PART – III CASH FLOW

3.1 Introduction

In this method of comparison, the cash flows of each alternative will be reduced to time zero by assuming an interest rate i. Then, depending on the type of decision, the best alternative will be selected by comparing the present worth amounts of the alternatives.

The sign of various amounts at different points in time in a cash flow diagram is to be decided based on the type of the decision problem.

In a revenue/profit-dominated cash flow diagram, the profit, revenue, salvage value (all inflows to an organization) will be assigned with positive sign. The costs (outflows) will be assigned with negative sign.

In case the decision is to select the alternative with the minimum cost, then the alternative with the least present worth amount will be selected. On the other hand, if the decision is to select the alternative with the maximum profit, then the alternative with the maximum present worth will be selected.

3.2 BASES FOR COMPARISON OF ALTERNATIVES

In most of the practical decision environments, executives will be forced to select the bestalternativefromasetofcompetingalternatives.

Let us assume that an organization has a huge sum of money for potential investment and there are three different projects whose initial outlay and annual revenues during their lives are known. The executive has to select the best alternative among these three competing projects.

In a cost dominated cash flow diagram, the costs (outflows) will be assigned with positive sign and the profit, revenue, salvage value (all inflows), etc. will be assigned with negative sign.

There are several bases for comparing the worthiness of the projects. These bases are:

1. Present worthmethod
2. Future worthmethod
3. Annual equivalentmethod
4. Rate of returnmethod

3.2.1 PRESENT WORTHMETHOD

- ✓ In this method of comparison, the cash flows of each alternative will be reduced to time zero by assuming an interest rate*i*.
- ✓ Then, depending on the type of decision, the best alternative will be selected by

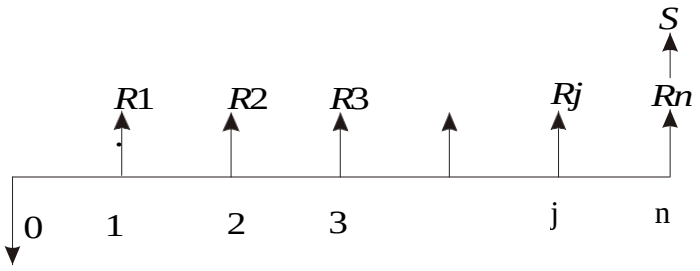
comparing the present worth amounts of thealternatives.

- ✓ Inacostdominatedcashflowdiagram,thecosts(outflows)willbeassignedwith positive sign and the profit, revenue, salvage value (all inflows), etc. will be assigned with negative sign.

- ✓ In a revenue/profit-dominated cash flow diagram, the profit, revenue, salvage value (all inflows to an organization) will be assigned with positive sign. The costs (outflows) will be assigned with negativesign.

3.1.1.1 Revenue-Dominated Cash Flow Diagram

A generalized revenue-dominated cash flow diagram to demonstrate the present worth method of comparison is presented in Fig.



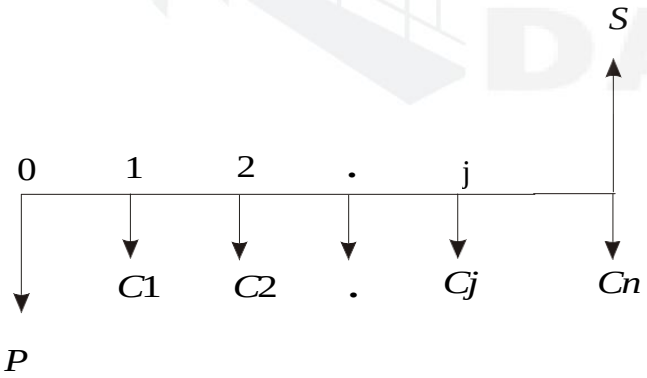
To find the present worth of the above cash flow diagram for a given interest rate, the formula is

$$PW(i) = -P + R1[1/(1+i)^1] + R2[1/(1+i)^2] + \ldots$$

$$+ Rj[1/(1+i)^j] + Rn[1/(1+i)^n] + S[1/(1+i)^n]$$

3.1.1.2 Cost-Dominated Cash Flow Diagram

A generalized cost-dominated cash flow diagram to demonstrate the present worth method of comparison is presented in Fig.



To compute the present worth amount of the above cash flow diagram for a given interest rate i, we have the formula

$$PW(i) = P + C1[1/(1+i)^1] + C2[1/(1+i)^2] + \ldots + Cj[1/(1+i)^j]$$
$$+ Cn[1/(1+i)^n] - S[1/(1+i)^n]$$

EXAMPLE

Alpha Industry is planning to expand its production operation. It has identified three different technologies for meeting the goal. The initial outlay and annual revenues with respect to each of the technologies are summarized in Table 1. Suggest the best technology which is to be implemented based on the present worth method of comparison assuming 20% interest rate, compounded annually.

Table 1

	Initial outlay (Rs.)	*Annual revenue* (Rs.)	*Life* (years)
Technology 1	12,00,000	4,00,000	10
Technology 2	20,00,000	6,00,000	10
Technology 3	18,00,000	5,00,000	10

Solution

In all the technologies, the initial outlay is assigned a negative sign and the annual revenues are assigned a positive sign.

TECHNOLOGY 1

Initial outlay, P = Rs. 12,00,000
Annual revenue, A = Rs. 4,00,000
Interest rate, i= 20%, compounded annually
Life of this technology, n = 10 years

The cash flow diagram of this technology is as shown in Fig. 4.3.

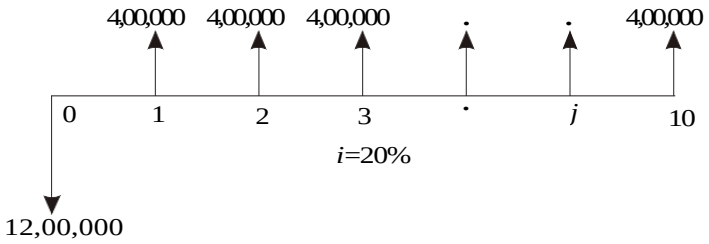


Fig. Cash flow diagram for technology 1.

The present worth expression for this technology is

$$PW(20\%)_1 = -12,00,000+4,00,000 \quad (P/A, 20\%,10)$$
$$= -12,00,000+4,00,000 \quad (4.1925)$$
$$= -12,00,000 + 16,77,000$$
$$= \text{Rs. } 4,77,000$$

Initial outlay, P = Rs. 20,00,000
Annual revenue, A = Rs. 6,00,000
Interest rate, i= 20%, compounded annually
Life of this technology, n = 10 years

The cash flow diagram of this technology is shown in Fig. 4.4.

6,00,000 6,00,000 6,00,000

The present worth expression for this technology is

$$PW(20\%)_2 = -20,00,000+6,00,000 \quad (P/A, 20\%,10)$$
$$= -20,00,000+6,00,000 \quad (4.1925)$$
$$= -20,00,000 + 25,15,500$$
$$= \text{Rs. } 5,15,500$$

TECHNOLOGY 3

Initial outlay, P = Rs. 18,00,000 Annual revenue, A = Rs. 5,00,000
Interest rate, i= 20%, compounded annually Life of this technology, n = 10 years

The cash flow diagram of this technology is shown in Fig. 4.5.

5,00,000 5,00,000 5,00,000

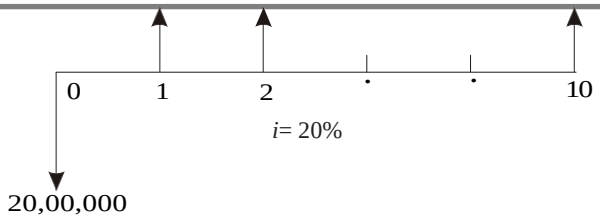


Fig. Cash flow diagram for technology 2

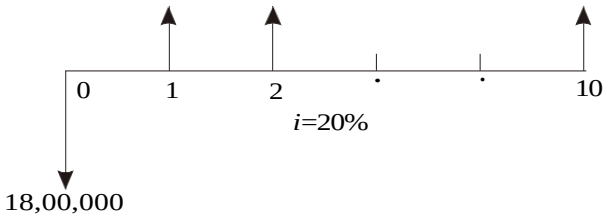


Fig. Cash flow diagram for technology 3.

The present worth expression for this technology is

$$PW(20\%)_3 = -18,00,000+5,00,000 \quad (P/A, 20\%,10)$$
$$= -18,00,000+5,00,000 \quad (4.1925)$$
$$= -18,00,000 + 20,96,250$$
$$= \text{Rs. } 2,96,250$$

From the above calculations, it is clear that the present worth of technology 2 is the highest among all the technologies. Therefore, technology 2 is suggested for implementation to expand theproduction.

3.1.2 FUTUREWORTHMETHOD

- ✓ In the future worth method of comparison of alternatives, the future worth of various alternatives will becomputed.
- ✓ Then, the alternative with the maximum future worth of net revenue or with the minimum future worthofnetcostwill beselectedasthebestalternativeforimplementation.

3.1.2.1 Revenue-Dominated Cash FlowDiagram

A generalized revenue-dominated cash flow diagram to demonstrate the future worth method of comparison is presented in Fig.

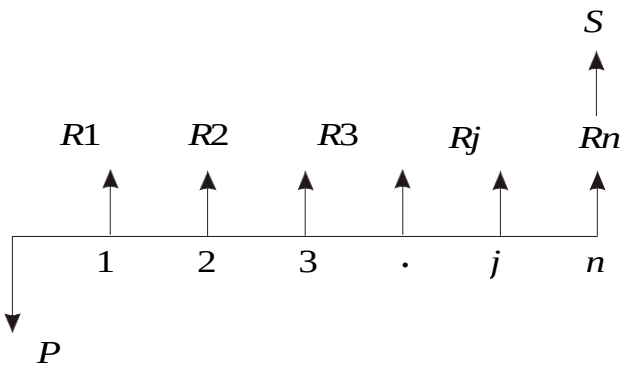


Fig Revenue-dominated cash flow diagram.

In Fig. *P* represents an initial investment, *Rj*the net-revenue at the end of the *j*th year, and *S* the salvage value at the end of the *n*th year.

The formula for the future worth of the above cash flow diagram for a given interest rate, *i*is

$$FW(i) = -P(1 + i)^n + R1(1 + i)^{n-1} + R2(1 + i)^{n-2} + \ldots$$

In the above formula, the expenditure is assigned with negative sign and the revenues are assigned with positive sign.

3.1.2.2 Cost-Dominated Cash FlowDiagram

A generalized cost-dominated cash flow diagram to demonstrate the future worth method of comparison is given inFig.

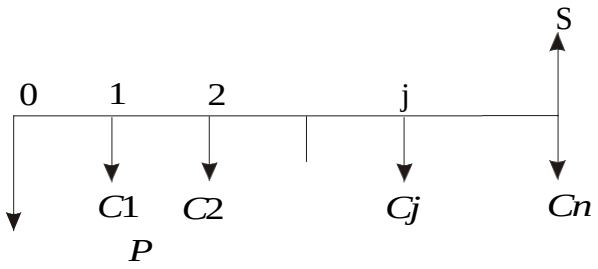


Fig. Cost-dominated cash flow diagram.

In Fig. 5.2, *P* represents an initial investment, *Cj*the net cost of operation and maintenance at the end of the *j* thyear, and *S* the salvage value at the end of the *n*thyear.

The formula for the future worth of the above cash flow diagram for a given interest rate, *i*is

$$FW(i) = P(1 + i)^n + C1(1 + i)^{n-1} + C2(1 + i)^{n-2} + \ldots + Cj(1 + i)^{n-j} + \ldots + Cn - S$$

EXAMPLE

Consider the following two mutually exclusive alternatives:

	End of year

Alternative	0	1	2	3	4
A(Rs.)	– 50,00,000	20,00,000	20,00,000	20,00,000	20,00,000
B(Rs.)	– 45,00,000	18,00,000	18,00,000	18,00,000	18,00,000

At *i*= 18%, select the best alternative based on future worth method ofcomparison.

Solution AlternativeA

Initial investment, *P* = Rs. 50,00,000
Annual equivalent revenue, *A* = Rs. 20,00,000
Interest rate, *i*= 18%, compounded annually
Life of alternative A = 4 years

The cash flow diagram of alternative A is shown in Fig.

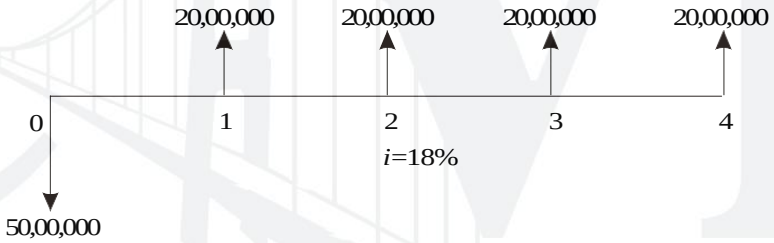


Fig. Cash flow diagram for alternative A.

The future worth amount of alternative B is computed as

$$FW_A(18\%) = -50,00,000(F/P, 18\%, 4) + 20,00,000(F/A, 18\%, 4)$$
$$= -50,00,000(1.939) + 20,00,000(5.215)$$
$$= \text{Rs. } 7,35,000$$

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Alternative B

Initial investment, P = Rs. 45,00,000
Annual equivalent revenue, A = Rs. 18,00,000
Interest rate, i= 18%, compounded annually
Life of alternative B = 4 years

The cash flow diagram of alternative B is illustrated in Fig..

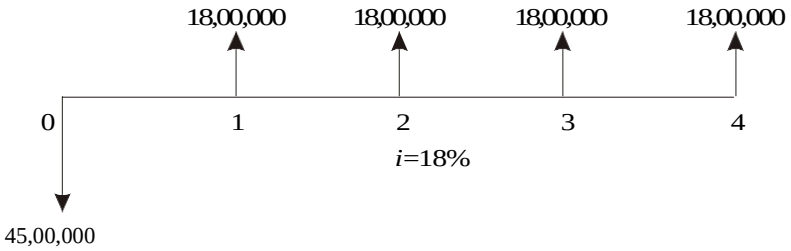


Fig. CashflowdiagramforalternativeB.

The future worth amount of alternative B is computed as

$FW_B(18\%) = -45,00,000(F/P, 18\%, 4) + 18,00,000\ (F/A, 18\%, 4)$

$= -45,00,000(1.939) + 18,00,000(5.215)$

= Rs. 6,61,500

3.1.3 ANNUAL EQUIVALENTMETHOD

- ✓ In the annual equivalent method of comparison, first the annual equivalent cost or therevenueofeachalternativewillbecomputed.
- ✓ Then the alternative with the maximum annual equivalent revenue in the case of revenue-based comparison or with the minimum annual equivalent cost in the case of cost- based comparison will be selected as the bestalternative.

3.1.3.1 Revenue-Dominated Cash FlowDiagram

A generalized revenue-dominated cash flow diagram to demonstrate the annual equivalent method of comparison is presented in Fig.

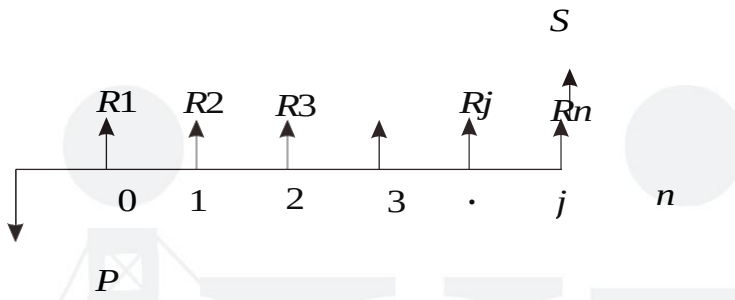


Fig. Revenue-dominated cash flow diagram.

In Fig. *P* represents an initial investment, *Rj*the net revenue at the end of the *j* th year, and *S* the salvage value at the end of the *n*th year.

The first step is to find the net present worth of the cash flow diagram using the following expression for a given interest rate, *i*:

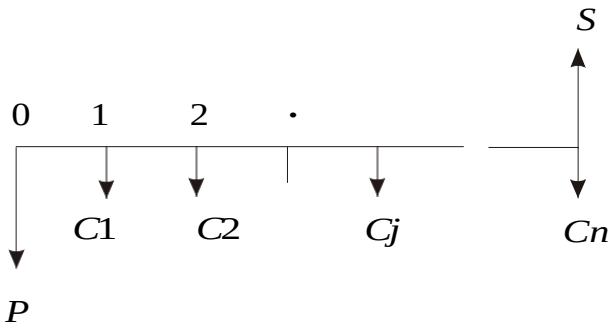
$$PW(i) = -P + R1/(1 + i)^1 + R2/(1 + i)^2 + \ldots$$

$$+ Rj/(1 + i)^j + \ldots + Rn/(1 + i)^n + S/(1 + i)^n$$

In the above formula, the expenditure is assigned with a negative sign and the revenues are assigned with a positive sign.

3.1.3.2 Cost-Dominated Cash FlowDiagram

A generalized cost-dominated cash flow diagram to demonstrate the annual equivalent method of comparison is illustrated in Fig.



In Fig, *P* represents an initial investment, *Cj*the net cost of operation and maintenance at the end of the *j*th year, and *S* the salvage value at the end of the *n*th year.

The first step is to find the net present worth of the cash flow diagram using the following relation for a given interest rate, *i*.

$$PW(i) = P + C1/(1 + i)^1 + C2/(1 + i)^2 + ...$$

$$+ Cj/(1 + i)^j + ... + Cn/(1 + i)^n - S/(1 + i)^n$$

EXAMPLE

A company provides a car to its chief executive. The owner of the company is concerned about the increasing cost of petrol. The cost per litre of petrol for the first year of operation is Rs. 21. He feels that the cost of petrol will be increasing by Re.1 every year. His experience with his company car indicates that it averages 9 km per litre of petrol. The executive expects to drive an average of 20,000 km each year for the next four years. What is the annual equivalent cost of fuel over this period of time?.If he is offered similar service with the same quality on rental basis at Rs. 60,000 per year, should the owner continue to provide company car for his executive or alternatively provide a rental car to his executive? Assume i= 18%. If the rental car is preferred, then the company car will find some other use within thecompany.

Solution

Average number of km run/year = 20,000 km
Number of km/litre of petrol = 9 km

Therefore,

Petrol consumption/year = 20,000/9 = 2222.2 litre
Cost/litre of petrol for the 1st year = Rs. 21
Cost/litre of petrol for the 2nd year = Rs. 21.00 + Re. 1.00
= Rs. 22.00
Cost/litre of petrol for the 3rd year = Rs. 22.00 + Re. 1.00
= Rs. 23.00
Cost/litre of petrol for the 4th year = Rs. 23.00 + Re. 1.00
= Rs. 24.00
Fuel expenditure for 1st year = 2222.2 21 = Rs. 46,666.20
Fuel expenditure for 2nd year = 2222.2 22 = Rs. 48,888.40
Fuel expenditure for 3rd year = 2222.2 23 = Rs. 51,110.60
Fuel expenditure for 4th year = 2222.2 24 = Rs. 53,332.80

The annual equal increment of the above expenditures is Rs. 2,222.20 (G). The cash flow diagram for this situation is depicted in Fig.

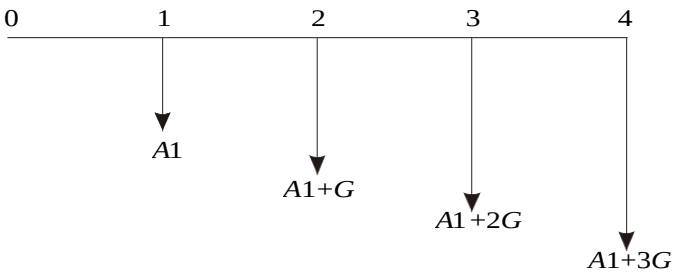


Fig. Uniform gradient series cash flow diagram.

In Fig., $A1$ = Rs. 46,666.20 and G = Rs. 2,222.20

$$A = A1 + G(A/G, 18\%, 4)$$
$$= 46{,}666.20 + 2222.2(1.2947)$$
$$= \text{Rs. } 49{,}543.28$$

The proposal of using the company car by spending for petrol by the company will cost an annual equivalent amount of Rs. 49,543.28 for four years. This amount is less than the annual rental value of Rs. 60,000. Therefore, the company should continue to provide its own car to its executive.

3.1.4 RATE OFRETURNMETHOD

- ✓ The rate of return of a cash flow pattern is the interest rate at which the present worth of that cash flow pattern reduces tozero.
- ✓ In this method of comparison, the rate of return for each alternative is computed. Then the alternative which has the highest rate of return is selected as the bestalternative.
- ✓ A generalized cash flow diagram to demonstrate the rate of return method of comparison is presented in Fig

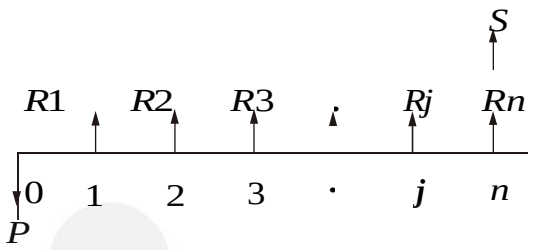


Fig. Generalized cash flowdiagram.

In the above cash flow diagram, P represents an initial investment, $Rj$the net revenue at the endofthe$j$thyear,and$S$thesalvagevalueattheendofthe$n$thyear.

The first step is to find the net present worth of the cash flow diagram using the following expression at a given interest rate, i.

$$PW(i) = -P + R1/(1+i)^1 + R2/(1+i)^2 + \ldots$$

$$+ Rj/(1+i)^j + \ldots + Rn/(1+i)^n + S/(1+i)^n$$

EXAMPLE

A person is planning a new business. The initial outlay and cash flow pattern for the new business are as listed below. The expected life of the business is five years. Find the rate of return for the newbusiness.

Period	0	1	2	3	4	5
Cashflow (Rs.)	–1,00,000	30,000	30,000	30,000	30,000	30,000

Solution

Initial investment = Rs. 1,00,000
Annual equal revenue = Rs. 30,000
Life = 5 years
The cash flow diagram for this situation is illustrated in Fig.

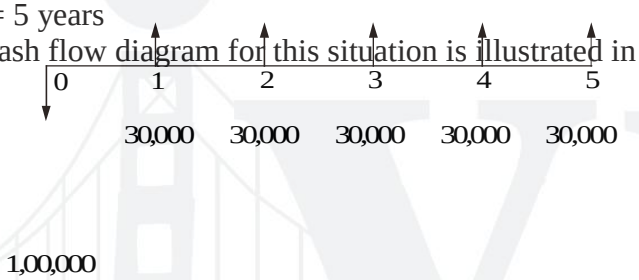


Fig. Cash flow diagram.

The present worth function for the business is

$PW(i) = -1,00,000 + 30,000(P/A, i, 5)$

When i= 10%,

$$PW(10\%) = -1,00,000 + 30,000(P/A, 10\%, 5)$$
$$= -1,00,000 + 30,000(3.7908)$$
$$= \text{Rs.}13,724.$$

When i= 15%,

$$PW(15\%) = -1,00,000 + 30,000(P/A, 15\%, 5)$$
$$= -1,00,000 + 30,000(3.3522)$$
$$= \text{Rs. } 566.$$

When i= 18%,

$$PW(18\%) = -1,00,000 + 30,000(P/A, 18\%, 5)$$
$$= -1,00,000 + 30,000(3.1272)$$
$$= \text{Rs. } -6,184$$

$$i = 15\% + \frac{566 - 0}{566 - (-6184)} (3\%)$$

$$= 15\% + 0.252\%$$

$$= 15.252\%$$

Therefore, the rate of return for the new business is 15.252%.