Debre Markos University

Institute of Technology

Construction Technology & Management Academic program

Development and Construction Economics

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Chapter-4

EVALUATION OF PUBLIC PROJECTS

Evaluation of public projects

- Public projects here mean those projects funded by Government (State). Some examples of Public projects are Dams, Defense projects, Highways, Education, Health…. etc.
- The objective of public projects is to provide goods/services to the public at the minimum cost.
- The benefit accrued from such projects should at least recover the cost of the projects.

Evaluation of public projects

To perform economic analysis of public alternatives;

- ✓ The costs (Initial and annual) and
- ✓ The benefits must be accurately estimated in “Monetary units.”

Benefit Cost Ratio

- One of the most commonly used criteria to evaluate public projects is Benefit-Cost Ratio (B/C).
- B/C ratio is defined as the ratio of benefit to public and cost to the Government.
- **B-C ratio can be obtained using any one of the PW analysis, FW Method, AE method.**
- **When comparisons of several alternatives are to be made, incremental based analysis should used.**

Cont...d

- B/C ratio of more than one indicates that benefit outweighs and thus the investment is justifiable (acceptable). For instance, B/C of 1.5 means that each invest of costs yields 1.5 times benefits over the life time of the project.
- B/C ratio of less than one indicated that benefit accrued from the project is less than the cost required to be invested and thus the investment is not justifiable.

Example

- A Government is planning for a hydro-electric project which will also provide flood control, irrigation & recreation benefits.
- The established benefits & cost of three alternatives are given in the following Table.
- The interest rate used for the analysis is 5%
- The life of each of the alternatives X, Y, and Z is to be assumed as 50 years.
- Choose the best alternative

All values are in million of Birr

Alternatives	X	Y	Z
Initial cost	250	350	500
Annual Power sales	10	12	18
Annual Flood control	2.5	3.5	5
Annual Irrigation benefit	3.5	4.5	6
Annual Recreation benefits	1	2	3.5
Annual Operation & Maintenance	2	2.5	3.5

Can you draw a CFD for each Alternative?

Computation of B/C using Annual Cost/worth analysis

Annual cost (C) computation	X	Y	Z
Annual cost equivalent = P x (A/P, 5%, 50)	250 x0.055 = 13.75	350x0.055 = 19.25	500x0.055 = 27.5
Operation & Maintenance cost	2	2.5	3.5
Receipt on power sales	-10	-12	-18
Total annual cost equivalent	**5.75**	**9.75**	**13**

$$A = P\left[\frac{i(1+i)^N}{(1+i)^N - 1}\right]$$

$$A = F\left[\frac{i}{(1+i)^N - 1}\right]$$

Annual Benefit (B) Computations	X	Y	Z
Annual Flood control	2.5	3.5	5
Annual Irrigation benefit	3.5	4.5	6
Annual Recreation benefits	1	2	3.5
Total annual benefit	**7**	**10**	**14.5**
B/C Ratio	**7/5.75 =1.22**	**10/9.75 =1.03**	**14.5/13 =1.12**

NB: B/C of the three alternatives are more than 1 and thus **all the above alternatives are economically viable**.

Incremental analysis to identify the best alternative

Annual cost C computation	Y-X	Z-X
Annual cost equivalent = P x (A/P, 5%, 50)	100 x 0.055 = 5.5	250 x 0.055 = 13.75
Operation & Maintenance cost	0.5	1.5
Receipt on power sales	-2	-8
Total annual cost equivalent	**4**	**7.25**

Incremental Analysis Cont.…d

Annual Benefit B Computations	**Y-X**	**Z-X**
Annual Flood control	1	2.5
Annual Irrigation benefit	1	2.5
Annual Recreation benefits	1	2.5
Total benefit	**3**	**7.5**
B/C Ratio	**3/4 = 0.75**	**7.5/7.25= 1.04**
Remarks	**B/C < 1 Reject Y**	**B/C >1 Accept Z**

Replacement Analysis

Defender - the existing equipment or building previously implemented.

Challenger - the new proposed replacement currently under consideration.

- The defender would have been purchased some years ago at some cost say Po.
- Today if it is traded in or sold because of a consider to buy a challenger, the value Obtained will be lower say P.
- The term (Po – P) is called the **sunk cost**.
- The sunk cost is never taken into account in engineering economic analysis.

Three reasons to consider a change.

1. Physical impairment (deterioration)
2. Altered requirements
3. New and improved technology is now available.

Engineers replace the existing due to:

- Obsolescence - technological change.
- Depletion - loss of market value.
- Deterioration - wear that is overly expensive to repair.
- Physical or mechanical impairment
- Uneconomic - increasing maintenance and / or operating cost.
- Inadequacy- the required function can no longer be carried out economically

Example 1

- An equipment which was purchased at a cost of 22000 Birr four years ago is considered for replacement against a challenger whose cost is 18000 Birr
- The existing equipment can be traded today at 6000 Birr and if kept on for another 6 years, will have a salvage value of 2000Birr.
- The annual maintenance cost of the existing asset is 7000Birr per year.
- The challenger has an annual operating cost of 3500Birr and its salvage value 3000Birr at end of yr. 6, use I = 15%

Solution

- Here Po = 22000birr, and P = 6000birr, S =2000birr at the end of 6 years from now.
- Thus, the annual equivalent cost of existing asset (Defender) = [6000 (A/P,15%, 6) +7000 -2000 x (A/F, 15%, 6) = ***8356.80.***

Please note that the sunk cost (Po – P) = 22000-

6000 = 16000 is not used anywhere in the analysis.

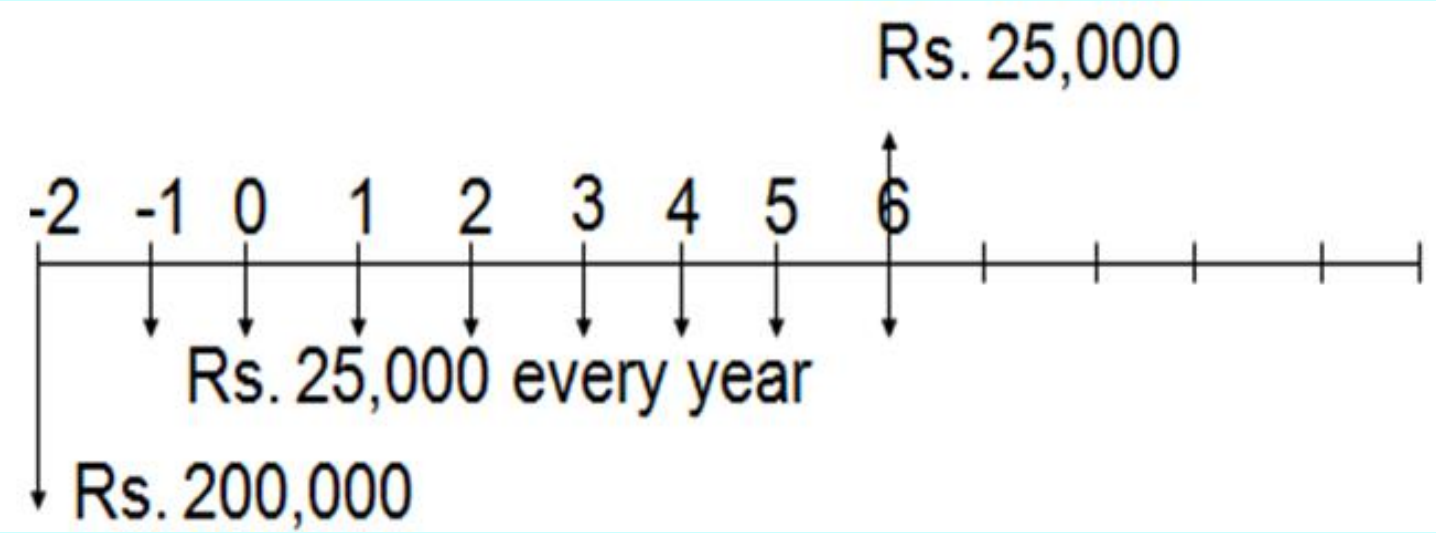
- Annual equivalent cost of challenger = [18000 x (A/P, 15%, 6) + 3500 - 3000 x (A/F, 15%, 6) = ***7913.***
- Since the equivalent annual cost of challenger is less than the defender, it would be economical to replace the existing equipment with the new one. Replacement is desirable.

Example 2

- ✓ Two years ago, an equipment was purchased at a cost of Rs. 200,000 to be useful for 8 years.
- ✓ Its salvage value at the end of its life is Rs. 25,000.
- ✓ The annual maintenance cost is Rs. 25,000.
- ✓ The market value of existing equipment is Rs. 120,000.
- ➢ Now a new equipment is available at Rs.150,000 to be useful for six years.
- ➢ Its annual maintenance cost is Rs.14,000. and salvage value of the new equipment is Rs. 20,000. If the interest rate is 12%.
- ➢ Shall replace the existing Equipment with the new equipment? Show your work clearly.

Solution

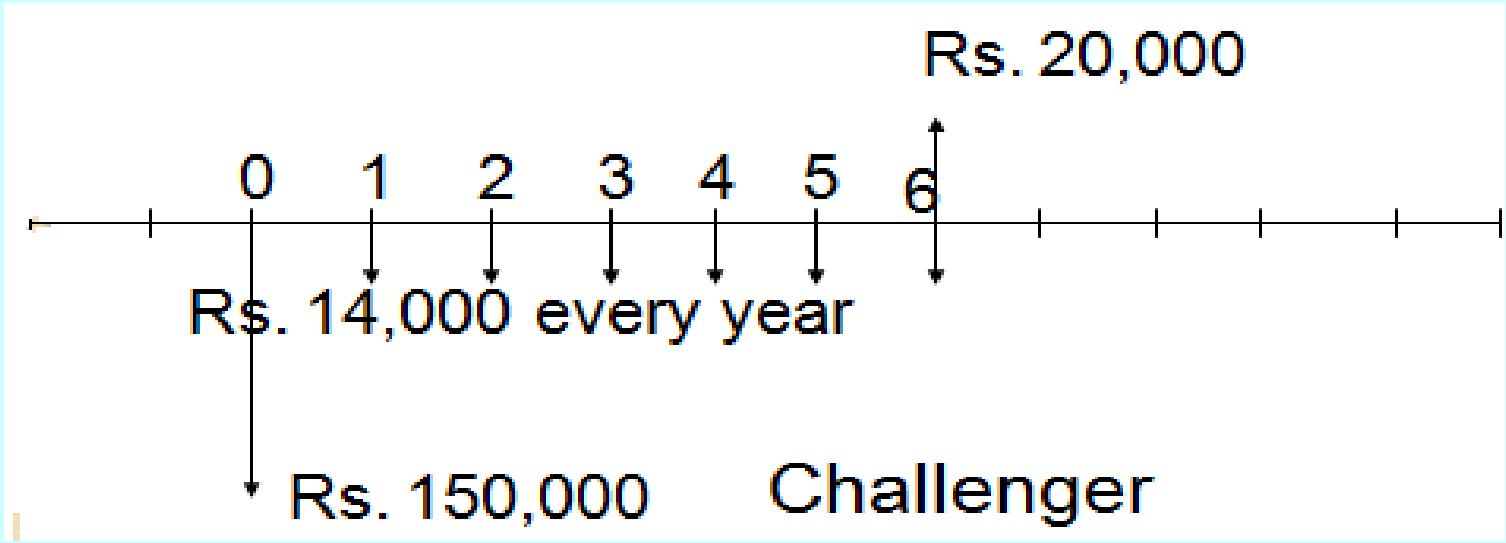
Defender is the existing equipment.



Market value of defender is Rs. 120,000

Equivalent Annual Cost
= 120,000 (A/P, 12%,6) + 25,000 – 25,000 (A/F, 12%,6) = 120,000 x 0.2432 + 25,000 – 25,000 x 0.1232
=51,104

Challenger is the new equipment.



Equivalent Annual Cost of Challenger

= 150,000 (A/P, 12%,6) + 14,000 – 20,000 (A/F, 12%,6)

= 150,000 x 0.2432 + 14,000 – 20,000 x 0.1232

= 48, 016

Hence replace the existing equipment with the Challenger

Example 3

A diesel engine was installed 10 years ago at a cost of 50,000birr. It has a present realizable market value of 15,000birr. If kept, it can be expected to last five years more, with operating and maintenance cost of 14,000 birr per year and to have a salvage value of Birr 8,000 at the end of the fifth year.

This engine can be replaced with an improved version costing 65,000 birr which has an expected life of 20 years. This improved version will have an estimated annual operating and maintenance cost of 9,000birr and ultimate salvage value of 13,000birr. Using an interest rate of 15%, make an annual equivalent cost analysis to determine whether to keep or replace the old engine.

Solution

Alternative 1 Old diesel engine

Purchase price = 50,000 birr

Present value (*P) = 15,000*

Salvage value = *8,000 birr*

Annual cost (*A) = 14,000*

Remaining life (*n) = 5 years*

Interest rate = 15%

ACE= 17,288.10birrr

Alternative 2 New diesel engine

Present value (*P) = 65,000*

Salvage value (*F) = 13,000*

Annual operating and maintenance cost (*A) = 9,000*

Life (*n) = 20 years*

Interest rate = 15%

ACE= 19,259.60birr

Hence, keep the old diesel engine