

AD-A053 207

TRAINING ANALYSIS AND EVALUATION GROUP (NAVY) ORLANDO FLA F/G 5/3
A GUIDEBOOK FOR ECONOMIC ANALYSIS IN THE NAVAL EDUCATION AND TR--ETC(U)
APR 78 W M SWOPE, E K GREEN

UNCLASSIFIED

TAE6-55

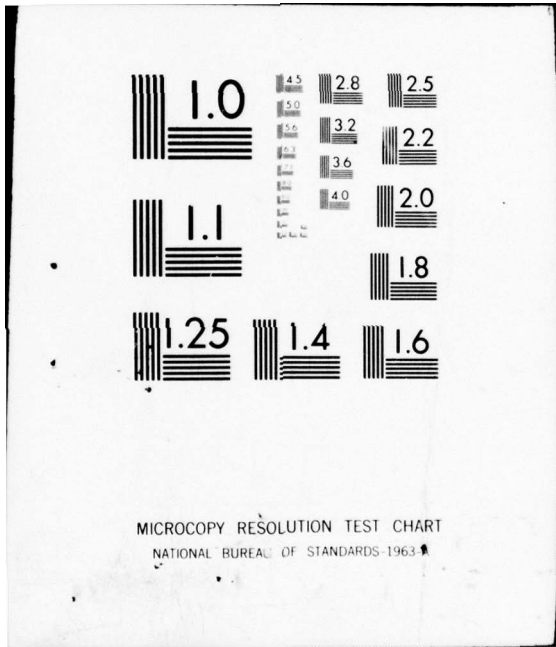
NL

1 OF 1
AD
A053207



A grid of 48 microfilm frames, arranged in 4 rows and 12 columns. The frames contain various types of content, including text, tables, and diagrams. The first frame in the second row is a large table with multiple columns and rows of data. The third frame in the second row shows a flowchart with several interconnected boxes. The fourth frame in the second row is another table. The fifth frame in the second row is a diagram with a central box and several arrows pointing outwards. The sixth frame in the second row is a table. The seventh frame in the second row is a table. The eighth frame in the second row is a table. The ninth frame in the second row is a table. The tenth frame in the second row is a table. The eleventh frame in the second row is a table. The twelfth frame in the second row is a table. The first frame in the third row is a table. The second frame in the third row is a table. The third frame in the third row is a table. The fourth frame in the third row is a table. The fifth frame in the third row is a table. The sixth frame in the third row is a table. The seventh frame in the third row is a table. The eighth frame in the third row is a table. The ninth frame in the third row is a table. The tenth frame in the third row is a table. The eleventh frame in the third row is a table. The twelfth frame in the third row is a table. The first frame in the fourth row is a table. The second frame in the fourth row is a table. The third frame in the fourth row is a table. The fourth frame in the fourth row is a table. The fifth frame in the fourth row is a table. The sixth frame in the fourth row is a table. The seventh frame in the fourth row is a table. The eighth frame in the fourth row is a table. The ninth frame in the fourth row is a table. The tenth frame in the fourth row is a table. The eleventh frame in the fourth row is a table. The twelfth frame in the fourth row is a table.

END
DATE
FILMED
6-78
DDC



AD A 053207

TAEAG

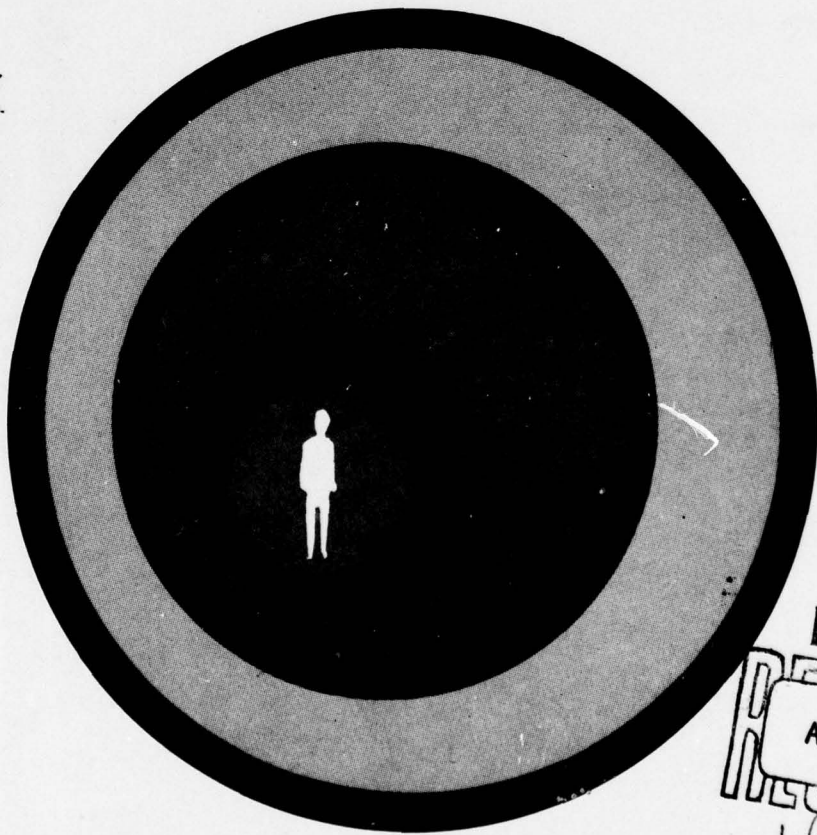
TRAINING
ANALYSIS
AND
EVALUATION
GROUP

12

TAEAG REPORT
NO. 55

A GUIDEBOOK FOR ECONOMIC ANALYSIS IN THE
NAVAL EDUCATION AND TRAINING COMMAND

DDC FILE COPY



FOCUS
ON
THE
TRAINED
MAN

DDC
RECEIVED
APR 26 1978
F

APPROVED FOR PUBLIC RELEASE;
DISTRIBUTION IS UNLIMITED

APRIL 1978



TRAINING ANALYSIS AND EVALUATION GROUP
ORLANDO, FLORIDA 32813

TAEG Report No. 55

A GUIDEBOOK FOR ECONOMIC ANALYSIS IN THE
NAVAL EDUCATION AND TRAINING COMMAND

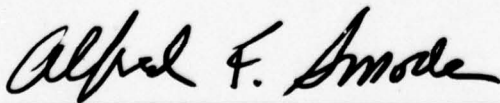
William M. Swope
Eric K. Green

Training Analysis and Evaluation Group


April 1978

GOVERNMENT RIGHTS IN DATA STATEMENT

Reproduction of this publication in whole
or in part is permitted for any purpose
of the United States Government.



ALFRED F. SMODE, Ph.D., Director,
Training Analysis and Evaluation Group



WORTH SCANLAND, Ph.D.
Assistant Chief of Staff
Research and Program Development
Chief of Naval Education and Training

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER TAEG Report No. 5	2. GOVT ACCESSION NO. 4 TAEG - 55	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) A Guidebook for Economic Analysis in the Naval Education and Training Command	5. TYPE OF REPORT & PERIOD COVERED Final Report March 1977 - April 1978	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) William M. Swope and Eric K. Green	8. CONTRACT OR GRANT NUMBER(s)	
9. PERFORMING ORGANIZATION NAME AND ADDRESS Training Analysis and Evaluation Group Orlando, FL 32813	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS	
11. CONTROLLING OFFICE NAME AND ADDRESS	12. REPORT DATE April 1978	13. NUMBER OF PAGES 49 (1251p.)
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)	15. SECURITY CLASS. (of this report) Unclassified	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution is unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report) APR 26 1978		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Economic Analysis Cost effective Cost/benefit		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This guidebook outlines in a simple and straightforward manner the essential steps in doing an economic analysis. It is procedurally oriented and intended for use in analysis of short-range operational problems.		

DD FORM 1 JAN 73 1473

EDITION OF 1 NOV 65 IS OBSOLETE
S/N 0102-LF-014-6601

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

TAEG Report No. 55

TABLE OF CONTENTS

<u>Section</u>		<u>Page</u>
I	INTRODUCTION.	5
	Objective of Guidebook.	5
	Organization of Guidebook	5
	Overview of the Economic Analysis Process	6
	Guidebook Limitations	6
II	DESCRIPTIONS OF TASKS	9
	Task 1. Statement of Problem	9
	Task 2. Determine the Planning Period.	9
	Task 3. Determine the Discount Rate.	9
	Task 4. Identify the Proposed Alternatives	10
	Task 5. Identify Resources Required.	10
	Task 6. Determine Cost of Resources Required	13
	Task 7. Determine if this Alternative Eliminates the Need for any Existing Equipment or Facilities.	16
	Task 8. Determine Value of Eliminated Equipment or Facilities	19
	Task 9. Time Phase and Compute the Present Value of Alternative.	19
	Task 10. Determine the Benefits, Strengths, and Weaknesses to be Attained from Accepting and Implementing the Alternative.	23
	Task 11. Compare Present Costs and Benefits of all Alternatives	24
	REFERENCES.	27
	APPENDIX A - ADDITIONAL REFERENCES FOR TASKS.	31
	APPENDIX B - EXAMPLES OF ECONOMIC ANALYSIS.	33
	APPENDIX C - DERIVATION OF MID-YEAR DISCOUNT FACTORS.	45
	APPENDIX D - GLOSSARY OF TERMS.	47

ACCESSION for	
NTIS	<input checked="" type="checkbox"/> File Section
DDC	<input type="checkbox"/> B of Section
UNANNOUNCED	<input type="checkbox"/>
JUL 1 1971	
BY	
DISTRIBUTION/AVAILABILITY NOTES	
A	

TAEG Report No. 55

LIST OF ILLUSTRATIONS

<u>Figure</u>		<u>Page</u>
1	Outline of the Tasks Necessary to Perform an Economic Analysis.	7
2	A Diagrammatic Scheme for Determining Cost of Resources Required for Each Alternative System	15
3	Procedure for Determining Value of Resources Released.	20

LIST OF TABLES

<u>Table</u>		<u>Page</u>
1	Discount Factors for Discount Rates Between 4 Percent and 12 Percent	11
2	Format for Collecting Data on Resources Required for Each Alternative	14
3	Format for Summarizing the Resource Costs of Each Alternative	17
4	Format for Collecting Data on the Resources Released by Each Alternative	18
5	Format for Summarizing the Value of Resources Released by Each Alternative	21
6	Format for Summarizing the Total Costs of Each Alternative.	22
A-1	Comprehensive List of References for Each Task	32
B-1	Resources Required for In-House Custodial Services	35
B-2	Format for Summarizing the Resource Costs of Each Alternative	36
B-3	A List of Resources Required for Current Publication System	38
B-4	The Cost of Resources Required for the Current Publication System	39

TAEG Report No. 55

LIST OF TABLES (continued)

<u>Table</u>		<u>Page</u>
B-5	Summary of Cost of Current System Analysis.	41
B-6	A List of Resources Required for the Text Editor System . .	42
B-7	Cost of Resources Required for Text Editor System	43
B-8	Summary of Cost of Text Editor System Analysis.	44
C-1	Mid-Year vs. End-of-Year Discount Factors (10% DR).	46

SECTION I

INTRODUCTION

This guidebook on economic analysis was prepared by the Training Analysis and Evaluation Group (TAEG) in cooperation with the Resources Management Division (Code N-62) of the Chief of Naval Education and Training (CNET). It is designed to be used by individuals within the Naval Education and Training Command who lack experience and training in the techniques of economic analysis but who are required, aperiodically, to perform these analyses.

The guidebook is intended to provide a systematic step-by-step approach to economic analysis of resource allocation problems. Discussions of the concepts, assumptions, and principles underlying the analytical techniques employed are intentionally omitted. These underlying bases are well documented in numerous publications. Many of these sources are referenced in this report and are available for those desiring more detailed information. Throughout the guidebook a number of "rules of thumb" are offered. These are provided without explanation or justification in keeping with the intent of this document.

OBJECTIVE OF GUIDEBOOK

The objective of this effort is to develop a procedurally-oriented economic analysis guidebook. The document is designed for mid-level managers and for analysts who are charged with making resource allocation decisions. Accordingly, the techniques proposed center on short-run operational problems such as equipment acquisition, contracting, and consolidation or reorganization of training activities.

ORGANIZATION OF GUIDEBOOK

The economic analysis process has been separated into discrete tasks which must be performed sequentially. An orderly set of tasks has been identified, and forms and procedures are provided to facilitate the accomplishment of each task. Following an overview of the economic analysis process, each task is then described with a minimum amount of detail on procedures and formats. Abbreviated information and guidance for performing the task are given with each task description. References which have been selected as the most relevant for each task are given immediately following each task description. A more extensive list of references for each task can be found in appendix A, table A-1. Copies of a number of these references are held by the local comptroller's office while others may be available at station libraries. If not locally available, additional information about the references may be obtained from TAEG. The references are listed in detail at the end of the report. Appendix B provides two examples of economic analysis which utilize the procedures outlined in this report. Appendix C illustrates the mathematical derivation of the mid-year discount factors used by the Department of Defense (DOD). Appendix D contains a glossary of terms which are relevant to economic analysis.

OVERVIEW OF THE ECONOMIC ANALYSIS PROCESS

The overall purpose of an economic analysis is to identify and cost all resources required by each alternative and then, given the benefits of each alternative, determine that alternative which is most cost effective. An outline of the economic analysis process is illustrated by the block diagram in figure 1. The sequential tasks illustrated in figure 1 offer a simplified procedure for identifying a set of alternatives, determining the resources required by each alternative, and then comparing the cost and benefits of the alternatives to determine which alternative is most cost effective. Task 1 through task 4 must be done only once for each analytical problem. The set of feasible alternatives identified in task 4 determines the number of times tasks 5 through 10 must be executed for each problem. For example, if there are four alternatives identified in task 4 then tasks 5 through 10 must be iterated four times. Finally, in task 11, the data developed in the previous tasks are used to compare all alternatives and the most cost effective alternative is recommended.

GUIDEBOOK LIMITATIONS

An economic analysis will seldom lead to cost estimates which are consistent with the budget data. This inconsistency arises because (1) economic analysis is concerned with the efficiency in the use of capital resources (i.e., resources which are already in the inventory) and (2) the time value of resources is made a part of the analysis. An economic analysis estimates the value of existing capital from the yield of the best available alternatives (called its opportunity cost) and includes this value as part of the cost. Budget data generally do not include the opportunity costs of resources in current inventory. Finally, all future benefits and costs are discounted because resources (or monies) received (or used) today are worth more than those monies received or used in the future. Discounting permits cost and benefit streams with different time phasing to be compared on an equal basis. Since economic analysis deals with discounted costs and benefits, the dollar flows shown in the analysis differ from those in the budget.

The forms illustrated throughout the guidebook are not intended for reproduction and general use in preparing an economic analysis. They have been deliberately compressed for expediency in presentation. However, for those individuals concerned with short planning periods the forms may be used without modification. The forms depict a general format which serves as the basis for preparing more extensive forms for specific analysis. Alternative forms which can also be used are described in DOD Instruction 7041.3.

Users are admonished not to expect every contingency encountered in doing an economic analysis to be covered by procedures outlined in this guidebook. Problems encountered in conducting an economic analysis are often so divergent that it is inevitable that the analysts will frequently need to exercise individual resourcefulness in applying these procedures to their problems.¹

¹ Assistance in economic analyses can be obtained by calling TAEG (autovon 791-4367) or the Analysis Branch, CNET, Code N-62 (autovon 922-3407).

TAEG Report No. 55

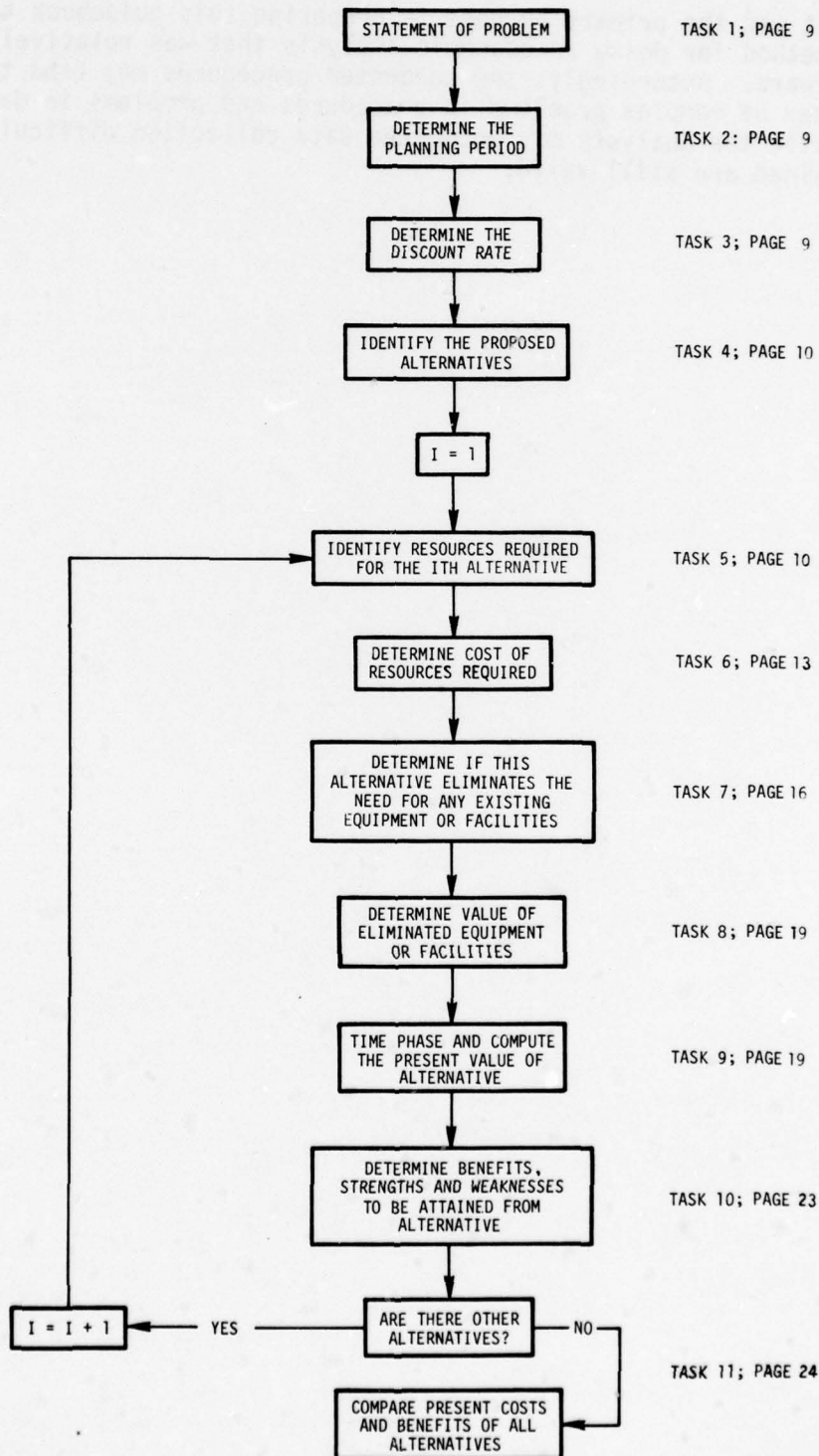
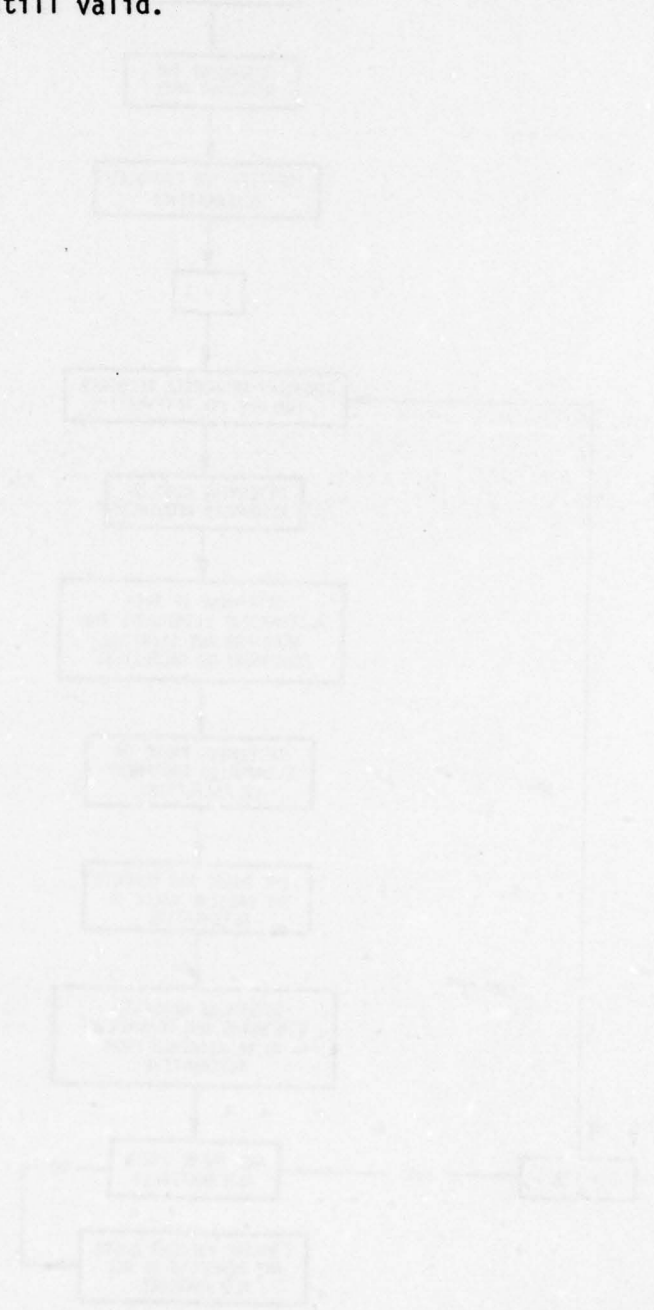


Figure 1. Outline of the Tasks Necessary to Perform an Economic Analysis

TAEG Report No. 55

Finally, it was the primary purpose in preparing this guidebook to develop and present a method for doing an economic analysis that was relatively simple and straightforward. Accordingly, the suggested procedures may tend to oversimplify what may be complex problems in procedures and problems in data collection. While the analysts may encounter data collection difficulties the procedures outlined are still valid.



SECTION II

DESCRIPTIONS OF TASKS

TASK 1. STATEMENT OF PROBLEM

DISCUSSION: Provide a brief statement explaining the problem to be analyzed giving the objectives, problem characteristics, constraints on the problem solution, and any relevant study assumptions.

REFERENCES: No. 1, pp. 2 and 3; No. 2, p. 3; No. 3, p. 3.

TASK 2. DETERMINE THE PLANNING PERIOD

DISCUSSION: Costs and benefits of any program are seldom limited to one year. Therefore, a decision must be made as to the time frame over which the analysis is to extend. It is necessary to specify a time period in order that alternative solutions can be realistically compared. The time period will frequently be dictated by the problem. For example, commercial/industrial (C/I) analyses usually require 3 years. In other situations, it may be convenient to use a planning period which coincides with expected life of the equipment or instructional material. In other situations, the planning period may be determined by administrative edict. If no justification or direction is available to determine the planning period, then use a period of 10 years.

REFERENCES: No. 1, p. 5; No. 2, pp. 12 and 13; No. 13, pp. 7 and 8.

TASK 3. DETERMINE THE DISCOUNT RATE

DISCUSSION: One of the major differences between economic analysis and cost analysis is that the time value of money (the medium to purchase resources) is considered in economic analysis. Money is a commodity; its price is the interest rate. One dollar deposited in a savings account will at the end of a year yield the dollar plus interest. Therefore, if a person is given the choice of receiving a dollar now or a dollar 1 year from now, the logical choice would be to accept the dollar today because, if invested, the dollar could be returned with interest 1 year later.

Discounting is a method which calculates the "present value" of dollars to be spent or received in the future. By present value is meant the worth today of some future dollar amount. The price of money, the interest rate, is used as the basis for determining the discount (present value) rate (see appendix C). The discount rate is used to compute a discount factor which, when multiplied by the future money amount, will give the present value of the future money amount.

In order to compare the cost of different alternatives (where expenditures are made in various time periods), the present value of the cost of each alternative must be determined. Given all other things being equal, the alternative with the lowest present value cost should be selected (this assumes all alternatives are of equal effectiveness).

TAEG Report No. 55

A great deal of controversy exists over the proper discount rate to use to determine present values. The current DOD Instruction 7041.3 directs that "future benefits and costs will be discounted at an annual rate of 10 percent."² The analyst is permitted to prepare an analysis using an alternative discount rate that he believes more applicable, provided he submits this as a supplement to the analysis using the prescribed 10 percent rate. Table 1 includes the discount factors computed from a 10 percent discount rate (price of money). Notice that the discount factors decrease over the future years; this means that the further in the future a dollar is received (or spent) the less it is worth today. Table 1 also includes discount factors listed for integer discount rates of 4 percent through 12 percent to cover the contingency of future amendments to the current DOD instruction.

REFERENCES: No. 1, pp. 14 through 17; No. 2, pp. 13 through 24; No. 3, pp. 25 through 28; No. 10, pp. 12 and 13.

TASK 4. IDENTIFY THE PROPOSED ALTERNATIVES

DISCUSSION: Alternate methods of accomplishing the objectives outlined in task 1 must be specified. The identification of alternatives is best accomplished by those skilled in the technical aspects of the problem. The status quo (i.e., continue to do business as usual) and the contracting for the function are examples of alternatives which might be included. Only very general specifications of alternatives are necessary for task 3. However, the analyst must comprehensively examine tasks 5 through 10 for each alternative, as results from those latter tasks will yield the information from which comparisons can be made.

REFERENCES: No. 1, pp. 3 through 5; No. 2, p. 4; No. 3, pp. 12 through 14; No. 10, pp. 4 and 5.

TASK 5. IDENTIFY RESOURCES REQUIRED

DISCUSSION: For each alternative identified in task 4 an identification of the physical resources required for the execution of that alternative must be specified. These resource requirements must be identified for each year in the planning period (as determined in task 2) according to the year in which they will be needed.

If the alternative being analyzed is a contract price and the government is not providing supplies or facilities, there will be no requirement for acquisition of in-house resources and consequently no requirement for doing task 5. In that case, go directly to task 6.

There are certain classes of resources and/or functions for which it would be too difficult and laborious to itemize each resource item required. For these, direct cost estimates may be made. For example, general supplies or the refurbishing of facilities may involve so many different items that an

²For projects where costs extend over 3 years or less, discounting is not required (DOD Instruction 7041.3).

TAEG Report No. 55

TABLE 1. DISCOUNT FACTORS FOR DISCOUNT RATES BETWEEN 4 PERCENT AND 12 PERCENT¹

Year	DISCOUNT FACTORS BASED UPON DISCOUNT RATES OF:								
	.04	.05	.06	.07	.08	.09	.10	.11	.12
1	.981	.976	.972	.967	.963	.959	.955	.950	.946
2	.943	.930	.917	.904	.892	.880	.868	.856	.845
3	.907	.885	.865	.845	.826	.807	.789	.771	.754
4	.872	.843	.816	.790	.764	.740	.717	.695	.674
5	.838	.803	.770	.738	.708	.679	.652	.626	.601
6	.806	.765	.726	.690	.655	.623	.593	.564	.537
7	.775	.728	.685	.645	.607	.572	.539	.508	.479
8	.745	.694	.646	.602	.562	.524	.490	.458	.428
9	.717	.661	.610	.563	.520	.481	.445	.412	.382
10	.689	.629	.575	.526	.482	.441	.405	.371	.341
11	.663	.600	.543	.492	.446	.405	.368	.335	.305
12	.637	.571	.512	.460	.413	.372	.334	.302	.272
13	.613	.544	.483	.420	.382	.341	.304	.272	.243
14	.589	.518	.456	.401	.354	.313	.276	.245	.217
15	.566	.493	.430	.375	.328	.287	.261	.220	.194
16	.545	.470	.405	.351	.305	.263	.228	.197	.173
17	.524	.447	.383	.328	.281	.241	.208	.179	.154
18	.503	.426	.361	.306	.260	.222	.189	.161	.138
19	.484	.406	.340	.286	.241	.203	.172	.145	.123
20	.466	.386	.321	.267	.223	.186	.156	.131	.110
21	.448	.368	.303	.250	.207	.171	.142	.118	.098
22	.430	.350	.286	.234	.191	.157	.129	.106	.088

TABLE 1. DISCOUNT FACTORS FOR DISCOUNT RATES
BETWEEN 4 PERCENT AND 12 PERCENT¹ (continued)

Year	DISCOUNT FACTORS BASED UPON DISCOUNT RATES OF:								
	.04	.05	.06	.07	.08	.09	.10	.11	.12
23	.414	.334	.270	.218	.177	.144	.117	.096	.078
24	.398	.318	.254	.204	.164	.132	.107	.086	.070
25	.383	.303	.240	.191	.152	.121	.097	.078	.062

¹Mid-year discount factors

TAEG Report No. 55

effort to list them would be meaningless. In that case, fairly reliable estimates of the costs of supplies can be derived from past expenditure patterns. A cost estimating relationship (CER) must be derived and used to make direct cost estimates. A cost estimating relationship is simply a means of relating costs of production to output levels and may take such forms as dollars per student, dollars per student hour, dollars per instructor, or dollars per square foot.

Completion of table 2 will identify and time phase the resources required for each alternative. Column one identifies the resource, column two identifies the units of measurement, and the remaining columns indicate the number of units required for each year. The number of years in the planning period (N) would be determined from task 2.

When direct cost estimates are made, the units of measurement shown will be dollars and the funding required for each year of the planning period would be entered in the appropriate columns of table 2.

REFERENCES: No. 3, pp. 14 through 18; No. 15, pp. 7 through 9; No. 19, pp. 12 through 13.

TASK 6. DETERMINE COST OF RESOURCES REQUIRED

DISCUSSION: The next step in the process is to determine the economic cost of all resource items that will be required to implement and operate each alternative for the planning period. These resource items might be classified in five main groups as suggested in task 5: Personnel, Supplies, Equipment, Facilities, and Other. The process illustrated in figure 2 can be used as a guide for costing each individual item in the resource group. The initial step is to determine if the resource is already available within your command/organization or if the resource will have to be purchased or acquired. If the resource is not available in-house, then the cost of the resource is simply the purchase or acquisition price. For example, if a truck is the resource required and none is available in-house, then the truck must be purchased (or rented) and its purchase price is the acquisition cost.

The more difficult part of this task is determining the value or cost to be placed on resources which are already in-house. Assume, for example, that a truck is required and that an adequate truck is already owned by the organization. The first step in placing a value on the truck is to make a determination if it is being currently used or if it is in surplus. If it is not currently being used, then it can be employed in this alternative without denying its use for some other in-house purpose and the cost depends on whether the truck would have been disposed. When it cannot be disposed, the cost of the truck is zero. If it can be disposed, the cost is equal to its market or salvage value. Note that the salvage value or market value of any unused resource should be used only if the resource would have been sold; otherwise, the cost of using the resource is zero.

TABLE 2. FORMAT FOR COLLECTING DATA ON RESOURCES REQUIRED FOR EACH ALTERNATIVE

RESOURCE GROUP	RESOURCE ITEM	MEASURE- MENT UNITS	QUANTITY OF RESOURCES WHICH MUST BE ACQUIRED IN EACH YEAR						
			1	2	3	4	5	6	N
Equipment									
Personnel									
Supplies									
Facilities									
Other									

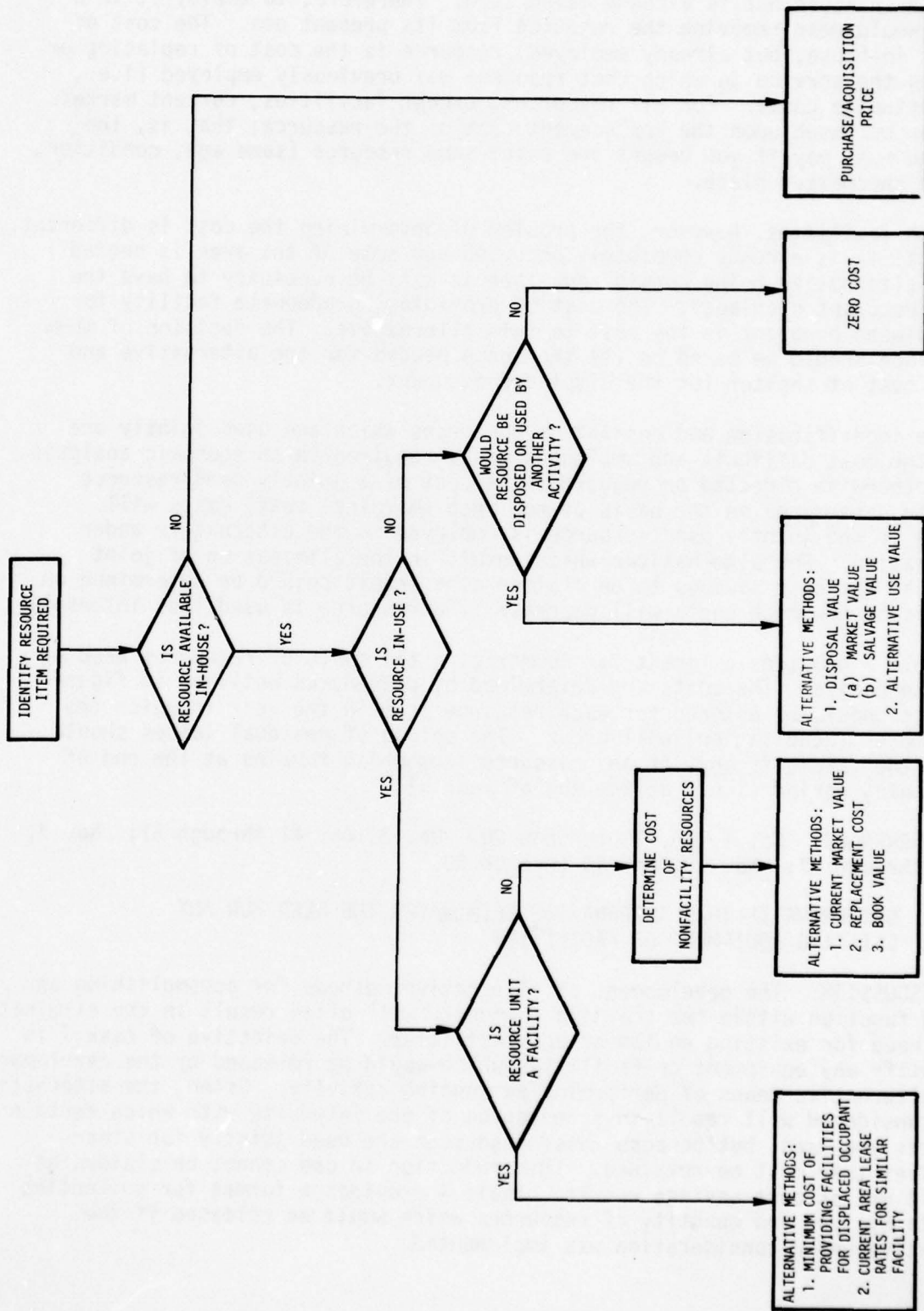


Figure 2. A Diagrammatic Scheme for Determining Cost of Resources Required for Each Alternative System

The other contingency shown in figure 2 is that a required resource is available in-house but is already being used. Therefore, to employ it in a new use would mean removing the resource from its present use. The cost of using an in-house, but already employed, resource is the cost of replacing or providing the service in which that resource was previously employed (i.e., its opportunity cost). For all resources, except facilities, current market value can be based upon the replacement cost of the resource; that is, the price you must pay if you bought the exact same resource (same age, condition, etc.) in the market place.

With facilities, however, the problem of determining the cost is different. If a facility is already completely occupied and some of the area is needed for the alternative being considered, then it will be necessary to have the current occupant displaced. The cost of providing an adequate facility for the displaced occupant is the cost to this alternative. The decision of whom to displace should be based on (1) the space needed for the alternative and (2) the cost of shelter for the displaced occupant.

The identification and costing of resources which are used jointly are two of the most difficult and ambiguous tasks required in an economic analysis. Unless otherwise directed or required, the cost of a jointly used resource should be determined on the basis of how much (marginal cost) costs will increase if the jointly used resource is employed in the alternative under consideration. For alternatives which result in the elimination of joint functions, the cost savings to be claimed as a credit should be determined on the basis of how much costs will decrease if a resource is used less intensely.

Table 3 provides a format for summarizing the costs of resources used by each alternative. The costs are determined by procedures outlined in figure 2. Costs should be entered for each resource item in the year in which the expenditures (acquisition) will occur. The column of residual values should include the value, if any, of any resource item which remains at the end of the planning period (i.e., at the end of year N).

REFERENCES: No. 1, pp. 10 through 20; No. 2, pp. 41 through 51; No. 3, pp. 18 through 27; No. 10, pp. 40 through 50.

TASK 7. DETERMINE IF THIS ALTERNATIVE ELIMINATES THE NEED FOR ANY EXISTING EQUIPMENT OR FACILITIES

DISCUSSION: The development of alternative methods for accomplishing an ongoing function within the training community will often result in the elimination of the need for existing equipment and facilities. The objective of task 7 is to identify any equipment or facilities which would be released by the development of an alternative means of performing an ongoing activity. Often, the alternative being considered will result in a reduction of the intensity with which certain resources are used, but because these resources are used jointly for other activities they must be retained. This reduction in use cannot be claimed as a credit unless cost savings result. Table 4 provides a format for collecting the data by type and quantity of resources which would be released if the alternative under consideration was implemented.

TABLE 3. FORMAT FOR SUMMARIZING THE RESOURCE COSTS OF EACH ALTERNATIVE

RESOURCE GROUP	RESOURCE ITEM	COST OF RESOURCES WHICH MUST BE ACQUIRED IN EACH YEAR						RESIDUAL VALUE
		1	2	3	4	5	6	
Equipment								
	Subtotal							
Personnel								
	Subtotal							
Supplies								
	Subtotal							
Facilities								
	Subtotal							
Other								
	Subtotal							
	TOTAL COSTS							

TABLE 4. FORMAT FOR COLLECTING DATA ON THE RESOURCES RELEASED BY EACH ALTERNATIVE

RESOURCE GROUP	RESOURCE ITEM	MEASUREMENT UNITS	QUANTITY OF RESOURCES RELEASED BY YEAR RELEASED					
			1	2	3	4	...	N
Equipment								
Facilities								
Personnel								

TAEG Report No. 55

REFERENCES: No. 2, pp. 43 and 44; No. 3, p. 25; No. 10, p. 43.

TASK 8. DETERMINE VALUE OF ELIMINATED EQUIPMENT OR FACILITIES

DISCUSSION: A cost for the resources identified in task 7 must be determined so that a proper credit can be given to the alternative under consideration. Figure 3 illustrates a procedure for computing the value of resources which might be released by the proposed alternative. If the resource or surplus capacity released has no other use, then the cost (i.e. the opportunity cost) of using that resource for the proposed alternative would be zero and no credit can be claimed.

The costs which the receiving activity can avoid should be used as the value of any surplus capacity which would be released. When it is not possible to obtain data for determining the value of the cost avoidance, then use an estimated sale (or market) price for the equipment or facilities. Support can be requested from the local representative of the Naval Facilities Engineering Command for determination of estimates for facilities. Table 5 provides a format which can be used to summarize the value of the resources which might be released. These values can be determined by applying the procedures outlined in figure 3 to the resources identified in table 4.

REFERENCES: No. 2, pp. 43 and 44; No. 10, p. 43.

TASK 9. TIME PHASE AND COMPUTE THE PRESENT VALUE OF ALTERNATIVE

DISCUSSION: Results from task 9 are intended to yield a summary of the information developed in the previous tasks. The additional resource requirements and their associated costs were identified in tasks 5 and 6. The resources released, if any, and their associated values were identified in tasks 7 and 8. All data is now ready to be compiled into a total life cycle cost for each alternative.

Table 6 provides a format for summarizing the cost data. The resource requirements will have been time phased in previous tasks and can be directly transferred to this form. Total annual (i.e., for years 1, 2, 3...N) costs for resources required are summarized in row 6. The final column in row 6 is a summary of all resource items which will have a residual value at the end of the planning period.

The total value of released assets is summarized in row 10 for all resource items which can be eliminated. The values are shown by the year in which they can be eliminated. The net per year cost for each year in the planning period is obtained by subtracting elements in row 10 from elements in row 6. The result is the net annual costs and they are entered in row 11.

The discount factor is entered in row 12 for each year in the planning period. The discount factor is computed on the basis of the discount rate selected in task 3. Table 1, page 11, presents the mid-year discount factors for integer discount rates from 4 percent through 12 percent. The current DOD

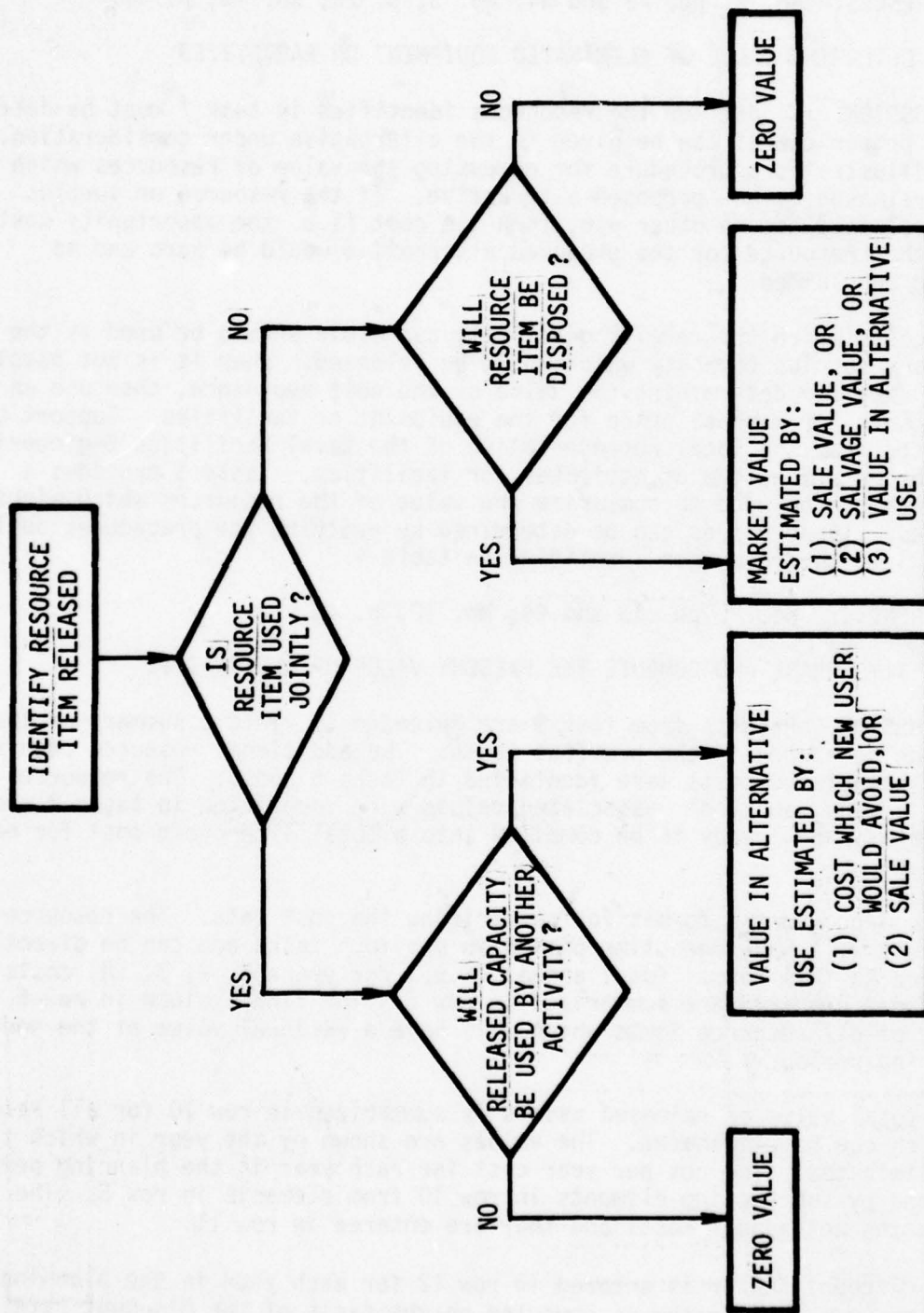


Figure 3. Procedure for Determining Value of Resources Released

TABLE 5. FORMAT FOR SUMMARIZING THE VALUE OF RESOURCES RELEASED BY EACH ALTERNATIVE

RESOURCE ITEM	VALUE OF RESOURCES BY YEAR RELEASED					
	1	2	3	4	5	6 ... N

TABLE 6. FORMAT FOR SUMMARIZING THE TOTAL COSTS OF EACH ALTERNATIVE

ITEM	1	2	3	4	5	6	.	.	.	N	RESIDUAL VALUE OF RESOURCES
RESOURCES REQUIRED	Equipment (1)										
	Facilities(2)										
	Personnel (3)										
	Supplies (4)										
	Other (5)										
	Subtotal (6)										
RESOURCES RELEASED	Equipment (7)										
	Facilities(8)										
	Other (9)										
	Subtotal (10)										
NET RESOURCES REQUIRED	(6)-(10) = (11)										
DISCOUNT FACTOR	(12)										
DISCOUNTED VALUE	(11)X(12) = (13)										

Present Value of Alternative =

instruction specifies that analyses within DOD are to be based upon the 10 percent discount rate. The discounted value in row 13 is computed by multiplying the net resources (row 11) by the discount factor (row 12). The residual value of resources is discounted using the N^{th} year discount factor. The discounted value is computed for each year in the planning period and entered in row 13. The present value of the alternative is computed by cumulating the discounted values (in row 13) over all years and subtracting, from the resultant sum, the discounted residual value (found in the last column of row 13).

REFERENCES: No. 2, pp. 13 through 24; No. 3, pp. 25 through 37; No. 10, pp. 10 and 11.

TASK 10. DETERMINE THE BENEFITS, STRENGTHS, AND WEAKNESSES TO BE ATTAINED FROM ACCEPTING AND IMPLEMENTING THE ALTERNATIVE

DISCUSSION: Results generated by this task should provide a qualitative assessment of the alternatives, other than the quantitative cost analysis completed in task 9. The analysis and evaluation of most alternatives deal with some qualitative aspects, which are not subsumed under the cost analysis. It is possible that these qualitative aspects could be so important as to outweigh any cost impacts which one might project. It is the purpose of this task to identify and evaluate any such noncost factors. Managers must include the nonquantifiable (i.e., the noncost factors) characteristics of each alternative into their decisionmaking process if they intend to reach the most rational decision. A few of the qualitative factors which should be addressed are: reliability, manageability, acceptability, impact on morale, safety, external constraints, and adaptability to change. Any caveats concerned with the analysis should be explicit.

Any noncost benefits obtained should be stated in terms of the problem statement defined in task 1. Assume, for example, that the problem statement was to determine the most cost-effective method of providing refuse disposal for a military installation. Assume further that the alternative under consideration is a proposal for contracting and we need to determine the noncost benefits and impacts from contracting this service. An example of a benefit/impact statement might be as follows:

- a. Contracting will provide for refuse pickup three times per week rather than a daily pickup under the current operation.
- b. Contracting will only provide for pickup between the hours of 0800 to 1700.
- c. Additional charges at the rate of \$30 per hour will be made for contingency pickups outside the hours 0800 to 1700.
- d. All refuse must be separated into combustible and noncombustible material.

TAEG Report No. 55

These factors or considerations are of the type that cannot readily be included under a cost analysis yet may be very important in the decision to contract or not to contract.

Upon completion of task 10, the analysts must determine if all alternatives have been considered. If there are other alternatives, then tasks 5 through 10 must be executed for each. The final data package will include a set of analyses for tasks 5 through 10 for each alternative under consideration. In task 11 the data packages will be compared for all alternatives.

REFERENCES: No. 1, pp. 22 through 31; No. 2, pp. 53 through 60; No. 3, pp. 27 through 30; No. 10, p. 60.

TASK 11. COMPARE PRESENT COSTS AND BENEFITS OF ALL ALTERNATIVES

DISCUSSION: The final step in the economic analysis process is to use the data and information derived from the preceding tasks to compare each of the proposed alternatives. The selection of the most cost-effective alternative will occur within one of the following four situations:

- Equal benefits - Unequal costs
- Equal benefits - Equal costs
- Unequal benefits - Equal costs
- Unequal benefits - Unequal costs

The most common situation used within the Naval Education and Training Command is situation one; equal benefits - unequal costs. This situation is most relevant because our training programs are usually designed to train to certain criteria. Thus, the required performance level of any training program is presumed to be the same, and training alternatives are designed only to provide the specified level of performance. Those alternatives which do so at lowest cost are most efficient. There are many areas, other than training, for which situation one applies; e.g., hardware acquisition, service contracts, and facilities maintenance all specify performance criteria for which minimum cost alternatives are selected.

Situation two, equal benefits - equal costs, will occur so infrequently that for most problems this contingency can be ignored as insignificant. When it does occur, decisions are made based solely on criteria such as that developed in task 10.

Situation three, unequal benefits - equal costs, is a situation that one should not expect to encounter very frequently. Unfortunately, it does occasionally occur as a result of the lead time required for budget submissions. Too often specific funds are identified for projects or programs occurring in the out years; then as the projects are developed the identified fund levels are taken as given parameters. Very little marginal analysis is done to determine the benefits which might be gained from alternative funding levels.

TAEG Report No. 55

In any event, economic analysis can provide useful management information by identifying those alternatives which yield the maximum benefits for any given level of expenditure.

Situation four, unequal benefits - unequal costs, is probably the most frequent situation when a literal and very rigorous approach is taken in the analysis. Situation four becomes the most difficult to evaluate because an evaluation will require a good deal of judgment, or subjectivity, on the part of the decision maker. While we intuitively suspect that alternative configurations of training resources will impact on the amount the student learns, we lack rigorous methods to develop empirical measures of the amount of training or education which has taken place. As a result, most analyses of training problems start from some fixed performance levels and then attempt to find the resource configuration which will meet those performance levels at minimum cost. Thus, most analyses of training problems are done under situation one above.

REFERENCES: No. 1, pp. 32 through 34; No. 2, pp. 53 through 60; No. 3, p. 30; No. 10, pp. 53 through 61.

TAEG Report No. 55

REFERENCES

1. Department of Defense. Economic Analysis Handbook. (2nd ed.). Defense Economic Analysis Council, OASD (C) SP&I, Washington, DC.
2. Department of the Navy. Economic Analysis Handbook. June 1975. Naval Facilities Engineering Command, Alexandria, VA.
3. Swope, William M. A Primer on Economic Analysis for Naval Training Systems. TAEG Report No. 31. March 1976. Training Analysis and Evaluation Group, Orlando, FL.
4. Hitch, Charles J. and McKean, Roland N. The Economics of Defense in the Nuclear Age. Harvard University Press, Cambridge, MA. 1961.
5. Stament, Alfred D., Bennett, Walter H., and Bowen, Brent L. Economic Analysis Handbook Theory and Application, Volume I - Army Investment Analysis. November 1973. General Research Corporation, Westgate Research Park, McLean, VA.
6. Stament, Alfred D., Bennett, Walter H., and Moore, William S. Economic Analysis Handbook Theory and Application, Volume II - Concepts and Techniques. November 1973. General Research Corporation, Westgate Research Park, McLean, VA.
7. Bennett, Walter H. and Stament, Alfred D. Economic Analysis Handbook Theory and Application, Volume III - Guide for Reviewers of Economic Analysis. November 1973. General Research Corporation, Westgate Research Park, McLean, VA.
8. Headquarters, U.S. Army Materiel Command. Engineering Design Handbook System Analysis and Cost-Effectiveness. AMCP 706-191. April 1971. Washington, DC.
9. Ulrey, Ivon W. and Ulrey, Ann P. Analysis for Managers of People and Things. Assistant Secretary of Defense, Washington, DC.
10. Brown, Richard S. Economic Analysis Handbook. June 1975. Naval Facilities Engineering Command, Alexandria, VA.
11. Stelmachowicz, Peter J. Can Cost Analysis Improve Management? December 1973. U.S. Army War College, Carlisle Barracks, PA.
12. Department of the Army. A Computer Model for Economic Analysis of Army Aircraft Ram Improvement Proposals. March 1974. U.S. Army Aviation Systems Commands, Office of the Comptroller, Cost Analysis Division, St. Louis, MO.
13. Department of Defense. Economic Analysis and Program Evaluation for Resource Management. DOD Instruction 7041.3.
14. Stament, Alfred D. and Bennett, Walter H. Economic Analysis Handbook Theory and Application, Volume IV - Case Studies. November 1973. General Research Corporation, Westgate Research Park, McLean, VA.

REFERENCES (continued)

15. Eassos, Tony. Guidelines for Preparing Economic Analysis for Army Aircraft Product Improvement Proposals. March 1974. U.S. Army Aviation Systems Command, Office of the Comptroller, Cost Analysis Division, St. Louis, MO.
16. Office of Management and Budget. Discount Rates to be Used in Evaluating Time-Distributed Costs and Benefits. Circular No. A-94. March 1972. Washington, DC.
17. Shishko, Robert. Choosing the Discount Rate for Defense Decisionmaking. R-1953-RC. July 1976. The RAND Corporation, Santa Monica, CA.
18. Pyhrr, Peter A. Zero-Base Budgeting. John Wiley & Sons, NY. 1973.
19. Bolduc, Robert A. Cost-Benefit Analysis: The Theory of Systems Analysis. June 1974. Florida Institute of Technology. Melbourne, FL.
20. Office of Management and Budget. Policies for Acquiring Commercial or Industrial Products and Services for Government Use. Circular No. A-76. August 1967.
21. Department of the Navy. Commercial or Industrial (C/I) Activities Program, CNETNOTE 4860. March 1977.
22. Department of the Navy. Commercial or Industrial Activities Program, SECNAVINST 4860.44.
23. Johnson, Ronald L. and Knobloch, Earle W. The A-7 Aloft Cost Model: A Study of High Technology Cost Estimating. December 1975. Naval Postgraduate School, Monterey, CA.
24. Department of Defense. Life Cycle Costing Guide for System Acquisitions. January 1973. Office of the Secretary of Defense, Washington, DC.
25. Department of the Navy. Cost Analysis. OPNAVINST 7000.17A.
26. Samuelson, Paul A. Economics. McGraw-Hill Book Company, NY. 1973.
27. Weston, J. Fred and Brigham, Eugene F. Managerial Finance. The Dryden Press, Hinsdale, IL. 1974.

TAEG Report No. 55

ADDITIONAL POLICY DIRECTIVES RELEVANT TO ECONOMIC ANALYSIS

- Office of Management and Budget. Policies for Acquiring Commercial or Industrial Products and Services for Government Use. Circular No. A-76. Washington, DC.
- Department of Defense. DOD Construction Manual. DOD 4270.1M.
- Department of Defense. Commercial or Industrial Activities. DOD Directive 4100.15.
- Department of Defense. Commercial or Industrial Activities - Operation of. DODINST 4100.33.
- Department of the Navy. Commercial or Industrial (C/I) Activities Program. NAVMATINST 4860.12.
- Department of the Navy. Naval Material Command Cost Analysis/Estimating Program. NAVMATINST 7000.19A.
- Department of the Navy. Commercial or Industrial Activities Program. CNETINST 4860.1.
- Department of the Navy. Commercial or Industrial (C/I) Activities Program. CNETNOTE 4860. March 1977.
- Department of the Navy. Economic Analysis and Program Evaluation. SECNAVINST 7000.14.
- Department of the Navy. Economic Analysis and Program Evaluation. OPNAVINST 7000.18.
- Department of the Navy. Economic Analysis of Proposed Military Construction Investments. OPNAVINST 11010.32.
- Department of the Navy. Economic Analysis of Military Construction Investments. NAVFACINST 11010.53.
- Department of the Navy. Design Economic Analysis Guidance for Naval Facilities. NAVFACINST 11010.55.
- Department of the Navy. Project Engineering Documentation (PED) for Proposed Military Construction Projects. NAVFACINST 11010.14.
- Department of the Navy. Shore Facilities Energy Conservation Survey Program. NAVFACINST 4100.6.

TAEG Report No. 55

APPENDIX A
ADDITIONAL REFERENCES FOR TASKS

TABLE A-1. COMPREHENSIVE LIST OF REFERENCES FOR EACH TASK

REFERENCE NUMBER	TASK 1	TASK 2	TASK 3	TASK 4	TASK 5 (Page Number)	TASK 6	TASK 7	TASK 8	TASK 9	TASK 10	TASK 11
1	2-3	5	14-17	3-5	10-20					22-31	32-34
2	3	12-13	13-24	4	41-51	43-44	43-44	43-44	13-24	53-60	53-60
3	11-12	37-39	25-28	12-14	14-18	18-27	25		25-37	27-30	30
4	23-25	213	205-218	118-119	165-177	173-174					
5	18-21	13-15		21-24	10						
6	10		119-125	22-25	26-37						
7	14-15			18-19	22-27						
8	2.5-2.9			2.10-2.17	2.43-2.54						
9	79.89				21-33						
10	3		12-13	4-5	40-50	43	43	43	10-11	60	53-61
11	1-3;6-7			10-17	10-17						
12	2-6										
13		7-8	5-7	1-2	2-9				4		
14		90									
15		9-10	10-12	5-6	7-9						13-15
16			1-6	1-4					1-7		
17			1-27								
18				6-15	124-127						
19				12-13	12-13						
20				1-9							
21				1-10							
22				1-4	472-476						463-480
23					66-76						
24					3.1-3.16						
25					1-11						
26											
27											

APPENDIX B
EXAMPLES OF ECONOMIC ANALYSIS

TAEG Report No. 55

EXAMPLE 1: A Preliminary Investigation into a Commercial/Industrial (C/I) Function

- Task 1: Determination of least cost custodial services at NATTC Hard Knocks. This would be a preliminary analysis only, as the format and cost factors are rigorously specified for an actual C/I cost analysis of any function when justification for in-house performance is based on cost.
- Task 2: Administrative policy sets a planning period of 3 years for functions which are considered a C/I activity.
- Task 3: As set forth in DOD Instruction 7041.3, a discount rate does not need to be employed for projects which have planning periods of 3 years or less.
- Task 4: Two alternatives will be evaluated for acquiring custodial service: (1) employ in-house resources or (2) contract with the private sector.
- Task 5: The resources required to complete the task in-house are listed in table B-1.
- Task 6: The costs of resources for the in-house alternative are listed in table B-2. Supplies and miscellaneous expenditures have already been estimated. Additional civilian personnel will have to be hired at the WG 2 and 3 levels and 20.4 percent will be added to their base pay to account for fringe benefits. Also, there will be a 3.4 percent annual inflation factor for WG salaries. A 4.7 percent factor is used for GS and a 4.54 percent factor for military (use latest factors). In a preliminary analysis such as this, contract costs could be approximated based on existing contracts for similar functions, or from engineering estimates. When conducting the C/I cost analysis in accordance with NAVMATINST 4860.12A, contract costs must be obtained from contractors using the firm bid/offer procedure.

	Year 1	Year 2	Year 3
Cost	\$314,500	333,400	353,400

- Task 7 - 9: Not applicable since no resources will be released and discounting is not required.
- Task 10: The basic strength of the in-house alternative is direct control; the basic weakness is an increase in bureaucracy. The basic strength of a private contractor is greater flexibility. However, costs may rise significantly when contract comes up for renewal with no ceiling points available to convert back to in-house.

TABLE B-1. RESOURCES REQUIRED FOR IN-HOUSE CUSTODIAL SERVICES

RESOURCE GROUP	RESOURCE ITEM	MEASURE- MENT UNITS	QUANTITY OF RESOURCES WHICH MUST BE ACQUIRED IN EACH YEAR							
			1	2	3	4	5	6	N	
Equipment										
Personnel	Civ Pers	Man-years	24	24	24	24				
	Mil Pers ¹	-	-	-	-	-				
Supplies	Maint & Rep	\$	5,000	5,310 ²	5,639 ²					
Facilities										
Other	Insurance, etc.	\$	11,600	11,600	11,600					

¹ Impossible due to fluctuating military labor pool.
² Inflation factor of 6.2 percent for materials (use latest factor).

TABLE B-2. FORMAT FOR SUMMARIZING THE RESOURCE COSTS OF EACH ALTERNATIVE

RESOURCE GROUP	RESOURCE ITEM	COST OF RESOURCES WHICH MUST BE ACQUIRED IN EACH YEAR						RESIDUAL VALUE
		1	2	3	4	5	6	
Equipment	Subtotal							
	Civ (WB 2 & 3) ¹	218,400	226,000	233,500				
Personnel	Subtotal							
	Maint & Repair	5,000	5,310	5,639				
Supplies	Subtotal							
	Insurance, etc.	11,600	11,600	11,600				
Facilities	Subtotal							
	TOTAL COSTS	235,000	242,910	250,739				
Other	Subtotal							
	TOTAL COSTS	235,000	242,910	250,739				

¹ Inflation factor for GS = 4.7%, WB = 3.4%, military = 4.54% (use latest factors).

T A E G Report No. 55

Task 11: Below is a listing of the annual costs, nondiscounted, of both alternatives. It is obvious that for each year the in-house alternative is the cheaper and therefore is the alternative which should be selected. As the in-house alternative is the cheaper, the need for the full C/I cost analysis is indicated. If the contract alternative had been cheaper, the contract could have been awarded without further analysis.

Cost of Alternatives

	Year 1	Year 2	Year 3	Total Cost
In-house	\$235,000	242,910	250,739	728,649
Contract	314,500	333,400	353,400	1,001,300

EXAMPLE 2: Economic Analysis of CNET Publishing System

- Task 1: Determination of the most cost effective publishing system for CNET.
- Task 2: The planning period will be 10 years as no other direction is given.
- Task 3: As set forth by DODINST 7041.3, a discount rate of 10 percent will be used. The following are the discount factors for years 1 through 10:

<u>Year</u>	<u>Factor</u>
1	.955
2	.868
3	.789
4	.717
5	.652
6	.593
7	.539
8	.490
9	.445
10	.405

- Task 4: There are two publication systems under consideration: (1) the current system and (2) text editor based system. The first analysis will be of the current system.
- Task 5A: Table B-3 lists the resources that will be required for the current publication system.
- Task 6A: Table B-4 shows the costs of the resources required to execute the current publication system.

TABLE B-3. A LIST OF RESOURCES REQUIRED FOR CURRENT PUBLICATION SYSTEM

RESOURCE GROUP	RESOURCE ITEM	MEASURE-MENT UNITS	QUANTITY OF RESOURCES WHICH MUST BE ACQUIRED IN EACH YEAR						N ¹
			1	2	3	4	5	6	
Equipment	Mag-Card IIs		7	7	7	7	7	7	7
	VDTs		14	14	14	14	14	14	14
	MTSCs		7	7	7	7	7	7	7
	Typewriters		18	18	18	18	18	18	18
	Authoring	Man-years	306.7	306.7	306.7	306.7	306.7	306.7	306.7
Personnel	Editing	Man-years	43.3	43.3	43.3	43.3	43.3	43.3	43.3
	Encoding/Composing	Man-years	25.8	25.8	25.8	25.8	25.8	25.8	25.8
	Typeset/Illust.	Man-years	38.7	38.7	38.7	38.7	38.7	38.7	38.7
Supplies									
Facilities									
Other	Printing	Million pgs	4321.6	4321.6	4321.6	4321.6	4321.6	4321.6	4321.6
	Binding	000s binds	3803.1	3803.1	3803.1	3803.1	3803.1	3803.1	3803.1
	Negatives	000s negs	85.5	85.5	85.5	85.5	85.5	85.5	85.5
	Plates	000s plates	100.2	100.2	100.2	100.2	100.2	100.2	100.2

¹ N = 10 years

TABLE B-4. THE COST OF RESOURCES REQUIRED FOR THE CURRENT PUBLICATION SYSTEM
(Thousand dollars)

RESOURCE GROUP	RESOURCE ITEM	COST OF RESOURCES WHICH MUST BE ACQUIRED IN EACH YEAR						RESIDUAL VALUE
		1	2	3	4	5	6	
Equipment	Rental/lease	96	96	96	96	96	96	96
	Maintenance	3	3	3	3	3	3	3
	Subtotal	99	99	99	99	99	99	99
Personnel	Authoring	6,517	6,517	6,517	6,517	6,517	6,517	6,517
	Editing/Encoding	952	952	952	952	952	952	952
	Comp/Type/Illust.	746	746	746	746	746	746	746
	Subtotal	8,215	8,215	8,215	8,215	8,215	8,215	8,215
Supplies								
	Subtotal							
Facilities								
	Subtotal							
Other	Printing	5,907	5,907	5,907	5,907	5,907	5,907	5,907
	Platemaking	165	165	165	165	165	165	165
	Subtotal	6,072	6,072	6,072	6,072	6,072	6,072	6,072
	TOTAL COSTS	14,386	14,386	14,386	14,386	14,386	14,386	14,386

¹ N = 10 years

TAEG Report No. 55

- Task 7A: The current publication system will not eliminate the need for any existing equipment or facilities.
- Task 8A: N/A (see Task 7)
- Task 9A: Table B-5 presents a summary of the costs of the current publication system.
- Task 10A: The main benefit of staying with the current system is that no risk is involved; it is a time tested system and it works. However, this system does not have the flexibility that is sometimes required.

The second alternative which must be analyzed is the text editor system. The following execution of tasks 5 through 10 presents the analysis for the text editor system:

- Task 5B: Table B-6 lists the resources that will be required by the text editor publication system.
- Task 6B: Table B-7 shows the costs of the resources required to execute the text editor publication system.
- Task 7B: Implementing this alternative would eliminate the need for the equipment used by the current system (see task 5 for a listing).
- Task 8B: The equipment to be disposed has little or no value as it is old and obsolete.
- Task 9B: Table B-8 presents a summary of the costs of the text editor publication system.
- Task 10B: The text editor system requires a substantial commitment for new equipment. This equipment offers greater flexibility for the system.
- Task 11: Both the current publication system and the proposed text editor system will satisfy CNET's publication requirements. Therefore, it is assumed that the benefits of each are equal. The present costs of each, however, are unequal. Over the planning period, the text editor system would cost approximately \$10 million less (discounted \$), given the benefits are equal. The text editor system is clearly more cost effective and would be recommended if the decision is to be based on cost savings alone.

TABLE B-5. SUMMARY OF COST OF CURRENT SYSTEM ANALYSIS
(Thousand dollars)

ITEM	RESOURCE GROUP	COST (VALUE) OF RESOURCES REQUIRED (RELEASED) BY YEAR										VALUE OF RELEASED RESOURCES	
		1	2	3	4	5	6	7	8	9	10		
RESOURCES REQUIRED	Equipment	99	99	99	99	99	99	99	99	99	99	99	99
	Facilities	0	0	0	0	0	0	0	0	0	0	0	0
	Personnel	8,215	8,215	8,215	8,215	8,215	8,215	8,215	8,215	8,215	8,215	8,215	8,215
	Supplies	0	0	0	0	0	0	0	0	0	0	0	0
	Other	6,072	6,072	6,072	6,072	6,072	6,072	6,072	6,072	6,072	6,072	6,072	6,072
	Subtotal	14,386	14,386	14,386	14,386	14,386	14,386	14,386	14,386	14,386	14,386	14,386	14,386
RESOURCES RELEASED	Equipment												
	Facilities												
	Other												
	Subtotal	0	0	0	0	0	0	0	0	0	0	0	0
NET RESOURCES REQUIRED		14,386	14,386	14,386	14,386	14,386	14,386	14,386	14,386	14,386	14,386	14,386	14,386
DISCOUNT FACTOR		.955	.868	.789	.717	.652	.593	.539	.490	.445	.405		
DISCOUNTED VALUE		13,739	12,487	11,351	10,315	9,380	8,531	7,754	7,049	6,402	5,826		

Present Value of Alternative - 92,834

TABLE B-6. A LIST OF RESOURCES REQUIRED FOR THE TEXT EDITOR SYSTEM

RESOURCE GROUP	RESOURCE ITEM	MEASURE- MENT UNITS	QUANTITY OF RESOURCES WHICH MUST BE ACQUIRED IN EACH YEAR					
			1	2	3	4	5	6 . . . N ¹
Equipment	4-Terminal Text Edit	3	3	3	3	3	3	3
	9-Terminal Text Edit	1	1	1	1	1	1	1
	Cluster Type Compos. System	1	1	1	1	1	1	1
	Typesetter	1	1	1	1	1	1	1
Personnel	Authoring	Man-years	306.7	306.7	306.7	306.7	306.7	306.7
	Editing	Man-years	36.7	36.7	36.7	36.7	36.7	36.7
	Encoding/Composing	Man-years	16.9	16.9	16.9	16.9	16.9	16.9
	Typeset/Illust.	Man-years	39.2	39.2	39.2	39.2	39.2	39.2
Supplies								
Facilities								
Other	Printing	Million pgs	3198.8	3198.8	3198.8	3198.8	3198.8	3198.8
	Binding	000s binds	3803.1	3803.1	3803.1	3803.1	3803.1	3803.1
	Negatives	000s negs	62.0	62.0	62.0	62.0	62.0	62.0
	Plates	000s plates	74.9	74.9	74.9	74.9	74.9	74.9

¹ N = 10 years

TABLE B-7. COST OF RESOURCES REQUIRED FOR TEXT EDITOR SYSTEM

RESOURCE GROUP	RESOURCE ITEM	COST OF RESOURCES (IN THOUSANDS) WHICH MUST BE ACQUIRED IN EACH YEAR						RESIDUAL VALUE
		1	2	3	4	5	6	
Equipment	Rental/lease	113	113	113	113	113	113	113
	Maintenance	51	51	51	51	51	51	51
	Subtotal	164	164	164	164	164	164	164
Personnel	Authoring	6,517	6,517	6,517	6,517	6,517	6,517	6,517
	Editing/Encoding	834	834	834	834	834	834	834
	Comp/Type/Illust.	735	735	735	735	735	735	735
	Subtotal	8,086	8,086	8,086	8,086	8,086	8,086	8,086
Supplies								
Facilities								
Other	Subtotal							
	Printing	4,402	4,402	4,402	4,402	4,402	4,402	4,402
	Platemaking	126	126	126	126	126	126	126
	Subtotal	4,528	4,528	4,528	4,528	4,528	4,528	4,528
	TOTAL COSTS	12,778	12,778	12,778	12,778	12,778	12,778	12,778

¹ N = 10 years

TABLE B-8. SUMMARY OF COST OF TEXT EDITOR SYSTEM ANALYSIS
(Thousand dollars)

ITEM	COST (VALUE) OF RESOURCES REQUIRED (RELEASED) BY YEAR										VALUE OF RELEASED RESOURCES	
	1	2	3	4	5	6	7	8	9	10		
RESOURCES REQUIRED												
Equipment	164	164	164	164	164	164	164	164	164	164	164	164
Facilities	0	0	0	0	0	0	0	0	0	0	0	0
Personnel	8,086	8,086	8,086	8,086	8,086	8,086	8,086	8,086	8,086	8,086	8,086	8,086
Supplies	0	0	0	0	0	0	0	0	0	0	0	0
Other	4,528	4,528	4,528	4,528	4,528	4,528	4,528	4,528	4,528	4,528	4,528	4,528
Subtotal	12,778	12,778	12,778	12,778	12,778	12,778	12,778	12,778	12,778	12,778	12,778	12,778
RESOURCES RELEASED												
Equipment												
Facilities												
Other												
Subtotal	0	0	0	0	0	0	0	0	0	0	0	0
NET RESOURCES REQUIRED	12,778	12,778	12,778	12,778	12,778	12,778	12,778	12,778	12,778	12,778	12,778	12,778
DISCOUNT FACTOR	.955	.868	.789	.717	.652	.593	.539	.490	.445	.405		
DISCOUNTED VALUE	12,203	11,091	10,082	9,162	8,331	7,577	6,887	6,261	5,686	5,175		

Present Value of Alternative - 82,455

TAEG Report No. 55

The computation of present values via discounting is accomplished by using the following equation:

$$PV = \frac{F}{(1+i)^n}$$

where PV is the present value, F is the future value, i is the discount rate (DR), and n stands for the number of years in the future. For example, if the discount rate is 10 percent and the period is 2 years from now the discount factor is $\frac{1}{(1.1)^2}$ or 0.826. This means that one dollar 2 years from now is worth 82.6 cents today.

The above is an example of an end-of-year discount factor. Within DOE, however, a mid-year factor is used; this is calculated by summing two end-of-year factors and then dividing by two. For example, looking at Table C-1, the end-of-year factor for period 2 is 0.826 (as derived earlier). To get the mid-year discount factor for period 2, add the end-of-year factors for periods two and three (0.826 + 0.751) and then divide by two to get 0.788. All the discount factors in this report have mid-year discount factors (Reference 27, pp. 222 through 229).

APPENDIX C
TABLE C-1. MID-YEAR VS. END-YEAR DISCOUNT FACTORS (10% DR)

DERIVATION OF MID-YEAR DISCOUNT FACTORS

Year	Mid-year factor	End-of-year factor
0	1.000	1.000
1	0.909	0.909
2	0.826	0.826
3	0.751	0.751

Diagram showing the derivation of mid-year factors from end-of-year factors:

- Year 2: (0.826 + 0.751) / 2 = 0.788
- Year 1: (0.909 + 0.826) / 2 = 0.867

TAEG Report No. 55

The computation of present values via discounting is accomplished by using the following equation:

$$DF = \frac{1}{(1+i)^n}$$

where DF is the discounting factor, i is the discount rate (DR), and n stands for the nth year in the future. For example, if the discount rate is 10 percent and the period is 3 years from now the discount factor is $\frac{1}{(1.1)^3}$ or 0.751. This means that one dollar 3 years from now is worth 75.1¢ today.

The above is an example of an end-of-year discount factor. Within DOD, however, a mid-year factor is used; this is calculated by summing two end-of-year factors and then dividing by two. For example, looking at table C-1, the end-of-year factor for period 3 is 0.751 (as derived earlier). To get the mid-year discount factor for period 3, add the end-of-year factors for periods two and three (0.826 + 0.751) and then divide by two to get 0.788. All the discount tables in this report have mid-year discount factors (Reference 27, pp. 228 through 230).

TABLE C-1. MID-YEAR VS. END-OF-YEAR DISCOUNT FACTORS (10% DR)

<u>Year</u>	<u>End-of-Year Factor</u>	<u>Mid-Year Factor</u>
0	1.000	0.954
1	0.909	
2	0.826	0.867
3	0.751	
		0.788

TAEG Report No. 55

APPENDIX D
GLOSSARY OF TERMS

TAEG Report No. 55

Capital	Physical assets having value and utility which extend over several discrete time periods. Examples are land, equipment, buildings, simulators.
Discount Rate	The interest rate used in calculating the present value of future costs and benefits. This rate represents the price of money (based on the average interest rate currently obtainable on loanable funds).
Discount Factor	The number (factor) is equal to $\frac{1}{(1+i)^n}$, where i is the discount rate and n is the year being considered.
Discounting	A computational technique using the discount rate to calculate the present value of future benefits and costs. Used in evaluating alternative proposals which have costs and/or benefits in (over) future years.
Economic Analysis	A systematic approach to the problem of choosing how to employ scarce resources and an investigation of the full implications of achieving a given objective in the most efficient and effective manner. The determination of efficiency and effectiveness is implicit in the assessment of the cost effectiveness of alternative approaches.
Incremental Cost	See Marginal Cost.
Marginal Analysis	Technique for evaluating an increment. A basis for comparing the additional cost to the additional benefit. The term <u>marginal</u> refers to the last increment of whatever is being considered (costs, benefits, units, etc.). Benefits per dollar of cost will be maximized when the value of the incremental benefit equals the incremental cost needed to realize the additional benefit. At any other point, either additional benefits could be obtained at less additional cost or additional benefits obtained would be less than the additional costs incurred.
Marginal Cost	Change in total cost due to a change in output. It is often used synonymously with incremental costs but the latter is usually considered a more general term. Thus, we speak of the marginal cost of training one additional student or the incremental cost of introducing a new training system.
Opportunity Cost	The benefits (value of a resource) that could have been obtained by the best alternative use of a resource which has been committed to a specific use. The measurable sacrifice foregone by forsaking an alternative investment.
Present Value	The present worth of past or future benefits and costs determined by applying discount procedures; this makes alternative programs and actions comparable regardless of time differences in money flows.

TAEG Report No. 55

Present Value Benefit	Calculation of each year's expected benefits multiplied by its discount factor and then summed over all years of the planning period.
Present Value Cost	Calculation of each year's expected cost multiplied by its discount factor and then summed over all years of the planning period.
Resources	Factors of production; inputs used in the production of goods and services. There are three broad resource categories: land, labor, and capital.

TAEG Report No. 55

DISTRIBUTION LIST

Air Force

Headquarters, Air Training Command (XPTD, Dr. D. E. Meyer)
Headquarters, Air Training Command (XPTIA, Mr. Goldman)
Air Force Human Resources Laboratory, Brooks Air Force Base
Air Force Human Resources Laboratory (Library), Lowry Air Force Base
Air Force Office of Scientific Research/AR (Dr. A. R. Fregly)

Army

Commandant, TRADOC (Technical Library)

Coast Guard

Commandant, U.S. Coast Guard Headquarters (G-P-1/62; G-RT/81)

Marine Corps

CMC (OT)
CGMCDEC (Mr. Greenup)
Director, Marine Corps Institute
CO MARCORCOMMELESCOL (ITS) (Mr. D. E. Mueller)

Navy

OASN (R&D) (Dr. S. Koslov)
OASN (MRA&L) (Dr. B. D. Rostker)
DASN (M) (Miss M. Snively)
OASN (MRA&L) (Mr. W. H. Lindahl)
CNO (OP-987P7, CAPT Connery; OP-991B, M. Malehorn; OP-987P10, Dr. R. Smith;
OP-987, Mr. H. Stone)
NAVCOMPT (NCD-7)
ONR (458, 455)
ONRBO Boston (Mr. J. Lester)
ONRBO Chicago
ONRBO Pasadena (Mr. E. E. Gloye)
CNM (MAT-08T2, Mr. A. L. Rubinstein)
CNET (01, 00A, N-5 (6 copies), N-62 (300 copies))
CNAVRES (02)
COMNAVSEASYSYSCOM (03, 047C1, 047C12)
COMNAVAIRSYSYSCOM (03, 340F)
CNET SUPPORT (00, 01A, 00A (2 copies))
CNTECHTRA (0161, Dr. Kerr (5 copies))
CNATRA (Mr. F. Schufletowski)

TAEG Report No. 55

DISTRIBUTION LIST (continued)

Navy (continued)

COMTRALANT
COMTRALANT (Educational Advisor)
COMTRAPAC (2 copies)
CO NAVPERSRANDCEN (Library (4 copies))
NAVPERSRANDCEN Liaison (01H)
Superintendent NAVPGSCOL (2124)
Superintendent Naval Academy Annapolis (Chairman, Behavioral Science Dept.)
CO NAVEDTRAPRODEVNEN (AH3)
CO NAVEDTRASUPPCEN NORVA
CO NAVEDTRASUPPCENPAC (5 copies)
CO NAVAEROMEDRSCHLAB (Chief Aviation Psych. Div.)
CO FLTCOMDIRSYSTRACENPAC
CO NAMTRAGRU
CISO, NTTCC Corry Station
CO NAVTRAEQUIPCEN (N-424 (2 copies), N-211, N-00AF, N-00M)
Center for Naval Analyses (2 copies)
U.S. Naval Institute (CDR Bowler)
OIC NODAC (2)
CO TRITRAFAC (2 copies)
CO NAVSUBTRACENPAC (2 copies)
CO FLEASWTRACENPAC
CO FLETRACEN SDIEGO

Other DOD

Military Assistant for Human Resources, OAD (E&LS) ODDR&E (COL Henry Taylor)
OASD (MRA&L) (LT COL Grosse)
Director, Human Resources Office, Defense Advanced Research Projects Agency
(Dr. R. Young)
Institute for Defense Analyses (Dr. Jesse Orlansky)

Information Exchanges

DDC (12 copies)
DLSIE (Mr. James Dowling)
Executive Editor, Psychological Abstracts, American Psychological Association
ERIC Processing and Reference Facility, Bethesda, MD (2 copies)