

project planning and management series

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ACKNOWLEDGEMENT

The Project Planning and Management Series consists of a set of manuals and associated modules presenting practical approaches, tools and techniques for project planning and management. (See list on back cover). A product of the Government of Jamaica/USAID National Planning Project (1976-1980), the series was developed by the Project Development Resource Team (PDRT) of PAMCO for use in "action-training" workshops and reflects extensive experience in training and project development. All present PDRT members are contributing authors and have worked together in writing, revising and publishing the series. Special credits are due to Dr. Meryln Kettering for design and development of the series; Dr. Bruce Brooks for writing final versions of many modules; Mrs. Marjorie Humphreys for assuming primary editing and production responsibility and for organizing draft papers into more useful materials; Mr. Lascelles Dixon, head of PDRT since 1979, for designing the cover and improving many of the illustrations; and Mrs. Christine Hinds and Miss Linette Johnson for typing the drafts and final manuscripts. Any comments on the series and its usefulness are welcome.

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MODULE 24

BENEFIT-COST RATIO ANALYSIS
Bruce Brooks

A. PREREQUISITES: MODUEL 21 - Discounting

REFERENCES: MODULE 27 - Economic Analysis

B. DISCUSSION:

The efficiency of project resource use is evaluated by this technique which weighs the benefits received from the project against the costs of the project and gives a measure of the efficiency of the project in the use of the resources. The way in which the costs and benefits are distributed among the expected beneficiaries is not shown by the Benefit-Cost Ratio (BCR). The BCR could be high but these high project benefits may accrue to a few beneficiaries of the project at the cost of the majority.

Computation of a BCR for a project requires a comparison of the benefits and the costs of the project. The time values of the cost and benefit streams are weighed in the computation by discounting the cost and benefit streams (SEE DISCOUNTING, MODULE 21) The BCR is the total discounted benefits of the project divided by the total discounted costs of the project, i.e.,

$$\frac{\text{Total Discounted Benefit Stream}}{\text{Total Discounted Cost Stream}} = \text{BCR}$$

If the computation results in a BCR that is greater than 1.0, this means that the project benefits exceed the costs when both are discounted at the estimated discount rate for capital. The size of the BCR reflects the efficiency of the project.

C. PURPOSE:

Benefit-Cost Ratio is a criterion for project evaluation that enables decision makers to determine if the project should be funded and to rank one project against other projects to determine the rank-order of the project when measured by this one measure of project worth.

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D. USE:

Rank-ordering of projects is done by using the BCR. It is used by decision makers as one measure of project worth in determining whether a project should be undertaken.

E. DEFINITIONS:

Project efficiency is a measure of the efficiency with which the costs of a project are reflected in the production rate of that project.

Rank-ordering of a project is the weighing of a project against other projects and then putting the projects in a priority listing according to the results of the measurements used plus other non-quantitative measures.

F. LIMITATIONS:

- a) Not all benefits can be quantified in monetary terms. Benefit-Cost Ratio is a financial measure of project efficiency. Any non-financial aspects that may result from the project are not included and these may be very important in measuring a project's efficiency.

An example of a non-monetary project benefit is community pride. Though community pride is not measurable in monetary terms, the generation of community pride by a project is a measure of the project's efficiency that is not included in BCR computations.

- b) Another limitation of BCR as a project worth criterion is its use to rank mutually exclusive projects. The net present worth criterion is a better tool for choosing between projects that are mutually exclusive. Since each measurement tool has one or more limitations, it is best to use more than one tool for measuring a project's worth, singly or when comparing it with other projects.

G. ASSUMPTIONS:

The project planners and implementers need to be cognizant of the need for accuracy in the selection of all of the analytical components; if not, the results of the analysis may lead to erroneous conclusions about the worth of a project.

Projects can be erroneously selected if the costs and benefits used in the computations are not reasonably accurate, and if the selected discount rate does not reflect the prevailing opportunity cost.

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H. OUTPUT:

The result of this analysis is an estimate of a project's financial worth and a quantity which can be used to rank a project in comparison with other similar projects which are being done on the same time scale. (It cannot be applied to mutually exclusive projects.)

I. STEPS IN BENEFIT-COST RATIO ANALYSIS:

Step 1 Decide on the annual gross benefits that are expected to flow from the project for each year that the project is expected to run. It is necessary to do as good a job as possible in estimating the project benefits. Either market prices or shadow prices (SEE MODULE 27 - ECONOMIC ANALYSIS) can be used to compute the estimated benefits that will accrue to the project. Shadow prices are preferable to market prices if the project is to run over an extended period of time.

Step 2 Decide on the annual gross costs that will occur for each year of the project. If the project is one which will benefit the entire economy there are certain costs which are not included, e.g., customs duties, taxes, and interest. But, if the project is for the benefit of a particular group, company or sector then all costs are included in the analysis.

Step 3 Discount the annual gross costs and benefits to determine their present worth. The discount rate used should correspond to the prevailing maximum rate of return to similar projects, i.e., the opportunity cost of funds invested. Considerable care should be exercised when selecting the discount rate. The discount factors for each year of the project that are applied to the annual gross benefits and costs can be computed. But the discount factor table in Module 21 can be used for this purpose and is much quicker and more convenient because the discount factors have already been computed.

Step 4 Compute the BCR by dividing the sum of the present annual worth of benefits by the sum of the present annual worth of costs.

$$\frac{Pwb}{Pwc} = BCR$$

Step 5 The BCR of a project is used to evaluate a project according to these guidelines:

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- a. When the BCR is greater than or equal to one (1.0) the project should be considered for funding.
- b. When the BCR is less than one (1.0), funding should be withheld from the project.

Step 6. Use the BCR to rank projects by placing the one with lowest BCR at the lowest numerical rank, the one next lowest BCR at next higher rank, etc. If it is a single project financial evaluation, then the rules stated in Step 5 above should be applied.

Example: An example of the computation necessary for ascertaining the BCR of a project is shown in Illustration 1.

ILLUSTRATION 1

COMPUTATION OF A BENEFIT-COST RATIO FOR A PROJECT
USING A 15% DISCOUNT RATE ('000's OF MONETARY UNITS)

YEAR	GROSS COSTS	DISCOUNT FACTORS (15% DISCOUNT RATE)	PRESENT WORTH OF GROSS COSTS	GROSS BENEFITS	PRESENT WORTH OF GROSS BENEFITS
1	820	.870	713	275	239
2	110	.756	83	275	208
3	110	.658	72	265	170
4	110	.572	63	265	152
5	110	.497	55	265	132
6	110	.432	48	260	112
7	110	.376	41	260	98
8	110	.327	36	260	85
9	110	.284	31	240	68
10	<u>110</u>	<u>.247</u>	<u>27</u>	<u>240</u>	<u>59</u>
TOTAL	<u>1810</u>	<u>5.019</u>	<u>1169</u>	<u>2605</u>	<u>1323</u>

$$\text{BCR} = \frac{\text{Present Worth of Gross Benefits}}{\text{Present Worth of Gross Costs}}$$

BCR for the project shown in Illustration 1., discounted at 15% annually is $\frac{1323}{1169} = 1.1$

Earlier PDRT working papers relevant to this topic include "Criteria to test Project Worthiness: Project Analysis and Appraisal, M. Kettering, 1977. (25 pages).

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ILLUSTRATION 2

AN EXAMPLE OF BENEFIT-COST RATIO AND NET PRESENT WORTH COMPUTATIONS FOR PROJECT OPTIONS 1, 11 AND 111, COMPARING GROSS BENEFITS TO GROSS COSTS, (000 OF MONETARY UNITS).

Option 1 Broiler Production 6,000 birds 4 batches/year

YEAR	GROSS COSTS (000's)	DISCOUNT FACTOR 15%	PRESENT WORTH (000's)	GROSS BENEFITS (000's)	DISCOUNT FACTOR 15%	PRESENT WORTH (000's)
1	68	.870	59.16	41	.870	35.69
2	43	.756	32.51	60	.756	45.36
3	43	.658	28.29	60	.658	39.48
4	43	.572	24.60	60	.572	34.32
5	43	.497	21.37	60	.497	29.82
6	42	.432	18.14	60	.432	25.92
7	43	.376	16.17	60	.376	22.56
8	44	.327	14.39	60	.327	19.62
9	44	.284	12.50	60	.284	17.04
10	45	.247	11.12	60	.247	14.82
TOTAL	458	5.019	238.25	581	5.019	284.63

Benefit Cost Ratio at 15% = $\frac{284.63}{238.25} = 1.2$; Net Present Worth at 15% = $284.63 - 238.25 = 46.38$

Option 11 Landscape Plant Production

YEAR	GROSS COSTS (000's)	DISCOUNT FACTOR 15%	PRESENT WORTH (000's)	GROSS BENEFITS (000's)	DISCOUNT FACTOR 15%	PRESENT WORTH (000's)
1	135	.870	117.45	270	.870	234.90
2	135	.756	102.06	390	.756	294.84
3	136	.658	89.49	394	.658	259.25
4	136	.572	77.79	399	.572	228.23
5	137	.497	68.09	403	.497	200.29
6	138	.432	59.62	408	.432	176.26
7	139	.376	52.26	408	.376	153.40
8	140	.327	45.78	408	.327	133.42
9	141	.284	40.04	408	.284	115.87
10	143	.247	35.32	408	.247	100.78
TOTAL	1380	5.019	687.90	3896	5.019	1897.24

Benefit Cost Ratio at 15% = $\frac{1897.24}{687.90} = 2.8$; Net Present Worth at 15% = $1897.24 - 687.90 = 1209.34$

Option 111 Pork Production

YEAR	GROSS COSTS (000's)	DISCOUNT FACTOR 15%	PRESENT WORTH (000's)	GROSS BENEFITS (000's)	DISCOUNT FACTOR 15%	PRESENT WORTH (000's)
1	122	.870	106.14	9	.870	7.83
2	112	.756	84.67	136	.756	102.82
3	108	.658	71.06	136	.658	89.49
4	103	.572	58.92	136	.572	77.79
5	98	.497	48.71	136	.497	67.59
6	105	.432	45.36	145	.432	62.64
7	97	.376	36.47	136	.376	51.14
8	98	.327	32.05	136	.327	44.47
9	99	.284	28.12	136	.284	38.62
10	100	.247	24.70	136	.247	33.59
TOTAL	1042	5.019	536.20	1242	5.019	575.98

Benefit-Cost Ratio at 15% = $\frac{575.98}{536.20} = 1.1$; Net Present Worth at 15% = $575.98 - 536.20 = 44.18$

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EXERCISE 1

COMPUTATION OF BENEFIT-COST RATIO FOR TWO PROJECTS
(all figures are in thousands of monetary units)PROJECT A:

<u>YEAR</u>	<u>GROSS ANNUAL COSTS</u>	<u>GROSS ANNUAL BENEFITS</u>
1	500	60
2	80	280
3	80	260
4	80	250
5	80	220
6	80	180

PROJECT B:

<u>YEAR</u>		
1	700	190
2	90	120
3	90	300
4	90	340
5	90	480
6	90	510
7	90	210

The project planners have decided that the opportunity cost of capital is 20% and this discount rate is to be used on both projects A and B.

1. Compute the BCR for each of the proposed projects.
2. Which project has the most favourable BCR?



Project Planning and Management Series.

MANUAL - I Planning for Project Implementation
MANUAL - P Project Planning
MANUAL - M Project Management
MANUAL - PF Pioneer Farm Implementation Planning

MODULES

1. Defining Project Objectives (Objective Trees)
2. The Logical Framework
3. Work Breakdown Structure
4. Activity Description Sheets
5. Project Organization
6. Linear Responsibility Charts
7. Project Scheduling - Bar Charts
8. Bar Charting for Project Control/Scheduling
9. Project Scheduling - Network Analysis
10. Milestones Description Charts
11. Resource Planning & Budgeting
12. The Role of PAMCO
13. Project Technology Analysis
14. Demand Analysis
15. Market Strategy Analysis
16. Project Area Analysis
17. Project Costs & Benefits
18. Project Profile
19. Financial Analysis
20. Cash Flow Analysis
21. Discounting
22. Net Present Worth Analysis
23. Cost-Benefit Analysis
24. Benefit-Cost Ratio Analysis
25. Internal Rate of Return
26. Social Analysis of a Project
27. Economic Analysis of Projects (including Border Pricing)
28. Financial Statements & Ratios
29. Project Selection & Ratios Analysis
30. Brainstorming
31. Decision-making System for Projects
32. Project Institutional Environmental Analysis
33. Ecological Analysis for Projects
34. Introduction to Contracts, Jamaican Contract Documents & Tendering Procedures
35. Selection & Use of Consultants
36. Project Documents for Planning & Implementation
37. Report Writing for Projects
38. Project Files
39. Formats for Pre-Feasibility & Feasibility Studies
40. Motivation of Employees and Personnel Evaluation
41. Design of a Project Management Control System
42. Evaluating & Forecasting Project Progress & Performance
43. Project Termination
44. Introduction to Lending Agencies
45. Organizing and Conducting Conference Meetings
46. Withdrawal of and Accounting for Loan Funds in the Financing of Projects