Present-worth and Capitalized-Cost Evaluation

Present-worth comparison of equal-life alternatives:

The following guidelines are applied to select an alternative using the present worth measure of worth:

One alternative – if PW ≥ 0, the requested rate of return is met or exceeded and the alternating is financially viable.

Two or more alternatives: select the alternative with the PW value that is numerically larger, that is, less negative or more positive, indicating a lower PW of costs or larger PW of net cash flow of receipts disbursements.

Ex:

Make a present-worth comparison of the equal-service machines for which the costs are shown below, if i = 10% per year.

	Type A	**Type B**
First cost + (P)$	2500	3500
Annual operating cost $	900	700
Salvage value $	200	350
Life, years	5	5

Solution:

PW_A = -2500 – 900 (P/A, 10%, 5) + 200 (P/F, 10%, 5) = -5788$

PW_B = -3500 – 700 (P/A, 10%, 5) + 350 (P/F, 10%, 5) = -3936$

Type A is selected, since the PW of costs for A are less – Note the plus sign on the savage value, since it is a receipt.

Present – worth comparison of different – life Alternatives

The alternatives must be compared over the same number of years.

The equal – service requirement can be satisfied by either of two approaches:

1- Compare the alternatives over a period of time equal to the least common multiple (LCM) for their lives.

2- Compare the alternatives using a study period of length n years, which does not necessarily take into consideration the lives of the alternatives. This is also called the planning horizon approach.

For the LCM approach, equal service is achieved by making the comparison over the least common multiple of lives between the alternatives, which automatically makes their cash flows extend to the same time period.

These methods have assumptions are:

- The alternatives under consideration will be needed for the least common multiple of years or more.
- The respective costs of the alternatives will be the same in all subsequent life cycles as they were in the first one.

For the second-period approach, a time horizon is chosen over which the economic analysis is to be conducted, and only those cash flows which occur during that time period are considered relevant to the analysis.

Ex:

	Machine A	**Machine B**
First cost, $	11.000	18.000
Annual operating cost $	3500	3100
Salvage value $	1000	2000
Life, years	6	9

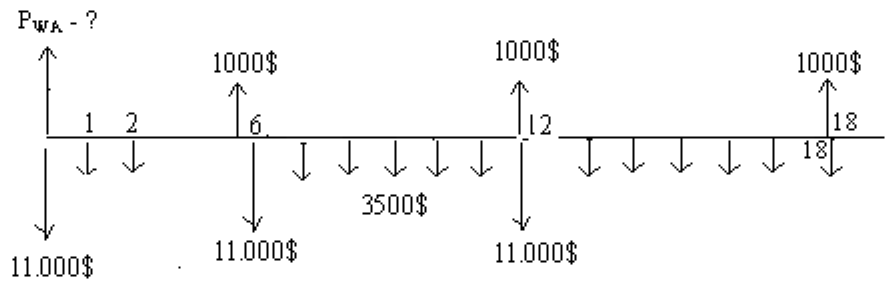
a) Determine which one should be selected on the basis of a present-worth comparison using an interest rate of 15% per year.

b) If a study period of 5 years is specified and the salvage values are not expected to change, which alternative should be selected?

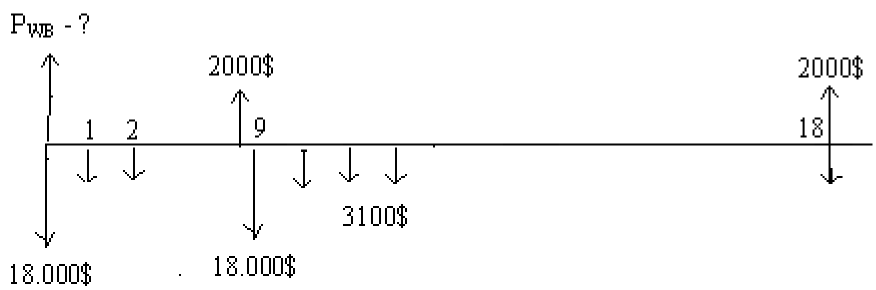
c) Which machine should be selected over a 6-year horizon if the salvage value of machine B is estimated to be 6000$ after 6 years?

Solution:

(a) Since the machines have different lives they must be compared over their LCM, which is 18 years.



Machine A



Machine B

PW_A = -11.000-11.000 (P/F,15%,6)+1000 (P/F,15%,6) – 11.000 (P/F, 15%, 12) + 1000 (P/F, 15%, 12) +
+1000 (P/F, 15%, 18) – 3500 (P/A, 15%, 18) =
= - 38.559$

PW_B = -18.000-18.000 (P/F,15%,9) + 2000 (P/F,15%,9) +
+2000 (P/F, 15%, 18) + 3100 (P/A, 15%, 18) =
= - 41.384$

Machine A is selected, since machine A costs less in PW terms than machine B.

(b) For a 5-year planning horizon no cycle repeat are necessary and SVA = 1000$ and SVB = 2000$ in year 5.

PW_A = -11.000 – 3500 (P/A, 15%, 5) + 1000 (P/F, 15%, 5)
= - 22236$
PW_B = -18000-3100 (P/A, 15%, 5) + 2000 (P/F, 15%, 5)
= -27397$

Machine A is still the better choice.

(c) For a 6 year planning horizon, SVB = 6000$ in year 6 and the PW equations are:

PW_A = -11.000 – 3500 (P/A, 15%, 6) + 1000 (P/F, 15%, 6)
= - 23813$
PW_B = -18000-3100 (P/A, 15%, 6) + 6000 (P/F, 15%, 6)
= -27138$

Machine A is still favored.

Life Cycle cost:

Life cycle cost is interpreted to mean the total of every cost estimate considered possible for a system with a long life.

The total anticipated costs of an alternative are usually estimated using major cost categories such as:

- Research and development costs – All expenditures for design, testing, manufacturing planning, Engineering services, software development….
- Production costs – the investment necessary to produce or acquire the product, including expenses to employ and train personnel, transport subassemblies and the final product and acquire equipment.
- Operating and support costs – All costs incurred to operate, maintain, inventory, and manage the product for its entire anticipated life.

Present-worth computations, using the P/F factor to discount the costs in each category to the time that the analysis is performed, are applied to complete the LCC analysis.

The approach of the LCC evaluation is to determine the cost of each alternative for its entire life and select the one with the minimum LCC.

Capitalized – cost calculations:

Capitalized cost (cc) refers to the present worth of a project tat is assumed to last forever. In general, the procedure followed in calculating the capitalized cost of an infinite sequence of cash flows is as follows:

1- Draw a cash-flow diagram showing all one time costs (and for incomes), Nd at least two cycles of all periodic costs.
2- Find the present worth of all one-time amounts.
3- Find the equivalent uniform annual worth (A value, through one life cycle of all recurring amounts and add this to all other uniform amounts occurring in years 1 through infinity. This results in a total equivalent uniform annual worth (AW).
4- Divide the A|W obtained in step 3 by the interest rate i to get the capitalized cost.
5- Add the value obtained in step 2 to the value obtained in step 4.

Capitalized cost = <u>AW</u> or PW = <u>AW</u> for n = &

i i

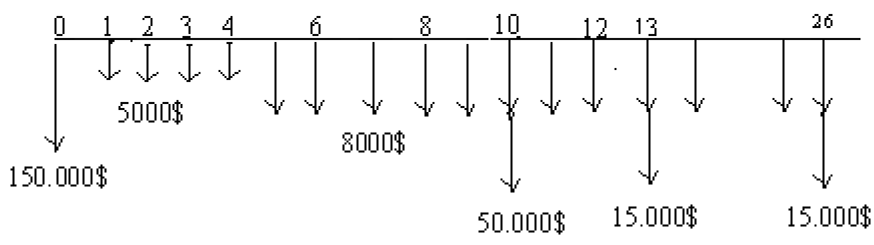
<u>Ex:</u>

Calculate the capitalized cost of a project that has an initial cost of 150.000$ and on additional investment cost of 50.000$ after 10 years. The annual operating cost will be 5000$ for the first 4 years and 8000$ thereafter. In, addition, there is expected to be a recurring major rework cost of 15.000$ every 13 years. Assume that I = 15% per year.

Solution:

The 5-step procedure outlined above is followed:

1- Draw a cash-flow diagram for two cycles



2- Find the present worth P1 of the nonrecurring costs of 150.000$ now and 50.000$ in year 10:

P_1 = 150.000 – 50.000 (P/F, 15%, 10) = 162.360$

3- Convert the recurring cost of 15000$ every 13 years into an annual worth A1 for the first 13 Years

$$A_1 = -15.000\ )A/F,\ 15\%,\ 13) = -437\$$$

Note that the same value, A = -437$, applies to all the other 13- year periods as well.

4- The capitalized cost for the -5000$ annual – cost series may be computed by either of two ways:

Consider a series of -5000$ from now to infinity and find the present worth of -8000$ - (-5000$) = 3000$ from y ear 5 on i or

Find the present worth of -5000$ for 4 years and the present worth of -8000$ from year 5 to infinity. Using the first method, we find that the annual cost (A2) is -5000$, and the present worth (P2) of -3000$ from year 5 to infinity, using eq. (*) and the P/F factor, is

$$P_2 = \frac{-3000}{0.15}(P/F,\ 15\%,\ 4) = -114336\$$$

The two annual costs are converted into a capitalized cost (P_3):

$$P_3 = \frac{A1 + A2}{i} = \frac{-437 + (-5000)}{0.15} = -36247\$$$

The total capitalized cost Pwt is obtained by adding the three PW values.

$$PWt = P1 + P2 + P3 = -210.043\$$$