

# CAPITAL PROJECT SCREENING AND SELECTION

Before studying the three measures of investment attractiveness, we will review a simple method that is commonly used to screen capital investments. One of the primary concerns of most business people is whether, and when, the money invested in a project can be recovered. The **payback method** screens projects on the basis of how long it takes for **net receipts to equal investment outlays**:

The payback period is determined by adding the expected cash flows for each year until the sum is equal to, or greater than, zero. The significance of this procedure can be easily explained. **The cumulative cash flow equals zero at the point where cash inflows exactly match or pay back the cash outflows**: thus, the project has reached the payback point. Once the cumulative cash flows exceed zero, cash inflows exceed cash outflows, and the project has begun to generate a profit, thus exceeding its payback point. This calculation can take one of two forms by either ignoring time-value-of money considerations or including them. The former case is usually designated as the **conventional-payback method** while the latter case is known as the **discounted-payback method**. A common standard used to determine whether to pursue a project is that a project does not merit consideration unless its payback period is shorter than some specified period of time. (This time limit is largely determined by management policy.)

For example, a high-tech firm, such as a computer-chip manufacturer, would set a short time limit for any new investment, because high-tech products rapidly become obsolete. If the payback period is within the acceptable range, a formal project evaluation (such as a present-worth analysis, which is the subject of this chapter) may begin. **It is important to remember that payback screening is not an end in itself, but rather a method of screening out certain obviously unacceptable investment alternatives before progressing to an analysis of potentially acceptable ones.**

## (I) Conventional-Payback Period with Salvage Value (ignores time value of money)

**Example 1:** Ashland Company has just bought a new spindle machine at a cost of ₦105,000 to replace one that had a salvage value of ₦20,000. The projected annual after-tax savings due to improved efficiency are as follows:

**Given:** Initial cost = ₦85,000; cash flow series as shown below. **Find:** Conventional-payback period.

Period	Cash flow (₦)	Cumulative cash flow (₦)
0	-105,000+20000	-85,000
1	15,000	-70,000
2	25,000	-45,000
3	35,000	-10,000
4	45,000	35,000
5	45,000	80,000
6	35,000	115,000

The salvage value of retired equipment becomes a major consideration in most justification analyses. (In this example, the salvage value of the old machine should be taken into account, as the company already decided to replace the old machine.) When used, the salvage value of the retired equipment is subtracted from the purchase price of the new equipment, revealing a closer true cost of the investment. **As we see from the cumulative cash flow series in table above, the total investment is recovered at the end of year 4. If the firm's stated maximum payback period is three years, the project would not pass the initial screening stage.** In this example, we assumed that cash flows occur only in discrete lumps at the ends of years. If cash flows occur continuously throughout the year, our calculation of the payback period needs adjustment. A negative balance of ₦10,000 remains at the start of year 4. If the ₦45,000 is expected to be received as a more or less continuous flow during year 4, then the total investment will be recovered two-tenths (₦10,000/₦45,000) of the way through the fourth year. In this situation, the prorated payback period is thus 3.2 years.

## Benefits and Flaws of Payback Screening

The **simplicity of the payback method is one of its most appealing qualities**. Initial project screening by the payback method **reduces the information search by focusing on that time at which the firm expects to recover the initial investment**. The method may also eliminate some alternatives. Thus reducing a firm's need to make further analysis efforts on those alternatives. But the much-used payback method of investment screening has a number of serious drawbacks as well:

The principal objection to the payback method is that **it fails to measure profitability; that is, it assumes that no profit is made during the payback period**. Simply measuring how long it will take to recover the initial investment outlay **contributes little to gauging the earning power of a project**. (For instance, if you know that the money you borrowed for the drill press is costing you 12% per year, the payback method will not be able to tell you how much your invested money is contributing toward your interest expense.) Because payback-period analysis ignores differences in the timing of cash flows, it **fails to recognize the difference between the present and future value of money**. By way of illustration, consider two investment projects:

Period (yrs)	Project 1(₹)	Project 2(₹)
0	-10,000	-10,000
1	1,000	9,000
2	9,000	1,000
3	1,000	1,000
Payback	2 years	2 years

Although the payback period for both investments can be the same in terms of numbers of years, project 2 is better, because most investment being recovered at the end of year 1 is worth more than that to be gained later. Because payback screening also ignores all proceeds after the payback period, it does not allow for the possible advantages of a project with a longer economic life.

## Discounted-Payback Period (considers time value of money)

One of the major disadvantages of **simple payback period** is that it ignores the time value of money. To counter this limitation, an alternative procedure called discounted payback period may be followed, which accounts for time value of money by discounting the cash inflows of the project.

## Formulas and Calculation Procedure

In discounted payback period we have to calculate the present value of each cash inflow taking the start of the first period as zero point. For this purpose the management has to set a suitable discount rate. The discounted cash inflow for each period is to be calculated using the formula:

$$\text{Discounted Cash Inflow} = \frac{\text{Actual Cash Inflow}}{(1 + i)^n}$$

Where,

**i** is the discount rate;

**n** is the period to which the cash inflow relates.

Usually the above formula is split into two components which are actual cash inflow and present value factor ( i.e.  $1 / (1 + i)^n$  ). Thus discounted cash flow is the product of actual cash flow and present value factor.

The rest of the procedure is similar to the calculation of simple payback period except that we have to use the discounted cash flows as calculated above instead of actual cash flows. The cumulative cash flow will be replaced by cumulative discounted cash flow.

$$\text{Discounted Payback Period} = A + \frac{B}{C}$$

Where,

- A** = Last period with a negative discounted cumulative cash flow;
- B** = Absolute value of discounted cumulative cash flow at the end of the period A;
- C** = Discounted cash flow during the period after A.

Note: In the calculation of simple payback period, we could use an alternative formula for situations where all the cash inflows were even. That formula won't be applicable here since it is extremely unlikely that discounted cash inflows will be even.

The calculation method is illustrated in the example below.

### Decision Rule

If the discounted payback period is less than the target period, accept the project. Otherwise reject.

### Example

An initial investment of \$2,324,000 is expected to generate \$600,000 per year for 6 years. Calculate the discounted payback period of the investment if the discount rate is 11%.

### Solution

Step 1: Prepare a table to calculate discounted cash flow of each period by multiplying the actual cash flows by present value factor. Create a cumulative discounted cash flow column.

Year n	Cash Flow CF	Present Value Factor $PV\$1=1/(1+i)^n$	Discounted Cash Flow $CF \times PV\$1$	Cumulative Discounted Cash Flow
0	\$ -2,324,000	1.0000	\$ -2,324,000	\$ -2,324,000
1	600,000	0.9009	540,541	- 1,783,459
2	600,000	0.8116	486,973	- 1,296,486
3	600,000	0.7312	438,715	- 857,771
4	600,000	0.6587	395,239	- 462,533
5	600,000	0.5935	356,071	- 106,462
6	600,000	0.5346	320,785	214,323

Step 2: Discounted Payback Period =  $5 + |-106,462| / 320,785 \approx 5.32$  years

### Advantages and Disadvantages

**Advantage:** Discounted payback period is more reliable than simple payback period since it accounts for time value of money. It is interesting to note that if a project has negative net present value it won't pay back the initial investment.

**Disadvantage:** It ignores the cash inflows from project after the payback period.

### Net-Present-Worth Criterion

Equivalent present value of the cash flows generated by the investment over a specified time interval, N with discounting at a specified interest rate, i.

$$NPV = \sum_{n=0}^N \frac{NCF_n}{(1+i)^n} = \frac{NCF_0}{(1+i)^0} + \frac{NCF_1}{(1+i)^1} + \frac{NCF_2}{(1+i)^2} + \dots + \frac{NCF_N}{(1+i)^N}, \text{ where NCF is net cash flow.}$$

The discount rate, i is the minimum attractive rate of return. That is, the rate of return that could be expected if the fund invested in the proposed project was to be invested elsewhere.

We will first summarize the basic procedure for applying the net-present-worth criterion to a typical investment project, as well as for comparing alternative projects.

### Evaluation of a Single Project

**Step 1: Determine the interest rate that the firm wishes to earn on its investments.** The interest rate you determine represents the rate at which the firm can always invest the money in its *investment* pool. **This interest rate is often referred to as either a *required rate of return* or a *minimum attractive rate of return* (MARR).** Usually this selection is a policy decision made by top management. It is possible for the MARR to change over the life of a project, but for now we will use a single rate of interest when calculating PW.

**Step 2:** Estimate the **service life** of the project.

**Step 3:** Estimate the **cash inflow for each period** over the service life.

**Step 4:** Estimate the **cash outflow for each period** over the service life.

**Step 5:** Determine the **net cash flows for each period** (net cash flow = cash inflow - cash outflow).

**Step 6: Find the present worth of each net cash flow (NCF) at the MARR.** Add up these present-worth figures; their sum is defined as the project's PW. That is, NCF, will be positive if the corresponding period has a net cash inflow and negative if the period has a net cash outflow.

$$PW = \frac{NCF_0}{(1+i)^0} + \frac{NCF_1}{(1+i)^1} + \frac{NCF_2}{(1+i)^2} + \dots + \frac{NCF_N}{(1+i)^N} = \sum_{n=0}^N \frac{NCF_n}{(1+i)^n} = \sum_{n=0}^N A_n(P/F, i, n)$$

Where,  $PW(i) = PW$  calculated at i,  $A_n =$  net cash flow at the end of period n,  $i =$  MARR (or cost of capital), and  $n =$  service life of the project.

**Step 7:** In this context, a **positive PW means that the equivalent worth of the inflows is greater than the equivalent worth of the outflows, so the project makes a profit.** Therefore, if the PW is positive for a single project, the project should be accepted; if it is negative, the project should be rejected. The process of applying the PW measure is implemented with the following **decision rule:**

**If  $PW > 0$ , accept the investment.**

**If PW = 0, remain indifferent.**  
**If PW < 0, reject the investment.**

### Comparing More Than One Alternative

Note that the foregoing decision rule is for evaluation of a single project for which you can estimate the revenues as well as the costs. The following guidelines should be used for evaluating and comparing more than one project:

1. If you need to select the best alternative, based on the net-present-worth criterion, **select the one with the highest PW, as long as all the alternatives have the same service lives.** Comparison of alternatives with unequal service lives requires special assumptions.

2. Comparison of mutually exclusive alternatives with the same revenues is performed on a *cost-only basis*. In this situation, you should accept the project that results in the **smallest PW of costs, or the least negative PW** (because you are minimizing costs, rather than maximizing profits).

**“some projects cannot be avoided-e.g., the installation of pollution-control equipment to comply with government regulations. In such a case, the project would be accepted even though its PW < 0”.**

**Example:** Use the data in the table below to select a choice out of the two machines. Use the criterion of NPV, annuity and future worth.

S/N		Machine A	Machine B
1	First cost	₦ 15,000	₦ 25,000
2	Annual cost	₦ 6,500	₦ 4,300
3	Useful life	12 years	12 years
4	Salvage value	0	0

Minimum attractive rate of return before income tax is stipulated to be 10%

**ANSWER:** NPV (Machine A) = ₦ 59,290; Annuity (Machine A) = ₦8,701

NPV (Machine B) = ₦ 54,300; Annuity (Machine B) = ₦7,969

**Select machine B**