P Net Present Value Method

The net present value of a project is the difference between the total present value of cash inflows and the initial investment of the project. If the future inflows of cash, which will take place from a project, are discounted with a certain rate of interest, then the present value of future inflows of cash is obtained. Again, if the initial investment is deducted from the present value of inflows of cash, then the net present value is obtained. Thus —

$$\mathbf{PV} = \frac{R_1}{(1+K)^1} + \frac{R_2}{(1+K)^2} + \frac{R_3}{(1+K)^3} + \ldots + \frac{R_n}{(1+K)^n}$$

where, —

$R_1, R_2, R_3, \ldots R_n$ are the inflows of cash for the 1st, 2nd, 3rd, ...nth year respectively ;

PV = Present value of inflows of cash ; and

K = Cost of capital or, Rate of discount.

NPV = PV – C

where, —

NPV = Net present value ; and

C = Initial investment.

❑ **Example 14 :** A project requires an initial cash outlay of ₹ 2,00,000 with an expected life of 5 years. It is expected that the project will generate the following cash inflows :

At the end of 1st year : ₹ 40,000
2nd year : ₹ 40,000
3rd year : ₹ 60,000
4th year : ₹ 60,000
5th year : ₹ 70,000.

If the cost of capital is 10%, calculate the Net Present Value of the Project.

• **Solution ⇒**

Let PV. = Present value.

Here, Cost of capital (K) = 10% or 0.10.

$$\therefore \quad PV = \frac{40,000}{(1 + 0.10)} + \frac{40,000}{(1 + 0.10)^2} + \frac{60,000}{(1 + 0.10)^3} + \frac{60,000}{(1 + 0.10)^4} + \frac{70,000}{(1 + 0.10)^5}$$

$$\text{or,} \quad PV = \frac{40,000}{1.10} + \frac{40,000}{(1.10)^2} + \frac{60,000}{(1.10)^3} + \frac{60,000}{(1.10)^4} + \frac{70,000}{(1.10)^5}$$

$$\text{or,} \quad PV = \frac{40,000}{1.10} + \frac{40,000}{1.21} + \frac{60,000}{1.331} + \frac{60,000}{1.4641} + \frac{70,000}{1.61051}$$

or, PV = 36363.64 + 33057.85 + 45078.89 + 40980.81 + 43464.49.

or, PV = 198945.68 or, 198946 (Approx.)

∴ NPV = PV – C

= ₹ (1,98,946 – 2,00,000)

= (–) ₹ 1054.

Summarised Rules for calculating the NPV : The net present value of a project can be determined briefly by applying the following steps :

Step - I ⇒ The present value of rupee one at a certain rate for a particular period is to be determined from the present value table. How the present value is determined with the help of the present value table has been discussed in 1st Chapter in the context of the discussion of the 'Time Value of Money'. So, it is not repeated here.

Step - II ⇒ In this step, the present value of cash inflow for the above period is to be determined by multiplying the cash inflow with the present value of rupee one determined in step-I. In the same way, the present value of cash inflows for the different years are to be ascertained.

Step - III ⇒ The total present value of cash inflows is to be determined by adding all the present values of cash inflows in different years.

Step - IV ⇒ The difference between the total present value of cash inflows and initial investment will be the net present value, *i.e.* Net Present Value = Total Present Value of cash inflows – Initial investment.

Net present value Method (NPV) :-

NPV method is generally considered as of the most important method for evaluating the capital investment proposals. when the pv of all cash outflows in the investment project is deducted from the pv of all the future stream of cash inflows arising out of that project, it is called the NPV method of evaluating any investment project.

This may be defined as follows:-

NPV = Σ PV of all cash inflow − Σ PV of all cash outflows

The eq.n for calculating NPV can be put as follows:-

where cash outflows is expected to occur only at the start of the investment project i.e. there will be no subsequent cash outflow (known as conventional cash flows)

$$NPV = \left[\frac{CI_1}{(1+k)^1} + \frac{CI_2}{(1+k)^2} + \frac{CI_3}{(1+k)^3} + \cdots + \frac{CI_n}{(1+k)^n} + \frac{S_n}{(1+k)^n} + \frac{W_n}{(1+k)^n}\right] - CO_0$$

$$= \sum_{t=1}^{n}\left[\frac{CI_t}{(1+k)^t} + \frac{S_n + W_n}{(1+k)^n}\right] - CO_0$$

where cash outflow is expected to occur at subsequent period (known as non-conventional cash flows)

$$NPV = \left[\frac{CI_1}{(1+k)^1} + \frac{CI_2}{(1+k)^2} + \frac{CI_3}{(1+k)^3} + \cdots + \frac{CI_n}{(1+k)^n} + \frac{S_n}{(1+k)^n} + \frac{W_n}{(1+k)^n}\right] - \left[CO_0 + \frac{CO_1}{(1+k)^1} + \frac{CO_2}{(1+k)^2} + \frac{CO_3}{(1+k)^3} + \cdots + \frac{CO_n}{(1+k)^n}\right]$$

$$= \sum_{t=1}^{n}\left[\frac{CI_t}{(1+k)^t} + \frac{S_n + W_n}{(1+k)^n}\right] - \sum_{t=0}^{n}\frac{CO_t}{(1+k)^t}$$

where NPV = net present value

CI_t = cash inflow in period t where $t = 1, 2, 3, \ldots n$

k = Discount factor i.e. cost of capital.

S_n = Salvage value of the asset in the final year or last year n (i.e. terminal cash inflow)

W_n = Recovery of working capital in the last year n (i.e. terminal cash inflows)

CO_t = cash outflow in period t where

$t = 0, 1, 2, 3, \ldots n$.

Decision criterion:-

In case of 'accept or reject' criterion:-

If NPV > 0, Accept the proposal

If NPV < 0, Reject the proposal

If NPV = 0, firm is indifferent.

If NPV = 0, it implies that the firm is indifferent between accepting & rejecting the investment proposal. However, this situation simply implies that the proposal only helps in recovering the original investments. So, there is a rare chance of accepting a project with zero NPV.

In case of ME projects:-

The NPV method can also be used to select between ME projects. The proposal with the highest +ve NPV is given the rank 1 & so on & the proposal with the lowest positive NPV is assigned the lowest rank. The proposals with -ve NPV is straightway rejected.

Example 15 : A company is considering investment in a project that costs ₹ 1,00,000 with an effective life of 5 years. It is expected that annual cash inflows of ₹ 36,000, ₹ 32,000, ₹ 28,000, ₹ 24,000 and ₹ 20,000 will be occurred from the project at the end of 1st, 2nd, 3rd, 4th and 5th year respectively. If the cost of capital is 10%, calculate the Net Present Value of the Project.

Solution ⇒

Statement showing the NPV

Year	*Cash inflows*	*Present value of Re. 1 at 10%*	*Present value of cash inflows* ₹
1	36,000	0.909	32,724
2	32,000	0.826	26,432
3	28,000	0.751	21,028
4	24,000	0.683	16,392
5	20,000	0.620	12,400
Total present value			1,08,976
Less : Initial investment			1,00,000
Net Present Value			8,976

P.1. Accept-Reject Principle

The following principles are followed in order to decide whether a proposed project will be accepted or rejected under the Net Present Value Method :

(i) **In case of only one project :** If the NPV of a project is positive, the project should be accepted. On the other hand, if it is negative, then the project should be rejected. It can be mentioned in this context that if the NPV of a project is zero, then it can be either accepted or rejected.

(ii) **In case of two projects :** When one project is to be selected out of two given projects, the project with greater the NPV is accepted.

(iii) **In case of mutually exclusive projects :** In case of mutually exclusive projects, the projects are arranged according to the ranks on the basis of their NPV. The project with highest NPV will be given rank 1, the second highest NPV will be given rank 2, and next to second highest will be given rank 3 and so on. The project with rank 1 will be the best one and hence it is to be accepted.

Example 16 : ABC Ltd. wants to undertake a project, for which it has the following five projects.

Projects	*Initial Investment* (₹)	*Annual Cash inflows* (₹)	*Estimated Life (Years)*
A	60,000	14,000	8
B	1,00,000	18,000	10
C	80,000	17,000	8
D	1,60,000	26,000	20
E	1,20,000	20,000	10

If the cost of capital is 15%, which project should be acquired by the company ?

Given : Present value of annuity of Re. 1 at a discount of 15% :

for 8 years = ₹ 4.6586

for 10 years = ₹ 5.1790

for 20 years = ₹ 6.3345.

• **Solution ⇒** **Statement showing the Net Present Value and Ranking of the Projects**

Projects	Initial investment C (₹)	Annual cash inflows (₹)	Life (Years)	PVF (₹)	PV (₹)	NPV = [PV – C] (₹)	Rank
A	60,000	14,000	8	4.6586	65,220	5,220	1
B	1,00,000	18,000	10	5.1790	93,222	(–) 6,778	4
C	80,000	17,000	8	4.6586	79,196	(–) 804	3
D	1,60,000	26,000	20	6.3345	1,64,697	4,697	2
E	1,20,000	20,000	10	5.1790	1,03,580	(–)16,420	5

It is clear from the above table that the Project A ranks 1. Thus, it should be acquired by the company as its NPV is highest.

Points to Remember

1. *Only the additional inflows of cash which take place after accepting a project are to be taken into account in evaluating the project, the entire inflows of cash are not to be taken into account* ***[See Example No. 17]***
2. *In order to determine the inflows of cash, tax is to be deducted from the profit before tax and thereafter depreciation is to be added with the balance* ***[See Example No. 18]***
3. *If there is a possibility of getting any scrap value after the end of life of the project, then the scrap value is to be taken into account with the inflow of cash for the last year* ***[See Example No. 19]***
4. *If a project requires additional investment in subsequent periods in addition to the initial investment, then present value of total investments is to be taken into consideration in evaluating the project* ***[See Example No. 20]***
5. *If additional working capital is needed for starting a project, then it will be taken into account with the initial investment. Again, such additional working capital is recovered after the end of the life of the project. So, it is to be taken into account with the inflow of cash for the last year.* ***[See Example No. 21]***

❑ **Example 17 :** A company has a project having an additional life of 5 years. It generates annual cash inflow of ₹ 20,000. At present, the company wishes to undertake a new project which requires an initial investment of ₹ 1,60,000. The new project will also have a working life of 5 years. If the new project is undertaken by the company, its future cash inflows will be increased to :

		₹
1st year	:	52,000
2nd year	:	68,000
3rd year	:	80,000
4th year	:	72,000
5th year	:	60,000.

If the cost of capital is 10%, should the new project be undertaken ?

• **Solution ⇒**

Statement showing the NPV

Year	Future cash inflows (₹)	Cash inflows from existing project (₹)	Cash inflows from new project (₹)	Present value of Re. 1 @ 10% (₹)	Present value (₹)
1	52,000	20,000	32,000	0.909	29,088
2	68,000	20,000	48,000	0.826	39,648
3	80,000	20,000	60,000	0.751	45,060
4	72,000	20,000	52,000	0.683	35,516
5	60,000	20,000	40,000	0.620	24,800
	Present value of the new project				1,74,112
Less :	Initial investment				1,60,000
	Net Present Value of the New Project				14,112

Comment : *It is clear from the above statement that the NPV of the new project is positive. So, the project should be accepted.*

❑ **Example 18 :** A plant costing ₹ 3,00,000 is required in order to undertake a proposed project. The effective life of the plant is 5 years. The estimated earnings before depreciation and tax of the project are as follows :

Year	(₹)
1	90,000
2	1,05,000
3	1,20,000
4	1,50,000
5	1,65,000

If the tax rate is 50%, cost of capital is 15% and the scrap value of the machine is zero, calculate the net present value and suggest whether the project should be accepted or not.

Given : The present value factors at a discount @ 15% rate are :

Year	:	1	2	3	4	5
PV Factors	:	0.8696	0.7561	0.6575	0.5718	0.4972

• **Solution ⇒**

Statement of Net Cash Inflows

Particulars	*1st year (₹)*	*2nd year (₹)*	*3rd year (₹)*	*4th year (₹)*	*5th year (₹)*
Profit before depreciation & taxes	90,000	1,05,000	1,20,000	1,50,000	1,65,000
Less : Depreciation	60,000	60,000	60,000	60,000	60,000
Profit before tax	30,000	45,000	60,000	90,000	1,05,000
Less : Tax @ 50%	15,000	22,500	30,000	45,000	52,500
Profit after tax	15,000	22,500	30,000	45,000	52,500
Add : Depreciation	60,000	60,000	60,000	60,000	60,000
Net Cash inflows	75,000	82,500	90,000	1,05,000	1,12,500

Statement showing the NPV

Year	Net Cash inflows (₹)	PVF of Re. 1 at 15% (₹)	Present Value (₹)
1	75,000	0.8696	65,220
2	82,500	0.7561	62,378
3	90,000	0.6575	59,175
4	1,05,000	0.5718	60,039
5	1,12,500	0.4972	55,935
	Total present value		3,02,747
Less :	Initial investment		3,00,000
	Net Present Value		2,747

Comment : *It is clear from the above table that the net present value of the given project is positive. So, the project should be accepted.*

❑ **Example 19 :** Alpha Co. Ltd. wants to undertake a project which requires a plant costing ₹ 3,00,000. The effective life of the plant is 5 years and its scrap value will be 10% after 5 years. The following cash inflows will be occurred from the project in the next 5 years :

Year	*Cash inflows (₹)*
1	60,000
2	90,000
3	1,08,000
4	1,20,000
5	1,02,000

If the cost of capital is 15%, calculate the NPV of the project.

Given : The present value factors at a discount @ 15% rate are :

Year	:	1	2	3	4	5
PVF at 15%	:	0.8696	0.7561	0.6575	0.5718	0.4972

• **Solution ⇒** **Statement showing the Net Present Value**

Year	Cash inflows (₹)	PVF of Re. 1 at 15% (₹)	Present Value (₹)
1	60,000	0.8696	52,176
2	90,000	0.7561	68,049
3	1,08,000	0.6575	71,010
4	1,20,000	0.5718	68,616
5	1,02,000	0.4972	59,714
5	30,000 (Scrap value)	0.4972	14,916
	Total present value		3,25,481
Less :	Initial investment		3,00,000
	Net Present Value		25,481

Note : Scrap Value = ₹ 3,00,000 × $\frac{10}{100}$ = ₹ 30,000.

Example 20 : A company is considering an investment project which requires an initial cash outlay of ₹ 2,50,000 on equipment. The project's economic life is 10 years. An additional investment of ₹ 1,00,000 would also be necessary at the end of each two years to restore the efficiency of the equipment. The annual cash inflows which are expected from the project are as follows :

Year	:	1	2	3	4	5	6	7	8	9	10
Cash inflows (₹ '000)	:	40	55	80	90	125	150	190	200	230	250

If the scrap value of the equipment is zero after 10 years and cost of capital is 20%, justify whether the project should be accepted or not by determining the net present value.

Given : The present value factors at a discount @ 15% rate are :

Year	:	1	2	3	4	5
PVF at 20%	:	0.833	0.694	0.579	0.482	0.402
		6	7	8	9	10
		0.335	0.279	0.233	0.194	0.162

• **Solution ⇒ Statement showing the Present Value of Cash Outflows**

Year	*Outflows of cash* (₹)	*PVF of Re. 1 at 20%* (₹)	*Present value* (₹)
0	2,50,000	1	2,50,000
2	1,00,000	0.694	69,400
4	1,00,000	0.482	48,200
6	1,00,000	0.335	35,500
8	1,00,000	0.233	23,300
Total present value of cash outflows			4,26,400

Statement showing the Net Present Value

Year	*Cash inflows* (₹)	*PVF of Re. 1 at 20%* (₹)	*Present value* (₹)
1	40,000	0.833	33,320
2	55,000	0.694	38,170
3	80,000	0.579	46,320
4	90,000	0.482	43,380
5	1,25,000	0.402	50,250
6	1,50,000	0.335	50,250
7	1,90,000	0.279	53,010
8	2,00,000	0.233	46,600
9	2,30,000	0.194	44,620
10	2,50,000	0.162	40,500
	Total present value of cash inflows		4,46,420
Less :	Total present value of cash outflows		4,26,400
	Net Present Value		20,020

Comment : It is clear from the above statement that the net present value of the given project is positive. So, the project should be accepted.

Note : The life span of the project is 10 years. So, the additional amount of ₹ 1,00,000 is not to be invested at the end of 10th year.

❑ **Example 21 :** Bharat Export Co. Ltd. is considering an investment project which requires an automatic machine costing ₹ 3,00,000 and an additional amount of ₹ 20,000 as working capital. The project is expected to yield annual (*before tax*) cash inflow of ₹ 40,000. It is estimated that the project will have a life of 10 years, at the end of which it will have a scrap value of ₹ 20,000. If the cost of capital is 10% and the present value of annuity of Re. 1 at 10% rate of discount for 10 years is ₹ 6.14 and the present value of Re. 1 at 10% rate of discount, received at the end of 10th year is Re. 0.386, calculate the net present value of the project and suggest whether the project should be accepted by the company or not. Assuming that the company is in the tax bracket of 50%.

• **Solution ⇒**

Statement of Annual Cash Inflows

Particulars		*(₹)*
	Before tax cash inflows	40,000
Less :	Tax @ 50%	20,000
	After tax cash inflows	20,000
Add :	Depreciation	28,000
	Annual Cash inflows	48,000

Statement showing the NPV

Year	*Particulars*	*Cash inflow (₹)*	*PV factor (₹)*	*Present value (₹)*
1 - 10	Annual cash inflows	48,000	6.14	2,94,720
10	Scrap value	20,000	0.386	7,720
10	Working capital	20,000	0.386	7,720
	Total present value of cash inflows			3,10,160
Less :	Total present value of cash outflows :		₹	
	Cost of machine		3,00,000	
	Working capital		20,000	
				3,20,000
	Net Present Value			(–) 9,840

Comment : It is clear from the above statement that the net present value of the project is negative. So, the project should be rejected.

Note : Annual Depreciation $= \frac{\text{Cost} - \text{Scrap}}{\text{Life}}$

$= \frac{3,00,000 - 20,000}{10}$

$=$ ₹ 28,000

P.2. Advantages and Disadvantages of NPV Method

■ **Advantages :** The advantages of NPV method are —

Firstly, the time value of money is considered in this method. So, it is possible to evaluate a proposed project correctly by using this method.

Secondly, this method is consistent with the financial objective of maximisation of wealth of the shareholders.

Thirdly, all the probable inflows of cash of the entire economic life of a project are considered in this method in evaluating the project. So, each project is evaluated on the basis of its entire returns.

Fourthly, a project should be evaluated under this method when it is expected that different amounts of returns will be obtained in different years. Because, the incomes stream of different years are converted into money value of a particular point of time.

■ **Disadvantages :** The disadvantages of the NPV method are —

Firstly, this method is very complex. To determine the present value of future inflows and outflows of cash is a very complex and laborious job.

Secondly, in this case, the present value of inflows of cash is determined by discounting the future cash flows with the rate of cost of capital. But determination of cost of capital is very difficult and there are differences of opinion regarding the process of determining such cost. So, if it is not possible to determine the correct cost of capital, then it will not be possible to evaluate a project properly.

Thirdly, it is not right to say that if a project has comparatively high NPV than others, the project will be a good one, because the initial investment of this project may be larger than the others.

Fourthly, if the life span of different projects are different, then their comparative evaluation may not be possible with the help of this method. As for instance, if the life span of a project with highest NPV is more, then capital remains blocked in it for a long period. So, the project may not be desirable.