Methods that consider the time value of money

(3) Discounted Cash Flow Method

- This method is based on the amount of the investment that is unreturned at the end of each year during the estimated life of the project
- A trial and error procedure is used to establish a rate of return which can be applied to yearly cash flow so that the original investment is reduced to zero (or to salvage and land value + working capital investment) during the project life.
- Thus, the rate of return by this method is equivalent to the maximum interest rate (normally after taxes) at which money can be borrowed to finance the project under conditions where the net cash flow to the project over its life would be just sufficient to pay all the principal and interest accumulated on the out-sanding principal.

Suppose M is the initial amount invested at the start of the project having a life of 5 years

$$M = FCI + WC$$

If the amount of money going into the project (profit earned each year) is x_1, x_2, x_3, x_4 and x_5 at the end of each year, the amount x_1 earns interest for 4 years, x_2 for 3 years, x_3 for 2 years, x_4 for 1 year and x_5 earns no interest

If the initial invested amount M earned interest for 5 years, the total sum would have been $M(1+i)^5$

Therefore, at the end of the service life, the total amount at the investor's disposal is

$$= x_1(1+i)^4 + x_2(1+i)^3 + x_3(1+i)^2 + x_4(1+i) + x_5 + V_s + W_c$$

This should be equal to $M(1+i)^5$

$$M(1+i)^5 = x_1(1+i)^4 + x_2(1+i)^3 + x_3(1+i)^2 + x_4(1+i) + x_5 + V_s + W_c$$

This equation is solved for i

<u>If i calculated is greater than the minimum rate of return then it is worth investing the money in the project</u>

To illustrate the basic principles involved in discounted-cash-flow calculations and the meaning of rate of return based on discounted cash flow, consider the case of a proposed project for which the following data apply:

Initial fixed-capital investment = \$100,000
Working-capital investment = \$10,000
Service life = 5 years
Salvage value at end of service life = \$10,000

Year	Predicted after-tax cash flow to project based on total income minus all costs except depreciation, \$ (expressed as end-of-year situation)
0	(110,000)
1	30,000
2	31,000
3	36,000
4	40,000
5	43,000

Designate the discounted-cash-flow rate of return as i. This rate of return represents the after-tax interest rate at which the investment is repaid by proceeds from the project. It is also the maximum after-tax interest rate at which funds could be borrowed for the investment and just break *even* at the end of the service life.

At the end of five years,

$$(\$110{,}000)(1+i)^5 = (\$30{,}000)(1+i)^4 + (\$31{,}000)(1+i)^3 + (\$36{,}000)(1+i)^2 + (\$40{,}000)(1+i) + \$43{,}000 + \$10{,}000 + \$10{,}000$$

Solving by trial and error for i gives $i = 0.207$, or the discounted-cash-flow rate of return is 20.7 percent.

If money is worth 15% compounded annually (minimum rate of return), the project may be considered economically viable as the discounted-cash-flow rate of return of 20.7% is greater than 15%

(4) Net Present Worth

The net present worth of the project is the difference between the present value of the annual cash flows and the initial required investment

For eg., in the previous example, TCI = $ 1,10,000

We can calculate the present worth of the cash flow, $P = \frac{S}{(1+i)^n}$

Money is compounded at 15% annually

Year	Cash Flow	P
1	30,000	26,087
2	31,000	23,440
3	36,000	23.671
4	40,000	22,870
5	(43,000 + 10,000+ 10,000)	31,317
		1,27,385

Net Present Worth = $1,27,385 - $ 1,10,000 = $ 17, 385

If the Net Present Worth is <u>positive</u>, then the project provides a return at a rate greater than the discount rate used in calculations.
In making comparisons of investments, the <u>larger the net present worth, the more favourable is the investment</u>

(5) Capitalized Cost

- The capitalized cost profitability concept is useful for comparing techniques (alternatives) that exist as possible investment choices within a single overall project
- Capitalized cost related to investment represents the amount of money that must be available initially to purchase the equipment and simultaneously provide sufficient funds for interest accumulation to permit perpetual replacement of the equipment
- When comparing options, if the operating costs do not vary, then the alternative giving the least capitalized cost is the desirable economic choice

The basic equation for estimating capitalized cost is

$$\kappa = C_v + \frac{C_R}{(1+i)^n - 1} = (C_R + V_s) + \frac{C_R}{(1+i)^n - 1}$$

$$\boxed{\kappa = \frac{C_R[(1+i)^n]}{(1+i)^n - 1} + V_s}$$

κ : capitalized cost

C_v: original cost of equipment

C_R : replacement cost

V_s : salvage value

i : interest rate

n: estimated service life of equipment

- Inclusion of operating costs
  - The capitalized cost concept can be extended to include operating costs by adding an additional capitalized cost to cover operating costs during the life of the project.
  - Each annual operating cost is considered as equivalent to a necessary piece of equipment that will last one year

The total capitalized cost (κ) is the sum of the capitalized cost for the initial investment and that for the operating costs plus the working capital

$$\kappa = \frac{C_{R[(1+i)^n]}}{(1+i)^n - 1} + V_s + \frac{annual\ cash\ expenses}{i} + working\ capital$$