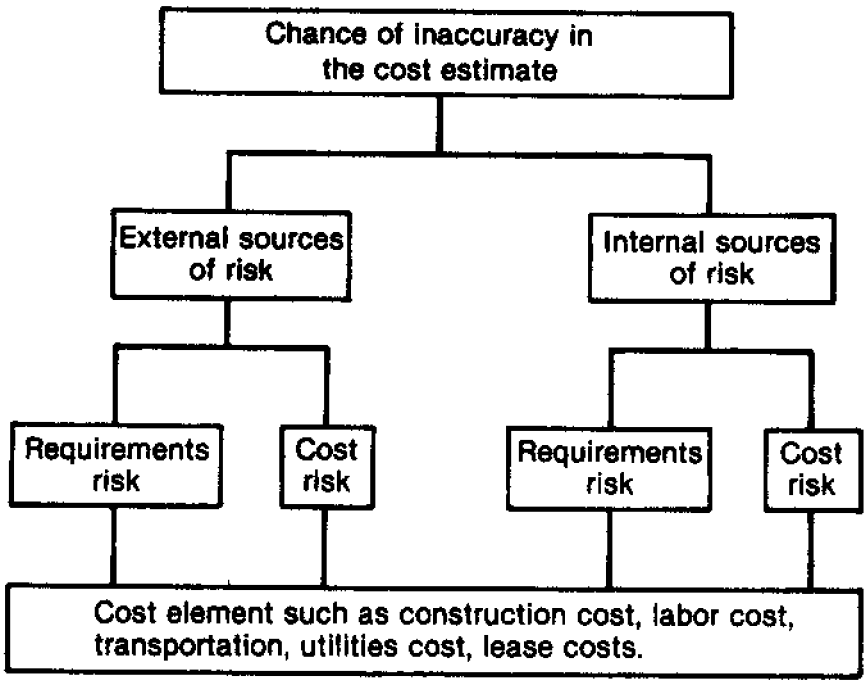


Figure 3-9. Conceptualization of risk and uncertainty

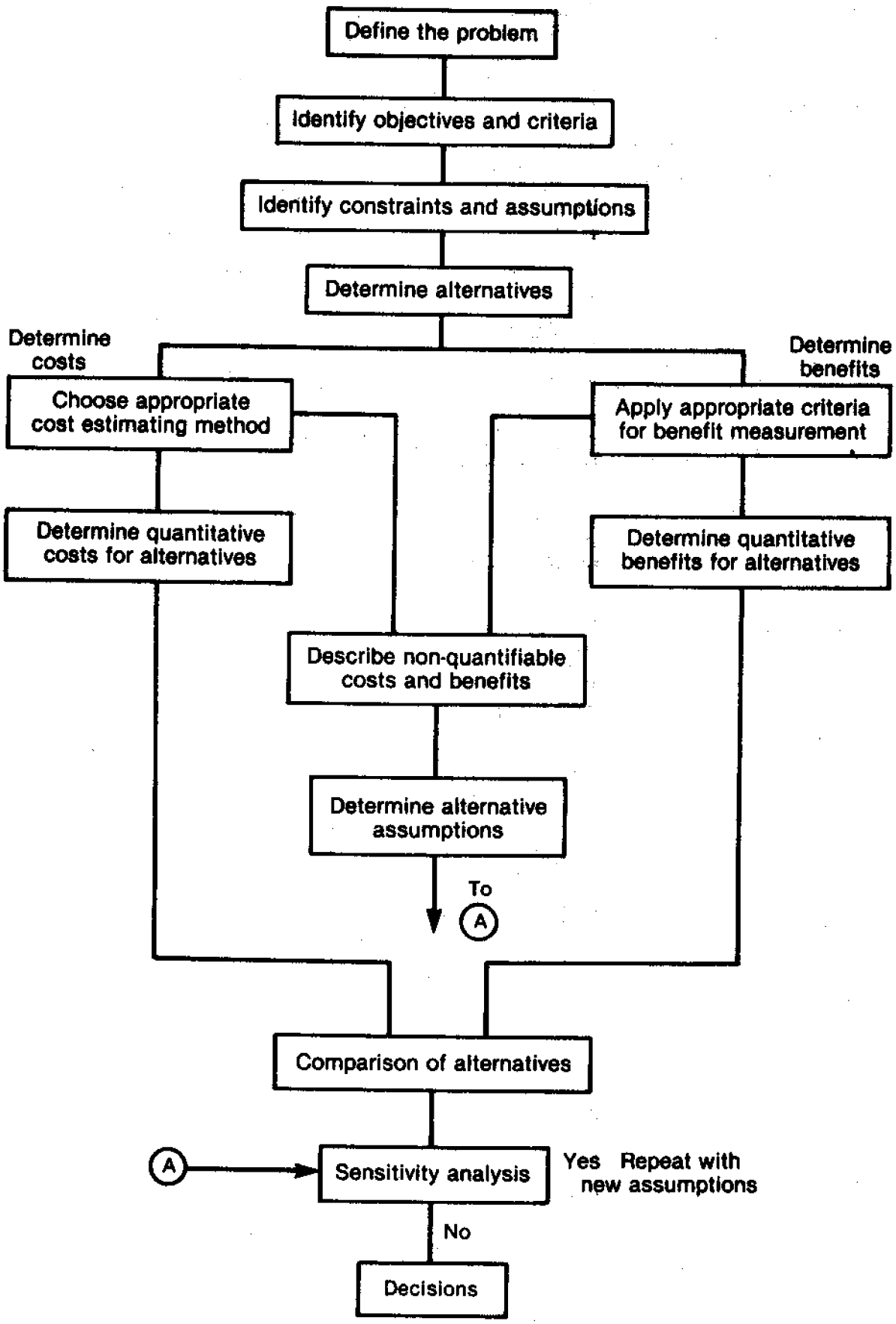


Figure 4-1. The analytical process

Appendix A
References

Section I
Related Publications

A related publication is merely a source of additional information. The user does not have to read it to understand this pamphlet. However, many of the publications listed below contain requirements, criteria, and other data that is required to perform an EA.

AR 1–1
Planning, Programming, and Budgeting Within the Department of the Army.

AR 5–4
Department of Army Productivity Improvement Program (DAMRIP)

AR 5–10
Reduction and Realignment Actions

AR 5–20
Commercial Activities Program

AR 11–18
The Cost Analysis Program

AR 11–28
Economic Analysis and Program Evaluation for Resource Management

AR 37–100
Account/Code Structure

AR 37–108
General Accounting and Reporting for Finance and Accounting Offices

AR 200–1
Environmental Protection and Enhancement

AR 210–20
Master Planning for Army Installations

AR 210–50
Family Housing Management

AR 335–15
Management Information Control System

AR 415–15
Military Construction, Army (MCA) Program Development

AR 415–17
Cost Estimating for Military Programming

AR 415–35
Minor Construction

AR 420–41
Utilities Contracts

AR 420–43
Electric Services

AR 420–46
Water and Sewage

AR 420–49
Heating, Energy Selection and Fuel Storage, Distribution, and Dispensing Systems.

AR 420–71
Leased Premises

AR 420–90
Fire Protection

CEHNDSP87–206–ED–ED
APC–ECONPACK User Manual

DA Pam 11–1
Guide for Improved Use of Defense Documentation Center by Cost Analysts

DA Pam 11–5
Standards for Presentation and Documentation of Life Cost Estimates for Army Materiel Systems

DOD 4100.33–H
DOD In–House vs Contract Commercial and Industrial Activities Cost Comparison Handbook

DOD 4270.1–M
DOD Construction Criteria Manual

HNDSP86–117–ED–ES
PAX ECONPACK Economic Analysis Package–Users Manual

NAVFAC P–442
Economic Analysis Handbook. (This handbook may be obtained from the Government Printing Officer or Naval Facilities Engineering Command, 200 Stovall St., ALEX VA 22332–0302.)

OMB Circular A–94
Discount Rates to be Used in Evaluating Time–Distributed Costs and Benefits

OMB Circular A–104
Comparative Cost Analysis for Decisions to Lease or Purchase General Purpose Real Property

Section II
Referenced Forms

DD Form 1410
Family Housing Inventory and Occupancy Report

DD Form 1411
Family Housing Inventory Designation and Assignment Report

DD Form 1523
Military Family Housing Justification

DD Form 1657
Determination of Unaccompanied Personnel Housing (UPH) Requirements

Appendix B
Economic Analysis Formats

B–1. Introduction

a. This appendix includes suggested sample formats that document and summarize some quantifiable elements of an economic analysis. Many of the entities suggested in these sample formats relate to housing cost and performance data found in recent standard reports. Use this data when it is available and relevant. The format and content of each economic analysis will depend on the nature of the alternatives and the specific characteristics of the organization and community. Although portions of each analysis will be unique, the basic structure of an analysis will be similar. The suggested

sample formats in figures B–1 through B–9 will aid in the presentation design, help ensure completeness and consistency, and aid in the communication process.

b. Each sample format is accompanied by a brief explanation. The specified content is not exhaustive or complete. For each analysis and each alternative, the analyst must find all cost elements and cost kinds that are relevant to the specific situation. The data accumulation and materials will then be designed for the most efficient processing and effective communication.

c. Identify the year for which the historical data is included and inflate it to the base year. Specify all changes in the basic cost level for future years. Include any periodic painting that is required by policy and extensive renovation or replacement that may be anticipated.

B–2. Explanation of cost element formats

a. Sample formats in figures B–1 through B–6 are designed to aid in the collection and accumulation of costs and related data. The subject areas are as follows:

(1) Allowances (fig B–1).
(2) Transportation (fig B–2).
(3) Maintenance and repair (fig B–3).
(4) Operations (fig B–4).
(5) Entomology and refuse (fig B–5).
(6) Other data requirements (fig B–6).

b. Add similar figures as appropriate or helpful to the analytical process. This information will be most useful when preparing the economic analysis. Most of it should be included in the economic analysis report.

c. Use the sample format in figure B–1 to collect basic data for calculating allowance costs. The data on this format is commonly known and readily available, with the exception of the column titled "No. of personnel to be included in economic analysis." The data for this column should include only the number of service personnel for each grade who are to be housed by the project. Enter the total deficiency in this column. Although maximum authorization will be attained by requesting the total deficiency, requests for 100 percent fill rates will seldom be approved.

d. Use the sample format in figure B–2 to collect basic data for calculating transportation costs. This includes costs for the soldiers and all family members. Information on the number of soldiers and the number of family members is included in format B–1. Airfare for family members should include amounts for going from the first duty station to an interim location, and then to join the soldier at the new duty station. Approximately 50 percent of the family members go to a temporary location before joining the soldier. If concurrent travel is authorized, expect all family members to transfer directly to the new duty station.

e. Use the sample format in figure B–3 to collect basic data for calculating M & R costs. There is a column for Government quarters and a column for leased quarters. Evaluate each account carefully. Future costs may not be exactly the same as past costs. The costs collected for this sample format can be used as a basis for estimating costs that may be included in the economic analysis.

f. Use the sample format in figure B–4 to collect basic data on operation of the housing area. These are actual costs. Use them only as a basis for making estimates.

g. Use the sample format in figure B–5 to collect basic data on pest control and refuse service. Observe the same cost element cautions that are expressed in *d* above.

h. Use the sample format in figure B–6 to collect basic data on the average waiting time for quarters. Also, use this sample data to identify other reports that may help to justify the basis for the economic analysis and the request for more housing. Add any other information, reports, or basic data sources to support the analysis or provide documentation of levels of cost or requirements.

BAQ/SHA Allowances for Installation

Grade	BAQ/LQA	SHA w/FM (daily rate)	Effective deficit per 1378	No. of personnel to be included in economic analysis
E–4	$206.10	$1.05	52	52
E–5	234.30	1.15	17	17
E–6	255.00	1.30	8	8

Note. Add other grades as necessary.

Payment	No. of Families/individuals	Average days on TLA	Average per day
TLA (sponsor with 2 FM)	47	30	$55.00
TLA (single)	21	16	22.00

Other relevant data:

Figure B-1. Sample format for family housing economic analysis: Cost element—Allowances

Transportation Allowances

	Expected inflation rate	Current cost
Airfare member (MAC)		$210—
Airfare 2 family members (MAC)		420—
Unaccompanied baggage (400 lbs)		400—
Family member baggage (700 lbs)		700—
POV shipment (port to port)		500—
Cost to ship 100 lbs HHG		64.83
Cost to store 100 lbs HHG		14.77
Average local HHG cost per DU		3,629—
Average Cost of HHG shipment claim		583—

Other relevant data:

Figure B-2. Sample format for family housing economic analysis: Cost element—Transportation

Maintenance Costs

Item	Government quarters expected Inflation	Government quarters expected cost/DU	Leased quarters expected Inflation	Leased quarters expected cost/DU
Service calls	%	$142	%	$142
Routine maintenance		671		671
Major repairs		417		–0–
Sanding and sealing		188		188
Exterior painting		255		–0–
Interior painting		182		
Other cost elements				
Total living area of project	290,200 ft sq		290,200 ft sq	

Other relevant data:

Figure B-3. Sample format for family housing economic analysis: Cost kind—Maintenance

Operations Expense

Item	Expected inflation	Govt quarters cost/DU	Leased quarters cost/DU
Sewage	%	wash	wash
Electricity		wash	wash
Gas		$.60/ft(2)/yr	–0–
Fuel oil		–0–	$.69/ft(2)/yr
Other fuels		–0–	–0–
Family housing office		wash	wash
Admin support		–0–	120—/yr
Control moving & handling		wash	wash
Water		$.10/ft(2)/yr	$.17/ft(2)/yr
Other cost elements			
Total living area of project		290,200 ft sq	290,200 ft sq

Other relevant data:

Figure B-4. Sample format for family housing economic analysis: Expense Item—Operations

Entomology and Refuse Expense

Item	Expected inflation	Govt quarters cost/DU	Leased quarters cost/DU
Refuse collection or disposal	%	wash	wash
Entomology service		wash	wash
Custodial service		wash	wash
Snow removal		wash	wash
Street cleaning		wash	wash
Total project living area		290,200 ft sq	290,200 ft sq

Other relevant data:

Figure B-5. Sample format for family housing economic analysis: Cost element—Entomology and refuse

Other Data Requirements

	Government	Economy
A. Cat 2—SO	20 days	10 days
B. Cat 3—FGO	45 days	15 days
C. Cat 4—CGO	67 days	28 days
D. Cat VA—SNCO	52 days	41 days
E. Cat VB—NCO	90 days	180 days

Other relevant data:

Note. Also provide the following information:
1. 1 copy DD 1410 report.
2. 1 copy DD 1411 report.
3. 1 copy DD 2576 report.
4. 1 copy of latest housing reports (DD forms 1377, 1378, 1379, 1656 Housing Referral Services Report, 1657, and 2085 Unaccompanied Personnel Housing Inventory and Utilization.

Figure B-6. Sample format for other data requirements

Cost kind	Cost elements subject to inflation of 8 percent*					Total** cost	Relevant period
	1, Personnel	2, M&S	3,	4,	5,		
Planning and programming	23,482	7,911				31,393	FY 82
One-time costs	4,190	1,658				5,848	FY 83
Operations costs							
Totals	$2,896,984	$345,967				$978,897	XXXXXX

Footnotes:

*Cost elements subject to the same inflation rate are entered on one sheet of Figure B-7. Use a separate sheet for each inflation rate. Be sure to use the rate calculated by subtracting the unusual inflation rate from the general inflation rate.

**The total cost for each cost kind is transferred to Figure B-8.

Notes:

1. Format B-7 is designed to help assemble and display base year costs of one alternative. A separate Figure B-7 is required for each inflation rate of each alternative. This format provides space to enter the name of each cost element (up to five). The format may be altered to accept more cost elements if needed. Also, various cost kinds include different sets of cost elements. It may be necessary to restrict one page of this format to data from several cost kinds and to prepare a separate page for other cost kinds.
2. A cost kind may be composed of cost elements that are expected to encounter several different levels of constant dollar cost over the term of the analysis. These cost kinds will require one line on this format for each relevant time period. Relevant time period refers to the period during which a constant level of constant dollar cost is kept.
3. The totals at the bottom of the format do not contribute to the content of the analysis. They are intended only for crosschecking to insure arithmetic accuracy.

Figure B-7. Estimated base year costs for alternative A

Project year	Cost kind from Figure B-7 include onetime and recurring costs								Total cost*	Inflated cost @**
	P&P	Onetime costs	Operations costs 3.	4.	5.	6.	7.	8.		
1	31,393								31,393	31,393
2		5,848							5,848	6,315
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
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26										
27										
28										
29										
30										
Totals*	$63,958	$10,724							$987,897	$1,062,55

Footnotes:
*These totals display the uninflated total project cost, except for the last column.
**The inflated costs for each year are transferred to Figure B-9.

Notes:
1. This figure is designed to aid in the accumulation of costs. It includes both base year (uninflated) costs and inflated costs for each project year. It also includes recurring costs and one-time costs for each project year. The one-time costs and recurring costs for a year must be added together before entering Figure B-8. A separate Figure B-8 is needed for each inflation rate of each alternative. This format provides space for the name of each cost kind (up to eight). The format may be altered to accept more cost kinds, if needed.
2. The totals at the bottom of the format show the total constant dollar cost for each cost kind, the total project cost in constant dollars, and the total project cost in inflated dollars. The inflated cost for each year is entered in Figure B-9.

Figure B-8. Eight percent inflated costs for alternative A

Project year	Inflated costs subject to the rates identified below*					Discount factor at 10 percent	Discounted cost
	8 percent	percent	percent	0**	Total		
1	31,393				31,393	0.954	29,948
2	6,246				6,246	0.867	5,415
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							

Footnotes:
*These inflated costs for each year are received from Figure B-8.
**The costs subject to the general inflation rate are not inflated, and are entered from a sheet of Figure B-7.

Notes:
1. This economic analysis cost summary, or a similar one, must be presented in the economic analysis report to highlight the interrelationships between cost kinds and those various alternatives that are analyzed. The information that enters this format comes directly from the inflated cost column of format B-8. Project years should be specified. Begin with the base year and end at the point of termination of the analysis.
2. The costs calculated in this format are entered in the economic analysis summary of the executive summary. (See Chapter 5 for details.)
3.

Total project cost (discounted)	$ 694,136
Less terminal value (discounted)	23,938
Net total project cost (discounted)	670,198
Uniform annual cost (with terminal value)	70,362
Uniform annual cost (without terminal value)	72,875

Figure B-9. Economic analysis cost summary for Alternative A

Appendix C
Sample Contract Statement of Work and Scope of Work

C–1.
This appendix includes a sample statement of work and a sample scope of work for contracting out the preparation of an economic analysis. Each covers a specific area for economic analysis of housing alternatives. They are presented to assist the operating installation that may lack competent personnel. They also will aid the installation whose staff is not available to perform required economic analyses. The person directing an economic analysis should be trained and experienced in economic and cost analysis. Both of these areas are complex, and an effective economic analysis will usually take several weeks of a qualified staff member's time.

C–2.
The process of contracting out an economic analysis reduces the amount of staff time needed; however, it does not relieve the organization of all effort and responsibility. Care must be taken to ensure that the contractor completes all aspects of the effort properly and within the expected time frames. This requires a well–written contract that specifies all requirements in detail. It also requires periodic inspection and supervision by organizational personnel to ensure quality of the end product. The samples at figures C–1 and C–2 are guides to assist organizations toward effective contracted projects.

Statement of Work
for
Furnishings Analysis in Overseas Areas

Background

The Deputy Assistant Secretary of Defense for Installations and Housing (DASD(I & H)) has directed the Army to implement a policy of full joint travel regulations (JTR) weight allowance of personally owned furnishings for Germany and Okinawa starting 1 October 1981. DASD(I & H) has noted that inflation may have invalidated the economic analyses used to make this decision and has directed the Army to revise the analyses by 15 September 1981.

Scope of work

The contractor will prepare an economic analysis report to compare the Government providing furnishings to the shipment of personally owned furnishings in Germany. The contractor is to develop the methodology to be used to conduct the economic analysis based on the guidelines furnished by the Government. The Government will collect all the required data and provide that data to the contractor in the format of the approved methodology. The contractor will review the data collected, identify all mission information needed by the approved methodology, resolve problem areas when data cannot be obtained, and ensure that all data elements have an audit trail. The contractor will prepare a written economic analysis report based on the data provided for Germany. The Government estimates the level of effort to be approximately 2 professional man–months.

Tasks

a. The contractor will develop the economic analysis methodology based on good, sound economic principles and the guidelines provided by the Government. The methodology must be approved by the Army Housing Management Office (DAEN–MPH–M).

b. The contractor will coordinate with the points of contact provided by the Government to ensure that appropriate data is collected that follows the approved methodology. The contractor will resolve with the Government any changes needed to the methodology when data cannot be collected as stated. The contractor will make one visit to Germany at the European Headquarters in Heidelberg to review the data collected and to assist the Government during this trip to resolve any data collection problems. This trip is expected to require 7 days including travel time.

c. The contractor will prepare a draft report for Germany. It will include an executive summary of the results and a detailed analysis of the data provided by the Government. The report will present costs of providing Government furnishings and costs of shipping personally owned furnishings. The contractor will provide a narrative of all factors that may be pertinent but not quantifiable to the decision to support either alternative. After Government review of the draft, the contractor will make all revisions and provide the Government a camera–ready copy of each page of the report.

Government–furnished equipment or materials

a. If contact with the Army installation is necessary to clarify problem areas, the Government will furnish telephone service to the contractor.

b. The Government will furnish all data elements for the analyses.

c. The Government will furnish DASD– and DA–level guidelines.

Meetings and reviews

a. The contractor will take part in meetings scheduled by the Government in the Washington DC area.

b. The contractor will review the data collected by the Government, including on–site review meetings in Heidelberg, Germany, as soon as the data is available. The trip to Germany will be approximately 7 days and will not require review of any classified information.

Reports

The contractor will prepare a written report to summarize the analysis for Germany. The contractor will deliver the draft report to HQDA (DAEN–ZCH–M), 20 Massachusetts Ave., WASH DC 20314–1000 by 1 August 1981. The Government review will require 30 days. The contractor will make the final submission, with the changes identified in the Government review of the report, in camera–ready copy within 7 calendar days from receipt of the review comments.

Minimums

The contractor must demonstrate the capability to meet the time frames and a background in economics with professional status.

Figure C-1. Sample contract statement of work—Furnishings analysis in overseas areas

Scope of Work
for
Economic and Sensitivity Analysis
for U.S. Army, Europe (USAREUR) and Seventh Army

Location. State of Hawaii, island of Oahu and Federal Republic of Germany.

Authority. CINCUSAREUR msg 031255Z Apr 81, subject: Housing Economic and Sensitivity Analysis.

Study objective. To conduct an economic and sensitivity analysis (using factor analysis) of alternative housing modes for USAREUR family housing in Germany.

Major tasks.

a. Determine factors for current status of providing family housing for USAREUR.

b. Make determination of basic data factors deemed to be critical or sensitive.

c. Apply factor analysis to the variables involved in the analysis of the alternative housing modes.

d. Devise and execute appropriate displays of output.

e. Prepare a report detailing findings.

Work Task Details: Work items will include, but not necessarily be limited to, the following:

a. With information and assumptions provided by U.S. Army Corps of Engineer (USACE), U.S. Army Division, Pacific Ocean (POD), and USAREUR, prepare an analysis of the alternatives below.

(1) Build–to–lease (BTL).

(2) New construction. U.S. Government (Military Construction, Army (MCA)).

(3) Payment of allowances.

b. The analysis will be performed for the following USAREUR installations:

Location	No. of units		
Grafenwoehr/Vilseck/Amberg	246		
Karlsruhe	53		
Bamburg	44		
Giessen	352	Total	695

c. The sensitivity and critical variables involved in the analysis of alternative housing modes will be run as a factor analysis using computer software. The computer time will be provided by POD and U.S. Army Division, Europe (EUD), but the input and analysis of these variables will be done by contractor personnel using POD and EUD terminals.

d. Appropriate displays of output will be developed by the contractor.

e. A report will be prepared summarizing current status and costs of housing and comparing those with alternatives. The factor analysis results will be summarized and displayed. The raw computer runs and other materials used in the analysis will be given to the Government when the contract is complete.

Period of Contract. Analysis of the three alternative modes will be completed within 20 calendar days after date of receipt of notice to proceed

Figure C-2. Sample scope of work—Economic and sensitivity analysis for U.S. Army, Europe (USAREUR), and Seventh Army

(NTP). Review of factor analysis and draft report shall be completed within 30 calendar days after date of receipt of the NTP. Final reports will be provided within 40 calendar days after receipt of the NTP.

Schedule.

Check point	Days after receipt of NTP	Percent complete	Conferences & submittals
1	20	50	Alternative mode analysis
2	30	90	Draft report
3	40	100	Final report

Equipment and Supplies. The contractor will provide all equipment and supplies to complete the required work. The Government will furnish computer hardware and computer software for contractor personnel use for the input and analysis of the variables.

Report format.

a. One copy of the draft report will be submitted to the contracting officer no later than 30 calendar days after date of receipt of the NTP. This will allow for review of the format and compliance with applicable contract provisions. The draft report will be returned to the contractor for completion within 5 calendar days following submission for review. The final report will be submitted within 40 calendar days after date of receipt of the NTP. Technical findings will not be subject to approval of the contracting officer, but changes in the findings and recommendations that are acceptable to the contractor will be included in the final report. If any changes are unacceptable to the contractor, the final report should include a statement that the findings do not necessarily represent the view or have the concurrence of the contracting officer.

b. The final report will be prepared in one original copy, suitable for reproduction, and will not be bound. The finished size of the report will be 8½ by 11 inches. Any enclosures will conform to the paper size and will be suitable for permanent binding along the left–hand margin. Text and line drawings will be clean, clear, and easily reproducible. The text will be single spaced. Report copies will not be stapled.

c. The final amended report will contain, as a minimum, the following:

(1) Explicit assumptions and bases for estimates.

(2) A discussion of methodology.

(3) Findings and data tabulation. Payments. A lump sum payment will be made when the contract ends.

Contractor's release. The contractor must submit a written and signed 'Contractor's Release of Claims' with the final bill for services rendered under the terms of this contract.

Conferences. During work progress, the contractor will confer with the contracting officer to provide preliminary study data, to assure that the completed work will be acceptable to the contracting officer. Conferences will be specifically arranged at the following times:

a. Twenty calendar days following receipt of the NTP for review of alternative mode analysis.

b. Thirty–five calendar days following receipt of the NTP for review of the draft report. Release of Information. The information developed, gathered, and assembled to fulfill the requirements of the contract as defined in or related to the scope of work will not be released by the contractor, his or her consultant, his or her subcontractors, or their associates before coordination with and approval by the contracting officer or his or her designee.

Ownership of Results. The information developed, gathered, assembled, and reproduced by the contractor, his or her consultants, subcontractors, or their associates to fulfill the contract requirements as defined or related to the scope of work will become the complete property of the Government and will not be used by the contractor for any purpose without the written consent of the contracting officer.

Contract Execution and Reports. The contractor will develop an objective final product to fulfill the terms of the contract. The Government expects that the contractor will properly and adequately include and thoroughly investigate all areas and sources of information pertinent to the objective analysis of the areas in the scope of work. The Government requires the contractor to consider all the following research areas in all reports, unless approval is granted by the contracting officer (or his or her representative) for the contractor to deviate from them:

a. Identification of the problem to include the—

(1) Introduction.

(2) Background.

(3) Statement of objective or purpose of the report and survey study.

(4) Questions to be addressed and resolved or specific objective of the study.

(5) Listing of conceptual or substantive assumptions that affect the report and study.

(6) Rationale or theoretical framework used in the study.

(7) Importance and purpose of the report and study.

(8) Definitions of all terms used in the report as they affect the objectivity and accuracy of the report.

b. Adequately detailed discussion of the methodology, approach, procedures, and techniques used in the sequence of development of the study and report to include concise and complete information, as shown below.

(1) Overview of the methodology, approach, procedures, and techniques.

(2) Description of the research design of the report and study.

(3) Description of how the sample, sample area, and geographic location, were selected as applicable.

(4) Description of the methods used to gather the information for the study.

(5) Synopsis of the collection and recording of data for the report and study.

(6) Detail of the limiting factors and assumptions governing the validity of the report and study.

Figure C-2. Sample scope of work—Economic and sensitivity analysis for U.S. Army, Europe (USAREUR), and Seventh Army—Continued

(7) Discussion of the limits of the material presented in the report.

c. Complete objective analysis and evaluation of the findings of the study to include the—

(1) Presentation of data in tables, charts, graphs, and sequential listings.

(2) Narrative presentation of findings.

(3) Identification of factual, inferential, opinionative, or speculative information.

(4) Concise and complete summary of all findings.

Figure C-2. Sample scope of work—Economic and sensitivity analysis for U.S. Army, Europe (USAREUR), and Seventh Army - Continued

Appendix D
Present Value Factors

This appendix contains four sets of present value factors. Each set applies to a specific condition. Use the factors in table D–1 only when the cash flow occurs evenly throughout the year, or when a single cash flow occurs near the midpoint of a year. Whether the cash flow occurs at the beginning or end of a year, use only the factors in table D–2. These factors apply only to amounts at the end of a year. A cash flow occurring at the beginning of a year must be treated as if it occurred at the end of the previous year. (For example, January 1, 1986 is equal to December 31, 1985.) These tables are for use if a computer is not available. ECONPACK includes calculation formulas, so these are not needed when ECONPACK is used on a PC or on PAX.

Mid-year present value factors

Year	Present value of $1 (Single amount) (10 percent)	Present value of $1 (Cumulative uniform series) (10 percent)
1	0.954	0.954
2	0.867	1.821
3	0.788	2.609
4	0.717	3.326
5	0.652	3.977
6	0.592	4.570
7	0.538	5.108
8	0.489	5.597
9	0.445	6.042
10	0.405	6.447
11	0.368	6.815
12	0.334	7.149
13	0.304	7.453
14	0.276	7.729
15	0.251	7.980
16	0.228	8.209
17	0.208	8.416
18	0.189	8.605
19	0.172	8.777
20	0.156	8.933
21	0.142	9.074
22	0.129	9.203
23	0.117	9.320
24	0.107	9.427
25	0.097	9.524
26	0.088	9.612
27	0.080	9.692
28	0.073	9.765
29	0.066	9.831
30	0.060	9.891

Note:
The left column of factors is based on continous compounding at a 10 percent effective annual discount rate, assuming uniform cash flows throughout stated 1 year periods. These factors are approximated by an arithmetic average of beginning and end of year single amount factors found in standard present value tables. When a cost or revenue occurs at the end of a year, use the factors presented in Table D-2.

Figure TABLE D-1. Mid–year present value factors

End-of-year present value factors

	Present value of $1 (single amount)	Present value of $1 (cumulative uniform series)
Year	10 percent	10 percent
1	0.909	0.909
2	0.826	1.735
3	0.751	2.486
4	0.683	3.169
5	0.621	3.790
6	0.564	4.354
7	0.513	4.867
8	0.466	5.333
9	0.424	5.757
10	0.386	6.143
11	0.350	6.493
12	0.319	6.812
13	0.290	7.102
14	0.263	7.365
15	0.239	7.604
16	0.218	7.822
17	0.198	8.020
18	0.180	8.200
19	0.164	8.364
20	0.149	8.513
21	0.135	8.648
22	0.123	8.771
23	0.112	8.883
24	0.102	8.985
25	0.092	9.077
26	0.084	9.161
27	0.076	9.237
28	0.069	9.306
29	0.063	9.369
30	0.057	9.426

Note:
The discount factors presented in the table above should be used only for end-of-year lump sum costs and returns. When a cost or return occurs in a steady stream, applying midyear discount factors may be more suitable.

Figure TABLE D-2. End–of–year present value factors

Appendix E
Estimating Residual Value

Where residual value is a factor in an economic analysis, such as in the new construction or lease buy–out alternatives, the building decay–obsolescence and site appreciation factors will be used to determine the value at any point in time. See table E–1 for building decay–obsolescence and site appreciation factors.

Building decay-obsolescence and site appreciation factors

Period of analysis	Building decay-obsolescence factors*	Site appreciation factors*
1	0.98300	1.01500
2	0.96629	1.03023
3	0.94986	1.04568
4	0.93371	1.06136
5	0.91784	1.07728
6	0.90224	1.09344
7	0.88690	1.10984
8	0.87182	1.12649
9	0.85700	1.14339
10	0.84243	1.16054
11	0.82811	1.17795
12	0.81403	1.19562
13	0.80019	1.21355
14	0.78659	1.23176
15	0.77322	1.25023
16	0.76007	1.26899
17	0.74715	1.28802
18	0.73445	1.30734
19	0.72197	1.32695
20	0.70969	1.34686
21	0.69763	1.36706
22	0.68577	1.38756
23	0.67411	1.40838
24	0.66265	1.42950
25	0.65139	1.45095
26	0.64031	1.47271
27	0.62943	1.49480
28	0.61873	1.51722
29	0.60821	1.53998
30	0.59787	1.56308

Footnote:
*The factors presented in the table above implicitly assume end-of-year building decay-obsolescence and site appreciation changes.

Figure TABLE E-1. Building decay–obsolescence and site appreciation factors

Glossary

Section I
Abbreviations

ADP
automatic data processing

Alt
alternative

BAQ
basic allowance for quarters

BR
bedroom

BTL
build–to–lease

BTU
British thermal unit

Cat
category

CCH
Cost Comparison Handbook

CCM
Construction Criteria Manual

CER
cost–estimating relationship

CGO
company grade officer

COB
command operating budget

COEA
cost and operational effectiveness analysis

CONUS
continental United States

DA
Department of the Army

DASD(I & H)
Deputy Assistant Secretary of Defense for Installations and Housing

DOD
Department of Defense

DLA
Defense Logistics Agency

DU
dwelling unit

DY
day

ECONPACK
economic analysis package

EUD
U.S. Army Division, Europe

FGO
field grade officer

FSA
Family Separation Allowance

FY
fiscal year

G & A
general and administrative

GS
General Schedule

GSA
General Services Administration

GFP
Government Furnished Property

HHG
household goods

HND
Huntsville District, Corps of Engineers

HQ
headquarters

HR
hour

JNCO
junior noncommissioned officer

JTR
Joint Travel Regulations

KWH
kilowatt hour

LQA
Living Quarters Allowance

M3
cubit meter

M & R
maintenance and repair

MACOM
major Army command

MCA
Military Construction, Army

MILCON
military construction

MPA
Military Personnel, Army

MTMC
Military Traffic Management Command

NCO
noncommissioned officer

NPV
net present value

NTP
notice to proceed

OCONUS
outside continental United States

OHA
Overseas Housing Allowance

OMB
Office of Management and Budget

OSD
Office of the Secretary of Defense

PAX
Programming, Administration, and Execution System

PC
Personal Computer (Microcomputer)

PCS
permanent change of station

POD
U.S. Army Division, Pacific Ocean

SF
square foot

SHMA
Segmented Housing Market Analysis

SLUG
standard level user charge

SNCO
senior noncommissioned officer

SO
staff officer

SOFA
Status of Forces Agreement

TLA
temporary lodging allowance

USACE
U.S. Army Corps of Engineers

USAREUR
U.S. Army, Europe

Section II
Terms

Acquisition cost
The amount paid to acquire an asset.

Actual cost
The amount based on cost incurred as distinguished from estimated costs. This includes standard cost properly adjusted for applicable variance.

Allocate
To assign an item of cost or a group of items of cost to one or more cost objectives. This term includes both direct assignment of cost

and the reassignment of a share from an indirect cost pool.

Allocation base
The denominator in the fraction used to develop an overhead rate. It is either the total of some element of expense (or group thereof) or a quantity measurement that is common to all items or activities to which the indirect costs are to be allocated.

Alternative
A choice of one or more approaches or projects as a means of fulfilling an objective, mission, or requirement.

Amortization
The gradual reduction of the balance in an account according to a specified schedule of time and amounts. This is usually used to liquidate a debt including interest.

Assets
Real and personal property and other items of monetary value.

Assumption
A belief or guess used to limit alternatives and to give a means for treating elements that are unknown or difficult to measure.

Basic labor rate
For Wage Board employees, the hourly rate to be applied to all hours worked and to all hours of annual leave earned, and sick, holiday and other leave taken. The General Schedule (GS) basic rate is the published annual rate of pay for the particular GS grade and step level.

Benefit
Quantitative or qualitative description of output performance. (See output measures.) The two most common types of benefits mentioned are—

a. Expected annual benefit. The dollar value (in constant dollars) of goods and services expected to result from a project for each of the years it is in operation.

b. Expected annual effects. An objective nonmonetary measure of project effects expected for each of the years the project is in operation. When dollar value cannot be placed on the effects of comparable projects, an objective measure of the effects may be available and useful to enable the comparison of alternative means of achieving specified objectives on the basis of their relative present value costs.

Benefit cost analysis
An analytical approach to solving problems of choice. It requires the definition of objectives and identification of alternative ways of achieving each objective of that alternative that yields the required level of benefits at the lowest cost. This same analytical process is often referred to as cost–effectiveness analysis when the benefits or outputs of the alternatives cannot be quantified in dollars. (In either form of analysis, qualitative and quantitative factors, foreseeable secondary or side effects, and noneconomic benefits are considered.)

Benefit cost ratio
A means for comparing programs and alternatives. This refers to the ratio of the measurable value of benefits divided by cost.

Bill of material
A detailed listing of the material requirements for providing a service or product.

Capital
Assets of a permanent character with continuing value. Examples are land, buildings, and other facilities including equipment.

Capitalized cost
The cost to acquire, install, and modify a tangible capital asset that has been added to an asset account.

Cartage
Transportation from a freight terminal to the point of use or consumption.

Command operating budget
An annual document that constitutes a command's recommendation for the allocation of resources during budget formulation.

Commercial or industrial–type functions
Those functions which, in their execution, provide the same type of products or services that could be obtained by contract from private commercial or industrial sources.

Constant year dollars
Monetary amounts always connected with a base year and showing the dollar purchasing power for that year. An estimate is said to be in constant dollars if costs for all work, whether prior, current or future, are adjusted so that they show the level of prices of the base year. When cost estimates are stated in constant dollars, the implicit condition is that the purchasing power of the dollar has remained unchanged over the time for the project being costed.

Contract administration costs
The costs incurred by the Government in assuring that a contract is faithfully executed by the Government and the contractor.

Cost and operational effectiveness analysis (COEA)
A documented investigation of the following:

a. Comparative effectiveness of alternative means of meeting a requirement for eliminating or reducing a force or mission defect.

b. The validity of the requirement in a scenario which has the approval of MACOM headquarters and Headquarters, Department of the Army.

c. The cost of developing, producing, issuing, and sustaining each alternative in a military environment for a time preceding the combat application.

Cost avoidance
Future planned or budgeted costs of the current course of action or status quo alternative that would not be incurred if another course of action were selected.

Cost–beneficial alternative
The alternative that—

a. Maximizes benefits when costs for each alternative are equal (the most effective alternative).

b. Minimizes costs when benefits are equal for each alternative (the most efficient alternative).

c. Maximizes benefit–cost ratio when costs and benefits are unequal.

Cost comparison (comparative cost analysis)
An accurate finding of whether it is more economical to acquire the needed products or services from the private sector or from an existing or proposed Government commercial or industrial–type activity.

Cost, Differential
See Differential Cost.

Cost, Direct
See Direct Cost.

Cost–effective alternative
The alternative that—

a. Maximizes benefits and outputs when costs for each alternative are equal (the most effective alternative).

b. Minimizes costs when benefits and outputs are equal for each alternative (the most efficient alternative).

c. Maximizes differential output per dollar difference when costs and benefits of all alternatives are unequal.

Cost–effectiveness analysis
(See benefit–cost analysis.)

Cost element
A basic unit of cost, such as labor or material. Related basic units are accumulated to form the total cost of each cost kind. (Also see expense item and cost kind.)

Cost–estimating relationship (CER)
A numeric expression of the link between a characteristic, a resource, or an activity and a particular cost connected with it. The expression may be a simple average, percentage, or complex equation derived by regression analysis that relates cost (dependent variable) to physical and performance characteristics (independent variable). For example, age of the structure may be determined, using regression analysis, to be a function of annual cost of maintenance. The CER shows how the

values of such independent variables are converted into estimated costs.

Cost, Fixed
See Fixed Cost.

Cost, Incremental
See Incremental Cost.

Cost, Indirect
See Indirect Cost.

Cost kind
A group of costs composed of a number of expense item that all contribute to accomplishment of the same function. Several cost kinds, or functions, contribute to accomplishment of an alternative.

Cost objective
A function, organizational subdivision, contract, or other work unit for which cost data are desired and for which provision is made to gather and measure the cost of such items as processes, products, jobs, and capitalized projects.

Cost of capital
An imputed charge on the Government's investment in all housing facilities and other assets needed for the work center to manufacture products or provide services.

Costing
The process of estimating or allocating costs for a specific activity, project, or organization.

Current costs
Costs incurred in the current accounting period.

Current dollars
Current year dollars that show purchasing power current to the year the dollars are spent. Prior costs stated in current dollars are the actual amounts paid out in these years. Future costs stated in current dollars are the projected actual amounts to be paid.

Current market value
The amount for which an item could be sold in today's market.

Delphi method
A technique for applying the informed judgment of a group of experts using a carefully planned program of sequential individual questioning without direct confrontation, and with maximum use of feedback of digested information in the investigation and solution of problems.

Demurrage
The compensation paid for the delay of a ship or freight car caused by the failure to load, unload, or dispatch in the time allowed.

Differential cost
A cost difference between two alternatives. A cost that must be incurred for one alternative, but not for another. This is also a cost that must be incurred in a different manner for one alternative than for another. The cost or rate of cost expenditure is different. The concept is as true for comparisons of a change and current operating levels as it is for comparisons of types of changes.

Direct cost
Any cost that can be identified specifically with a final cost objective. Direct costs are not limited to items that are incorporated in the end product as material or labor. Costs that can be identified specifically with a product or service are direct costs of that product or service. All costs identified specifically with other products or services are direct costs of those products or services.

Direct labor
That portion of salaries and wages that, as a practical matter, can be identified with and charged only to a specific product or service.

Direct material
The costs of such goods as raw material, parts, subassemblies, components, and supplies that, as a practical matter, can be identified specifically with the product or service (the final cost objective) under review.

Discount rate
The interest rate used to discount or calculate future costs and benefits to arrive at their present values. (See present value.)

Discounting
A technique for converting various cash flows occurring over a period of time to equivalent amounts at a common point in time, considering the time value of money, to provide a valid comparison. (See present value.)

Economic analysis
A systematic approach to the problem of choosing how to use scarce resources and an investigation of the full implications of achieving a given objective in the most efficient or effective manner. It provides a formal method to identify, analyze, and compare costs and benefits of alternative courses of action to select the most efficient or effective way to achieve the objective.

Economic life
The period of time over which the benefits to be gained from a project may reasonably be expected to accrue to the DOD. (Although economic life is not necessarily the same as physical life or technological life, it is largely affected by both the obsolescence of the investment itself and the purpose it is designed to achieve.) The economic life of a project begins in the year it starts producing benefits. It is possible that investments may occur several years before the time the project economic life begins.

Economic savings
Savings resulting from a decision that yields improved effectiveness or efficiency. Although the alternative may cost more, combat readiness or mission ability improvements may be more valuable than the amount of added cost. The short–term cost may be higher, but long–term costs may be lower, resulting in an economic saving. A short–term cost may produce an economic saving by deferring or eliminating a future cost.

Effectiveness
The performance or output received from an approach or project. (See Output and Output measures.)

Efficiency
The degree to which output performance is optimized for a given distribution of inputs.

Energy resources
Resources that can be used to provide energy needs. Energy resources, in general use, are liquid petroleum products, coal, natural gas, liquefied petroleum gas, purchased electricity, purchased steam, nuclear fuel, solar radiation, and batteries. Special energy resources that may apply in specific cases are manpower, animal power, special gases, special liquids, liquefied gases, solid fuel, chemicals, wind, waves, and geothermal conditions.

Equipment
Machinery, furniture, vehicles, or machines used or capable of being used to manufacture supplies or to perform services or for any administrative or general plant purposes.

Estimated cost
A general term indicating that the cost figure presented is not the result of actual operations. The estimate may be based on past experience with like operations, or it may be based on detailed analysis including estimates of all relevant expense items.

Estimating cost
The process of determining a future or past result in terms of cost based on available data.

Expense item
A basic unit of cost, such as labor or material. Related basic units are accumulated to form the total cost of each cost kind. (Also see cost element and cost kind.)

Expected annual cost
The expected annual dollar value (in constant dollars) of the number of resources, goods, and services to set up and carry out a project.

Expected cost or expected value
A statistical term specifically identifying the results of applying a probability distribution to actual or estimated performance values.

Feasible alternative
An alternative that is affordable and executable and, when specified, meets a minimum level of benefits for effectiveness.

Final cost objective
A cost objective that has both direct and indirect costs allocated to it and, in the cost accumulation system, is one of the final accumulation points.

Fiscal year
The accounting period for which annual financial statements are regularly prepared. The Government's fiscal year begins on 1 October and ends on 30 September.

Fixed cost
Cost incurred whether or not any quantity of an item is produced. These costs do not fluctuate with variations in output. For example, the total rent of a large apartment complex might be considered a fixed cost because it does not vary with the number of units occupied.

Fringe benefits
Allowances and services provided to employees as compensation in addition to basic salaries and wages.

Full costs
The total of all direct and indirect costs allocable to a product or service.

General and administrative (G & A) expense
Any management, financial, or other expense that is incurred by or allocated to an organizational unit and which is for the general management and administration of the unit as a whole. G & A expense does not include those management expenses whose beneficial or causal relationship to cost objectives can be more directly measured by a base other than a cost input base representing the total activity of the unit during a cost accounting period.

Goal
The end purpose of a project. The end toward which all efforts are directed.

Government–furnished facilities and equipment
Facilities and equipment in the possession of or acquired directly by the Government and subsequently delivered or otherwise made available to the contractor.

General price index
The ratio of a year's price level to a base year price level for all goods and services. This is sometimes called composite price index or general inflation rate.

Historical cost
The cost of any object based on actual dollar or equivalent outlay ascertained after the act. Any one of a number of methods of cost determination may be used.

Imputed cost
Costs that do not involve an actual expenditure of funds; hence, they do not appear in the final records. These are costs not actually incurred because of the nature of the transaction but they should be included in the decision process.

Incremental cost
A cost increase or decrease that results from a change in operations. These costs are often stated in terms of cost change per unit of change. Also, they are sometimes stated in terms of total cost of a change in operations.

Indirect costs (overhead)
Any cost not directly related to a single final cost objective, but related to two or more final cost objectives or with at least one intermediate cost objective. Indirect cost includes overhead and other fixed costs and groups of resources other than direct costs required to add up all segments of total cost. For example, the cost of bookkeeping is often not identified with a single type of output.

Inflation
A rise in the general price level that results in a decline in the purchasing power of money. It is measured by changes in price indices relative to a base year.

In–house performance
The performance of services or manufacture of products by Army military or civilian personnel to support Army functions. This includes in–house Army performance of commercial– or industrial–type functions for DOD components and other Federal departments and agencies.

Insurance costs
The cost to the Government arising from liabilities and losses not covered by insurance. The costs are incurred in agreement with the Government's policy of acting as a self–insurer. (See imputed costs.)

Interagency support
Products or services furnished from the capacity of another Government agency or organization to the agency that will provide the product or service being estimated.

Investment costs
Costs associated with acquiring equipment, real property, nonrecurring services, nonrecurring production (start up) costs, and other one–time costs . Investment costs need not all occur in a single year.

Kind of Cost
See cost kinds.

Labor time standard
A preestablished measure, in temporal terms, of the quantity of labor required to do a task.

Least cost alternative
The alternative producing at less cost the same or greater quantity of a given output than another alternative.

Life–cycle costs
The total cost of an item or system over its full life. It includes the cost of research, development, investment, operation, maintenance, support, and, where fitting, disposal.

Maintenance and repair
Cost incurred to keep buildings and equipment in normal operating condition.

Net benefit
(See present value net benefit.)

Net book value
The capitalized cost of an asset or group of assets shown in the accounting records less accumulated depreciation or other applicable offset.

Objectives
Statements of results to be achieved in mission–related terms by the project being studied.

One–time costs
The nonrecurring costs to the Government when it either starts or ends an in–house activity as a result of a decision to change the source, character, or condition of a product or service.

Operational costs
Recurring costs needed to operate and maintain an operational capability. Also called operation and support costs.

Operations overhead costs
The indirect costs that are necessarily incurred during a fiscal year to produce or deliver the products or services being provided by an organizational element.

Opportunity costs
Other income or expense avoidance, foregone by using limited resources for a specific purpose.

Other direct costs
All those direct costs (exclusive of direct labor and direct material) that are identified as having been incurred for a certain product or service.

Output
The products, functions, tasks, services, or capabilities an organization exists to produce, complete, attain, or maintain. The objectives justifying the existence of the organization and its consumption of resources. Classes of output information are defined as follows:

a. External benefits. The results of products or services produced by an organization, expressed in terms of benefits received by other organizations. Examples are adequacy and quality of major items of equipment being repaired.

b. Organizational products. The description of what is being produced by an organization for external use or effect. Examples are numbers of major items of equipment repaired or amount of ordnance delivered.

c. Evaluated work measures. The levels of

activity showing efficiency and effectiveness through application of engineered, historical, or assumed standards; for example, earned man–hours or years.

d. Levels of activity. The number of staff–hours used or units of work performed. Examples are number of overtime hours worked, number of square feet covered, and number of personnel trained. (Reclassifications of costs are not output measures, but they sometimes permit output to be inferred. Examples are the number of personnel assigned, number of activities managed, and the dollar value of activity managed.)

Output measures
Useful descriptions of functions, tasks, or missions performed by an organization and of capabilities possessed.

Overhead rate
A percentage, or monetary unit related to a quantitative measure, derived by dividing an indirect cost pool by an allocation base.

Overtime and other premium pay
Amounts added to basic salaries for working longer than the regularly scheduled hours or under unusual conditions.

Ownership cost (or cost of ownership)
A product's or service's prorata share of the depreciation and cost of capital applicable to the fixed assets required for performance.

Payback period
The time required for the stream of cash proceeds and cost savings produced by an investment to equal the original cash outlay of the investment. This is one of several project evaluation methods. It is also called the payoff period and cash recovery period.

Physical life
The estimated number of years that a piece of equipment or building can physically be used by DOD to accomplish the function for which it was procured or constructed.

Present value benefit
Each year's expected yearly benefit multiplied by its discount factor and then summed over all years of the planning period.

Present value cost
Each year's expected yearly cost multiplied by its discount factor and then summed over all years of the planning period.

Present value net benefit
The difference between present value benefit and present value cost.

Pricing
The process of setting the amount or amounts to be received in return for goods and services.

Probability
Numeric expression of the likelihood or chance of occurrence of a given event or outcome. It is expressed as a number ranging from zero to one.

Proposal
Any offer or other submission used as a basis for pricing a contract, contract modification or termination settlement, or for securing payments thereunder.

Real property
Land and rights therein, utility generation plants and distribution systems, buildings, structures, and improvements thereto.

Recurring costs
Expenses for personnel, material consumed, operations, overhead, support services, and other items incurred on a repetitive basis.

Rent
The cost incurred for the use of another entity's tangible assets (land, plant, machinery, and so forth) in providing the product or service being estimated.

Residual value
The proceeds (less removal and disposal costs if any) realized upon disposal of a tangible capital asset. It usually is measured by the net proceeds from the sale or other disposal of the asset or its fair value if the asset is traded on another asset.

Return on investment
The amount of revenue (savings) received from an investment.

Risk
In decision theory, the distinction is made that risk is quantifiable, while uncertainty is not. In situations of risk, the probabilities connected with potential outcomes are known. The term may be connected with situations of repeated events, each individually unpredictable but with the average outcome highly predictable. In situations of uncertainty, the probabilities are not known. This pamphlet uses the terms risk and uncertainty interchangeably.

Salvage value
(See Residual value.)

Savings
Reduction in costs achieved without reduction in performance. It is always computed with respect to the existing course of action or status quo in an economic analysis.

Savings–investment ratio (SIR)
The ratio of savings to investment when considering an alternative to an existing process. The SIR must be based on total savings and total investment without omission of wash costs. Omitting the wash costs will favor the project with the smallest saving.

Segmented Marketing Housing Analysis
An analysis of private rental housing assets available for Army housing needs within a 1 hour commute or 30 miles from the installation at peak traffic periods.

Sensitivity analysis
An investigation of how the economic analysis results may change with respect to changes in the system parameters or basic assumptions. If a change in parameter or assumption changes the study results, they are said to be sensitive to that parameter or assumption. As a minimum, a complete sensitivity analysis will consider the following:

a. The effect of changes in high expense items.

b. Challenges to assumptions.

c. The effect of changes in inflation.

d. The effect of changes in discount rates.

e. The effect of changes in monetary exchange rates.

Standard costs
Any cost computed with the use of preestablished measures.

Standard level user charge (SLUC)
The amount which GSA assesses Federal agencies for their assigned space in GSA–controlled buildings. This SLUC rate is a composite of the following three ingredients:

a. The fair annual rental appraisal rate for space, utilities, and normal services.

b. An escalation of this rate.

c. An added charge for standard protection.

Standard military rate
Standard rates set by DOD for expensing military personnel services. These standard rates are a composite of military basic pay, incentive, special pay, and certain other expenses and allowances.

Standby maintenance costs
The costs necessary for the upkeep of property held in a standby status to assure contract performance. This maintenance neither adds value to the property nor appreciably prolongs its useful life. Rather, the maintenance keeps the property in an efficient operating condition so it will be available for possible use in case of nonperformance by the contractor.

Sunk costs
Unrecoverable investment costs of past periods or unavoidable costs committed to a project (such as contract termination costs). Sunk costs have no bearing on the results of comparative cost studies and economic analyses, except economic program evaluations.

Support costs
Costs incurred by one organizational unit for the benefit of another.

Tangible capital asset
An asset that has physical substance, more than minimal value, and is expected to be

held for continued use or possession beyond the current accounting period.

Technological life
The estimated number of years before technology will make the existing or proposed equipment or facilities obsolete.

Terminal value
(See Residual value.)

Uncertainty
Level of knowledge about outcomes in a decision for which it is impossible to assign probabilities in advance. Outcomes not clearly identified or defined. Lack of sureness of outcomes.

Uniform annual cost
The amount of money that if budgeted in equal yearly installments would pay for the project. The total present value of these installments would be equal to the total present value computed from the estimated life–cycle costs.

Variable costs
The portion of total cost that depends on output and tends to vary with changes in production level.

Wash cost
A cost that is identical for all alternatives being evaluated. A wash cost is to be omitted from the analysis because it cannot alter the decision. It increases all alternatives by the same amount during the same time periods. Wash costs must not be omitted from an analysis which included calculation of statistics such as averages, SIR, and percentages.

Work statement (statement of work)
A comprehensive description of what is to be done including performance standards. The work statement should describe all requirements, such as duties, tasks, responsibilities, frequency of performance of repetitive functions, and requirements for furnishing facilities and materials.

Section III
Special Abbreviations and Terms
There are no special terms.

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