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3.0 INTRODUCTION

The value of any particular asset is not easy to determine as the value of any asset is determined by the present value of the future cash flows associated with the assets which itself are uncertain in nature. The managers are continually faced with decisions regarding the various alternative investments scenarios. In this unit we look at the various types of capital investment decisions which the finance manager takes we are

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also going to look at the ways and means to estimate the costs and benefits associated with these decisions.

3.1 OBJECTIVES

After going through this unit, you should be able to:

- understand the nature and importance of capital investment decisions, and
- explain the various evaluation criteria for investment decisions.

3.2 THE INVESTMENT PROBLEM

Firms continually invest funds in assets and these assets produce cash flows and income, which can be either reinvested or paid to the shareholders. These assets represent the firms capital and is the firm's total assets and includes tangible and intangible assets. Capital investment is the firm's investment in its assets. The firm's capital investment decision may be comprised of a number of distinct decisions each referred to as a project. A capital project is a set of assets that are contingent on the other and are considered together. The investment decisions of the firms are decisions concerning a firm's capital investment.

Investment decisions of capital projects are primarily based on two factors:

(i) the changes in the firm's future cash flows by investing in a particular capital project, and

(ii) the uncertainty associated with future cash flows.

The value of a firm is the present value of all its future cash flows and the source of these future cash flows are:

- Assets that are already in place • Future investment opportunities.

Future cash flows are re-discounted at a rate which takes into consideration the risk and uncertaininty of these cash flows. Cash flow risk comes from two basic sources:

- ***Sales risk***, which is the degree of uncertainty related to the number of units that will be sold and the price realised.

- ***Operating risk***, which is the degree of uncertainty concerning cash flows that arises from the particular mix of fixed and variable operating costs of sales. Risk is associated with general economic conditions prevailing in the markets in which goods and services are sold, whereas the operating risk is determined by the product itself and is related to the sensitivity of operating cash flows to changes in sales. The combination of these two risks is business risks.

The discount rate (the rate of return required to compensate the suppliers of capital) is a function of business risk associated with the project. From the investors perspective the

discount rate is the required rate of return (RRR) and from the firm's perspective, the discount rate is the cost of capital.

3.3 CAPITAL INVESTMENT AND FIRM'S VALUE

As, we have already discussed the firm's value is the present value of all the future cash flows. In order to assess whether the capital investments are adding value to the firm we have to look at the future cash flows associated with capital investment and the discount rate which would equate these cash flows to their present values.

Capital Budgeting: Capital budgeting is the process of identifying and selecting investments in the long lived assets or the assets which are expected to produce benefits over more than a year. Business is all about exploring avenues for growth and innovation, which requires continuous evaluation of possible investment opportunities. Capital budgeting to a large extent depends upon the corporate strategy.

3.3.1 Stages in Capital Budgeting Process

There are four stages in the capital budgeting process:

Stage 1: Investment Screening and Selection − Projects consistent with the corporate strategy are identified by the various functional units (production, marketing, research and development) of the firm. Once the projects are identified, projects are evaluated and screened by an investment committee comprising of senior managers. The main focus of this process is to estimate how the investment proposal will affect the future cash flows of the firm and hence the value of the firm.

Stage 2: Capital Budgeting Proposal − Once the investment proposal survives the scrutiny of the investment committee, a capital budget is proposed for the project. The capital budget lists the amount of investment required for each investment proposal. This proposal may start with estimates of expected revenue and costs. At a later stage inputs from marketing, purchasing engineering, production and accounting and finance functions are put together.

Stage 3: Budgeting Approval and Authorisation Projects included in the capital budgets are authorised, which allows further fact gathering research and analysis as a result of which the capital budget proposal is refined and put up for approval. The approval allows the expenditure on the project. In some firms the projects are authorised and approved concurrently, where as in others a project is first authorised so that the estimates can be refined. It is then approved. Large expenditures require formal authorisation and approvals whereas capital expenditures within a certain limit can be approved by the managers themselves.

Stage 4: Project Tracking − Once the project is approved the next step is to execute it. The concerned managers periodically report the progress of the project as well as any

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variances from the plan. The managers also report about time and cost overruns. This process of reporting is known as project tracking

Classifying Investment Project

Investment projects are classified according to their economic life. The economic life or useful life of an asset is determined by its:

- Physical decoration
- Obsolescence
- The degree of competition in the market for a product.

The economic life of an asset is an estimate of the length of time that the asset would provide benefits to the firm. After its useful life, the revenues generated by the assets decline rapidly and expenses on the assets increase in a disproportionate manner.

Generally an investment requires an immediate commitment of funds (cash outflows) and the benefits are received over a period of time in the form of cash inflows. If cash inflows are limited to current period only these types of investments are known as short term investments. If these benefits are spread over many years, these types of investments are referred to as long term investments and expenditure on these investments is known as capital expenditure.

3.3.2 Importance of Capital Investment Decisions

Investment decisions are vital and crucial for any company and merit special attention because of the following reasons:

- They influence the firm's growth in the long run
- They affect the risk of the firm
- They involve commitment of large amount of funds
- They are irreversible or reversible at substantial loss • They are among the most difficult decisions to make.

Growth: Investment decisions affect the growth rate of the firm. A firm's decisions to invest in long-term assets will have a bearing on the rate and direction of its future growth. The assumptions on which capital investment decisions are based have to be estimated with a fair degree of precision; otherwise this may lead to the creation of excessive capacity and simultaneous increase in interest and other costs. On the other hand inadequate investments would lead to a loss of market share.

Risk: The risk complexion of the firm may also change with long- term commitment of funds for capital assets. The capital assets are financed by a mix of internal accruals, long-term borrowings and issue of fresh equity. The firms using borrowings to finance capital projects become more risky as the future cash flows associated with the capital projects are uncertain.
Funding: Investment decisions generally require large amount of funds, which make it imperative for the firms to plan their investment programame very carefully and make an advance arrangement for procuring finances internally or externally.

Irreversibility: Most of the capital investments are irreversible or reversible at very significant costs. Once the funds are committed for a capital project it becomes

imperative for the firm to complete the project, abandoning it mid way would cause heavy losses to the firm as it is difficult to find a market for such custom made plant and machinery.

Complexity: Investment decisions are among the firm's most difficult decisions. The reasons for the complexity of these decisions are that they involve estimating the future cash flows of an investment, decisions, which in turn are depended on economic, political, social and technological variables.

3.3.3 Types of Investment Decisions

There are many ways of classifying investments, which are briefly described as follows:

(a) **Expansion and Diversification**

Increasing economic activities may lead the company in to adding new capacity to its existing product lines to expand existing operations. For example, most of the steel companies have increased their plant capacity to meet increased steel demand. Some of these companies have installed additional capacity to produce specialised products like cold rolled sheets, flat products etc. These types of expansion are known as related diversification. On the other hand the companies may go for unrelated diversification, which requires investment in new products and a new kind of production activity within the company. For example, Reliance Industries Ltd. (RIL) primarily a textile and petrochemical Company diversified into tele- communication. These types of diversification are known as unrelated diversification. In either case the objective of the investment is to generate additional revenue. Investment in existing or new products is also known as revenue-expansion investments.

(b) **Replacement and Modernisation**

Rapid technological advancements have necessitated the replacement and modernisation of existing plants and machinery. The main objective of replacement is to improve operating efficiency and reduce costs. Cost savings may lead to increased profits but the revenue may remain unchanged. In cases where replacement decisions lead to substantial technological and operational improvements, it may also lead to increase in revenues. Replacement investments are also referred to as cost reduction investment.

(c) **Forward and Backward Integration**

All companies require raw materials for production and the final product manufactured may be used as raw material for another company. When the companies integrate the source of raw material/inputs it is known as backward integration, for example, a cloth weaving company investing in yarn spinning, a petroleum product refining company investing in hydrocarbon exploration. In the same way when the intermediate product manufactured is further processed

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to make another product having a higher value it is known as forward integration, for example, a petroleum product refining company investing in manufacturing petrochemicals. The basic objective of forward and backward integration is to be present at every stage of the value chain.

Another way to classify investments is as follows:

(a) **Mutually Exclusive Investments**
These types of investment decisions involve choosing among different alternatives. Choosing one alternative will exclude all other alternatives. For example, for capital power generation a company may either choose between a gas based or coal based power generator. Choosing any one of the alternatives will automatically exclude all the other available alternatives.

(b) **Independent Investments**

In these type of investment decisions, the choosing of one of the capital investment will not affect the decision making process for other investments. For example, in a cement manufacturing plant, the installation of a rotatory klin and a captive power plant are independent decisions and decision regarding one alternative will not affect the other decision. (b) **Contingent Investments**

In these types of investments, the decision regarding one project is dependent on the decision regarding another project. For example, a steel company contemplating investments in a blast furnace. The decision regarding this project would be contingent upon the investment in iron ore mines.

3.4 INVESTMENT EVALUATION CRITERIA

The investment evaluation process consist of three steps, which are as follows:

- Estimation of cash flows.
- Estimation of the required rate of return (the opportunity cost of capital).
- Application of a decision rule for making the choice.

Investment Decision Rule

For evaluating a capital investment proposal certain factors needs to be taken into consideration. Any capital budgeting technique should take into consideration the following factors:

1) It should consider all cash flows associated with the project.
2) It should provide for clear and unambiguous way of separating good projects from the bad ones.
3) It should help in ranking projects according to their profitability.
4) It should recognise the fact that bigger cash flows are preferable to smaller ones and early cash flows are preferable to later ones.

Evaluation Criteria

A number of investment criteria (Capital Budgeting Techniques) are used in practice. They may be grouped under the following two categories:

1) Non Discounted Cash Flow Criteria

- Pay Back Period (PB)
- Accounting Rate of Return (ARR).

2) Discounted Cash Flows (DCF) Criteria
   - Net Present Value (NPV)
   - Internal Rate of Return (IRR)
   - Profitability Index (PI).

Cash Flow from Investments

A firm invests only to increase the value of their ownership interest. A firm will have cash flows in the future from its past investment decisions. When it invests in new assets, it expects the future cash flows to be greater than without the new investment.

Incremental Cash Flows

The difference between the cash flows of the firm with the investment project and the cash flow of the firm without the investment project both over the same period of time- is referred to as the projects incremental cash flows.

A more useful way of evaluating the change in value of the firm is the break down of the project's cash flow into two components:

1) The present value of the cash flows from the projects operating activities (revenue minus operating expenses), referred to as the project's operating cash flow (OCF); and

2) The present value of the investment cash flows which are the cash flow associated with the expenditure needed to acquire the projects asset and any cash flow associated with the disposal of the asset.

The present value of a project's operating cash flow are generally positive and the present value of the investment cash flows is typically negative.

Investment Cash Flows

When we consider the cash flows of an investment we must also consider all the cash flows associated with acquiring and disposing of assets in the investment.

Asset Acquisition

In acquiring any asset there are three types of cash flow to consider:

1) Cost of the asset
2) Set up expenditures, including shipping and installation 3) Any tax credit.

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In addition to these factors two other factors viz., sunk cost and the opportunity cost should be factored in the analysis of new projects.

Sunk cost is any cost that has already been incurred that does not affect future cash flows of the firm, e.g., Research and Development cost of new products.

In case the new project uses already existing assets (generating cash flows) the cash flows foregone to use the above said assets represents the opportunity cost that must be included in the analysis of the new project. However, these foregone cash flows are not asset acquisition cash flows, but they represent operating cash flows that could have occurred but will not because of the new project, they must be considered part of the project's future operating cash flows.

Asset Disposal

At the end of the useful life of an asset the firm may be able to sell it or pay someone to diamantal and haul it away. If a firm is making replacement decision the cash flow from disposal of the asset must be factored in since this cash flow is relevant to the acquisition of the new assets. For the disposal of an existing asset whether at the end of the useful life or when it is replaced, two types of cash flows must be considered:

1) The firm receives or pays in disposing off the asset
2) The tax consequences resulting from the disposal.

Cash flow from disposing assets = proceeds or payments from disposal of assets – Taxes from disposing assets.

The tax on disposal would depend upon three factors:

1) The expected sales price.
2) The book value of the asset for tax purpose. The book value of an asset is (Original cost of acquisition – Accumulated depreciation). The book value is also referred to written Down Value (WDV).
3) The tax rate at the time of disposal.

If a firm sells the asset for more than its book value but for less uses than its original cost, the difference between the sales price and the book value for taxable purposes (called the tax basis) is a gain taxable at ordinary tax rates. If the firm sells the asset for more than its original cost than the gain is broken into two parts:

1) **Capital Gain:** The difference between the sales price and original cost.
2) **Recapture of Depreciation:** The difference between the original cost and the written down value.

The capital gains are taxed at special rates usually lower than the ordinary rates. The recapture of depreciation is taxed at the ordinary rate. If a firm sells off asset for less than its book value, the result is capital loss. The capital loss can be offset against capital gains.

Operating Cash Flows

In the simplest form of investment there is a cash outflow when assets are acquired and there may be either cash outflow or inflow during the economic life of the asset. The investment in assets or undertaking new projects results in change in revenue,

expenditure, taxes and working capital. These are operating cash flows which result directly from the operating activities.

The operating cash flows cannot be predicted accurately for the future but an effort must be made to estimate the input for future planning. These estimates depend upon research, engineering analysis, operation research, competitor's analyses and managerial experience.

Estimating Cash flows

Non Discounted Cash Flow Criteria

Capital budgeting decisions are based on future information relating to costs and benefits associated with all the proposals being considered, besides the required rate of return which measures profitability. Therefore, the following data or information is required before using any technique of capital budgeting.

Cash Flows

In capital budgeting decisions, the costs and benefits of a proposal are measured in terms of cash flows. Clash flows refer to cash revenue minus cash expenses or cash oriented measures of return generated by a proposal. The costs are denoted as cash outflows whereas the benefits are denoted as cash inflows. The cash flows associated with a proposal, usually, involves the following three types of cash flows:

- Initial Investment or Cash Outflows • Net Annual Cash Inflows
- Terminal Cash Inflows. **Initial Investment or Cash Outflows** In case of new projects, the initial investment is an outlay of total cash outflows that takes place in the initial period (zero time period) when an asset is purchased. It comprises:

- ***Cost of New Asset*** to purchase land, building, machinery etc. including expenses on insurance, freight, loading and unloading, installation cost etc.

- ***Opportunity Cost***, if the new investment makes use of some existing facilities for example, if a firm proposes to invest in a machine to be installed on some surplus land of the firm, the opportunity cost of this land would be its selling price.

- ***Additional Working Capital*** i.e., excess of current assets over current liabilities required to extend additional credit, to carry additional inventory, and to enlarge its cash balances.

In cash of **replacement projects,** while determining the amount of initial investment in the new asset in place of an old asset, the scrap or salvage value of the old asset is deducted from the cost and installation charges of the new asset.

The computation of cash outflows has been shown in the following *Table*:

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Computation of Initial Investment

	Rs.
Purchase Price of the Asset (including duties and taxes, if any)	…….
Add : Insurance, Freight and Installations costs	…….
Add : Net Opportunity Cost (if any)	…….
Add : Net increase in working capital required	…….
	…….
Less : Cash Inflows in the form of scrap of salvage value of the old assets (in case of replacement decisions)	…….
Initial Investment or Cash Outlay	…….

Net Annual Cash Inflows or Operating Cash Flows

The initial investment or cash outflows are expected to generate a series of cash inflows in the form of cash profits by the project. These cash inflows may be the same every year throughout the life of the project or may vary from one year to another. These annual cash inflows are not accounting profits, because accounting profits are affected by accruals, provisions for future losses and non-cash transactions such as depreciation, preliminary expenses etc. Therefore, cash inflows that are related to capital budgeting decisions are the after tax cash inflows. In other words, net annual cash inflow refers to the annual net income (profits) before depreciation and after tax. For the calculation of these cash inflows, first of all income before tax is calculated by deducting all cash operating expenses and depreciation from the sales revenues. After deducting the tax, the amount of depreciation is added to the income after tax. The balance is the net cash inflows from the project which can also be calculated as follows:

NCF = Sales – EXP – DEP – TAX + DEP
Or = EBT – TAX + DEP

The amount of net annual cash inflows may also be determined by preparing a profitability statement in the following way:

(1) Profitability Statement (in revenue increasing decisions):

	Rs.
Annual Sales Revenue	……..
Less : Operating Expenses including depreciation	……..
Income before tax	…….
Less: Income Tax	…….
Net Income after tax	……..
Add : Depreciation	……..
Net Cash Inflows	……

(2) Profitability Statement (in cost reduction decision):

	Rs.
(A) Estimated Saving	
Estimated Savings in direct wages	…….
Estimated Savings in Scrap	…….
Total Savings (A)	…….
(B) Estimated Additional Costs	
Additional cost of maintenance	……..
Additional cost of supervision Add:	……..
Cost of indirect material	……..
Additional depreciation	……..
Total Additional Costs (B)	……..
Net Savings before tax (A−B)	……..
Less : Income Tax	……..
Net Savings after tax	……..
Add: Additional depreciation	……..
Net Savings after tax or Cash Inflows	.
	……..

(3) Terminal Cash Inflows

The cash inflows for the last or terminal year of the project will also include the terminal cash inflows in addition to annual cash inflows. The terminal cash inflows i.e., cash inflows to the firm in the last (terminal) year may occur in two ways:

(i) The estimated salvage or scrap value of the project realisable at the end of the economic life of the project or at the time of its termination,

(ii) The working capital which was invested in the beginning will no longer be required as the project is being terminated. This working capital released will be available back to the firm.

Payback Period Method

In the Payback period method the payback period is usually expressed in years, the time in which the cash outflows equal cash inflows. This method is focused on liquidity and profitability. This method recognises the original capital invested in a project. The basic element of this method is calculation of recovery time, by accumulation of the cash inflow (including depreciation) year by year until the cash inflows equal the amount of original investment. In simple terms it may be defined as the number of years required to recover the cost of investments.

$$\text{Payback period} = \frac{\text{Initial Investments } C_o}{} =$$

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AnnualCashflows C

Example 3.1:

Initial Investment Year	Project X (1,00,000)		Project Y (1,00,000)	
	Cash inflows to date	Total cash inflows	Cash inflows to date	Total cash inflows
1	20000	20000	25000	25000
2	20000	40000	25000	50000
3	30000	70000	50000	100000
4	30000	100000	20000	120000
5	50000	150000	10000	130000

Solution:
In this example project Y would be selected as its payback period of three years is shorter than the four years payback period of Project X.

Bail out Factor

In the above discussion we have skipped the probability of scrapping the project before the payback period. The salvage value of the project has to be taken into consideration. The bailout payback time is reached when the cumulative cash receipts plus the salvage value at the end of a particular year equals the initial investment.

Example 3.2: Project A costs Rs. 200000 and Project B Costs Rs. 3000000 both have a ten-year life. Uniform cash receipts expected are A Rs. 40,000 p.a. and B Rs. 80,000 p.a. Calculate the payback period.

Solution:

Under traditional payback

$$\text{Project A} = \frac{\text{Rs.2,00,000}}{\text{Rs.40,000}} = 5 \text{ years}$$

$$\text{Project B} = \frac{\text{Rs.3,00,000}}{\text{Rs.80,000}} = 3.75 \text{ years}$$

Merits of Payback Method

(a) It is simple and easy to understand and apply.
(b) This method is useful in case of capital rationing and in situations where there is high amount of uncertainity.
(c) Assuming regarding future interest rates are not changing.
(d) Firms facing liquidity constraints can use this technique to rank projects according to their ability to repay quickly.

Demerits of Payback Method

(a) This method does not take into consideration the time value of money.
(b) This method ignores cash generation beyond payback period.
(c) This method does not indicate whether an investment should be accepted or rejected.
(d) This method is biased against those investments which yield return after a long period.

Payback Period Reciprocal

An alternative way of expressing payback period is "payback period reciprocal" which is expressed as

$$\frac{1}{\text{PaybackPeriod}} \times 100$$

Thus, if a project has a payback period of 5 years then the payback period reciprocal would be

$$\frac{1}{5} \times 100 = 20\%$$

Accounting Rate of Return Method (ARR)

The Accounting Rate of Return uses the accounting information as revealed by financial statements, to measure the profitability of an investment. The accounting rate of return is the ratio of average after tax profit divided by average investment.

$$\text{ARR} = \frac{\text{Average Income}}{\text{AverageInvestment}}$$

$$\frac{\sum_{t=1}^{n} \text{EBIT}(1-\text{T})/\text{n}}{(I_0 + I_n)/2}$$

Here average income is adjusted for interest. Of the various accounting rate of return, the highest rate of return is taken to be the best investment proposal. In case the accounting rate of return is less than the cost of capital or the prevailing interest rate than that particular investment proposal is rejected.

Example 3.3: A project with a capital expenditure of Rs. 5,00,000 is expected to produce the following profits (after deducting depreciation).

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Year	Rs.
1	40,000
2	80,000
3	90,000
4	30,000

Solution :

$$\text{Average annual profits} = \frac{40,000 + 80,000 + 90,000 + 30,000}{4} = \text{Rs.}60,000$$

Average investment assuming no scrap value is the average of the investment at the beginning and the investment at the end.

$$\text{i.e., } \frac{\text{Rs.}5,00,000 + 0}{2} = \text{Rs.}2,50,000$$

Note: If the residual value is not zero but say Rs. 60,000 then the average investment would be,

$$\frac{\text{Rs. } 5,00,000 + \text{Rs.}60,000}{2} = \text{Rs. } 2,80,000$$

$$\text{The accounting rates of return} = \frac{\text{Rs.}60,000}{\text{Rs.}2,50,000} \times 100 = 24\%$$

This percentage is compared with those of other projects in order that the investment yielding the highest rate of return can be selected.

Example 3.4: Consider the following investment opportunity:

A machine is available for purchase at a cost of Rs. 80,000.

We expect it to have a life of five years and to have a scrap value of Rs. 10,000 at the end of the five-year period. We have estimated that it will generate additional profits over its life as follows:

Year	Rs.
1	20,000
2	40,000
3	30,000
4	15,000
5	5,000

These estimates are of profits before depreciation. You are required to calculate the return on capital employed.

Solution:

Total profit before deprecation over the life of the machine = Rs. 1,10,000

$$\text{Average profit p. a.} = \frac{\text{Rs.1,10,000}}{\text{5years}} = \text{Rs. 22,000}$$

Total depreciation over the life of the machine = Rs. 80,000 − Rs. 10,000 = Rs 70,000

$$\text{Average depreciation p.a.} = \frac{\text{Rs.70,000}}{\text{5years}} = \text{Rs.14,000}$$

Average annual profit after depreciation = Rs. 22,000 − Rs. 14,000 = Rs. 8,000

Original investment required = Rs. 80,000

$$\text{Accounting rate of return} = \frac{\text{Rs.8,000}}{80,000} \times 100 = 10\%$$

Return on average investment:

$$\text{Average investment} = \frac{80,000 + 10,000}{2} = \text{Rs.45,000}$$

$$\text{Therefore, accounting rate of return} = \frac{8,000}{45,000} \times 100 = 17.78\%$$

Merits of ARR

- It is easy to calculate
- It is not based on cash flows but on profits
- It takes into consideration all the years involved in the life of the project.

Demerits of ARR

- It does not take into consideration time value of money
- Change in depreciation policy may bring inconsistency in results
- This method fails to distinguish the size of the investment
- It is biased against short term projects
- Acceptance and rejection decisions are based on subjective management targets.

✆ Check Your Progress 1

1) A factory engaged in the manufacture of electronic goods has a ten-year old equipment depreciated on straight-line method. The useful life of the equipment was estimated to be 20 years with residual value of Rs.3 Lakhs (original cost of the equipment being Rs. 23 Lakhs). The output of the equipment is 1200 units per hour.

The management now proposes to install new equipment worth Rs. 50 Lakhs which has an estimated life of 15 years and a residual value of Rs. 5 Lakhs. The payment terms for the new equipment include a part exchange provision of

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Rs. 6 Lakhs in respect of the existing equipment. The output of the new equipment is 3,000 units per hours.

Particulars	Existing Equipment (Rs.)	New Equipment (Rs.)
Wages	1,00,000	1,20,000
Repair and Maintenance	20,000	52,000
Consumables	3,20,000	4,80,000
Power	1,20,000	1,50,000
Allocation of Fixed Costs	60,000	80,000
Total hours run per year	2,400	2,400

You are required to prepare a comparative schedule showing total conversion cost as well as cost per 1000 units after considering interest @ 10% on net cash outflow for procuring the new equipment and also for providing for the yearly recovery of the loss suffered in the transaction.

2) T.Ltd. has specialised in the manufacture of a particular type of transistor. Recently, it has developed a new model and is confident of selling all the 8,000 units (new product) that would be manufactured in a year. The required capital equipment would cost Rs. 25 Lakhs and that would have an economic life of 4 years with no significant salvage value at the end of such a period. During the first four years, the promotional expenses would be as planned below: -

Year	1	2	3	4
Expenses (Rs.)				
Advertisement	1,00,000	75,000	60,000	30,000
Others	50,000	75,000	90,000	1,20,000

Variable costs of producing and selling a unit would be Rs. 250. Additional fixed operating costs to be incurred because of this new products is budgeted at Rs. 75,000 per year. The management expects a discounted return of 15% (after tax) on investment in the new product. You are required to work out an initial selling price per unit of the new product that may be fixed with a view to obtaining the desired return on investment. Assume a tax rate of 40% and use of straight-line method of depreciation for tax purpose.

Note: The present value of annuity of Rs. 1 received or paid in a steady stream throughout the period of four years in the future at 15 % is 3.0078.

3) A company proposes to undertake one of the two mutually exclusive projects namely, AXE and BXE. The initial outlay and annual cash inflows are as under:

Particular	AXE	BXE
Initial Capital outlay (Rs.)	22,50,000	30,00,000
Salvage Value at the end of the life	0	0
Economic life (years)	4	7

Particulars		AXE	BXE
	Year	Rs. Lakhs	Rs. Lakhs
After tax annual cash inflows	1	6.00	5.00
	2	12.50	7.50
	3	10.00	7.50
	4	7.50	12.50
	5	-	12.50
	6	-	10.00
	7	-	8.00

The company's cost of capital is 16%.

Required: (i) Calculate for each project (a) Net present value of Cash flows (b) Internal rate of return (ii) Recommend with reasons, which of the two projects should be undertaken by the Company.

Present value of Re. 1

Year	16%	19%	20%	21%	22%	23%
1	.862	.840	.833	.826	.820	.813
2	.743	.706	.694	.683	.672	.661
3	.641	.593	.579	.564	.551	.537
4	.532	.499	.482	.467	.451	.437
5	.476	.419	.402	.386	.370	.355
6	.410	.352	.335	.319	.303	.289
7	.354	.296	.279	.263	.249	.235
8	.305	.249	.233	.218	.204	.191

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Discounted Cash Flow (DCF) Techniques

1) Net Present Value (NPV) Method

In this method all cash flows attributable to a capital investment project are discounted by a chosen percentage e.g., the firms weighted average cost of capital to obtain the present value of the future cash flows. If the present value of the future cash flows is higher than the present value of the investments the proposal is accepted else rejected. In order to arrive at the net present value the present value of the future cash flows is deducted from the initial investment.

$$NPV = \frac{C_1}{(1+k)} + \frac{C_2}{(1+k)^2} + \frac{C_3}{(1+k)^3} + \ldots + \frac{C_n}{(1+k)^n} - C_0$$

$$NPV = \sum_{t=1}^{n} \frac{C_n}{(1+k)^t} - C_0$$

Where C_0 = initial investment (cash outflows)
C_t = Cash flows occurring at time t K= discount rate

Example 3.5: A firm can invest Rs. 10,000 in a project with a life of three years.

Year	Rs.
1	4,000
2	5,000
3	4,000

The cost of capital is 10% p.a should the investment be made?

Solution:

Firstly the discount factors can be calculated based on Rs. 1 received in with r rate of interest in 3 year

$$\frac{1}{(1+r)^n}$$

Year 1	$= \frac{Re.1}{(1.10/100)}$	$= \frac{Re.1}{(1.10)}$	= 0.909
Year 2	$= \frac{Re.1}{(1+10/100)^2}$	$= \frac{Re.1}{(1.10)^2}$	= 0.826

Year 3	$= \frac{\text{Re.1}}{(1+10/100)^3}$	$= \frac{\text{Re.1}}{(1.10)^3}$	= 0.751

In this chapter, the tables given at the end of the block are used wherever possible. Obviously, where a particular year or rate of interest is not given in the tables it will be necessary to resort to the basic discounting formula.

Year	Cash flow Rs.	Discount factor	Present value Rs.
0	10,000	1,000	10,000
1	4,000	0.909	636
2	5,000	0.826	4130
3	4,000	0.751	3.4
			NPV = 770

Since the net present value is positive, investment in the project can be made.

Example 3.6: Machine A costs Rs. 1,00,000 payable immediately. Machine B costs Rs. 1,20,000 half payable immediately and half payable in one year's time. The cash receipts expected are as follows:

Year (at the end)	A	B
1	20,000	
2	60,000	60,000
3	40,000	60,000
4	30,000	80,000
5	20,000	

With 7% interest which machine should be selected?

Solution:

Machine A

Year	Cash flow Rs.	DF@ 7%	PV Rs.
0	1,00,000	1,00000	1,00,000
1	20,000	0.93458	18692
2	60,000	0.87344	52,406
3	40,000	0.81630	32652
4	30,000	0.76289	22887
5	20,000	0.71299	14,260
			NPV = 40,897

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Machine B

Year	Cash Flow Rs	DF@ 7%	PV Rs.
0	60,000	1,00000	60000
1	60,000	0.93458	56075
2	60,000	0.857344	52406
3	60,000	0.81630	48978
4	80,000	0.76289	61.031
			NPV = 46340

Since Machine B has the higher NPV, our decision should be to select Machine B.

Merits of NPV Method:

- It recognise the time value of money
- It considers the total benefits arising out of the proposal over its lifetime.
- This method is particularly useful for selection of mutually exclusive projects

Demerits of NPV Method:

- It is difficult to calculate as well as understand.
- Calculating the discount rate is complicated.
- This method is an absolute measure. When two projects are considered this method will favour the project with the higher NPV.
- If two projects with different life spans are evaluated using this method, this method may not yield satisfactory result.

2) Internal Rate of Return (IRR) Method

Internal rate of return is a percentage discount rate used in capital investment appraisals which makes the present value of the cost of the project equal to the future cash flows of the project. It is the rate of return which equates the present value of anticipated net cash flows with the initial outlay. The IRR is also defined as the rate at which the net present value is Zero. The test of profitability of a project is the relationship between the internal rate of return (%) of the project and the minimum acceptable rate of return. The IRR can be determined by solving the following equation for r:

$$_{0} = \overset{=}{} + \overset{2}{} + \overset{3}{} + \ldots \overset{n}{} \qquad C_1 \quad C \quad C \quad C$$

$$(1+r) \quad (1+r)^2 \quad (1+k)^3 \quad (1+r) \qquad C$$

$$\_\_\_\_\_ \quad \_\_\_\_\_ \quad \_\_\_\_\_ \quad \_\_\_\_\_ n$$

$$C_0 = \sum_{tn=1} \_\_\_\_\_ (1C + {}_t r)_t - C_0 = 0$$

The IRR equation is the same as the one used for the NPV method. The only difference is that in the NPV method, the required rate of return k is known while in the IRR method the value of r has to be determined at which the net present value becomes zero.

A project is accepted if the internal rate of return is higher than the cost of capital.

Example 3.7: A company has to select one of the following two projects:

	Project A	Project B
Cost	11000	10000
Cash inflows		
Year 1	6000	1000
2	2000	1000
3	1000	2000
4	5000	10000

Using the internal rate of return method suggest which project is preferable.

Solution:

The cash inflow is not uniform and hence the internal rate of return will have to be calculated by the trial and error method. In order to have an approximate idea about such a rate, it will be better to find out the Factor. The factor reflects the same relationship of investment and cash inflows in case of payback calculation:

F	I/C
Where F	Factor to be located
I	Original investment
C	Average cash inflow per year
The factor in case of Project A would be:	The factor in case of Project B would be:
$F = \frac{11,000}{3,500} = 3.14$	$F = \frac{10,000}{3,500} = 2.86$

The factor thus calculated will be located in the table given at the end of the unit on the line representing number of years corresponding to estimated useful life of the asset.

This would give the expected rate of return to be applied for discounting the cash inflows, the internal rate of return.

In case of Project A, the rate comes to 10% while in case of Project B it comes to 15%.

Project A

Year	Cash inflows	Discounting factor at 10%`	Present value Rs.

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1	6,000	0.909	5454
2	2,000	0.826	1652
3	1,000	0.751	751
4	5,000	0.683	3415
Total present value			

The present value at 10% comes to Rs. 11,272. The initial investment is Rs. 11,000. Internal rate of return may be taken approximately at 10%.

In case more exactness is required another trial rate which is slightly higher than 10% (since at this rate the present value is more than initial investment may be taken) Taking a rate of 12%, the following results would emerge:

Year	Cash inflows Rs.	Discounting factor at 12%	Present value Rs.
1	6,000	0.893	5358
2	2,000	0.797	1594
3	1,000	0.712	712
4	5,000	0.636	3180
Total present			10,844

The internal rate of return is thus more than 10% but less than 12%. The exact rate may be calculated as follows. Difference calculated in present

P.V. required	Rs. 11,000	
P.V. at 10%	Rs. 11,272	(+) Rs. 272
P.V. at 12%	Rs. 10,844	(−) Rs. 156

Actual IRR = $10+\frac{272}{272+156}\times 2 = 11.27\%$

Project B

Year	Cash inflows Rs.	Discounting factor At 15%	Present Value Rs.
1	1,000	0.870	870
2	1,000	0.756	756
3	2,000	0.658	1316
4	10,000	0.572	5720
Total present value			8662

Since present value at 15% adds up to Rs. 8,662, a lower rate of discount should be taken. Taking a rate of 10% the following will be the result.

Year	Cash inflows Rs.	Discounting factor At 10%	Present Value Rs.
1	1000	0.909	909

2	1000	0.826	826
3	2000	0.751	1502
4	10000	0.683	6830
Total present value			10067

The present value at 10% cumulates Rs. 10067 which is more or less equal to the initial investment. Hence the internal rate of return may be taken as 10%
In order to have more exactness to internal rate of return can be interpolated as done in case of Project A.

P.V. required	Rs. 10,000	
P.V. at 10%	Rs. 10067	(+) Rs. 67
P.V. at 15%	Rs. 8,662	(−) Rs. 1,338
Actual IRR	$10+\frac{67}{67+1338}\times 5$	10.24%

Thus, internal rate of return in case of Project A is higher as compared to Project B. Hence, Project A is preferable.

Example 3.8: The project cash flows from two mutually exclusive Projects A and B are as under:

Period	Project A	Project B
0 (outflow)	Rs. 22,000	Rs. 27,000
1 to 4 (inflow)	Rs. 6,000 cash year	Rs. 7,000 each year
Project life	Years	7 years

- Advice on project selection with reference to internal rate of return
- Will it make any difference in project selection, if the cash flow from Project B is for 8 years instead of 7 year @ Rs. 7,000 each year?

Relevant P.V. factors at	For 7 years	For 8 years
15%	4.16	4.49
16%	4.04	4.34
17%	3.92	4.21
18%	3.81	4.08
19%	3.1	3.95
20%	3.60	3.84

Solution:

(i) Project selection based on internal rate of return.

The present values of Project A and Project B is calculated as follows:

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Discount Rate	P.V. Factor for 7 yrs.	Project A		Project B	
		Cash inflow p.a (Rs.)	P.V (Rs.)		
15%	4.16	6000	24960	7000	29120
16%	4.04	6000	24240	7000	28280
17%	3.92	6000	23520	7000	27440
18%	3.81	6000	22,860	7000	26670
19%	3.71	6000	22260	70000	25970
20%	3.60	6000	216000	7000	25200

Project A

Since the original investment in Project A is Rs. 22,000 its IRR will fall between 19% and 20%.

	Rs.
P.V. of cash inflows at 19%	22,260
P.V. of cash inflows at 20%	21,600
Difference	660

Now, IRR of Project A is calculated as follows, by applying the formula for interpretation:

$$\text{IRR} = 19 + \frac{22,260 - 22,000}{660} \times 1 = 19.4\% \text{ (approx)}$$

Project B

Since the original investment in project B is Rs. 27,000, its IRR will fall between 17% to 18%.

	Rs.
P.V. of cash inflows at 17%	27,440
P.V. of cash inflows at 18%	26,670
Difference	770

Now, the IRR of Project B is ascertained as follows:

$$\text{IRR} = 17 + \frac{27,440 - 27,000}{770} \times 1 = 17.6\% \text{ (approximately)}$$

Selection of Project:

The IRR of Project A and Project B are 19.4% and 17.6% respectively. A project can be selected because of its higher IRR over the other Projects. Hence Project A is to be preferred as it has a higher IRR of 19.4%.

(i) Calculation of IRR of Project B whose cash flow from the Project is for 8 years instead of 7 years

Discount factor	P.V. factor for 8 years Rs.	Cash inflow each year Rs.	P.V. of cash inflows
15%	4.49	7,000	31,430
16%	4.34	000	30380
17%	4.21	7,000	29470
18%	4.08	7000	28,560
19%	3.95	7,000	27,650
20%	3.84	7,000	26,880

Since, the original investment in Project B is Rs. 27, 000, its IRR will fall between 19% to 210%.

	Rs.
P.V. of cash inflows at 19%	27650
P.V. of cash inflows @ 20%	26880
Difference	770

Now, IRR of Project B is calculated as follows:

$$\text{IRR } 19 + \frac{27,650 - 27,000}{770} \times 1 = 19.8\% \text{ (}\textit{approximately}\text{)}$$

Selection of Project:

With the change in cash inflow of Project B from, 7 years to 8 years, its IRR is also improved from 17.6% to 19.8% and it is also higher than the IRB of Project A (i.e., 19.4%). Hence, Project B can be selected (based on its 8 years of cash inflows).

Example 3.9: Two investment projects are being considered with the following cash flow projections:

	Project 1	Project 2
Initial outlay		
Cash inflows		
Year 1	10	120
Year 2	30	90
Year 3	210	50
Year 4	50	10

Required:

(a) Prepare on a single graph present value profiles for each project. Use interest rates from 0% to 20% at 5% intervals.

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(b) Using the graph paper determine the IRR for each of the projects (c) State for which range of costs of capital Project 1 would be preferred to Project 2.

Solution:

Workgroups

	Undiscou -nted cash flow	Discounted at 5 %		Discounted at 10%		Discounted at 15%		Discounted at 20 %	
	Rs. 000	Discount factor	Cash Flow Rs. 000	Discount factor	Cash Flow Rs. 000	Discount factor	Cash Flow Rs. 000	Discount Factor	Cash Flow Rs. 000
t 1									
	(200)	1.000	(200)	1.000	(200)	1.000	(200)	1.000	(200)
	10	0.952	9.5	0.909	9.1	0.870	8.7	0.833	8.3
	30	0.907	27.2	0.826	24.8	0.756	22.7	0.694	20.8
	210	0.864	181.4	0.751	157.7	0.657	138.0	0.579	121.6
	50	0.823	41.2	0.683	34.2	0.572	28.6	0.482	24.1
	100		59.3		25.8		2.0		25.2
t 2									
	200	1.000	200	1.000	200	1.000	200	1.000	200
	120	0.952	114.2	0.909	109.1	0.870	104.4	0.833	100.0
	90	0.907	87.6	0.826	74.3	0.756	68.0	0.694	62.5
	50	0.864	43.2	0.51	37.6	0.657	32.9	0.579	29.0
	10	0.823	8.2	0.683	6.8	0.572	5.7	0.482	4.8
	70		47.2		27.8		11.0		3.7

R Project 1	15% (to nearest %)
R Project 2	19% to nearest %)

If the cost of capital is <9% (rounded) Project 1 would be preferred.

If the cost of capital is > 9% rounded project 2 would be preferred
The later cash inflows from Project 1 are more heavily discounted the higher the rate of interest in comparison with the earlier cash inflows on Project 2.

Merits of IRR Method:

(a) It considers the time value of money
(b) It takes into account total cash inflows and cash outflows.

Demerits of IRR Method:

(a) It involves tedious calculations, based on trial and error method
(b) It produces multiple rates which can be confusing (c)
Assessment of cash flows can't be estimated accurately (d)
Single discount rate ignores varying future interest rates.

3. Profitability Index (PI) Method

Another time adjusted method of evaluating the investment proposals is the Benefit Cost (B/C) ratio or Profitability Index (PI). Profitability Index is the ratio of the present value of cash inflows at the required rate of return, to the initial cash outflow of the investment. The formula for calculating benefit cost ratio or profitability index is as follows:

$$PI = \frac{\text{PV of cash inflows}}{\text{Initial cash outlay}} = \frac{PV(C_t)}{C_0} = \sum_{t=1}^{n} (1+k)_t \div C_0$$

A project may be accepted if it's PI is greater than one.

Example 3.10: The following mutually exclusive projects can be considered**:**

Rs.

Particulars	Project A	Project B
1. P.V of cash inflows	20,000	8,000
2. Initial cash outlay	15,000	5,000
3. Net present value	5,000	3,000
4. Profitability index 1/2	1.33	1.60

Solution:

Accordingly to the NPV Method, Project A would be preferred, whereas accordingly to Profitability Index Project B would be preferred.

Although PI method is based on NPV, it is a better evaluation technique than NPV in a situation of capital rationing. For example, two projects may have the same NPV of Rs. 10,000 but Project A requires initial outlay of Rs, 1,00,000 where as B only Rs. 50,000. Project B would be preferred as per the yardstick of the PI method.

Example 3.11:

Original outlay Rs 8,000
Life of the project 3 years
Cash inflows Rs. 4,000 p.a for 3 years
Cost of capital 10% p.a
Expected interest rates at which the cash inflows will be re-invested:

Year end	%
1	8

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2	8
3	8

Solution:

First of all, it is necessary to calculate of the total compounded sum which will be discounted to the present value.

Year	Cash inflow Rs.	Rate of Interest %	Years for investment	Compounding factor	Total compounding sum (Rs)
1	4,000	8	2	1.166	4,664
2	4,000	8	1	1.080	4,320
3	4,000	8	0	1.000	4,000
					12,984

Now, we have to calculate the present value of Rs. 12,984 by applying the discount rate of 10%

$$\text{Present Value} = \frac{\text{Compounded value of cash inflow}}{(1+i)^n}$$

$$= \frac{12,984}{(1.10)^3} = \text{Rs.}9,755 = 12984 \times 0.7513 = \text{Rs,}9,755$$

(0.7513 being the p.v of Re. 1 received after 3 years).

Here, since the present value of reinvested cash flows i.e Rs. 9,755 is greater than the original cash outlay of Rs. 8,000, the project would be accepted under the terminal value criterion.

Example 3.12: XYZ Ltd. is implementing a project with a initial capital outlay of Rs. 7,600. Its cash inflows are as follows:

Year	Rs.
1	6,000
2	2,000
3	1,000
4	5,000

The expected rate of return on the capital invested is 12% p.a calculate the discounted payback period of the project. **Solution:**

Computation of present value of cash flows.

Year	Cash inflow Rs.	Discounted factor @ 12%	Present Value Rs.
1.	6,000	0.893	5,358
2	2,000	0.797	1,594
3	1,000	0.712	712
4	5,000	0.636	3,180
		Total P.V	10,844

The discounted payback period of the project is 3 years i.e., the discounted cash inflows for the first three years (i.e., Rs. 5358 +Rs. 1594 + 712) is equivalent to the initial capital outlay of Rs. 7600.

Example 3.13: A Company is considering a capital investment proposal where two alternatives involving differing degrees of mechanisation are being considered. Both investments would have a five-year life.

In Option 1 new machinery would cost Rs. 2,78,000 and in Option 2 Rs. 8,05,000. Anticipated scrap values after 5 years are Rs. 28,000 and 1,50,000 respectively. Depreciation is provided on a straight-line basis. Option 1 would generate annual cash inflows of Rs. 1,00,000 and Option 2, Rs. 2,50,000. The cost of capital is 15%.

Required:

(a) Calculate for each option:
  (i) the payback period
  (ii) the accounting rate of return, based on average book value
  (iii) the net present value
  (iv) the internal rate of return

(b) Identify the preferred option, giving reasons for your choice.

(a) (i) **Payback period:**

$$\text{Option 1} = \frac{2,78,000}{1,00,000} = 2.78 \text{years}$$

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$$\text{Option 2} = \frac{8,05,000}{2,50,000} = 3.32 \text{ years}$$

(ii) **Accounting rate of return:**

Option 1

Annual Depreciation	$\frac{2,78,000 - 28,000}{5}$	50,000
Annual Profit	Rs. 50,000 (1, 00,000 cash flow − 50,000 depreciation)	
Average Investment	$\frac{2,78,000 + 28,000}{2}$	1,53,000
Accounting rate of return	$\frac{50,000}{1,53,000} \times 100\%$	33%

Option 2

Annual depreciation	$\frac{8,05,000 - 1,50,000}{5}$	Rs. 1,31,000
Annual Profit	Rs. 1,19,000	Rs. 2,50,000 cash flow- Rs. 1,31,000 depreciation
Average investment	$\frac{8,05,000 + 1,50,000}{2}$	Rs. 4,77,500
Accounting rate of return	$\frac{1,19,000}{4,77,500} \times 100$	25%

(iii) **Net present value (at 15% cost of capital):**

Option 1

Year 0		(2,78,000)
Year 1-5	(1,00,000×3.353)	3,35,300
Year 5	(28,000×0.497)	13,900
	NPV	71,200

Option 2

Approx cumulative discount factor (5 year) = $\frac{7,40,000}{2,50,000} = 2.96 = 20\%$

NPV at 20% **(Rs.)**

Year 0		(8,05,000)
Year 1-5	(2,50,000×3.353)	8,38,300
Year 5	(1,50,000× 0.497)	74,500
	NPV	1,07,800

(iv) **Internal rate of return:**

Option 1

Approx: Commutative discount factor (5 years) = $\frac{2,68,000}{1,00,000}$ = 2.68 = 25%

NPV at 25%

Year 0		(2,78,000)
Year 1-5	(1,00,000x 2.689)	2,68,900
Year 5	(28,000 x 0.328)	9,200
	NPV	100

IRR 25%

Option 2

Approx cumulative discount factor (5 years) $\frac{7,40,000}{2,50,000}$ = 2.96 = 20%

NPV at 20% :

Year 0		(8,05,000)
Year 1-5	(2,50,000 ×2.991)	7,47,700
Year 5	(1,50,000 ×0.402)	60,300
	NPV	3,000

IRR = 15%+$\left(\frac{5\times 1,07,800}{1,04,800}\right)$= 20.1% ∴IRR 20%

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Both projects are indicated as being worthwhile when the discounted cash flow returns are compared with the cost of capital. The payback period, accounting rate of return, and internal rate of return calculations all points to option 1 being preferred. The net present value calculation, on the other hand, favours option 2.

The basic reason for the different ranking provided by the NPV method is an absolute money measure which takes into account the scale of the investment as well as the quality. The other three appraisal methods provide measure, which express returns relative to the investment. Investments of comparable relative quality will have the same returns regardless of scale. For example, an annual profit of Rs. 20 on an investment of Rs. 100 will have the same relative return as an annual profit of Rs. 2,00,000 on an investment of Rs. 10,00,000. If one is concerned especially with quality then the relative measures would provide the required ranking. However, if the objective is to maximise wealth, investment worth should be measured by the surplus net present value generated, over and above the cost of the capital.

In the situation in the question the differential between option 1 and option 2 provides an internal rate of return of 18% as follows:

NPV at 18%

Year 0		(5,27,000)
Year 1-5	(1,50,000 ×3.127)	4,69,100
Year 5	(1,22,000 ×0.437)	53,300
	NPV	4,600

The additional investment of Rs. 5,27,000 in option 2 is worthwhile as the IRR of 18 % exceeds the cost of capital.

Finally, it should be recognised that both the payback method and the accounting rate of return method have deficiencies. They do not provide an adequate measure of investment worth. The percentage return including the accounting rate of return calculations is not comparable with the cost of the capital.

The PI method is a conceptually sound method. It takes into consideration the time value of money. It is also consistent with the value maximisation principle. Like NPV and IRR methods the PI method also requires estimations of cash flows and discount rate. In practice, the estimation of discount rates and cash flows is difficult.

✆ Check Your Progress 2

1) Precision Instruments is considering two mutually exclusive Project X and Y: Following details are made available to you.

		Project X	Project Y
Project Cost		700	700

Cash inflows:	Year 1	100	500
	Year 2	200	400
	Year 3	300	200
	Year 4	450	100
	Year 5	600	100
	Total	1,650	1,300

Assume no residual values at the end of the fifth year. The firm's cost of capital is 10% required, in respect of each of the two projects: (i) Net present value, using 10% discounting (ii) Internal rate of return: (iii) Profitability index.

Present Value of Re.1

Year	**10%**	**25%**	**26%**	**2%**	**28%**	**36%**	**37%**	**38%**	**40%**
1	.909	.800	.794	.787	.781	.735	.730	.725	.714
2	.826	.640	.630	.620	.610	.541	.533	.525	.510
3	.751	.512	.500	.488	.477	.398	.389	.381	.364
4	.683	.410	.397	.384	.373	.292	.284	.276	.260
5	.621	.328	.315	.303	.291	.215	.207	.200	.186

2) XYZ Ltd. Has decided to diversity its production and wants to invest its surplus funds on a profitable project. It has under consideration only two projects. "A" and "B". The cost of Project "A" is Rs. 100 Lakhs and that of "B" is Rs. 150 Lakhs. Both projects are expected to have a life of 8 years only and at the end of this period "A" will have a salvage value of Rs 4 Lakhs and "B" Rs. 14 Lakhs. The running expenses of "A" will be Rs. 35 Lakhs per year and that of "B" Rs. 20 Lakhs per year. In both case the company expects a rate of return of 10%. The company tax rate is 50%. Depreciation is charged on a straight-line basis. Which project should the company take up?

Note: Present value of annuity of Re. 1 for eight years at 10% is 5.335 and present value of Re. 1 received at the end of the eight-year is 0.467.

3) National Electronics Ltd. An electronic goods manufacturing company, is producing a large range of electronic goods. It has under consideration two projects "X" and "Y", each costing Rs. 120 Lakhs.

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The projects are mutually exclusive and the company is considering the selection of one of the two projects. Cash flows have been worked out for both the projects and the details are given below. "X" has a life of 8 years and "Y" has a life of 6 years. Both will have zero salvage value at the end of their operational lives. The company is already making profits and its tax rate is 50%. The cost of capital of the company is 15%.

At the end of the year	Project "X"	Project "Y"	Preset value of rupee at 15%
	(In Lakhs of rupees)		
1	25	40	0.870
2	35	60	0.756
3	45	80	0.685
4	65	50	0.572
5	65	30	0.497
6	55	20	0.432
7	35	-	0.36
8	15	-	0.327

The company presently follow straight-line method of depreciating assets. Advises the company regarding the selection of the project.

3.5 SUMMARY

Capital investment decisions are complex decisions as they involve estimating future cash flows associated with that particular investment. There are broadly two techniques which are used for appraising the worth of an investment project:

(i) Discounted cash flow criteria
(ii) Non discounted cash flow
criteria.

The basic difference between these two techniques is that the former uses the concept of the time value of money, whereas in the latter technique absolute returns are used.

3.6 SELF-ASSESSMENT QUESTIONS/EXERCISES

1) Write short notes on 'Internal Rate of Return'.

2) Write short notes on 'Capital Rationing'.

3) Write short notes on an 'Average Rate of Return'.

4) What is meant by 'Internal Rate of Return' of a project? How do you calculate I.R.R (Internal Rate of Return) given the initial investment on the Project and cash flows arising during the expected life of the Project?

5) Write short notes on 'Accounting Rate of Return'.

6) Distinguish clearly between Average rate of return and Internal rate of return.

7) Explain the operation of any two techniques (one a discounting method and another a none-discounting one for evaluation of investment decisions.

8) Write short notes on 'Profitability Index'.

9) What criteria must be satisfied for an investment evaluation to be ideal?

10) Can the payback period method of evaluating projects identify the ones that will maximise wealth? Explain.

11) Consider two projects, AA and BB, that have identical, positive net present values, but project BB is riskier than AA. If these projects are mutually exclusive, what is your investment decision?

12) Can the net present value method of evaluating projects identify the ones that will maximise wealth? Explain.

13) The decision rules for the net present value and the profitability index methods are related. Explain the relationship between these two sets of decision rules.

14) What is the source of the conflict between net present value and the profitability index decision rules in evaluating mutually exclusive projects?

15) Suppose you calculate a project's net present value to be Rs.3,000, what does this mean?

16) Suppose you calculate a project's profitability index to be 1.4. What does this mean?

17) The internal rate of return is often referred to as the yield on an investment. Explain the analogy between the internal rate of return on an investment and the yield-to maturity on a bond.

18) The net present value method and the internal rate of return method may produce different decisions when selecting among mutually exclusive projects. What is the source of this conflict?

19) The modified internal rate of return is designed to overcome a deficiency in the internal rate of return method. Specifically, what problem is the MIRR designed to overcome?

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20) Based upon our analysis of the alternative techniques to evaluate projects, which method or methods are preferable in terms of maximising owners' wealth?

21) You are evaluating an investment project, Project ZZ, with the following cash flows?

Period	Cash Flow Rs.
0	100,000
1	35,027
2	35,027
3	35,027
4	35,027

Calculate the following:

(a) Payback period
(b) Net present value, assuming a 10% cost of capital (c) Net present value, assuming a 16% cost of capital
(d) Profitability index, assuming a 10% cost of capital
(e) Internal rate of return

26) You are evaluating an investment project, Project YY with the following cash flow:

Period	Cash Flow Rs.
0	100,000
1	43,798
2	35,027
3	35,027
4	35,027

Calculate the following:

(a) Payback period

(b) Net present value, assuming a 10% cost of capital (c) Net present value, assuming a 14% cost of capital

(d) Profitability index, assuming a 10% cost of capital

(e) Profitability index, assuming a 14% cost of capital

(f) Internal rate of return

27) You are evaluating an investment project, Project XX with the following cash flows:

Period	Cash Flow Rs.
0	200,000
1	65,000
2	65,000
3	65,000
4	65,000
5	65,000

Calculating the following:

(a) Payback period

(b) Net present value, assuming a 10% cost of capital (c) Net present value, assuming a 15% cost of capital

(d) Profitability index, assuming a 10% cost of capital

(e) Profitability index, assuming a 15% cost of capital

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(f) Internal rate of return

28) Suppose you are evaluating two mutually exclusive projects, Project/Item 1 and Project/Item 2 with the following cash flows:

End of Year Cash Flows		
Year	Item 1 Rs.	Item 2 Rs.
2000	10,000	Rs.10,000
2001	3,293	0
2002	3,293	0
2003	3,293	0
2004	3,293	14,641

(a) If the cost of capital on both project, is 5% which project, if any, would you choose? Why?

(b) If the cost of capital on both projects is 8% which project, if any, would you choose? Why?

(c) If the cost of capital on both projects is 11% which project, if any, would you choose? Why?

(d) If the cost of capital on both projects is 14% which projects, if any, would you choose? Why?

(e) At what discount rate would you be indifferent between choosing Item 1 and Item 2?

(f) On the same graph, draw the investment profiles of Item 1 and Item 2. Indicate the following terms:

- Crossover discount rate
- NPV of Item 1 if the cost of Capital is 5%
- NPV of Item 2 if cost of Capital is 5%
- IRR of Item 1
- IRR of Item 2

29) Consider the results after analysing the following five projects:

Projects	Outlay Rs.	NPV Rs.
AA	300,000	10,000
BB	400,000	20,000
CC	200,000	10,000
DD	100,000	10,000
EE	200,000	-15,000

Suppose there is a limit on the capital budget of Rs.600,000. Which projects should we invest in, given our capital budget?

30) Consider these three independent projects?

Period	FF Rs.	GG Rs.	HH Rs.
0	100,000	200,000	300,000
1	30,000	40,000	40,000
2	30,000	40,000	40,000
3	30,000	40,000	40,000
4	40,000	120,000	240,000
Cost of Capital	5%	6%	7%

(a) If there is no limit on the capital budget, which projects would you choose? Why?

(b) If there is a limit on the capital budget of Rs.300,000, which projects would you choose? Why?

3.7 SOLUTIONS/ANSWERS

Check Your Progress 1

1) Working notes:

(i) Calculation of Depreciation per annum

$$\text{Existing equipment} = \frac{\text{Rs.23,00,000} - \text{Rs.3,00,000}}{20\text{year}} = \text{Rs.1,00,000p.a.}$$

$$\text{New equipment} = \frac{\text{Rs.50,00,000} - \text{Rs.5,00,000}}{15\text{year}} = \text{Rs.3,00,000p.a.}$$

(ii) Loss on sale of existing equipment

(Rs.)

Cost	23,00,000
Less Deprecation (Rs)1,00,000×10*years*)	10,00,000
	13,00,000

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Less: Exchange value	6,00,000
Loss on exchange with new equipment	7,00,000

Loss per annum = Rs. 7,00,000/10 years = Rs. 70,000 p.a

(iii) Calculation of Interest (cash outflow) on purchase of new equipment

(Rs.)

Cost of new equipment	50,00000
Less Exchange value of old equipment Deprecation	6,00,000
Net cash outflow	44,00,000
Interest (Rs. 44,00,000×10/100)	6,00,000

Comparative statement showing total conversation cost as well as cost 1,000 units.

Particulars	Equipment	
	Old	New
Annual Depreciation	1,00,000	3,00,000
Loss on sale of old equipment	-	70,000
Interest on capital	-	4,40,000
Wages	1,00,000	1,20,000
Repairs and Maintenance	20,000	52,000
Consumables	3,20,000	4,80,000
Power	1,20,000	1,50,000
Allocation of fixed expenses	60,000	80,000
Total conversation Cost (i)	7,20,000	16,92,000
Total run hours p.a (ii)	2,400	2,400
Operating Cost per hour (rs.) (i) (ii)	300	705
Output per hour (Units)	1,200	3000
Operating Cost (per 1,000 Units Units Rs.)	250	235

Analysis:

On replacement of existing equipment with new equipment there is a saving of Rs. 15 (i.e., Rs. 250- Rs. 235) per 1,000 units. Hence, replacement is recommended.

2) Let the initial selling price per unit of new product be 'x'

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Then total sales = 8000 units ×x = 8,000 x

Calculation of cash costs p.a

(Rs.)

Variable costs	(8,000 units×Rs. 250	20,00,000
Advt. And other expenses		1,50,000
Addl. Fixed operating cost		75,000

Total Cash costs p.a		22,25,000

Depreciation p.a	Rs.25,00,000 / 4years	Rs. 6,25,000 p.a
Profit before Tax	8,000 x−(22,25,000+6,25,000)	8,000x–28,50,000
Tax @ 40% on Profit	0.40 (8,000x−28, 50,000	3,200x−11,40,000
Total Cash outflow	22,25,000+3,200x−11, 40,000	3,200x+10,85,000
Net Annual Cash inflow	8,000×−(3,200x+10,85,000)	4,800x−10,85,000
Initial cash outflow	Present value of cash inflow	
Rs. 25,00,000	(4,800×-10, 85,000) ×3.0079	
25,00,000	14,438×-32,63,571.50	
14.438x	25,00,000+32,63,571.50	
14.438x	57,63,57,1.50	
X	57,63,51.50/14,438	Rs. 399.20

Hence, the initial selling price of the new product is Rs. 399.20 per unit.

3) (i) NPV and IRR for the two project proposals:

Year	AXE			BXE		
	Cash flows Rs. Lakhs	Discount Factor @ 16%	Total PVs Rs. Lakhs	Cash flows Rs. Lakhs	Discount Factor @ 16%	Total PVs Rs. lakhs
0	22.50	1.000	22.50	30.00	1.000	30.00
1	6.00	0.862	5.17	5.00	0.862	4.30
2	12.50	0.743	9.29	7.50	0.743	5.57
3	10.00	0.641	6.41	7.50	0.641	4.81
4	7.50	0.552	4.14	12.50	0.552	6.90

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5				12.50	0.476	5.95
6				10.00	0.410	4.10
7				8.00	0.354	2.83
Net Present value			2.51			4.46
Year	AXE			BXE		
	Cash flows Rs. Lakhs	Discount Factor @20%	Total PVs Rs. Lakhs	Cash flows Rs. Lakhs	Discount Factor @ 24%	Total PVs Rs. Lakhs
0	22.50	1.000	22.50	30.00	1.000	30.00
1	6.00	0.833	5.00	5.00	0.806	4.03
2	12.50	0.694	8.68	7.50	0.650	4.88
3.	10.00	0.579	5.79	7.50	0.524	3.93
4	7.50	0.482	3.62	12.50	0.423	5.29
5	-	-	-	12.50	0.341	4.26
6	-	-	-	10.00	0.275	2.75
7	-	-	-	8.00	0.222	1.78
Profit Value			23.09			26.92
Less Initial Outlay			22.50			30.00
NPV			0.59			3.08

IRR

Project AXE = $16 + \times 4 \quad \frac{2.51}{51 - 0.59}$ = 16+5.23 = 21.23% 2.

$\frac{4.46}{46 + 3.08}$ Project BX = $16 + \times 8$ = 16+4.73 = 20.73% 4.

(ii) Analysis:

The IRRs of both projects AXE and BXE are very similar, with barely one-half % separating them from each other. In such a case of marginal difference, it would be necessary to re-validate key assumptions and use sensitivity analysis to determine impact upon project returns to changes in key variables. The project that is less sensitive to such variations may be preferred. Also while NPVs and IRRs may provide a basis for financial decision-making, it is very important to check whether either project is in line with corporate strategy. The

one more in tune with such strategy may be preferred even if the financial numbers are not the highest among the competing proposals.

Check Your Progress 2

1) (i) Net Present Value (NPV) (10% discounting)

(Rs. Lakhs)

Year	EFAT		PV Factor at 10%	Total PV	
	X	Y		X	Y
0	700	700	1.000	700	700
1	100	500	0.909	90.90	454.50
2	200	400	0.826	165.20	330.40
3	300	200	0.751	225.30	150.20
4	450	100	0.683	307.35	68.30
5	600	100	0.621	372.60	62.10
			Net Present value	461.35	365.50

(ii) Internal Rate of Return (IRR)

Project X (Rs. In lakhs)

Year	CFAT X	PV Factor At		Total PV At	
		27%	28%	27%	28%
0	700	1.0	1.0	700.00	700.00
1	100	.787	.781	78.70	78.10
2	200	.620	.610	124.00	122.00
3	300	.488	.477	146.40	143.10
4	450	.384	.373	172.80	167.85
5	600	.303	.291	181.80	174.60
NPV				3.70	14.35

IRR = $27 + \times 1 =$ 27+0.205 = 27.21%

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$\frac{3.70}{70+14.35}$ 3.

Project X (Rs. In lakhs)

Year	CFAT X	PV Factor at		Total PV At	
		37%	38%	37%	38%
0	700	1.000	1.000	700.00	7.00.00
1	500	.730	.725	365.00	362.50
2	400	.533	.525	213.20	210.00
3	200	.389	.381	7.80	6.20
4	100	.284	.276	28.40	27.60
5	100	.207	.200	20.70	20.0
NPV				5.10	3.00

$\frac{5.10}{10+3.00}$ IRR = $37+\times 1=$
37+0.63 = 37.63% 5.

(iii) Profitability Index

PI	$\frac{\text{TotalP.V.of cashinflow@10\%}}{\text{Initialcashoutlay}}$
Project X	$\frac{\text{Rs.1,161.35Lakhs}}{\text{Rs.700Lakhs}} = 1.659$
Project Y	$\frac{\text{Rs.1,065.50Lakhs}}{\text{Rs.700Lakhs}} = 1.522$

2) Computation of NPV of the Projects

(Rs. in Lakhs)

Particulars		Project A	Project B
Profit after Tax	(10% of cost of Project	10.00	15.00
Add: Depreciation	(p.a)	12.00	17.00

Net cash inflow p.a		22.00	32.00
Present value of Net cash inflow for 8 years @ 10% annuity i.e. annuity factor 5.335		117.370	170.72
Present value of salvage value at the end of 8th year at 0.467		1.868	6.538
P.V. of Total Cash inflow		119.238	177.258
Less: Initial investment		100.000	150.000
Net Preset Value		19.238	27.258

Analysis:
Under the NPV analysis of Projects, Project B has higher NPV. Hence, Project B is suggested for implementation.

3) Computation of net present value of the projects

Project "X" (Rs. in Lakhs)

End of year	Cash flow	Depreciation	PBY	Tax	PAT	Net C.F. (PAT+Deprn.)	Discount factor @ 15%	P.V
1	25	15	10	5	5	20	0.870	17.40
2	35	15	20	10	10	25	0.756	18.90
3	45	15	30	15	15	30	0.658	19.74
4	65	15	50	25	25	40	0.572	22.88
5	65	15	50	25	25	40	0.497	19.88
6	55	15	40	20	20	35	0.432	15.12
7	35	15	20	10	10	25	0.376	9.40

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8	15	15	-	-	-	15	0.27	4.91
PV of cash inflows								128.23
Less: Initial investment								120.00
Net Present Value								10.33

Project "Y"

End of year	Cash flow	Deprec-iation	PBY	Tax	PAT	Net C.F. (PAT+Deprn.)	Discount factor @ 15%	P.V
1	40	20	20	10	10	30	0.870	26.40
2	60	20	40	20	20	40	0.56	30.24
3	80	20	60	30	30	50	0.658	32.90
4	50	20	30	15	15	35	0.572	20.02
5	30	20	10	5	5	25	0.497	12.43
6	20	20	-	-	-	20	0.432	8.64
PV of cash inflows								130.33
Less: Initial investment								120.00
Net Present value								10.33

As Project "Y" has a higher Net Present Value. It should be taken up.