UNIT-6

PAYBACK PERIOD

Payback period in capital budgeting refers to the period of time required to recover the funds expended in an investment. This method is considered as one of the simplest method of capital budgeting. This is also referred to as the 'back of the envelope' calculation method. The payback method simply measures how long (in years and/or in months) it takes to recover the initial investment. Usually, the maximum acceptable payback period is determined by the management. The normal rule that is followed is that if the payback period is less than the maximum acceptable payback period, one should accept the project whereas if the payback period is greater than the maximum acceptable payback period, one should reject the project. When there are two competing projects, the project that has the lowest payback period should be chosen.

$$\text{Payback period} = \frac{\text{Cost of Investment}}{\text{annual inflow}}$$

$$payback\ period = lower\ year + \frac{\text{Cost of Investment} - \text{ACCI of lower year}}{\text{ACCI of upper year} - \text{ACCI of lower year}}$$

$$\text{where; ACCI} - \text{Annual accumulated cash inflow}$$

Merits:

1. The payback method is widely used by large firms to evaluate small projects and by small firms to evaluate most projects.
2. It is simple and intuitive, and considers cash flows rather than accounting profits.
3. It also gives implicit consideration to the timing of cash flows and is widely used as a supplement to other methods such as NPV and IRR.

Demerits:

- One major weakness of the payback method is that the appropriate payback period is a number subjectively determined by the management.
- It fails to consider the principle of wealth maximization because it is not based on discounted cash flows, and thus provides no indication as to whether a project adds to firm value or not.
- It also fails to fully consider the time value of money.

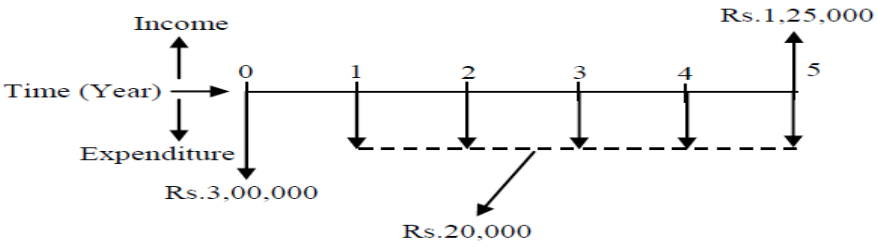
Ex 1: There are two alternatives for purchasing a concrete mixer. Both the alternatives have same useful life. The cash flow details of alternatives are as follows; **Alternative-1:** Initial purchase cost = Rs.3,00,000, Annual operating and maintenance cost = Rs.20,000, Expected salvage value = Rs.1,25,000, Useful life = 5 years. **Alternative-2:** Initial purchase cost = Rs.2,00,000, Annual

operating and maintenance cost = Rs.35,000, Expected salvage value = Rs.70,000, Useful life = 5 years. Using present worth method, find out which alternative should be selected, if the rate of interest is 10% per year.

Sol: Since both alternatives have the same life span i.e. 5years, the present worth of the alternatives will be compared over a period of 5 years.

Alternative1:

The initial cost, P = Rs.3,00,000 (cash outflow), Annual operating and maintenance cost, A = Rs.20,000 (cash outflow), Salvage value, F = Rs.1,25,000 (cash inflow).



Cash flow diagram of Alternative-1

$$PW_1 = -3,00,000 - 20,000 \times \frac{(1+i)^n - 1}{i(1+i)^n} + 1,25,000 \times \frac{1}{(1+i)^n}$$

$$PW_1 = -3,00,000 - 20,000 \times \frac{(1+0.1)^5 - 1}{0.1(1+0.1)^5} + 1,25,000 \times \frac{1}{(1+0.1)^5}$$

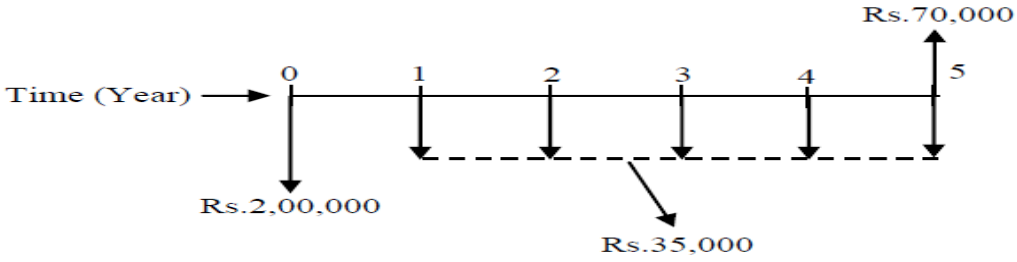
$$PW_1 = -3,00,000 - 20,000 \times 3.7908 + 1,25,000 \times 0.6209$$

$$PW_1 = -\ 3,00,000 - 75,816 + 77,613$$

$$\boldsymbol{PW_1 = -\ Rs.2,98,203}$$

Alternative2:

The initial cost, P = Rs.2,00,000 (cash outflow), Annual operating and maintenance cost, A = Rs.35,000 (cash outflow), Salvage value, F = Rs.70,000 (cash inflow).



Cash flow diagram of Alternative-2

$$PW_2 = -2,00,000 - 35,000(P/A,\ i,\ n) + 70,000(P/F,\ i,\ n)$$

$$PW_2 = -2,00,000 - 35,000(P/A,\ 10\%,\ 5) + 70,000(P/F,\ 10\%,\ 5)$$

$$PW_2 = -2,00,000 - 35,000 \times \frac{(1+i)^n - 1}{i(1+i)^n} + 70,000 \times \frac{1}{(1+i)^n}$$

$$PW_2 = -2,00,000 - 35,000 \times \frac{(1+0.1)^5 - 1}{0.1(1+0.1)^5} + 70,000 \times \frac{1}{(1+0.1)^5}$$

$$PW_2 = -2,00,000 - 35,000 \times 3.7908 + 70,000 \times 0.6209$$

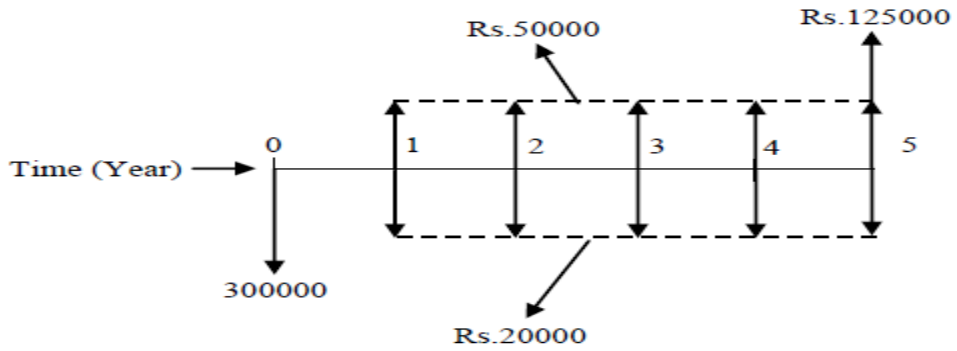
$$PW_2 = -2,00,000 - 1,32,678 + 43,463$$

$$\mathbf{PW_2 = -\ Rs.2,89,215}$$

Comparing the equivalent present worth of both the alternatives, it is observed that Alternative-2 will be selected as it shows lower negative equivalent present worth compared to Alternative-1 at the interest rate of 10% per year.

Ex2: Alternative-1: Initial purchase cost = Rs.300000, Annual operating and maintenance cost = Rs.20000, Expected salvage value = Rs.125000, Useful life = 5 years. **Alternative-2:** Initial purchase cost = Rs.200000, Annual operating and maintenance cost = Rs.35000, Expected salvage value = Rs.70000, Useful life = 5 years. The annual revenue to be generated from Alternative-1 and Alternative-2 are Rs.50000 and Rs.45000 respectively. Compute the equivalent present worth of the alternatives at the rate of interest 10% per year and find out the economical alternative.

Sol:



Cash flow diagram of Alternative-1

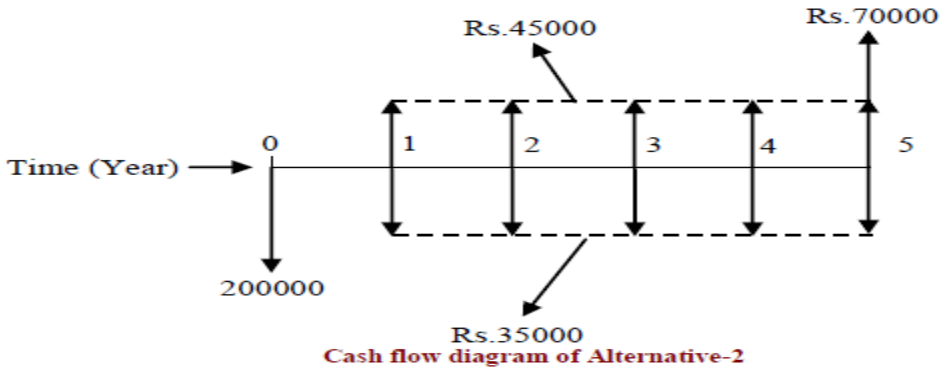
$$PW_1 = -300000 + 30000 \times \frac{(1+i)^n - 1}{i(1+i)^n} + 125000 \times \frac{1}{(1+i)^n}$$

$$PW_1 = -300000 + 30000 \times \frac{(1+0.1)^5 - 1}{0.1(1+0.1)^5} + 125000 \times \frac{1}{(1+0.1)^5}$$

$$PW_1 = -300000 + 30000 \times 3.7908 + 125000 \times 0.6209$$

$$PW_1 = -300000 + 113724 + 77613$$

***PW1* = - Rs.108663**



Cash flow diagram of Alternative-2

$$PW_2 = -200000 + 10000 \times \frac{(1+i)^n - 1}{i(1+i)^n} + 70000 \times \frac{1}{(1+i)^n}$$

$$PW_2 = -200000 + 10000 \times \frac{(1+0.1)^5 - 1}{0.1(1+0.1)^5} + 70000 \times \frac{1}{(1+0.1)^5}$$

$$PW_2 = -200000 + 10000 \times 3.7908 + 70000 \times 0.6209$$

$$PW_2 = -200000 + 37908 + 43463$$

***PW₂* = - Rs.118629**

Comparing the equivalent present worth of the both the alternatives, it is observed that Alternative-1 will be selected as it shows lower cost compared to Alternative-2. The annual revenue to be generated by the alternatives made the difference as compared to the outcome obtained in Example-1.

Different life span alternatives:

In case of mutually exclusive alternatives, those have different life spans, the comparison is generally made over the same number of years i.e. a common study period. This is because; the comparison of the mutually exclusive alternatives over same period of time is required for unbiased economic evaluation of the alternatives. If the comparison of the alternatives is not

made over the same life span, then the cost alternative having shorter life span will result in lower equivalent present worth i.e. lower cost than the cost alternative having longer life span.

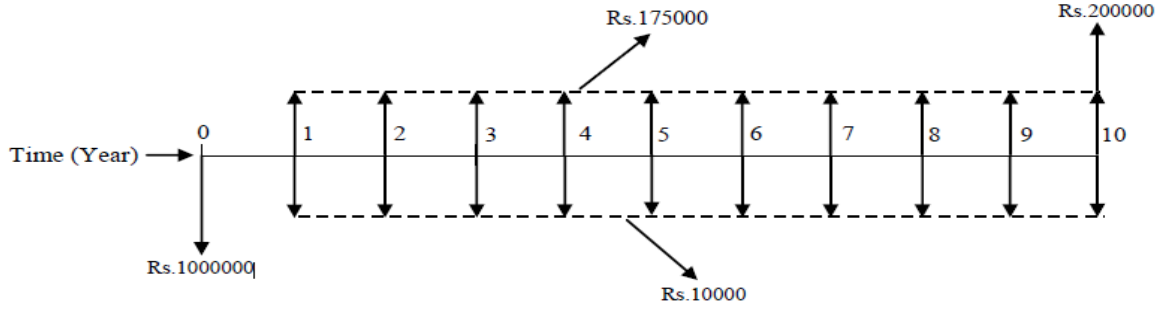
The two approaches used for economic comparison of different life span alternatives are as follows;

i) Comparison of mutually exclusive alternatives over a time period that is equal to least common multiple (LCM) of the individual life spans

ii) Comparison of mutually exclusive alternatives over a study period which is not necessarily equal to the life span of any of the alternatives.

Ex3: The alternatives are from two different manufacturing companies for purchasing a machine. The cash flow details of the alternatives are as follows; **Alternative-1:** Initial purchase price = Rs.1000000, Annual operating cost = Rs.10000, Expected annual income = Rs.175000, Expected salvage value = Rs.200000, Useful life = 10 years. **Alternative-2:** Initial purchase price = Rs.700000, Annual operating cost = Rs.15000, Expected annual income = Rs.165000, Expected salvage value = Rs.250000, Useful life = 5 years. Using present worth method, find out the most economical alternative at the interest rate of 10% per year.

Sol: The alternatives have different life spans i.e. 10 years and 5 years. Thus the comparison will be made over a time period equal to the least common multiple of the life spans of the alternatives. In this case the least common multiple of the life spans is 10 years. Thus the cash flow of Alternative-1 will be analyzed for one cycle (duration of 10 years) whereas the cash flow of Alternative-2 will be analyzed for two cycles (duration of 5 years for each cycle). The cash flow of the Alternative-2 for the second cycle will be exactly same as that in the first cycle.



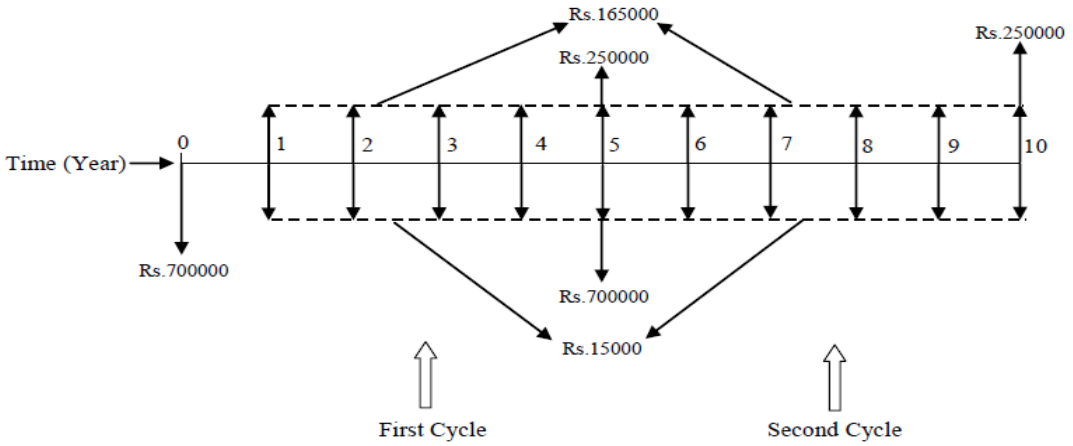
Cash flow diagram of Alternative-1

$$PW1 = -1000000 + (175000 - 10000)\left[\frac{(1+i)^n - 1}{i(1+i)^n}\right] + 200000\left[\frac{1}{(1+i)^n}\right]$$

$$PW_1 = -1000000 + 165000 \times 6.1446 + 200000 \times 0.3855$$

$$PW_1 = -1000000 + 1013859 + 77100$$

$$PW_1 = \text{Rs.}90959$$



Cash flow diagram of Alternative-2 for two cycles

$$\boldsymbol{PW2 = -700000 + (165000 - 15000)\left[\frac{(1+i)^n - 1}{i(1+i)^n}\right] + (700000 - 250000)\left[\frac{1}{(1+i)^5}\right] + 250000\left[\frac{1}{(1+i)^{10}}\right]}$$

$$PW_2 = -\ 700000 + 150000 \times 6.1446 - 450000 \times 0.6209 + 250000 \times 0.3855$$

$$PW_2 = -\ 700000 + 921690 - 279405 + 96375$$

$$\boldsymbol{PW_2 = Rs.38660}$$

Thus from the comparison of equivalent present worth of the alternatives, it is evident that Alternative-1 will be selected for purchase of the compression testing machine as it shows the higher positive equivalent present worth.

RETURN ON INVESTMENT

Return on investment (ROI) is a measure that investigates the amount of additional profits produced due to a certain investment. Businesses use this calculation to compare different scenarios for investments to see which would produce the greatest profit and benefit for the company.

However, this calculation can also be used to analyze the best scenario for other forms of investment, such as if someone wishes to purchase a car, buy a computer, pay for college, etc.

The simplest form of the formula for ROI involves only two values: the cost of the investment and the gain from the investment. The formula is as follows:

$$ROI\ (\%) = \frac{\text{Gain from Investment} - \text{Cost of Investment}}{\text{Cost of Investment}} \times 100$$

The ratio is multiplied by 100, making it a percent. This way, a person is able to see what percentage of their investment has been gained back after a period of time. Some, however, prefer to leave it in decimal form, or ratio form.

LIFE CYCLE COSTING ANALYSIS- LIGHTING

There is lack of awareness of the fact that the variable costs (operation costs), especially the energy costs of a lighting installation during the whole life cycle, are mostly the largest part of the total costs, and that proper maintenance plans can save a lot of energy during the operating phase of the installation. Due to this lack of awareness in common practice, life cycle costs (LCC) and maintenance plans are very seldom (rarely) put into practice. The calculations show that the management of LCC in the design phase can change the evaluation of different lighting solutions significantly. This adds weight to the energy aspects and thus influencing the final decision of the client to more energy efficient lighting solutions.

Long term assessment of costs associated with "lighting and daylighting techniques Fontoynont (2009)" has studied financial data leading to the comparison of costs of various daylighting and lighting techniques over long time periods. The techniques are compared on the basis of illumination delivered on the work plane per year. The selected daylighting techniques were: roof monitors, façade windows, borrowed light windows, light wells, daylight guidance systems, as well as off-grid lighting based on LEDs powered by photovoltaics. These solutions were compared with electric lighting installations consisting of various sources: fluorescent lamps, tungsten halogen lamps and LEDs

General results of the study were:

— Apertures (openings) in the envelope of the building are cost effective in directing light in the peripheral spaces of a building, mainly if they are durable and require little maintenance.

— Daylighting systems aimed at bringing daylight deeply into a building are generally not cost effective, unless they use ready-made industrial products with high optical performance and low maintenance, and collect daylight directly from the building envelope.

— Tungsten halogen lamps, when used continuously for lighting, are very expensive and need to be replaced by fluorescent lamps or LEDs.

— Depending on the evolution of performance and costs of LEDs and photovoltaic panels, there could also be options to generalize lighting based on LEDs and possibly to supply them with electricity generated directly from photovoltaic panels.